Tankerhoosen River Watershed Management Plan

Friends of the Hockanum River Linear Park of Vernon, Inc.

In Association with:

Town of Vernon
North Central Conservation District
Rivers Alliance of Connecticut
Hockanum River Watershed Association
Belding Wildlife Management Area

March 2009

FUSS & O'NEILL
Disciplines to Deliver

78 Interstate Drive
West Springfield, MA 01089

20050257.A20

FUSS & O'NEILL

Table of Contents

Tankerhoosen River Watershed Management Plan

Tables **Page**

Table of Contents

Tankerhoosen River Watershed Management Plan

Figures (continued)

Appendices

Executive Summary

E.1 The Tankerhoosen – A Key Inland Watershed

The Tankerhoosen River watershed is an approximately 12.9 square-mile sub-regional basin within the larger Hockanum River and Connecticut River watersheds in north-central Connecticut. Approximately 70% of the watershed is located within the Town of Vernon, with the remaining portions within the Towns of Tolland, Bolton, and Manchester.

The upper Tankerhoosen River is a cold water stream supporting self-sustaining native trout populations that rank among the best of their kind in the state.

The Tankerhoosen River has long been recognized as an important natural resource and a key inland watershed critical to the health of Long Island Sound. The high water quality (classified as A) in the upper regions of the Tankerhoosen River sustains a significant natural resource of the State of Connecticut – the Belding Wild Trout Management Area, one of only two Class I wild trout areas east of the Connecticut River. The importance of these small, high-quality watersheds to the downstream health of the larger river basins, and therefore to Long Island Sound, is well recognized. Of utmost importance to these high quality watersheds is protection of the headwaters regions.

The importance of protecting the Tankerhoosen is recognized by both local and state agencies. The State Plan of Conservation and Development identifies the riverway as a proposed preservation and conservation area. The Vernon Open Space Plan proposes a greenway plan of 2000 preserved acres along the Tankerhoosen. Most recently, The Nature Conservancy has identified several key watersheds in the state that it considers particularly important to the future protection of Long Island Sound, including the Tankerhoosen River watershed.

E.2 Potential Threats to Water Quality

The headwaters region of the Tankerhoosen River is bisected by Interstate 84. Development pressure in this headwaters region at the Exit 67 interchange in Vernon poses a major threat to the long-term health of the watershed. Further stresses on the headwaters have been created by development of an industrial park in Tolland through which a key headwater stream flows, as well as the presence of the highway itself, which continues to generate increasing traffic loads from development along the I-84 corridor. There has also been declining water quality in the lower reaches of the Tankerhoosen River in recent years. The lower region of the watershed is classified as "B", and was cited as impaired in the Connecticut Department of Environmental

Protection's (DEP) most recent list of water bodies not meeting water quality standards.

E.3 The Need for a Comprehensive Watershed Plan

The need for local decision-makers to consider the environmental consequences of development proposals that would impact the Tankerhoosen River has been expressed by the watershed towns, local advocacy groups including the Friends of the Hockanum River Linear Park and the Hockanum River Watershed Association, The Nature Conservancy, and the DEP.

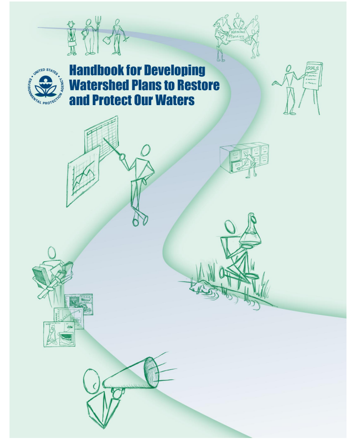
An informal partnership was formed in 2005 to build upon the successful community-based river monitoring and assessment program of the Connecticut River Watch Program and the Hockanum River Watch Program. Led by the Friends of the Hockanum River Linear Park, this group also included representatives of the Hockanum River Watershed Association, the Belding Wildlife Management Area, the North Central Conservation District, the Town of Vernon, and other local volunteers. Their objective was to address the immediate and long-term threats to water quality and natural resources in the Tankerhoosen River watershed by developing and implementing a comprehensive, scientifically-based watershed management plan.

In 2007, the Friends of the Hockanum River Linear Park retained Fuss & O Neill, Inc. to develop a management plan for the Tankerhoosen River watershed. The goal of the watershed management plan is to identify recommendations that will help maintain and enhance water quality and ecological health in and along the Tankerhoosen River and its tributaries. Funding for the project has been provided by the National Fish and Wildlife Foundation, Long Island Sound Futures Fund, Rivers Alliance of Connecticut, and the Town of Vernon. A Technical Advisory Committee was also formed to guide the development of the plan, including representatives of the previously mentioned groups. This plan reflects the combined efforts of Fuss & O Neill, the Technical Advisory Committee, stakeholders, and state and local resource agencies.

E.4 Plan Development Process

The Tankerhoosen River Watershed Management Plan is the culmination of desktop analyses and field assessments performed by the project team under the direction of the Technical Advisory Committee. The plan synthesizes information from earlier studies and reports on the watershed, Geographical Information System (GIS) mapping and analyses, review of land use regulations, and detailed field assessments to document baseline watershed conditions, the potential impacts of future development in the watershed, and recommended actions to protect and restore water quality and natural resources.

The plan has also been developed consistent with EPA's guidance for the development of watershed-based plans, which includes nine key elements that establish the structure of the plan. These nine elements include specific goals, objectives, and strategies to protect and restore water quality; methods to build and strengthen working partnerships; a dual focus on addressing existing problems and preventing new ones; a strategy for implementing the plan; and a feedback loop to evaluate progress and revise the plan as necessary. Following this approach will enable implementation projects under this plan to be considered for funding under Section 319 of the Clean Water Act



The management plan was developed to satisfy EPA's criteria for watershed-based plans.

Development of the watershed management plan consisted of the following five major tasks:

1. Assessment of baseline and potential future watershed conditions,
2. Review of land use regulations in the watershed,
3. Field inventories of stream corridors and upland areas in the watershed,
4. Identification of watershed management goals, objectives, and potential management strategies to address watershed issues,
5. Development of watershed-wide, targeted, and site-specific watershed management recommendations.

The initial task was to develop an understanding of the current conditions of the Tankerhoosen River watershed. To accomplish this, the project team reviewed existing watershed data, studies, and reports; compiled and analyzed GIS mapping of the watershed and various subwatersheds; and developed pollutant loading and impervious cover models to evaluate areas in the watershed that are most at-risk from future development.

A comparative subwatershed analysis was also performed to identify the Tankerhoosen River subwatersheds that 1) are more sensitive to future development and should be the focus of watershed conservation efforts to maintain existing high-quality resources and conditions and 2) are likely to have been impacted and have greater potential for restoration to improve or enhance existing conditions. The results of the baseline assessment were documented in the report, *Baseline Watershed Assessment, Tankerhoosen River Watershed*, dated May 28, 2008 (Fuss & O Neill, Inc.).

The results of the comparative subwatershed analysis were used to target individual subwatersheds for detailed field inventories. Using screening-level assessment procedures developed by the Center for Watershed Protection and EPA, field crews assessed approximately 8.7 miles of stream corridors, potential hotspot land uses, and representative residential neighborhoods, streets, and storm drainage systems. The field inventories identified a number of common issues and problems, as well as potential candidate sites for stormwater retrofits, stream restoration, and other targeted projects.

The project team also reviewed municipal land use regulations and planning documents within the watershed towns, focusing on Vernon and Tolland, which comprise the majority of the land area in the Tankerhoosen River watershed and have the greatest potential for future development. The land use regulatory review identified a number of recommendations to improve stormwater management, encourage or require the use of Low Impact Development (LID), reduce the amount of impervious cover generated by future development, and better protect watercourses, wetlands, and riparian areas.

The combined results of the watershed field inventories and land use regulatory review are described in the report, *Watershed Field Inventories and Land Use Regulatory Review, Tankerhoosen River Watershed*, dated October 2008 (Fuss & O Neill, Inc.).

The project team then developed a series of goals, objectives, and potential management strategies for the watershed based upon the results of the watershed inventory and evaluation phases of the project. Potential management strategies were further refined with input from the Technical Advisory Committee, culminating in the plan recommendations that are presented in this document.

E.5 Watershed Management Goals

The Tankerhoosen River Watershed Management Plan is intended to be an affordable and effective plan that can be implemented by the watershed municipalities, residents, and other stakeholders. The overall goal of the plan is to maintain and enhance water quality and ecological health in and along the Tankerhoosen River and its tributaries, which is essential to the economic well-being, environmental and public health, recreational opportunities, and quality of life for the residents, local governments, and visitors of the Tankerhoosen River watershed. This can be achieved by:

- Protecting the upper region of the Tankerhoosen River watershed, including high-quality headwater streams that sustain significant natural resources such as the Belding Wild Trout Management Area, from existing pollutant sources and future threats related to new development and redevelopment.

- Restoring and enhancing the water quality and ecological health of impacted portions of the Tankerhoosen River and its tributaries to support designated uses for fish and wildlife habitat and recreational uses.

E.6 Plan Recommendations

A set of specific objectives and recommended actions were developed to satisfy the management goals for the watershed. The plan recommendations include watershed-wide recommendations that can be implemented throughout the Tankerhoosen River watershed, targeted recommendations that are tailored to issues within specific subwatersheds or areas, and site-specific recommendations to address issues at selected sites that were identified during the watershed field inventories. Recommendations can be viewed as short-term, mid-term, and long-term according to their implementation priority.

- *Short-Term Recommendations* are initial actions to be accomplished within the first one to two years of plan implementation. These actions establish the framework for implementing subsequent plan recommendations. Such actions include development of local regulations and stormwater design guidance, discharge investigations, education program planning, and field inventories within previously unassessed subwatersheds. Small demonstration restoration projects could be completed during this phase, however construction of larger retrofit practices and stream restoration projects requiring extensive design, engineering, and permitting should be planned for later implementation.

- *Mid-Term Recommendations* involve continued programmatic and operational measures, delivery of educational and outreach materials, and construction of one or two larger retrofit and/or stream restoration projects over the next two to four years. Progress on land conservation, LID implementation, and discharge investigation follow-up activities should be completed during this period, as well as project monitoring and tracking.

- *Long-Term Recommendations* consist of continued implementation of any additional projects necessary to meet watershed objectives, as well as an evaluation of progress, accounting of successes and lessons learned, and an update of the watershed management plan. Long-term recommendations are intended to be completed during the next 5- to 10-year timeframe and beyond.

Table ES-1 summarizes the management recommendations for the Tankerhoosen River watershed. The recommendations are organized by implementation priority (short-, mid-, and long-term) and scale/location (watershed, targeted, or site-specific). Successful implementation of this plan will require a cooperative effort and commitment from the key watershed stakeholders, including a recommended watershed coalition consisting of the Friends of the Hockanum River Linear Park and other members of the Technical Advisory Committee, the watershed municipalities and citizens, state and federal agencies, and other groups. The table also identifies the watershed stakeholders who should be involved in implementing the plan recommendations in either a lead or support role.

FUSS & O'NEILL

Table ES-1. Watershed Management Plan Recommendations Summary

Key Actions	Priority	Scale/Location	Who Should be Involved (L = lead, A = assist)											
			Watershed Towns	Friends of HRLP	Watershed Coalition	Landowners	NCCD	HRWA	Belding WMA	ConnDOT	CTDEP	NRCS	USEPA	Citizens/Volunteers
Objective 1. Build a Foundation for Implementing the Plan														
Form sustainable partnership or coalition	S	W	A	L			A	A	A		A			
Adopt watershed management plan	S	W	L		A									
Identify potential funding sources and submit grant applications	S	W	L		L	A	A	A	A	A	A	A		
Objective 2. Enhance In-Stream and Riparian Habitat														
Conduct fish passage assessments	S	T	A		L		A	A						
Revise local stream crossing & stormwater design standards	S	W	L											
Belding Pond Dam removal feasibility evaluation	S	T			A						A	L		
Conduct aquatic invasive species study	S	S	A		L									
Priority stream restoration projects	M/L	S	A		L							A		
Objective 3. Protect/Restore Riparian Buffers														
Priority riparian buffer restoration projects	M/L	S	A		L	A			A			A		
Adopt stream buffer regulations, pending enabling legislation	M	W	L											
Revise riparian buffer recommendations (Tolland)	S	W	L											
Incorporate invasive species management measures	M	T			L			A	A		A			
Objective 4. Identify and Eliminate Illicit Discharges														
Targeted illicit discharge investigations	S	T	L		A		A							
Implement municipal IDDE programs	M	W	L											
Priority stream cleanup efforts	S	S			L			A						A
Develop education/outreach materials	S	W			L		A				A			
Deliver education/outreach to the public	M	W	L				A							
Objective 5. Residential Management Practices														
Increase watershed stewardship signage in residential areas	M	W	L		A		A	A						A
Encourage disconnection of rooftop runoff	M	W	L		A		A							
Develop education/outreach materials	S	W			L		A							
Deliver education/outreach to the public	M	W	L				A							
Objective 6. Municipal and Business Management Practices														
Review municipal facility compliance	S	W	L											
Improve municipal stormwater management programs	S/M	W	L											
Implement street sweeping and catch basin cleaning	M	W	L							L				
Develop education/outreach materials	S	W			L		A							

Table ES-1. Watershed Management Plan Recommendations Summary

Key Actions	Priority	Scale/Location	Who Should be Involved (L = lead, A = assist): Watershed Towns	Friends of HRLP	Watershed Coalition	Landowners	NCCD	HRWA	Belding WMA	ConnDOT	CTDEP	NRCS	USEPA	Citizens/Volunteers
Deliver education/outreach to the public	M	W	L				A							
Increase watershed stewardship signage in commercial areas	M	W	L		A		A	A						A
Objective 7. Implement Water Quality Monitoring Program														
Develop and implement long-term monitoring program	S	W			L		A	A			A			A
Field monitoring study of LID effectiveness	M	W	A		L		A							
Objective 8. Protect Open Space														
Priority land acquisitions	S/M	T	L		A	A			A		A			
Continue to implement municipal open space plans	S	T	L											
Seek alternative funding sources for open space acquisition	S/M	T	L		A									
Promote use of open space through trail maps and events	S/M	T			L			A	A					
Develop and implement invasive species management plan	M	T			L			A			A			A
Objective 9. Promote LID and Sustainable Site Design														
Monitor effectiveness of LID regulations (Tolland)	S/M	W	L											
Revise Inland Wetland regulations for consistency (Tolland)	S	W	L											
Develop and implement new stormwater/LID regulations (Vernon)	S	W	L											
Form advisory committee	S	W	L											
Develop Town stormwater/LID manual and/or guidance	S	W	L											
Update existing zoning, subdivision, wetlands regulations	S	W	L											
Priority stormwater retrofits	M/L	S	A		L		A			A				
Incorporate LID into Town projects	M	W	L											
LID demonstration projects (green roads, public works, schools)	S	S	L		A		A							
Develop education/outreach materials	S	W			L		A				A			
Deliver education/outreach to the public	M	W	L				A							
Objective 10. Assess Additional Subwatersheds														
Perform stream and upland assessments	S	T			L		A	A	A					A

Priority Abbreviations: S = short-term, M = mid-term, L = long-term Scale/Location Abbreviations: W = watershed-wide, T = targeted, S = site-specific
HRLP – Hockanum River Linear Park, NCCD – North Central Conservation District, HRWA – Hockanum River Watershed Association, ConnDOT – Connecticut Department of Transportation, CTDEP – Connecticut Department of Environmental Protection, NRCS – Natural Resource Conservation Service, USGS – United States Geological Survey, USEPA – U.S. Environmental Protection Agency, Belding WMA – Belding Wildlife Management Area

1 Introduction

1.1 The Call for a Comprehensive Watershed-Based Plan

The Tankerhoosen – A Key Inland Watershed

The upper Tankerhoosen River is a cold water stream supporting self-sustaining native trout populations that rank among the best of their kind in the state.

The Tankerhoosen River watershed is an approximately 12.9 square-mile sub-regional basin within the larger Hockanum River and Connecticut River watersheds in north-central Connecticut. Approximately 70% of the watershed is located within the Town of Vernon, with the remaining portions within the Towns of Tolland, Bolton, and Manchester.

The Tankerhoosen River has long been recognized as an important natural resource and a key inland watershed critical to the health of Long Island Sound. The high water quality (classified as A) in the upper regions of the Tankerhoosen River sustains a significant natural resource of the State of Connecticut – the Belding Wild Trout Management Area, one of only two Class I wild trout areas east of the Connecticut River. The importance of these small, high-quality watersheds to the downstream health of the larger river basins, and therefore to Long Island Sound, is well recognized. Of utmost importance to these high quality watersheds is protection of the headwaters regions.

The importance of protecting the Tankerhoosen is recognized by both local and state agencies. The State Plan of Conservation and Development identifies the riverway as a proposed preservation and conservation area. The Vernon Open Space Plan proposes a greenway plan of 2000 preserved acres along the Tankerhoosen. Most recently, The Nature Conservancy has identified several key watersheds in the state that it considers particularly important to the future protection of Long Island Sound, including the Tankerhoosen River watershed.

Potential Threats to Water Quality

The headwaters region of the Tankerhoosen River is bisected by Interstate 84. Development pressure in this headwaters region at the Exit 67 interchange in Vernon poses a major threat to the long-term health of the watershed. Further stresses on the headwaters have been created by development of an industrial park in Tolland through which a key headwater stream flows, as well as the presence of the highway itself, which continues to generate increasing traffic loads from development along the I-84 corridor. There has also been declining water quality in the lower reaches of the Tankerhoosen River in recent years. The lower region of the watershed is classified as "B", and was cited as impaired in the Connecticut Department of Environmental

Protection's (DEP) most recent list of water bodies not meeting water quality standards.

The Need for a Comprehensive Watershed Plan

The need for local decision-makers to consider the environmental consequences of development proposals that would impact the Tankerhoosen River has been expressed by the watershed towns, local advocacy groups including the Friends of the Hockanum River Linear Park and the Hockanum River Watershed Association, The Nature Conservancy, and the DEP.

An informal partnership was formed in 2005 to build upon the successful community-based river monitoring and assessment program of the Connecticut River Watch Program and the Hockanum River Watch Program. Led by the Friends of the Hockanum River Linear Park, this group also included representatives of the Hockanum River Watershed Association, the Belding Wildlife Management Area, the North Central Conservation District, the Town of Vernon, and other local volunteers. Their objective was to address the immediate and long-term threats to water quality and natural resources in the Tankerhoosen River watershed by developing and implementing a comprehensive, scientifically-based watershed management plan.

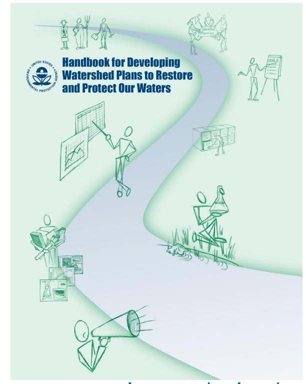
In 2007, the Friends of the Hockanum River Linear Park retained Fuss & O'Neill, Inc. to develop a management plan for the Tankerhoosen River watershed. Funding for the project has been provided by the National Fish and Wildlife Foundation, Long Island Sound Futures Fund, Rivers Alliance of Connecticut, and the Town of Vernon. A Technical Advisory Committee was also formed to guide the development of the plan, including representatives of the previously mentioned groups. This plan is the culmination of efforts between Fuss & O'Neill, the Technical Advisory Committee, stakeholders, and state and local resource agencies.

The goal of the watershed management plan is to identify recommendations that will maintain and enhance water quality and ecological health in and along the Tankerhoosen River and its tributaries, including protection of high-quality natural resources and restoration or enhancement of the water quality and ecological health of impacted portions of the Tankerhoosen River. This plan also describes a replicable approach to watershed-based planning, which satisfies the guidance set forth by the U.S. Environmental Protection Agency (EPA) in Section 319 of the Clean Water Act for developing watershed-based plans, thus enabling implementation projects under this plan to be considered for Section 319 funds.

1.2 Plan Development Process

The Tankerhoosen River Watershed Management Plan is the culmination of desktop analyses and field assessments performed by the project team under the direction of the Technical Advisory Committee. The plan synthesizes information from earlier studies and reports on the watershed, Geographical Information System (GIS) mapping and analyses, review of land use regulations, and detailed field assessments to document baseline watershed conditions, the potential impacts of future development in the watershed, and recommended actions to protect and restore water quality and natural resources.

The plan has also been developed consistent with EPA's guidance for the development of watershed-based plans, which includes nine key elements that establish the structure of the plan. These nine elements include specific goals, objectives, and strategies to protect and restore water quality; methods to build and strengthen working partnerships; a dual focus on addressing existing problems and preventing new ones; a strategy for implementing the plan; and a feedback loop to evaluate progress and revise the plan as necessary. Following this approach will enable implementation projects under this plan to be considered for funding under Section 319 of the Clean Water Act



The management plan was developed to satisfy EPA's criteria for watershed-based plans.

Development of the watershed management plan consisted of the following five major tasks:

1. Assessment of baseline and potential future watershed conditions,
2. Review of land use regulations in the watershed,
3. Field inventories of stream corridors and upland areas in the watershed,
4. Identification of watershed management goals, objectives, and potential management strategies to address watershed issues,
5. Development of watershed-wide, targeted, and site-specific watershed management recommendations.

The initial task was to develop an understanding of the current conditions of the Tankerhoosen River watershed. To accomplish this, the project team reviewed existing watershed data, studies, and reports; compiled and analyzed GIS mapping of the watershed and various subwatersheds; and developed pollutant loading and impervious cover models to evaluate areas in the watershed that are most at-risk from future development.

A comparative subwatershed analysis was also performed to identify the Tankerhoosen River subwatersheds that 1) are more sensitive to future development and should be the focus of watershed conservation efforts to maintain existing high-quality resources and conditions and 2) are likely to have been impacted and have greater potential for restoration to improve or enhance existing conditions. The results of the baseline assessment were documented in the report, *Baseline Watershed Assessment, Tankerhoosen River Watershed*, dated May 28, 2008 (Fuss & O'Neill, Inc.), a copy of which is provided on CD-ROM in Appendix A of this plan.

The results of the comparative subwatershed analysis were used to target individual subwatersheds for detailed field inventories. Using screening-level assessment procedures developed by the Center for Watershed Protection and EPA, field crews assessed approximately 8.7 miles of stream corridors, potential hotspot land uses, and representative residential neighborhoods, streets, and storm drainage systems. The field inventories identified a number of common issues and problems, as well as potential candidate sites for stormwater retrofits, stream restoration, and other targeted projects.

The project team also reviewed municipal land use regulations and planning documents within the watershed towns, focusing on Vernon and Tolland, which comprise the majority of the land area in the Tankerhoosen River watershed and have the greatest potential for future development. The land use regulatory review identified a number of recommendations to improve stormwater management, encourage or require the use of Low Impact Development (LID), reduce the amount of impervious cover generated by future development, and better protect watercourses, wetlands, and riparian areas.

The combined results of the watershed field inventories and land use regulatory review are described in the report, *Watershed Field Inventories and Land Use Regulatory Review, Tankerhoosen River Watershed*, dated October 2008 (Fuss & O Neill, Inc.), a copy of which is provided on CD-ROM in Appendix A of this plan.

The project team then developed a series of goals, objectives, and potential management strategies for the watershed based upon the results of the watershed inventory and evaluation phases of the project. Potential management strategies were further refined with input from the Technical Advisory Committee, culminating in the plan recommendations that are presented in this document.

2 Baseline Watershed Conditions

This section describes the current conditions in the Tankerhoosen River watershed. The information is based upon a review of existing watershed data, studies, and reports; preparation and analysis of watershed GIS mapping; and pollutant loading and impervious cover models to evaluate areas in the watershed that are most at-risk from future development. More detailed information on the baseline assessment is available in *Baseline Watershed Assessment, Tankerhoosen River Watershed* (Fuss & O Neill, Inc., May 28, 2008), a copy of which is provided on CD-ROM in Appendix A of this watershed management plan.

2.1 Watershed Description

The Tankerhoosen River watershed is a small but very important 12.85 square-mile sub-regional basin within the Hockanum River watershed (Figure 2-1). Approximately 70% of the watershed is located within the Town of Vernon, with the remaining portions within the Towns of Tolland, Bolton, and Manchester (Table 2-1).

Table 2-1. Distribution of Municipalities in the Tankerhoosen River Watershed

Town Name	Town Acreage	Acreage in Watershed	% of Town in Watershed	% of Watershed
Manchester	17,408	461	2.7	5.6
Vernon	11,904	5,572	46.8	67.7
Tolland	25,856	1,547	5.9	18.8
Bolton	9,920	646	6.5	7.9
Totals	**65,088**	**8,226**		**100.0**

A basic profile of the watershed is provided in Table 2-2. Later sections of this document provide more detailed information on these watershed characteristics.

Table 2-2. Profile of the Tankerhoosen River Watershed

Area	12.85 square miles (8,226 acres)
Stream Length	approximately 17.2 miles
Subwatersheds	10 subwatersheds
Jurisdictions	4 towns
Water Quality	DEP Impaired Waters List for habitat for fish and other aquatic life
Current Impervious Cover	9.8%
Subwatersheds Selected for Detailed Assessment Based on Vulnerability Assessment	Clarks Brook Gages Brook Gages Brook South Tributary Lower Tankerhoosen River Walker Reservoir
Subwatersheds Selected for Detailed Assessment Based on Restoration Potential	Clarks Brook Gages Brook Lower Tankerhoosen River Middle Tankerhoosen River Tucker Brook
Major Transportation Routes	Interstates 84 and 384 U.S. Routes 6 and 44 State Routes 30 and 31

Table 2-2. Profile of the Tankerhoosen River Watershed

Significant Natural and Historic Features	Belding Wildlife Management Area Valley Falls Park Webster-Knapp Preserve Bolton Notch Pond Walker Reservoir Talcottville Historic District

The high water quality (classified as A) in the upper regions of the Tankerhoosen River sustains a significant natural resource of the State of Connecticut – the Belding Wild Trout Management Area, one of only two Class I wild trout areas east of the Connecticut River. The importance of these small, high quality watersheds to the downstream health of the larger river basins, and therefore to Long Island Sound, is well recognized. Of utmost importance to these high quality watersheds is protection of the headwaters regions.

The headwaters region of the Tankerhoosen River is bisected by Interstate 84. Development pressure in this headwaters region at the Exit 67 interchange in Vernon poses a major threat to the long-term health of the watershed. Further stresses on the headwaters have been created by development of an industrial park in Tolland through which a key headwater stream flows, as well as the presence of the highway itself, which continues to generate increasing traffic loads from development along the I-84 corridor. There has also been declining water quality in the lower reaches of the Tankerhoosen River in recent years. The lower region of the watershed is classified as "B", and was cited as impaired in the Connecticut Department of Environmental Protection's (DEP) *2006 List of Connecticut Waterbodies Not Meeting Water Quality Standards.*

The importance of protecting the pristine upper region of the Tankerhoosen is recognized by both local and state agencies. The State Plan of Conservation and Development identifies the riverway as a proposed preservation and conservation area. The Vernon Open Space Plan proposes a greenway plan of 2000 preserved acres along the Tankerhoosen. Most recently, The Nature Conservancy (TNC) has identified several key watersheds in the state that it considers particularly important to the future protection of Long Island Sound, including the Tankerhoosen River watershed. The need for local decision-makers to give utmost consideration to the environmental consequences of development proposals that would impact the River, has been expressed by TNC and by the DEP.

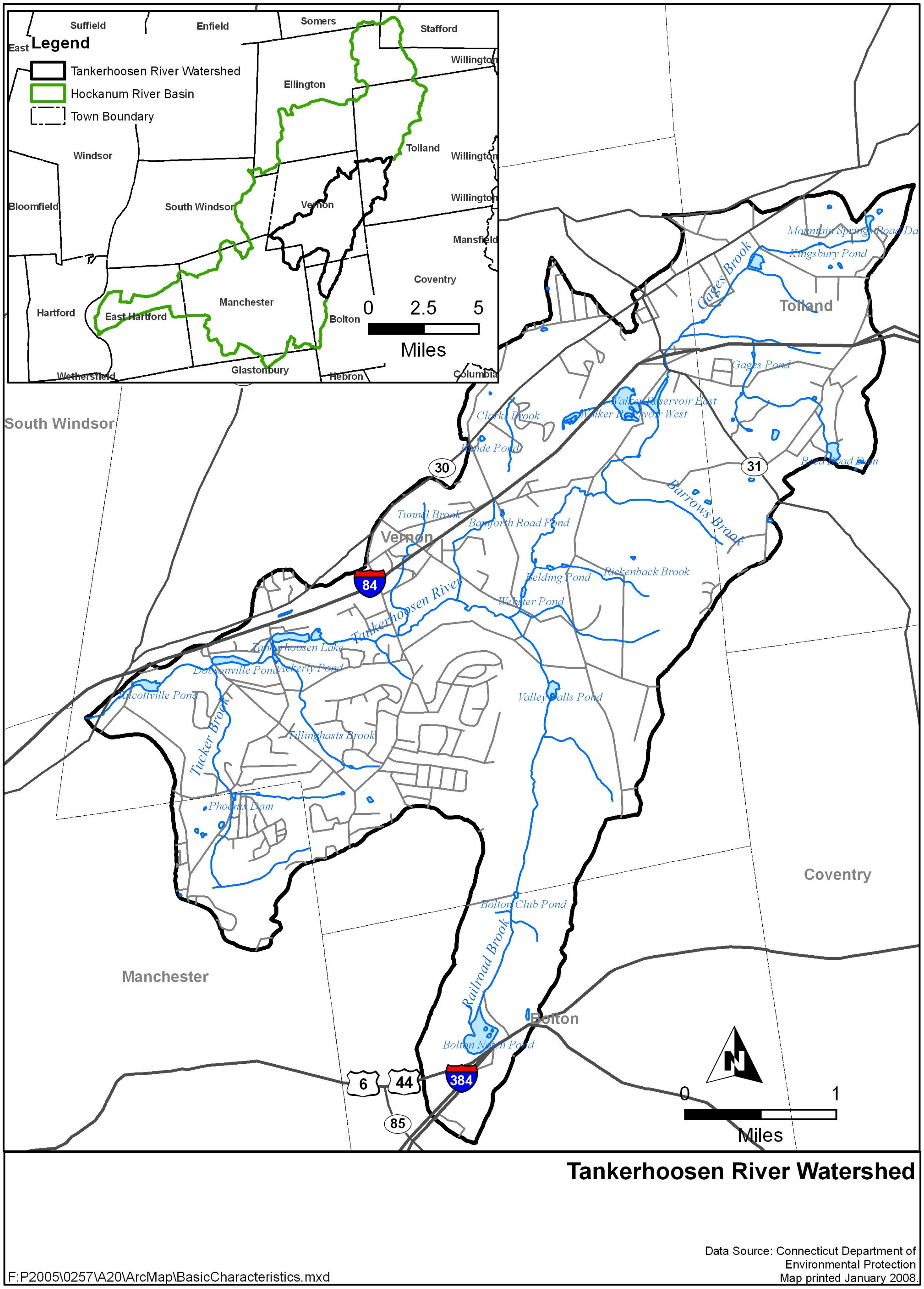


Figure 2-1. Tankerhoosen River Watershed

2.2 Geologic and Historical Perspective

2.2.1 Geology

The State of Connecticut is comprised of three distinct geologic units divided longitudinally across the state. These three units are known as the Western Uplands, the Central Valley, and the Eastern Uplands. The Western and Eastern Uplands are comprised of metamorphic rocks – rocks subjected to intense heat and pressure of the Earth's interior – while the Central Valley is a younger unit comprised of sedimentary rocks. The Central Valley began forming about 225 million years ago when the super-continent Pangaea began to break apart. A large rift formed a long, narrow valley through the middle of the state, eventually filling with sediments from the eroding hills to the east and west (presently known as the Eastern and Western Uplands). The sediments were compacted into soft, easily eroded, red and brown sandstones through which the Connecticut Rivers flows.

The Tankerhoosen River watershed is almost entirely within the Eastern Uplands. The westernmost portion of the watershed is located within the Central Valley. The boundary between the Central Valley and the Eastern Uplands is located near the Vernon-Manchester town line and known as the Bolton Range. The Bolton Range was formed as a result of the different rates of erosion of the less resistant sediments of the Central Valley creating an abrupt rise into the resistant rocks of the Eastern Uplands.

Drastic changes in the surficial geology have occurred within Connecticut since the formation of these geologic regions. Above the sandstone of the Central Valley and the metamorphic bedrock of the Eastern Uplands lie extensive glacial deposits, or "glacial till," left as the large glaciers receded. Melting glacier ice formed rivers which sorted glacial till into layers of sand and gravel, or "stratified drift." The Tankerhoosen River flows through hills of glacial till in the steep Eastern Uplands and then drops into the stratified drift of the Central Valley (Bell, 1985).

2.2.2 Population and Industry

Beginning about 10,000 years ago, as the last glacial ice retreated from New England, Native American populations settled Connecticut and the areas along the Tankerhoosen River. The river was used by Native Americans as a source of fish and a travel route to the Connecticut River (Hockanum River Watershed Association, 1998). The Podunks of East Hartford and Manchester, the Nipmucks of Ellington and Tolland were among the tribes that farmed corn in the fertile river floodplains of the Tankerhoosen River. In addition to agriculture, the tribes used the land within the watershed for hunting, gathering, and fishing.

European settlers brought a marked change in land use to Connecticut. Land was cleared and agriculture was the primary use through the Revolutionary War era. However, the availability of more fertile lands in western New York, northern Ohio, and Pennsylvania led to the great migration of Connecticut farmers during the 1800s.

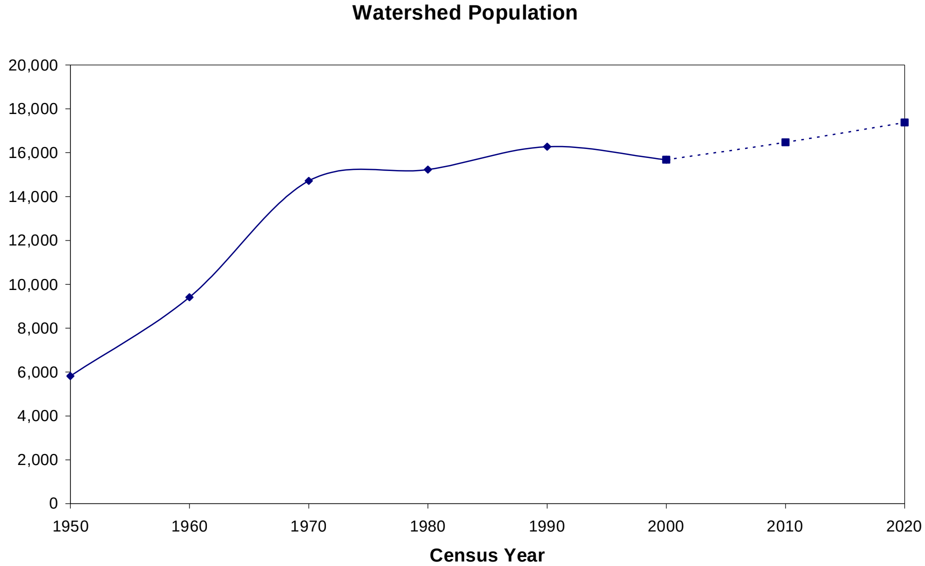
Those who stayed worked in the many factories that arose along the rivers and streams, and manufacturing became a major economic force (Gibbons et al., 1992).

The Tankerhoosen River was no exception to the development patterns across Connecticut. From the headwaters at Gages Brook, the elevation drop of the Tankerhoosen River was ideally suited to power a wide variety of mills. During the eighteenth and nineteenth centuries, several mills associated with the textile, cotton-wool, energy, and paper industries were built near these waterfalls and in other areas in the watershed. The Talcottville Historical District is located in southwestern portion of the Tankerhoosen River watershed near the confluence with the Hockanum River. One of the first cotton mills in America was built by Peter Dobson in the early 1800's in Talcottville. The mill burned down in 1909, not to be rebuilt. Peter Dobson is also famous for early observations that ice may have played a role in the erosion and transport of rock in the region.

The Vernon Depot, located within the watershed on Church Street, was an active transportation center during the early part of the twentieth century. The Hartford, Providence and Fishkill Railroad ran seven times a day at the Depot, with connections to Rockville. The Keystone Arch on Tunnel Road (also known as the Keystone Tunnel) was constructed circa 1850 to allow trains to traverse Tunnel Road without disrupting street traffic toward Vernon Center. The 108-foot long tunnel is constructed of 30 arches, each of which consists of a center keystone with nine stones forming the curves on either side. The tunnel is considered by historians to be a fine piece of historic architecture and as a monument to the integrity and skilled workmanship of its builders.

Valley Falls was the site of the first industry in Vernon, a saw mill, in 1740. Valley Falls Park hosted a small mill complex for flaxseed oil and cotton between 1850 and 1877. Beginning in the mid-1800s until the mid-1900s the property was converted into farmland for producing corn, hay, oats, butter, and cheese. In 2001, the historic farmhouse and six outbuildings were purchased by the Friends of Valley Falls, Inc. to ensure preservation of the historical complex. Alternate forms of manufacturing power put most of the mills out of business by the late 1950s. Dozens of the mill buildings and their associated dams remain an integral component of the river.

Rapid population growth in the post-war era of the 1950s and 1960s slowed significantly as developable land became scare (see Figure 2-2). Today, the population of the Tankerhoosen River watershed is approximately 16,000, which is more than double the population of the watershed in the 1950s. Commercial and residential development has occurred in the watershed since the 1970s, with a continued decline in industrial uses. Significant commercial development along the major transportation corridors and residential development in the watershed has increased watershed impervious coverage and contributed to degraded water quality in portions of the Tankerhoosen River and its tributaries. Numerous historical impoundments within the watershed also continue to serve as barriers to fish passage along the Tankerhoosen River and its tributaries.



Source: Connecticut Population Projections, Series 95.1, Office of Policy and Management, September 1995.

Figure 2-2. Population Trends in the Tankerhoosen River Watershed

2.2.3 Recreation Resources

The Tankerhoosen River provides many opportunities for recreational activities, such as fishing, swimming, and limited boating. Along the river, there are both town and state lands that are preserved for parks, wildlife sanctuaries and rail-trails. Recreational activities in these areas include hiking, biking, cross-country skiing, ice skating, nature observation, and aesthetic enjoyment.

Some of the prominent recreational centers in the watershed include the Walker Reservoir East, the Belding Wildlife Management Area, Valley Falls Park, Bolton Notch Pond, Freja Park, the Rails-to-Trails, and Phoenix Mill Park. Each of these areas provides parking, picnicking, and trails for walking and cross-country skiing. The Belding Wildlife Management Area was the location of the first Class I Trout Management Area in Connecticut. Recreational areas that also have historical significance include the Dobsonville Pond and Talcottville Pond. Additionally, the area associated with the confluence of the Tankerhoosen and Hockanum Rivers includes a privately owned recreational facility and is the starting point for the annual Manchester Canoe and Kayak Race.

2.2.4 Watershed Restoration Efforts

The Connecticut River Watch Program (CRWP), a volunteer water quality monitoring, protection, and improvement program for the Connecticut River and its tributaries, is working closely with the Hockanum River Watch Program (HRWA) and North Central Conservation District to develop and support a community-based river monitoring and assessment program in the Tankerhoosen River watershed. The CRWP monitoring program has included stream walk surveys and rapid bioassessments (cost-effective biological survey techniques) along the Tankerhoosen River, as well as other areas of the larger Hockanum River watershed.

The Connecticut DEP also conducts routine ambient water quality and benthic monitoring at approximately twelve locations along the Hockanum and Tankerhoosen Rivers. The data assist in documenting the chemical and biological quality of surface waters within the watershed and will be used to support the development of a Total Maximum Daily Load (TMDL), which will address sources of water quality impairment in the Hockanum and Tankerhoosen Rivers.

Baystate Environmental Consultants, Inc. (BEC) conducted a feasibility study in 2002 for the dredging of Tankerhoosen Lake and subsequently prepared a Watershed Management Plan for Tankerhoosen Lake in 2004. The plan identified watershed factors that have directly affected or have the potential to affect the water quality and overall health of Tankerhoosen Lake. The project recommended a Town-wide approach for reducing the quantity of pollutants, specifically sediment and nutrients, reaching Tankerhoosen Lake. BEC personnel conducted field observations of the major contributing watercourses and impoundments in the Tankerhoosen Lake watershed to identify point sources of sediment and nutrients as well as nonpoint source pollutants. BEC recommended that the Town of Vernon require the implementation of stormwater best management practices (BMPs) that maximize to the extent practicable, the removal of total suspended solids and nutrients. In addition to the lake dredging project recommended in the feasibility study, BEC also recommended several structural and nonstructural elements, including a sediment trap at the inlet of Tankerhoosen Lake, installation of deep sump catch basins at key locations, maintenance of cross-culverts and drainage structures, and grass swales and vegetated filter strips. None of the BEC recommendations has been implemented to date.

2.3 Natural Resources

2.3.1 Hydrology

The Tankerhoosen River watershed is 12.85 square-miles, with the majority of the watershed (approximately 70 percent) located within the Town of Vernon (Figure 2-1). Gages Brook and its associated southern tributary comprise the headwaters region of the watershed, eventually flowing into Walker Reservoir East. Gages Brook is located in the northwest portion of the Town of Vernon and within the western portion of neighboring Tolland. A few small impoundments are located within the Gages Brook watershed. The brook receives drainage from the I-84 corridor near the Vernon-Tolland town boundary. In Tolland, Gages Brook flows through an industrial park and residential areas.

Walker Reservoir is no longer an active public water supply but rather a recreational resource that attracts hikers, fisherman, and ice skaters. The Tankerhoosen River, which is a moderately sized (16 feet wide) upland stream, originates at the outlet of Walker Reservoir East and bisects the Town of Vernon on the south side of Interstate

84. The river flows southwest for approximately five miles to the Hockanum River in the Talcottville section of Vernon.

Barrows Brook, Rickenback Brook, and several other small tributaries drain the eastern portion of the upper Tankerhoosen River watershed between Walker Reservoir and the confluence with Railroad Brook near Webster Pond. Barrows Brook is the furthest upstream tributary to the Tankerhoosen River and flows through undeveloped, privately owned land. Rickenback Brook flows east to west through a relatively undeveloped portion of Vernon and discharges to the Tankerhoosen River approximately 0.4 miles upstream of the river's confluence with Railroad Brook. Portions of this brook are within the Belding Wildlife Management Area and have been established for catch and release trout fishing (BEC, 2004).

Railroad Brook drains the southern portions of the watershed, beginning at Bolton Notch Pond in Bolton, and flows north through Valley Falls Park and the Belding Wildlife Management Area before joining the Tankerhoosen River. Valley Falls Pond is located along Railroad Brook within the confines of the Valley Falls Park property. Railroad Brook flows through primarily undeveloped land and discharges to the Tankerhoosen River approximately 1.6 miles upstream of Tankerhoosen Lake (BEC, 2004).

Clarks Brook and Tunnel Brook join the Tankerhoosen River in the middle portion of the watershed prior to the river's confluence with the DEP-owned Tankerhoosen Lake, the first of three DEP-owned run-of-river ponds. Clarks Brook originates north of I-84 and drains primarily industrial/commercial and undeveloped land within the Town of Vernon. Clarks Brook discharges to the Tankerhoosen River approximately 0.5 miles upstream of the river's confluence with Tunnel Brook. Tunnel Brook is located in the central portion of Vernon, flowing north to south and crossing the I-84 corridor. The brook empties into the Tankerhoosen River approximately 0.65 miles upstream of the inlet to Tankerhoosen Lake (BEC, 2004).

Dobsonville Pond is located just downstream of Tankerhoosen Lake. Tucker Brook, which drains the southeastern portion of the watershed and a residential section of the Town of Manchester, joins the Tankerhoosen River immediately upstream of Dobsonville Reservoir dam. Further downstream are Talcottville Pond and the confluence with the Hockanum River near the Vernon/Manchester town line.

Overall the Tankerhoosen River is comprised of a large percentage of first and second order (i.e., headwater) streams according to the Strahler Stream Order classification system. Stream hydrology and water quality in headwater streams are important components of ecosystem health because they are a critical food source for the entire river, influence downstream conditions, and support biodiversity.

Ten subwatersheds within the Tankerhoosen River watershed have been delineated for the purposes of this assessment. The subwatershed delineations are based on the CTDEP local basin delineations, modified slightly based on surface water hydrology and grouped accordingly to facilitate assessment and development of watershed management plan recommendations. Figure 2-3 depicts the subwatersheds identified in this assessment, and Table 2-3 summarizes the basic characteristics of the subwatersheds.

Table 2-3. Tankerhoosen River Subwatersheds

Subwatershed	Acronym	Area (acres)	Area (square miles)
Bolton Notch Pond	BNP	344	0.54
Clarks Brook	CB	647	1.01
Gages Brook	GB	695	1.09
Gages Brook South Tributary	GBST	680	1.06
Lower Tankerhoosen River	LTR	321	0.5
Middle Tankerhoosen River	MTR	1,578	2.46
Railroad Brook	RB	1,208	1.89
Tucker Brook	TB	934	1.46
Upper Tankerhoosen River	UTR	1472	2.3
Walker Reservoir	WR	347	0.54
Tankerhoosen River Watershed		**8,226**	**12.85**

The Tankerhoosen River Watershed is located in an area with a temperate and humid climate. Based on historical climate information available from the NOAA National Weather Service weather station in Harford/Bradley International Airport in Windsor Locks, Connecticut, precipitation is generally well-distributed throughout the year with the wettest conditions in August and November and driest in February (worldclimate.com for Hartford/Bradley International Airport, Hartford County). In Windsor Locks, the mean annual precipitation over a 41-year period of record is 44.4 inches, and the 24-hour average temperature ranges from a high of 73.6°F in July to a low of 24.6°F in January.

Generally, the designated 100-year floodplain of the Tankerhoosen River is confined along a narrow corridor (<500 feet wide) surrounding the river. The entire length of the Tankerhoosen River is within the Federal Emergency Management Agency (FEMA) designated 100-year floodplain, with the exception of a small reach near the river's headwaters, between Reservoir Road and Fish and Game Road. The lower reach of Railroad Brook (below Valley Falls Pond including the pond) is also within the 100-year floodplain. Walker Reservoir West and East and portions of Gages Brook also lie within the designated 100-year floodplain (BEC, 2004).

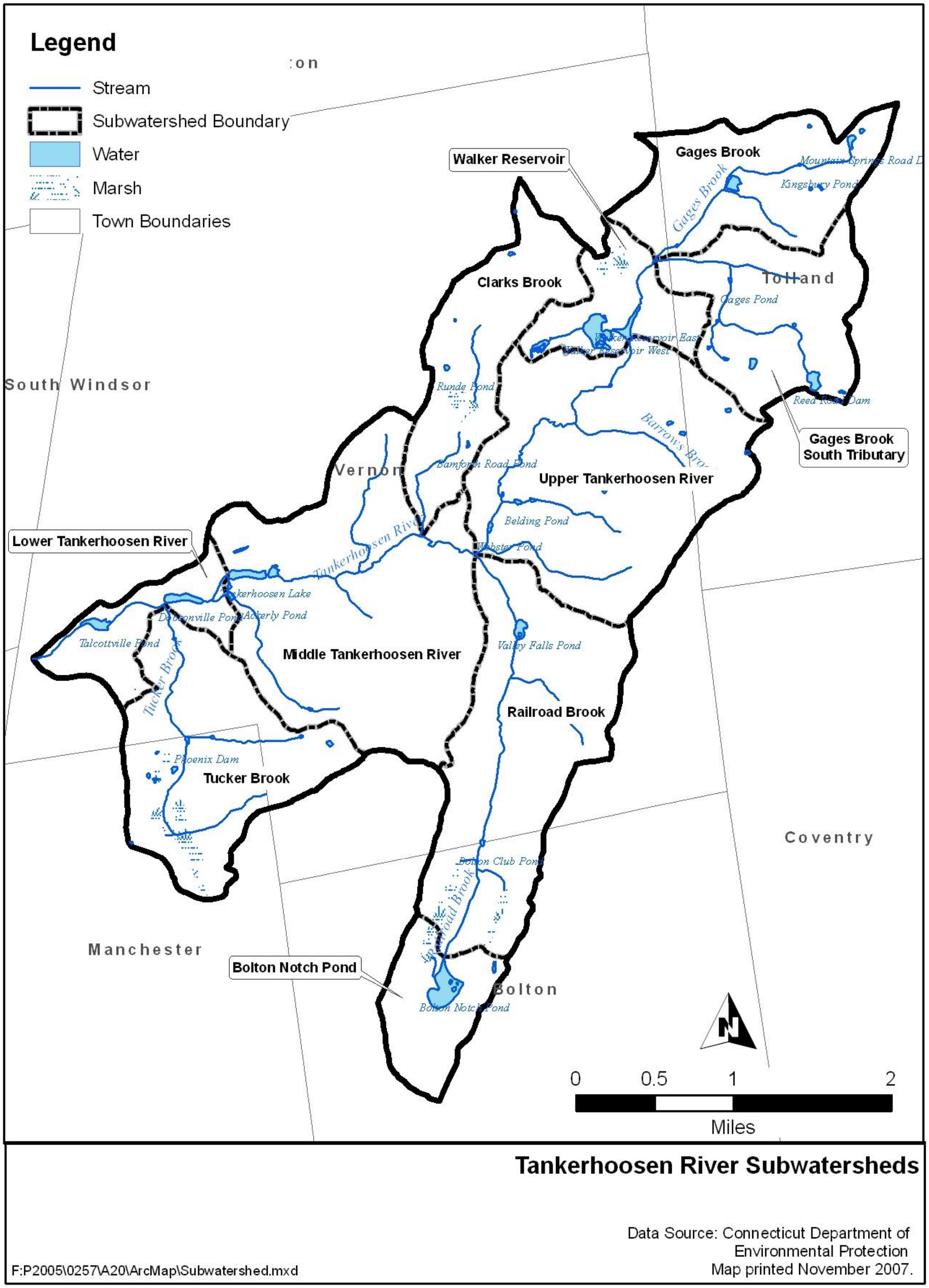


Figure 2-3. Tankerhoosen River Subwatersheds

2.4 Water Quality

2.4.1 Classifications and Impairments

The Federal Clean Water Act (CWA) was developed to protect the nation's surface waters. Through authorization of the CWA, the United States Congress declared as a national goal "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water wherever attainable". Connecticut Water Quality Standards are established in accordance with Section 22a-426 of the Connecticut General Statutes and Section 303 of the CWA. The Water Quality Standards are used to establish priorities for pollution abatement efforts. Based on the Water Quality Standards, Water Quality Classifications establish designated uses for surface and ground waters and identify the criteria necessary to support these uses. The Water Quality Classification system classifies inland surface waters into four different categories ranging from Class AA to D. Table 2-4 summarizes the Connecticut Surface Water Quality Classifications.

Table 2-4. Connecticut Inland Surface Water Quality Classifications

<table>
<tr><th>Designated Use</th><th>Class AA</th><th>Class A</th><th>Class B</th><th>Class C</th><th>Class D</th></tr>
<tr><td>Existing/proposed drinking water supply</td><td>•</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Potential drinking water supply</td><td>•</td><td>•</td><td></td><td></td><td></td></tr>
<tr><td>Fish and wildlife habitat</td><td>•</td><td>•</td><td>•</td><td></td><td></td></tr>
<tr><td>Recreational use</td><td>•</td><td>•</td><td>•</td><td colspan="2" rowspan="2">Class C and D waters may be suitable for certain fish and wildlife habitat, certain recreational activities, industrial use, and navigation</td></tr>
<tr><td>Agricultural and industrial use</td><td>•</td><td>•</td><td>•</td></tr>
</table>

Source: DEP Surface Water Quality Standards, December 17, 2002

Figure 2-4 depicts the Water Quality Classifications of surface waters in the Tankerhoosen River watershed. Surface waters throughout the Tankerhoosen River watershed are classified as Class A with the exception of the Tankerhoosen Lake, Dobsonville Pond, and Talcottville Pond which are classified as Class B/A.

The CWA (Federal Clean Water Act) requires states to:

1. Adopt Water Quality Standards,
2. Assess surface waters to evaluate compliance with Water Quality Standards,
3. Identify those waters not currently meeting Water Quality Standards, and
4. Develop Total Maximum Daily Load (TMDL) analysis and other management plans to bring water bodies into compliance with Water Quality Standards.

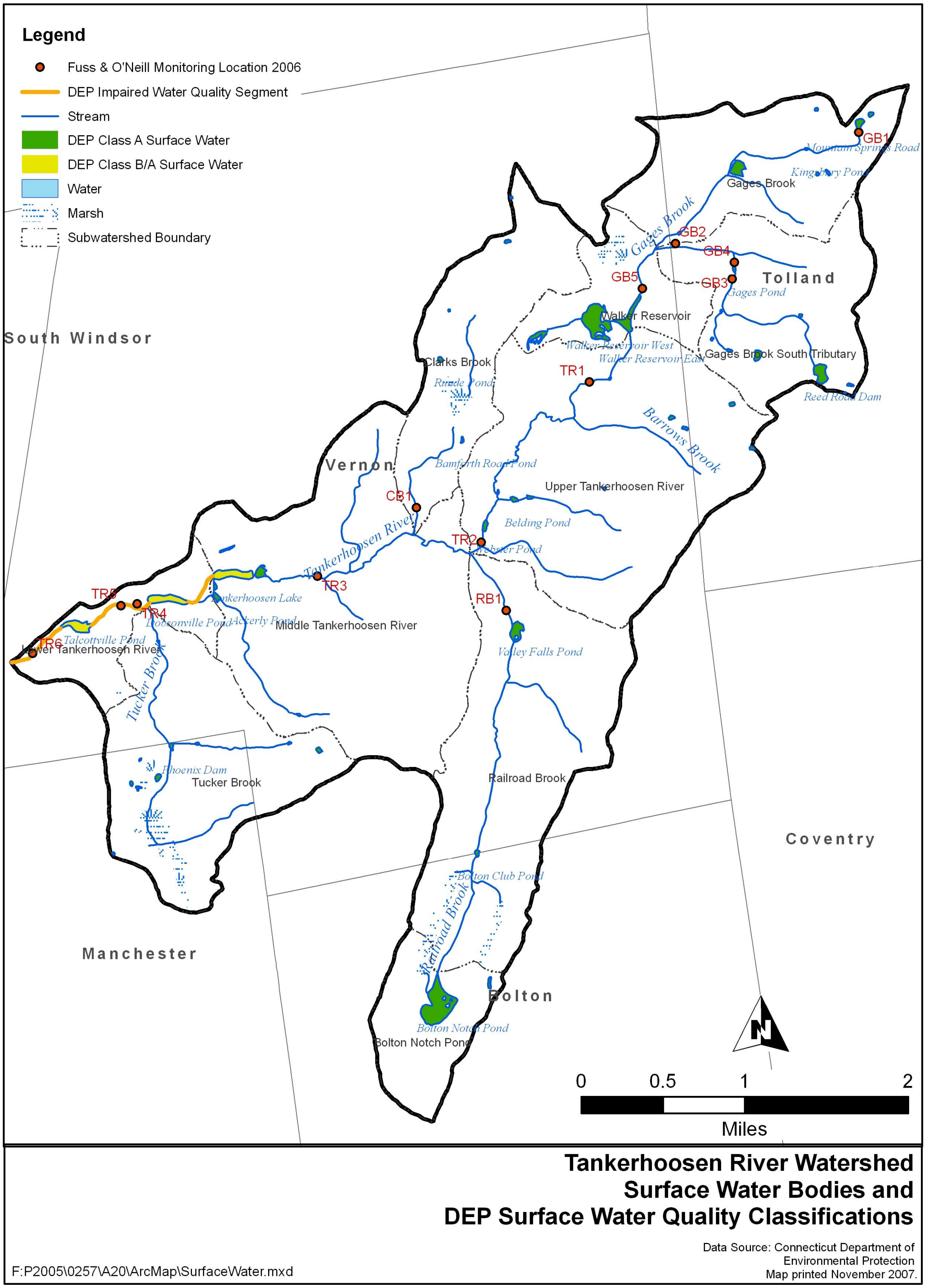


Figure 2-4. Water Quality Classifications

A portion of the Tankerhoosen River does not meet Water Quality Standards for at least one of the designated uses. The impaired segment consists of the lower 1.51 miles of the Tankerhoosen River from Tankerhoosen Lakes to its confluence with the Hockanum River. The impaired uses include habitat for fish, other aquatic life, and wildlife. The causes and sources of impairment in the lower reaches of the Tankerhoosen River have not been identified and are currently listed as "unknown." TMDLs provide the framework to restore impaired waters by establishing the maximum amount of a pollutant that a water body can assimilate without adverse impact to aquatic life, recreation, or other public uses. The *2006 List of Connecticut Waterbodies Not Meeting Water Quality Standards* includes a priority ranking system for development of a TMDL specific to the contaminants in each impaired segment: high (H), medium (M), low (L), or under study (T). DEP has identified the impaired segment of the Tankerhoosen River as a high priority for development of a TMDL to restore the impairment. Table 2-5 summarizes the location and nature of the impairment.

Table 2-5. Tankerhoosen River Watershed Impaired Waters

Location Description	Waterbody Segment Length	Impaired Designated Use	Use Support	Cause	TMDL Priority	Potential Source
From mouth at Hockanum River, upstream to Tankerhoosen Lake	1.51 miles	Habitat for Fish, Other Aquatic Life and Wildlife	P	Impairment Unknown	H	Source Unknown

Source: DEP, 2006
H – high priority for which there is assessment information that suggests that a TMDL may be needed to restore the water quality impairment.
P – partially supporting

2.4.2 Tankerhoosen River Watershed Water Quality Monitoring Study

A water quality monitoring study was conducted in October and November 2006 to establish current baseline water quality conditions in the watershed, identify water quality impacts, and begin to develop a water quality database for the watershed (Fuss & O'Neill, 2007). Chemical water quality monitoring and biological assessments were conducted during dry and wet weather conditions. Samples were collected from fourteen locations throughout the watershed on four occasions (Figure 2-4). A variety of parameters were measured including pH, temperature, dissolved oxygen, and conductivity, which all reported values within normal ranges. These results indicate that the water quality of the watershed is generally good. However, some of the measured parameters including turbidity, metals, nitrogen, phosphorus, and bacteria highlighted some of water quality issues in the watershed. A brief discussion of the water quality parameters and identified issues is provided below:

Turbidity

Based on the wet weather monitoring results, excessive turbidity is a water quality issue in the Tankerhoosen River and its tributaries, particularly Gages Brook (Figure 2-5). Stream channel erosion and stormwater runoff from impervious surfaces and construction sites are potential sources of the observed turbidity during large precipitation events such as the August 2006 wet weather monitoring event, although it is difficult to attribute the turbidity excursions to a particular source. During the August 2006 wet weather monitoring event, turbidity measurements generally exhibited a declining trend from upstream to downstream within the watershed. Elevated levels of indicator bacteria (total coliform and *E. coli*) were measured at all monitoring locations during the October 2006 wet weather monitoring event, suggesting stormwater runoff and other non-point sources (pet waste, waterfowl, septic systems, etc.) as likely contributors of elevated pathogen levels in the Tankerhoosen River and its tributaries.

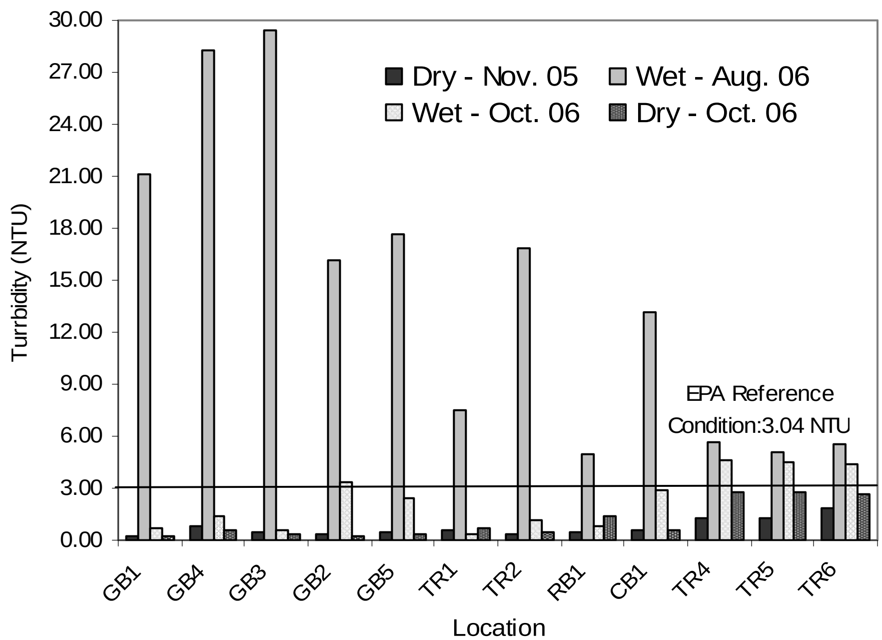


Figure 2-5. Turbidity – Tankerhoosen River Watershed

Metals

The monitoring data suggest a wet weather source of metals to Gages Brook (Figure 2-6 and Figure 2-7). Results from the August 2006 monitoring event indicate a wet weather source of metals close to the I-84 crossing of Gages Brook, as the dissolved copper concentration was consistently below detection limits at the Gages Brook headwaters monitoring location (GB1) and in excess of the chronic aquatic life criterion at several of the downstream Gages Brook locations. The highest wet weather lead concentration was measured in the Gages Brook monitoring location immediately downstream of I-84, which further suggests that highway runoff is a likely source of metals to Gages Brook. Exceedances of the CT WQS for lead were also measured along the Tankerhoosen River at the Fish and Game Road. (TR1) and Bolton Road (TR2) monitoring locations. Elevated dissolved copper and lead concentrations were also measured at the Clarks Brook monitoring location. The data suggest that metals are a potential source of impairment in Gages Brook, Clarks Brook, and the Tankerhoosen River during wet weather. The November 2005 results also indicate dry weather sources of dissolved copper to Gages Brook between the headwaters monitoring location (GB1) and the monitoring location behind the Tolland Agricultural Center (GB2).

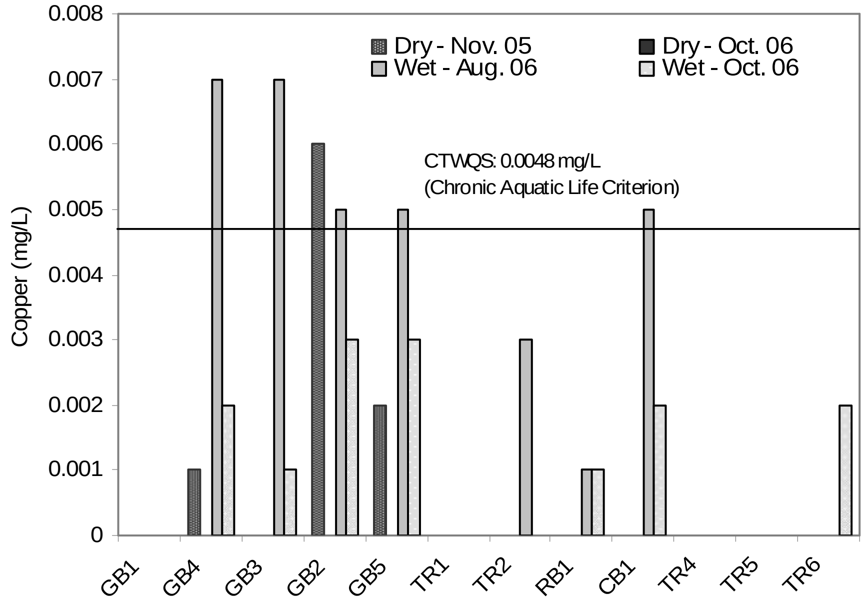


Figure 2-6. Dissolved Copper – Tankerhoosen River Watershed

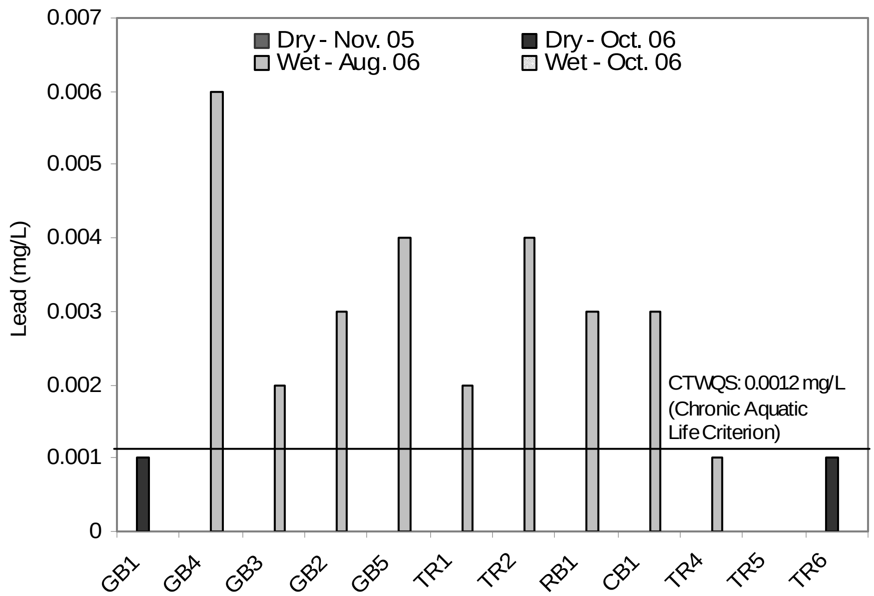


Figure 2-7. Lead – Tankerhoosen River Watershed

Nutrients

Many of the monitoring locations exceeded the EPA recommended Total Nitrogen criterion for rivers in Ecoregion XIV of 0.71 mg/L (Figure 2-8). Nitrogen concentrations were consistently higher at the Gages Brook monitoring locations than the other monitoring locations in both wet and dry weather.

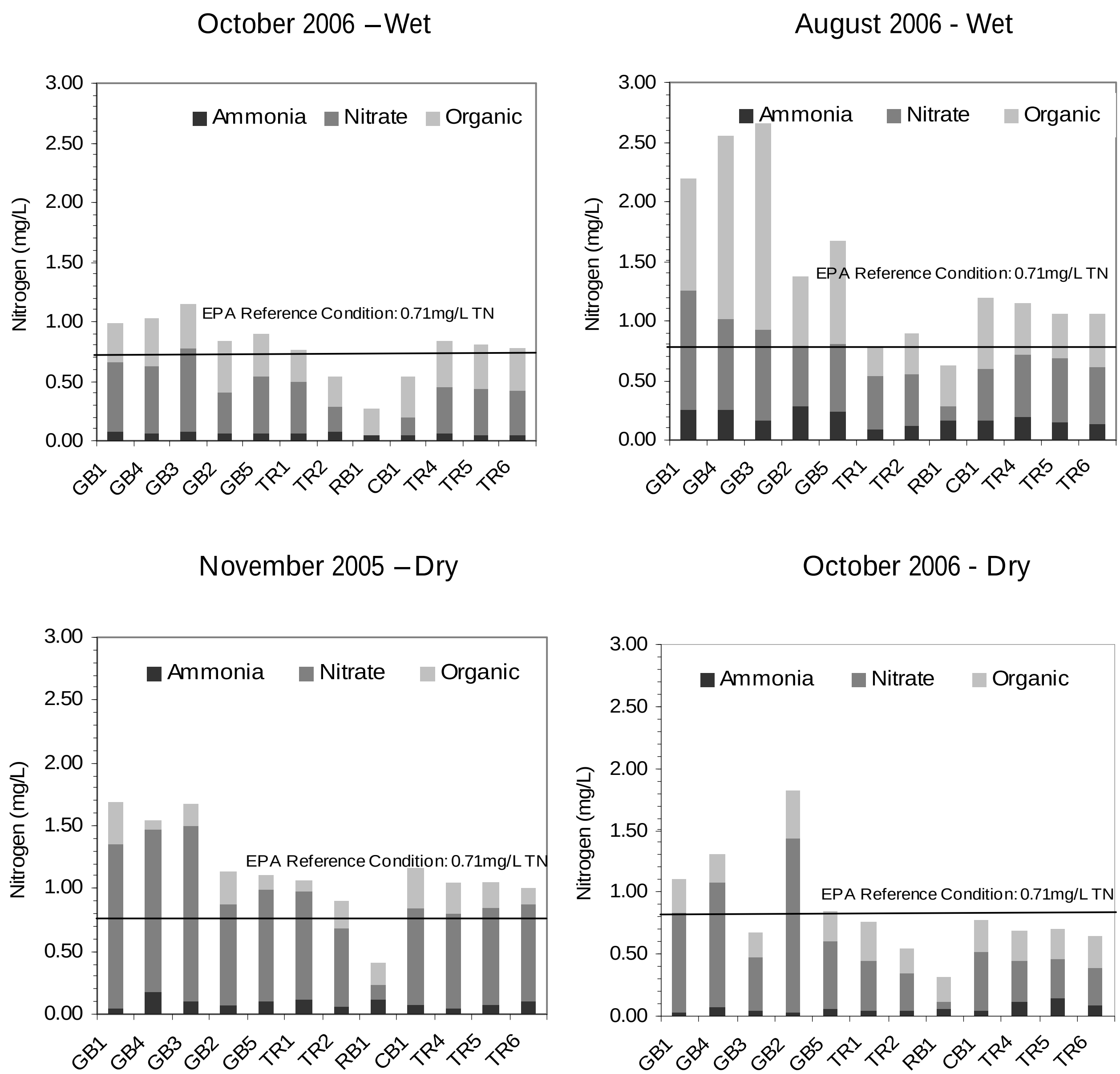


Figure 2-8. Nitrogen Species – Tankerhoosen River Watershed

Phosphorus concentrations measured during the wet and dry weather events significantly exceeded the CT WQS and EPA criterion at most locations (Figure 2-9). The elevated phosphorus levels are an indicator of potential organic enrichment and algal growth in water bodies along the Tankerhoosen River and its tributaries, which could impair aquatic life support and contact recreation under certain conditions.

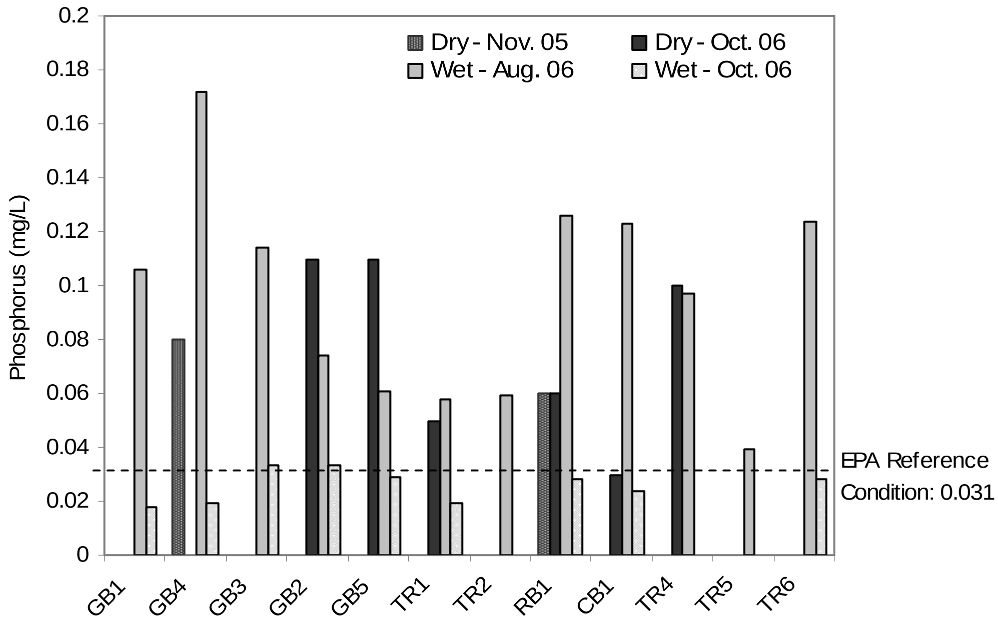


Figure 2-9. Phosphorus – Tankerhoosen River Watershed

Indicator Bacteria

Elevated levels of indicator bacteria (total coliform and *E. coli*) were measured at all monitoring locations during the October 2006 wet weather monitoring event, suggesting stormwater runoff and other non-point sources (pet waste, waterfowl, septic systems, etc.) as likely contributors of elevated pathogen levels in the Tankerhoosen River and its tributaries. Dry weather indicator bacteria concentrations were much lower than wet weather. Natural sources of indicator bacteria such as waterfowl or wildlife may have contributed to several dry weather exceedances of the CT WQS for total coliform at the Gages Brook monitoring location behind the Tolland Agricultural Center and at the Tankerhoosen River monitoring location just upstream of Fish and Game Road.

Bioassessments

The 2006 bioassessment data (RBV and Fuss & O Neill data collectively) vary considerably by site, but generally indicate very good water quality at most of the monitoring locations, with the exception of the lower Tankerhoosen River near the confluence with the Hockanum River and downstream of Dobsonville Pond. This finding is consistent with previous impairments identified in the lower reaches of the

Tankerhoosen River by the CTDEP. Despite the water quality issues identified in Gages Brook, Clarks Brook, and in certain reaches of the Tankerhoosen River (i.e., heavy metals, turbidity and suspended solids, and potential nutrient enrichment), the 2006 bioassessment data indicate little or no impairment to the benthic communities at the monitored locations.

2.5 Wetlands

Generally, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Wetlands and buffer zones between watercourses and developed areas help to preserve stream water quality by filtering pollutants, encouraging infiltration of stormwater runoff, and protecting against stream bank erosion.

Wetlands in Connecticut are designated by soil classification. Figure 2-10 depicts the extent and distribution of wetland soils in the Tankerhoosen River watershed based on Natural Resources Conservation Service soil classifications. Figure 2-10 also depicts wetland mapping available from the U.S. Fish & Wildlife Service National Wetlands Inventory. Wetlands soils comprise 11.3% of the overall watershed (approximately 926 acres), while 4% of the watershed area (approximately 320 acres) is mapped as freshwater emergent wetlands or freshwater forested/shrub wetlands. The concentration of wetland soils is generally higher in the undeveloped portions of the watershed. Mapped wetland soils are generally located in riparian and floodplain areas along the Tankerhoosen River and its major tributaries. Table 2-6 summarizes wetland soils coverage by subwatershed.

Table 2-6. Wetland Soils Coverage in the Tankerhoosen River Watershed

Subwatershed Name	Wetland Soils Area (ac)	% of Subwatershed
Bolton Notch Pond	20	5.8 %
Clarks Brook	101	15.5 %
Gages Brook	111	15.9 %
Gages Brook South Tributary	34	5.1 %
Lower Tankerhoosen River	7	2.3 %
Middle Tankerhoosen River	188	11.9 %
Railroad Brook	136	11.3 %
Tucker Brook	109	11.7 %
Upper Tankerhoosen River	193	13.1 %
Walker Reservoir	27	7.6 %
Tankerhoosen River Watershed	**926**	**11.3%**

At least twenty vernal pools have been identified within the Tankerhoosen watershed by certified scientists (see Figure 2-10). The majority of these were cited by Mr. Ed Pawluk of Connecticut Ecosystems, LLC in a study conducted for the Vernon Conservation Commission. Several of these pools are considered exemplary vernal pools, and as such merit the highest possible level of protection and conservation (Connecticut Ecosystems, LLC, 2005).

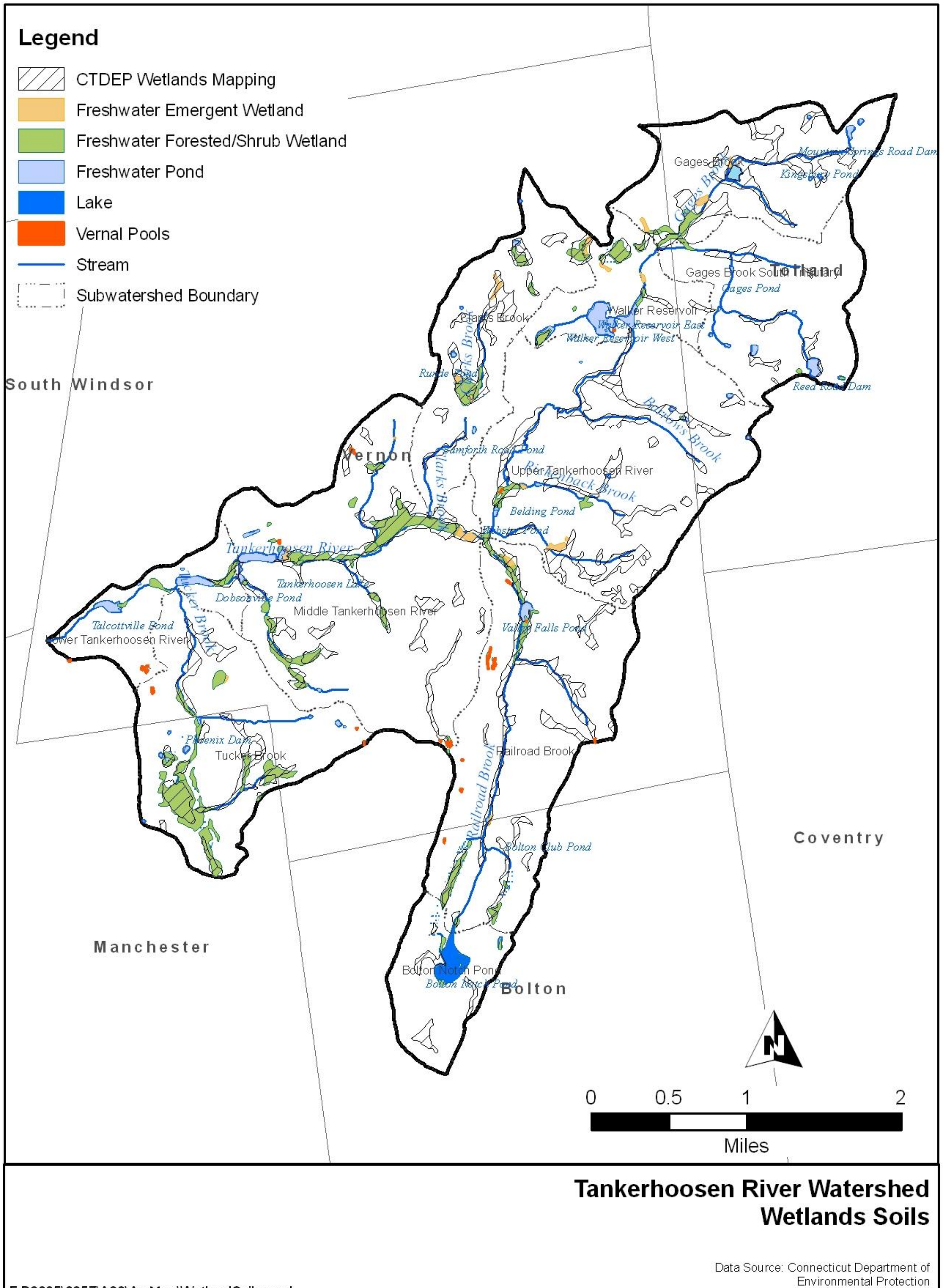


Figure 2-10. Wetland Soils – Tankerhoosen River Watershed

In 1993, a comprehensive survey of plant life was conducted in the 1,400-acre watershed from Valley Falls Park in Vernon to Bolton Notch State Park in Bolton (Sexton, 1993). The study was sponsored by the Town of Bolton Conservation Commission and the Town of Vernon Conservation Commission. A total of 345 species representing 82 families were identified. A small band of marble exists a short distance north and south of the cut at Bolton Notch. A plant species unique to this area includes the Yellow Lady's Slipper. Marble is rare east of the Connecticut River and supports additional plants preferring more basic soil including the purple cliff-brake and maidenhair fern (Sexton, 1993).

2.6 Fish and Wildlife Resources

Portions of the Tankerhoosen River have abundant habitats supportive of a variety of fish and wildlife. Various waterbodies, wetlands, and upland areas provide habitat to fish, mammals, amphibians, and birds.

Particularly notable is the 282-acre Belding Wildlife Management Area located in the central portion of the Tankerhoosen River watershed. The Belding Wildlife Management Area is a significant natural resource of undeveloped land owned by the State of Connecticut and managed by the DEP. A 1.4-mile section of the Tankerhoosen River within the Belding Wildlife Management Area is managed as a Class 1 Wild Trout Management Area and is one of only two such areas in eastern Connecticut. This section of stream is characterized by natural reproduction sufficient to produce robust populations of native brook trout (up to 8-10 inches) and wild brown trout (up to 10-11 inches) exhibiting above average growth rates (DEP correspondence, 2003).

Areas in the Tankerhoosen River watershed that provide significant habitat are summarized in Table 2-7. These areas provide habitat for some of the most valuable or unique natural resources or ecosystems in their respective communities. Other open space areas are described in the Land Use and Land Cover section of this report.

Table 2-7. Areas Providing Habitat for Valuable or Unique Natural Resources

Town	Areas
Vernon	• Vernal Pools on Box Mountain • Tancanhoosen LLC Parcel • Talcottville Gorge • Belding Wildlife Management Area • Belding Wild Trout Management Area • Valley Falls Park • Rambling Ridge Property • Webster-Knapp Preserve
Tolland	• Tolland and Charter Marshes
Bolton	• Freja Park • Bolton Notch State Park

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005; amended in 2008.

Freja Park is a 21-acre, wooded town-owned area located west of Bolton Notch Pond. Freja Park serves as a gateway for the 1,400-acre Bolton Notch/Valley Falls watershed area. The town of Bolton originally acquired the property in 1968, but the park suffered from abuse and neglect. Beginning in March 1998, restoration efforts have been underway including numerous Earth Day Clean-up events with the help of volunteers, Boy Scouts, Conservation Commission members. A total of over two tons of litter have been removed from the park.

2.6.1 Fisheries

The Tankerhoosen River historically hosted large runs of many anadromous fish species. Development of the river with dams from 1700 to the 1920s created barriers to fish migration, which extirpated the salmon run and severely limited the upstream habitat for shad and river herring. Despite these obstacles, the Tankerhoosen River and its tributaries support a variety of fish species as detailed in Table 2-8.

The Tankerhoosen River is a cold water stream starting only a short distance below Walker Reservoir. The generally cold water temperatures in the Tankerhoosen are the result of extensive spring water inputs (DEP correspondence, 2008).

As indicated previously, the Belding Wild Trout Management Area in the upper portions of the Tankerhoosen River watershed is a Class 1 Wild Trout Management Area with self-sustaining native trout populations that rank among the best of their kind in the state. Portions of the remainder of the Tankerhoosen River are stocked annually by the DEP Inland Fisheries Division. Valley Falls Park Pond is stocked in the spring and winter with about 4,400 rainbow trout and generates between 7,500-8,000 angler hours of fishing annually. Walker Reservoir, upstream of the Belding Wildlife Management Area, is stocked each spring with over 1,800 adult brown and rainbow trout (DEP correspondence, 2003).

Table 2-8. Fish Species

	Bolton Notch Pond	Gages Brook	Lower Tank. River	Middle Tank. River	Upper Tank. River	Railroad Brook
American Eel				X	X	X
Brown Bullhead	X					X
Black Crappie	X				X	
Blacknose Dace		X		X	X	X
Brook Trout		X		X	X	X
Brown Trout			X	X	X	X
Bluegill	X		X	X	X	X
Chain Pickerel	X		X	X		
Common Shiner				X	X	X
Creek Chub				X	X	
Fallfish				X	X	
Fathead Minnow		X				
Golden Shiner	X			X	X	
Longnose Dace				X	X	
Largemouth Bass		X	X	X	X	X
Pumpkinseed Sunfish	X	X	X	X	X	X
Rainbow Trout				X	X	X
Rockbass			X			
Smallmouth Bass			X			
Tessellated Darter			X	X	X	

Table 2-8. Fish Species

	Bolton Notch Pond	Gages Brook	Lower Tank. River	Middle Tank. River	Upper Tank. River	Railroad Brook
White Sucker		X		X	X	X
Yellow Perch	X			X		X
Tiger Trout					Stocked in Pond	
Golden Trout					Stocked in Pond	

2.6.2 Birds

Bird surveys were conducted in 2004 at the Tancanhoosen LLC property, within Valley Falls Park, and at various Town of Vernon properties, including areas around Walker Reservoir East and on the Connecticut Light & Power line site.

Eighty bird species were detected during the 2004 surveys. Seventy four species were counted during standardized bird counts at 24 count points, and 6 more were detected as incidental observations. The greatest number of species occurred at Walker Reservoir, while the former gravel pit on the Tancanhoosen LLC property contained the most uncommon birds. Prairie warbler, field sparrow, brown thrasher and eastern towhee were detected on the Tancanhoosen LLC property throughout the breeding season. Populations of these species are declining and brown thrasher is on Connecticut's list of Species of Special Concern. These birds are dependent on early successional habitats such as grassland and shrubland. These habitat types have been lost to reforestation and human development. The gravel pit is at an early successional stage with open, grassy habitat and short, scattered pine trees. This site will eventually revert to a forested habitat unless actively managed to maintain early successional habitat. Once the site is reforested, early successional species will disappear from this site (Seymour, 2004).

The Tankerhoosen River watershed also supports a wide range of bird of species. Surveys performed in 2003 and 2004 reported evidence of great blue heron, wood duck, willow flycatcher, hermit thrush, black-throated blue warbler, broad-winged hawk, hairy woodpecker, pileated woodpecker, olive-sided flycatcher, yellow-throated vireo, red-breasted nuthatch, blue-gray gnatcatcher, Nashville warbler, pine warbler, blackpoll warbler, blackburnian warbler, cerulean warbler, worm-eating warbler, and Canada warbler. European starling and house sparrow, two introduced invasive species, were also identified (Seymour, 2004). A complete species list is provided in the *Baseline Watershed Assessment* (Fuss & O Neill, May 28, 2008).

During 1999, a bird survey was completed to determine the species diversity and the relative abundance of breeding landbirds within Freja Park and Bolton Notch State Park (Comins, 1999). Of the total 55 species were recorded, 51 were likely nesting species and four were probably non-nesting visitors or migrants. An additional fourteen species were not recorded on the survey, but were identified as likely to occur during the nesting season. Another twenty-nine species have reasonable possibility of occurring in the nesting season from time to time or could be attracted to the area.

Two Connecticut State Species of Special Concern were recorded; six species were listed as National Audubon Society Watch List High Conservation Priority species in Connecticut were recorded; an additional six species not listed as watch species were listed by Partners in Flight as High Conservation Priority Species in Connecticut; fourteen species that were uncommon nesters in the Hartford area were recorded (Comins, 1999). See report for additional listing of specific species.

2.6.3 Amphibians & Reptiles

Amphibian and reptile surveys were conducted in 2004 within the Tankerhoosen River watershed, including the Belding Wildlife Management Area, Barrows Brook, and Railroad Brook. Some of the species identified included Northern redback salamander, Northern two-lined salamander, Spotted salamander, American toad, Northern spring peeper, Gray treefrog, Wood frog, Green frog, Pickerel frog, Painted turtle, and Garter snake. The most abundant amphibian species detected during this study was the northern redback salamander. A complete list of the identified amphibian and reptile species is provided in the *Baseline Watershed Assessment* (Fuss & O'Neill, May 28, 2008). A previously undocumented vernal pool was discovered between Reservoir Road and Walker Reservoir West. Additional vernal pools were identified on Bolton Road and above Valley Falls Park (Seymour, 2004).

2.6.4 Threatened and Endangered Species

The DEP Natural Diversity Data Base (NDDB) maintains information on the location and status of endangered, threatened, and special concern species in Connecticut. Figure 2-11 displays the generalized areas of endangered, threatened, and special concern species in the Tankerhoosen River watershed. The areas represent a buffered zone around known species or community locations. The locations of species and natural community occurrences depicted on the NDDB mapping are based on data collected over the years by the Environmental and Geographic Information Center's Geologic and Natural History Survey, other units of the DEP, conservation groups, and the scientific community. Approximately ten such areas were identified throughout the watershed. Because new information is continually being added to the Natural Diversity Database and existing information updated, the areas are reviewed on an annual basis by the DEP. Areas can be removed or added based upon the results of the review.

Table 2-9. Endangered, Threatened, and Special Concern Species

Common Name	Scientific Name	Status
	Flora	
Climbing fern	*Lygodium palmatum*	Special Concern
Sphagnum	*Sphagnum pulchrum*	--
Beaked sedge	*Carex rostrata*	--
Leatherleaf	*Chamaedaphne calyculata*	--
	Fauna	
Eastern pearlshell	*Margaritifera margaritifera*	Special Concern
Brown thrasher	*Toxostoma rufum*	Special Concern
Southern bog lemming	*Synaptomys cooperi*	Special Concern
Wood turtle	*Clemmys insculpta*	Special Concern
Purple martin	*Progne subis*	Threatened

Table 2-9. Endangered, Threatened, and Special Concern Species

Common Name	Scientific Name	Status
Eastern box turtle	*Terrapene c. carolina*	Special Concern
Habitats		
Medium fen	--	--
Subacidic rocky summit/outcrop	--	--

Source: DEP Natural Diversity Data Base, 2008.

- "Endangered Species" means any native species documented by biological research and inventory to be in danger of extirpation (local extinction) throughout all or a significant portion of its range within Connecticut and to have no more than five occurrences in the state.
- "Threatened Species" means any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within Connecticut and to have no more than nine occurrences in the state.
- "Species of Special Concern" means any native plant or any native nonharvested wildlife species documented to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population, or has become locally extinct in Connecticut.

2.7 Watershed Modifications

2.7.1 Dams, Impoundments, & Water Supply

The historical industrial use of the Tankerhoosen River and its major tributaries has left behind many small dams and impoundments. Most of this infrastructure is no longer used for power generation, and many of these impoundments currently provide aquatic and wildlife habitat and recreational opportunities. Many of the dams in the watershed are also an impediment to fish migration.

According to the DEP Dam Safety Regulations, the hazard classification of a dam is based on the damage potential from failure of the structure. Figure 2-12 shows the location and hazard classification of the identified dams within the watershed. Some of the dams which no longer serve an integral function to industry or public use have fallen into disrepair and pose a potential hazard to downstream properties.

Table 2-10 lists the major drinking water supplies within the Tankerhoosen River watershed that are regulated under the DEP Water Diversion program.

Table 2-10. Major Drinking Water Supplies

Name	Name of Diversion	MGD	Town
Connecticut Water Company	Vernon Well #1	0.1728	Vernon
	Vernon Well #2	0.1728	Vernon
	Vernon Well #3	0.1440	Vernon
	Vernon Well #4	0.1728	Vernon
	Vernon Well #5	0.4320	Vernon
Manchester Water Department	New Bolton Well Field, Well #1,2,3	Various	Bolton

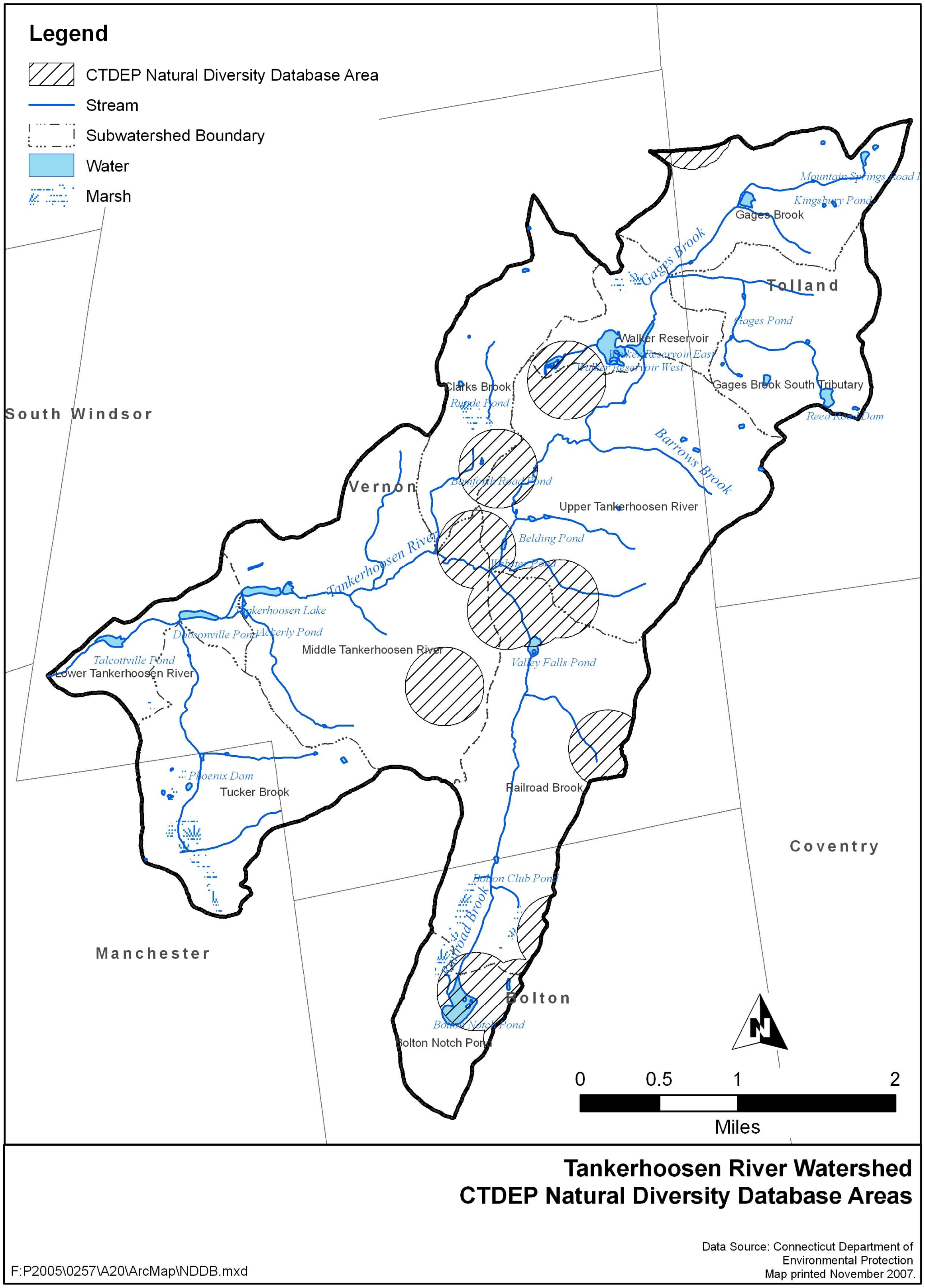


Figure 2-11. DEP Natural Diversity Database Areas – Tankerhoosen River Watershed

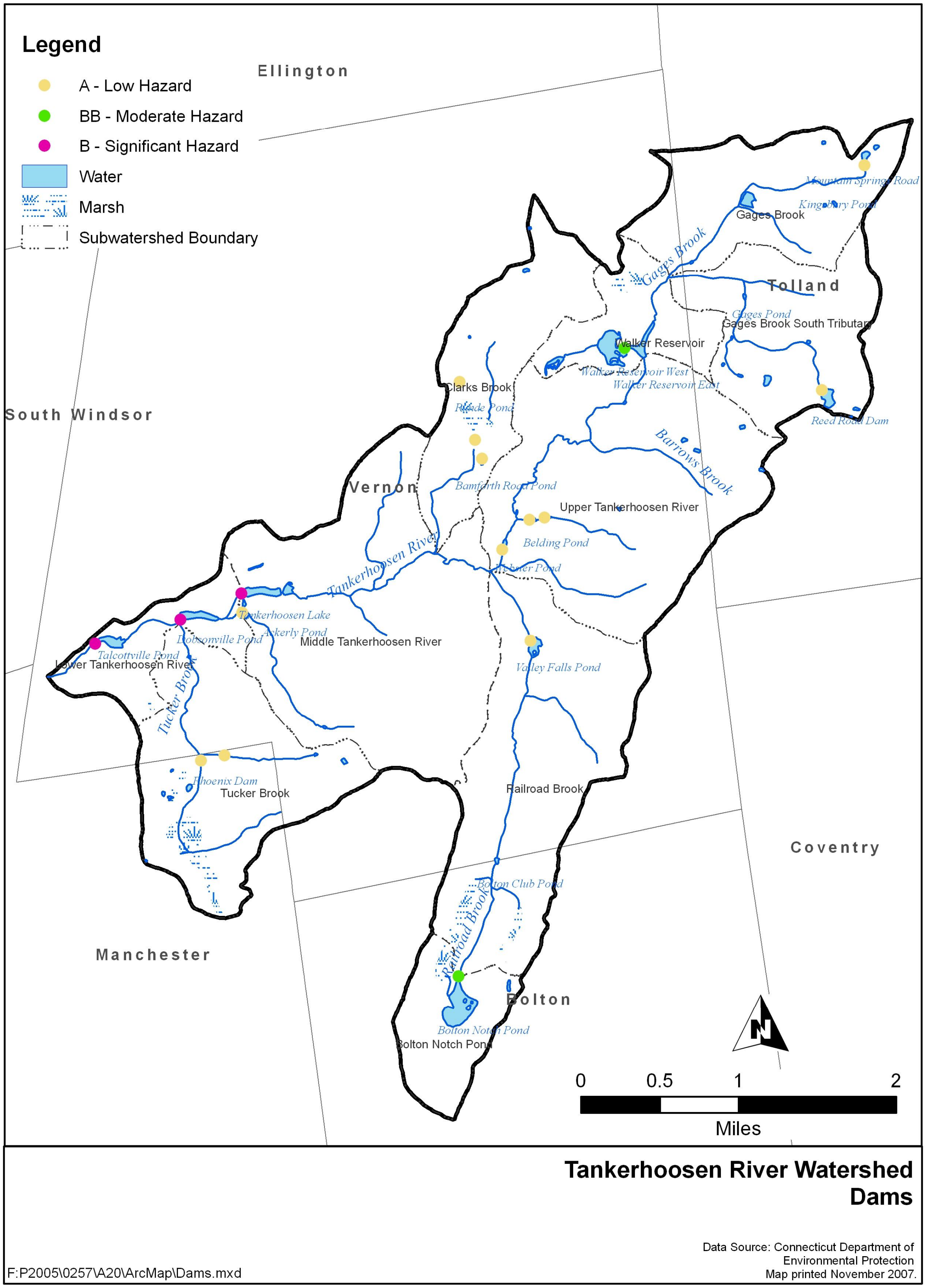


Figure 2-12. DEP Regulated Dams – Tankerhoosen River Watershed

The DEP, with Cooperation from the Connecticut Water Company, has identified two preliminary (Level B) Aquifer Protection Areas associated with these wells within the Tankerhoosen River watershed, as shown in Figure 2-13. Aquifer Protection Areas are designated around active well fields in sand and gravel aquifers that serve more than 1,000 people. Level B mapping identifies the general area of aquifer recharge based primarily on topography. The watershed communities are required to establish land use regulations for these areas to limit potential contamination to public groundwater supplies. Private groundwater supply wells are also prevalent throughout areas of the watershed that are not served by public water supplies.

2.7.2 Wastewater Discharges

As summarized in Table 2-11, there are number of industrial, commercial, and municipal facilities in the Tankerhoosen River Watershed with surface water discharges regulated under the National Pollutant Discharge Elimination System (NPDES) permit program, which is administered by the Connecticut DEP. The facilities listed in Table 2-5 have either permitted wastewater or stormwater discharges to surface waters. The majority of these facilities are located in Vernon. There are no municipal wastewater treatment plants located within the Tankerhoosen River watershed.

Table 2-11. NPDES Regulated Facilities

Town	Facility	Location	Permit Number
Vernon	Carpenter's Mobil	447 Hartford Turnpike	GVS000915
	Company 1 Firehouse	724 Hartford Turnpike	GVM000592
	Connecticut Golfland	95 Hartford Turnpike	GPL000108
	First Student	25 Whitney Ferguson Road	GSI001217
	Motiva Enterprises LLC	444 Hartford Turnpike	GGR001404
	Moore's Automotive	1245 Hartford Turnpike	GVM000806
	Mount Vernon Apartments	1120 Hartford Turnpike	GVS000863
	Oakland Meadows	1158 Hartford Turnpike	GSN001098
	Tighitco, Inc.	101-77 Industrial Park Road	GSI001599
	Vernon Maintenance	37 Campbell Avenue	GVS000988
			GSI000074
	VMS Construction Company	120 Bolton Road	GVM000980
Bolton	Transportation Facility	326 Boston Turnpike	GSI001179
	Hull's Autobody	299-301 Boston Turnpike	GVM000800
Tolland	Dari Farms	Gerber Drive	GSN000814
	Mr. Sparkle Car Wash	157 Hartford Turnpike	GVM000646
	Connecticut Light & Power Co.	45 Tolland Stage Road	GVS001027
	Gerber Scientific Inc.	24 Industrial Park Road West	GSI000914
	Standard Register Co.	259 Hartford Turnpike	GPP000152
			GPH000345
	CNC Software Inc.	671 Old Post Road	GSN000070
	Belvedere Ridge	601 Old Post Road	GSN001308

Source: DEP, December 2007

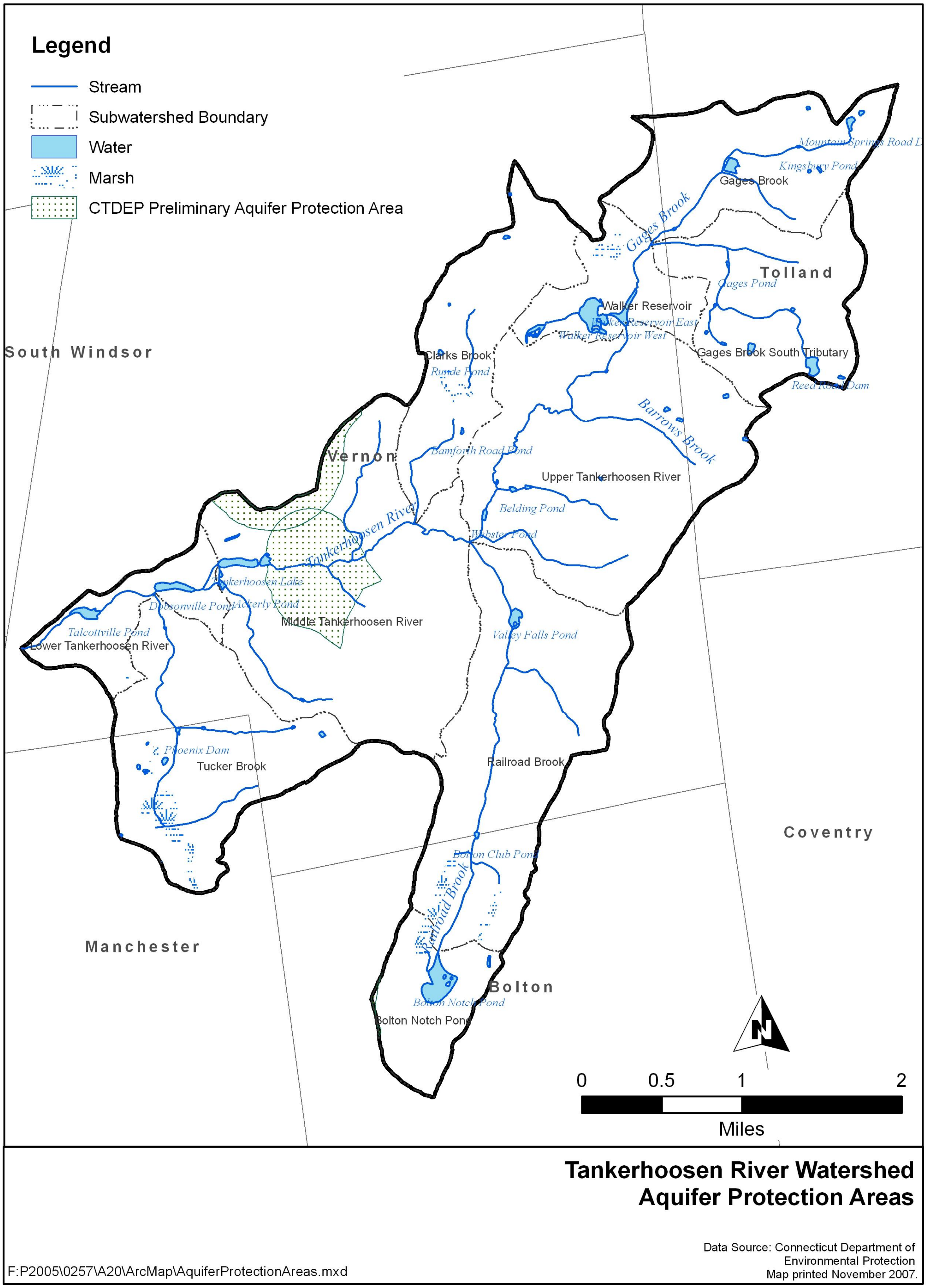


Figure 2-13. DEP Aquifer Protection Areas – Tankerhoosen River Watershed

Figure 2-14 depicts sewer service areas in the watershed. Areas outside of the mapped sewer service areas are presumed to be on individual sewage disposal (i.e., septic) systems. Approximately 23% of the overall Tankerhoosen River watershed area is served by municipal sanitary sewers.

Historical and current industrial and commercial development within the Tankerhoosen River watershed poses a potential threat to surface water and groundwater supplies in the watershed. Illegal waste disposal, improper use and disposal of chemicals such as used oil, pesticides, and herbicides, and chemical spills are potential sources of contaminants from industrial and commercial facilities. As summarized in Table 2-12, several hazardous waste generators and other regulated sites are located within the watershed. These facilities are located in both Vernon and Tolland in the central and upper portions of the watershed.

Table 2-12. Summary of Regulated Sites

Site Type	Number of Sites	
	Vernon	Tolland
Hazardous Waste Generator	5	6
Air Emissions	1	2
CERCLA Site	1 (1 on Final NPL)	0

There is one site that is listed as potential hazardous waste site that EPA has evaluated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), otherwise known as "Superfund." This site, Precision Plating Corporation, is located in the Hillside Industrial Park in Vernon and is currently on the Final National Priorities List (NPL). Chromium contaminated groundwater at the site is being remediated under the direction of the DEP.

2.8 Land Use and Land Cover

The type and distribution of land use within a watershed have direct impact on nonpoint sources of pollution and water quality. This section describes the land use and land cover patterns in the Tankerhoosen River watershed.

2.8.1 Current Conditions

Land Use

Figure 2-15 depicts general land use patterns in the Tankerhoosen River watershed. The data in Figure 2-15 are parcel-based land use categories for the watershed communities, provided by the Capital Region Council of Governments (CRCOG). The land uses in the watershed include 20 land use categories (Table 2-13). Approximately 60% of the watershed consists of developed land uses, with single-family residential comprising the largest percentage (40%). Highway and other road right-of-ways comprise approximately 9% of the watershed area. Approximately 30% is classified as resource/recreation land use, which includes committed and uncommitted open space. Major portions of the riparian areas adjacent to the Tankerhoosen River and its tributaries are located within resource/recreation areas.

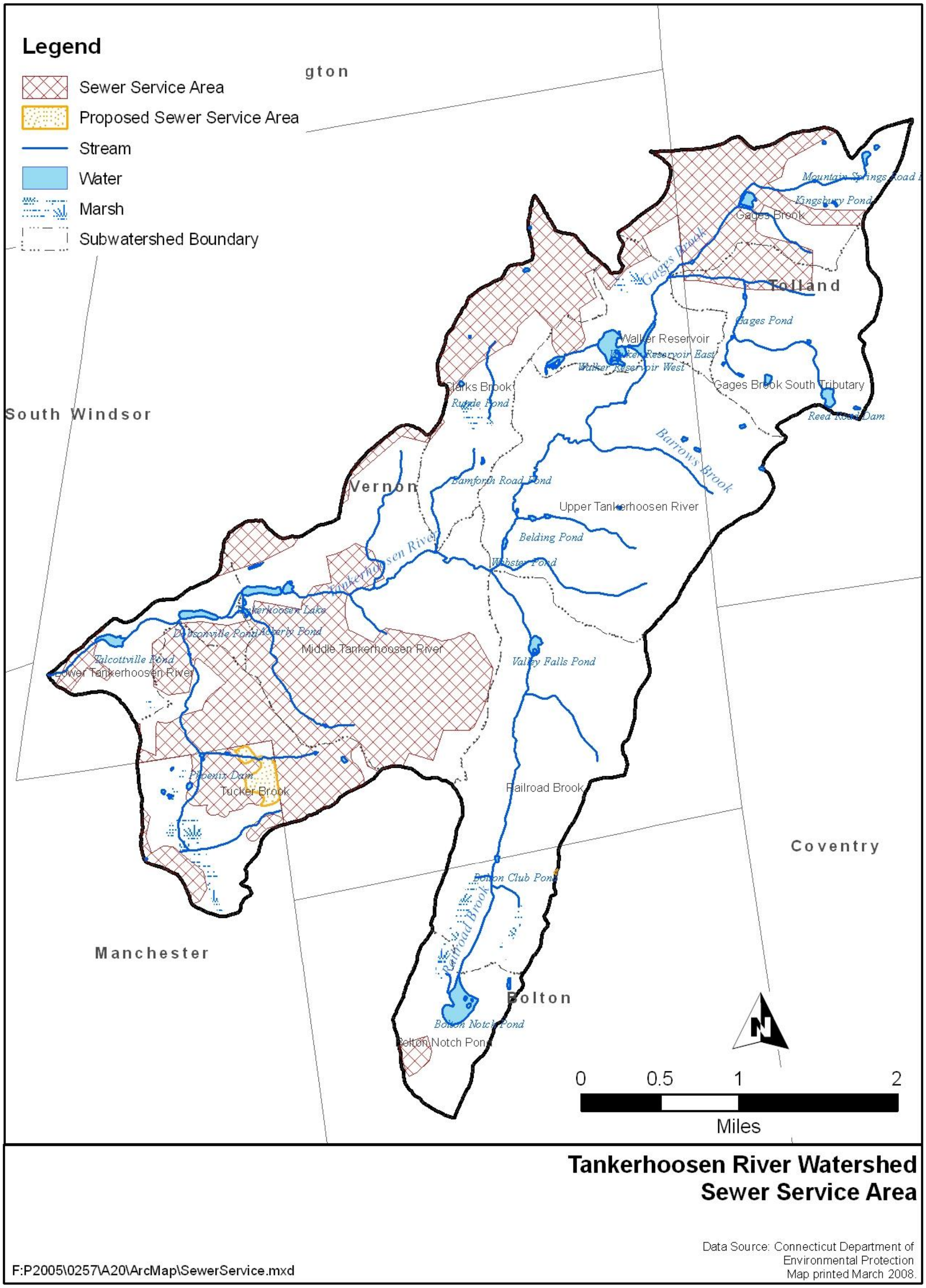


Figure 2-14. Sewer Service Areas – Tankerhoosen River Watershed

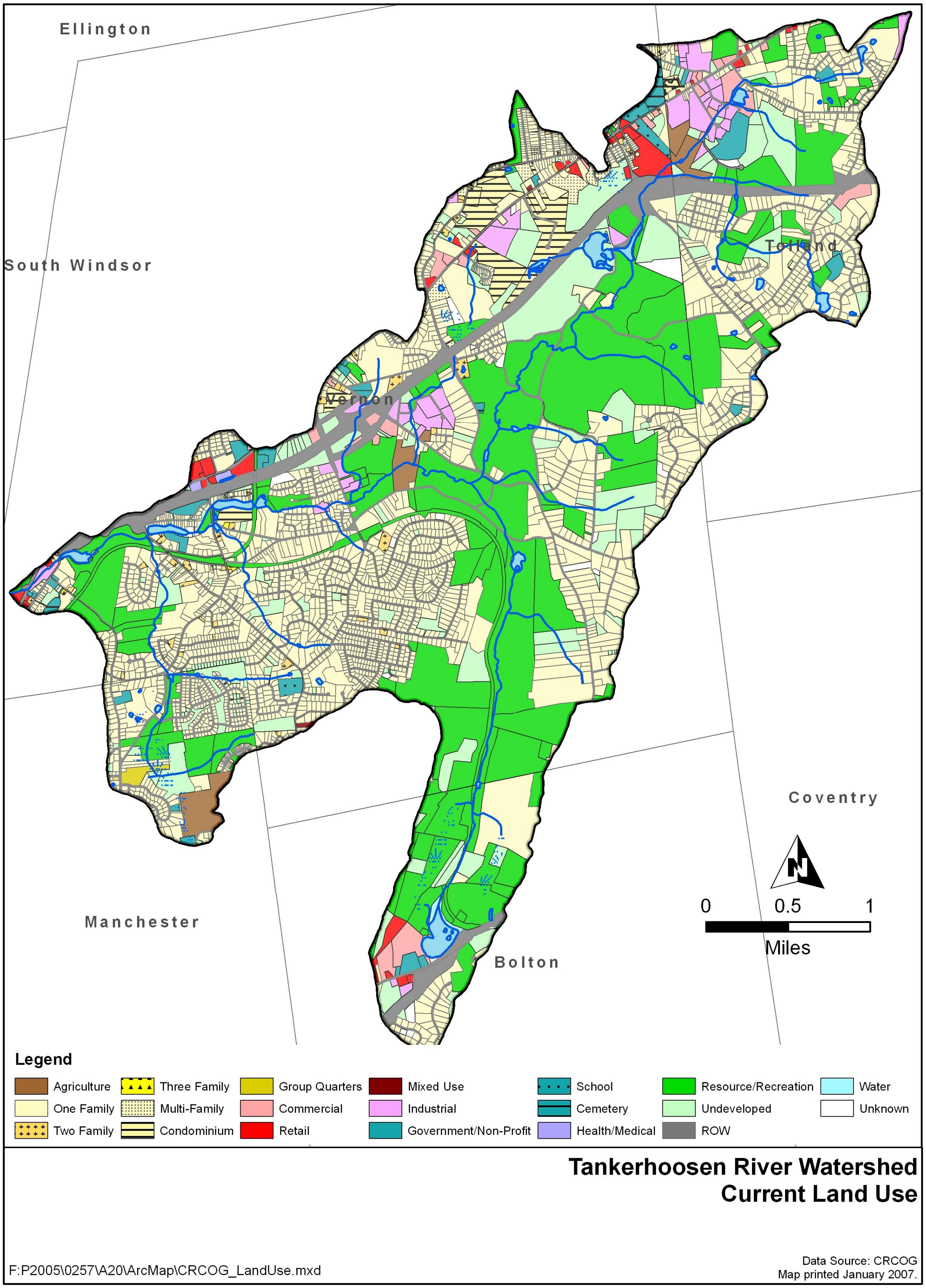


Figure 2-15. Current Land Use – Tankerhoosen River Watershed

Areas in the northern portion of the watershed are more commercialized and have a greater retail and industrial use, with commercial, retail, and industrial land uses comprising approximately 4% of the watershed area. The majority of the commercial, industrial, and retail areas are located in headwater regions adjacent to the major transportation corridors of I-84/Route 30 and I-384.

Table 2-13. Current Land Use – Tankerhoosen River Watershed

Land Use Type	Acres	Percent of Watershed
Agriculture	103	1%
One Family	3160	38%
Two Family	48	<1 %
Three Family	2	<1 %
Multi Family	39	<1 %
Condominium	165	2%
Group Quarters	12	<1 %
Commercial	110	1%
Retail	88	1%
Mixed Use	3	<1 %
Industrial	183	2%
Government/Non-Profit	102	1%
School	26	<1 %
Cemetery	22	<1 %
Health/Medical	6	<1 %
Resource/Recreation	2398	29%
Undeveloped	851	10%
Right-of-way	770	9%
Water	77	<1 %
Unknown	61	<1 %

In the Tankerhoosen River watershed, several tracts of potentially developable land have been permanently preserved as "committed" open space. Committed open space parcels in the Town of Vernon and the Town of Bolton were identified through available land use mapping and confirmed by members of the Technical Advisory Committee and the Bolton Conservation Commission. Committed open space parcels in Tolland and Manchester were determined through available mapping from each Town's Plan of Conservation and Development (POCD) and from the Connecticut Office of Policy and Management Municipal Plans of Conservation and Development. In general, the committed open space areas include deeded open space that is privately owned, parcels owned by land trusts, land owned by the State of Connecticut as well as parks owned by the Town of Vernon and Town of Bolton, including the Hop River State Park Trail, Valley Falls Park, Freja Park, and Bolton Notch State Park. This land is protected against future development and is generally located in the central and southern portion of the watershed. Figure 2-16 identifies the committed open space land in the watershed.

In addition, several parcels within the watershed are designated for agricultural or forestry use under Public Act 490. While development is not prohibited on this land, this program reduces the tax burden on this land, thereby relieving some of the pressure to develop the land and allows it to continue to serve as open space.

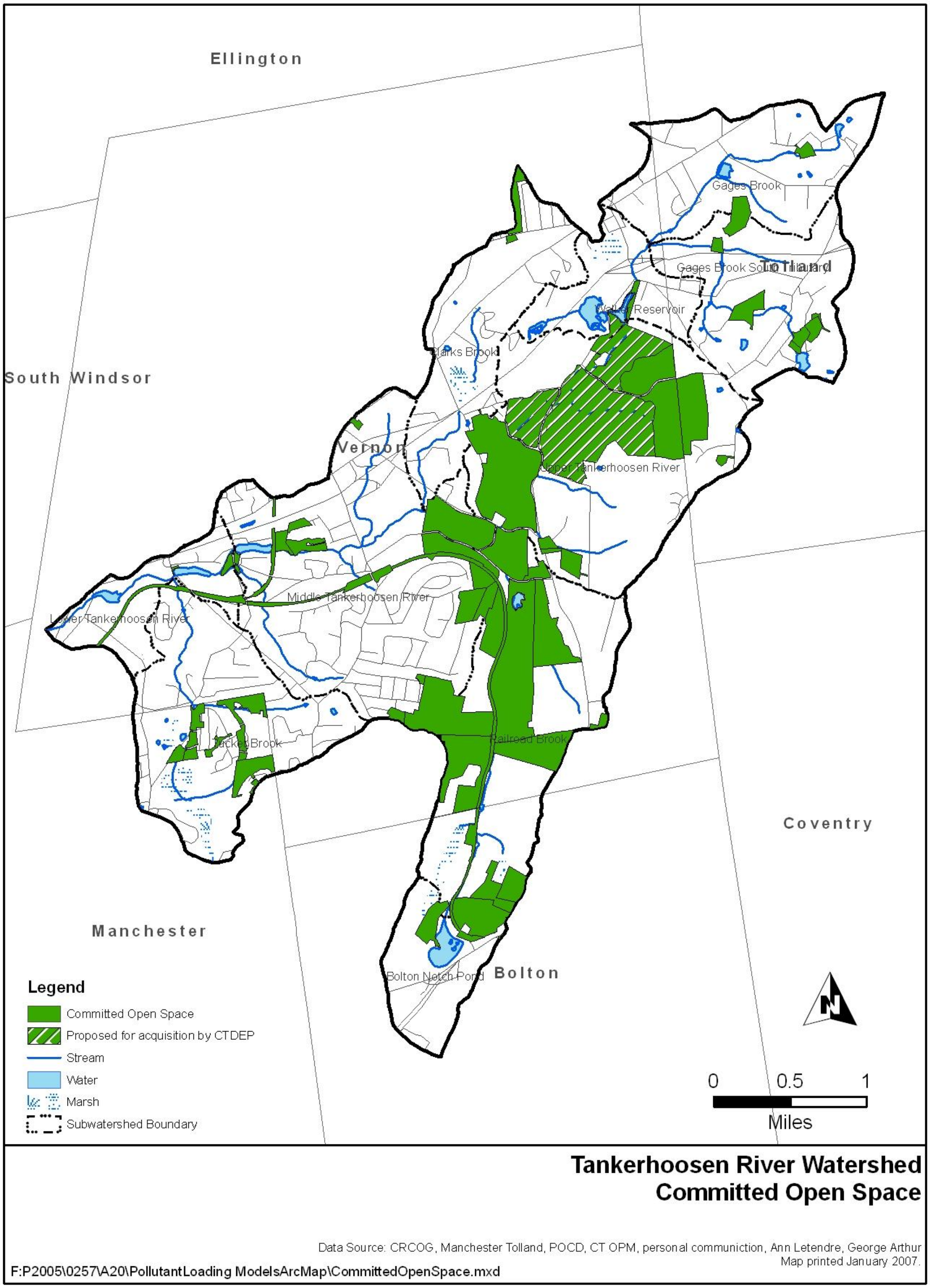


Figure 2-16. Committed Open Space – Tankerhoosen River Watershed

Zoning

Figure 2-17 depicts the zoning designations in the Tankerhoosen River watershed. The data in Figure 2-17 are also parcel-based and provided by CRCOG. The majority of the Tankerhoosen River watershed is zoned for residential uses. Commercial and industrial zones associated with the I-384 and I-84 corridors are located in the southern and northern portions of the watershed, respectively.

Land Cover

Figure 2-18 depicts the general land cover in the Tankerhoosen River watershed. Data shown in Figure 2-18 are land cover categories derived from 2002 Landsat satellite imagery with ground resolution of 30 meters. The land cover data in the watershed are summarized into ten categories (Table 2-8). These ten categories are those used in the Connecticut Land Cover Map Series and are described following the table (University of Connecticut Center for Land Use Education and Research).

Table 2-14. Land Cover – Tankerhoosen River Watershed

Land Cover Type	1985		2002		Relative Percent Change[1]	Relative Percent Change[2]
	Acres	Percent of Watershed	Acres	Percent of Watershed		
Barren	91	1%	162	2%	1%	78%
Coniferous Forest	454	6%	430	5%	-1%	-5%
Deciduous Forest	4581	56%	4085	50%	-6%	-11%
Developed	1793	22%	2201	27%	5%	23%
Forested Wetland	192	2%	175	2%	0	-9%
Non-Forested Wetland	2	< 1 %	19	<1 %	0	912%
Other Grasses and Agriculture	551	7%	603	7%	0	9%
Turf and grass	448	5%	447	5%	0	0%
Utility Right of Way	19	< 1 %	17	<1 %	0	-12%
Water	95	2%	88	1%	1%	-7%

[1]Calculation = % land cover 2002 - % land cover 1985

[2]Calculation = (acres land cover 2002 – acres land cover 1985) / acres land cover 1985

Source: University of Connecticut's Center for Land Use Education and Research (CLEAR)

- Barren – Mostly non-agricultural areas free from vegetation, such as sand, sand and gravel operations, bare exposed rock, mines, and quarries. Also includes some urban areas where the composition of construction materials spectrally resembles more natural materials. Also includes some bare soil agricultural fields.
- Coniferous Forest – Includes Southern New England mixed softwood forests. May include isolated low density residential areas.
- Deciduous Forest – Includes Southern New England mixed hardwood forests. Also includes scrub areas characterized by patches of dense woody vegetation. May include isolated low density residential areas.
- Developed – High density built-up areas typically associated with commercial, industrial and residential activities and transportation routes. These areas contain a significant amount of impervious surfaces, roofs, roads, and other concrete and asphalt surfaces.
- Forested Wetland – Includes areas depicted as wetland, but with forested cover. Also includes some small watercourses due to spectral characteristics of mixed pixels that include both water and vegetation.
- Non-forested Wetland – Includes areas that predominantly are wet throughout most of the year and that have a detectable vegetative cover (therefore not open water). Also includes some small watercourses due to spectral characteristics of mixed pixels that include both water and vegetation.
- Other Grasses and Agriculture – Includes non-maintained grassy areas commonly found along transportation routes and other developed areas and also agricultural fields used for both crop production and pasture.

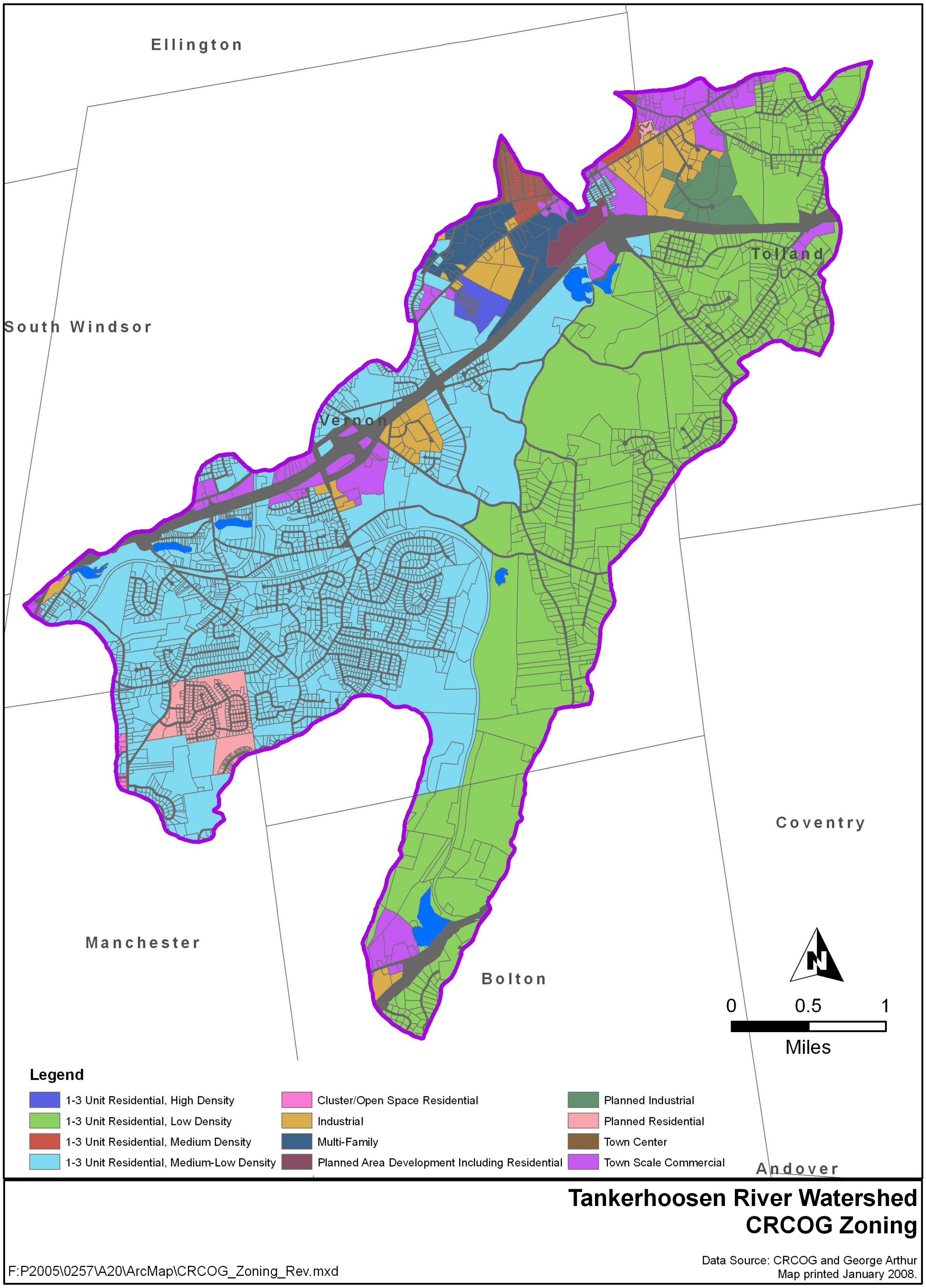


Figure 2-17. Watershed Zoning as Defined by CRCOG – Tankerhoosen River Watershed

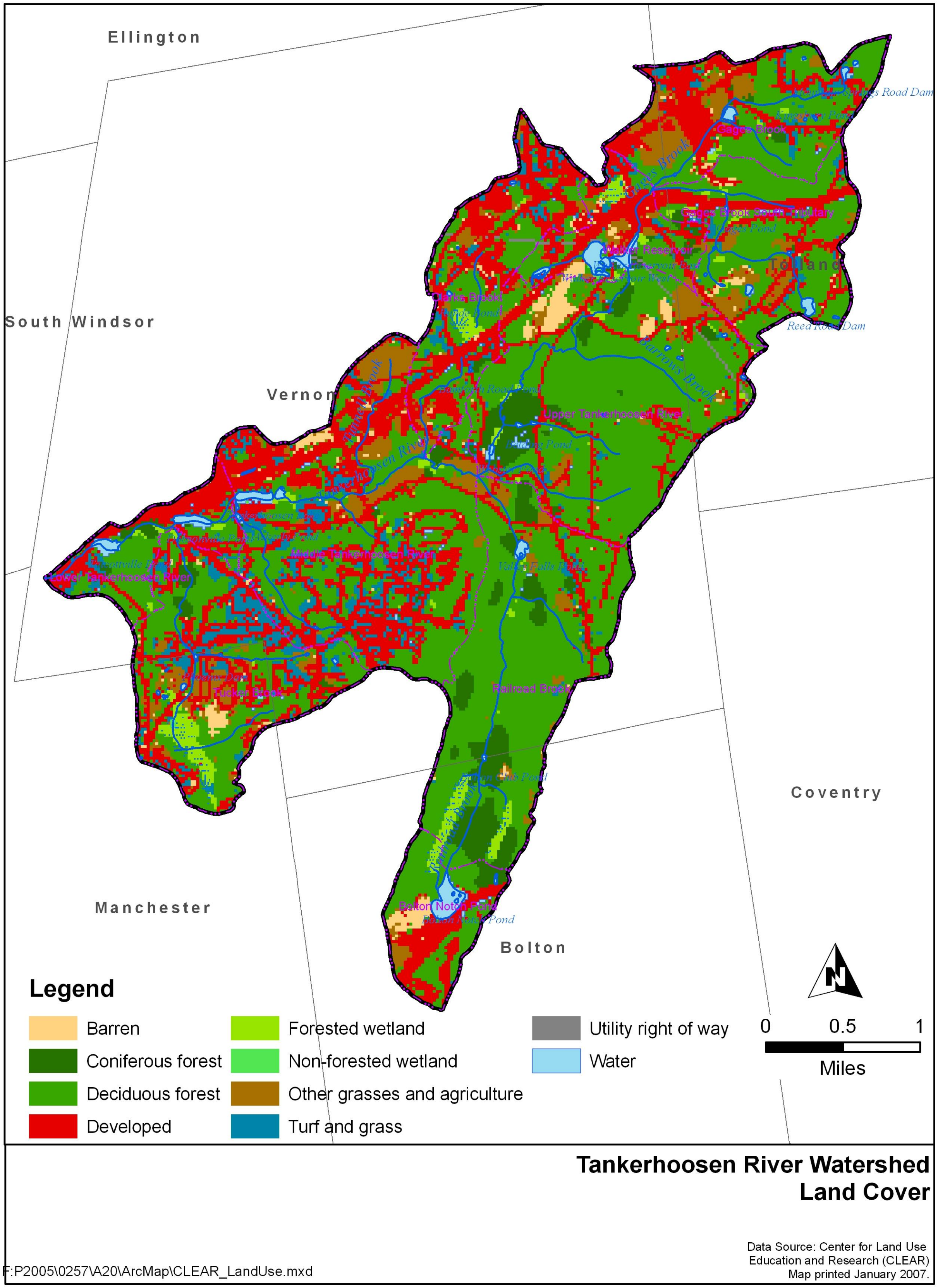


Figure 2-18. Land Cover – Tankerhoosen River Watershed

- Turf & Grass – A compound category of undifferentiated maintained grasses associated mostly with developed areas. This class contains cultivated lawns typical of residential neighborhoods, parks, cemeteries, golf courses, turf farms, and other maintained grassy areas. Also includes some agricultural fields due to similar spectral reflectance properties.
- Utility – Includes utility rights-of-way. This category was manually digitized on-screen from rights-of-way visible in the Landsat satellite imagery. The class was digitized within the deciduous and coniferous categories only.
- Water – Open water bodies and watercourses with relatively deep water.

Forest Cover

Forested areas are the predominant land cover type in the Tankerhoosen River watershed. Approximately 55% of the watershed consists of deciduous and coniferous forests, primarily in the central and southern portions of the watershed. Table 2-15 compares the total acres and percent forest cover by subwatershed. The percent forest cover in each subwatershed ranges from approximately 31% in the Walker Reservoir subwatershed to approximately 86% in the Railroad Brook subwatershed. Based on a literature threshold values documented in several studies (CLEAR, 2007), watershed forest cover of 65% or greater is the minimum needed for a healthy aquatic invertebrate community. Only two of the ten subwatersheds, Railroad Brook and the Upper Tankerhoosen River, exceed the threshold value of 65%. Based on a recommendation of the American Forests organization, 40% forest cover is a reasonable threshold goal for urban areas. All but two subwatersheds, Clarks Brook (34.8 %) and Walker Reservoir (31.3 %), both of which are located in the northern and most developed portion of the watershed, meet this goal.

Table 2-15. Forest Cover – Tankerhoosen River Watershed

Subwatershed Name	Forest Cover in Subwatershed (acres)	Percent Forest Cover in each Subwatershed	Developable Forest Cover in Subwatershed (acres)	Forest Cover that is Developable
Bolton Notch Pond	171	49.60%	41	24.00%
Clarks Brook	226	34.80%	70	30.90%
Gages Brook	314	45.20%	134	42.60%
Gages Brook South Tributary	395	58.10%	171	43.30%
Lower Tankerhoosen River	149	46.60%	82	54.90%
Middle Tankerhoosen River	625	39.60%	122	19.60%
Railroad Brook	1043	86.30%	346	33.20%
Tucker Brook	374	40.00%	119	31.80%
Upper Tankerhoosen River	1110	75.40%	278	25.00%
Walker Reservoir	109	31.30%	54	49.20%
Tankerhoosen River Watershed	**4515**	54.90%	1416	31.40%

Table 2-15 also includes a comparison of the amount of forest cover in each subwatershed that could potentially be developed in the future (i.e., "developable"). Refer to Section 2.5.2 for a discussion of the determination of "developable" areas and watershed buildout scenario. The percent of forest cover that is developable for each subwatershed ranges from approximately 20% in the Middle Tankerhoosen River subwatershed and up to approximately 55% in the Lower Tankerhoosen River subwatershed. These results suggest that future development within the watershed has the potential to significantly reduce forest cover and, in some subwatersheds, to below recommended thresholds.

Riparian Vegetation

Riparian, or streamside, corridors are critical areas important to stream stability, pollutant removal, and wildlife habitat. These areas are also sometimes called "buffer" areas, but are not to be confused with regulatory review zones, which are often also called buffers (CLEAR 2007). A stream walk survey of the Tankerhoosen River conducted in 1999 revealed that riparian buffers of 100 feet are common between the river and developed areas. However, some areas along the lower reaches of the Tankerhoosen River were identified as having stream buffers of less than 25 feet, according to the results of a 2000 stream walk survey of the Tankerhoosen River.

In order to assess the status and of the riparian corridors in the Tankerhoosen River watershed, the acreage of forest cover within the riparian area (defined as a 200-foot buffer on both sides of streams and a 200-foot buffer from waterbody shorelines) was calculated for each of the ten subwatersheds based on the 2002 Center for Land Use Education and Research (CLEAR) forest land cover classes (coniferous and deciduous forest). The results are provided in Table 2-16.

Table 2-16. Forest Cover in Riparian Corridors

Subwatershed Name	Forest Cover in 200-foot Riparian Corridor (acres)	Percent of 200-foot Riparian Corridor that is Forested
Bolton Notch Pond	19	34.90%
Clarks Brook	42	46.30%
Gages Brook	85	61.40%
Gages Brook South Tributary	93	62.30%
Lower Tankerhoosen River	31	35.80%
Middle Tankerhoosen River	99	41.80%
Railroad Brook	167	87.20%
Tucker Brook	92	51.80%
Upper Tankerhoosen River	216	80.70%
Walker Reservoir	21	23.10%
Tankerhoosen River Watershed	**866**	**58.30%**

Forest cover within the 200-foot riparian corridor for the overall Tankerhoosen River Watershed is nearly 60%, although the amounts vary considerably by subwatershed. Railroad Brook (87.2%) and the Upper Tankerhoosen River (80.7%) subwatersheds have the highest percentage of forest cover within the 200-foot riparian corridor. Walker Reservoir (23.1%) and Bolton Notch Pond (34.9%) have the lowest percentage of forest cover within the 200-foot riparian corridor. These results indicate that large portions of the watershed streams and waterbodies are well-protected by intact riparian forest cover, although several subwatersheds have significantly lower riparian forest cover.

Developed Areas

Developed areas are also a dominant land cover type in the Tankerhoosen River watershed. Approximately 27% of the watershed consists of commercial, industrial, residential, and transportation land cover types (i.e. "developed" category) that follow the major transportation corridors, regional retail and commercial areas, and population centers. Approximately 7% of the watershed consists of other grass and agriculture, although only a small portion of this (approximately 1%) consists of land in active agricultural use.

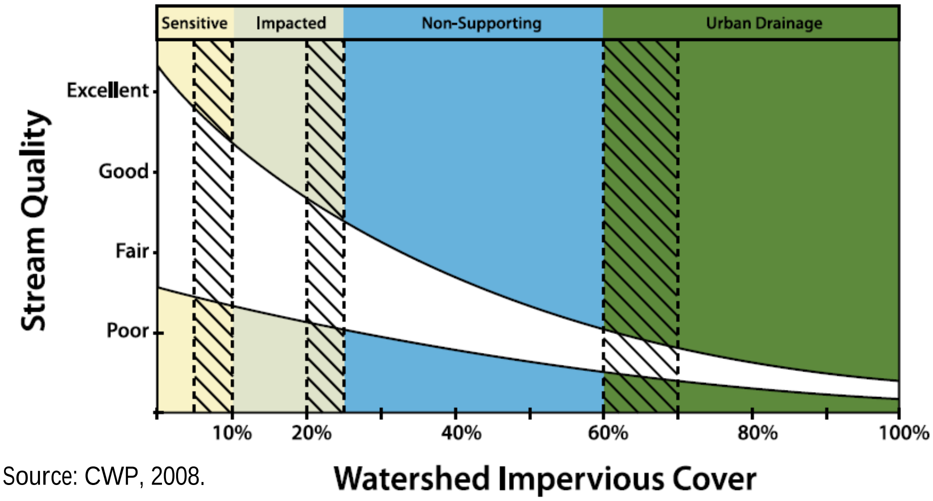
A comparison of watershed land cover data between 1985 and 2002 (Table 2-14) shows a moderate increase in watershed development during this period (5% increase in developed cover types) and a corresponding loss of coniferous (1% decrease) and deciduous forest (6% decrease).

Impervious Cover

Impervious cover has emerged as a measurable, integrating concept used to assess the overall condition of a watershed. Numerous studies have documented the cumulative effects of urbanization on stream and watershed ecology (Center for Watershed Protection, 2003; Schueler et al., 1992; Schueler, 1994; Schueler, 1995; Booth and Reinelt, 1993, Arnold and Gibbons, 1996; Brant, 1999; Shaver and Maxted, 1996). Research has also demonstrated similar effects of urbanization and watershed impervious cover on downstream receiving waters such as lakes, reservoirs, estuaries, and coastal areas.

The correlation between watershed impervious cover and stream indicators is due to the relationship between impervious cover and stormwater runoff, since streams and receiving water bodies are directly influenced by stormwater quantity and quality. Although well-defined imperviousness thresholds are difficult to recommend, research has generally shown that when impervious cover in a watershed reaches between 10 and 25 percent, ecological stress becomes clearly apparent. Between 25 and 60 percent, stream stability is reduced, habitat is lost, water quality becomes degraded, and biological diversity decreases (NRDC, 1999). Watershed imperviousness in excess of 60 percent is generally indicative of watersheds with significant urban drainage. Figure 2-19 illustrates this effect. These research findings have been integrated into a general watershed planning model known as the impervious cover model (ICM) (CWP, 2003). The ICM has also been confirmed locally in Connecticut by the DEP, which has determined a statewide impervious cover threshold of 12 percent for aquatic life impairment (Belucci, DEP, 2007).

A GIS-based impervious cover analysis was performed for the Hockanum River watershed and including the Tankerhoosen River watershed by staff from the Department of Natural Resources Management and Engineering at the University of Connecticut (Civco, 2005). The satellite-derived land cover data described previously were used in the analysis. This technique, known as "direct impervious surface modeling", extracted impervious surface data directly from 2002 Landsat imagery to estimate the amount of impervious surface within each pixel. The DEP GIS basin layer was used to calculate the percent of imperviousness by basin. Figure 2-19 graphically summarizes the results of this analysis.



Source: Source: CWP, 2008.

Figure 2-19. Conceptual Model Illustrating Relationship Between Watershed Impervious Cover and Stream Quality

The overall imperviousness of the Tankerhoosen River watershed is estimated at approximately 9.7%. This level of impervious cover is slightly below the CTDEP aquatic life impairment threshold of approximately 12%, where ecological stress and stream impacts become apparent. As shown in Figure 2-20 and summarized in Table 2-17, impervious cover in much of the central and southern portions of the watershed (Upper Tankerhoosen River and Railroad Brook watersheds) is less than 5%, consistent with the high percentage of forest cover and conservation land in these areas. The headwater tributaries of the Tankerhoosen River, specifically Gages Brook, are estimated to have approximately 11.5% impervious cover, while localized subwatershed areas around Bolton Notch Pond, Walker Reservoir, and Dobsonville Pond have impervious cover near or above 20%.

Table 2-17. Percent Impervious Cover – Tankerhoosen River Watershed

Subwatershed	Percent Impervious Cover
Bolton Notch Pond	16.60%
Clarks Brook	17.20%
Gages Brook	11.50%
Gages Brook South Tributary	11.30%
Lower Tankerhoosen River	15.80%
Middle Tankerhoosen River	12.90%
Railroad Brook	1.70%
Tucker Brook	8.10%
Upper Tankerhoosen River	4.50%
Walker Reservoir	19.90%
Tankerhoosen River Watershed	**9.70%**

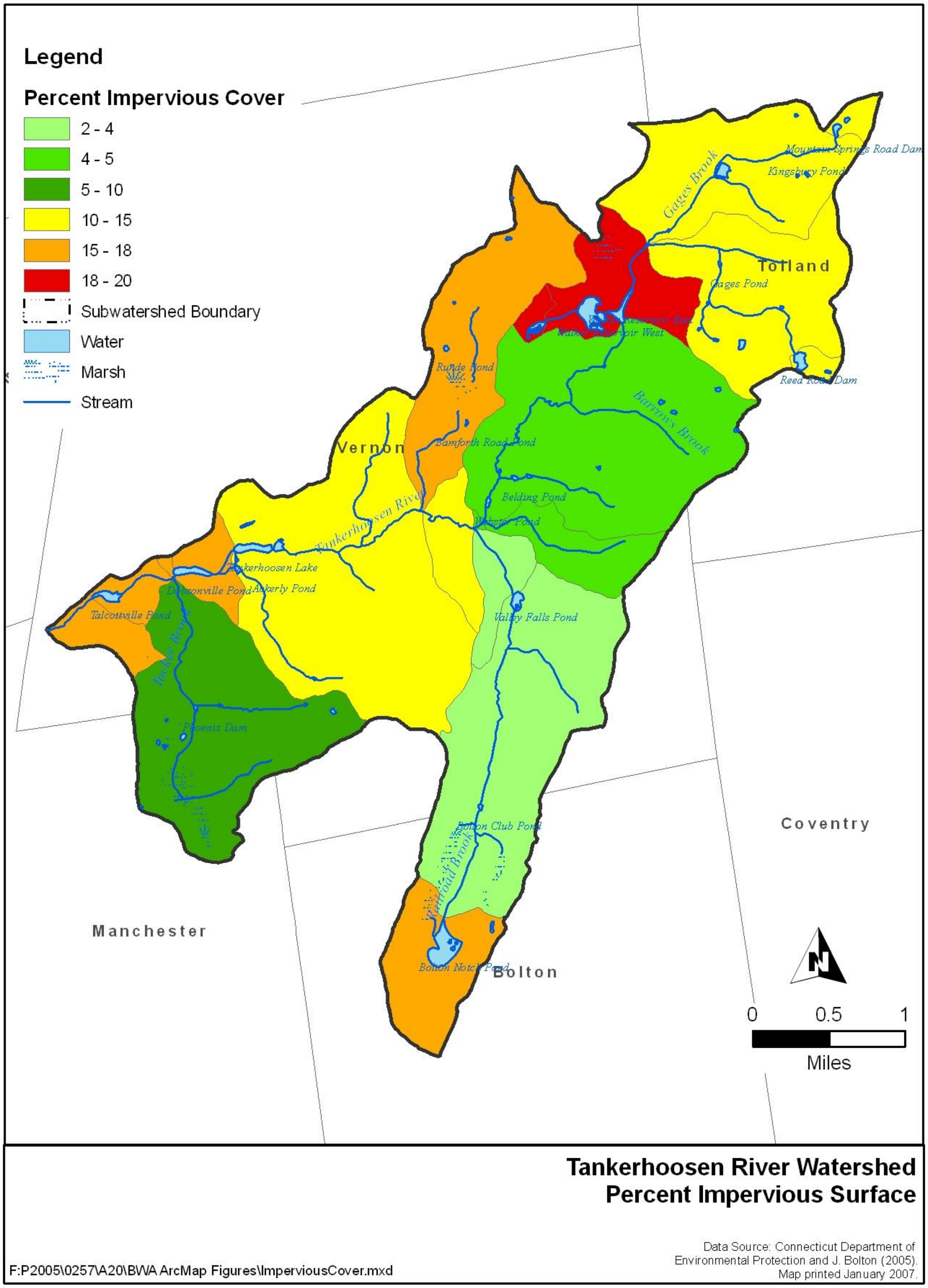


Figure 2-20. Current Impervious Cover – Tankerhoosen River Watershed

The results of this analysis provide an initial diagnosis of potential stream and receiving water quality within the watershed study area. The analysis method and ICM are based on several assumptions and caveats, which limits its application to screening-level evaluations. Some of the assumptions of the ICM include:

- Requires accurate estimates of percent impervious cover, which is defined as the total amount of impervious cover over a subwatershed area. The resolution of the land cover data used in the evaluation is relatively coarse, although sufficient for a screening-level analysis.
- Predicts potential rather than actual stream quality.
- Does not predict the precise score of an individual stream quality indicator but rather predicts the average behavior of a group of indicators over a range of impervious cover.
- The 10 percent and 25 percent thresholds are approximate transitions rather than sharp breakpoints.
- The ICM has not been validated for lakes, reservoirs, aquifers, and estuaries.
- Does not currently predict the impact of watershed best management practices (treatment or non-structural controls).
- Does not consider the geographic distribution of the impervious cover relative to the streams and receiving waters. Effective impervious cover (impervious cover that is hydraulically connected to the drainage system) has been recommended as a better metric, although determining effective impervious cover requires extensive and often subjective judgment as to whether it is connected or not.

Impervious cover is a more robust and reliable indicator of overall stream quality beyond the 10 percent threshold. The influence of impervious cover on stream quality is relatively weak compared to other potential watershed factors such as percent forest cover, riparian community, historical land use, soils, agriculture, etc. for impervious cover less than 10 percent.

2.8.2 Future Conditions

A watershed buildout analysis was also conducted as part of this assessment to assist in the identification of subwatersheds with the highest restoration potential as well as the greatest vulnerability. The purpose of the analysis is to estimate the future land use and impervious cover conditions of the watershed as a result of maximum development allowed by the current zoning within the watershed.

Land Use

Watershed lands that could be developed in the future (i.e., "developable" land) were subdivided into two categories, based on the CRCOG parcel-based land use data:

- *New Development* - areas that are currently undeveloped and could become new developments in the future. Land designated as "new development" includes those parcels that are designated as "undeveloped" and "resource/recreation" in the CROCG land use data and not identified as committed open space.

- *Redevelopment* - areas that are currently underdeveloped and could be redeveloped with a higher intensity land use in the future. Land designated for "redevelopment" were limited to single-family residential parcels in the CRCOG land use data that could be subdivided and/or redeveloped in the future.

Areas having the following physical and/or regulatory constraints were also removed from consideration for future development or redevelopment: water bodies, wetland soils, and soils whose slope characteristics defined by NRCS exceed 15% (i.e., steep slope soils). Resulting fragments of land smaller than ¼-acre in size for new development and 3 acres in size for redevelopment were also removed from the analysis. Table 2-18 and Figure 2-21 summarize the amount of developable land by subwatershed, including the new development and redevelopment categories.

Table 2-18. Developable Land – Tankerhoosen River Watershed

Subwatershed	New Development (acres)	New Development Percent in Subwatershed	Redevelopment (acres)	Redevelopment Percent in Subwatershed
Bolton Notch Pond	49	14.30%	11	3.20%
Clarks Brook	57	8.80%	52	8.10%
Gages Brook	129	18.50%	72	10.30%
Gages Brook South Trib.	123	18.10%	102	15.00%
Lower Tankerhoosen R.	91	28.50%	17	5.40%
Middle Tankerhoosen R.	127	8.00%	141	8.90%
Railroad Brook	212	17.60%	172	14.30%
Tucker Brook	122	13.10%	89	9.50%
Upper Tankerhoosen R.	238	16.10%	150	10.20%
Walker Reservoir	108	31.30%	13	3.80%
Total	**1257**	**15.30%**	**820**	**10.00%**

The future land use buildout scenario was estimated by assigning new land uses to developable areas, while maintaining the existing land uses for developed and unbuildable land (wetland soils, steep slope soils, etc.). The developable areas were assigned a future land use based on maximum degree of development allowed by the existing zoning category. Table 2-19 presents the future land use category assigned to each developable parcel based on the zoning category. This analysis assumes development of Act 490 parcels consistent with the underlying zoning and does not account for future zone changes or future land development regulatory changes.

Table 2-19. Assigned Future Land Use Category

Zoning Category	Future Land Use
1-3 Unit Residential, High Density	Condominium
1-3 Unit Residential, Medium Density	Three Family
1-3 Unit Residential, Medium-Low Density	Two Family
1-3 Unit Residential, Low Density	One Family
Cluster/Open Space Residential	One-Family
Industrial	Industrial
Multi-Family	Multi-Family
Planned Area Development Including Residential	Mixed Use
Planned Industrial	Industrial
Planned Residential	Multi-Family
Town Center	Mixed Use
Town Scale Commercial	Commercial

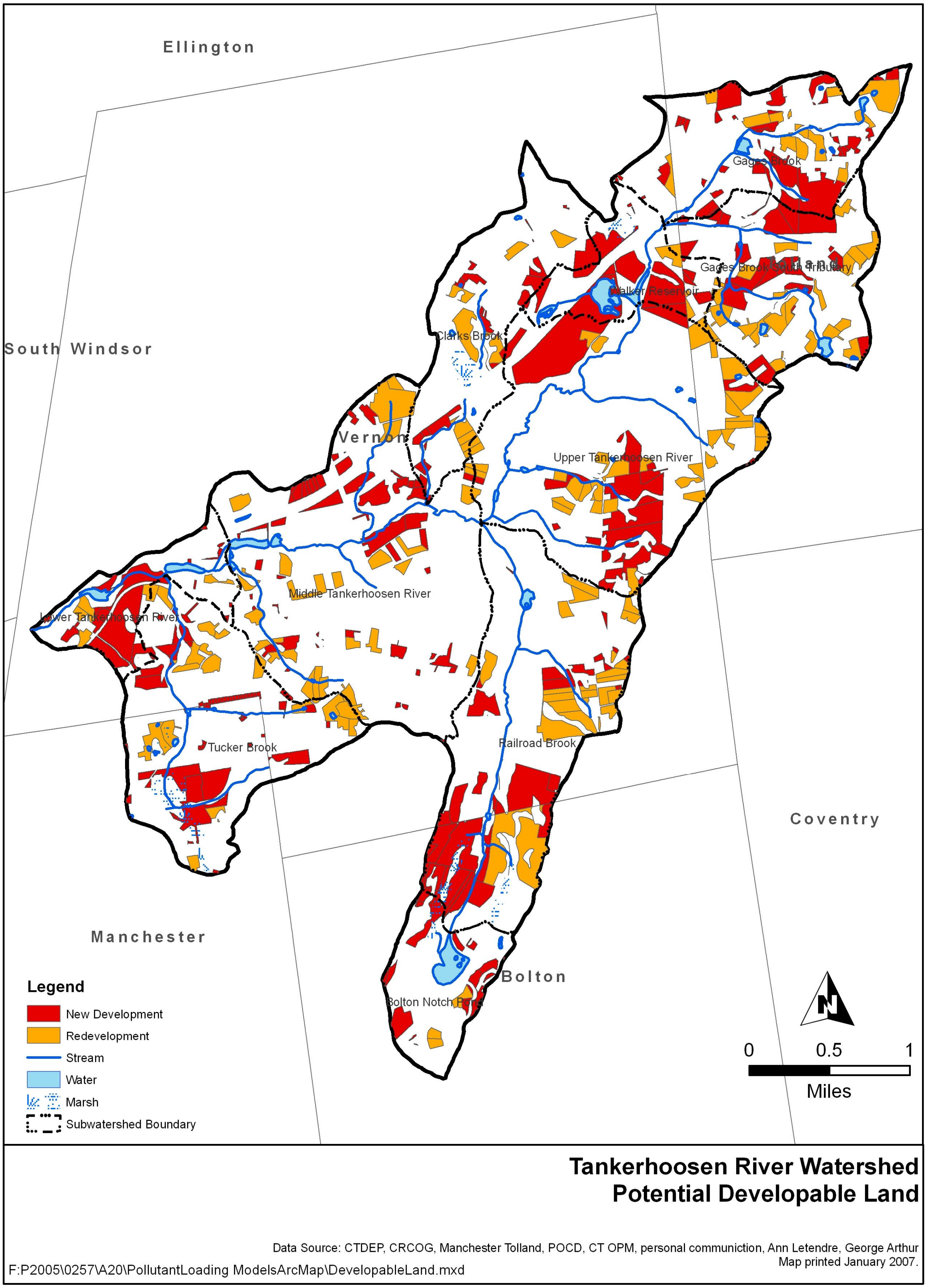


Figure 2-21. Developable Land – Tankerhoosen River Watershed

The results of the buildout analysis are summarized in Table 2-20, which compares acreage of existing and future land use in the watershed. The most significant potential land use change is in the residential land use categories, which is predicted to increase by approximately 15% watershed-wide. The area of resource/recreation and undeveloped land is predicted to decrease by approximately 15% watershed-wide, while commercial and industrial land are predicted to increase by approximately 3%.

Table 2-20. Landuse Buildout Analysis Results

Land Use Type	$Acres_{Existing}$	Percent of $Basin_{Existing}$	$Acres_{Future}$	Percent of $Basin_{Future}$	Relative Percent Change
Agriculture	103	1%	89	1%	0
One Family	3160	38%	3415	42%	4%
Two Family	48	<1 %	811	10%	10%
Three Family	2	<1 %	3	<1 %	0
Multi Family	39	<1 %	60	1%	1%
Condominium	165	2%	177	2%	0
Group Quarters	12	<1 %	12	<1 %	0
Commercial	110	1%	206	3%	2%
Retail	88	1%	88	1%	0
Mixed Use	3	<1 %	33	<1 %	0
Industrial	183	2%	270	3%	1%
Government/Non-Profit	102	1%	102	1%	0
School	26	<1 %	26	<1 %	0
Cemetery	22	<1 %	14	<1 %	0
Health/Medical	6	<1 %	6	<1 %	0
Resource/Recreation	2398	29%	1787	22%	-7%
Undeveloped	851	10%	233	3%	-7%
Right-of-way	770	9%	770	9%	0
Water	77	<1 %	77	<1 %	0
Unknown	61	<1 %	46	<1 %	0

Impervious Cover

The watershed buildout analysis was used in conjunction with the existing conditions impervious cover analysis to estimate future impervious cover in the Tankerhoosen River subwatersheds. To complete this analysis, impervious cover was included as a parameter in the pollutant load model described in Section 2.6.

Land use data for both existing and buildout conditions were then entered into the model to determine the change in impervious cover for each subwatershed. The predicted change in impervious cover was then added to the existing impervious cover estimates to estimate future impervious cover.

Table 2-21 presents estimates of existing and future impervious cover by subwatershed. The shaded cells in the table highlight the subwatersheds in which future impervious cover is predicted to approach or exceed either the "sensitive" (10% to 12%) or "impacted" (25%) threshold values as described by the Impervious Cover Model.

Table 2-21. Percent Impervious Cover – Existing and Future Conditions

Subwatershed	Existing Percent Impervious Cover	Future Percent Impervious Cover	Percent Change[1]
Bolton Notch Pond	16.60%	18.90%	2.30%
Clarks Brook	17.20%	20.60%	3.40%
Gages Brook	11.50%	14.20%	2.70%
Gages Brook South Tributary	11.30%	13.50%	2.20%
Lower Tankerhoosen River	15.80%	23.00%	7.20%
Middle Tankerhoosen River	12.90%	15.50%	2.60%
Railroad Brook	1.70%	3.40%	1.70%
Tucker Brook	8.10%	10.30%	2.20%
Upper Tankerhoosen River	4.50%	4.70%	0.20%
Walker Reservoir	19.90%	29.13%	9.20%
Total	**9.87%**	**12.47%**	**2.60%**

1. Percent change = $(IC^{Future} - IC^{Existing}) \times 100$

It is significant to note that, based on this analysis, the overall impervious cover in the Tankerhoosen River watershed is predicted to increase from less than 10% to greater than 12%, which is considered impacted. The largest change in impervious cover is predicted in the Walker Reservoir subwatershed, where imperviousness could increase from approximately 20%, or "impacted," to approximately 29%, or "non-supporting." Additionally, the impervious cover in Gages Brook and the associated Gages Brook South Tributary subwatersheds, both of which are important headwater streams, is predicted to cross the state-wide 12% sensitive threshold value.

Another useful metric was developed by Goetz et al. (2003) for the Chesapeake Bay region, which combines subwatershed impervious cover and tree cover within the 100-foot stream buffer. Each of the subwatersheds within the Tankerhoosen River Basin was analyzed with regard to the combined impervious cover/riparian zone metric, which is summarized in Table 2-22 by Goetz et al. (2003).

Table 2-22. Impervious Cover/Riparian Zone Metric

Stream Health	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Stream Buffer
Excellent	< = 6%	>=65%
Good	6-10%	60-65%
Fair	10-25%	40-60%
Poor	> 25%	<40%

Natural vegetation was determined using the CLEAR land cover data and included the deciduous forest, coniferous forest, forested wetland, and non-forested wetland categories. The Table 2-23 presents the results from the combined impervious cover/riparian zone metric.

Table 2-23. Impervious Cover/Riparian Zone Metric – Existing and Future Conditions

Subwatershed	Existing		Future	
	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Stream Buffer	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Stream Buffer
Bolton Notch Pond	16.6%	40.4%	18.9%	39.8%
Clarks Brook	17.2%	51.9%	20.6%	38.0%
Gages Brook	11.5%	59.5%	14.2%	50.1%
Gages Brook South Tributary	11.3%	69.6%	13.5%	40.2%
Lower Tankerhoosen River	15.8%	42.7%	23.0%	26.0%
Middle Tankerhoosen River	12.9%	49.7%	15.5%	41.8%
Railroad Brook	1.7%	89.4%	3.4%	73.7%
Tucker Brook	8.1%	65.5%	10.3%	49.6%
Upper Tankerhoosen River	4.5%	84.6%	4.7%	76.3%
Walker Reservoir	19.9%	41.2%	29.1%	31.8%

Overall, most of the Tankerhoosen River subwatersheds are currently categorized as "fair" to "good" based on the riparian zone metric published by Goetz et al. (2003), while several of the key headwater streams, including Railroad Brook and the Upper Tankerhoosen River, fall into the highest category. Comparison between the existing and future ratings indicates that four of the ten subwatersheds (Clarks Brook, Gages Brook South Tributary, Lower Tankerhoosen River, and Tucker Brook) are predicted to experience a decline in stream health as a result of future development and, in particular, development within the riparian corridor.

2.9 Pollutant Loading

A pollutant loading model was developed using the land use/land cover data described in Section 2-5. The model was used to compare existing nonpoint source (NPS) pollutant loads from the watershed to projected future pollutant loads that would occur under a watershed buildout scenario. It is important to note that the results of this screening-level analysis are intended for the purposes of comparing existing and future conditions and not to predict future water quality. This section summarizes the methods and results of the analysis, which are presented in greater detail in the *Baseline Watershed Assessment, Tankerhoosen River Watershed*, dated May 28, 2008 (Fuss & O Neill, Inc.).

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 4.0, was used for this analysis. This model was developed for US EPA by Tetra Tech in EPA Region 5 and has since been modified for use in other areas of the country. The model calculates watershed pollutant loads for sediment and nutrients based on land use-related pollutant sources, including urban runoff, septic system failures, stream bank erosion, and agricultural activities. The model also allows simulation of best management practices (BMPs) and Low Impact Development (LID) practices to reduce pollutant loads.

Data obtained as part of the Land Use/Land Cover analysis presented in Section 2.5.2 were used to generate model inputs. Several other model parameters were specified for each pollutant and subwatershed, including:

- Event Mean Concentrations (EMCs), which are literature values for the mean concentration of a pollutant in stormwater runoff for each land use.
- Curve Number (CN), which is a measure of the runoff potential of the land surface and is a function of soil type, cover condition, and slope.

The model was applied to each subwatershed to estimate pollutant loads for each subwatershed under existing land use and future land use scenarios, as described in Section 2-5. The existing and future pollutant loads were compared to assess anticipated changes in loads for each subwatershed. Table 2-24 presents the results of this analysis. Results are shown in terms of increase in pollutant loading rate (the mass of pollutant to be discharged from each acre of land in a watershed) and percent increase in pollutant load (based on the total pollutant discharge from each of the watersheds).

Table 2-24. Projected Pollutant Loading Rate and Load Increases

Watershed	Loading Rate Increase (Load Increase per Acre, mass [lb or ton]/ac-yr)				Load Increase (%) (Total for Each Watershed)			
	N	P	BOD	Sediment	N	P	BOD	Sediment
Bolton Notch Pond (318 ac)	0.66	0.1	2.7	0.012	9.6%	8.0%	10.9%	7.7%
Clarks Brook (647 ac)	0.91	0.13	3.9	0.017	14.1%	12.9%	16.1%	11.7%
Gages Brook (695 ac)	1.29	0.19	5.6	0.027	19.4%	17.0%	21.5%	16.7%
Gages Brook South Trib. (680 ac)	0.73	0.11	3.1	0.014	12.2%	10.2%	14.1%	10.5%
Lower Tankerhoosen R. (306 ac)	1.31	0.1	6.3	0.022	20.0%	8.9%	27.6%	14.7%
Middle Tankerhoosen R. (1570 ac)	0.63	0.07	3.1	0.008	10.6%	7.6%	14.2%	5.8%
Railroad Brook (1203 ac)	0.89	0.06	4.3	0.015	56.8%	20.3%	69.8%	46.4%
Tucker Brook (934 ac)	0.67	0.04	3.3	0.012	14.1%	5.3%	18.0%	9.4%
Upper Tankerhoosen R. (1472 ac)	0.24	0.05	1.1	0.003	9.3%	11.1%	11.2%	6.0%
Walker Reservoir (322 ac)	1.86	0.28	8.6	0.036	25.8%	23.3%	34.6%	21.6%
Total (8149 ac)	0.77	0.09	3.5	0.013	16.0%	11.4%	19.9%	12.0%

Several of the subwatersheds are predicted to experience significantly higher increases in pollutant loads and loading rates under a watershed buildout scenario. These include:

- *Gages Brook*. The existing conditions pollutant load model indicates that this subwatershed is characterized by both relatively high total pollutant loads and pollutant loading rates, with approximately 70% urban land use, the largest amount of industrial land use, and the second-highest commercial land use composition in the entire watershed. The buildout condition of this watershed is projected to result in a 19% increase in urban land use with a corresponding decrease in forest; and the new urban land is likely to consist of new residential and industrial development. As such, relatively large loads and loading rate increases may occur.

- *Lower Tankerhoosen River*. The existing conditions pollutant load model for this subwatershed predicts relatively small loads (since the watershed area is small) and moderate loading rates. Under a buildout scenario, this subwatershed is projected to result in more than a 20% increase in nitrogen and BOD loads. The resulting loading rates for these parameters are projected to be the second highest of the Tankerhoosen River subwatersheds.

- *Railroad Brook*. The projected buildout pollutant loadings in this subwatershed for nitrogen and BOD are anticipated to increase by approximately 57% and 70%, respectively. Significant increases are also anticipated in phosphorus and sediment loads. Currently, the Railroad Brook sub watershed is heavily forested, with comparatively little development. Several large tracts of land within this subwatershed are potentially available for future development, especially in Bolton and South Vernon, which makes this watershed vulnerable to potentially significant pollutant load increases.

- *Walker Reservoir*. The existing conditions pollutant loading model suggests that this subwatershed has some of the highest levels of pollutant loads within the overall Tankerhoosen River watershed. Potential land use changes in this subwatershed include significant areas of new residential and mixed-use development, much of which is located adjacent to Walker Reservoir. These changes are predicted to result in the greatest increases in pollutant loading rates for all of the parameters evaluated.

2.10 Comparative Subwatershed Analysis

A Comparative Subwatershed Analysis was performed for the Tankerhoosen River subwatersheds to identify the subwatersheds with the greatest vulnerability and restoration potential. Subwatershed "metrics" were used to conduct this analysis. Metrics are numeric values that characterize the relative vulnerability and restoration potential of a subwatershed. The metrics used are presented in Table 2-25. The results of this analysis will be used to prioritize field assessment efforts in future phases of this study and to guide plan recommendations.

The analysis involves a screening level evaluation of selected subwatershed metrics that are derived by analyzing available GIS layers and other subwatershed data sources. The basic approach used to conduct the Comparative Subwatershed Analysis consisted of:

1. Delineation of subwatershed boundaries and review of available metric data.
2. Selection and calculation of metrics that best describe subwatershed vulnerability and restoration potential. (The metrics used to rank subwatershed vulnerability were selected separately from the metrics used to rank subwatershed restoration potential.)
3. Developing weighting and scoring rules to assign points to each metric.

4. Computing aggregate scores and developing initial subwatershed rankings.

Subwatersheds with higher aggregate "vulnerability" scores are more sensitive to future development and should be the focus of watershed conservation efforts to maintain existing high-quality resources and conditions. Subwatersheds with higher aggregate "restoration potential" scores are more likely to have been impacted and have greater potential for restoration to improve upon existing conditions. This approach enables watershed planners to allocate limited resources on subwatershed where restoration and conservation efforts have the greatest chances of success.

The following sections describe the metrics used and the rationale for their selection, how the various metrics were calculated, and the results of the evaluation. Available GIS and other data were used to compute the value of each metric.

Table 2-25. Summary of Subwatershed Vulnerability Metrics

Subwatershed Metric	How Metric is Measured	Indicates Higher Vulnerability Potential When	Metric Points
1. Impervious Cover Change	% increase in impervious cover in subwatershed	**Increase in IC is high**, suggesting greater development potential and stream impacts	Award 1 pt for each 1% increase in impervious cover
2. Impervious Cover Threshold	Comparison of current and future IC relative to ICM threshold	**Predicted IC crosses "impacted" (12%) threshold**, development could result in significant stream impacts	Award 5 pts for each exceedance of the 12% threshold
3. Stream Order	% of subwatershed consisting of 1st or 2nd order streams	**Subwatershed consists of more lower order streams**, vulnerability of headwater streams for habitat and water quality protection	Award 6 pts if 100% of streams are 1st and 2nd order; 4 pts if 50% are 1st and 2nd order; 2 pts if 33% are 1st and 2nd order; 0 pts if 0% are 1st and 2nd order
4. Pollutant Loading	% increase in pollutant loading in subwatershed	**Increase in pollutant loading is high**, suggesting water quality impacts from future development	Award 1 pt for each pollutant loading parameter > 10% and 3 pts for each parameter >20%
5. Industrial/ Commercial Land	% of subwatershed as industrial or commercial land	**Industrial/commercial land is high**, greater potential for water quality impacts from pollutant hot spot	Award 1 pt for each 2% of subwatershed classified as industrial or commercial/retail
6. Forest Cover	% of subwatershed with developable forest cover	**Area of developable forest cover is high**, potential for significant future reductions in forested land	Award 1 pt for each 5% of subwatershed with developable forest cover
7. Stream Corridor Forest Cover	% of stream corridor that is forested	**Corridor forest cover is high**, potential for significant future reductions in forested riparian areas if public ownership of corridor is low	Add 1 pt for each 10% increase in forest cover
8. Public Ownership of Stream Corridor	% of stream corridor that is publicly owned	**Public ownership is low** (see metric 7)	Add 1 pt for each 10% reduction of stream corridor in public ownership
9. Road Crossings	number of road crossings / square mile	**Number of road crossings is high**, greater potential for direct stormwater discharges from roadways	<1 = 0pts; 1 to 5 = 1 pts; 5 to 8 = 3 pts; 9 to 12 = 5 pts; 13-15 = 7pt; >15 = 10 pts
10. Developed	% of subwatershed	**Area served by septic is high**,	Award 1 pt for each 5% of

Table 2-25. Summary of Subwatershed Vulnerability Metrics

Subwatershed Metric	How Metric is Measured	Indicates Higher Vulnerability Potential When	Metric Points
Areas with Septic	served by septic	indicating potential for pollutant loadings from failing septic systems	subwatershed area served by septic
11. Drinking Water Resources	Acreage of developable land within a public drinking water supply area	**Area of developable land is high**, greater potential for impacts to sensitive surface and groundwater drinking water supplies	Award 3 pts for each subwatershed within an aquifer protection area

2.10.1 Priority Subwatersheds for Conservation

The results of the subwatershed vulnerability analysis are summarized in Table 2-26.

Table 2-26. Results of Subwatershed Vulnerability Analysis

Subwatershed	Impervious Cover Change	Impervious Cover Threshold	Stream Order	Pollutant Loading	Industrial/ Commercial Land	Developable Forest Cover	Stream Corridor Forest Cover	Public Ownership of Stream Corridor	Road Crossings	Developed Areas Served by Septic	Drinking Water Resources	Total
Bolton Notch Pond	2	10	6	1	7	2	3	3	0	5	0	41
Clarks Brook	3	10	6	4	7	2	5	5	1	4	0	47
Gages Brook	3	5	6	6	11	4	6	6	3	5	0	55
Gages Brook South Tributary	2	5	6	4	1	5	6	5	3	5	0	42
Lower Tankerhoosen River	7	10	0	7	2	5	4	5	7	5	0	53
Middle Tankerhoosen River	3	10	2	2	2	2	4	5	3	3	3	38
Railroad Brook	2	0	6	12	0	6	9	0	5	1	0	40
Tucker Brook	2	0	6	2	0	3	5	6	3	2	0	28
Upper Tankerhoosen River	0	0	4	2	0	4	8	3	3	3	0	27
Walker Reservoir	9	10	4	4	2	3	2	5	10	6	0	56

As shown in Table 2-27, the following subwatersheds are considered most vulnerable to future development impacts and should be given highest priority for conservation efforts to maintain existing resource conditions:

- Clarks Brook,
- Gages Brook,
- Gages Brook South Tributary,
- Lower Tankerhoosen River,
- Walker Reservoir.

Table 2-27. Summary of Subwatershed Restoration Potential Metrics

Subwatershed Metric	How Metric is Measured	Indicates Higher Restoration Potential When	Metric Points
1. Existing Impervious Cover	% impervious cover in subwatershed	**Current impervious cover is low**, suggesting range of possible sites for storage retrofits and stream repairs	<10% = 10 pts; 10 to 15% = 5 pts; >15% = 1 pt
2. Publicly-owned land	% of subwatershed that is publicly owned	**Public land ownership is high**, providing range of potential sites for restoration practices	Award 1 pt for each 2.5% of subwatershed in public ownership
3. Industrial Land	% of subwatershed that is industrial land	**Industrial land is high**, suggesting potential for source controls, discharge prevention, and on-site retrofits	Award 1 pt for each 2% of subwatershed classified as industrial
4. Forest Cover	% forest cover in subwatershed	**Forest cover is low**, suggesting potential for upland and riparian reforestation	<35% = 7pts; 36 to 50% = 5 pts; 50 to 70% = 3 pts; >70% = 1pt
5. Wetland Cover	% of subwatershed that is wetlands	**Wetland cover is high**, suggesting potential for wetland and riparian restoration	Award 1 pt for each 2% of subwatershed area
6.Development Potential	% of developable land in subwatershed	**No more development is expected**; stable conditions increase feasibility of stream repairs and storage retrofits	30 to 35% = 1pts; 25 to 30% = 4 pts; 20 to 25% = 7 pts; 15 to 25% = 10pt
7. Stream Density	stream miles / square mile	**Stream density is high**, suggesting greater feasibility of corridor practices	Award 1 pt for each 10% increase in stream density from watershed average of 1.3 stream miles / square mile
8. Stream Corridor Forest Cover	% of stream corridor that is forested	**Corridor forest cover is low**, suggesting feasibility of riparian reforestation and stream repairs	Add 1 pt for each 10% reduction in forest cover
9. Public Ownership of Corridor	% of stream corridor that is publicly owned	**Public corridor ownership is high**, suggesting greater feasibility of corridor practices	Add 1 pt for each 10% of stream corridor in public ownership
10. Road Crossings	number of road crossings / square mile	**Number of road crossings is high**, suggesting greater potential for stream repairs, culvert modifications	<1 = 0pts; 1 to 5 = 1 pts; 5 to 8 = 3 pts; 9 to 12 = 5 pts; 13-15 = 7pt; >15 = 10 pts
11. Developed Areas with Septic	% of subwatershed that is served by septic	**Area served by septic is high**, suggesting greater potential for septic system upgrades	Award 1 pt for each 5% of subwatershed area served by septic
12. Water Quality Impairments	number of water quality impairments / square mile	**Number of water quality impairments is high**, suggesting regulatory need to focus on WQ improvements	Award 3 pts for each water quality impairment identified

The results of the subwatershed restoration potential analysis are summarized in Table 2-28.

Table 2-28. Results of Subwatershed Restoration Potential Analysis

Subwatershed	Existing Impervious Cover	Publicly-owned Land	Industrial Land	Forest Cover	Wetland Cover	Development Potential	Stream Density	Stream Corridor Forest Cover	Public Ownership of Stream Corridor	Road Crossings	Developed Areas Served by Septic	Water Quality Impairments	Total
Bolton Notch Pond	1	1	1	5	3	10	0	6	6	0	5	0	38
Clarks Brook	1	10	5	7	8	10	0	4	11	1	4	0	60
Gages Brook	5	12	6	5	8	4	10	3	12	3	5	6	79
Gages Brook South Tributary	5	3	0	3	3	1	14	2	9	3	5	9	57
Lower Tankerhoosen River	1	6	1	5	1	1	15	5	11	7	5	6	64
Middle Tankerhoosen River	5	6	1	5	6	10	5	5	10	5	3	0	61
Railroad Brook	10	0	0	1	6	1	9	0	0	5	1	0	34
Tucker Brook	10	10	0	5	6	7	11	4	11	1	2	0	66
Upper Tankerhoosen River	10	3	0	1	7	4	12	1	6	3	3	3	52
Walker Reservoir	1	10	1	7	4	1	0	7	9	10	6	0	55

As shown in Table 2-28, the following subwatersheds should be given highest priority for restoration potential to improve upon existing conditions:

- Clarks Brook,
- Gages Brook,
- Lower Tankerhoosen River,
- Middle Tankerhoosen River,
- Tucker Brook.

Based on the combined results of the subwatershed vulnerability and restoration potential analyses, the following subwatersheds were recommended for detailed assessment and planning:

- Clarks Brook,
- Gages Brook,
- Gages Brook South Tributary,
- Lower Tankerhoosen River,
- Middle Tankerhoosen River,
- Tucker Brook,
- Walker Reservoir.

3 Watershed Field Inventories

Field inventories were performed during summer 2008 to further assess existing watershed conditions and potential sources of pollution. The field inventories are screening level tools for locating potential pollutant sources and environmental problems in a watershed along with possible locations where restoration opportunities and mitigation measures can be implemented. The field inventories included selected stream corridors and upland areas within priority subwatersheds, which were identified from the Comparative Subwatershed Analysis. Field inventories were performed within the priority subwatersheds identified in Section 2.7.1.

This section of the watershed management plan provides a summary of the methods and results of the field inventories. More detailed information on the field inventory methods and findings is available in *Watershed Field Inventories and Land Use Regulatory Review* (Fuss & O Neill, October 2008), a copy of which is provided on CD-ROM as Appendix A of this watershed management plan.

The stream corridor assessment procedure used in this study is adapted from the U.S. EPA Rapid Bioassessment (RBA) protocol (EPA, 1999) and the Center for Watershed Protection's Unified Stream Assessment (USA) method (CWP, 2005). Upland areas and activities that may impact stream quality were also assessed using methods adapted from the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance (USSR) techniques (CWP, 2005). The upland assessments included inventories of selected representative residential neighborhoods, streets and storm drainage systems, and land uses with higher potential pollutant loads (i.e., "hotspot" land uses). Field assessment efforts were targeted on stream segments and upland areas with the greatest potential for direct impacts to the streams. These areas were identified through aerial and land use mapping. To the extent possible, efforts were also focused on publicly-owned land, which typically offers greater opportunities for retrofits and mitigation projects as opposed to privately-owned land.

During the field inventories, crews assessed approximately 8.7 miles of stream corridors, six potential hotspot locations, five representative residential neighborhoods, and a number of streets and storm drainage systems associated with the residential neighborhoods and hotspot land uses. Field inventory nomenclature used throughout this report is summarized in Table 3-1. Copies of completed field assessment forms are provided as attachments to the *Watershed Field Inventories and Land Use Regulatory Review* (Fuss & O Neill, October 2008). Photographs of specific or representative pollutant sources and problem areas are included throughout this document for illustrative purposes. All of the photographs taken during the field inventories are available on CD.

Table 3-1. Field Inventory Nomenclature

Clarks Brook	CB
Lower Tankerhoosen River	LTR
Middle Tankerhoosen River	MTR
Walker Reservoir	WR
Gages Brook	GB
Gages Brook South Tributary	GBST
Tucker Brook	TB

Table 3-1. Field Inventory Nomenclature

Reach Level Assessment	RCH
Channel Modification	CM
Severe Bank Erosion	ER
Impacted Buffer	IB
Stormwater Outfall	OT
Stream Crossing	SC
Trash & Debris	TB
Utilities	UT
Hotspot Investigation	HSI
Neighborhood Site Assessment	NSA
Streets and Storm Drains	SSD

3.1 Summary of Findings

A variety of common issues and problems were identified during the field inventories. Some prevalent issues throughout the watershed are described below.

- Overall in-stream habitat in the assessed reaches was mixed. Some of the assessed reaches have high quality habitat, with riparian cover, good floodplain connection, varied substrate, and significant stream shading. In other segments, in-stream habitat is marginal to poor due to bank erosion, buffer encroachment, trash and debris, lack of shading, and in-stream sedimentation. However, the majority of the stream reaches assessed appear to be either supporting biological communities (fish, frogs, birds, etc.) or sufficient to support such communities. Many potential barriers to fish passage were observed throughout the watershed, including perched culverts, culverts with very shallow flow, and natural and manmade dams. Therefore, the impact of potential fish barriers and the feasibility of fish barrier removal efforts should be investigated further.

Arch-type railroad crossing (SC-02) may prevent fish passage and is suffering from downstream scour evidenced by the large pool shown in the photograph.

- Stream buffer encroachments are prevalent along stream corridors in or near areas of residential and commercial development. Residential lawns and some commercial lawns extend down to the banks of the stream in many areas, particularly in residential back yards. Yard waste such as grass clippings, leaves, and brush and waste materials were also common occurrences in and near these areas where easy access exists to the streams. Education, signage,

Stream segment GB-05B showing limited vegetative buffer and a small footbridge crossing the stream.

stream buffer regulations, and stream cleanups are potential approaches for improving buffer management.

- Residential areas appear to contribute significant quantities of rooftop runoff to the storm drainage system, particularly in medium and high-density residential neighborhoods with smaller yards. Many small outfall pipes were observed from the backyards of residential areas, which are presumably associated with foundation drains, yard drains, or roof downspouts. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system and reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.

Trash and debris along Reach CB-02.

- Numerous outfalls were observed from virtually all of the land uses encountered during the stream assessments. Many appear to be associated with sources having low potential for water quality impacts (i.e., residential foundation drains), while others were of unknown origin and should be the focus of future investigation. Illicit discharge investigations are recommended in targeted areas and land uses.

- Invasive species (phragmites, cattails, reed canary grass, etc.) were observed in stream corridors in many areas of the watershed. Invasive species management should be incorporated into stream corridor restoration activities.

Stream crossing (SC-01) below I-84 and outfall (OT-03) along reach GBST-02.

- Parking lots associated with apartment complexes, institutional land uses (schools), and commuter lots are potential candidates for stormwater retrofits to reduce site runoff and improve water quality through the use of bioretention, water quality swales, buffer strips/level spreaders, and other small-scale LID approaches.

- The field assessments identified very little evidence of storm drain stenciling or watershed stewardship signage, with the exception of a residential subdivision in the Tucker Brook subwatershed.

- Most of the developed areas surveyed have inadequate stormwater quality controls. Many of the residential developments were constructed prior to the advent of modern stormwater quality regulations and design requirements. Therefore, most of the development observed in the watershed employs traditional curb and gutter storm drainage collection systems with little, if any, stormwater management beyond detention basins for peak flow control. In most cases, the stormwater management controls that were observed at newer developments were not being maintained.

- No Low Impact Development (LID) design practices were observed in the watershed. With the recent shift toward LID site design and stormwater management requirements, as demonstrated by the Town of Tolland's new LID regulations and design manual, the watershed is an ideal candidate to showcase LID practices for both new development and retrofit applications. Local LID demonstration sites are a valuable tool for public education and promoting the widespread use of such practices. Incorporating LID into town projects, including roadway projects, can also serve as a proactive model for private development.

- Stormwater runoff from Interstate 84, other state roads such as Route 30 and 31, and local roads typically receives little or no treatment prior to discharge. Such discharges are a source of sediment and other pollutants to the receiving water bodies. Opportunities exist for stormwater retrofits at roadway stormwater outfalls

- Relatively isolated areas of moderate to severe streambank erosion were observed throughout the assessed portions of the watershed. Most of these areas are located at or downstream of stormwater outfalls in developed areas of the watershed. Access to many of these areas is limited; therefore, potential candidate sites for bank stabilization projects should be evaluated further for overall feasibility.

Stream segment GB-05B showing area of stream bank erosion.

- Very few active construction sites were observed in the watershed. However, a large amount of developable land exists in the watershed, and future construction activity is a major potential source of polluted runoff. Approaches for stronger soil erosion and sedimentation controls include regulating building envelopes, encouraging property owners to minimize clearing for other purposes, and requiring drainage review for activities that disturb less than ½ acre.

- Due to limited project funding, not all stream segments in the priority subwatersheds were assessed, and other subwatersheds (Railroad Brook, Bolton Notch Pond, and Upper Tankerhoosen River) were not assessed as they were determined to be less vulnerable to future development impacts. A schedule should be established for assessing the remaining stream segments and subwatersheds.

3.2 Stream Corridor Assessment

Stream corridors within the Tankerhoosen River watershed were assessed during June 3 through 6, 2008, and on July 2 and 10, 2008. Field crews consisted of staff from Fuss & O Neill, the North Central Conservation District, and volunteers with Friends of the Hockanum River Linear Park of Vernon. Stream corridors were assessed along selected reaches within priority subwatersheds using methods adapted from the U.S. EPA Rapid Bioassessment (RBA) protocol (EPA, 1999) and the Center for Watershed Protection s Unified Stream Assessment (USA) (CWP, 2005).

The stream assessment method used in this study is a continuous stream walk method that identifies and evaluates the following impact conditions for each reach:

- Outfalls (OT), including stormwater and other manmade point discharges;
- Severe Bank Erosion (ER), such as bank sloughing, active widening, and incision;
- Impacted Buffer (IB), which is a narrowing or lack of natural vegetation;
- Utilities in the stream corridor (UT), such as leaking or exposed pipes;
- Trash and Debris (TR), such as drums, yard waste, and other illegal dumping;
- Stream Crossings (SC), which are hard objects, whether natural or artificial, that restrict or constrain the flow of water. These may include bridges, culverts, dams, and falls;
- Channel Modification (CM), where the stream bottom, banks, or direction have been modified;
- Miscellaneous (MI), other impacts or features not otherwise covered; and
- Reach Level Assessment (RCH), the average characteristics of each reach.

The stream assessment method also includes a semi-quantitative scoring system as part of the reach level assessment to evaluate the overall condition of the stream, riparian buffer, and floodplain, based on a consideration of in-stream habitat, vegetative protection, bank erosion, floodplain connection, vegetated buffer width, floodplain vegetation and habitat, and floodplain encroachment.

Collected information was entered into a database and used to quantify the overall condition of stream corridors in the watershed, compare subwatersheds within the watershed to each other, and prioritize areas for restoration, stormwater retrofit, land preservation, and other stewardship opportunities.

Stream reaches were assigned a subwatershed abbreviation followed by a two-digit numerical identifier. Reaches were generally numbered sequentially from downstream to upstream when in series and west to east upstream from confluences. A reach was considered to be a stream segment with relatively consistent geomorphology and surrounding land use, and generally less than one-half mile in length. Features noted at reach junctions (e.g., culvert crossings) were associated with the downstream reach. Impact conditions within each reach were numbered sequentially with an abbreviation followed by a two-digit number. For example, the second stream crossing in a reach would have the identifier SC-02.

Forty-one stream reaches were evaluated in the Tankerhoosen River watershed using this stream assessment protocol. Table 3-2 summarizes the number of impact conditions identified and reach level assessments that were performed within each subwatershed.

Table 3-2. Number of Reach Level Assessments Performed and Impact Conditions Identified

Subwatershed	RCH	CM	ER	IB	OT	SC	TD	UT
Clarks Brook	5	--	2	--	10	8	2	--
Lower Tankerhoosen River	1	--	--	--	1	1	--	--
Middle Tankerhoosen River	5	--	1	--	14	5	7	--
Walker Reservoir	5	--	--	--	6	6	--	--
Gages Brook	12	1	8	5	21	12	3	1
Gages Brook South Trib.	7	1	1	1	3	8	--	--
Tucker Brook	6	--	2	4	9	9	3	--

Reach level assessment scores were assigned by field crews based upon the overall stream, buffer, and floodplain conditions. A subjective determination of eight criteria is assessed on a scale of 0 to 20; 0 relating to poor conditions and 20 being optimal conditions. The total of these scores provides a quantitative index of overall stream health and condition. The maximum possible number of points that would be assigned for a fully optimal stream reach is 160 points.

Streams were assessed relative to a base condition, which for this study, is the highest scoring stream reach in the Tankerhoosen River watershed (153 points). All other assessed stream reaches were assigned a numerical score and categorized relative to the base score of 153 points (Table 3-3). Reaches scoring greater than 90% of the base condition (138 points) are considered "excellent", between 75% and 90% of the base condition are categorized as "good", between 55% and 75% of the base condition are categorized as "fair", between 35% and 55% of the base condition are categorized as "poor", and less than 35% of the base condition are categorized as "very poor". Table 3-4 summarizes stream reach assessment scores and classifications for the assessed stream reaches.

Table 3-3. Stream Reach Classifications

Category	Percentile	Point Threshold
Excellent	90%	≥138
Good	75%	≥115
Fair	55%	≥84
Poor	35%	≥54
Very Poor	<35%	<54

Table 3-4. Stream Reach Assessment Scores and Classifications

Excellent		Good		Fair		Poor		Very Poor	
Reach ID	Score	Reach ID	Score	Reach ID	Score	Reach ID	Score	Reach ID	Score
MTR-08	153	GBST-02	127	GB-09	114	TB-04B	83	GB-05B	53
GB-10	146	GB-02	120	GBST-03	111	MTR-01	82	WR-01	35
GBST-04A	146	GBST-09B	120	LTR-03	111	GB-04	80		
GBST-01	145	TB-02	119	GB-07	105	WR-02	80		
MTR-07	139	GBST-04B	117	CB-03	104	WR-04	76		
CB-04	138	TB-01	116	GB-01	102	GB-03B	72		
		GB-08	115	GB-03A	97	GBST-09A	59		
				MTR-09	94				
				GB-05A	93				
				CB-02	93				
				TB-03	92				
				TB-04A	92				
				WR-03	91				
				GB-06	88				
				MTR-02	87				
				CB-01	85				
				WR-05	84				
Note: TB04C and CB-05 were not scored during the reach level assessment									

As depicted in Figure 3-1, MTR-08 is the highest rated stream reach due to good riparian cover and bed material. WR-03 is considered fair due to the presence of invasive species within the riparian corridor. TB-04B and GB-05B are poor and very poor, respectively, because of poor channel characteristics, outfalls, stream crossings, trash and debris and lack of stream buffer and bank erosion in the case of GB-05B.

Figure 3-1. Examples of Stream Reaches in Various Classification Categories

Additional details regarding the assessed stream reaches are provided in *Watershed Field Inventories and Land Use Regulatory Review* (Fuss & O Neill, October 2008), a copy of which is provided on CD-ROM in Appendix A of this plan.

3.3 Upland Assessments

Fuss and O Neill conducted upland assessments in the Tankerhoosen watershed in July 2008. The field observations assist in identifying pollution prevention and potential restoration opportunities at hotspot land uses and residential neighborhoods in the watershed. Factors that were considered when determining which hotspots and neighborhood areas to prioritize for assessment include:

- Stream condition (assessed during stream corridor inventory),
- Site proximity to the stream,
- Land use type and development density,
- Land ownership,
- Restoration potential.

The assessment framework was adapted from the Unified Subwatershed and Site Reconnaissance (USSR) method developed by the Center for Watershed Protection. USSR is a "windshield survey" evaluation method in which field crews drive and walk through areas of the watershed to quickly identify pollution prevention and restoration opportunities. The three major components to the upland assessments conducted in the Tankerhoosen watershed are: hotspots, residential neighborhoods, and streets and storm drains. Field data forms that were completed during the assessments are provided in *Watershed Field Inventories and Land Use Regulatory Review* (Fuss & O Neill, October 2008).

3.3.1 Hotspot Investigations

Hotspot site investigations were conducted for six representative sites with a high potential to contribute polluted stormwater runoff to the storm drain system and receiving streams. The purpose of the investigation was to qualitatively assess the potential for stormwater pollution from previously identified commercial, industrial, municipal or transport-related sites. The hotspot investigation was limited in scope to representative hotspot facilities in order to evaluate and illustrate common issues. The investigation was not intended to be an exhaustive review of all potential hotspot facilities in the entire watershed nor a detailed inspection or audit of each facility, which are beyond the scope of this study.

The hotspots examined in the field were located within the Lower Tankerhoosen River, Walker Reservoir, Clarks Brook, and Gages Brook subwatersheds. Representative priority hotspots were selected to cover a range of watersheds and land uses, including three industrial sites, one commercial site, one transportation-related site, and one state/municipal site. Sites are identified by the watershed abbreviation, followed by "HSI" and a numeric identifier. Table 3-5 summarizes the selected hotspots that were evaluated. Several of the sites that were investigated are privately owned, and field crews were unable to gain full access to the sites to closely evaluate the storm drainage and other site characteristics.

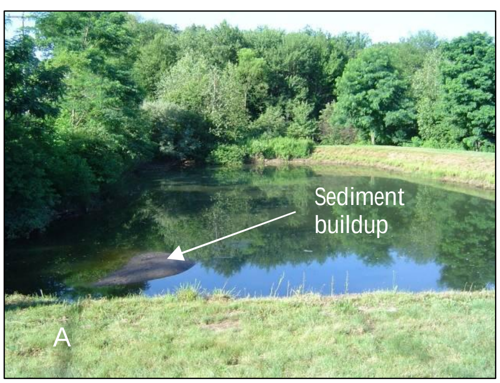
Table 3-5. Hotspot Site Investigation Summary

Site ID (Watershed)	Land Use Category	Description of Site Operations
GB-HSI-01 (Gages Brook)	Industrial	Industrial Park - Gerber Technologies Office Building
GB-HSI-02 (Gages Brook)	Industrial	Dari Farms Ice Cream Distribution Center
WR-HIS-01 (Walker Reservoir)	Transportation	ConnDOT Commuter Lot
CB-HIS-01 (Clarks Brook)	Commercial	Superior Energy - Propane
CB-HIS-02 (Clarks Brook)	Industrial	Sand, gravel, construction storage/processing facility
LTR-HIS-01 (Lower Tankerhoosen River)	State/Municipal	ConnDOT Maintenance and Service Center

Gerber Technologies Office Building

The Gerber Technologies office building is located in the Tolland Industrial on Industrial Park Road West adjacent to Gages Brook. The office building has landscaped areas around the building with shrubs and turf lawn. The site is characterized by a large amount of impervious cover, consisting of building roof areas and parking lots. Approximately 100 vehicles were parked in the employee parking lots at the time of the inspection. Stormwater runoff from the site appears to discharge to the stormwater basin located near the southern limit of the site. The stormwater basin is a wet pond design containing a permanent pool of water and is approximately 70 feet wide by 140 feet long. The basin contained accumulated sediment captured from the site runoff. The basin outfall discharges to Gages Brook via a riprap spillway.

The stormwater basin that receives runoff from the Gerber Technologies facility incorporates many of the recommended elements to meet current stormwater quantity and quality design criteria. However, the basin is also in need of maintenance as demonstrated by the sediment accumulation near the center of the basin and the overgrown woody vegetation at the overflow spillway. Existing stormwater basins such as this one may also be good retrofit candidate to improve treatment effectiveness by incorporating a sediment forebay at the basin inlet, which may also facilitate routine sediment removal.



Stormwater basin at the Gerber Technologies facility on Industrial Park Road West. Sediment has built up near the center of the basin (A) and its overflow spillway is overgrown with vegetation (B).

Dari Farms Ice Cream Distribution Facility

The Dari Farms distribution facility is also located in the Tolland Industrial Park on Research Way/Gerber Drive near the divide between the Gages Brook and Gages Brook South Tributary subwatersheds. The facility is estimated to be less than 5 years old, as evidenced by the facility's modern pollution prevention site design elements including a covered fueling station, no visible outdoor storage of materials, and well maintained landscaping on the grounds. Possible pollution sources to the storm drainage system are the runoff from the large impervious areas on the site (the roof and parking areas) and potential vehicle fluids from truck fueling activities and employee vehicles. It could not be determined whether stormwater is managed on-site, by the downgradient stormwater basin near the Gerber Technologies facility, or both. The site did not appear to incorporate Low Impact Development (LID) design features such as vegetated swales or parking lot bioretention. New commercial and industrial facilities with significant impervious area, such as this one, are potential candidates for on-site LID and stormwater treatment practices to reduce runoff volume and pollutant loads.

The Dari Farms Ice Cream Distribution Facility has a covered fueling station and landscaped grounds (shown in the foreground).

ConnDOT Commuter Parking Lot

The hotspot investigation included the Connecticut Department of Transportation commuter parking lot at exit 67 of Interstate-84, which is located in the Walker Reservoir subwatershed.

Approximately 150 vehicles were parked at the lot during the site visit, which occurred on a weekday during mid-day. The site is contains significant impervious cover and high-intensity vehicle usage and is therefore a source of automobile-related stormwater pollutants including hydrocarbons, sediment, and metals. The entire parking lot drains to a double catch basin located on the southeastern side of the lot. The catch basin discharges through a short wetland corridor and subsequently to the stream segment located upstream of Reservoir Road and Walker Reservoir East. An easily accessible grass strip exists between the paved lot and the adjacent wetland and stream corridor. This site is a potential stormwater retrofit candidate (bioretention or water quality swale) to encourage infiltration and provide additional treatment for the parking lot runoff.

The southeastern side of the Interstate 86 Exit 67 commuter parking lot showing the edge of the lot on the left side of the photograph and the wetland corridor on the right side. The center of the photograph shows the easily accessible and open area for a potential stormwater retrofit.

Superior Energy

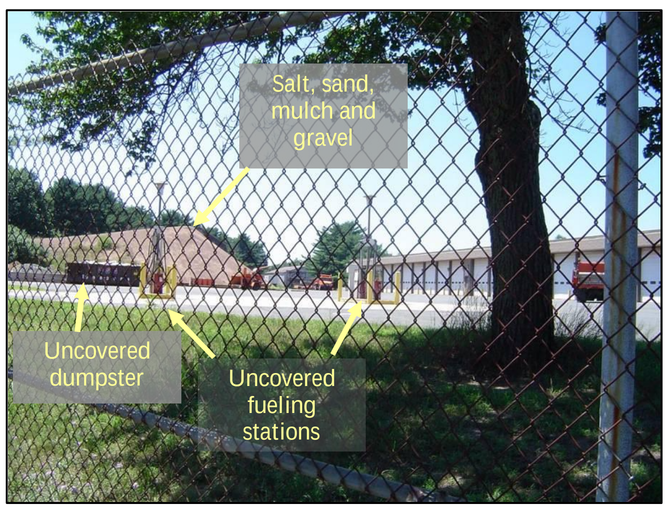
Superior Energy is a propane gas and related equipment distributor located on Hartford Turnpike (Route 30) in Vernon. The site is located within the Clarks Brook subwatershed near the headwaters of Clarks Brook. The property consists of a retail store, a paved parking lot for delivery trucks, and outdoor storage of propane tanks. It is unknown if vehicle maintenance or fueling occurs on-site. The site appears to have been modified in the past through grading/filling based on an inspection of the existing site drainage and discussions with facility personnel. This site should be further investigated to better define potential impacts of the historical filling, current drainage issues, and plans for additional site development.

Sand & Gravel Facility

The facility is located on Clark Road at the western end of Industrial Park Road and near the western limit of the Clarks Brook subwatershed. Facility operations appear to include storage and processing of sand, gravel and other construction materials. The site contains one building, which is assumed to be an office and/or maintenance area. The majority of the site consists of an unpaved yard used for the storage of sand and gravel piles and equipment to process the materials and load transport vehicles. The site contains numerous potential sources of sediment and other pollutants associated with the sand and gravel stockpiles, heavy equipment and vehicles, waste construction materials stored outdoors, and pipes and debris in the yard. Sand and gravel operations such as this should employ stormwater pollution prevention practices and source controls as required by the DEP *General Permit for Stormwater Discharges Associated with Industrial Activity*, in addition to stormwater treatment practices to reduce sediment and hydrocarbon loadings in site stormwater runoff.

DOT Maintenance Service Center

The State of Connecticut operates a Department of Transportation Maintenance Service Center for District #1 located on Campbell Avenue in Vernon, which is located in the Lower Tankerhoosen River subwatershed. The facility has an office building, garages for vehicle storage and maintenance, a small parking lot, outdoor storage of sand, salt, gravel and mulch, and an uncovered outdoor fueling station. Vehicle maintenance activities and outdoor vehicle fueling are potential sources of stormwater pollution, in addition to the outdoor stockpile storage.



ConnDOT District #1 Maintenance Service Center, Campbell Avenue

A rolloff dumpster was observed to be overflowing and uncovered at the time of the windshield survey. Municipal and state-operated highway maintenance facilities such as this should employ source controls, pollution prevention, and stormwater treatment practices as necessary in accordance with the DEP *General Permit for Stormwater Discharges Associated with Industrial Activity*.

3.3.2 Neighborhood Source Assessment

Stormwater runoff from existing residential neighborhoods and future residential development in the watershed is an important consideration for this study, since approximately 40 percent of the Tankerhoosen River watershed consists of residential land use and future buildout of the watershed could result in conversion of an additional 10 percent of the watershed to residential land use. Neighborhood source assessments were conducted on July 16, 2008 to evaluate pollution source areas, stewardship behaviors, and residential restoration opportunities within individual residential neighborhoods throughout the watershed. The residential behaviors that contribute to stormwater quality were assessed by considering the following source areas for "average" neighborhoods throughout the subwatershed:

- Yards and Lawns
- Driveways, Sidewalks, and Curbs
- Rooftops
- Common Areas

Neighborhoods were selected for assessment based on their proximity to stream corridors and their overall potential to contribute pollutants to the stream. The selected neighborhoods include a variety of residential types, including low- and high-density single-family residential and multi-family residential (apartments and condos). One field sheet was completed for each neighborhood assessed. The selected neighborhoods are located in the Tucker Brook, Lower Tankerhoosen River, Clarks Brook, Walker Reservoir, and Gages Brook subwatersheds, as summarized in Table 3-6.

Each neighborhood was assigned a score for pollution severity and restoration potential. Pollution severity is a measure of how much nonpoint source pollution a neighborhood is likely generating based on easily observable features such as lawn care practices, drainage patterns, oil stains, etc. Restoration potential is a measure of the feasibility of on-site retrofits or behavior changes based on available space, number of opportunities, presence of a strong homeowners association, and other factors.

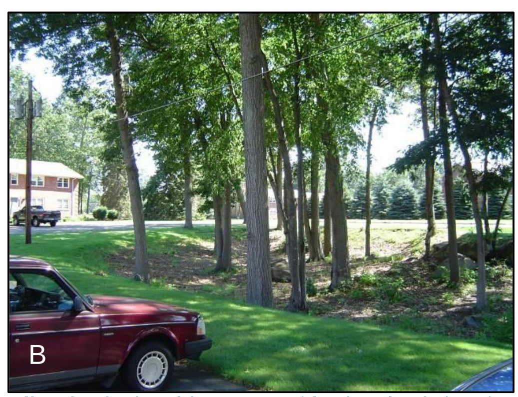
Table 3-6. Neighborhood Source Assessments Conducted in the Tankerhoosen River Watershed

Neighborhood/ Subdivision Name	Subwatershed	Residential Type	Pollution Severity	Restoration Potential
Mount Vernon Apartments	Walker Reservoir	Multi-family	Moderate	Moderate
Campbell Avenue	Lower Tankerhoosen River	High-density, single-family	Moderate	Low
Valley View Drive/Andrew Way	Gages Brook	Medium-density, single-family	None	Low
High Manor Mobile Home Park	Clarks Brook	High-density, single-family	Moderate	Moderate
Meadowbrook Drive	Tucker Brook	Medium-density, single-family with open space areas	None	Low

Mount Vernon Apartments

The Mount Vernon apartments are a 33-acre multi-family housing complex situated between Hartford Turnpike (Route 30) and Interstate 84 in the Walker Reservoir subwatershed. The apartments are served by outdoor surface parking lots in front of each building. Site imperviousness is estimated at approximately 50 percent. Runoff downspouts are connected directly to the site stormwater drainage system, and parking areas are served by traditional curb and gutter drainage. The complex is generally well-maintained, with generally clean gutters, catch basins, and parking areas. Some oil staining was observed on the pavement within individual parking stalls

The overall pollution severity is rated as moderate due to the large amount of directly connected impervious area and potential pollutant sources from parking areas. This site is a potential retrofit candidate to reduce stormwater runoff from the site, including disconnecting downspouts from the storm drainage system and redirecting them to pervious grass areas, rain barrels/cisterns, and rain gardens. Multi-family parking lots, such as the parking lots at this complex, may also be good candidates for stormwater retrofits. The following photograph depicts an existing landscaped area adjacent to the parking lot that could potentially function as a bioretention/rain garden.



The Mount Vernon apartment complex buildings showing clean and well-maintained parking areas and landscaping (A) and a landscaped area that has the potential to be used as a rain garden (B).

Campbell Avenue

The Campbell Avenue residential development is a 13-acre neighborhood of single family homes on approximately ¼ acre lots. The neighborhood is located off of Dobson Avenue and is situated between Interstate 84 and the ConnDOT Maintenance Service Center to the north and Dobsonville Pond to the south. The age of the neighborhood is estimated as approximately 50 years. Almost none of the homes have a garage, and nearly all have impervious driveways connected to the street curb and gutter drainage system. No on-site or centralized stormwater management practices were observed, other than curb and gutter drainage. Most of the homes have downspouts that are directed to pervious lawn areas near the house. Landscaping practices were minimal. This type of older, high density single family residential neighborhood has limited potential for stormwater retrofits due to limited land area.

Valley View Drive/Andrew Way

The Valley View Drive/Andrew Way neighborhood is approximately 55 acres in size and located near the headwaters of Gages Brook. The neighborhood is approximately 25 years old and consists of single family homes occupying approximately 1-acre lots. Most of the homes have garages and a high percentage of the lots are covered by lawn (60%) and landscaped areas (20%). The subdivision is served by traditional curb and gutter drainage. No centralized stormwater management measures were observed. Approximately three quarters of the roof downspouts are connected to adjacent pervious areas. Overall, the neighborhood was rated as having low pollution potential and limited potential for stormwater retrofits.

A typical lot in the Valley View Drive/Andrew Way neighborhood.

High Manor Mobile Home Park

High Manor Mobile Home Park is an approximately 28-acre neighborhood located in the Clarks Brook subwatershed, situated between Route 30 and Interstate 84. The park is believed to have been developed in the 1970s. The average lot in the neighborhood has approximately 40 percent impervious cover, including the home and driveway, 40 percent grass cover, and 20 percent landscaped area. Approximately 90 percent of the homes have roof downspouts that discharge to lawns. The streets have traditional curb and gutter drainage, and storm drain inlets were observed to be clean. No centralized stormwater management measures were observed.

A street view of the High Manor Mobile Home Park showing turf lawns with some mature trees on the properties.

Meadowbrook Drive

The Meadowbrook Drive neighborhood is an approximately 100-acre residential neighborhood in the northeast corner of Manchester. The neighborhood is situated in the central portion of the Tucker Brook subwatershed, and Tucker Brook flows partially through and along the north and west sides of the development. The subdivision is estimated as approximately 10 years old, and the average lot size for the single family homes in the subdivision is approximately ½ acre. All of the homes have garages. The driveway, sidewalks and curb areas are clean and dry. A majority of the homes have roof downspouts that discharge to pervious lawn areas. The street storm drains are stenciled. An approximately 1-acre wet stormwater basin near the corner of Yale and Chatham Drives receives runoff from the subdivision storm drainage system. The basin outlet discharges to Tucker Brook. At the time of the inspection the stormwater basin outlet was observed to be overgrown with vegetation, and stream bank erosion was observed at the outfall to the stream. The basin appears to be in need of regular maintenance. Buffer encroachment, stream crossings, residential drain outfalls, and yard waste dumping were common in residential areas along the stream corridors in this subdivision.

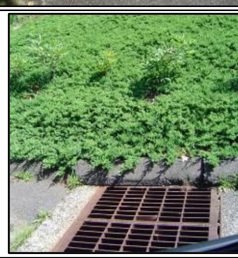

Typical conditions in the Meadowbrook Drive neighborhood showing landscaping, lot sizes, and general cleanliness.

3.3.3 Streets and Storm Drain Assessment

Urban streets and storm drains can be a source of stormwater pollutants if not maintained on a regular basis. The condition of the local road and storm drain infrastructure can be assessed to determine if existing maintenance practice could reduce pollutant accumulation. Selected streets and storm drains were assessed during the upland field inventories conducted on July 16, 2008. Most of the streets and storm drains that were assessed are located in or near hotspot or neighborhood source assessment locations. Findings of the street and storm drain assessment are summarized below. Photographs of the storm drains and the street conditions evaluated are provided as Table 3-7.

FUSS & O'NEILL

Table 3-7. Streets and Storm Drain Assessment Photographs

Location	Storm Drains		Streets
Campbell Avenue			
Mount Vernon Apartments			
Valley View Drive/Andrew Way			
High Manor Mobile Home Park			
Gerber Technologies			
Clark Road Industrial Park			[No photo]

Most of the streets were clean, free of sediment and debris, and in good condition. The one exception is Industrial Park Road in the Clark Road Industrial Park where roads were observed to be in poor condition (cracked, broken, and sediment accumulation). Storm drains along Industrial Park Road were also partially obstructed with sediment, leaves, trash, and one of the catch basins had standing water above the elevation of the stream water surface, indicating blockage of the outlet pipe. Many of the inspected catch basins had varying degrees of sediment accumulation and nearly all could benefit from increased clean-out and street sweeping. With the exception of the Meadowbrook Drive subdivision in the Tucker Brook subwatershed, none of the storm drains observed during the field assessments was stenciled.

4 Land Use Regulatory Review

4.1 Introduction

Municipal land use regulations control patterns of new development and redevelopment and can play a significant role in protecting water quality and other natural resources in a watershed. These commonly include local plans of conservation and development, zoning regulations, subdivision regulations, inland wetland regulations, and stormwater regulations, all of which influence the type and density of development that can occur within a watershed. Local land use regulations often vary by town within a watershed, and regulations are periodically revised in response to development pressure, shifts in attitude toward natural resource protection, and political and socioeconomic factors.

A key element in the development of a Watershed Management Plan is to identify potential land use regulatory mechanisms (i.e., new or modified land use regulations) that can be implemented by the watershed towns to strengthen existing land use controls and better protect natural resources within the watershed. Many Connecticut communities are in the process of developing new or modified land use regulations that incorporate Low Impact Development (LID) and related stormwater management approaches to address stormwater quantity and quality objectives. Communities in urbanized areas are also faced with a mandate to meet State and Federal Phase II stormwater permit requirements under the National Pollutant Discharge Elimination System (NPDES) program, as well as addressing local concerns about the damaging effects of increased impervious cover and uncontrolled stormwater runoff from land development and suburban sprawl.

An opportunity exists for the watershed towns to develop revised and/or new regulatory mechanisms to satisfy Phase II stormwater requirements, while also protecting water quality and other natural resources in the Tankerhoosen River watershed consistent with the objectives of this plan.

This section summarizes the following information:

- Existing municipal land use planning entities and regulations for each of the watershed communities based on information obtained from a land use questionnaire conducted by the North Central Conservation District in 2005 as part of the *Hockanum River State of the Watershed Report* (Fuss & O Neill, 2005). The information was updated where necessary to reflect current conditions.

- Existing land use regulations and related planning documents that pertain to stormwater management and natural resource protection issues, as well as potential approaches for developing regulatory mechanisms to incorporate improved stormwater management, including LID concepts and opportunities to reduce impervious cover, into the local land use regulations. The regulatory review was performed for the towns of Tolland and Vernon because they comprise the majority of the land area in the Tankerhoosen River watershed and have the greatest potential for future development. Findings of the regulatory review are described in the report *Watershed Field Inventories and Land Use Regulatory Review* (Fuss & O Neill, October 2008), as well as a technical memorandum dated June 9, 2008 for the Town of Vernon, a copy of which is provided in Appendix B of this watershed management plan.

4.2 Summary of Land Use Planning Entities

The 2005 land use questionnaire provided information from the watershed municipalities on the land use regulations in each town, including information on wetlands and watercourses regulations, zoning regulations, plans of development, open space planning, and stormwater regulations. The following paragraphs summarize information obtained from the questionnaire, which was updated to reflect current conditions as of October 2008.

Local land use regulations are administered by various Town commissions, boards, and agencies. Land use commissions in the Tankerhoosen River watershed communities are summarized in Table 4-1.

Table 4-1. Tankerhoosen River Watershed Land Use Commissions

Town	Land Use Commissions
Manchester	• Planning and Zoning Commission (acts as Inland Wetlands and Watercourses Agency) • Conservation Commission
Vernon	• Planning and Zoning Commission • Inland Wetlands Commission • Conservation Commission • Design Review Advisory Commission • Open Space Task Force • Local Historic Properties Commission
Tolland	• Planning and Zoning Commission • Inland Wetlands and Watercourses Commission • Conservation Commission • Design Advisory Board
Bolton	• Planning and Zoning Commission • Inland Wetlands Commission • Conservation Commission • Open Space Preservation, Acquisition, and Conservation Committee

Source: Hockanum River –State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005; amended in 2008.

Table 4-2 summarizes the current plan of development, subdivision, inland wetlands, zoning, floodplain management, and stormwater regulations for the watershed towns. The table lists the last revision date for the applicable land use regulations.

Table 4-2. Municipal Land Use Regulations

Regulation	Manchester	Vernon	Tolland	Bolton
Plan of Development	2004	2001	1999	1990
Subdivision Regulations	2005	2007	2008	2004
Wetlands Regulations	2007	2006	2007	2006
Zoning Regulations	2008	2009	2008	2005
Floodplain Management	1994	In Zoning Regs.	None	2005
Stormwater Regulations	Connecticut Stormwater Quality Manual	In Zoning Regs.	2008 (LID)	2004

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005; amended in 2008.

Inland Wetlands & Watercourses

Regulating activity with the potential to affect wetlands and watercourses is an essential component in preserving or improving the water quality and overall health of the Tankerhoosen River. In Connecticut, the Inland Wetlands and Watercourses Act requires that each municipality establish an Inland Wetlands and Watercourses Agency or Commission and local regulations regulating private and municipal work located in or affecting wetlands or watercourses.

Each of the surveyed watershed towns has an inland wetlands agency, and each town has defined an upland review area, or distance from wetlands and watercourses that is subject to review. Three of the four watershed towns indicated that they have identified wetlands or watercourses that are impaired or that require restoration or require special protection. Table 4-3 summarizes the regulating agencies, upland review areas, and identified wetlands and watercourses of special significance for the surveyed watershed towns.

Table 4-3. Inland Wetlands and Watercourses Regulations

Town	Regulating Agency	Upland Review Area	Wetlands and Watercourses of Special Significance
Manchester	Planning & Zoning Commission	50' wetlands and watercourses	None identified
Vernon	Inland Wetlands & Watercourses Agency	100' wetlands 200' designated watercourses	• Vernal pools on Box Mountain Road • Tankerhoosen River • Hockanum River • Belding Wildlife Management Area
Tolland	Inland Wetlands & Watercourses Commission	50' wetlands 100' watercourses	Preliminary*
Bolton	Inland Wetlands Commission, Conservation Commission	100' wetlands and watercourses	Yes*

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005. *Information available from the individual towns; amended in 2008.

Stormwater Management and Soil Erosion and Sediment Control

Development of the landscape with impervious surfaces can alter the hydrology of a watershed and has the potential to adversely affect water quality and aquatic habitat. As a result of development, vegetated and forested land that consists of pervious surfaces is largely replaced by land uses with impervious surfaces. This transformation increases the amount of stormwater runoff from a site, decreases infiltration and groundwater recharge, and alters natural drainage patterns. Natural pollutant removal mechanisms provided by on-site vegetation and soils have less opportunity to remove pollutants from stormwater runoff. During construction, soils are also exposed to rainfall, which increases the potential for erosion and sedimentation. Development can also introduce new sources of pollutants from everyday activities associated with residential, commercial, and industrial land uses.

Stormwater runoff both during construction and following completion of construction for new development and redevelopment projects is regulated at the local and state levels. All of the watershed towns have erosion and sediment control regulations as mandated by the Soil Erosion and Sediment Control Act. Most Connecticut municipalities have adopted regulations requiring that a soil erosion and sediment control plan be submitted with any application for development within the municipality when the disturbed area of such development is more than one-half acre. Projects that disturb greater than 5 acres of land are subject to regulation under the DEP *General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities*. This permit applies to discharges of stormwater and dewatering wastewaters from construction activities including, but not limited to, clearing, grading, and excavation that result in the disturbance of 5 or more acres of total land area on a site. Pursuant to Phase II of the NPDES Stormwater Program, construction activities disturbing between 1 and 5 acres have been delegated by DEP to the municipalities provided that the erosion and sediment control plan is reviewed and receives approval from the town, under the Soil Erosion and Sedimentation Control Act.

Post-construction stormwater quantity and quality are also regulated by the watershed municipalities through municipal planning and zoning and inland wetlands and watercourses regulations. All of the watershed towns are subject to the requirements of the NPDES Phase II stormwater program, which is regulated under the DEP *General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems* (MS4 General Permit). The MS4 General Permit regulates the quality of municipal stormwater discharges and requires the creation of a Stormwater Management Plan that addresses the following six minimum control measures:

1. Public education and outreach on storm water impacts required throughout the entire municipality;
2. Public involvement/participation required throughout the entire municipality;
3. Illicit discharge detection and elimination required throughout the entire municipality including mapping all storm water discharges from a pipe or conduit with a diameter of 15 inches or greater (or equivalent cross-sectional area) owned or operated by the municipality;
4. Construction site storm water runoff control required throughout the entire municipality;

5. Post-construction storm water management in new development and redevelopment; and
6. Pollution prevention/good housekeeping for municipal operations.

The DEP *Connecticut Stormwater Quality Manual* provides guidance on the measures necessary to protect the waters of the State of Connecticut from the adverse impacts of post-construction stormwater runoff. It is intended for use as a planning tool and design guidance document by the regulated and regulatory communities involved in stormwater quality management in Connecticut. The manual provides uniform guidance for developers, engineers, and review agencies on the selection, design, and application of stormwater control measures. All of the watershed towns in the Tankerhoosen River watershed have indicated that they use the stormwater manual in reviewing development proposals for stormwater management issues.

In February 2008, the Town of Tolland amended its zoning and subdivision regulations to require that Low Impact Development (LID) techniques be implemented on all development to protect high quality wetlands, watercourses, open water bodies and other sensitive areas from the impacts of point and nonpoint sources of stormwater due to land development projects. Tolland also developed a companion LID design manual.

Open Space

Open space plays a critical role in protecting and preserving the health of a watershed by limiting development and impervious coverage, preserving natural pollutant attenuation characteristics, and supporting other planning objectives such as farmland preservation, community preservation, and passive recreation. Open space includes preserved natural areas as well as lightly developed parks and playgrounds.

While approximately 40 percent of the Tankerhoosen River watershed consists of undeveloped land uses, much of this land is not considered open space because it may be privately owned and ultimately developed. Protected open space areas include deeded open space that is privately owned, parcels owned by land trusts, state and federally-owned land, land owned by water companies, and municipal park land. Such land is protected against future development. Each of the watershed towns has prepared an open space plan for their respective communities (Table 4-4).

Table 4-4. Status of Municipal Open Space Plans
in the Tankerhoosen River Watershed

Town	Open Space Plan
Manchester	2004
Vernon	2005
Tolland	2006
Bolton	2004

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005; amended in 2008.

In addition to the designation of protected open space through donation, purchase of land by a town, conservation or land trusts, or other private and/or public agencies, towns also require that some land be dedicated as open space with the development of new subdivisions. The subdivision regulations of all of the towns in the Tankerhoosen River watershed require the set aside of a percentage of new subdivisions as open space, and all but Manchester have provisions for fee-in-lieu-of open space. Table 4-5 summarizes responses from the surveyed watershed communities regarding their current open space regulations.

A majority of the surveyed watershed towns also allow "cluster development" and "open space subdivisions" in their subdivision regulations. These are compact forms of development that concentrate density in one portion of the site in exchange for reduced density elsewhere, thereby reducing overall site imperviousness and associated stormwater impacts and potentially avoiding development in sensitive areas of a site.

Table 4-5. Open Space Regulations

Town	Allow Cluster Development	Allow Open Space Subdivisions	Subdivision Open Space	
			Required	Fee in lieu of
Manchester	Yes	No	Yes, 6%	No
Vernon	Yes	No	Yes	Yes
Tolland	Yes	Yes	Yes, 10%	Yes
Bolton	Yes	Yes	Yes	Yes

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005; amended in 2008.

4.3 Summary of Existing Regulations

The following policy, regulatory and planning documents were reviewed for the towns of Vernon and Tolland relative to stormwater management and natural resource protection:

- Subdivision Regulations,
- Zoning Regulations,
- Inland Wetland and Watercourses Regulations,
- Plan of Conservation and Development/Open Space Plan.

4.3.1 Town of Vernon

The Town of Vernon has a number of land use regulations that regulate construction and post-construction stormwater runoff from new development and redevelopment activities, and provide for protection of natural resources. The local regulations are particularly strong in terms of erosion and sediment control (as well as consistent between the various regulations), open space protection, and regulating activities that can potentially affect wetlands and watercourses, including requirements for watercourse buffers. However, there are several areas where the regulations and design standards and guidance could be strengthened through amendments or new regulations to clarify and strengthen stormwater management requirements and better promote the use of LID principles.

This section contains preliminary recommendations for the town of Vernon based on the review of the existing land use regulations and planning documents. The recommendations in this section are a summary of the more detailed regulatory review, which is provided in the technical memorandum dated June 9, 2008 (Appendix B).

Town Design Manual

- Develop a Town stormwater and LID design manual. A local manual should reference applicable sections of the DEP Connecticut Stormwater Quality Manual to take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town. The Town land use regulations should also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the land use regulations.

- Include a section of the design manual that addresses stormwater retrofits for redevelopment and drainage system upgrade and maintenance projects. Stormwater retrofits for residential and commercial redevelopment projects are an important element for the Town's stormwater management strategy given the level of existing development in the Town. Stormwater retrofits also present an opportunity to implement lot-level LID strategies as opposed to larger end-of-pipe controls where land may not be available for stormwater management facilities.

- Incorporate/reference stormwater quantity and conveyance sections of the Connecticut DOT Drainage Manual for consistency with state drainage standards.

Stormwater Management Standards

- Develop and incorporate into the Town stormwater design manual a set of stormwater management standards, which would become regulatory standards referenced by the existing Town land use regulations and/or new stormwater ordinance. Development of stormwater management standards would allow Vernon to establish clearer, specific standards that all projects must meet in order to obtain local land use permits. The stormwater standards could include LID requirements, complement the hydrologic sizing criteria in the *Connecticut Stormwater Quality Manual* and be tailored (using variable minimum performance standards) to protect specific water bodies or sensitive resources in the Town of Vernon. An example set of stormwater management standards is included with the memorandum in Appendix B.

New or Modified Stormwater Regulations

- Develop and implement new or revised stormwater regulations to 1) satisfy Phase II Stormwater Program regulatory requirements, 2) encourage or require LID principles to be implemented for development projects in Vernon, and 3) address other local drainage and natural resource protection issues identified by the Town. Two potential approaches have been identified – 1) a new stand-alone stormwater ordinance, or 2) addition/amendments to the existing Zoning Regulations.

- Form an advisory committee or workgroup consisting of representatives from the various land use commissions and selected Town departments to further evaluate and select the best approach for Vernon, including key decisions regarding:

    - If a new, stand-alone stormwater ordinance is selected, which department or commission will have responsibility for administering the program (i.e., the "Stormwater Authority")?
    - Which projects and activities will the new ordinance apply to (i.e., applicability)?
    - How will applications be received and reviewed?
    - Who will be responsible for inspections and enforcement?
    - Will additional staff be required to handle the increased workload to review and process applications?

4.3.2 Town of Tolland

Zoning and Subdivision Regulations

The Town of Tolland amended its zoning and subdivision regulations to:

1. Incorporate Low Impact Development (LID) principles. The Town also developed a companion LID Design Manual that provides recommendations for site design, road design, and stormwater management.
2. Create a natural Resource and Wildlife Protection Overlay Zone around sensitive habitat areas and steep slopes throughout the town.
3. Adopt density-based zoning to replace the minimum lot size requirements.

Tolland is one of the first towns in Connecticut to adopt comprehensive LID regulations. The regulations are a good model for the other watershed communities to require the use of LID practices. The regulations are currently in the early stages of implementation. The Town should continue to monitor the effectiveness of the LID regulations as development projects subject to the new regulations are designed, reviewed, and constructed.

Inland Wetlands and Watercourses Regulations

The Inland Wetlands and Watercourses regulations were amended in 2007, and are in accordance with the Connecticut General Statues. The regulations define an Upland Review Area extending a minimum 50 feet from the edge of a wetlands and/or watercourse and a extending a minimum of one hundred 100 feet from any watercourse, including intermittent watercourses. The width of the Upland Review Area may be doubled in cases where the slopes bordering the wetland and/or watercourse are in excess of 15%, the presence of highly erodible soils, or unique and/or easily damaged wetland ecosystems exist.

Permit application requirements include documentation that proposed stormwater quality management systems, at a minimum, conform to the DEP *Connecticut Stormwater Quality Manual*, as amended. The Inland Wetlands and Watercourses Regulations should be revised to require that projects also meet the design requirements contained in the Tolland LID Design Manual, for consistency with the zoning and subdivision regulations and to promote the use of LID.

The town should also consider incorporating more explicit watercourse buffer recommendations, including minimum buffer widths, similar to the watercourse buffer provisions in the Town of Vernon Inland Wetlands and Watercourses Regulations. Pending passage of enabling legislation by the Connecticut state legislature, the Town should also adopt riparian buffer protection regulations that would establish requirements for a contiguous buffer strip on either side of selected watercourses such that they remain in a natural, undisturbed state.

Plan of Conservation and Development

The Tolland Planning & Zoning Commission is in the process of updating the 1999 Plan of Conservation & Development (POCD) in accordance with the Connecticut General Statutes which requires the plan to be updated every ten years. The plan will establish a common vision for the future of the community and determine policies that will help attain that vision. The plan will address a range of themes, including natural resources, open space, utility infrastructure, and community development.

The Town's planning consultant has prepared draft recommendations related to conservation issues as part of the POCD update process. The recommendations address surface and groundwater quality, important habitat areas, drainage issues, green infrastructure, and open space protection. Some of the key recommendations for natural resource protection that also apply within the Tankerhoosen River watershed include (Planimetrics, 2008):

- Future development should occur in a manner and in locations that are environmentally sustainable.
- Impacts from existing development should be minimized through education, incentives, and town leadership.

Open Space and Conservation Plan

The 2006 Tolland Open Space and Conservation Plan inventoried natural resources throughout the town, including wetlands, rivers and streams, lakes and ponds, vernal pools, water supply watersheds, forest resources, and wildlife resources. In addition to the Open Space and Conservation Plan, the town has also completed or is implementing the following open space preservation activities (Planimetrics, 2008):

- Establishing an Open Space Acquisition Fund.
- Setting up a structured process for open space procurement and management.
- Promoting the use of open space, with trail maps and programmed activities.
- Tapping into a volunteer group for maintenance (Tolland Conservation Corps).

5 Watershed Goals and Objectives

This section presents the overall management goals for the watershed, specific objectives and indicators to measure progress in achieving the objectives, and recommended management strategies. The goals, objectives, and management strategies presented in this section were developed in conjunction with the Technical Advisory Committee based upon the results of the watershed inventory and evaluation phases of the project.

5.1 Watershed Management Goals

The watershed management goals for the Tankerhoosen River watershed are summarized below. The first two goals listed below reflect the overall goals for managing the Tankerhoosen River, while the latter two reflect protection/preservation and restoration goals, respectively.

- Develop an affordable and effective watershed management plan that can be implemented by the watershed municipalities, residents, and other stakeholders.

- Maintain and enhance water quality and ecological health in and along the Tankerhoosen River and its tributaries, which is essential to the economic well-being, environmental and public health, recreational opportunities, and quality of life for the residents, local governments, and visitors of the Tankerhoosen River watershed.

- Protect the upper region of the Tankerhoosen River watershed, including high-quality headwater streams that sustain significant natural resources such as the Belding Wild Trout Management Area, from existing pollutant sources and future threats related to new development and redevelopment.

- Restore and enhance the water quality and ecological health of impacted portions of the Tankerhoosen River and its tributaries to support designated uses for fish and wildlife habitat and recreational use.

5.2 Watershed Management Objectives and Strategies

Specific objectives and recommended management strategies to achieve the watershed management goals are described below. Additional details of the recommended management strategies, including implementation priority, schedule, costs, funding sources, and implementation responsibilities, are presented in Section 6 of this plan.

Objective 1. Establish a sustainable coalition of partners to take a leadership role in implementing the Tankerhoosen River Watershed Management Plan, and encourage inter-municipal coordination in managing water quality and habitat issues in the watershed through this coalition.

Management Strategies

- Maintain the existing Technical Advisory Committee but shift its responsibilities from planning to implementation.
- Include representatives from each of the watershed municipalities (Vernon, Tolland, Manchester, and Bolton), the Connecticut Department of Environmental Protection, and possibly new members to fill in missing expertise.
- This group would form the core of a watershed partnership or coalition specifically for implementing the Tankerhoosen River Watershed Management Plan. The coalition would take the lead on implementing specific action items identified in the watershed plan, including:
  - Identify funding opportunities for grants or other financial assistance,
  - Periodically review and update action items in the plan (at least every 5 years),
  - Develop annual work plans (i.e., specific "to-do" lists),
  - Host annual public meetings to celebrate accomplishments, recognize participants, review lessons learned, and solicit feedback on plan updates and next steps.
- Encourage adoption of the watershed plan by the watershed municipalities.
- Identify funding sources and prepare and submit grant applications for projects identified in the watershed plan.

Objective 2. Enhance in-stream and riparian habitat along the river and its tributaries to sustain a diversity of aquatic life.

Management Strategies

- Conduct a fish passage assessment to refine the understanding of fish passage barriers throughout the watershed and opportunities for restoring fish passage and aquatic habitat for various parts of the river system.
- Revise local storm drainage design standards and regulations such that new or modified stream crossings are designed consistent with the Connecticut DEP Stream Crossing Guidelines (February 26, 2008).
- Investigate the feasibility of dam removal, including the implications of release of contaminated sediments behind the dams. Consider the impacts of dams beyond barriers to anadromous fish passage and fragmentation of resident fish populations. Dams affect water quality and particularly coldwater habitat. Accompany dam removal feasibility studies with assessments of fish passage at culverts upstream and downstream of the dams.
- Implement priority stream bank stabilization projects identified during the watershed field inventories.

Objective 3. Protect existing and restore degraded vegetative and riparian buffers.

Management Strategies

- Implement priority buffer reforestation and invasive species management projects identified during the watershed field inventories.
- Pending passage of enabling legislation by the Connecticut state legislature, adopt riparian buffer protection regulations that would establish a contiguous buffer strip on either side of the river such that it remains in a natural, undisturbed state.
- Tolland should consider incorporating more explicit watercourse buffer protection, including minimum buffer widths, similar to the watercourse buffer recommendations in the Town of Vernon Inland Wetlands and Watercourses Regulations.
    - Vernon should adopt LID regulations, which include site design credits or other similar incentives for developers to restore or establish vegetative buffers as part of site development.
    - Partner with the Connecticut Department of Transportation on state roadway projects in the watershed to request Transportation Equity Enhancement funding available for habitat/ecological restoration projects under SAFTEA-LU).
    - Educate developers, town staff, and the public.

Objective 4. Improve water quality by identifying and eliminating illicit discharges and encouraging stream cleanups.

Management Strategies

- Follow-up with recommended discharge investigations (by the responsible municipality) identified during the watershed field inventories.
- Ensure that illicit discharge detection and elimination (IDDE) efforts of the watershed municipalities (required by the MS4 General Permit) include their respective areas of the Tankerhoosen River watershed.
- Ensure that the watershed municipalities implement IDDE programs as required by the MS4 General Permit, including an ordinance or other regulatory mechanism to effectively prohibit non-stormwater discharges into the regulated municipal separate storm sewer system and an IDDE Plan to detect and eliminate existing and future non-stormwater discharges, including illegal dumping.
- Implement priority stream cleanup projects identified during the watershed field inventories.
- Educate town staff and the public.

Objective 5. Build awareness of land stewardship and management practices and reduce nonpoint source impacts in residential areas.

Management Strategies

- Increase watershed stewardship signage (watershed, stream, stormwater pollution prevention, and storm drain markings).
- Encourage disconnection of rooftop runoff from the storm drainage system to reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.
- Tailor education efforts to the types of pollution producing behaviors observed in residential neighborhoods throughout the watershed (buffer encroachments, yard waste, piped discharges, septic system maintenance for unsewered areas, etc.).
- Encourage the creation of backyard habitat in residential areas that abut the Tankerhoosen River and its tributaries and recognize efforts of the public.

Objective 6. Advance local government and community business awareness of the Tankerhoosen River through pollution prevention education and watershed restoration outreach activities.

Management Strategies

- The watershed municipalities should review the current compliance of their municipal facilities in the watershed with pollution prevention best management practices and applicable regulatory programs. "Good housekeeping" at municipal facilities should serve as demonstration sites for comparable private operations. Recognize examples of good practices and hold them up as models.
- The watershed municipalities should improve implementation of municipal stormwater management programs during the second term of the MS4 General Permit.
- Create a general brochure and presentation to inform businesses about pollution prevention. Conduct compliance assistance outreach (e.g., visits, group training, and/or printed materials) for specific types of businesses in the watershed (e.g., light industry, offices, commercial retail centers, restaurants).
    - Create educational displays in highly visible, strategic locations throughout the watershed to highlight water quality and habitat amenities, and to reinforce the watershed protection efforts in the watershed.
    - Increase watershed stewardship signage (watershed, stream, stormwater pollution prevention, and storm drain markings).

Objective 7. Implement an ongoing water quality and biological monitoring program to assess the effectiveness of implementation efforts and build upon the existing water quality database to guide future decision making.

Management Strategies

- Establish a long-term water quality and biological monitoring program building upon previous baseline monitoring and ongoing DEP and volunteer monitoring efforts.
- Conduct a field monitoring study of the effectiveness of new LID practices (pervious pavement, rain gardens, etc.) in the watershed. The study could be used as a demonstration project to highlight a "local, real-world" example of LID stormwater design.

Objective 8. Manage, maintain, and promote existing open space and continue to acquire open space that meets resource protection and recreational goals within the watershed.

Management Strategies

- Continue efforts to acquire unprotected open space, with priority given to the headwater subwatersheds (Gages Brook, Gages Brook South Tributary, Walker Reservoir, Upper Tankerhoosen River, Railroad Brook, and Bolton Notch Pond), riparian areas, and contiguous unfragmented parcels of open space.
- Implement existing municipal Open Space Plans and update the plans at least once every 5 years. Endorse the remaining priority open space in the watershed as high priority open space conservation areas in the municipal Open Space Plans and Plans of Conservation and Development.
- Seek alternative funding sources and approaches for open space acquisition such as state grants, limited market rate development on a parcel to help fund the acquisition of the remainder of the parcel as open space, transferring development rights from sensitive locations to locations better suited for development.
- Create watershed-wide trail maps and promote the use of existing open space by publicizing trail maps and events on open space parcels.
- Develop an invasive species management plan for the watershed, including prevention and education efforts to preempt arrivals, early detection and citizen monitoring efforts, rapid response measures for successful eradication, and when a species cannot be eradicated, continued control efforts that are necessary to minimize ecological and economic impacts.

Objective 9. Mitigate the negative impacts of stormwater runoff on hydrology and water quality through the use of Low Impact Development, sustainable design, and other state-of-the-art stormwater management practices.

Management Strategies (Regulatory)

- All municipalities in the watershed are subject to the NPDES Phase II requirements, including adoption of a local regulatory mechanism to control construction and post-construction runoff from new development and redevelopment projects.
- Tolland is one of the first towns in Connecticut to adopt comprehensive LID regulations. The regulations are a good model for the other watershed communities to require the use of LID practices. The regulations are currently in the early stages of implementation. The Town of Tolland should continue to monitor the effectiveness of the LID regulations as development projects subject to the new regulations are designed, reviewed, and constructed.
- The Tolland Inland Wetlands and Watercourses Regulations should be revised to require that projects also meet the design requirements contained in the Tolland LID Design Manual, for consistency with the zoning and subdivision regulations.
- Vernon should develop and implement new or revised stormwater/LID regulations to 1) satisfy Phase II Stormwater Program regulatory requirements, 2) encourage or require LID principles to be implemented for development projects, and 3) address other local drainage and natural resource protection issues identified by the Town.
    - Two potential approaches have been identified – 1) a new stand-alone stormwater ordinance, or 2) addition/amendments to the existing Zoning Regulations.
    - Vernon should form an advisory committee or workgroup consisting of representatives from the various land use commissions and selected Town departments to further evaluate and select the best approach for Vernon.
    - Vernon should develop a Town stormwater and LID design manual, incorporating a set of stormwater management standards, which would become regulatory standards referenced by the existing Town land use regulations and/or new stormwater regulations.
- Other amendments to the Vernon Subdivision, Zoning, and Inland Wetlands regulations are recommended to achieve reductions in impervious cover and to promote the use of LID practices (see Vernon Land Use Regulatory Review recommendations, Appendix B).
- Manchester and Bolton should also consider adopting LID design guidance and regulations or similar regulatory mechanism that satisfies the NPDES Phase II requirements and promotes or requires the use of LID design practices.
- All of the watershed communities should consider updating their zoning regulations to require a zoning permit/drainage review for land clearing activities less than ½ acre and minimize land clearing by regulating building envelope or through the use of an LID credit system.

Management Strategies (Structural)

- Install priority stormwater retrofits (municipal, state, and private outfalls and/or sites) for water quality improvements based on watershed field inventory recommendations.
- Watershed towns should incorporate LID into town projects, including roadway work using emerging LID/Green Roads principles. The Town of Tolland should take a leadership role by incorporating LID into a high-profile demonstration project at a publicly-owned facility. The site should be regularly monitored and actively used for educational purposes.
- Education for developers, town staff, and the public.

Objective 10. Conduct additional assessment in non-priority subwatersheds.

Management Strategies

- Not all of the Tankerhoosen River subwatersheds and/or stream reaches were assessed during the development of this watershed management plan. Therefore, the remaining subwatersheds (Railroad Brook, Bolton Notch Pond, and the Upper Tankerhoosen River) and stream reaches should be assessed over the next two years to identify additional site-specific issues and restoration projects.

6 Watershed Management Recommendations

This section of the plan describes specific recommendations to meet the watershed management goals and objectives outlined in Section 5. The recommendations include watershed-wide recommendations that can be implemented throughout the Tankerhoosen River watershed, targeted recommendations that are tailored to issues within specific subwatersheds or areas, and site-specific recommendations to address issues at selected sites that were identified during the watershed field inventories.

The recommendations presented in this section are classified according to their implementation priority. Recommendations can be viewed as short-term, mid-term, and long-term, as summarized below:

- *Short-Term Recommendations* are initial actions to be accomplished within the first one to two years of plan implementation. These actions establish the framework for implementing subsequent plan recommendations. Such actions include development of local regulations and stormwater design guidance, discharge investigations, education program planning, and field inventories within previously unassessed subwatersheds. Small demonstration restoration projects could be completed during this phase, however construction of larger retrofit practices and stream restoration projects requiring extensive design, engineering, and permitting should be planned for later implementation.

- *Mid-Term Recommendations* involve continued programmatic and operational measures, delivery of educational and outreach materials, and construction of one or two larger retrofit and/or stream restoration projects over the next two to four years. Progress on land conservation, LID implementation, and discharge investigation follow-up activities should be completed during this period, as well as project monitoring and tracking.

- *Long-Term Recommendations* consist of continued implementation of any additional projects necessary to meet watershed objectives, as well as an evaluation of progress, accounting of successes and lessons learned, and an update of the watershed management plan. Long-term recommendations are intended to be completed during the next 5- to 10-year timeframe and beyond.

Table 6-1 summarizes the management recommendations for the Tankerhoosen River watershed based upon the management objectives identified in the previous section. The recommendations are organized by implementation priority (short-, mid-, and long-term), scale and location (watershed, targeted, or site-specific), and the groups who are responsible for implementing the recommendations. The remainder of this section presents detailed plan recommendations, including implementation priority, schedule, anticipated benefits, potential costs, funding sources, implementation responsibilities, and an evaluation framework to measure the progress and of plan implementation.

FUSS & O'NEILL

Table 6-1. Watershed Management Plan Recommendations Summary

Key Actions	Priority	Scale/Location	Who Should be Involved (L = lead, A = assist)											
			Watershed Towns	Friends of HRLP	Watershed Coalition	Landowners	NCCD	HRWA	Belding WMA	ConnDOT	CTDEP	NRCS	USEPA	Citizens/Volunteers
Objective 1. Build a Foundation for Implementing the Plan														
Form sustainable partnership or coalition	S	W	A	L			A	A	A		A			
Adopt watershed management plan	S	W	L		A									
Identify potential funding sources and submit grant applications	S	W	L		L	A	A	A	A	A	A	A		
Objective 2. Enhance In-Stream and Riparian Habitat														
Conduct fish passage assessments	S	T	A		L		A	A						
Revise local stream crossing & stormwater design standards	S	W	L											
Belding Pond Dam removal feasibility evaluation	S	T			A						A	L		
Conduct aquatic invasive species study	S	S	A		L									
Priority stream restoration projects	M/L	S	A		L							A		
Objective 3. Protect/Restore Riparian Buffers														
Priority riparian buffer restoration projects	M/L	S	A		L	A			A			A		
Adopt stream buffer regulations, pending enabling legislation	M	W	L											
Revise riparian buffer recommendations (Tolland)	S	W	L											
Incorporate invasive species management measures	M	T			L			A	A		A			
Objective 4. Identify and Eliminate Illicit Discharges														
Targeted illicit discharge investigations	S	T	L		A		A							
Implement municipal IDDE programs	M	W	L											
Priority stream cleanup efforts	S	S			L			A						A
Develop education/outreach materials	S	W			L		A				A			
Deliver education/outreach to the public	M	W	L				A							
Objective 5. Residential Management Practices														
Increase watershed stewardship signage in residential areas	M	W	L		A		A	A						A
Encourage disconnection of rooftop runoff	M	W	L		A		A							
Develop education/outreach materials	S	W			L		A							
Deliver education/outreach to the public	M	W	L				A							
Objective 6. Municipal and Business Management Practices														
Review municipal facility compliance	S	W	L											
Improve municipal stormwater management programs	S/M	W	L											
Implement street sweeping and catch basin cleaning	M	W	L							L				

Table 6-1. Watershed Management Plan Recommendations Summary

Key Actions	Priority	Scale/Location	Who Should be Involved (L = lead, A = assist)													
			Watershed Towns	Friends of HRLP	Watershed Coalition	Landowners	NCCD	HRWA	Belding WMA	ConnDOT	CTDEP	NRCS	USEPA	Citizens/Volunteers
Develop education/outreach materials	S	W			L		A							
Deliver education/outreach to the public	M	W	L				A							
Increase watershed stewardship signage in commercial areas	M	W	L		A		A	A						A
Objective 7. Implement Water Quality Monitoring Program														
Develop and implement long-term monitoring program	S	W			L		A	A			A			A
Field monitoring study of LID effectiveness	M	W	A		L		A							
Objective 8. Protect Open Space														
Priority land acquisitions	S/M	T	L		A	A			A		A			
Continue to implement municipal open space plans	S	T	L											
Seek alternative funding sources for open space acquisition	S/M	T	L		A									
Promote use of open space through trail maps and events	S/M	T			L			A	A					
Develop and implement invasive species management plan	M	T			L			A			A			A
Objective 9. Promote LID and Sustainable Site Design														
Monitor effectiveness of LID regulations (Tolland)	S/M	W	L											
Revise Inland Wetland regulations for consistency (Tolland)	S	W	L											
Develop and implement new stormwater/LID regulations (Vernon)	S	W	L											
Form advisory committee	S	W	L											
Develop Town stormwater/LID manual and/or guidance	S	W	L											
Update existing zoning, subdivision, wetlands regulations	S	W	L											
Priority stormwater retrofits	M/L	S	A		L		A			A				
Incorporate LID into Town projects	M	W	L											
LID demonstration projects (green roads, public works, schools)	S	S	L		A		A							
Develop education/outreach materials	S	W			L		A				A			
Deliver education/outreach to the public	M	W	L				A							
Objective 10. Assess Additional Subwatersheds														
Perform stream and upland assessments	S	T			L		A	A	A					A

Priority Abbreviations: S = short-term, M = mid-term, L = long-term Scale/Location Abbreviations: W = watershed-wide, T = targeted, S = site-specific
HRLP – Hockanum River Linear Park, NCCD – North Central Conservation District, HRWA – Hockanum River Watershed Association, ConnDOT – Connecticut Department of Transportation, CTDEP – Connecticut Department of Environmental Protection, NRCS – Natural Resource Conservation Service, USGS – United States Geological Survey, USEPA – U.S. Environmental Protection Agency, Belding WMA – Belding Wildlife Management Area

6.1 Watershed-Wide Recommendations

Watershed-wide recommendations are those recommendations that can be implemented throughout the Tankerhoosen River watershed. These basic measures can be implemented in each of the watershed towns, are applicable in most areas of the watershed, and are intended to address nonpoint source pollution through municipal land use regulations, public education and outreach, open space protection, and watershed monitoring. The benefits of these measures are primarily long-term, cumulative benefits resulting from source control, pollution prevention, and improved stormwater management for new development and redevelopment projects.

6.1.1 Build a Foundation for Implementing the Plan

During the planning process, the Technical Advisory Committee provided direction and local knowledge of the watershed in guiding the watershed assessments, determining priorities, and developing the management plan. As the focus of the planning process moves towards implementation, the Technical Advisory Committee, under the leadership of the Friends of the Hockanum River Linear Park, should transition to a watershed partnership or coalition specifically for implementing the Tankerhoosen River Watershed Management Plan. Recommended actions include:

- Maintain the existing Technical Advisory Committee but shift its responsibilities from planning to implementation.
- Include representatives from each of the watershed municipalities (Vernon, Tolland, Manchester, and Bolton), the Connecticut Department of Environmental Protection, and possibly new members to fill in missing expertise.
- Periodically review and update action items in the plan (at least every 5 years).
- Develop annual work plans (i.e., specific "to-do" lists).
- Host annual public meetings to celebrate accomplishments, recognize participants, review lessons learned, and solicit feedback on plan updates and next steps.
- Encourage adoption of the watershed plan by the watershed municipalities. As a group, the watershed partnership or coalition should encourage formal adoption of the watershed plan by the watershed towns and develop basic guidelines and procedures for long-term membership.
- Review and prioritize potential funding sources that have been preliminarily identified in this plan (see Section 6.5.3), and prepare and submit grant applications for projects identified in the watershed plan.

6.1.2 Municipal Regulations and Design Guidance

The regulatory review described in Section 4 of this plan identifies areas for improvements in local land use regulations and municipal stormwater design guidance to strengthen stormwater management and resource protection throughout the watershed. More detailed recommendations that were identified for the Town of Vernon are described in the technical memorandum provided in Appendix B. Many of the detailed concepts and recommendations that are described in the Vernon land use regulatory review memorandum are also applicable to the other watershed towns.

Town of Tolland

1. *LID/Stormwater Regulations*

    - Tolland is one of the first towns in Connecticut to adopt comprehensive LID regulations. The regulations are a good model for the other watershed communities to require the use of LID practices. The regulations are currently in the early stages of implementation. The Town of Tolland should continue to monitor the effectiveness of the LID regulations as development projects subject to the new regulations are designed, reviewed, and constructed.

2. *Inland Wetlands and Watercourses Regulations*

    - The Tolland Inland Wetlands and Watercourses Regulations should be revised to require that projects also meet the design requirements contained in the Tolland LID Design Manual, for consistency with the zoning and subdivision regulations and to further promote the use of LID. Permit application requirements include documentation that proposed stormwater quality management systems, at a minimum, conform to the DEP Connecticut Stormwater Quality Manual, as amended.

    - The town should also consider incorporating more explicit watercourse buffer recommendations, including minimum buffer widths, similar to the watercourse buffer provisions in the Town of Vernon Inland Wetlands and Watercourses Regulations. Pending passage of enabling legislation by the Connecticut state legislature, the Town should also adopt riparian buffer protection regulations that would establish requirements for a contiguous buffer strip on either side of selected watercourses such that they remain in a natural, undisturbed state.

Town of Vernon

1. *Town Design Manual*

    - Vernon should develop a Town stormwater and LID design manual. A local manual should reference applicable sections of the DEP Connecticut Stormwater Quality Manual to take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town. The Town land use regulations should also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the land use regulations.

- The design manual should include a section that addresses stormwater retrofits for redevelopment and drainage system upgrade and maintenance projects. Stormwater retrofits for residential and commercial redevelopment projects are an important element for the Town's stormwater management strategy given the level of existing development in the Town. Stormwater retrofits also present an opportunity to implement lot-level LID strategies as opposed to larger end-of-pipe controls where land may not be available for stormwater management.

- The design manual should incorporate or reference stormwater quantity and conveyance sections of the Connecticut DOT Drainage Manual for consistency with state drainage standards.

2. *Stormwater Management Standards*

- The Town should develop and incorporate into the design manual a set of stormwater management standards, which would become regulatory standards referenced by the existing Town land use regulations and/or new stormwater ordinance. Development of stormwater management standards would allow Vernon to establish clearer, specific standards that all projects must meet in order to obtain local land use permits. The stormwater standards could include LID requirements, complement the hydrologic sizing criteria in the DEP *Connecticut Stormwater Quality Manual* and be tailored (using variable minimum performance standards) to protect specific water bodies or sensitive resources in the Town of Vernon. An example set of stormwater management standards is included in the memorandum in Appendix B.

3. *New or Modified Stormwater Regulations*

- The Town of Vernon should develop and implement new or revised stormwater regulations to 1) satisfy Phase II Stormwater Program regulatory requirements, 2) encourage or require LID principles to be implemented for development projects in Vernon, and 3) address other local drainage and natural resource protection issues identified by the Town. Two potential approaches have been identified – 1) a new stand-alone stormwater ordinance, or 2) addition or amendments to the existing Zoning Regulations. Both approaches are discussed in Appendix B.

- The Town should form an advisory committee or workgroup consisting of representatives from the various land use commissions and selected Town departments to further evaluate and select the best approach for Vernon, including key decisions regarding:

- If a new, stand-alone stormwater ordinance is selected, which department or commission will have responsibility for administering the program (i.e., the "Stormwater Authority")?
- Which projects and activities will the new ordinance apply to (i.e., applicability)?
- How will applications be received and reviewed?
- Who will be responsible for inspections and enforcement?
- Will additional staff be required to handle the increased workload to review and process applications?

4. Subdivision Regulations

- Amend Section 6.4 to reference the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, as opposed to the outdated reference to the 1976 version of the Erosion and Sediment Control Handbook.

- Section 6.5.1.1 (Street Grading and Improvement): Consider eliminating the curbing requirement for roads with grades less than 5% to encourage the use of vegetated swales and similar LID practices.

- Section 6.6.6 (Cul-de-sacs): Consider smaller cul-de-sac radius of (30 to 40 feet), or alternative designs such as hammerheads, to reduce impervious cover, such that the design allows for continuous turning movement of the largest fire fighting vehicle used by the Town of Vernon. Also consider encouraging the use of LID bioretention/rain gardens in cul-de-sac islands for stormwater management.

- Section 6.7.1 (Design Standards, Road Width): Consider pavement widths of between 24 and 28 feet, if such a reduction will not negatively impact public safety or emergency response. Refer to Table 4-3 in the Connecticut Stormwater Quality Manual for potential variation in residential roadway widths based on terrain and development density.

- Section 6.7.2 (Design Standards, Curbs): Consider eliminating the curbing requirement for roads with grades less than 5% to encourage the use of vegetated swales and similar LID practices.

- Section 6.9 (Drainage and Storm Sewers): Modify these sections to reference stormwater management standards and LID principles contained in a stand-alone stormwater ordinance or new section of the Zoning Regulations, and/or the Town stormwater design manual.

- Section 6.9.3 (Drainage Design): Amend this section to allow the use of roadside vegetated swales designed in accordance with the Town stormwater design manual.

- Section 6.12.1 (Sidewalks): Consider requiring sidewalks on only one side of the street and reduce sidewalk width to 3 or 4 feet. Grade sidewalks to the front yard rather than to the street. Consider using alternative materials such as pavers, stone dust, or pervious concrete.

- Section 6.14 (Certified Erosion and Sediment Control Plan): Amend the single family exemption such that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land, which is consistent with the Phase II Stormwater Program regulatory requirement.

5. *Zoning Regulations*

- Section 3.4 (General Provisions): If the Town develops a local stormwater design manual, change the reference to the Connecticut Stormwater Quality Manual to the Town manual.

- Sections 4.1 through 4.25 (Use Districts, Setbacks and Lot Dimensions): Review current setbacks and lot dimensions for potential to relax side yard setbacks and allow narrower frontages to reduce road length and site imperviousness, and to relax front setback requirements to reduce driveway length and lot imperviousness.

- Section 12 (Off-street Parking and Loading): Review existing parking ratios to see if lower ratios are warranted and feasible. The required parking ratio for a particular land use should be enforced as both a maximum and minimum to limit excess parking space construction and impervious cover. Consider allowing the Commission to approve parking lots with more spaces than the allowed maximum provided all of the spaces above the maximum number are composed of a pervious surface, and where adequate stormwater management is provided. Also consider parking spaces held in reserve for phased developments, thereby avoiding the situation where unnecessary parking is not constructed if future phases of development do not occur.

  Clarify Section 12 of the regulations to encourage the use of shared parking. Where shared parking is used, the Zoning Regulations should require a corresponding reduction in parking spaces.

  Consider adding language to Section 12 that references specific stormwater management and landscape design standards in the Town stormwater manual and/or the Connecticut Stormwater Quality Manual.

- Section 18 (Activities Requiring a Certified Erosion and Sediment Control Plan): Amend the single family exemption such that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land, which is consistent with the Phase II Stormwater Program regulatory requirement.

6. Inland Wetlands and Watercourses Regulations

- Section 4.5 (Evaluation of Proposed Activities): Add language referencing the stormwater management standards and LID principles contained in the Town stormwater manual and/or the Connecticut Stormwater Quality Manual.

- Pending passage of enabling legislation by the Connecticut state legislature, the Town should also adopt riparian buffer protection regulations that would establish requirements (as opposed to recommendations) for a contiguous buffer strip on either side of selected watercourses such that they remain in a natural, undisturbed state.

Other Watershed Towns

- Manchester and Bolton should also consider adopting LID design guidance and regulations or similar regulatory mechanism that satisfies the NPDES Phase II requirements and promotes or requires the use of LID design practices.

- All of the watershed communities should consider updating their zoning regulations to require a zoning permit/drainage review for land clearing activities less than ½ acre and minimize land clearing by regulating building envelope or through the use of an LID credit system.

6.1.3 Illicit Discharge Detection and Elimination

Municipal Illicit Discharge Programs

Illicit discharges are non-stormwater flows that discharge into the stormwater drainage system or directly into surface waters. Failing septic systems, wastewater connections to the storm drain system, and illegal dumping are among the types of illicit discharges that can occur in residential and commercial areas. Depending on the source, an illicit discharge may contain a variety of pollutants that can impact both human health and the aquatic environment. A number of potential illicit discharges were identified throughout the watershed during the stream inventories. Identifying and eliminating these discharges is an important means of pollution source control for the watershed.

All of the watershed towns are subject to the requirements of the NPDES Phase II stormwater program, which is regulated under the DEP General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit). The MS4 General Permit regulates the quality of discharges from municipal storm drainage systems. The program requires the towns to implement an ordinance or other regulatory mechanism to effectively prohibit non-stormwater discharges into the municipal storm drainage system, as well as sanctions to ensure compliance. This includes developing an Illicit Discharge Detection and Elimination (IDDE) Plan to detect and eliminate existing and future non-stormwater discharges, including illegal dumping.

The MS4 General Permit is anticipated to be reissued in 2009, which represents an opportunity for the watershed towns to review their compliance status relative to the MS4 General Permit requirements, including the illicit discharge detection and elimination component.

The following recommendations apply to each of the watershed towns:

- Review the compliance status of the municipal stormwater management programs relative to each of the minimum measures addressed in the existing and proposed MS4 General Permit. Modify the stormwater management plans as necessary.
- Ensure that illicit discharge detection and elimination efforts of the watershed municipalities include their respective areas of the Tankerhoosen River watershed.
- Conduct follow-up illicit discharge investigations at priority outfall locations identified during the watershed inventories (see Site-Specific Recommendations).
- Develop and implement an ordinance or other regulatory mechanism to effectively prohibit non-stormwater discharges into the regulated municipal separate storm sewer system and an IDDE Plan to detect and eliminate existing and future non-stormwater discharges, including illegal dumping.

6.1.4 Residential Practices

Watershed Stewardship Signage

Stewardship signage can be an effective way of educating the public on the importance of preserving natural resources and common ways in which they may be impacting these resources. The general public is often unaware of the cumulative effects of their every-day activities. Signage can play an important role in making the connection between every-day activities and their sometimes harmful results.

Routine residential practices that can affect water quality and the natural environment include improper disposal of trash, pet waste, yard waste, and hazardous wastes; excessive use of fertilizers and pesticides; depositing fluids and materials in storm drains; and improper management of riparian areas. Educational signage can take the form of kiosks in public areas, storm drain markers or stencils, anti-dumping signs, proper pet waste management signs, and roadside/stream side signage (examples include "adopt a stream/roadway" programs).

The watershed field inventories identified very little evidence of storm drain stenciling or watershed stewardship signage. Stormwater and pollution prevention signage is generally lacking in most residential areas of the watershed. The watershed towns, together with other local stakeholders and volunteers, should consider additional storm drain marking in residential neighborhoods, heavy pedestrian areas served by storm sewers, and municipal facilities (schools, town offices, parks, libraries, etc.).

Rooftop Disconnection

Rain barrel used to capture and re-use rooftop runoff (Source: CWP, 2007).

Residential areas appear to contribute significant quantities of rooftop runoff to the storm drainage system, particularly in medium and high-density residential neighborhoods with smaller yards. Many small outfall pipes were observed from the backyards of residential areas, which are presumably associated with foundation drains, yard drains, or roof downspouts. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system or surface waters directly, and reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.

Runoff from commercial rooftops can be directed to bioretention planting beds (Source: CWP, 2007).

Rooftop disconnection (also referred to as "downspout or roof leader disconnection") is a cost-effective on-site option for reducing the volume and cost of stormwater that requires public management. Runoff from residential rooftops is collected by eaves troughs, which are installed along the edge of the roofline. Water collected in the eaves trough is conveyed to ground level by one or more downspouts. Downspouts may then connect directly into the storm sewer system or discharge to driveways, which in turn convey the water to the street and storm drainage system.

Rooftop disconnection has a number of economic and environmental benefits to the municipality and the homeowner. The major benefits include:

- Reduces volumes of flows conveyed and resulting loads to watercourses,
- Reduces the volume of flow to the municipal storm drainage system,
- Increases infiltration and groundwater recharge,
- Provides options to "recycle" rainwater.

Rooftop disconnection is ideal in neighborhoods where roof leaders are directly connected to the storm drainage system and in medium density residential areas with lot sizes in the 0.25 to 1.0 acre range (CWP, 2007). However, most residential areas that contribute rooftop runoff to the storm drainage system are potential retrofit candidates for some form of rooftop disconnection.

A variety of alternatives are available for residential and non-residential rooftop disconnections, ranging from simple disconnections to more complex delivery systems. Residential rooftop disconnection options include (Figure 6-1):

- Simple disconnection,
- Rain barrels and rain gardens,
- French drain or dry wells.

Non-residential rooftop disconnection options include (Figure 6-1):

- Simple disconnection,
- Rain gardens,
- Stormwater planters and cisterns,
- Green rooftops.

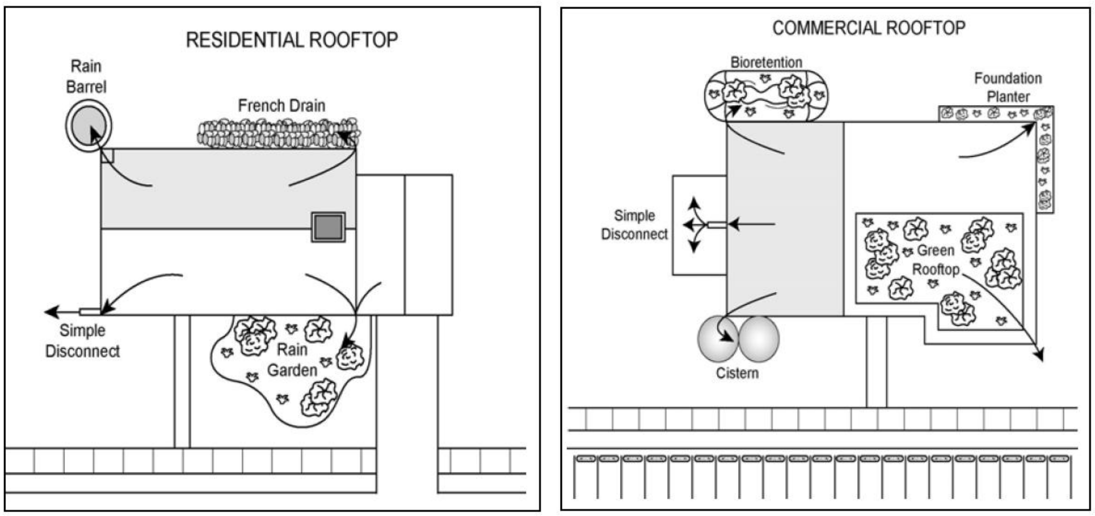


Figure 6-1. Residential and Commercial Rooftop Disconnection Retrofit Strategies (Source: CWP, 2007)

The Town of Vernon should incorporate rooftop disconnections for new development and redevelopment projects in the recommended stormwater/LID regulatory mechanism and design manual. The manual should require the use of rooftop disconnection and other LID techniques or provide incentives for their use such as an LID credit system. The manual should also include specific criteria regarding the suitability and design of various rooftop disconnection practices.

Individual rooftop retrofits target a small area, requiring the participation of many homeowners and businesses to make a measurable difference across a subwatershed. As a result, a coordinated effort is required for widespread participation in such a program, which typically includes a combination of targeted education, technical assistance, and financial subsidies to homeowners or the business community. Examples of effective local rooftop disconnection programs are presented in *Urban Stormwater Retrofit Practices* (CWP, 2007) http://www.cwp.org/Resource_Library/Center_Docs/USRM/ELC_USRM3.pdf.

6.1.5 Municipal and Business Practices

The municipal/state facilities and businesses that were observed during the field inventories exhibited examples of both good pollution prevention practices and opportunities for improvement. The watershed municipalities and ConnDOT should review the current compliance of their respective facilities (public works/maintenance facilities, parks, schools, public safety facilities, etc.) in the watershed with pollution prevention best management practices and applicable regulatory requirements. "Good housekeeping" at municipal facilities should serve as demonstration sites for comparable private operations, many of which are also subject to stormwater pollution prevention and other similar state and federal regulatory programs (oil pollution prevention, hazardous waste, air emissions). Examples of good practices should be recognized and modeled. The proposed watershed coalition should provide guidance (e.g., visits, group training, and/or printed materials) and develop incentives to encourage local businesses to adopt these model practices. Light industry, offices, commercial retail centers, and restaurants in the watershed should be the focus of these efforts.

With the pending reissuance of the DEP MS4 General Permit, the watershed towns have an opportunity to re-evaluate and improve upon the effectiveness of their municipal stormwater management programs during the second term of the MS4 General Permit. This includes the municipal good housekeeping minimum measure contained in the General Permit. The towns should modify their stormwater management plans to include audits of pollution prevention and good housekeeping practices at their respective municipal facilities, as well as re-evaluate their municipal street sweeping, catch basin cleaning, and drainage system maintenance efforts. At a minimum, all streets in the watershed should be swept at least twice per year, with more frequent sweeping of targeted areas, as necessary and as equipment and funding allow. Vacuum-assisted sweeping has been shown to be more effective than conventional mechanical broom sweeping for removing finer particulates.

Educational signage should also be considered in commercial business areas along the major transportation corridors in the watershed, including Interstate 84, Route 30, Route 31, and other heavily-traveled local roads that cross the Tankerhoosen River and its major tributaries. Increased educational signage explaining the linkage between recreational centers in the watershed and the Tankerhoosen River is also recommended within Walker Reservoir East, the Belding Wildlife Management Area, Valley Falls Park, Bolton Notch Pond, Freja Park, the Rails-to-Trails, and Phoenix Mill Park.

6.1.6 Education and Outreach

Nearly all source control and pollution prevention measures rely on some form of public education to change public behavior. In some cases, education efforts must be targeted at municipal officials and public works employees (e.g., stormwater ordinances, roadway deicing application, storm drainage system maintenance). The general public, including residents, business owners and operators, plays an important role in almost all of the source control and pollution prevention measures described in this plan.

Often, the public is not aware of the critical role they have in protecting water resources. Public education is an important part of an overall pollution prevention and source control program because it raises awareness of both personal responsibilities and the responsibilities of others relative to environmental protection and teaches people what individual actions they can take to prevent pollution. This increased understanding has the additional benefit of fostering support for watershed management efforts.

Public education programs can consist of a variety of elements including:

- Educational displays, pamphlets, booklets, and utility stuffers;
- Use of the media (newspapers, television, radio);
- Promotional giveaways (hats, t-shirts, bumper stickers, etc.);
- Stormwater educational materials;
- Classroom education.

The choice of outreach materials depends on the resources available and the target audience. A public education and outreach program should be designed to offer a broad discussion of stormwater and water quality issues. For maximum effectiveness, the program should target selected geographic areas or subwatersheds, audiences, and potential sources of pollution. A variety of general educational materials on stormwater and pollution prevention are available from state and federal government agencies, as well as education and industry groups.

The NPDES Phase II stormwater permitting program has generated a plethora of educational materials regarding water quality and nonpoint source pollution. A collection of educational materials is maintained by the U.S. EPA and is accessible to the public via the U.S. EPA's Nonpoint Source Outreach Toolbox (http://www.epa.gov/nps/toolbox/) and NPDES Stormwater Program page (http://cfpub.epa.gov/npdes/home.cfm?program_id=6). The materials target various audiences including the residences, commercial businesses, and industry. Additional materials can be found at www.asist.net/stormwebs.htm and www.stormwatereducation.com/index_flash.html.

Through implementation of their municipal stormwater programs, the watershed towns should ensure that their public participation and outreach programs focus on target audiences and areas within the Tankerhoosen River watershed. The following target audiences are recommended for watershed public education and outreach programs:

- Homeowners and renters,
- Public school system,
- Builders and residential contractors,
- Residential and commercial lawn care and landscaping professionals,
- Commercial and retail businesses.

Public education and outreach programs should target one or more of the following activities and sources of pollution:

- Illicit discharges,
- Residential downspout disconnection (rain barrels, dry wells, etc.),
- Lawn care practices,
- Yard waste disposal,
- Backyard riparian buffer practices,
- Low Impact Development for homeowners and contractors,
- Septic system maintenance,
- Construction erosion and sediment control,
- Pet waste management.

Educational displays should also be considered for highly visible, strategic locations throughout the watershed to highlight water quality and habitat amenities, and to reinforce the watershed protection efforts. Potential locations include stormwater and LID retrofit demonstration projects at schools, public parking lots, commuter parking lots, and recreational areas (see Site-Specific Recommendations).

6.1.7 Water Quality Monitoring Program

Long-Term Monitoring Program

Continued chemical and biological monitoring within the Tankerhoosen River watershed is recommended to refine the understanding of water quality impacts from potential point and non-point pollution sources in the watershed, to continue developing a water quality database for the watershed to guide environmental decision-making, and to measure the progress toward meeting water quality goals in the watershed. Additional funding sources should be sought to finance future monitoring efforts.

Recommended modifications to the Tankerhoosen river watershed water quality monitoring program for future monitoring events include:

- Chemical monitoring is recommended along Gages Brook immediately downstream of the industrial park to further evaluate potential dry weather impacts and possible illicit connections/discharges from facilities in the industrial park. The Town of Tolland should designate the industrial park as a focus area for its municipal stormwater management program, including outfall monitoring and illicit discharge detection and elimination efforts.

- Chemical monitoring is recommended along tributaries of the lower Tankerhoosen River (Tucker Brook and Tunnel Brook) that have not been previously monitored to provide information on pollutant contributions from developed areas within the lower Tankerhoosen River watershed.

LID Retrofit Demonstration Monitoring

Water quality monitoring (runoff volumes and pollutant concentrations) is recommended in conjunction with the potential LID retrofit demonstration projects that are described in the Targeted and Site-Specific Recommendations sections of this plan. Monitoring of the retrofit site(s) is recommended before and after the installation of the retrofit. Such a monitoring program could help quantify the benefits of innovative LID techniques within the Tankerhoosen River watershed, but would require a significant funding source for a comprehensive and statistically-valid "before and after" study design.

6.2 Targeted Recommendations

Targeted recommendations are tailored to address issues within specific subwatersheds or areas, rather than watershed-wide. Targeted recommendations also include actions to address common types of problems that were identified at representative locations throughout the watershed, but where additional studies or evaluations are required to develop site-specific recommendations. Targeted recommendations can have both short- and long-term benefits. Appendix C contains a series of subwatershed maps that depict targeted stream corridor recommendations.

6.2.1 Priority Parcels for Open Space Protection

As described earlier in this plan, conservation of open space is critical in protecting and preserving the health of a watershed by limiting development and impervious coverage, preserving natural pollutant attenuation characteristics, and supporting other planning objectives such as farmland preservation, community preservation, and passive recreation. Each of the watershed towns continues to implement open space plans for their respective communities.

There are several common ways that undeveloped land can be preserved and protected as open space. These include outright purchase (fee simple), conservation easements, purchase of development rights, and land donations. Regardless of the mechanism, critical to the success of protecting open space land is having a source of funding that can be readily accessed when windows of opportunity to acquire significant parcels arise.

The open space plans of the watershed towns identify priority parcels for preservation and protection. A key goal of the Town of Vernon's Open Space Plan (Revised October 12, 2005) is to protect the Tankerhoosen River watershed and associated wildlife habitat by creating contiguous greenways within the watershed. Preservation of key parcels in the watershed will help to offset the long-term, cumulative impacts of non-point source pollution. The plan's objective is to expand the large contiguous greenway formed by Valley Falls Park, the Belding Wildlife Management Area, Bolton Lakes, and State of Connecticut preserved land in order to protect the Tankerhoosen River and its tributaries from non-point source pollution, link important wildlife habitats, enhance biodiversity, and create extensive opportunities for outdoor recreation. The open space plans of the other watershed towns also identify protection of key natural resources and water quality, including the Tankerhoosen River and its watershed, as an important goal.

The watershed towns, working closely with other stakeholders including local land owners, should:

- Continue to implement their municipal Open Space Plans and update the plans at least once every 5 years. Endorse the remaining priority open space in the watershed as high priority open space conservation areas in the municipal Open Space Plans and Plans of Conservation and Development.
- Continue to pursue funding sources and alternative approaches for open space acquisition such as state grants, limited market rate development on a parcel to help fund the acquisition of the remainder of the parcel as open space, and transferring development rights from sensitive locations to locations better suited for development.
- Create watershed-wide trail maps and promote the use of existing open space by publicizing trail maps and events on open space parcels.

Priority should be given to larger properties that meet one or more of the following general criteria:

- Are contiguous with and would extend current greenways and riparian areas along headwater (1st or 2nd order) streams and other water bodies,
- Provide linkages between existing open space areas and linkages to existing trails,
- Provide important scenic, historic, cultural, or natural resource value,
- Protect groundwater and surface water supply sources,
- Protect other critical environmental resources.

Figure 6-2 identifies priority parcels throughout the watershed that should be targeted for open space protection. Several of these parcels, which are among Vernon's highest priority for open space protection, are also described below.

Tancanhoosen LLC Property

This collection of parcels comprises approximately 470 acres of land and is situated in the headwaters of the Tankerhoosen River watershed, between Walker Reservoir and the Belding Wildlife Management Area. The site is located near the Exit 67 interchange of Interstate 84 and has experienced significant development pressure. The parcel encompasses over 1.5 miles of the Tankerhoosen River that harbors a significant wild trout area. The site is characterized mostly by forested upland, and some steeply-sloped forested wetlands along the Tankerhoosen. A forested swamp and marsh area also exists on the site near Walker Reservoir. Preservation of this property would serve to offset continuing non-point source pollution pressures on the Tankerhoosen; contribute significantly to the wildlife corridor (greenway) expansion; and provide recreational value and diverse habitats including wetland aquatic habitats, stream habitats, and upland forest habitats.

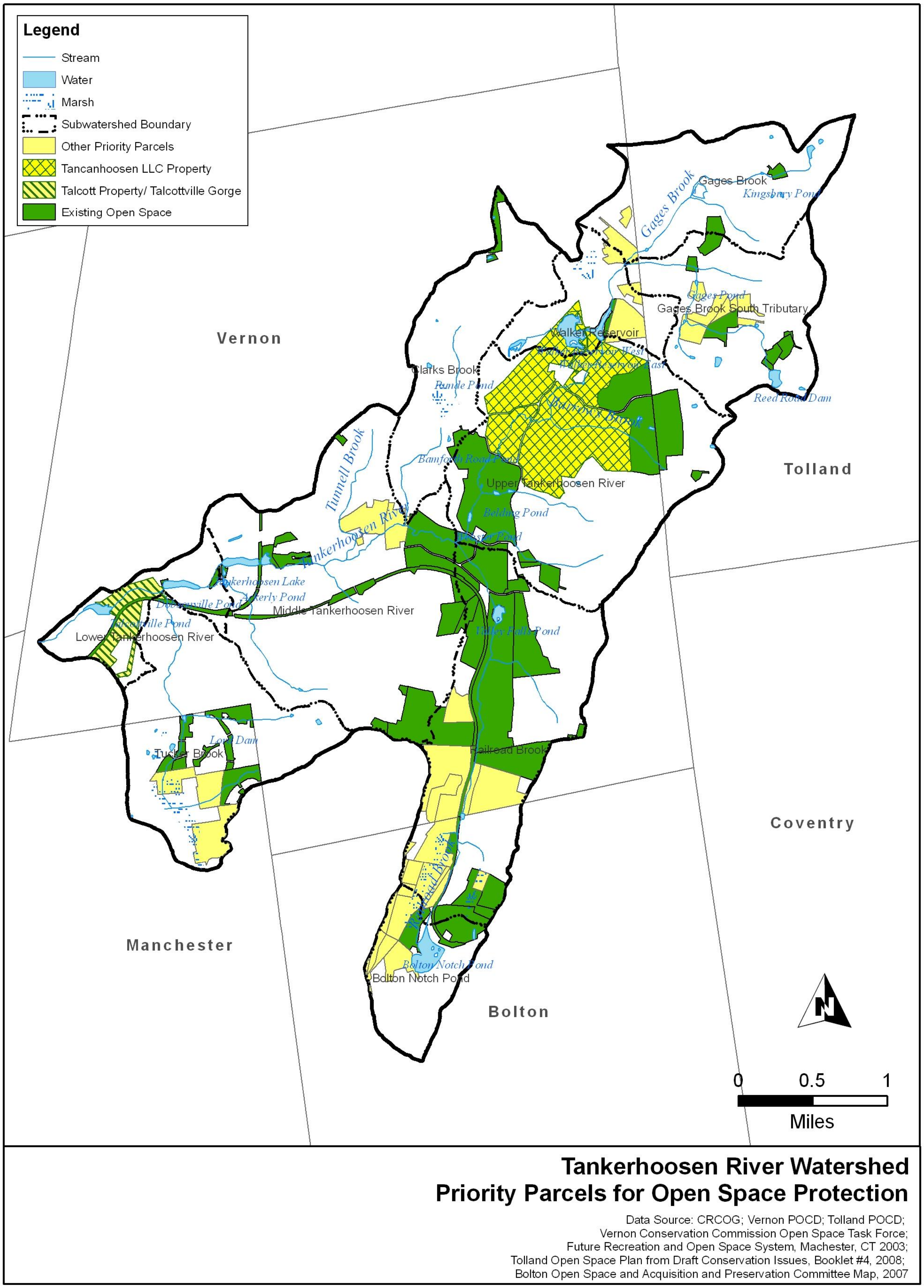


Figure 6-2. Priority Parcels for Open Space Protection

The DEP has been actively pursuing purchase of this property, although funding has been delayed due to recent state budget cuts. The property remains a high priority for acquisition by the DEP, which is a key open space recommendation of this watershed management plan.

Talcottville Gorge Property

This area, known as Talcottville Gorge, is a largely forested, scenic area bisected by the Tankerhoosen River, generally situated between Talcottville Pond and Dobsonville Pond in the lower Tankerhoosen River watershed. The site encompasses a geologically significant gorge with steeply sloped rock outcroppings, a dam and falls, a small pond; and remains of early 19th century textile mills. The acreage also encompasses parcels on either side of Elm Hill Road, which are comprised of some wetlands and steep slopes and forested land and also bound the Rails to Trails. The nearby village area is designated a local historic district. Due to its diverse natural resource, cultural, and recreational value, this property ranks as the highest priority in the Town of Vernon's Open Space Plan.

6.2.2 Invasive Plant Species Management

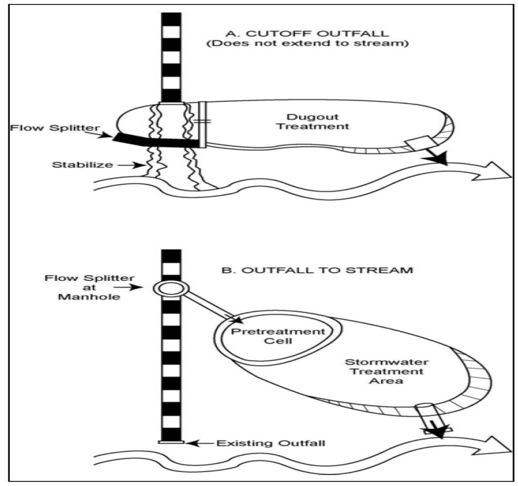
Invasive terrestrial plant species (phragmites, cattails, reed canary grass, etc.) were observed in stream corridors in many areas of the watershed during the field inventories. Management measures for control of invasive plant species should be incorporated into site-specific stream restoration activities. An invasive plant species management plan should be developed for targeted areas or subwatersheds, including the Walker Reservoir, Tucker Brook, and Gages Brook South Tributary subwatersheds. The plan could identify prevention and education efforts to preempt arrivals, early detection and citizen monitoring efforts, response measures for successful eradication, and when a species cannot be eradicated, continued control efforts that are necessary to minimize ecological and economic impacts. Information on invasive plant species planning and management can be obtained from:

- U.S. Fish and Wildlife Service: (http://www.fws.gov/invasives/staffTrainingModule/planning/introduction.html),
- The Connecticut Department of Environmental Protection,
- The Nature Conservancy (TNC),
- Connecticut Invasive Plant Working Group (CIPWG).

6.2.3 Targeted Stormwater Outfall Retrofits

Stormwater runoff from many of the state and local roads in the watershed typically receives little or no treatment prior to discharge. Such discharges are a source of sediment and other pollutants to the receiving water bodies. Opportunities exist for stormwater retrofits at roadway stormwater outfalls, particularly at or near roadway stream crossings.

This type of retrofit creates new treatment adjacent to the stream corridor near the terminus of an existing storm drain outfall. Outfall retrofits are designed off-line by splitting flow from the existing storm drain pipe (or ditch) and diverting it to a stormwater treatment area formed by an existing depression, excavation or constructed berm. A flow splitter allows larger storms to remain in the existing pipe (or ditch) and bypass the retrofit. Typical stormwater treatment options at outfall retrofits can include stormwater basins, constructed wetlands (Figure 6-3), and bioretention.



A common strategy for outfall retrofits in the stream corridor (Source: CWP, 2007).

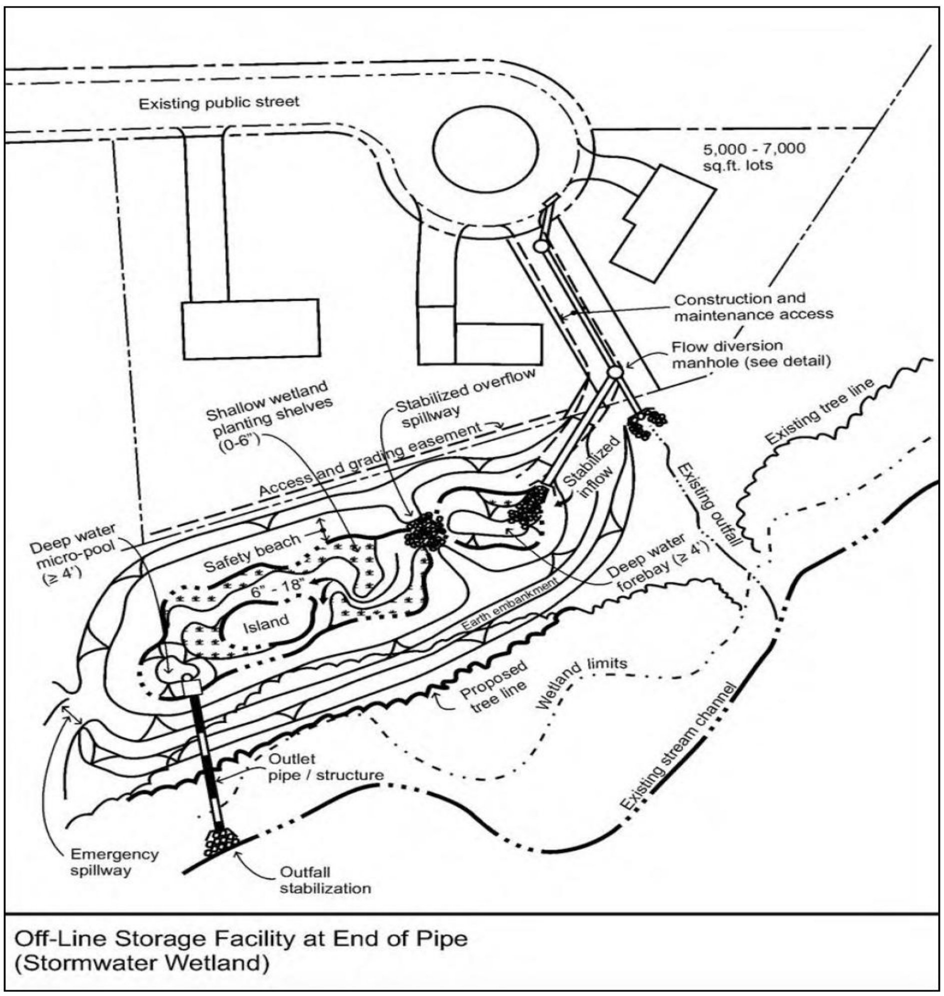


Figure 6-3. Example Constructed Wetland Outfall Retrofit (Source: CWP, 2007)

Table 6-2 lists potential outfall retrofit opportunities that were identified during the watershed field inventories, as well as outfalls where illicit discharge investigations and stabilization measures are recommended (see maps in Appendix C). The feasibility of retrofits at these outfalls should be further evaluated based on consideration of site-specific factors including hydraulic head, available space, soil conditions, and easements.

Table 6-2. Priority Outfall Retrofit Sites

Watershed	Stream Reach	ID	Recommendation			Location
			Stormwater Retrofit	Investigate Illicit Discharge	Stabilize or Repair Outfall	
Clarks Brook	CB-04	OT-01		ü		Downstream of Rockledge Road
Gages Brook	GB-03A	OT-01			ü	Outfall of sedimentation basin on Gerber Drive
	GB-04	OT-01	ü			Adjacent to Industrial Park Road West
	GB-04	OT-02		ü		250 ft south of Industrial Park Road East
	GB-04	OT-03	ü		ü	100 ft south of Industrial Park Road East
	GB-04	OT-04B		ü		Adjacent to Industrial Park Road East
	GB-05B	OT-01			ü	Outfall of detention pond CNC Software
	GB-09	OT-01	ü	ü		Along road adjacent to Industrial Park Road East
	GB-09	OT-02			ü	Along road adjacent to Industrial Park Road East
Gages Brook South Tributary	GBST-02	OT-01	ü		ü	I-84 Drainage at 0.6 miles east of Exit 67
	GBST-02	OT-02			ü	I-84 Drainage 1,000 ft east of OT-01
Lower Tankerhoosen River	LTR-03	OT-01		ü		I-84 runoff from detention pond near Exit 65
Middle Tankerhoosen River	MTR-09	OT-10		ü		South of Warren Street

Table 6-2. Priority Outfall Retrofit Sites

Watershed	Stream Reach	ID	Recommendation			Location
			Stormwater Retrofit	Investigate Illicit Discharge	Stabilize or Repair Outfall	
Tucker Brook	TB-04B	OT-01	ü		ü	End of Yale Drive, outfall from detention pond
	TB-04C	OT-02		ü		North of Chatham Drive 500 ft east of OT-01
	TB-04C	OT-04		ü	ü	North of Chatham Drive 350 ft east of OT-02
Walker Reservoir	WR-05	OT-01		ü		At Mile Hill Road

6.2.4 Watershed Fish Passage Assessments

Upper Tankerhoosen

The upper portion of the Tankerhoosen River and Railroad Brook support a variety of fish species. This portion of the watershed also includes the Belding Wild Trout Management Area, which has some of the highest-quality, self-sustaining native trout populations in the state. A number of existing or potential barriers to fish passage were identified during the stream inventories (Appendix C). However, the Upper Tankerhoosen River and Railroad Brook subwatersheds were not assessed during the field inventories as they were determined to be less vulnerable to future development impacts.

A field inventory is recommended along the upper portions of the Tankerhoosen River to identify potential barriers to fish passage such as culverts, dams, and other obstructions. The Tankerhoosen River is a cold water stream starting only a short distance below Walker Reservoir. The proposed removal of Belding Pond Dam approximately 1 mile downstream of Walker Reservoir (see Section 6.3.4) could potentially provide for additional passage of resident fish populations upstream to Walker Reservoir and tributaries of the Upper Tankerhoosen River, including Rickenback Brook and Barrows Brook.

Lower Tankerhoosen

The three run-of-river impoundments on the Lower Tankerhoosen River restrict fish passage within this portion of the river. Nevertheless, resident populations of brown trout, bass, and other fish species have been documented in the Lower Tankerhoosen. Although there are no diadromous fish (herring, shad) passage plans for these dams, there has been an effort in recent years to provide American eel passage at inland dams when there is a need and an opportunity.

The Lower Tankerhoosen River should be further evaluated for the presence of American eel and other resident fish populations that could potentially benefit from fish passage at these three dams. If justified, the DEP Inland Fisheries Division should request that any repairs to the dams include provisions for fish passage for resident fish populations.

6.2.5 Targeted Illicit Discharge Investigations

Numerous outfalls were observed from virtually all of the land uses encountered during the stream assessments. Many appear to be associated with sources having low potential for water quality impacts (i.e., residential foundation drains), while others were of unknown origin and should be the focus of future investigation. Priority outfalls that were identified for follow-up illicit discharge investigations are depicted on the subwatershed maps in Appendix C and summarized in Table 6-2.

Methods for identifying illicit discharges can vary widely in the level of effort and cost required for implementation. The following field-based methods are typically used to identify illicit discharges:

- *Testing of Dry Weather Discharges:* Flows from stormwater outfalls during dry weather may indicate an illicit discharge. A combination of visual inspection and chemical analysis of dry weather discharges can aid in identifying potential discharge sources.
- *Visual Inspection:* Examination of piping connections by either physical examination or closed-circuit camera can be used to identify possible illicit connections.
- *Review of Piping Schematics:* Examination of architectural plans and plumbing details can reveal potential sites of improper connections.
- *Smoke Testing:* Injection of a non-toxic vapor (smoke) into the facility plumbing system and following its path of travel can be used to locate connections.
- *Dye Testing:* In this method, appropriate colored dyes are added into the drain water of suspect piping. Appearance of the dyed water in the storm drainage system indicates an illicit discharge. As mentioned in the discussion of septic system discharges, testing for optical brighteners can provide an indication of the presence of domestic wastewater flows.
- *Infrared, Aerial, and Thermal Photography:* Use of aerial, infrared, and thermal photography to locate patterns of stream temperature, land surface moisture, and vegetative growth are emerging techniques to identify potential illicit discharges to stormwater systems.

Other sources of information on performing illicit discharge investigations include:

- New England Interstate Water Pollution Control Commission: http://www.neiwpcc.org/neiwpcc_docs/iddmanual.pdf
- Center for Watershed Protection: http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/idde.htm

The watershed towns are required to develop illicit discharge detection and elimination programs under the NPDES Stormwater Phase II program. The Towns should perform follow-up investigations of the potential illicit discharges that were identified in this watershed study as part of their ongoing municipal stormwater permit program.

6.2.6 Additional Subwatershed Field Assessments

Due to limited project funding, not all stream segments in the priority subwatersheds were assessed, and other subwatersheds were not assessed as they were determined to be less vulnerable to future development impacts. The remaining subwatersheds and stream reaches (Table 6-3) should be assessed over the next two years, pending the availability of funding, to identify additional site-specific issues and potential watershed restoration opportunities.

Table 6-3. Additional Subwatersheds and Stream Reaches to be Assessed

Subwatershed	Stream Reach	Proposed Schedule
Lower Tankerhoosen River	All except LTR-03	Summer/Fall 2009
Middle Tankerhoosen River	MTR-03, MTR-04, MTR-05, MTR-06, MTR-10, MTR-11, MTR-12	Summer/Fall 2009
Gages Brook South Tributary	GBST-06, GBST-07, GBST-08	Summer/Fall 2009
Tucker Brook	TB-05, TB-06, TB-07, TB-08, TB-09, TB-10, TB-11, TB-12	Summer/Fall 2009
Railroad Brook	All reaches	Summer/Fall 2010
Bolton Notch Pond	All reaches	Summer/Fall 2010
Upper Tankerhoosen River	All reaches	Summer/Fall 2010

6.3 Site-Specific Recommendations

Site-specific recommendations are tailored to address issues at selected sites that were identified during the watershed field inventories. These recommendations also provide examples of the types of projects that could be implemented at similar sites throughout the watershed. Site-specific recommendations can have both short- and long-term benefits.

6.3.1 Stormwater Retrofit Opportunities

Stormwater retrofits are structural practices installed in upland areas to capture and treat stormwater runoff before it is delivered to the storm drainage system, and ultimately, the Tankerhoosen River or its tributaries. A total of 10 retrofit sites were identified based on the field inventories and review of previous studies and reports. The majority of the stormwater retrofit opportunities are on publicly-owned land. This list is not intended to be all-inclusive, as only several representative subwatersheds and target areas were included in the field inventories. Rather, the retrofit sites identified in this section should be considered representative of the types of retrofit opportunities that exist throughout the watershed.

The stormwater retrofit options identified in this section generally focus on Low Impact Development techniques such as bioretention practices, porous pavement, water quality swales, stormwater basins, and constructed wetlands. They also include traditional practices such as sediment forebays and deep sump catch basins. Conceptual designs and typical details for the proposed retrofit concepts are provided in Appendix D. While the retrofit concepts presented in this section require additional site-specific evaluation to verify their ultimate feasibility, they illustrate how stormwater retrofits can be applied at these and similar sites throughout the watershed and provide the basis for future implementation projects.

Northeast School

- The paved driveway and parking area at the Northeast School provides an opportunity for a highly visible parking lot retrofit. Retrofits at schools provide an ideal learning opportunity for children and the community. Similar retrofits could be implemented at other schools throughout the watershed.
- *Bioretention on existing traffic island and parking lot median.* These retrofits could be implemented in the Northeast School parking lot by excavating a depression in the existing landscaped areas and planting with plants that tolerate wet conditions. Existing curbing separating the parking area from the traffic islands could also be removed and replaced with curb stops, allowing stormwater to flow into the bioretention areas while protecting the areas from vehicular traffic. Adjacent paved walkways could be replaced with porous pavers for additional infiltration. Existing driveway catch basins could be replaced with outlet structures for the bioretention areas. If soils are not suitable for stormwater infiltration, an underdrain could be installed below the bioretention areas, which would then serve as stormwater filtration devices primarily to treat the water quality volume.
- *Install a new stormwater basin*. As an alternative to the bioretention concept, a new stormwater basin could be located near the corner of Route 30 and the school driveway adjacent to the athletic field to treat runoff from the driveway and parking lot. A new outlet structure could connect to the existing storm drainage system.

Mount Vernon Apartments

- *Install a new stormwater basin in the lawn area along the apartment complex driveway*. The new basin would receive stormwater from the apartment complex's existing drainage system via a diversion manhole that could be constructed to divert low to moderate flows into the stormwater basin for treatment, but high flows would bypass the basin. Existing catch basins could also be replaced with deep sump, hooded catch basins to remove coarse sediment and floatable material.

Fire Station (Route 30)

- *Replace the existing stormwater leakoff with a constructed stormwater basin and swale.* A small constructed stormwater basin and vegetated swale is recommended to treat runoff from the fire station parking lot. The basin would be located along the south side of the parking lot/access road. Removal of a portion of the paved area may be necessary to allow room for the basin. The basin would discharge to the existing natural wetland via a short vegetated swale. The swale would be located on the outlet side of the wetland. Other types of stormwater treatment measures may not be feasible for this location since groundwater is likely to be shallow due to its close proximity to natural wetlands.

Vernon Historical Society (Route 30)

- *Construct a new vegetated swale and pocket wetland*. A new vegetated swale could be constructed along the south side of the parking lot. This swale would convey runoff to the west along the edge of the parking lot. On the southwestern corner of the property's upland area, a pocket wetland could be constructed adjacent to Myrtle's Garden, an existing landscaped area. The pocket wetland would provide partial treatment of stormwater flows and could be used as a demonstration project. The pocket wetland would discharge to existing natural wetlands via a short vegetated swale.
- The retrofits for the Vernon Historical Society and Fire Station sites are examples of the types of retrofits that could be applied at other municipal parking lots throughout the watershed.

ConnDOT Commuter Lot (Route 6/44 and I-384 Interchange)

- *Construct a new vegetated swale and stormwater basin along the east side of the commuter lot*. The commuter lot located at the I-384 and Route6/44 interchange near Bolton Notch Pond is elevated significantly, providing a low area on the south and east sides of the lot. This topography creates two areas that offer potential opportunities for stormwater basins. The low area on the east side of the lot is a more feasible location for a new stormwater basin since buried utilities may be present to the south, and existing surface drainage from the commuter lot enters the low area south of the lot. Surface drainage from the parking lot would be conveyed and treated by creating a new water quality swale. The swale would convey runoff to a new sediment forebay and stormwater basin, which would discharge to an existing ditch and culvert.

ConnDOT Commuter Lot (I-84, Exit 67)

- *Install a long, narrow stormwater basin along the east side of the commuter lot to capture and treat flows from the parking area*. An existing catch basin inlet can be eliminated and a short swale provided to convey flow into the basin. The basin would then convey flows north to maximize retention time since the majority of runoff would enter the wetland at its southern end. Curbing along the adjacent edge of the parking lot could be eliminated and replaced with curb stops, and the area between the basin and the parking lot replaced with a vegetated filter strip if overland flow to the wetland could be facilitated at other low points.
- Similar stormwater retrofits could potentially be implemented at other state, municipal, and commercial parking lots throughout the watershed.

Gerber Technologies Office Building

- *Retrofit an existing stormwater basin with a riprap berm to form a sediment forebay*. The existing stormwater basin that receives runoff from the Gerber Technologies facility incorporates many of the recommended elements to meet current stormwater quantity and quality design criteria. However, the basin is also in need of maintenance as demonstrated by the sediment accumulation near the center of the basin and the overgrown woody vegetation at the overflow spillway. Existing stormwater basins such as this one may also be good retrofit candidate to improve treatment effectiveness by incorporating a sediment forebay at the basin inlet, which may also facilitate routine sediment removal. A sediment forebay would restrict coarse pollutants to a smaller area in the basin, improving treatment of the stormwater that the basin currently receives and facilitating easier maintenance.
- *Maintain the existing riprap outfall, or replace if necessary*. The existing riprap channel leading from this basin to Gages Brook is becoming blocked with shrubs and trees which may restrict its function during a large precipitation event. Additionally, water was observed flowing through the channel rather than over it. The trees and vegetation should be cleared from this channel and the stumps removed. The existing riprap should then be removed, and either replaced with properly bedded riprap, perhaps of a smaller average diameter stone if appropriate, or replaced with a grass swale to facilitate mowing if discharge velocities allow.

Lake Street School

- *Convert existing island in turn-around in front of school into demonstration bioretention/rain garden*. The traffic island in front of the school is a potentially ideal candidate for conversion to a stormwater bioretention area to treat runoff from the school parking lot. The existing island receives surface runoff from the paved turnaround and parking lot areas, but conveys the runoff via a paved low-flow channel through the island to a downgradient headwall and piped drainage system. The island could be converted to a planted bioretention area, incorporating either an exfiltration design if soils allow or an underdrain discharge to the existing storm drainage system for stormwater filtration. The existing walkway and culvert could be replaced with a small pedestrian bridge to. The existing headwall and culvert could be replaced with an outlet structure to convey higher flows.
- This potential retrofit is an excellent opportunity for a bioretention demonstration project.

Tankerhoosen Lake and Tankerhoosen River Road Crossings

- *Construct sediment forebay at inlet of Tankerhoosen Lake and associated treatment retrofits at selected road crossings.* In a 2004 watershed study of Tankerhoosen Lake, Baystate Environmental Consultants recommended the creation of a sediment trap/forebay at the inlet of Tankerhoosen Lake, installation of deep sump catch basins at key locations, maintenance of cross-culverts and drainage structures, and grass swales and vegetated filter strips. None of the BEC recommendations has been implemented to date.

6.3.2 Riparian Buffer Restoration Opportunities

A mature riparian buffer (Source: Delaware Riverkeeper Network).

Riparian buffers are naturally vegetated areas adjacent to waterways, including streams, ponds, and wetlands. This natural vegetation protects the land adjoining a waterway by preserving the floodplain, keeping native soils intact, and maintaining the streamside land and streambanks. Vegetative buffers help encourage infiltration of rainfall and runoff, and provide absorption for high stream flows, which helps reduce flooding and drought. The vegetative community of riparian buffers provides habitat for many species of plants and animals, many of them dependent on riparian habitat features for survival and many of them threatened or endangered species. The buffer area provides a living cushion between upland land use and water, protecting water quality, the hydrologic regime of the waterway and stream structure. The naturally vegetated buffer filters out pollutants, captures sediment, regulates stream water temperature and processes many contaminants through vegetative uptake. Riparian buffers should be kept intact or restored wherever possible (Delaware Riverkeeper Network, undated).

Stream buffer encroachments are prevalent throughout the Tankerhoosen River watershed along stream corridors in or near areas of residential and commercial development. Residential lawns and some commercial lawns extend down to the banks of the stream in many areas, particularly in residential back yards. Yard waste such as grass clippings, leaves, and brush and waste materials were also common occurrences in and near these areas where easy access exists to the streams. Historical mill development along the banks of the Tankerhoosen and its tributaries has also resulted in the loss of riparian forest cover and encroachment of the built environment upon the river.

Table 6-4 lists stream reaches with impacted riparian buffers and potential buffer restoration candidates that were identified during the watershed field inventories (see maps in Appendix C). In general, riparian buffers are more effective along smaller, headwater streams. Potential riparian buffer restoration approaches for these areas include:

- Installation of new riparian buffers,
- Widening existing riparian buffers,
- Invasive species removal/management,
- Tree planting/reforestation.

The feasibility of riparian buffer restoration at these sites should be further evaluated based on consideration of site-specific factors including site access, available land area, land ownership, soil conditions, appropriate buffer width, and native plant species.

Table 6-4. Priority Riparian Buffer Restoration Sites

Watershed	Stream Reach	ID	Location
Gages Brook	GB-03B	IB-01	Along Gerber Drive
	GB-06	IB-01	At footbridge south of Valley View Drive
	GB-07	IB-01	100 feet downstream of Andrew Way
	GB-08	IB-01	50 feet upstream of Andrew Way
	GB-10	IB-01	Begins at house on downstream end of reach to 1,500 feet upstream
Gages Brook South Tributary	GBST-04B	IB-01	Rear of house along Leohr Road
Lower Tankerhoosen River	--	Not Assessed	400-ft length of Tankerhoosen River adjacent to Talcottville Mill
Tucker Brook	TB-01	IB-01	At confluent with Lower Tankerhoosen River
	TB-03	IB-01	50 feet downstream of IB-02
	TB-03	IB-02	400 feet downstream of IB-03
	TB-03	IB-03	250 feet northwest of Vernon Street
	TB-04C	IB-01	Behind houses at end of Yale Drive
	TB-04C	IB-02	Behind houses along Chatham Drive

Talcottville Mill Riparian Damage

In the fall of 2008, extensive removal of trees and vegetated buffer occurred along an approximately 400-foot segment of the Lower Tankerhoosen River. The vegetation removal, and subsequent installation of stone bank stabilization along both sides of the Tankerhoosen River, was associated with redevelopment activities at the Talcottville Mill property. The work was performed without prior approval from the Town of Vernon, the DEP, or the U.S. Army Corps of Engineers. The Town continues to coordinate with the state and federal resource agencies to determine an appropriate course of action to repair the riparian damage.

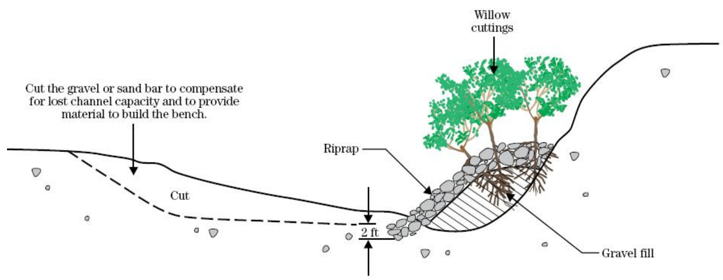
Corrective actions to restore the lost streambank vegetation and riparian habitat should balance the goal of full restoration with potential disturbance and further water quality impacts associated with complete removal of the existing stone. A dual approach that utilizes the existing stone bank stabilization and introduces new vegetative plantings may be prudent. The feasibility of such an approach should be further evaluated. Subsequent site redevelopment should also incorporate riparian buffer restoration measures (trees and vegetative plantings) into the master plan for the site.

6.3.3 Stream Restoration Opportunities

Streambank erosion along Gages Brook.

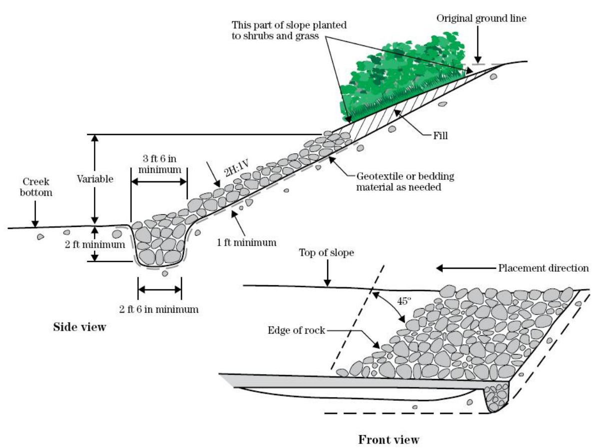
Relatively isolated areas of moderate to severe streambank erosion were observed throughout the assessed portions of the watershed. Most of these areas are located at or downstream of stormwater outfalls in developed areas of the watershed. Table 6-5 lists stream reaches with moderate to severe bank erosion that were identified during the watershed field inventories (see maps in Appendix C). These reaches are potential streambank restoration candidates. Streambank restoration requires use of a system of treatment techniques that work together to stabilize slopes, reduce erosion, and improve aquatic habitat. Although every site is different and requires detailed design of restoration components that work together, typical restoration techniques include:

- *Slope Stabilization Techniques.* Of primary concern is preventing an unstable slope from additional failure. It is likely that the slope of an eroded bank is close to the limit of its stability, such that additional loading or saturation of the soil could cause a slide. The slope must first be stabilized before techniques to prevent additional erosion can be implemented. If adequate room is available surrounding the stream, it may be possible to flatten the slope to ensure stability. If site constraints prevent flattening the slope, such as a road, structure, or utilities lying just inland from the bank, it may be necessary to provide structural support for the slope, or buttress the slope while providing adequate flow capacity by widening the channel by a corresponding amount along the inside of the bend. In combination with earthwork, slope stabilization should also include a combination of plantings and toe protection techniques to prevent future destabilization.



Typical slope stabilization where flattering the slope is not allowable (Source: NEH-654).

- *Toe Protection Techniques.* The toe of the streambank, or the portion of the bank where the slope transitions into the relatively flat stream channel bottom, is subject to constant erosive forces of flowing water, especially along the outside bank of bends. Protecting the toe is critical to ensure that upper portions of the bank are not further undermined. A variety of techniques have developed for toe protection, including constructing cribs made from logs, gabions (baskets filled with stone), woody debris anchored in place, and placed or dumped riprap protection. Bioengineering



Typical toe protection for erosion and scour resistance (Source: NEH-654).

techniques are usually not adequate on this part of the slope since the selected treatment technique must be designed to resist the shear stress and energy of the flowing water during high flow conditions, continue deep enough below the stream bottom to resist scour, and not be susceptible to ice damage.

- *Bioengineering Techniques.* Although hard armoring and engineered slope stability systems can be used effectively to restore an area of degraded bank, these techniques often lack habitat and riparian ecological value that natural conditions provide. In addition, engineered techniques are not "self-healing," in that, when damaged, they may fail and allow the degradation of the bank to resume. Bioengineering techniques can be used to avoid these consequences. Streambank bioengineering includes the use of living plant material to supplement or replace engineered systems. Typically, grasses, forbes, shrubs, and trees are used to hold soil in place, resist erosion of high flow events, provide habitat value, and grow into a natural system that could work in place of engineered systems when those systems eventually fail. Native shrub and tree species that root well from cuttings, such as willow and dogwood, can be planted along the bank, projecting into the stream, or through a riprap layer using a variety of techniques to meet site needs. Native grasses and forbes can be planted in areas subject to ice damage or where trees and shrubs are not preferred.

Bioengineering techniques used for slope stabilization and redirection (Source: NEH-654).

- *Grade Control Techniques.* Downcutting of a stream can present a significant problem since it may disconnect a stream from its wetland. Treatment techniques are available that create artificial hard points along a downcutting reach. These points set the bottom elevation of the stream channel, limiting its downward movement along the treated reach.

- *Riparian Buffer Improvement.* An important step in preventing degradation of the river corridor is to improve the width and quality of the existing riparian buffer, or providing a buffer where encroachment has removed it. The riparian buffer provides an important protection and ecological system that supports and complements the riverine system.

Access to many of the potential streambank restoration sites is limited; therefore, potential candidate sites for bank stabilization projects should be evaluated further for overall feasibility including land ownership, erosion severity, upstream and downstream conditions, infrastructure constraints, and construction access to the stream.

Table 6-5. Priority Stream Restoration Sites

Watershed	Stream Reach	ID	Location
Gages Brook	GB-01	ER-01	250 feet upstream of confluence with Gages South Tributary
	GB-01	ER-02	250 feet upstream of confluence with Gages South Tributary
	GB-03A	ER-01	Along entire reach
	GB-05B	ER-01	Downstream side of Old Post Road
	GB-06	ER-01	450 ft upstream of Old Post Road
	GB-06	ER-02	900 ft upstream of Old Post Road
	GB-06	ER-03	1,100 ft upstream of Old Post Road
	GB-06	ER-04	1,200 ft upstream of Old Post Road
Gages Brook South Tributary	GBST-09B	ER-01	700 ft downstream of Tolland Farms Road
Middle Tankerhoosen River	MTR-09	ER-01	Adjacent to Warren Avenue
Tucker Brook	TB-01	ER-01	100 ft upstream of confluence with Lower Tankerhoosen River
	TB-03	ER-01	400 ft downstream of Phoenix Street, adjacent to utility Right-of-Way
Clarks Brook	CB-02	ER-01	Adjacent to baseball field on Bolton Road
	CB-03	ER-01	Rear of Industrial Park Road building complex

6.3.4 Dams and Impoundments

In addition to the recommended fish passage barrier assessments along the upper and lower portions of the Tankerhoosen River (see Section 6.2.4), additional site-specific actions are recommended for several of the dams and impoundments in the watershed.

Walker Reservoir Dam

An engineering evaluation of Walker Reservoir Dam was performed in 1998 by Karl Acimovic, P.E. on behalf of the Vernon Parks and Recreation Department. The dam was determined to be in poor to fair overall condition, requiring significant modifications and improvements to prevent overtopping of the embankment adjacent to the spillway and subsequent erosion of the crest of the dam. The dam should be re-evaluated to verify what modifications, if any, were implemented in response to the 1998 study findings and to assess current conditions.

Walker Reservoir feeds the headwaters of the Tankerhoosen River and is believed to function as "sink" for pollutants carried from upstream areas including Gages Brook. Walker Reservoir is suspected to play a key role in protecting the high quality of the upper portions of the Tankerhoosen River, in addition to the spring water inputs that also feed the upper reaches of the Tankerhoosen. The relationship between the water quality of Walker Reservoir and the Tankerhoosen River is unclear given the limited available monitoring data. Additional study of the water quality of Walker Reservoir and its potential impact on the Tankerhoosen River is recommended in order to understand this relationship and develop management recommendations for Walker Reservoir that are also protective of the Tankerhoosen River.

Valley Falls Pond Dam

An engineering evaluation of Valley Falls Pond Dam was performed in 1997 by Karl Acimovic, P.E. on behalf of the Vernon Parks and Recreation Department. The dam was also determined to be in poor to fair condition due to the poor structural condition of the downstream earth embankment, seepage from the downstream toe of embankment, and poor condition of the secondary spillway and inadequate spillway capacity. A number of recommendations were made including tree removal, increasing the spillway capacity, a new intake/outlet structure, embankment reconstruction and toe drain installation, and reconstruction of the primary spillway. The dam should be re-evaluated to verify what modifications, if any, were implemented in response to the 1997 study findings and to assess current conditions.

Belding Pond Dam

The Natural Resources Conservation Service (NRCS) is evaluating the feasibility of removing the Belding Pond Dam, which is located along the Tankerhoosen River upstream of the Belding Wildlife Management Area. As described previously, removal of the dam could potentially provide for additional passage of resident fish populations upstream to Walker Reservoir and tributaries of the Upper Tankerhoosen River, including Rickenback Brook and Barrows Brook. The feasibility evaluation should consider a range of factors including potential impacts of removal on stream geomorphology, habitat, recreation, economics, and management of legacy sediment accumulated behind the dam.

6.3.5 Aquatic Invasive Species Study

In 2008, the Vernon Conservation Commission verified the presence of the aquatic invasive species, variable leaf milfoil, in Valley Falls Pond, which is located along Railroad Brook before the confluence with the Tankerhoosen River in the Belding WMA. Variable leaf milfoil is one of the two most common invasive milfoil species found in Connecticut, the other being Eurasian milfoil.

Variable leaf milfoil is native to the southern U.S. It first arrived in Connecticut in 1936, and has become a nuisance in many Connecticut lakes, especially in the southeast part of the state. Like Eurasian milfoil, variable leaf milfoil produces long stems that rise to the water's surface, where they spread, producing dense mats of vegetation. Control of this species can be difficult. According to "Nuisance Aquatic Vegetation Management," a guidebook published by DEP (undated), milfoil should generally not be cut to control it, since each piece can grow into another plant. The guidebook states that the most effective chemical controls are systemic herbicides applied at low dosages, which would require a DEP permit. A physical removal method, referred to as "suction harvesting", is being used to remove variable leaf milfoil from Crystal Lake in Ellington and Stafford Springs, Connecticut.

Fanwort, another aquatic invasive plant species that can form large colonies in quiet water bodies, was recently noted in Walker Reservoir by Aquatics Research. Fanwort can grow aggressively and clog drainage canals, ponds, lakes, reservoirs, and slow-moving freshwater streams. It represents a threat to Walker Reservoir and other water bodies throughout the watershed.

An aquatic plant survey and feasibility study is recommended to evaluate the extent and distribution of variable leaf milfoil in Valley Falls Pond, evaluate a range of potential control alternatives, and to identify a preferred control strategy, including costs and potential funding sources. An aquatic plant study of Walker Reservoir is also recommended, including a plant survey for fanwort and other aquatic plants that could threaten the health of the reservoir and other water bodies in the watershed.

More information on aquatic invasive plants is available from:

- Connecticut Invasive Plants council is available at: http://nbii-nin.ciesin.columbia.edu/ipane/ctcouncil/CT_invasive.htm.
- Connecticut Agricultural Experiment Station at: http://www.ct.gov/caes/
- Connecticut Department of Environmental Protection at http://www.ct.gov/dep/cwp/view.asp?a=2702&q=323494&depNav_GID=1641
- The Connecticut Aquatic Nuisance Species Management Plan: http://www.ctiwr.uconn.edu/ProjANS/SubmittedMaterial2005/Material200601/ANS%20Plan%20Final%20Draft121905.pdf.
- The National Invasive Species Information Center: http://www.invasivespeciesinfo.gov/aquatics/watermilfoil.shtml.

6.3.6 Priority Stream Cleanups

The watershed field inventories identified isolated areas of trash and debris dumping along most of the assessed streams. Stream clean-ups and trash removal are often cosmetic and temporary. However, they are an effective tool for involving and educating the public about stream degradation. In addition, some trash and debris accumulation may present risks to infrastructure and increased flooding, such as when outfalls and culverts become clogged with trash.

Table 6-6 lists stream reaches where significant trash and debris were observed (see maps in Appendix C). These sites are recommended candidates for targeted stream cleanups.

Table 6-6. Priority Stream Cleanup Sites

Watershed	Stream Reach	ID	Location	Material
Gages Brook	GB-01	TR-01	Near bridge downstream of detention pond	Sticks, brush wood fencing
	GB-02	TR-01	300 ft upstream of detention pond, adjacent to agricultural field	Tires and automotive debris
	GB-08	TR-01	350 ft downstream of Mountain Springs Road	Tire, bathtub, and two 55-gal drums
Middle Tankerhoosen River	MTR-01	TR-01	650 ft upstream of TR-02	55-gal drum (unknown material, may be toxic)
	MTR-01	TR-02	North of residence on Frederick Road	Debris piled from removal of beaver dam
	MTR-01	TR-03	South of residence on Susan Road	Approx. 16 closed 5-gal buckets
	MTR-09	TR-01	Rear of residences on Tunnel View Terrace	Yard waste and tennis balls
	MTR-09	TR-02	Rear of residences on Tunnel View Terrace	Yard waste (small amount)
	MTR-09	TR-03	Rear of residences on Warren Avenue	Yard waste (small amount)
	MTR-09	TR-04	400 ft downstream of Tunnel Road	Leaves, logs, tires stumps
Tucker Brook	TB-04B	TR-01	End of Yale Drive, outfall from detention pond	Grass and brush clippings
	TB-04C	TR-01	Behind houses along Chatham Drive	Yard waste
	TB-04C	TR-02	Behind houses along Chatham Drive	Pieces of tree approx 1 ft diameter; 2-10ft long
Clarks Brook	CB-02	TR-01	50 ft upstream of Industrial Park Road stream crossing	6 tires; automotive waste; appliance; 55-gallon drum
	CB-03	TR-01	Rear of Industrial Park Road building complex	Automotive waste

6.4 Estimated Costs and Load Reductions

6.4.1 Estimated Costs

Planning level costs were estimated for the targeted and site-specific recommendations in this plan, where sufficiently detailed information was available. The cost estimates assist watershed stakeholders to evaluate the financial resources and funding sources that may be required to implement the plan.

Table 6-7 summarizes typical ranges of planning level unit costs for the targeted recommendations, and some of the site-specific recommendations, that are identified in this plan. Additional information is required to develop more detailed cost estimates for these recommendations.

Table 6-7. Typical Unit Costs for Management Plan Recommendations

Recommendation	Planning Level Cost ($)	Source
Invasive Species Management Plan	$15,000 to 30,000	Professional engineering experience
Targeted Stormwater Outfall Retrofits (design and construction; 2009 $ per cubic ft of runoff treated)		Center for Watershed Protection, Urban Stormwater Retrofit Practices (2007)
Bioretention	$10.00 to 25.00	
Stormwater Ponds/Basins	$4.00 to 13.00	
Water Quality Swales	$11.00 to 31.00	
Watershed Fish Passage Assessment		
Upper Tankerhoosen	$10,000 to 15,000	
Lower Tankerhoosen	$5,000 to 10,000	
Illicit Discharge Investigation	Costs vary significantly depending on investigation methods and findings	Center for Watershed Protection, IDDE Manual (2004), NEIWPCC IDDE Manual (2003)
Additional Subwatershed Field Assessments	$10,000 to 15,000 (varies depending on the use of volunteers)	Center for Watershed Protection, Unified Stream Assessment (2005)
Riparian Buffer Restoration ($ per acre)		NRCS, Coginchaug River Watershed Based Plan (2008)
Grass/herbaceous buffer	$450 to 850	
Tree and shrub planting	$2,000 to 3,000	
Streambank Restoration (good access, $ per 100 linear feet))		
Bank stabilization	$1,300 to 9,600	NOAA Stream Restoration Cost Estimates (2000)
Channel rehabilitation	$1,100 to 3,700	
Evaluation of Dams & Impoundments		Professional engineering experience
Walker Reservoir Dam Evaluation	$5,000 to 10,000	
Walker Reservoir Water Quality Study	$20,000 to 30,000	
Valley Falls Pond Dam Evaluation	$5,000 to 10,000	
Belding Pond Dam Removal Feasibility Evaluation	$30,000 to 40,000	
Aquatic Invasive Species Study and Invasives Control (Valley Falls Pond and Walker Reservoir)	Cost varies depending on removal method (mechanical harvesting, herbicide application, etc.)	
Stream Cleanups	Highly dependent on the amount of donated supplies and services	

More detailed planning level costs were estimated for the site-specific stormwater retrofits described in Section 6.3.1. These estimates are based upon unit costs derived from published sources and the conceptual designs presented in Appendix D of this plan. Capital (construction, design, permitting, and contingency) and operation and maintenance costs were included in the estimates, and a total annualized cost is presented in 2009 dollars based on the anticipated design life of each retrofit. Table 6-8 summarizes planning level cost estimates for the site-specific stormwater retrofits. A more detailed cost estimate table is included in Appendix E.

Table 6-8. Planning Level Cost Estimates for Site-Specific Stormwater Retrofits

Recommendation	Construction Cost (2009)	Design, Permitting, Contingency		Total Cost	Lifespan (yrs)	Annual Cost Over Lifespan	O&M (% Cost)	O&M ($/yr)	Total Capitalized Cost/yr over lifespan
		% Construction	Cost						
Tankerhoosen Lake									
Sediment Forebay	$93,700	32%	$30,000	$123,700	30	$6,310	6%	$380	$6,690
Deep Sump CBs, piping, and swale	$24,300	32%	$7,800	$32,100	50	$1,250	15%	$190	$1,440
Northeast School									
Bioretention Area 1	$42,100	32%	$13,500	$55,600	15	$4,660	8%	$370	$5,030
Bioretention Area 2	$31,100	32%	$10,000	$41,100	15	$3,440	8%	$280	$3,720
SW Basin	$18,100	32%	$5,800	$23,900	30	$1,220	6%	$70	$1,290
Mount Vernon Apartments									
SW Basin	$42,600	32%	$13,600	$56,200	30	$2,870	6%	$170	$3,040
Deep Sump CBs	$18,800	32%	$6,000	$24,800	50	$960	20%	$190	$1,150
Fire Station (Route 30)									
SW Basin	$21,600	32%	$6,900	$28,500	30	$1,450	6%	$90	$1,540
Vegetated Swale	$900	32%	$300	$1,200	10	$140	7%	$10	$150
Vernon Historical Society (Route 30)									
Pocket Wetland	$5,500	32%	$1,800	$7,300	10	$860	6%	$50	$910
Vegetated swale	$9,600	32%	$3,100	$12,700	10	$1,490	6%	$90	$1,580
ConnDOT Commuter Lot (Route 6/44 and I-384 Interchange)									
Vegetated swale	$7,700	32%	$2,500	$10,200	29	$530	7%	$40	$570
SW Basin	$51,700	32%	$16,500	$68,200	30	$3,480	6%	$210	3,690
ConnDOT Commuter Lot (I-84, Exit 67)									
SW Basin	$38,500	32%	$12,300	$50,800	30	$2,590	6%	$160	$2,750
Vegetated Swale	$1,500	32%	$500	$2,000	10	$230	7%	$20	$250
Gerber Technologies Office Building									
Sediment Forebay	$2,000	32%	$600	$2,600	30	$130	30%	$40	$170
Discharge Channel	$9,000	32%	$2,900	$11,900	30	$610	10%	$60	$670
Lake Street School									
Bioretention	$71,300	32%	$22,800	$94,100	15	$7,880	8%	$630	$8,510

6.4.2 Load Reductions

Pollutant load reductions were estimated for the following watershed management plan recommendations using the STEPL pollutant loading model described in the *Baseline Watershed Assessment* report (Fuss & O Neill, May 28, 2008):

1. Implementation of LID treatment practices (bioretention, filter or buffer strips adjacent to impervious areas, and infiltration swales to treat runoff from impervious surfaces) for all future development and redevelopment activity in the watershed, assuming adoption of a local LID stormwater regulatory mechanism and design standards by the Town of Vernon and the other watershed towns that currently do not have such requirements,

2. Implementation of stormwater retrofits in existing developed areas (commercial, industrial, institutional and roadway land uses) to treat runoff from a percentage of each subwatershed, which would be dictated by subwatershed feasibility factors and site-specific conditions.

Pollutant load reductions for total suspended solids (TSS), phosphorus (P), nitrogen (N), and biochemical oxygen demand (BOD) for the above scenarios were estimated for 1) existing conditions, 2) future buildout of the watershed without the proposed controls, and 3) future buildout with the proposed controls.

Table 6-9 summarizes anticipated sediment loads and anticipated load reductions resulting from the implementation of LID treatment practices for all future development and redevelopment projects in the watershed. Sediment load reductions resulting from the use of LID practices varies by subwatershed, but is generally between 4 and 10 percent. The anticipated load reductions for nutrients and BOD are of a similar magnitude (Table 6-10).

Table 6-9. Anticipated Effectiveness of LID in Reducing Sediment Loads

Subwatershed	Existing Conditions (tons/yr)	Future Buildout Without LID Controls (tons/yr)	Future Buildout With LID Controls (tons/yr)	Load Reduction Due to LID Controls (%)
Bolton Notch Pond	48.8	53.3	51.4	3.5%
Clarks Brook	88.2	100.4	92.1	8.1%
Gages Brook	92.3	112.8	102.6	9.0%
Gages Brook South Trib.	82.7	93.3	88.7	4.8%
Lower Tankerhoosen River	45.0	52.9	47.9	8.9%
Middle Tankerhoosen River	199.0	220.2	203.5	7.3%
Railroad Brook	32.0	52.7	37.5	28.2%
Tucker Brook	86.1	98.4	89.0	9.1%
Upper Tankerhoosen River	73.2	80.2	76.7	4.2%
Walker Reservoir	52.6	65.6	58.0	11.1%

Table 6-10. Anticipated Effectiveness of LID in Reducing Nutrient and BOD Loads

Subwatershed	Future Buildout With LID Controls (tons/yr)			Load Reduction Due to LID Controls (%)		
	N	P	BOD	N	P	BOD
Bolton Notch Pond	1.1	0.18	4.1	2.0%	2.7%	2.1%
Clarks Brook	2.1	0.30	8.1	4.6%	6.4%	5.1%
Gages Brook	2.5	0.38	10.0	4.8%	7.4%	4.9%
Gages Brook South Tributary	2.0	0.31	7.5	2.7%	3.9%	2.9%
Lower Tankerhoosen River	1.1	0.16	4.0	5.8%	5.9%	7.2%
Middle Tankerhoosen River	4.7	0.66	18.0	4.4%	5.8%	5.2%
Railroad Brook	1.1	0.12	4.9	16.2%	20.5%	16.8%
Tucker Brook	2.2	0.28	8.8	5.6%	6.2%	6.4%
Upper Tankerhoosen River	1.8	0.26	7.1	2.6%	4.3%	2.9%
Walker Reservoir	1.3	0.20	4.8	6.5%	9.5%	7.8%

Note that sediment loads (Table 6-9) under the future buildout scenario, even with the implementation of LID controls alone, are slightly higher than existing sediment loads in all of the subwatersheds. This result suggests that other source controls/pollution prevention, stormwater retrofits, and watershed restoration practices are necessary to maintain existing pollutant loads or to achieve net reductions in pollutant loads under a future buildout scenario.

The pollutant loading model was then used to estimate the effectiveness of implementing stormwater retrofits in existing developed areas (commercial, industrial, institutional and roadway land uses) to treat runoff from a portion of each subwatershed. Ideally, the entire area watershed could be retrofitted to achieve maximum pollutant load reductions. In practice, stormwater retrofits can be difficult to implement in an urbanized watershed due to a variety of physical constraints and other factors. Therefore, stormwater retrofits are typically limited to treating runoff from some percentage of the total developed area in a subwatershed.

The pollutant loading model was then used to estimate the anticipated pollutant load reductions, compared to existing conditions, for stormwater retrofits applied to between 5 and 30 percent of the developed area (commercial, industrial, institutional and roadway land uses) in each subwatershed. Table 6-11 summarizes the results of this evaluation for sediment, which indicate that even modest applications of watershed-wide stormwater retrofits (20 to 30 percent of the area retrofitted), can result in significant pollutant load reductions (10 to 20 percent sediment load reductions).

Table 6-11. Anticipated Effectiveness of Stormwater Retrofits as a Function of Watershed Treatment Area

Subwatershed	Sediment Load (tons/yr)				
	Existing Conditions	With Retrofits (5% of Watershed Area)	With Retrofits (10% of Watershed Area)	With Retrofits (20% of Watershed Area)	With Retrofits (30% of Watershed Area)
Bolton Notch Pond	48.8	47.2	45.5	42.2	38.9
Clarks Brook	88.2	85.9	83.5	78.9	74.2
Gages Brook	92.3	89.8	87.2	82.1	77.0
Gages Brook South Trib.	82.7	80.4	78.2	73.7	69.2

Table 6-11. Anticipated Effectiveness of Stormwater Retrofits as a Function of Watershed Treatment Area

Subwatershed	Sediment Load (tons/yr)				
	Existing Conditions	With Retrofits (5% of Watershed Area)	With Retrofits (10% of Watershed Area)	With Retrofits (20% of Watershed Area)	With Retrofits (30% of Watershed Area)
Lower Tankerhoosen R.	45.0	43.5	42.0	39.1	36.2
Middle Tankerhoosen R.	199.0	193.9	188.8	178.6	168.5
Railroad Brook	32.0	31.6	31.3	30.6	29.8
Tucker Brook	86.1	84.3	82.5	78.9	75.3
Upper Tankerhoosen R.	73.2	71.7	70.2	67.1	64.1
Walker Reservoir	52.6	50.9	49.2	45.8	42.4

Finally, the potential effectiveness of 1) new LID controls for future development and redevelopment activity in the watershed and 2) stormwater retrofits at existing developed land uses were evaluated collectively to determine the minimum treatment area required for stormwater retrofits in each subwatershed to maintain existing pollutant loads under future buildout conditions. This approach provides a target stormwater retrofit treatment area (which varies by pollutant) for each subwatershed to meet the overall goal of "no net increase in watershed pollutant loads". Table 6-12 lists these minimum retrofit area targets.

Additional retrofits, source controls/pollution prevention, and other watershed restoration practices described in this plan could be implemented to achieve net reductions in future pollutant loads or to maintain existing loads if the target stormwater retrofit treatment areas are not feasible.

Table 6-12. Minimum Retrofit Area (Percent of Subwatershed) Necessary to Maintain Existing Pollutant Loads

Subwatershed	Nitrogen	Phosphorus	Sediment
Bolton Notch Pond	25%	15%	10%
Clarks Brook	35%	15%	10%
Gages Brook	50%	40%	25%
Gages Brook South Tributary	50%	25%	15%
Lower Tankerhoosen River	40%	15%	15%
Middle Tankerhoosen River	30%	15%	5%
Railroad Brook*	--	--	--
Tucker Brook	50%	15%	10%
Upper Tankerhoosen River	50%	50%	15%
Walker Reservoir	50%	35%	20%
** No commercial, industrial, institutional land use and only 17 acres of transportation land use in this subwatershed.*			

6.5 Plan Implementation

6.5.1 Schedule and Milestones

Table 6-13 is a proposed implementation schedule, including actions/milestones, anticipated timeline, products, and evaluation criteria. This table should be revised as necessary to reflect future changes to the watershed plan and implementation activities.

Table 6-13. Proposed Implementation Schedule

Actions	Lead Entity	Timeline	Products	Evaluation Criteria
Objective 1. Build a Foundation for Implementing the Plan				
Form coalition	Friends of HRLP	1-2 yrs	Funding sources and grant applications	Grant applications submitted
Adopt plan	Towns			
Identify potential funding sources	Coalition			
Submit grant applications	Coalition/Towns			
Objective 2. Enhance In-Stream and Riparian Habitat				
Conduct fish passage assessments	Coalition	1-2 yrs	Assessment findings	
Revise local stream crossing & stormwater design standards	Towns	1-2 yrs	Revised standards	
Belding Pond Dam removal feasibility evaluation	NRCS, DEP	1-2 yrs	Evaluation findings	
Conduct aquatic invasive species study	Coalition, Towns	1-2 yrs	Study findings	
Priority stream restoration projects	Coalition, Towns	2-10 yrs	Completed projects	Photos, # sites, WQ monitoring
Objective 3. Protect/Restore Riparian Buffers				
Priority riparian buffer restoration projects	Coalition	2-10 yrs	Completed projects	Photos, # sites, WQ monitoring
Adopt stream buffer regulations, pending enabling legislation	Towns	2-4 yrs	Adopted regulations	
Revise riparian buffer recommendations (Tolland)	Towns	1-2 yrs	Revised recommend.	
Objective 4. Identify and Eliminate Illicit Discharges				
Targeted illicit discharge investigations	Towns	1-2 yrs	Investigation findings	# discharges removed
Implement municipal IDDE programs	Towns	2-4 yrs		
Priority stream cleanup efforts	Coalition	1-2 yrs	Trash removed	# cleanups
Develop education/outreach materials	Coalition, Towns	1-2 yrs	Educational materials	Number of participants & feedback
Deliver education/outreach to the public	Coalition, Towns	2-4 yrs		
Objective 5. Residential Management Practices				
Increase watershed stewardship signage in residential areas	Towns	2-4 yrs	New signage	# signs
Encourage disconnection of rooftop runoff	Towns	2-4 yrs	Rain barrels, disconnections	# participants
Develop education/outreach materials	Coalition, Towns	1-2 yrs	Educational materials	Number of participants & feedback
Deliver education/outreach to the public	Coalition, Towns	2-4 yrs		
Objective 6. Municipal and Business Management Practices				
Review municipal facility compliance	Towns	1-2 yrs	Review findings	Improved BMPs

Table 6-13. Proposed Implementation Schedule

Actions	Lead Entity	Timeline	Products	Evaluation Criteria
Improve municipal stormwater management programs	Towns	1-4 yrs	Revised SWMPs	
Implement street sweeping and catch basin cleaning	Towns, DOT	2-4 yrs	Sweeping and CB cleaning	Frequency
Develop education/outreach materials	Coalition, Towns	1-2 yrs	Educational materials	Number of participants & feedback
Deliver education/outreach to the public	Coalition, Towns	2-4 yrs		
Increase watershed stewardship signage in commercial areas	Towns	2-4 yrs	New signage	# signs
Objective 7. Implement Water Quality Monitoring Program				
Develop and implement long-term monitoring program	Coalition	1-2 yrs	Monitoring data, report	Review results with agencies
LID demonstration monitoring	Coalition	2-4 yrs		
Objective 8. Protect Open Space				
Priority land acquisitions	Towns	1-4 yrs	Protected land	#sites/ acres protected
Continue to implement municipal open space plans	Towns	1-4 yrs		
Seek alternative funding sources for open space acquisition	Towns	1-4 yrs		
Promote use of open space through trail maps and events	Coalition	1-2 yrs	New maps and events sponsored	# events
Develop and implement invasive species management plan	Coalition	2-4 yrs	Management plan	
Objective 9. Promote LID and Sustainable Site Design				
Monitor effectiveness of LID regulations (Tolland)	Town	1-4 yrs	LID measures installed	Photos, WQ monitoring, 3rd party reviews
Revise Inland Wetland regulations for consistency (Tolland)	Town	1-2 yrs	Revised regulations	
Develop and implement new stormwater/LID regulations (Vernon)	Town	1-2 yrs	New SW/LID regulations, revised existing regulations	
Form advisory committee				
Develop Town stormwater/LID manual and/or guidance				
Update existing zoning, subdivision, wetlands regulations				
Priority stormwater retrofits	Coalition	2-10 yrs	Completed projects	Photos, # sites, WQ monitoring
Incorporate LID into Town projects	Town	2-4 yrs	LID measures installed	Photos, WQ monitoring
LID demonstration projects (green roads, public works, schools)	Town	1-2 yrs		
Develop education/outreach materials	Coalition, Towns	1-2 yrs	Educational materials	Number of participants & feedback
Deliver education/outreach to the public	Coalition, Towns	2-4 yrs		
Objective 10. Assess Additional Subwatersheds				
Perform stream and upland assessments	Coalition	1-2 yrs	Inventory findings	# projects identified

6.5.2 Funding Sources

A variety of local, state, and federal sources are potentially available to provide funding for the implementation of this watershed management plan, in addition to potential funds contributed by local grassroots organizations and concerned citizens. Table 6-14 is a list of potential funding sources that has been developed by DEP and NRCS, and further refined through this planning process. The funding entities and grant programs listed in the table is not intended to be an exhaustive list; the table can be used as a starting point to seek funding opportunities for implementation of the recommendations in this watershed plan. The information presented in this watershed management plan and the supporting study documentation will support future grant proposals by demonstrating a comprehensive, scientifically-based approach for addressing identified concerns consistent with EPA's recommended watershed-based approach. The table of potential funding sources is intended to be a living document that should be updated periodically to reflect the availability of funding or changes to the funding cycle, and to include other funding entities or grant programs.

Table 6-14. Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
DEP Watershed Funding Website					
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=335494&depNav_GID=1654&pp=12&n=1 Index of many potential funding sources for funding watershed-based planning projects.					
DEP CT Landowner Incentive Program	Up to $25,000	At least 25%			
http://www.ct.gov/dep/cwp/view.asp?a=2723&q=325734&depNav_GID=1655					
DEP Long Island Sound License Plate Program	$25,000			January	March
http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323782&depNav_GID=1635					
DEP Open Space and Watershed Land Acquisition				March	June
860-424-3016 david.stygar@ct.gov http://www.ct.gov/dep/cwp/view.asp?a=2706&q=323834&depNav_GID=1641					
DEP Recreation and Natural Heritage Trust Program					
http://www.ct.gov/dep/cwp/view.asp?a=2706&q=323840&depNav_GID=1641					
Eastman Kodak / Nat'l Geographic American Greenways Awards optional Program	$2500	$300	Optional	April	June
jwhite@conservationfund.org, Jen White					
EPA Healthy Communities Grant Program	$35,000	$5,000	Optional, up to 5%	March	May
617-918-1698 Padula.Jennifer@epa.gov					
Northeast Utilities Environmental Community Grant Program	$250	$1,000			April 15
http://www.nu.com/environmental/grant.asp Cash incentives for non-profit organizations					

Table 6-14. Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
EPA Targeted Watershed Grants Program			25% of total project costs (non-federal)		
http://www.epa.gov/twg/ Requires Governor nomination.					
DEP CWA Section 319 NPS			40% of total project costs (non-federal)		October 15
Nonpoint Source Management http://www.ct.gov/dep/nps 20-25 projects targeting both priority watersheds and statewide issues.					
DEP Section 6217 Coastal NPS			N/A		
http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323554&depNav_GID=1709 Section 6217 of the CZARA of 1990 requires the State of Connecticut to implement specific management measures to control NPS pollution in coastal waters. Management measures are economically achievable measures that reflect the best available technology for reducing nonpoint source pollution.					
DEP Hazard Mitigation Grant Program			75% Federal / 25% Local		
http://www.ct.gov/dep/cwp/view.asp?a=2720&q=325654&depNav_GID=1654 Provides financial assistance to state and local governments for projects that reduce or eliminate the long-term risk to human life and property from the effects from natural hazards.					
American Rivers - NOAA Community-Based Restoration Program Partnership					
http://www.amrivers.org/feature/restorationgrants.htm These grants are designed to provide support for local communities that are utilizing dam removal or fish passage to restore and protect the ecological integrity of their rivers and improve freshwater habitats important to migratory fish.					
FishAmerica Foundation Conservation Grants	Average $7,500				
703-519-9691 x247 fishamerica@asafishing.org					
Municipal Flood & Erosion Control Board	1/3 project cost	2/3 project cost			
NFWF Long Island Sound Futures Fund Small Grants	$6,000	$1,000	Optional (non-federal)	December	March
NFWF Long Island Sound Futures Fund Large Grants	$150,000	$10,000	Optional (non-federal)	December	March
631-289-0150 Lynn Dwyer Lynn.Dwyer@nfwf.org					
NRCS Conservation Reserve Program					
Jan Dybdahl, (860) 871-4018 http://www.ct.nrcs.usda.gov					
NRCS Wildlife Habitat Incentives Program (WHIP)	$50,000/year	$1,000	25%		
Jan Dybdahl, (860) 871-4018 http://www.ct.nrcs.usda.gov For creation, enhancement, maintenance of wildlife habitat; for privately owned lands.					
NRCS Environmental Quality Incentives Program (EQIP)	$50,000/year		25-50%		
Jan Dybdahl, (860) 871-4018 http://www.ct.nrcs.usda.gov For implementation of conservation measures on agricultural lands.					
NRCS Healthy Forests Reserve Program					
For restoring and enhancing forest ecosystems http://www.nrcs.usda.gov/programs/HFRP/ProgInfo/Index.htm					
NRCS Wetlands Reserve Program					

Table 6-14. Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
Nels Barrett, (860) 871-4015 http://www.ct.nrcs.usda.gov For protection, restoration and enhancement of wetlands					
USFS Watershed and Clean Water Action and Forestry Innovation Grants					
http://www.na.fs.fed.us/watershed/gp_innovation.shtm This effort between USDA FS-Northeastern Area and State Foresters to implement a challenge grant program to promote watershed health through support of state and local restoration and protection efforts.					
Corporate Wetlands Restoration Partnership (CWRP)	Typically $20,000	Typically $5,000	3 to 1	April and August	
http://www.ctcwrp.org/9/ Can also apply for in-kind services, e.g. surveying, etc.					
DEP 319 NPS Watershed Assistance Small Grant			40% of total project costs (non-federal)		
860-361-9349 rivers@riversalliance.org					
Trout Unlimited Embrace A Stream	$5,000				
USFWS National Coastal Wetlands Conservation Grant Program	$1 million		50%		
Ken Burton 703-358-2229 Only states can apply.					
YSI Foundation	$60,000		Optional	March	April
937-767-7241 x406 Susan Miller Susan Miller smiller@ysi.com					
Other Financial Opportunities					
Private Foundation Grants and Awards					
http://www.rivernetwork.org Private foundations are potential sources of funding to support watershed management activities. Many private foundations post grant guidelines on websites. Two online resources for researching sources of potential funding are provided in the contact information.					
Congressional Appropriation - Direct Federal Funding					
Congressman Larson, Courtney, DeLauro, Shays, Murphy					
State Appropriations - Direct State Funding					
http://www.cga.ct.gov/					
Membership Drives					
Membership drives can provide a stable source of income to support watershed management programs.					
Donations					
Donations can be a major source of revenue for supporting watershed activities, and can be received in a variety of ways.					
User Fees, Taxes, and Assessments					
Taxes are used to fund activities that do not provide a specific benefit, but provide a more general benefit to the community.					
Rates and Charges					
Alabama law authorizes some public utilities to collect rates and charges for the services they provide.					
Stormwater Utility Districts					
A stormwater utility district is a legal construction that allows municipalities to designated management districts where storm sewers are maintained in order to the quality of local waters. Once the district is established, the municipality may assess a fee to all property owners.					
Impact Fees					
Impact fees are also known as capital contribution, facilities fees, or system development charges, among other names.					

Table 6-14. Potential Funding Sources

Funding Source	Maximum Dollar Amount	Minimum Dollar Amount	Required Match	Applications Open	Deadline
Special Assessments					
Special assessments are created for the specific purpose of financing capital improvements, such as provisions, to serve a specific area.					
Sales Tax/Local Option Sales Tax					
Local governments, both cities and counties, have the authority to add additional taxes. Local governments can use tax revenues to provide funding for a variety of projects and activities.					
Property Tax					
These taxes generally support a significant portion of a county's or municipality's non-public enterprise activities.					
Excise Taxes					
These taxes require special legislation, and the funds generated through the tax are limited to specific uses: lodging, food, etc.					
Bonds and Loans					
Bonds and loans can be used to finance capital improvements. These programs are appropriate for local governments and utilities to support capital projects.					
Investment Income					
Some organizations have elected to establish their own foundations or endowment funds to provide long-term funding stability. Endowment funds can be established and managed by a single organization-specific foundation or an organization may elect to have a community foundation to hold and administer its endowment. With an endowment fund, the principal or actual cash raised is invested. The organization may elect to tap into the principal under certain established circumstances.					
Emerging Opportunities For Program Support Water Quality Trading					
Trading allows regulated entities to purchase credits for pollutant reductions in the watershed or a specified part of the watershed to meet or exceed regulatory or voluntary goals. There are a number of variations for water quality credit trading frameworks. Credits can be traded, or bought and sold, between point sources only, between NPSs only, or between point sources and NPSs.					
Mitigation and Conservation Banking					
Mitigation and Conservation banks are created by property owners who restore and/or preserve their land in its natural condition. Such banks have been developed by public, nonprofit, and private entities. In exchange for preserving the land, the "bankers" get permission from appropriate state and federal agencies to sell mitigation banking credits to developers wanting to mitigate the impacts of proposed development. By purchasing the mitigation bank credits, the developer avoids having to mitigate the impacts of their development on site. Public and nonprofit mitigation banks may use the funds generated from the sale of the credits to fund the purchase of additional land for preservation and/or for the restoration of the lands to a natural state.					

Source: Coginchaug River Watershed Based Plan, NRCS, July 2008.

7 References

Bair, Brian (2000). *Stream Restoration Cost Estimates*. Salmon Habitat Restoration Cost Workshop Proceedings, NOAA National Marine Fisheries Service.

Baystate Environmental Consultants, Inc. (2004). *Watershed Management Plan for Tankerhoosen Lake*.

Bell, M. (1985). *The Face of Connecticut*. Connecticut Geological and Natural History Survey of Connecticut. Bulletin 110. Hartford, Connecticut.

Center for Watershed Protection (2005 rev). *Urban Subwatershed Restoration Manual No. 10: Unified Stream Assessment: A User's Manual (Version 2.0)*

Center for Land Use Education and Research (2007) *The Status of Connecticut's Coast Riparian Corridors: Research Summary*.

Charlotte – Mecklenburg Storm Water Services (2008). *BMP Design Standards Manual*.

Civco, D. (2005). *Hockanum River Watershed Percent Imperviousness by Basin*. Department of Natural Resources Management and Engineering at the University of Connecticut. GIS Map prepared by J. Bolton. March 2005.

Comins, Patrick (1999). *Breeding Landbird Survey Freja Park/Bolton Notch State Park*. Town of Bolton Conservation Commission.

Connecticut Department of Environmental Protection. (2002). *Surface Water Quality Standards (Effective December 17, 2002). Ground Water Quality Standards (Effective April 12, 1996)*.

Connecticut Department of Environmental Protection (2006). *2006 Listing of Connecticut Waterbodies Not Meeting Water Quality Standards*.

Connecticut River Watch Program (My 2004). *Hockanum River Rapid Bioassessment Summary Report*. Middletown, Connecticut.

Connecticut River Watch Program (March 2005). *Hockanum River Rapid Bioassessmet Summary Report*. Middletown, Connecticut.

Connecticut River Watch Program (May 2000). *Hockanum River Stream Walk Summary Report*. Middletown, Connecticut.

Connecticut River Watch Program (September 2001). *Hockanum River Stream Walk Summary Report*. Middletown, Connecticut.

Fuss & O'Neill, Inc. (2005). *The Hockanum River State of the Watershed Report. Prepared for the North Central Conservation District, Inc*. December 2005.

Fuss & O'Neill, Inc. (2007). *Tankerhoosen River Watershed Water Quality Monitoring Study*. Prepared for the Friends of the Hockanum River Linear Park of Vernon, Inc. March 2007.

Fuss & O Neill, Inc. (2008). *Baseline Watershed Assessment, Tankerhoosen River Watershed*. May 28, 2008.

Fuss & O Neill, Inc. (2008). *Watershed Field Inventories and Land Use Regulatory Review, Tankerhoosen River Watershed.* October 2008.

Gibbons, J. and Gibbons, G. (1992). *The Coginchaug River Greenway – Proposed Management Plan*. University of Connecticut Cooperative Extension System. Haddam, Connecticut.

Goetz, S.J., R.K. Wright, A.J. Smith, E. Zineckerb and E. Schaubb. 2003. *IKONOS imagery for resource management: Tree cover, impervious surfaces, and riparian buffer analyses in the mid-Atlantic region*. Remote Sensing of Environment 88 (2003) 195 208.

NEH-654 (2007). *Stream Restoration Design*. Unites States Department of Agriculture Natural Resources Conservation Service National Engineering Handbook, Washington, D.C.

NQQD (2004). *Findings from the National Stormwater Quality Database, Research Progress Report*. Prepared by the Center for Watershed Protection.

NURP (1983). *Results of the Nationwide Urban Runoff Program*. U.S. Environmental Protection Agency Water Planning Division, PB 84-185552, Washington, D.C.

Prisloe, Michael, Emily Hoffhine Wilson, Chester Arnold (2003). *Refinement of Population-Calibrated Land-Cover-Specific Impervious Surface Coefficients for Connecticut*. Final Report, DEP Project 01-08 Task #6. University of Connecticut Middlesex County Extension Center, Haddam, CT. Accessed at http://www.nemo.uconn.edu/tools/impervious_surfaces/ literature.htm on March 12, 2008.

Sexton, Karen (1993). *Vascular Plant Inventory of the Valley Falls/Bolton Notch Watershed*.

Seymour, Jane and Friends of the Hockanum River Linear Park of Vernon, Inc. (2004). *Wildlife Surveys at Selected Locations within the Tankershoosen Watershed*. Vernon, Connecticut.

Sleavin, William J., Daniel L. Civco, Sandy Prisloe, Laurie Giannotti, (2000). *Measuring Impervious Surfaces for Non-Point Source Pollutant Modeling*. Proceedings of the 2000 ASPRS Annual Convention. Accessed at http://www.nemo.uconn.edu/tools/ impervious_surfaces/literature.htm on March 12, 2008.

Tetra Tech., Inc. *Spreadsheet Tool for the Estimation of Pollutant Load (STEPL)*. Version 4.0. Developed for the U.S. EPA

United States Environmental Protection Agency (EPA). 2005. *Waste Cleanup & Reuse in New England: Precision Plating Corp.* URL: www.epa.gov/region1/superfund/sites/precision.

University of Connecticut Center for Land Use Education and Research (CLEAR). *Connecticut's Changing Landscape – Statewide Land Cover*. URL: www.clear.uconn.edu/projects/landscape/statewide_landcover.htm.

WTM (2001). *Watershed Treatment Model User's Guide - Version 3.1.* Prepared by the Center for Watershed Protection.

Appendix A

Baseline Watershed Assessment
Watershed Field Inventories and Land Use Regulatory Review
(CD-ROM)

Baseline Watershed Assessment
Tankerhoosen River Watershed

Friends of the Hockanum River
Linear Park of Vernon, Inc.

In Association With:

Town of Vernon
North Central Conservation District
Rivers Alliance of Connecticut
Hockanum River Watershed Association
Belding Wildlife Trust

Vernon, CT

May 28, 2008

FUSS & O'NEILL
Disciplines to Deliver

Fuss & O'Neill, Inc.
78 Interstate Drive
West Springfield, MA 01089

BASELINE WATERSHED ASSESSMENT
Tankerhoosen River Watershed

TABLE OF CONTENTS

SECTION PAGE

BASELINE WATERSHED ASSESSMENT
Tankerhoosen River Watershed

TABLE OF CONTENTS
(continued)

BASELINE WATERSHED ASSESSMENT
Tankerhoosen River Watershed

TABLE OF CONTENTS
(continued)

1.0 INTRODUCTION

The Friends of the Hockanum River Linear Park of Vernon, Inc. (the "Friends") has retained Fuss & O Neill to prepare a Watershed Management Plan for the Tankerhoosen River watershed. The Watershed Management Plan will be developed through a collaborative effort with a Technical Advisory Committee consisting of the Friends, the Town of Vernon (Planning Department and Conservation Commission), the North Central Conservation District, the Hockanum River Watershed Association, Rivers Alliance of Connecticut, and the Belding Wildlife Trust. The first part of the plan will consist of an assessment of existing conditions in the watershed, an evaluation of pollutant sources in the watershed to prioritize watershed protection and restoration strategies, as well as prioritization of action items that could be adopted by governmental agencies and private groups to protect and improve the health of the Tankerhoosen River watershed. The recommended plan will be developed to address the priorities and issues identified in previous phases of the plan development, with participation by the Technical Advisory Committee.

2.0 BACKGROUND

The Tankerhoosen River watershed is a small but very important 12.85 square-mile sub-regional basin within the Hockanum River watershed (Figure 1-1). Approximately 70% of the watershed is located within the Town of Vernon, with the remaining portions within the Towns of Tolland, Bolton, and Manchester (Table 1-1).

Table 1-1: Distribution of Municipalities in the Tankerhoosen River Watershed

Town Name	Town Acreage	Acreage in Watershed	% of Town in Watershed	% of Watershed
Manchester	17,408	461	2.7	5.6
Vernon	11,904	5,572	46.8	67.9
Tolland	25,856	1,547	5.9	18.6
Bolton	9,920	646	6.5	7.9
Totals	65,088	8,226		100.0

A basic profile of the watershed is provided in Table 1-2. Later sections of this document provide more detailed information on these watershed characteristics.

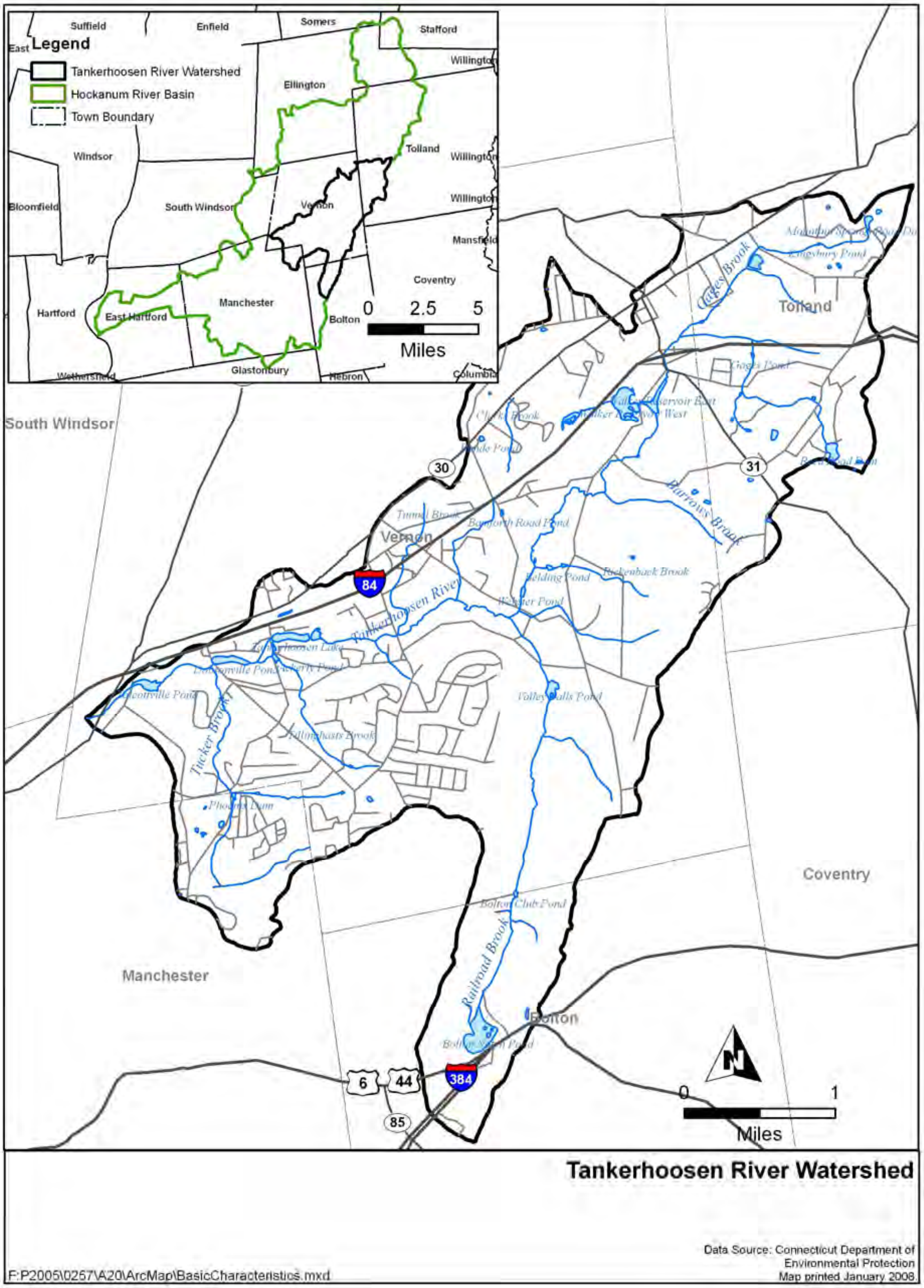


Figure 1-1: Tankerhoosen River Watershed

Table 1-2: Profile of the Tankerhoosen River Watershed

Area	C 12.85 square miles (8,226 acres)
Stream Length	C approximately 17.2 miles
Subwatersheds	C 10 subwatersheds
Jurisdictions	C 4 towns and cities
Water Quality	C 2006 DEP Impaired Waters List for habitat for fish and other aquatic life
Current Impervious Cover	C 9.8%
Subwatersheds Selected for Detailed Assessment based on Vulnerability Assessment	C Clarks Brook C Gages Brook C Gages Brook South Tributary C Lower Tankerhoosen River C Walker Reservoir
Subwatersheds Selected for Detailed Assessment based on Restoration Potential	C Clarks Brook C Gages Brook C Lower Tankerhoosen River C Middle Tankerhoosen River C Tucker Brook
Major Transportation Routes	C Interstates 84 and 384 C U.S. Routes 6 and 44 C State Routes 30 and 31
Significant Natural and Historic Features	C Belding Wildlife Management Area C Valley Falls Park C Northern Connecticut Land Trust C Bolton Notch Pond C Walker Reservoir C Talcottville Historic District

The high water quality (classified as A) in the upper regions of the Tankerhoosen River sustain a significant natural resource of the State of Connecticut – the Belding Wild Trout Management Area, one of only two Class I wild trout areas east of the Connecticut River. The importance of these small, high quality watersheds to the downstream health of the larger river basins, and therefore to Long Island Sound, is well recognized. Of utmost importance to these high quality watersheds is protection of the headwaters regions.

The headwaters region of the Tankerhoosen River is bisected by Interstate 84. Recent development pressure in this headwaters region at the Exit 67 interchange in Vernon poses a major threat to the long-term health of the watershed. Further stresses on the headwaters have been created by development of an industrial park in Tolland through which a key headwater stream flows, as well as the presence of the highway itself, which continues to generate increasing traffic loads from development along the I-84 corridor. There has also been declining water quality in the lower reaches of the Tankerhoosen River in recent years. The lower region of the watershed is classified as "B", and was cited as impaired in the DEP's most recent "List of Connecticut Waterbodies Not Meeting Water Quality Standards".

The importance of protecting the pristine upper region of the Tankerhoosen is recognized by both local and state agencies. The 2000-2004 State Plan of Conservation and Development identifies the riverway as a proposed preservation and conservation area. The Vernon Open Space Plan proposes a greenway plan of 2000 preserved acres along the Tankerhoosen. Most recently, the Nature Conservancy has identified several key watersheds in the state that it considers particularly important to the future protection of Long Island Sound, including the Tankerhoosen River watershed. The need for local decision-makers to give utmost consideration to the environmental consequences of development proposals that would impact the River, has been expressed by The Nature Conservancy (TNC) and by the Connecticut Department of Environmental Protection (DEP).

To address these very real and immediate threats, the Friends began a watershed assessment for the Tankerhoosen River in March 2007. The objective of this initial assessment was to describe and understand the overall health, quality and flow of waters within the watershed and to identify potential threats to water quality in the watershed. The assessment included water quality monitoring and natural resource inventories to begin establishing baseline conditions against which future monitoring can be measured. The next step in the watershed planning process is to develop a comprehensive management plan that will provide guidance to local decision-makers and to serve as an educational tool and reference document for those interested in protection of the Tankerhoosen River.

3.0 DEVELOPMENT OF THE BASELINE ASSESSMENT

The initial task in developing a Watershed Management Plan for the Tankerhoosen River is to develop an understanding of baseline, or existing conditions in the watershed. To accomplish this, the following tasks were completed:

- Reviewed existing watershed data, studies, and reports;
- Compiled and analyzed available Geographic Information System (GIS) data for the watershed;
- Consulted with the Technical Advisory Committee, the watershed municipalities, and the regional planning agency regarding available land use information, mapping, and land use planning regulations;
- Identified and delineated subwatersheds within the over Tankerhoosen River watershed; and
- Conducted a comparative subwatershed analysis to prioritize watershed field inventories and management plan recommendations.

The results of this watershed inventory are presented in this document, including a description of current watershed conditions for the following categories:

- Geological and historical perspective;
- Natural resources including hydrology, water quality, wetlands and watercourses, fish and wildlife resources and habitat;
- Watershed modifications including dams, water supply, wastewater discharges, and regulated sites; and
- Land use and land cover.

In addition, the results of a comparative subwatershed analysis are also presented.

4.0 GEOLOGIC AND HISTORICAL PERSPECTIVE

4.1 Geology

The State of Connecticut is comprised of three distinct geologic units divided longitudinally across the state. These three units are known as the Western Uplands, the Central Valley, and the Eastern Uplands. The Western and Eastern Uplands are comprised of metamorphic rocks – rocks subjected to intense heat and pressure of the Earth's interior – while the Central Valley is a younger unit comprised of sedimentary rocks. The Central Valley began forming about 225 million years ago when the super-continent Pangaea began to break apart. A large rift formed a long, narrow valley through the middle of the state, eventually filling with sediments from the eroding hills to the east and west (presently known as the Eastern and Western Uplands). The sediments were compacted into soft, easily eroded, red and brown sandstones through which the Connecticut Rivers flows.

The Tankerhoosen River watershed is almost entirely within the Eastern Uplands. The westernmost portion of the watershed is located within the Central Valley. The boundary between the Central Valley and the Eastern Uplands is located near the Vernon-Manchester town line and known as the Bolton Range. The Bolton Range was formed as a result of the different rates of erosion of the less resistant sediments of the Central Valley creating an abrupt rise into the resistant rocks of the Eastern Uplands.

Drastic changes in the surficial geology have occurred within Connecticut since the formation of these geologic regions. Above the sandstone of the Central Valley and the metamorphic bedrock of the Eastern Uplands lie extensive glacial deposits, or "glacial till," left as the large glaciers receded. Melting glacier ice formed rivers which sorted glacial till into layers of sand and gravel, or "stratified drift." The Tankerhoosen River flows through hills of glacial till in the steep Eastern Uplands and then drops into the stratified drift of the Central Valley (Bell, 1985).

4.2 Population and Industry

Beginning about 10,000 years ago, as the last glacial ice retreated from New England, Native American populations settled Connecticut and the areas along the Tankerhoosen River. The river was used by Native Americans as a source of fish and a travel route to the Connecticut River (Hockanum River Watershed Association, 1998). The Podunks of East Hartford and Manchester, the Nipmucks of Ellington and Tolland were among the tribes that farmed corn in the fertile river floodplains of the Tankerhoosen River. In addition to agriculture, the tribes used the land within the watershed for hunting, gathering, and fishing.

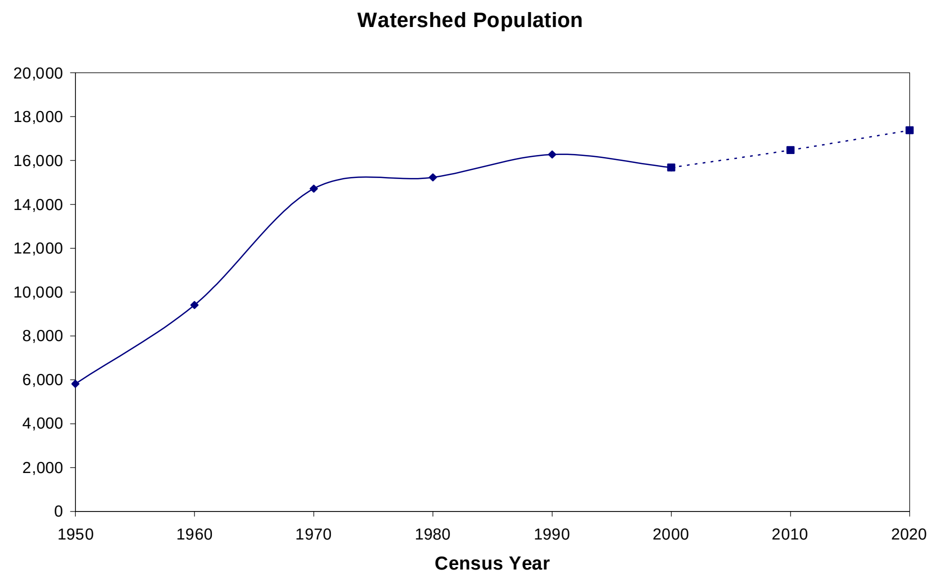
European settlers brought a marked change in land use to Connecticut. Land was cleared and agriculture was the primary use through the Revolutionary War era. However, the availability of more fertile lands in western New York, northern Ohio, and Pennsylvania led to the great migration of Connecticut farmers during the 1800s. Those who stayed worked in the many factories that arose along the rivers and streams, and manufacturing became a major economic force (Gibbons et al., 1992).

The Tankerhoosen River was no exception to the development patterns across Connecticut. From the headwaters at Gages Brook, the elevation drop of the Tankerhoosen River was ideally suited to power a wide variety of mills. During the eighteenth and nineteenth centuries, several mills associated with the textile, cotton-wool, energy, and paper industries were built near these waterfalls and in other areas in the watershed. The Talcottville Historical District is located in southwestern portion of the Tankerhoosen River watershed near the confluence with the Hockanum River. One of the first cotton mills in America was built by Peter Dobson in the early 1800's in Talcottville. The mill burned down in 1909, not to be rebuilt. Peter Dobson is also famous for early observations that ice may have played a role in the erosion and transport of rock in the region.

The Vernon Depot, located within the watershed on Church Street, was an active transportation center during the early part of the twentieth century. The Hartford, Providence and Fishkill Railroad ran seven times a day at the Depot, with connections to Rockville. The Keystone Arch on Tunnel Road (also known as the Keystone Tunnel) was constructed circa 1850 to allow trains to traverse Tunnel Road without disrupting street traffic toward Vernon Center. The 108-foot long tunnel is constructed of 30 arches, each of which consists of a center keystone with nine stones forming the curves on either side. The tunnel is considered by historians to be a fine piece of historic architecture and as a monument to the integrity and skilled workmanship of its builders.

Valley Falls was the site of the first industry in Vernon, a saw mill, in 1740. Valley Falls Park hosted a small mill complex for flaxseed oil and cotton between 1850 and 1877. Beginning in the mid-1800s until the mid-1900s the property was converted into farmland for producing corn, hay, oats, butter, and cheese. In 2001, the historic farmhouse and six outbuildings were purchased by the Friends of Valley Falls, Inc. to ensure preservation of the historical complex. Alternate forms of manufacturing power put most of the mills out of business by the late 1950s. Dozens of the mill buildings and their associated dams remain an integral component of the river.

Rapid population growth in the post-war era of the 1950s and 1960s slowed significantly as developable land became scare (see Figure 4-1). Today, the population of the Tankerhoosen River watershed is approximately 16,000, which is more than double the population of the watershed in the 1950s. Commercial and residential development has occurred in the watershed since the 1970s, with a continued decline in industrial uses. Significant commercial development along the major transportation corridors and residential development in the watershed has increased watershed impervious coverage and contributed to degraded water quality in portions of the Tankerhoosen River and its tributaries. Numerous historical impoundments within the watershed also continue to serve as barriers to fish passage along the Tankerhoosen River and its tributaries.



Source: Connecticut Population Projections, Series 95.1, Office of Policy and Management, September 1995

Figure 4-1: Population Trends in the Tankerhoosen River Watershed

4.3 Recreation Resources

The Tankerhoosen River provides many opportunities for recreational activities, such as fishing, swimming, and limited boating. Along the river, there are both town and state lands that are preserved for parks, wildlife sanctuaries and rail-trails. Recreational activities in these areas include hiking, biking, cross-country skiing, ice skating, nature observation, and aesthetic enjoyment.

Some of the prominent recreational centers in the watershed include the Walker Reservoir East, the Belding Wildlife Management Area, Valley Falls Park, Bolton Notch Pond, Freja Park, the Rails-to-Trails, and Phoenix Mill Park. Each of these areas provides parking, picnicking, and trails for walking and cross-country skiing. The Belding Wildlife Management Area was the location of the first Class I Trout Management Area in Connecticut. Recreational areas that also have historical significance include the Dobsonville Pond and Talcottville Pond. Additionally, the area associated with the confluence of the Tankerhoosen and Hockanum Rivers includes a privately owned recreational facility and is the starting point for the annual Manchester Canoe and Kayak Race.

4.4 Watershed Restoration Efforts

The Connecticut River Watch Program (CRWP), a volunteer water quality monitoring, protection, and improvement program for the Connecticut River and its tributaries, is working closely with the Hockanum River Watch Program (HRWA) and North Central Conservation District to develop and support a community-based river monitoring and assessment program in the Tankerhoosen River watershed. The CRWP monitoring program has included stream

walk surveys and rapid bioassessments (cost-effective biological survey techniques) along the Tankerhoosen River, as well as other areas of the larger Hockanum River watershed.
The Connecticut DEP also conducts routine ambient water quality and benthic monitoring at approximately twelve locations along the Hockanum and Tankerhoosen Rivers. The data assist in documenting the chemical and biological quality of surface waters within the watershed and will be used to support the development of a Total Maximum Daily Load (TMDL), which will address sources of water quality impairment in the Hockanum and Tankerhoosen Rivers.

Baystate Environmental Consultants, Inc. (BEC) conducted a feasibility study in 2002 for the dredging of Tankerhoosen Lake and subsequently prepared a Watershed Management Plan for Tankerhoosen Lake in 2004. The plan identified watershed factors that have directly affected or have the potential to affect the water quality and overall health of Tankerhoosen Lake. The project recommended a Town-wide approach for reducing the quantity of pollutants, specifically sediment and nutrients, reaching Tankerhoosen Lake. BEC personnel conducted field observations of the major contributing watercourses and impoundments in the Tankerhoosen Lake watershed to identify point sources of sediment and nutrients as well as nonpoint source pollutants. BEC recommended that the Town of Vernon require the implementation of stormwater best management practices (BMPs) that maximize to the extent practicable, the removal of total suspended solids and nutrients. In addition to the lake dredging project recommended in the feasibility study, BEC also recommended several structural and nonstructural elements, including a sediment trap at the inlet of Tankerhoosen Lake, installation of deep sump catch basins at key locations, maintenance of cross-culverts and drainage structures, and grass swales and vegetated filter strips. None of the BEC recommendations has been implemented to date.

5.0 NATURAL RESOURCES

5.1 Hydrology

The Tankerhoosen River watershed is 12.85 square-miles, with the majority of the watershed (approximately 70 percent) located within the Town of Vernon (Figure 1-1). Gages Brook and its associated southern tributary comprise the headwaters region of the watershed, eventually flowing into Walker Reservoir East. Gages Brook is located in the northwest portion of the Town of Vernon and within the western portion of neighboring Tolland. A few small impoundments are located within the Gages Brook watershed. The brook receives drainage from the I-84 corridor near the Vernon-Tolland town boundary. In Tolland, Gages Brook flows through an industrial park and residential areas.

Walker Reservoir is no longer an active public water supply but rather a recreational resource that attracts hikers, fisherman, and ice skaters. The Tankerhoosen River, which is a moderately sized (16 feet wide) upland stream, originates at the outlet of Walker Reservoir East and bisects the Town of Vernon on the south side of Interstate 84. The river flows southwest for approximately five miles to the Hockanum River in the Talcottville section of Vernon.

Barrows Brook, Rickenback Brook, and several other small tributaries drain the eastern portion of the upper Tankerhoosen River watershed between Walker Reservoir and the confluence with Railroad Brook near Webster Pond. Barrows Brook is the furthest upstream tributary to the Tankerhoosen River and flows through undeveloped, privately owned land. Rickenback Brook flows east to west through a relatively undeveloped portion of Vernon and discharges to the Tankerhoosen River approximately 0.4 miles upstream of the river's confluence with Railroad Brook. Portions of this brook are within the Belding Wildlife Management Area and have been established for catch and release trout fishing (BEC, 2004).

Railroad Brook drains the southern portions of the watershed, beginning at Bolton Notch Pond in Bolton, and flows north through Valley Falls Park and the Belding Wildlife Management Area before joining the Tankerhoosen River. Valley Falls Pond is located along Railroad Brook within the confines of the Valley Falls Park property. Railroad Brook flows through primarily undeveloped land and discharges to the Tankerhoosen River approximately 1.6 miles upstream of Tankerhoosen Lake (BEC, 2004).

Clarks Brook and Tunnel Brook join the Tankerhoosen River in the middle portion of the watershed prior to the river's confluence with the DEP-owned Tankerhoosen Lake, the first of three DEP-owned run-of-river ponds. Clarks Brook originates north of I-84 and drains primarily industrial/commercial and undeveloped land within the Town of Vernon. Clarks Brook discharges to the Tankerhoosen River approximately 0.5 miles upstream of the river's confluence with Tunnel Brook. Tunnel Brook is located in the central portion of Vernon, flowing north to south and crossing the I-84 corridor. The brook empties into the Tankerhoosen River approximately 0.65 miles upstream of the inlet to Tankerhoosen Lake (BEC, 2004).

Dobsonville Pond is located just downstream of Tankerhoosen Lake. Tucker Brook, which drains the southeastern portion of the watershed and a residential section of the Town of Manchester, joins the Tankerhoosen River immediately upstream of Dobsonville Reservoir dam. Further downstream is Talcottville Pond and the confluence with the Hockanum River near the Vernon/Manchester town line.

Overall the Tankerhoosen River is comprised of a large percentage of first and second order (i.e., headwater) streams according to the Strahler Stream Order classification system. Stream hydrology and water quality in headwater streams are important components of ecosystem health because they are a critical food source for the entire river, influence downstream conditions, and support biodiversity.

Ten subwatersheds within the Tankerhoosen River watershed have been delineated for the purposes of this assessment. The subwatershed delineations are based on the CTDEP local basin delineations, modified slightly based on surface water hydrology and grouped accordingly to facilitate assessment and development of watershed management plan recommendations. Figure 5-1 depicts the subwatersheds identified in this assessment, and Table 5-1 summarizes the basic characteristics of the identified subwatersheds.

Table 5-1: Tankerhoosen River Subwatersheds

Subwatershed	Acronym	Area (acres)	Area (square miles)
Bolton Notch Pond	BNP	344	0.54
Clarks Brook	CB	647	1.01
Gages Brook	GB	695	1.09
Gages Brook South Tributary	GBST	680	1.06
Lower Tankerhoosen River	LTR	321	0.50
Middle Tankerhoosen River	MTR	1,578	2.46
Railroad Brook	RB	1,208	1.89
Tucker Brook	TB	934	1.46
Upper Tankerhoosen River	UTR	1472	2.30
Walker Reservoir	WR	347	0.54
Tankerhoosen River Watershed		8,226	12.85

The Tankerhoosen River Watershed is located in an area with a temperate and humid climate. Based on historical climate information available from the NOAA National Weather Service weather station in Harford/Bradley International Airport in Windsor Locks, Connecticut, precipitation is generally well-distributed throughout the year with the wettest conditions in August and November and driest in February (worldclimate.com for Hartford/Bradley International Airport, Hartford County). In Windsor Locks, the mean annual precipitation over a 41-year period of record is 44.4 inches, and the 24-hour average temperature ranges from a high of 73.6°F in July to a low of 24.6°F in January.

Generally, the designated 100-year floodplain of the Tankerhoosen River is confined along a narrow corridor (<500 feet wide) surrounding the river. The entire length of the Tankerhoosen River is within the Federal Emergency Management Agency (FEMA) designated 100-year floodplain, with the exception of a small reach near the river's headwaters, between Reservoir Road and Fish and Game Road. The lower reach of Railroad Brook (below Valley Falls Pond including the pond) is also within the 100-year floodplain. Walker Reservoir West and East and portions of Gages Brook also lie within the designated 100-year floodplain (BEC, 2004).

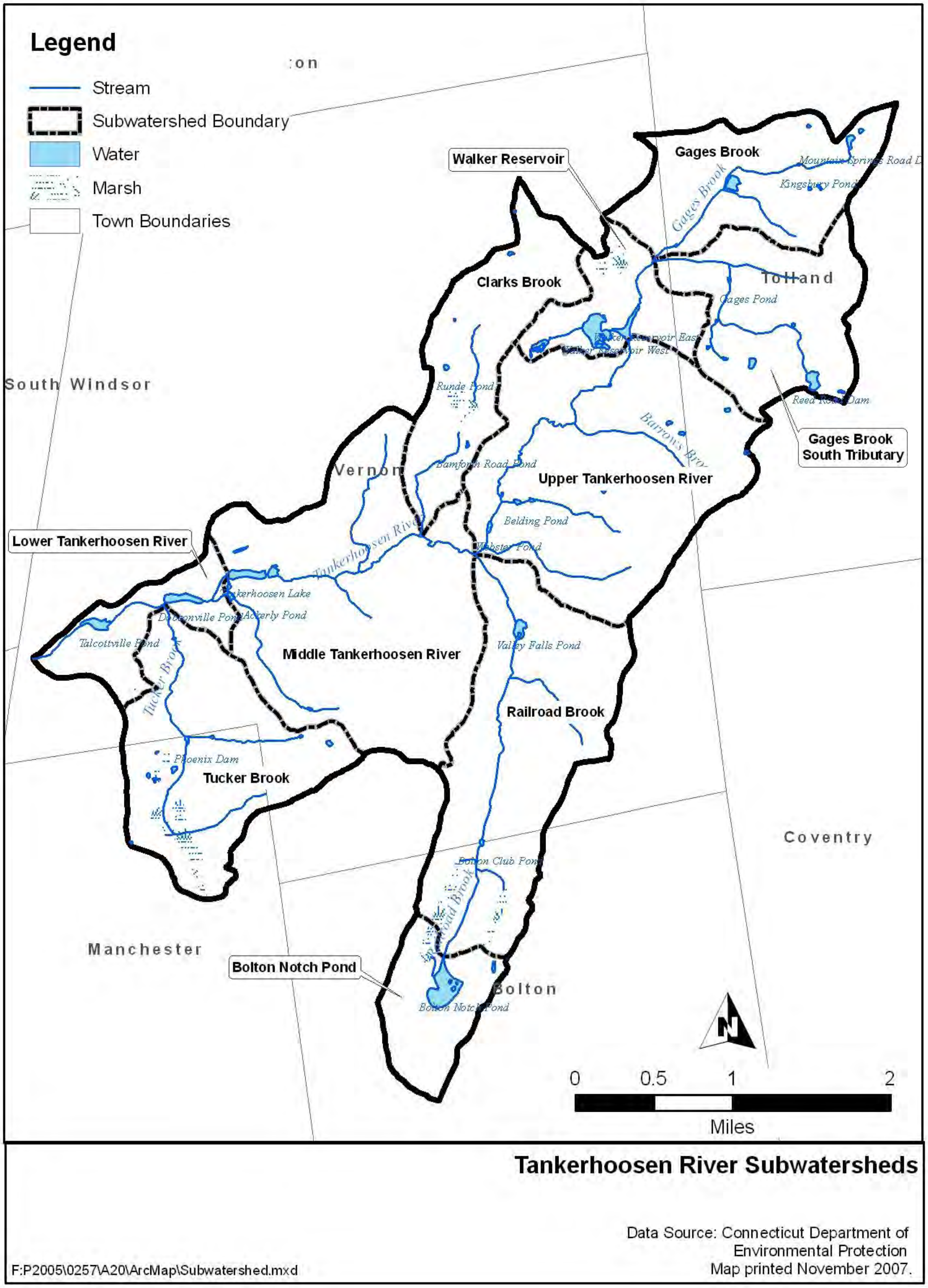


Figure 5-1: Tankerhoosen River Subwatersheds

5.2 Water Quality

5.2.1 Classifications and Impairments

The Federal Clean Water Act (CWA) was developed to protect the nation's surface waters. Through authorization of the CWA, the United States Congress declared as a national goal "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water wherever attainable". Connecticut Water Quality Standards are established in accordance with Section 22a-426 of the Connecticut General Statutes and Section 303 of the CWA. The Water Quality Standards are used to establish priorities for pollution abatement efforts. Based on the Water Quality Standards, Water Quality Classifications establish designated uses for surface and ground waters and identify the criteria necessary to support these uses. The Water Quality Classification system classifies inland surface waters into four different categories ranging from Class AA to D. Table 5-2 summarizes the Connecticut Surface Water Quality Classifications.

Table 5-2: Connecticut Inland Surface Water Quality Classifications

Designated Use	Class AA	Class A	Class B	Class C	Class D
Existing/proposed drinking water supply	●				
Potential drinking water supply	●	●			
Fish and wildlife habitat	●	●	●	Class C and D waters may be suitable for certain fish and wildlife habitat, certain recreational activities, industrial use, and navigation	
Recreational use	●	●	●		
Agricultural and industrial use	●	●	●		

Source: DEP Surface Water Quality Standards, December 17, 2002

Figure 5-2 depicts the Water Quality Classifications of surface waters in the Tankerhoosen River watershed. Surface waters throughout the Tankerhoosen River watershed are classified as Class A with the exception of the Tankerhoosen Lake, Dobsonville Pond, and Talcottville Pond which are classified as Class B/A.

The CWA (Federal Clean Water Act) requires states to:

1. Adopt Water Quality Standards,
2. Assess surface waters to evaluate compliance with Water Quality Standards,
3. Identify those waters not currently meeting Water Quality Standards, and
4. Develop Total Maximum Daily Load (TMDL) analysis and other management plans to bring water bodies into compliance with Water Quality Standards.

A portion of the Tankerhoosen River does not meet Water Quality Standards for at least one of the designated uses. The impaired segment consists of the lower 1.51 miles of the Tankerhoosen River from Tankerhoosen Lakes to its confluence with the Hockanum River. The impaired uses include habitat for fish, other aquatic life, and wildlife. The causes and sources of impairment in the lower reaches of the Tankerhoosen River have not been identified and are currently listed as "unknown." TMDLs provide the framework to restore impaired waters by establishing the maximum amount of a pollutant that a water body can assimilate without adverse impact to aquatic life, recreation, or other public uses. The *2006 List of Connecticut Waterbodies Not Meeting Water Quality Standards* includes a priority ranking system for development of a TMDL specific to the contaminants in each impaired segment: high (H), medium (M), low (L), or under study (T). DEP has identified the impaired segment of the Tankerhoosen River as a high priority for development of a TMDL to restore the impairment. Table 5-3 summarizes the location and nature of the impairment.

Table 5-3: Tankerhoosen River Watershed Impaired Waters

Location Description	Waterbody Segment Length	Impaired Designated Use	Use Support	Cause	TMDL Priority	Potential Source
From mouth at Hockanum River , upstream to Tankerhoosen Lake	1.51 miles	Habitat for Fish, Other Aquatic Life and Wildlife	P	Impairment Unknown	H	Source Unknown

Source: DEP, 2006
H – high priority for which there is assessment information that suggests that a TMDL may be needed to restore the water quality impairment.
P – partially supporting

5.2.2 Tankerhoosen River Watershed Water Quality Monitoring Study

A water quality monitoring study was conducted in October and November 2006 to establish current baseline water quality conditions in the watershed, identify water quality impacts, and begin to develop a water quality database for the watershed (Fuss & O'Neill, 2007). Chemical water quality monitoring and biological assessments were conducted during dry and wet weather conditions. Samples were collected from fourteen locations throughout the watershed on four occasions (Figure 5-2). A variety of parameters were measured including pH, temperature, dissolved oxygen, and conductivity, which all reported values within normal ranges. These results indicate that the water quality of the watershed is generally good. However, some of the measured parameters including turbidity, metals, nitrogen, phosphorus, and bacteria highlighted some of water quality issues in the watershed. A brief discussion of the water quality parameters and identified issues is provided below:

Turbidity

Based on the wet weather monitoring results, excessive turbidity is a water quality issue in the Tankerhoosen River and its tributaries, particularly Gages Brook (Figure 5-3). Stream channel erosion and stormwater runoff from impervious surfaces and construction sites are potential sources of the observed turbidity during large precipitation events such as the August 2006 wet weather monitoring event, although it is difficult to attribute the turbidity excursions to a particular source. During the August 2006 wet weather monitoring event, turbidity measurements generally exhibited a declining trend from upstream to downstream within the watershed. Elevated levels of indicator bacteria (total coliform and *E. coli*) were measured at all monitoring locations during the October 2006 wet weather monitoring event, suggesting stormwater runoff and other non-point sources (pet waste, waterfowl, septic systems, etc.) as likely contributors of elevated pathogen levels in the Tankerhoosen River and its tributaries.

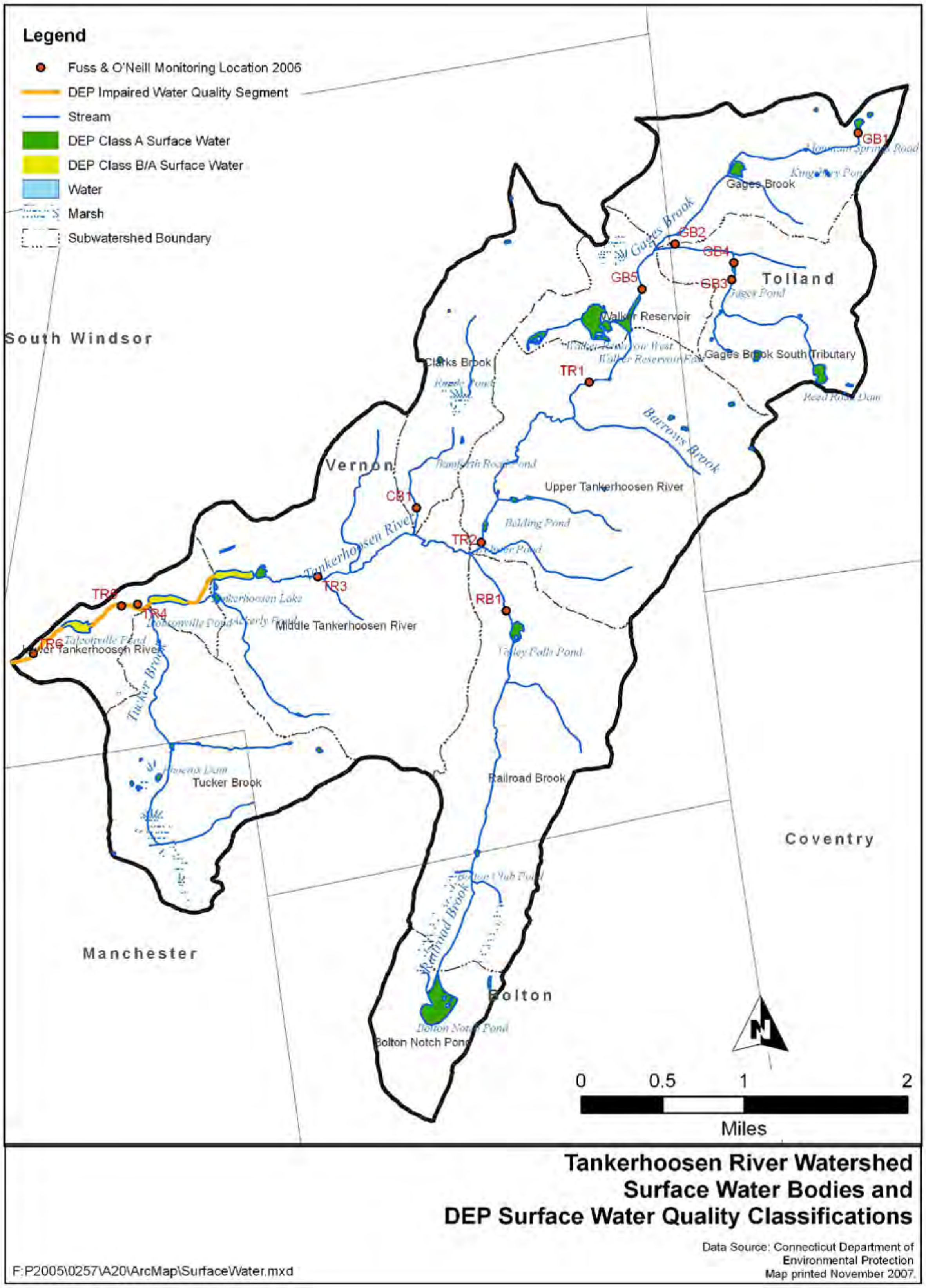


Figure 5-2: DEP Water Quality Classifications

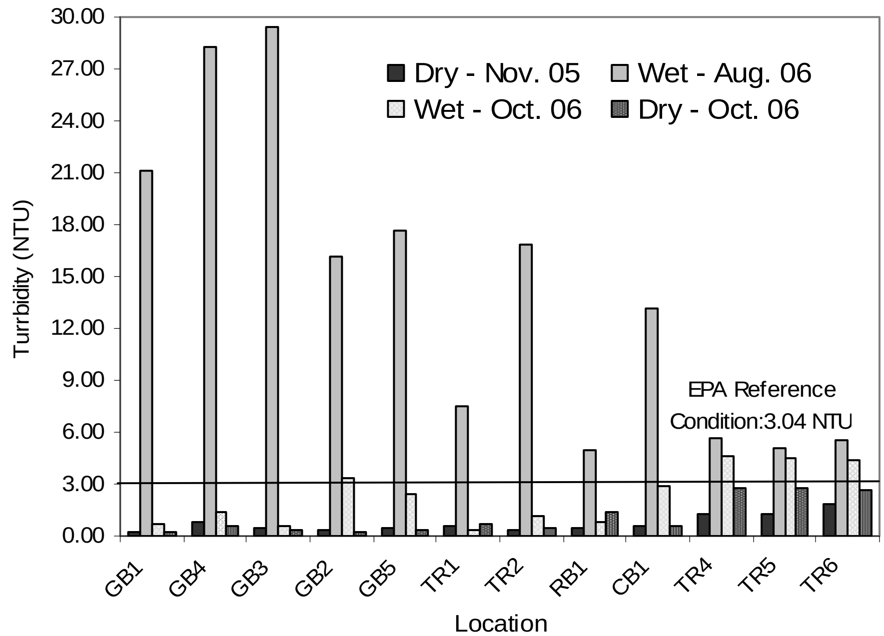


Figure 5-3: Turbidity – Tankerhoosen River Watershed

Metals

The monitoring data suggest a wet weather source of metals to Gages Brook (Figure 5-4 and Figure 5-5). Results from the August 2006 monitoring event indicate a wet weather source of metals close to the I-84 crossing of Gages Brook, as the dissolved copper concentration was consistently below detection limits at the Gages Brook headwaters monitoring location (GB1) and in excess of the chronic aquatic life criterion at several of the downstream Gages Brook locations. The highest wet weather lead concentration was measured in the Gages Brook monitoring location immediately downstream of I-84, which further suggests that highway runoff is a likely source of metals to Gages Brook. Exceedances of the CT WQS for lead were also measured along the Tankerhoosen River at the Fish and Game Road. (TR1) and Bolton Road (TR2) monitoring locations. Elevated dissolved copper and lead concentrations were also measured at the Clarks Brook monitoring location. The data suggest that metals are a potential source of impairment in Gages Brook, Clarks Brook, and the Tankerhoosen River during wet weather. The November 2005 results also indicate dry weather sources of dissolved copper to Gages Brook between the headwaters monitoring location (GB1) and the monitoring location behind the Tolland Agricultural Center (GB2).

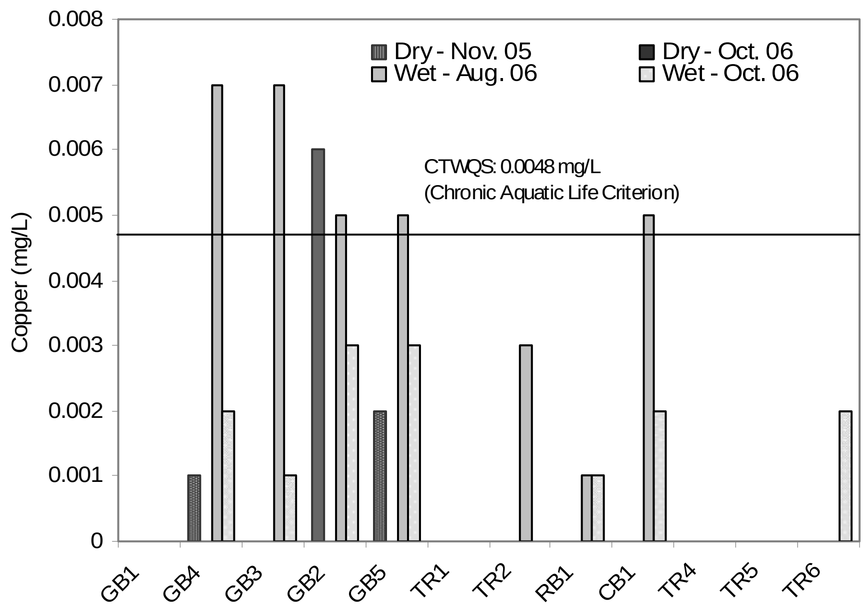


Figure 5-4: Dissolved Copper – Tankerhoosen River Watershed

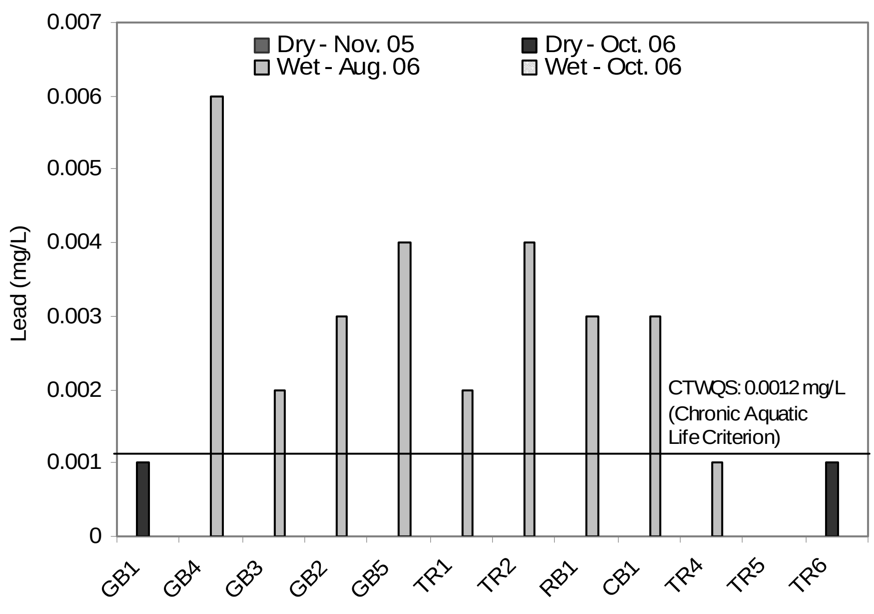


Figure 5-5: Lead – Tankerhoosen River Watershed

Nitrogen & Phosphorus

Many of the monitoring locations exceeded the EPA recommended Total Nitrogen criterion for rivers in Ecoregion XIV of 0.71 mg/L (Figure 5-6). Nitrogen concentrations were consistently higher at the Gages Brook monitoring locations than the other monitoring locations in both wet and dry weather.

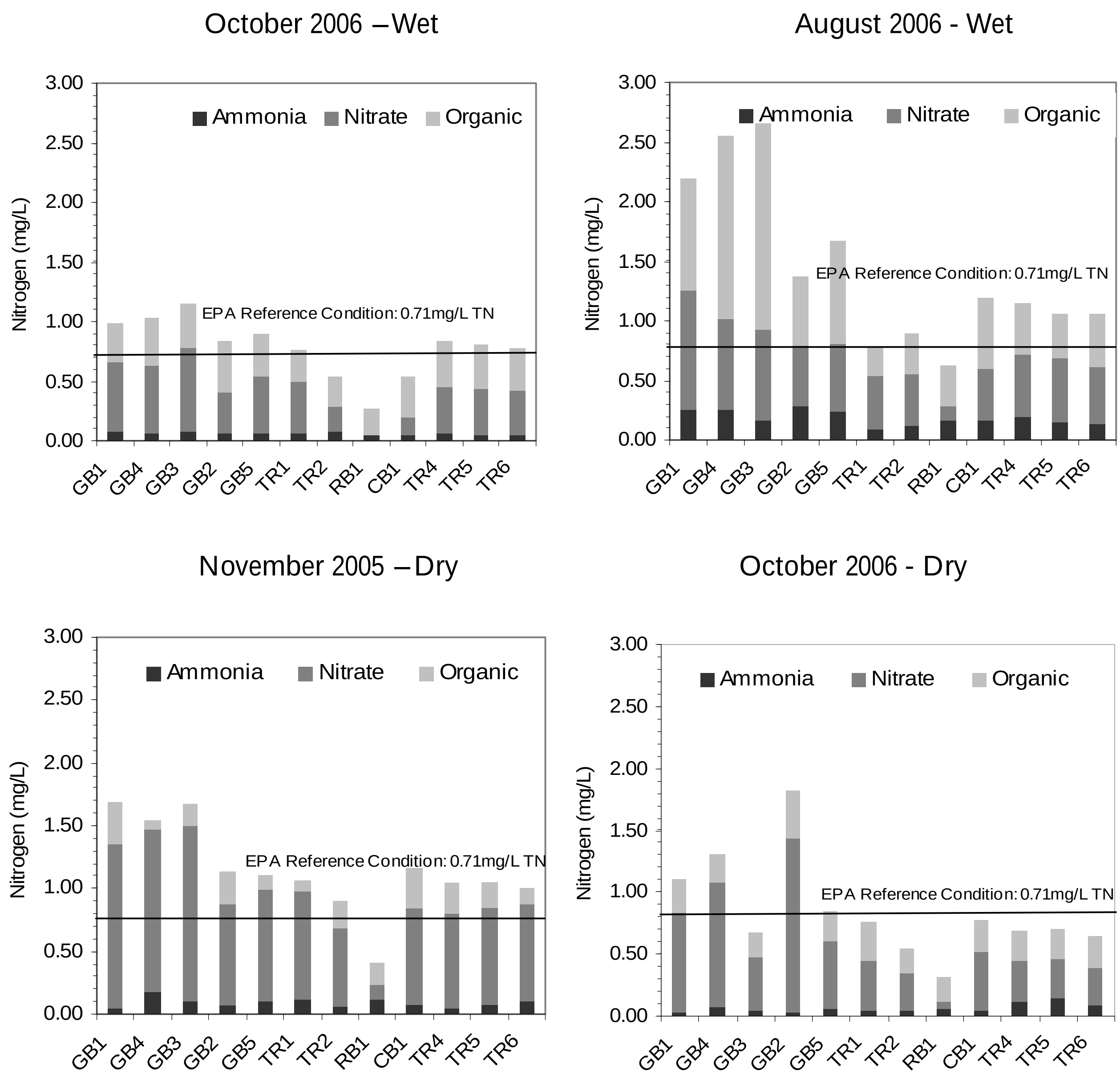


Figure 5-6: Nitrogen Species – Tankerhoosen River Watershed

Phosphorus concentrations measured during the wet and dry weather events significantly exceeded the CT WQS and EPA criterion at most locations (Figure 5-7). The elevated phosphorus levels are an indicator of potential organic enrichment and algal growth in water bodies along the Tankerhoosen River and its tributaries, which could impair aquatic life support and contact recreation under certain conditions.

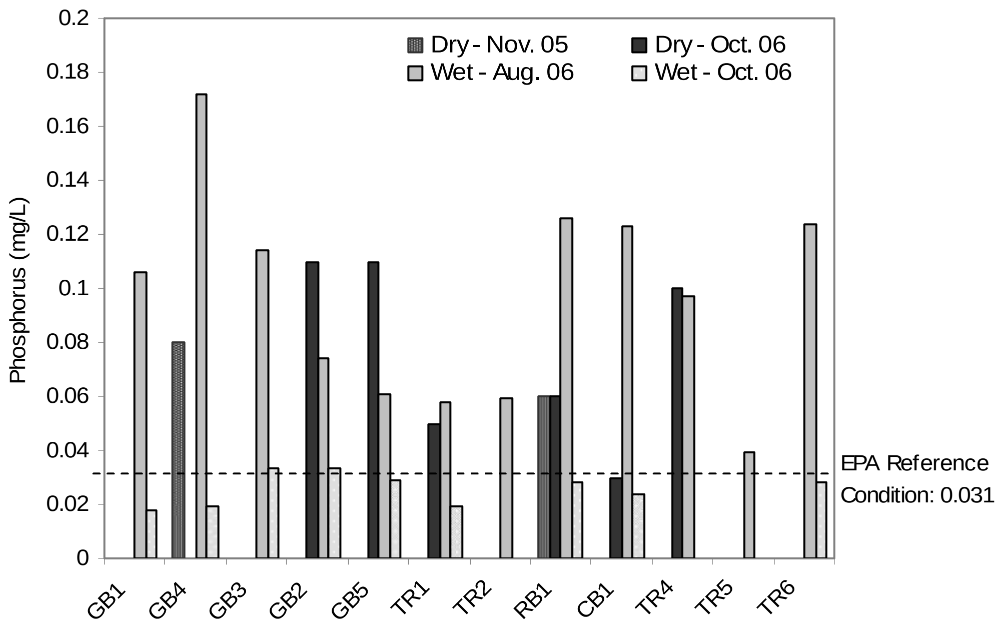


Figure 5-7: Phosphorus – Tankerhoosen River Watershed

Indicator Bacteria

Elevated levels of indicator bacteria (total coliform and *E. coli*) were measured at all monitoring locations during the October 2006 wet weather monitoring event, suggesting stormwater runoff and other non-point sources (pet waste, waterfowl, septic systems, etc.) as likely contributors of elevated pathogen levels in the Tankerhoosen River and its tributaries. Dry weather indicator bacteria concentrations were much lower than wet weather. Natural sources of indicator bacteria such as waterfowl or wildlife may have contributed to several dry weather exceedances of the CT WQS for total coliform at the Gages Brook monitoring location behind the Tolland Agricultural Center and at the Tankerhoosen River monitoring location just upstream of Fish and Game Road.

Bioassessment Results

The 2006 bioassessment data (RBV and Fuss & O Neill data collectively) vary considerably by site, but generally indicate very good water quality at most of the monitoring locations, with the exception of the lower Tankerhoosen River near the confluence with the Hockanum River and downstream of Dobsonville Pond. This finding is consistent with previous impairments identified in the lower reaches of the Tankerhoosen River by the CTDEP. Despite the water quality issues identified in Gages Brook, Clarks Brook, and in certain reaches of the

Tankerhoosen River (i.e., heavy metals, turbidity and suspended solids, and potential nutrient enrichment), the 2006 bioassessment data indicate little or no impairment to the benthic communities at the monitored locations.

5.3 Wetlands

Generally, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Wetlands and buffer zones between watercourses and developed areas help to preserve stream water quality by filtering pollutants, encouraging infiltration of stormwater runoff, and protecting against stream bank erosion.

Wetlands in Connecticut are designated by soil classification. Figure 5-8 depicts the extent and distribution of wetland soils in the Tankerhoosen River watershed based on Natural Resources Conservation Service soil classifications. Figure 5-8 also depicts wetland mapping available from the U.S. Fish & Wildlife Service National Wetlands Inventory. Wetlands soils comprise 11.3% of the overall watershed (approximately 926 acres), while 4% of the watershed area (approximately 320 acres) is mapped as freshwater emergent wetlands or freshwater forested/shrub wetlands. The concentration of wetland soils is generally higher in the undeveloped portions of the watershed. Mapped wetland soils are generally located in riparian and floodplain areas along the Tankerhoosen River and its major tributaries. Table 5-4 summarizes wetland soils coverage by subwatershed.

Table 5-4: Wetland Soils Coverage in the Tankerhoosen River Subwatersheds

Subwatershed Name	Wetland Soils Area (ac)	% of Subwatershed
Bolton Notch Pond	20	5.8 %
Clarks Brook	101	15.5 %
Gages Brook	111	15.9 %
Gages Brook South Tributary	34	5.1 %
Lower Tankerhoosen River	7	2.3 %
Middle Tankerhoosen River	188	11.9 %
Railroad Brook	136	11.3 %
Tucker Brook	109	11.7 %
Upper Tankerhoosen River	193	13.1 %
Walker Reservoir	27	7.6 %
Tankerhoosen River Watershed	926	11.3%

At least twenty vernal pools have been identified within the Tankerhoosen watershed by certified scientists (see Figure 5-8). The majority of these were cited by Mr. Ed Pawluk of Connecticut Ecosystems, LLC in a study conducted for the Vernon Conservation Commission. Several of these pools are considered exemplary vernal pools, and as such merit the highest possible level of protection and conservation (Connecticut Ecosystems, LLC, 2005).

In 1993, a comprehensive survey of plant life was conducted in the 1,400-acre watershed from Valley Falls Park in Vernon to Bolton Notch State Park in Bolton (Sexton, 1993). The study was sponsored by the Town of Bolton Conservation Commission and the Town of Vernon Conservation Commission. A total of 345 species representing 82 families were identified. A small band of marble exists a short distance north and south of the cut at Bolton Notch. A plant species unique to this area includes the Yellow Lady's Slipper. Marble is rare east of the Connecticut River and supports additional plants preferring more basic soil including the purple cliff-brake and maidenhair fern (Sexton, 1993).

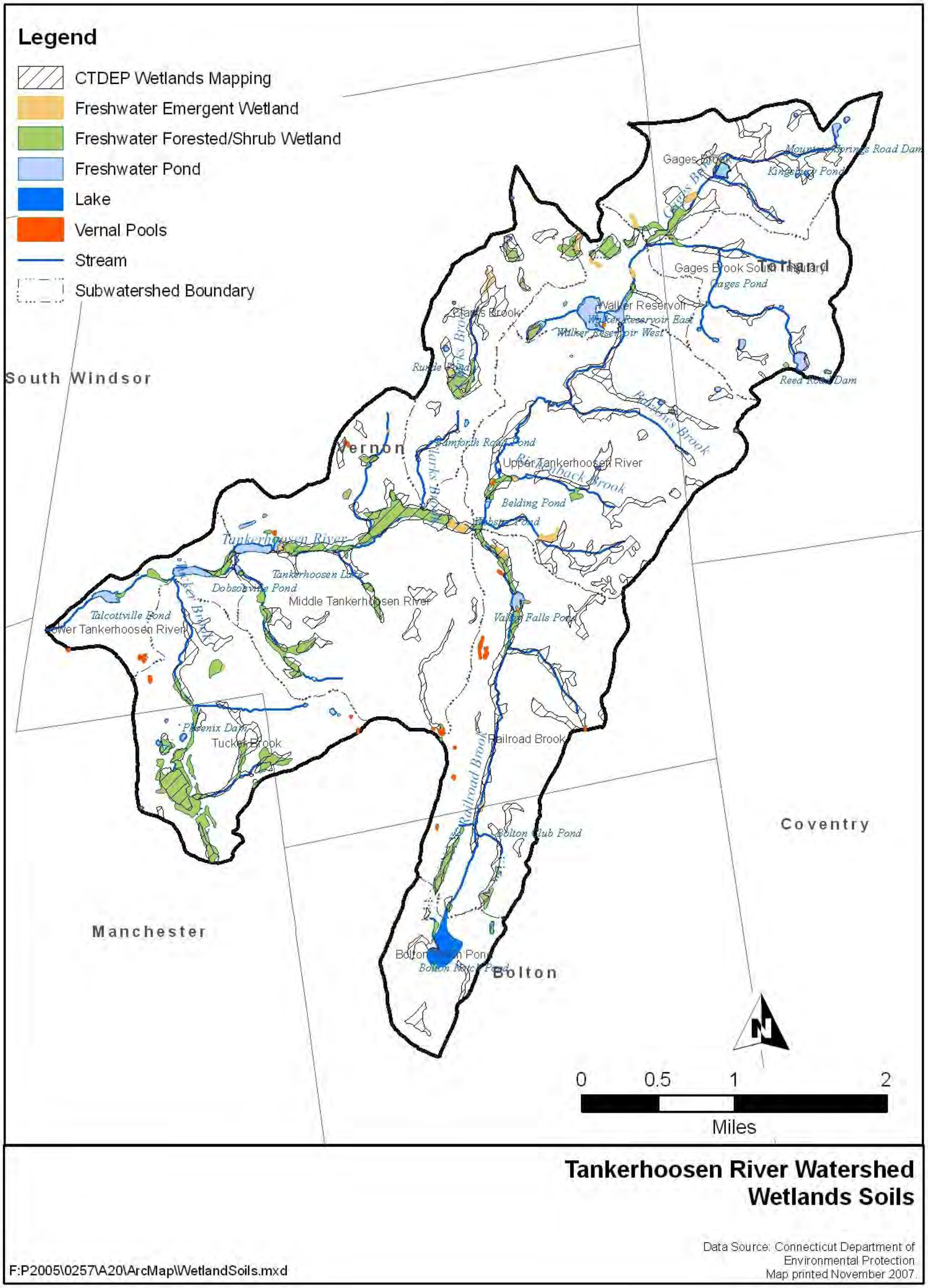


Figure 5-8: Wetland Soils – Tankerhoosen River Watershed

5.4 Fish and Wildlife Resources

Portions of the Tankerhoosen River have abundant habitats supportive of a variety of fish and wildlife. Various waterbodies, wetlands, and upland areas provide habitat to fish, mammals, amphibians, and birds.

Particularly notable is the 282-acre Belding Wildlife Management Area located in the central portion of the Tankerhoosen River watershed. The Belding Wildlife Management Area is a significant natural resource of undeveloped land owned by the State of Connecticut and managed by the DEP. A 1.4-mile section of the Tankerhoosen River within the Belding Wildlife Management Area is managed as a Class 1 Wild Trout Management Area and is one of only two such areas in eastern Connecticut. This section of stream is characterized by natural reproduction sufficient to produce robust populations of native brook trout (up to 8-10 inches) and wild brown trout (up to 10-11 inches) exhibiting above average growth rates (DEP correspondence, 2003).

Areas in the Tankerhoosen River watershed that provide significant habitat are summarized in Table 5-5. These areas provide habitat for some of the most valuable or unique natural resources or ecosystems in their respective communities. Other open space areas are described in the Land Use and Land Cover section of this report.

Table 5-5: Areas Providing Habitat for Valuable or Unique Natural Resources

Town	Areas
Vernon	• Vernal Pools on Box Mountain • Tancanhoosen LLC Parcel • Talcottville Gorge • Belding Wildlife Management Area • Belding Wild Trout Management Area • Valley Falls Park • Rambling Ridge Property • Northern Connecticut Land Trust Properties
Tolland	• Tolland and Charter Marshes
Bolton	• Freja Park • Bolton Notch State Park

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005

Freja Park is a 21-acre, wooded town-owned area located west of Bolton Notch Pond. Freja Park serves as a gateway for the 1,400-acre Bolton Notch/Valley Falls watershed area. The town of Bolton originally acquired the property in 1968, but the park suffered from abuse and neglect. Beginning in March 1998, restoration efforts have been underway including numerous Earth Day Clean-up events with the help of volunteers, Boy Scouts, Conservation Commission members. A total of over two tons of litter have been removed from the park.

5.4.1 Fisheries

The Tankerhoosen River historically hosted large runs of many anadromous fish species. Development of the river with dams from 1700 to the 1920s created barriers to fish migration, which extirpated the salmon run and severely limited the upstream habitat for shad and river herring. Despite these obstacles, the Tankerhoosen River and its tributaries support a variety of fish species as detailed in Table 5-6.

The Tankerhoosen River is a cold water stream starting only a short distance below Walker Reservoir. The generally cold water temperatures in the Tankerhoosen are the result of extensive spring water inputs (DEP correspondence, 2008).

As indicated previously, the Belding Wild Trout Management Area in the upper portions of the Tankerhoosen River watershed is a Class 1 Wild Trout Management Area with self-sustaining native trout populations that rank among the best of their kind in the state. Portions of the remainder of the Tankerhoosen River are stocked annually by the DEP Inland Fisheries Division. Valley Falls Park Pond is stocked in the spring and winter with about 4,400 rainbow trout and generates between 7,500-8,000 angler hours of fishing annually. Walker Reservoir, upstream of the Belding Wildlife Management Area, is stocked each spring with over 1,800 adult brown and rainbow trout (DEP correspondence, 2003).

Table 5-6: Fish Species

	Bolton Notch Pond	Gages Brook	Lower Tankerhoosen River	Middle Tankerhoosen River	Upper Tankerhoosen River	Railroad Brook
American Eel				X	X	X
Brown Bullhead	X					X
Black Crappie	X				X	
Blacknose Dace		X		X	X	X
Brook Trout		X		X	X	X
Brown Trout			X	X	X	X
Bluegill	X		X	X	X	X
Chain Pickerel	X		X	X		
Common Shiner				X	X	X
Creek Chub				X	X	
Fallfish				X	X	
Fathead Minnow		X				
Golden Shiner	X			X	X	
Longnose Dace				X	X	
Largemouth Bass		X	X	X	X	X
Pumpkinseed Sunfish	X	X	X	X	X	X
Rainbow Trout				X	X	X
Rockbass			X			
Smallmouth Bass			X			
Tessellated Darter			X	X	X	
White Sucker		X		X	X	X
Yellow Perch	X			X		X
Tiger Trout					Stocked in Pond	
Golden Trout					Stocked in Pond	

5.4.2 Birds

Bird surveys were conducted in 2004 at the Tancanhoosen LLC property, within Valley Falls Park, and at various Town of Vernon properties, including areas around Walker Reservoir East and on the Connecticut Light & Power line site.

Eighty bird species were detected during the 2004 surveys. Seventy four species were counted during standardized bird counts at 24 count points, and 6 more were detected as incidental observations. The greatest number of species occurred at Walker Reservoir, while the former gravel pit on the Tancanhoosen LLC property contained the most uncommon birds. Prairie warbler, field sparrow, brown thrasher and eastern towhee were detected on the Tancanhoosen LLC property throughout the breeding season. Populations of these species are declining and brown thrasher is on Connecticut's list of Species of Special Concern. These birds are dependent on early successional habitats such as grassland and shrubland. These habitat types have been lost to reforestation and human development. The gravel pit is at an early successional stage with open, grassy habitat and short, scattered pine trees. This site will eventually revert to a forested habitat unless actively managed to maintain early successional habitat. Once the site is reforested, early successional species will disappear from this site (Seymour, 2004).

The Tankerhoosen River watershed also supports a wide range of bird of species. Surveys performed in 2003 and 2004 reported evidence of great blue heron, wood duck, willow flycatcher, hermit thrush, black-throated blue warbler, broad-winged hawk, hairy woodpecker, pileated woodpecker, olive-sided flycatcher, yellow-throated vireo, red-breasted nuthatch, blue-gray gnatcatcher, Nashville warbler, pine warbler, blackpoll warbler, blackburnian warbler, cerulean warbler, worm-eating warbler, and Canada warbler. European starling and house sparrow, two introduced invasive species, were also identified (Seymour, 2004). A complete species list is provided in Appendix A.

During 1999, a bird survey was completed to determine the species diversity and the relative abundance of breeding landbirds within Freja Park and Bolton Notch State Park (Comins, 1999). Of the total 55 species were recorded, 51 were likely nesting species and four were probably non-nesting visitors or migrants. An additional fourteen species were not recorded on the survey, but were identified as likely to occur during the nesting season. Another twenty-nine species have reasonable possibility of occurring in the nesting season from time to time or could be attracted to the area. Two Connecticut State Species of Special Concern were recorded; six species were listed as National Audubon Society Watch List High Conservation Priority species in Connecticut were recorded; an additional six species not listed as watch species were listed by Partners in Flight as High Conservation Priority Species in Connecticut; fourteen species that were uncommon nesters in the Hartford area were recorded (Comins, 1999). See report for additional listing of specific species.

5.4.3 Amphibians & Reptiles

Amphibian and reptile surveys were conducted in 2004 within the Tankerhoosen River watershed, including the Belding Wildlife Management Area, Barrows Brook, and Railroad Brook. Some of the species identified included Northern redback salamander, Northern two-lined salamander, Spotted salamander, American toad, Northern spring peeper, Gray treefrog, Wood frog, Green frog, Pickerel frog, Painted turtle, and Garter snake. The most abundant amphibian species detected during this study was the northern redback salamander. A complete list of the identified amphibian and reptile species is included as Appendix A. A previously undocumented vernal pool was discovered between Reservoir Road and Walker Reservoir West. Additional vernal pools were identified on Bolton Road and above Valley Falls Park (Seymour, 2004).

5.4.3 Threatened and Endangered Species

The DEP Natural Diversity Data Base (NDDB) maintains information on the location and status of endangered, threatened, and special concern species in Connecticut. Figure 5-9 displays the generalized areas of endangered, threatened, and special concern species in the Tankerhoosen River watershed. The areas represent a buffered zone around known species or community locations. The locations of species and natural community occurrences depicted on the NDDB mapping are based on data collected over the years by the Environmental and Geographic Information Center's Geologic and Natural History Survey, other units of the DEP, conservation groups, and the scientific community. Approximately ten such areas were identified throughout the watershed. Because new information is continually being added to the Natural Diversity Database and existing information updated, the areas are reviewed on an annual basis by the DEP. Areas can be removed or added based upon the results of the review.

Table 5-7: Endangered, Threatened, and Special Concern Species

Common Name	Scientific Name	Status
Flora		
Climbing fern	*Lygodium palmatum*	Special Concern
Sphagnum	*Sphagnum pulchrum*	--
Beaked sedge	*Carex rostrata*	--
Leatherleaf	*Chamaedaphne calyculata*	--
Fauna		
Eastern pearlshell	*Margaritifera margaritifera*	Special Concern
Brown thrasher	*Toxostoma rufum*	Special Concern
Southern bog lemming	*Synaptomys cooperi*	Special Concern
Wood turtle	*Clemmys insculpta*	Special Concern
Purple martin	*Progne subis*	Threatened
Eastern box turtle	*Terrapene c. carolina*	Special Concern
Habitats		
Medium fen	--	--
Subacidic rocky summit/outcrop	--	--

Source: DEP Natural Diversity Data Base, 2008.

- "Endangered Species" means any native species documented by biological research and inventory to be in danger of extirpation (local extinction) throughout all or a significant portion of its range within Connecticut and to have no more than five occurrences in the state.
- "Threatened Species" means any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within Connecticut and to have no more than nine occurrences in the state.
- "Species of Special Concern" means any native plant or any native nonharvested wildlife species documented to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population, or has become locally extinct in Connecticut.

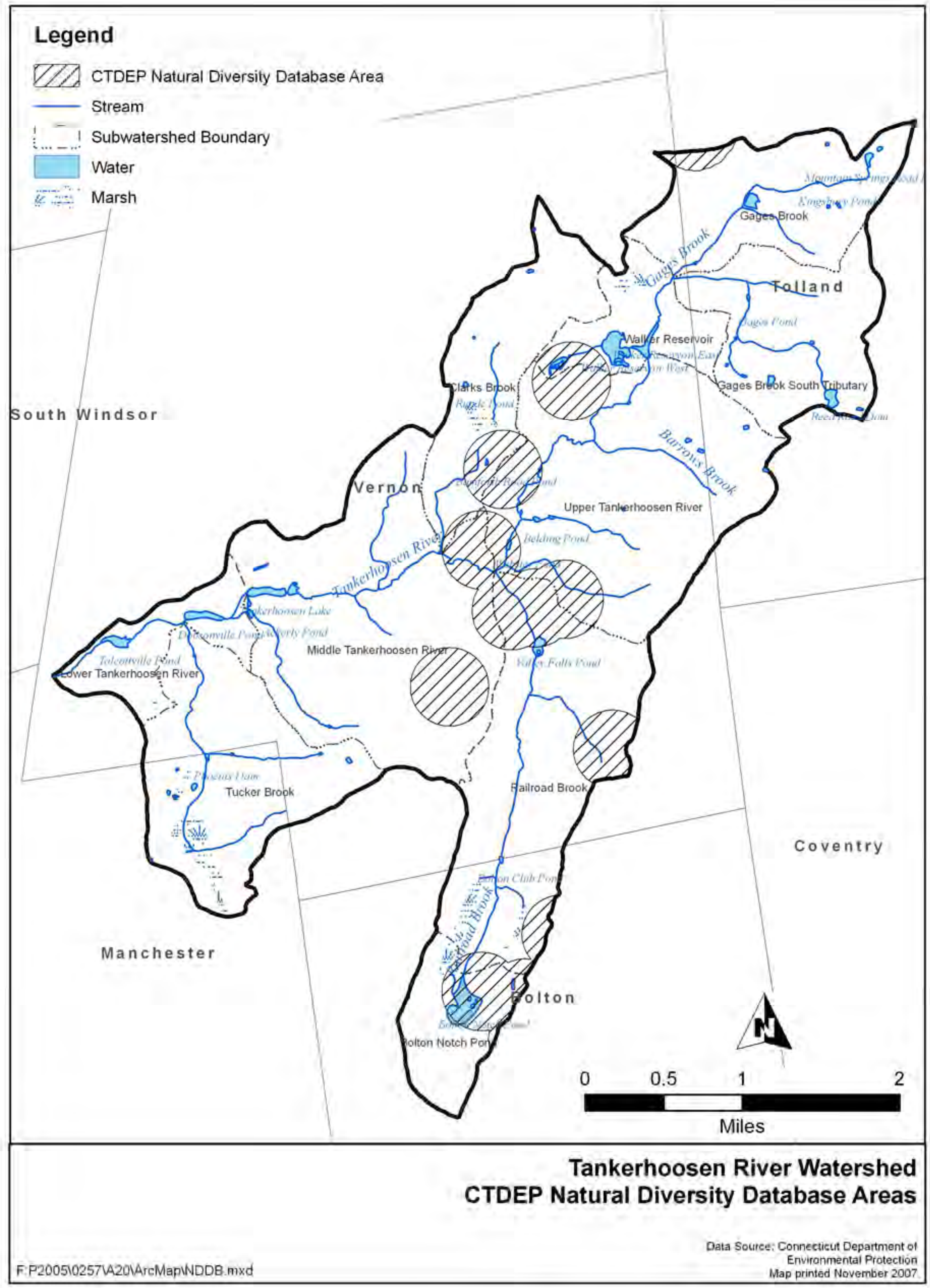


Figure 5-9: CTDEP Natural Diversity Database Areas – Tankerhoosen River Watershed

6.0 WATERSHED MODIFICATIONS

6.1 Dams, Impoundments, & Water Supply

The historical industrial use of the Tankerhoosen River and its major tributaries has left behind many small dams and impoundments. Most of this infrastructure is no longer used for power generation, and many of these impoundments currently provide aquatic and wildlife habitat and recreational opportunities. Many of the dams in the watershed are also an impediment to fish migration.

According to the DEP Dam Safety Regulations, the hazard classification of a dam is based on the damage potential from failure of the structure. Figure 6-1 shows the location and hazard classification of the identified dams within the watershed. Some of the dams which no longer serve an integral function to industry or public use have fallen into disrepair and pose a potential hazard to downstream properties.

Table 6-1 lists the major drinking water supplies within the Tankerhoosen River watershed which are regulated under the DEP Water Diversion program.

Table 6-1: Major Drinking Water Supplies

Name	Name of Diversion	MGD	Town
Connecticut Water Company	Vernon Well #1	0.1728	Vernon
	Vernon Well #2	0.1728	Vernon
	Vernon Well #3	0.1440	Vernon
	Vernon Well #4	0.1728	Vernon
	Vernon Well #5	0.4320	Vernon
Manchester Water Department	New Bolton Well Field, Well #1,2,3	Various	Bolton

The DEP, with Cooperation from the Connecticut Water Company, has identified two preliminary (Level B) Aquifer Protection Areas associated with these wells within the Tankerhoosen River watershed, as shown in Figure 6-2. Aquifer Protection Areas are designated around active well fields in sand and gravel aquifers that serve more than 1,000 people. Level B mapping identifies the general area of aquifer contribution/recharge based primarily on topography. The watershed communities are required to establish land use regulations for these areas to limit potential contamination to public groundwater supplies. Private groundwater supply wells are also prevalent throughout areas of the watershed that are not served by public water supplies.

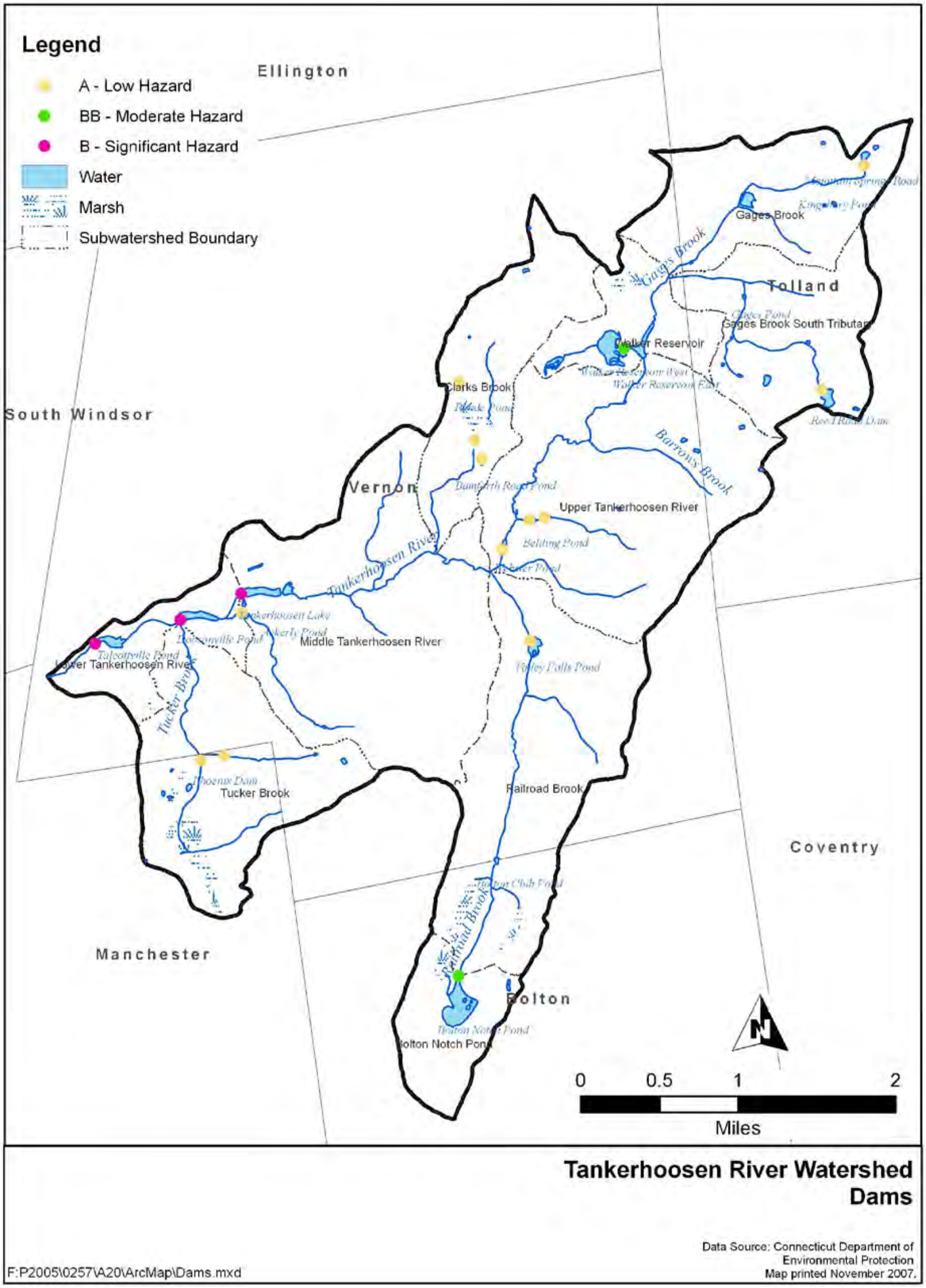


Figure 6-1: CTDEP Regulated Dams – Tankerhoosen River Watershed

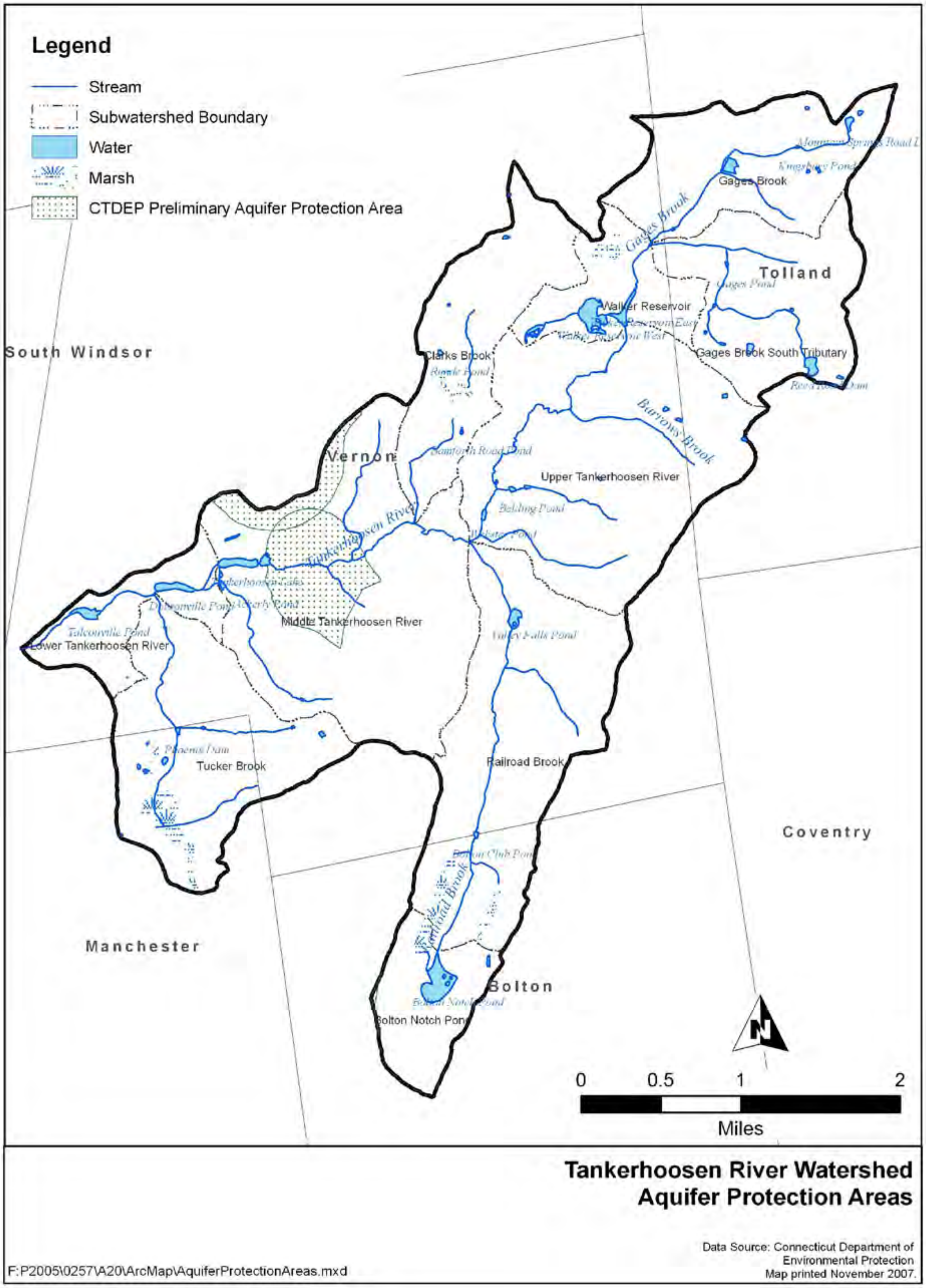


Figure 6-2: CTDEP Aquifer Protection Areas – Tankerhoosen River Watershed

6.2 Wastewater Discharges

As summarized in Table 6-2, there are number of industrial, commercial, and municipal facilities in the Tankerhoosen River Watershed with surface water discharges regulated under the National Pollutant Discharge Elimination System (NPDES) permit program, which is administered by the Connecticut DEP. The facilities listed in Table 6-2 have either permitted wastewater or stormwater discharges to surface waters. The majority of these facilities are located in Vernon. There are no municipal wastewater treatment plants located within the Tankerhoosen River watershed.

Table 6-2: NPDES Regulated Facilities

Town	Facility	Location	Permit Number
Vernon	Carpenter's Mobil	447 Hartford Turnpike	GVS000915
	Company 1 Firehouse	724 Hartford Turnpike	GVM000592
	Connecticut Golfland	95 Hartford Turnpike	GPL000108
	First Student	25 Whitney Ferguson Road	GSI001217
	Motiva Enterprises LLC	444 Hartford Turnpike	GGR001404
	Moore's Automotive	1245 Hartford Turnpike	GVM000806
	Mount Vernon Apartments	1120 Hartford Turnpike	GVS000863
	Oakland Meadows	1158 Hartford Turnpike	GSN001098
	Tighitco, Inc.	101-77 Industrial Park Road	GSI001599
	Vernon Maintenance	37 Campbell Avenue	GVS000988 GSI000074
	VMS Construction Company	120 Bolton Road	GVM000980
Bolton	Transportation Facility	326 Boston Turnpike	GSI001179
	Hull's Autobody	299-301 Boston Turnpike	GVM000800
Tolland	Dari Farms	Gerber Drive	GSN000814
	Mr. Sparkle Car Wash	157 Hartford Turnpike	GVM000646
	Connecticut Light & Power Co.	45 Tolland Stage Road	GVS001027
	Gerber Scientific Inc.	24 Industrial Park Road West	GSI000914
	Standard Register Co.	259 Hartford Turnpike	GPP000152 GPH000345
	CNC Software Inc.	671 Old Post Road	GSN000070
	Belvedere Ridge	601 Old Post Road	GSN001308

Source: DEP December 2007

Figure 6-3 depicts sewer service areas in the watershed. Areas outside of the mapped sewer service areas are presumed to be on individual sewage disposal (i.e., septic) systems. Approximately 23% of the overall Tankerhoosen River watershed area is served by municipal sanitary sewers.

6.3 Regulated Sites

Historical and current industrial and commercial development within the Tankerhoosen River watershed poses a potential threat to surface water and groundwater supplies in the watershed. Illegal waste disposal, improper use and disposal of chemicals such as used oil, pesticides, and herbicides, and chemical spills are potential sources of contaminants from industrial and commercial facilities. As summarized in the following table, several hazardous waste generators and other regulated sites are located within the watershed. These facilities are located in both Vernon and Tolland in the central and upper portions of the watershed.

Table 6-3: Summary of Regulated Sites

Site Type	Number of sites	
	Vernon	Tolland
Hazardous Waste Generator	5	6
Air Emissions	1	2
CERCLA Site	1 (1 on Final NPL)	0

Source: epa.gov/region1/superfund/sites/precision, accessed Nov. 2007.

There is one site that is listed as potential hazardous waste site that EPA has evaluated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), otherwise known as "Superfund." This site, Precision Plating Corporation, is located in the Hillside Industrial Park in Vernon and is currently on the Final National Priorities List (NPL). Chromium contaminated groundwater at the site is being remediated under the direction of the DEP.

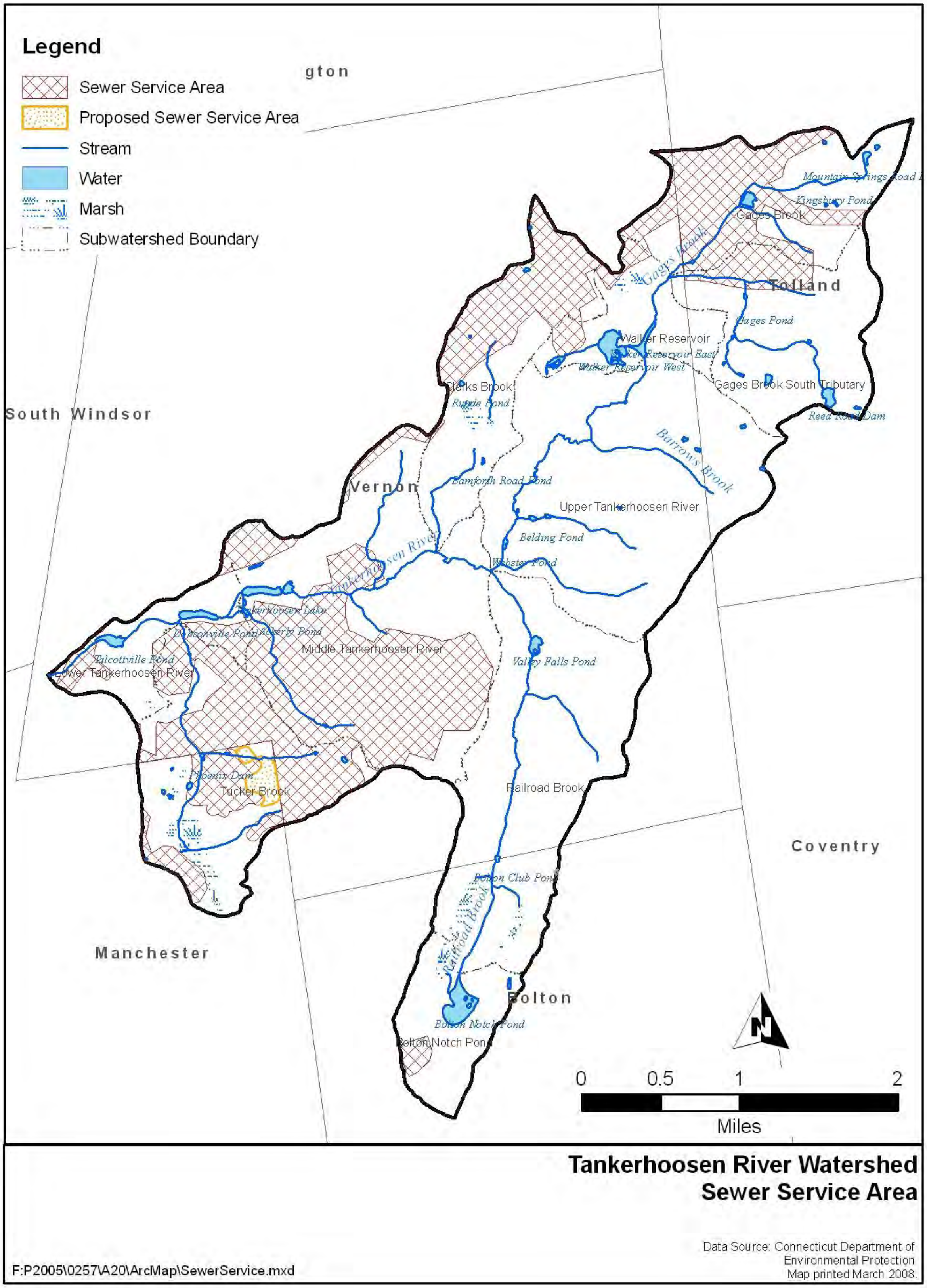


Figure 6-3: Sewer Service Areas – Tankerhoosen River Watershed

7.0 LAND USE AND LAND COVER

The type and distribution of land use within a watershed have direct impact on nonpoint sources of pollution and water quality. This section describes the land use and land cover patterns in the Tankerhoosen River watershed.

7.1 Current Conditions

7.1.1 Land Use

Figure 7-1 depicts general land use patterns in the Tankerhoosen River watershed. The data in Figure 7-1 are parcel-based land use categories for the watershed communities, provided by the Capital Region Council of Governments (CRCOG). The land uses in the watershed include 20 land use categories (Table 7-1). Approximately 60% of the watershed consists of developed land uses, with single-family residential comprising the largest percentage (40%). Highway and other road right-of-ways comprise approximately 9% of the watershed area. Approximately 30% is classified as resource/recreation land use, which includes committed and uncommitted open space. Major portions of the riparian areas adjacent to the Tankerhoosen River and its tributaries are located within resource/recreation areas. Areas in the northern portion of the watershed are more commercialized and have a greater retail and industrial use, with commercial, retail, and industrial land uses comprising approximately 4% of the watershed area. The majority of the commercial, industrial, and retail areas are located in headwater regions adjacent to the major transportation corridors of I-84/Route 30 and I-384.

Table 7-1: Current Land Use – Tankerhoosen River Watershed

Land Use Type	Acres	Percent of Watershed
Agriculture	103	1 %
One Family	3160	38 %
Two Family	48	<1 %
Three Family	2	<1 %
Multi Family	39	<1 %
Condominium	165	2 %
Group Quarters	12	<1 %
Commercial	110	1 %
Retail	88	1 %
Mixed Use	3	<1 %
Industrial	183	2 %
Government/Non-Profit	102	1 %
School	26	<1 %
Cemetery	22	<1 %
Health/Medical	6	<1 %
Resource/Recreation	2398	29 %
Undeveloped	851	10 %
Right-of-way	770	9 %
Water	77	<1 %
Unknown	61	<1 %

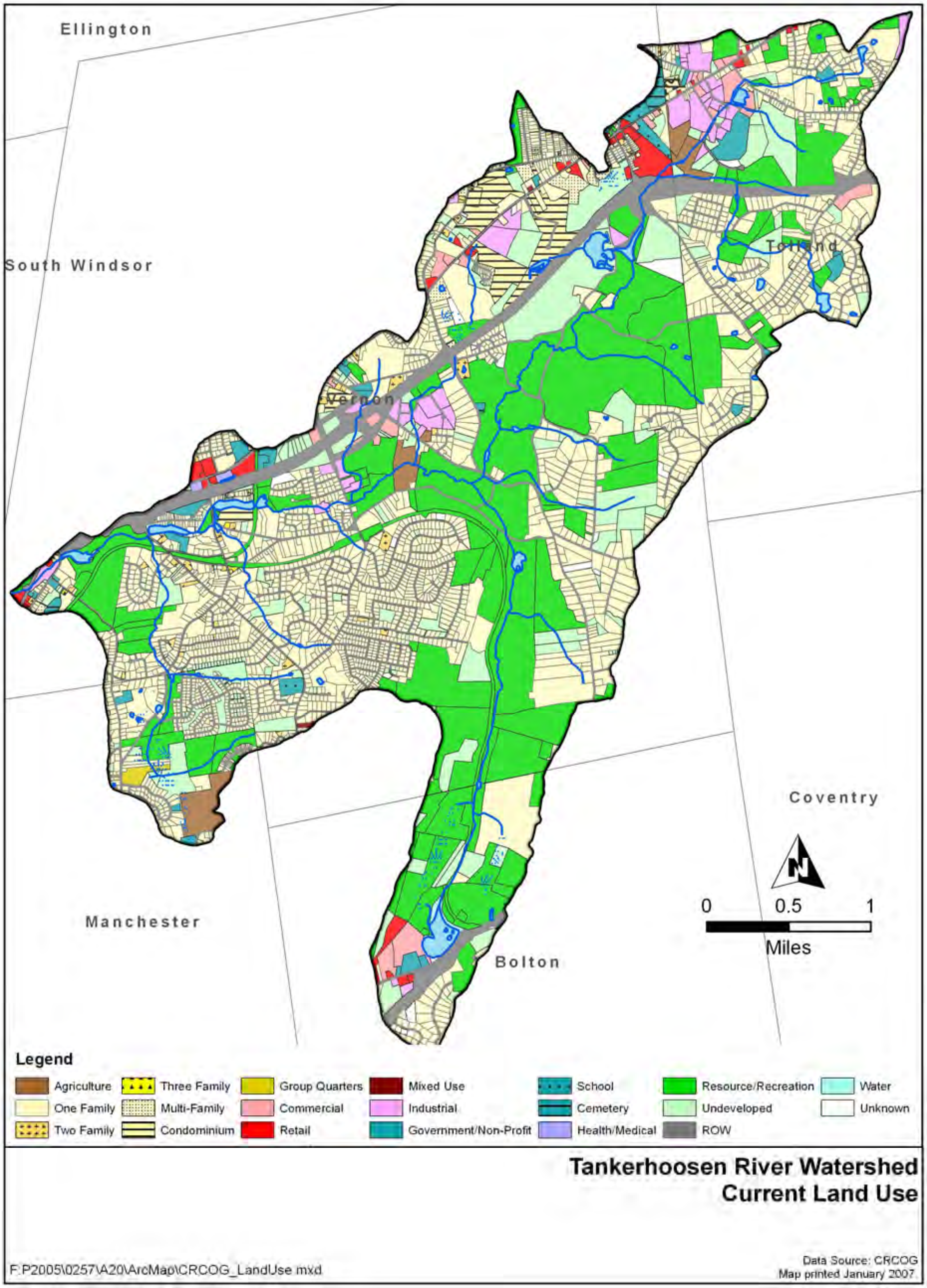


Figure 7-1: Current Land Use – Tankerhoosen River Watershed

In the Tankerhoosen River watershed, several tracts of potentially developable land have been permanently preserved as "committed" open space. Committed open space parcels in the Town of Vernon and the Town of Bolton were identified through available land use mapping and confirmed by members of the Technical Advisory Committee and the Bolton Conservation Commission. Committed open space parcels in Tolland and Manchester were determined through available mapping from each Town's Plan of Conservation and Development (POCD) and from the Connecticut Office of Policy and Management Municipal Plans of Conservation and Development. In general, the committed open space areas include deeded open space that is privately owned, parcels owned by land trusts, land owned by the State of Connecticut as well as parks owned by the Town of Vernon and Town of Bolton, including the Hop River State Park Trail, Valley Falls Park, Freja Park, and Bolton Notch State Park. This land is protected against future development and is generally located in the central and southern portion of the watershed. Figure 7-2 identifies the committed open space land in the watershed.

In addition, several parcels within the watershed are designated for agricultural or forestry use under Public Act 490. While development is not prohibited on this land, this program reduces the tax burden on this land, thereby relieving some of the pressure to develop the land and allows it to continue to serve as open space.

7.1.2 Zoning

Figure 7-3 depicts parcel-based zoning designations in the Tankerhoosen River watershed, as provided by CRCOG. The majority of the Tankerhoosen River watershed is zoned for residential uses. Commercial and industrial zones associated with the I-384 and I-84 corridors are located in the southern and northern portions of the watershed, respectively.

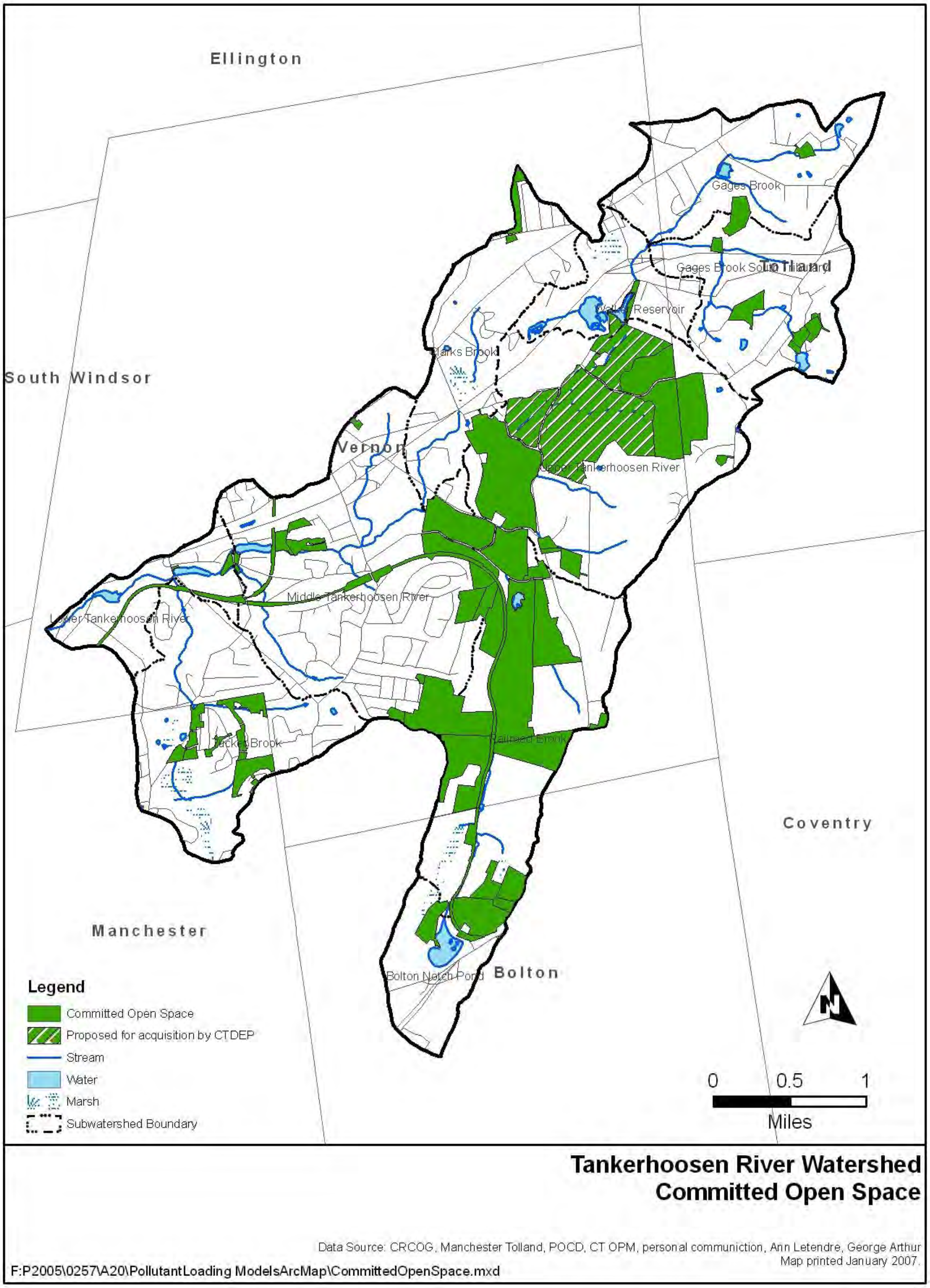


Figure 7-2: Committed Open Space – Tankerhoosen River Watershed

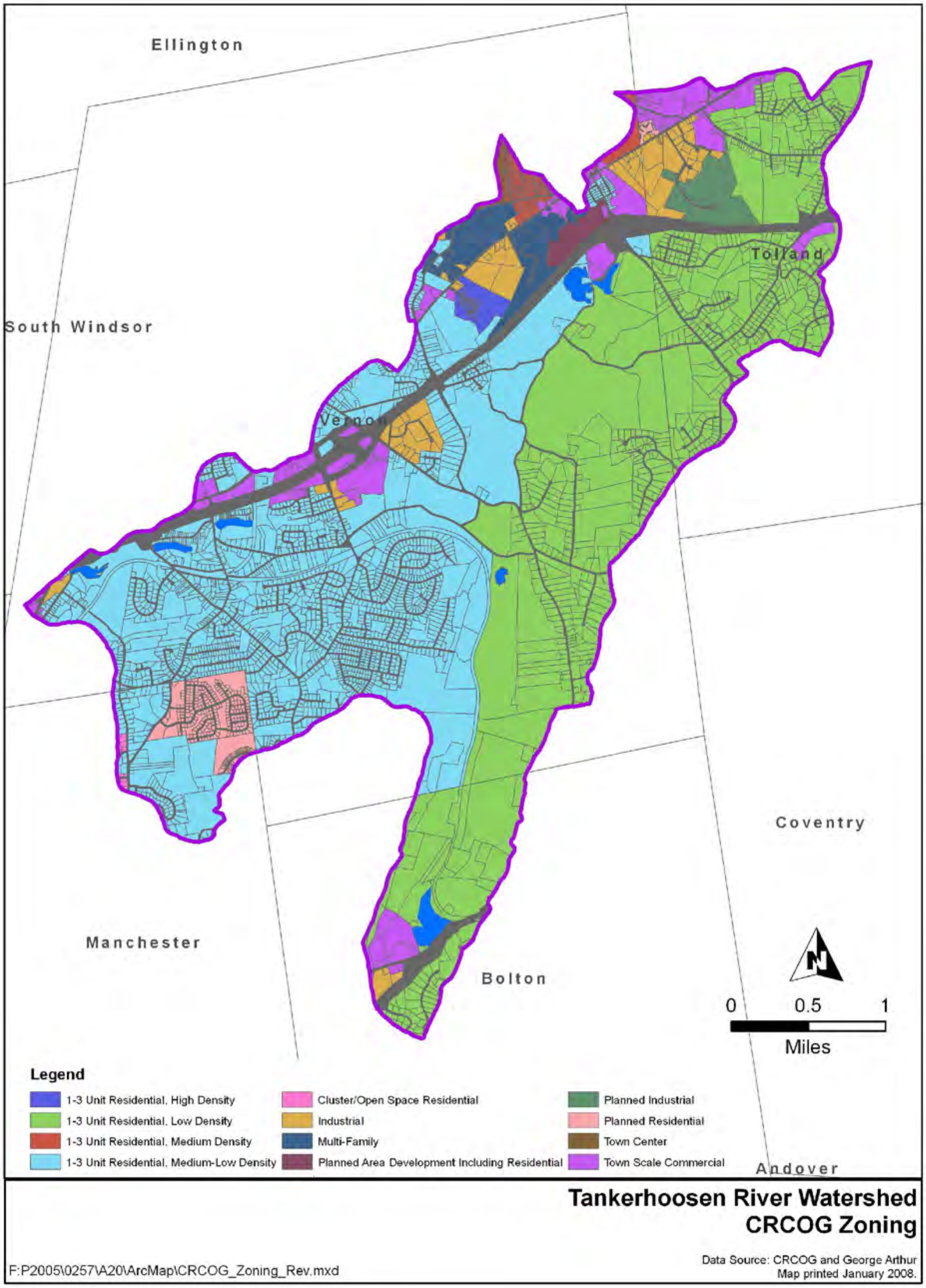


Figure 7-3: Watershed Zoning as Defined by CRCOG – Tankerhoosen River Watershed

7.1.3 Land Cover

Figure 7-4 depicts the general land cover in the Tankerhoosen River watershed. Data shown in Figure 7-4 are land cover categories derived from 2002 Landsat satellite imagery with ground resolution of 30 meters. The land cover data in the watershed are summarized into ten categories (Table 7-2). These ten categories are those used in the Connecticut Land Cover Map Series and are described following the table (University of Connecticut Center for Land Use Education and Research).

Table 7-2: Land Cover – Tankerhoosen River Watershed

Land Cover Type	1985 Acres	1985 Percent of Watershed	2002 Acres	2002 Percent of Watershed	Relative Percent Change[1]	Relative Rate of Change[2]
Barren	91	1 %	162	2 %	1%	78%
Coniferous Forest	454	6 %	430	5 %	-1%	-5%
Deciduous Forest	4581	56 %	4085	50 %	-6%	-11%
Developed	1793	22 %	2201	27 %	5%	23%
Forested Wetland	192	2 %	175	2 %	0	-9%
Non-forested Wetland	2	< 1 %	19	<1 %	0	912%
Other grasses and agriculture	551	7 %	603	7 %	0	9%
Turf and grass	448	5 %	447	5 %	0	0%
Utility Right of Way	19	< 1 %	17	<1 %	0	-12%
Water	95	2 %	88	1 %	1%	-7%

[1]Calculation = % land cover 2002 - % land cover 1985
[2]Calculation = (acres land cover 2002 – acres land cover 1985) / acres land cover 1985

Land Cover Type	1985 Acres	1985 Percent of Basin	2002 Acres	2002 Percent of Basin	Relative Percent Change[1]	Relative Rate of Change[2]
Barren	91	1	162	2	1%	78%
Coniferous Forest	454	6	430	5	-1%	-5%
Deciduous Forest	4581	56	4085	50	-6%	-11%
Developed	1793	22	2201	27	5%	23%
Forested Wetland	192	2	175	2	0	-9%
Non-forested Wetland	2	< 1	19	<1	0	912%
Other grasses and agriculture	551	7	603	7	0	9%
Turf and grass	448	5	447	5	0	0%
Utility Right of Way	19	< 1	17	<1	0	-12%
Water	95	2	88	1	1%	-7%

[1]Calculation = % land cover 2002 - % land cover 1985
[2]Calculation = (acres land cover 2002 – acres land cover 1985) / acres land cover 1985
Source: University of Connecticut's Center for Land Use Education and Research (CLEAR)

- Barren – Mostly non-agricultural areas free from vegetation, such as sand, sand and gravel operations, bare exposed rock, mines, and quarries. Also includes some urban areas where the composition of construction materials spectrally resembles more natural materials. Also includes some bare soil agricultural fields.
- Coniferous Forest – Includes Southern New England mixed softwood forests. May include isolated low density residential areas.
- Deciduous Forest – Includes Southern New England mixed hardwood forests. Also includes scrub areas characterized by patches of dense woody vegetation. May include isolated low density residential areas.
- Developed – High density built-up areas typically associated with commercial, industrial and residential activities and transportation routes. These areas contain a significant amount of impervious surfaces, roofs, roads, and other concrete and asphalt surfaces.
- Forested Wetland – Includes areas depicted as wetland, but with forested cover. Also includes some small watercourses due to spectral characteristics of mixed pixels that include both water and vegetation.
- Non-forested Wetland – Includes areas that predominantly are wet throughout most of the year and that have a detectable vegetative cover (therefore not open water). Also includes some small watercourses due to spectral characteristics of mixed pixels that include both water and vegetation.
- Other Grasses and Agriculture – Includes non-maintained grassy areas commonly found along transportation routes and other developed areas and also agricultural fields used for both crop production and pasture.
- Turf & Grass – A compound category of undifferentiated maintained grasses associated mostly with developed areas. This class contains cultivated lawns typical of residential neighborhoods, parks, cemeteries, golf courses, turf farms, and other maintained grassy areas. Also includes some agricultural fields due to similar spectral reflectance properties.
- Utility – Includes utility rights-of-way. This category was manually digitized on-screen from rights-of-way visible in the Landsat satellite imagery. The class was digitized within the deciduous and coniferous categories only.
- Water – Open water bodies and watercourses with relatively deep water.

Forest Cover

Forested areas are the predominant land cover type in the Tankerhoosen River watershed. Approximately 55% of the watershed consists of deciduous and coniferous forests, primarily in the central and southern portions of the watershed. Table 7-3 compares the total acres and percent forest cover by subwatershed. The percent forest cover in each subwatershed ranges from approximately 31% in the Walker Reservoir subwatershed to approximately 86% in the Railroad Brook subwatershed. Based on a literature threshold values documented in several studies (CLEAR, 2007), watershed forest cover of 65% or greater is the minimum needed for a healthy aquatic invertebrate community. Only two of the ten subwatersheds, Railroad Brook and the Upper Tankerhoosen River, exceed the threshold value of 65%. Based on a recommendation of the American Forests organization, 40% forest cover is a reasonable threshold goal for urban areas. All but two subwatersheds, Clarks Brook (34.8 %) and Walker Reservoir (31.3 %), both of which are located in the northern and most developed portion of the watershed, meet this goal.

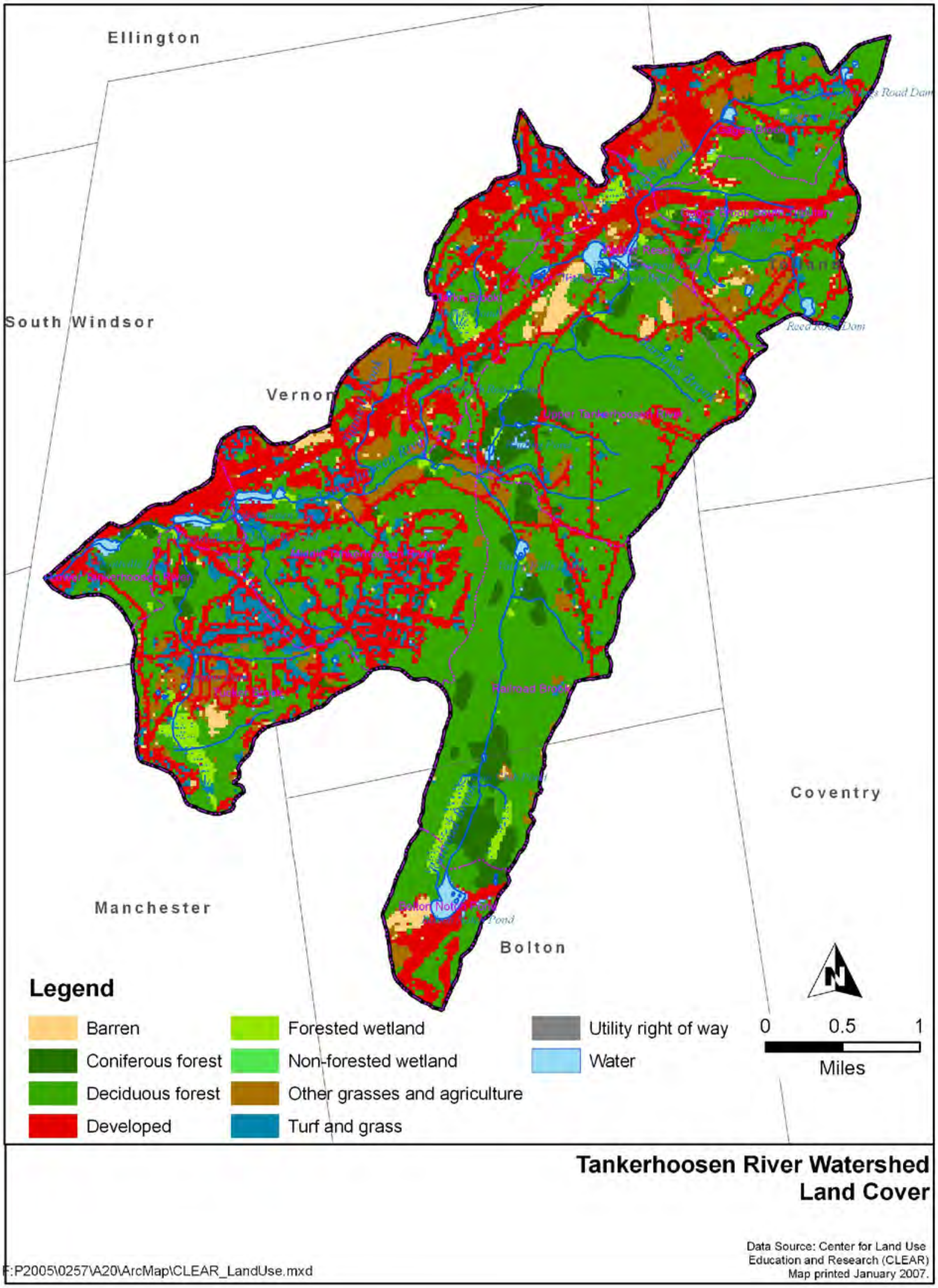


Figure 7-4: Land Cover – Tankerhoosen River Watershed

Table 7-3: Forest Cover – Tankerhoosen River Watershed

Subwatershed Name	Forest Cover in Subwatershed (acres)	Percent Forest Cover in each Subwatershed	Developable Forest Cover in Subwatershed (acres)	Percent of Forest Cover that is Developable
Bolton Notch Pond	171	49.6 %	41	24.0 %
Clarks Brook	226	34.8 %	70	30.9 %
Gages Brook	314	45.2 %	134	42.6 %
Gages Brook South Tributary	395	58.1 %	171	43.3 %
Lower Tankerhoosen River	149	46.6 %	82	54.9 %
Middle Tankerhoosen River	625	39.6 %	122	19.6 %
Railroad Brook	1043	86.3 %	346	33.2 %
Tucker Brook	374	40.0 %	119	31.8 %
Upper Tankerhoosen River	1110	75.4 %	278	25.0 %
Walker Reservoir	109	31.3 %	54	49.2 %
Tankerhoosen River Watershed	4515	54.9 %	1416	31.4 %

Table 7-3 also includes a comparison of the amount of forest cover in each subwatershed that could potentially be developed in the future (i.e., "developable"). Refer to Section 7.2.1 for a discussion of the determination of "developable" areas and watershed buildout scenario. The percent of forest cover that is developable for each subwatershed ranges from approximately 20% in the Middle Tankerhoosen River subwatershed and up to approximately 55% in the Lower Tankerhoosen River subwatershed. These results suggest that future development within the watershed has the potential to significantly reduce forest cover and, in some subwatersheds, to below recommended thresholds.

Riparian Vegetation

Riparian, or streamside, corridors are critical areas important to stream stability, pollutant removal, and wildlife habitat. These areas are also sometimes called "buffer" areas, but are not to be confused with regulatory review zones, which are often also called buffers (CLEAR 2007). A stream walk survey of the Tankerhoosen River conducted in 1999 revealed that riparian buffers of 100 feet are common between the river and developed areas. However, some areas along the lower reaches of the Tankerhoosen River were identified as having stream buffers of less than 25 feet, according to the results of a 2000 stream walk survey of the Tankerhoosen River.

In order to assess the status and of the riparian corridors in the Tankerhoosen River watershed, the acreage of forest cover within the riparian area (defined as a 200-foot buffer on both sides of streams and a 200-foot buffer from waterbody shorelines) was calculated for each of the ten subwatersheds based on the 2002 Center for Land Use Education and Research (CLEAR) forest land cover classes (coniferous and deciduous forest). The results are provided in
Table 7-4.

Table 7-4: Forest Cover in Riparian Areas in the Tankerhoosen River Subwatersheds

Subwatershed Name	Forest Cover in 200-foot Riparian Corridor (acres)	Percent of 200-foot Riparian Corridor that is Forested
Bolton Notch Pond	19	34.9 %
Clarks Brook	42	46.3 %
Gages Brook	85	61.4 %
Gages Brook South Tributary	93	62.3 %
Lower Tankerhoosen River	31	35.8 %
Middle Tankerhoosen River	99	41.8 %
Railroad Brook	167	87.2 %
Tucker Brook	92	51.8 %
Upper Tankerhoosen River	216	80.7 %
Walker Reservoir	21	23.1 %
Tankerhoosen River Watershed	866	58.3%

Forest cover within the 200-foot riparian corridor for the overall Tankerhoosen River Watershed is nearly 60%, although the amounts vary considerably by subwatershed. Railroad Brook (87.2%) and the Upper Tankerhoosen River (80.7%) subwatersheds have the highest percentage of forest cover within the 200-foot riparian corridor. Walker Reservoir (23.1%) and Bolton Notch Pond (34.9%) have the lowest percentage of forest cover within the 200-foot riparian corridor. These results indicate that large portions of the watershed streams and waterbodies are well-protected by intact riparian forest cover, although several subwatersheds have significantly lower riparian forest cover.

Developed Areas

Developed areas are also a dominant land cover type in the Tankerhoosen River watershed. Approximately 27% of the watershed consists of commercial, industrial, residential, and transportation land cover types (i.e. "developed" category) that follow the major transportation corridors, regional retail and commercial areas, and population centers. Approximately 7% of the watershed consists of other grass and agriculture, although only a small portion of this (approximately 1%) consists of land in active agricultural use.

A comparison of watershed land cover data between 1985 and 2002 (Table 7-2) shows a moderate increase in watershed development during this period (5% increase in developed cover types) and a corresponding loss of coniferous (1% decrease) and deciduous forest (6% decrease).

7.1.4 Impervious Cover

Impervious cover has emerged as a measurable, integrating concept used to assess the overall condition of a watershed. Numerous studies have documented the cumulative effects of urbanization on stream and watershed ecology (Center for Watershed Protection, 2003; Schueler et al., 1992; Schueler, 1994; Schueler, 1995; Booth and Reinelt, 1993, Arnold and Gibbons, 1996; Brant, 1999; Shaver and Maxted, 1996). Research has also demonstrated similar effects of urbanization and watershed impervious cover on downstream receiving waters such as lakes, reservoirs, estuaries, and coastal areas.

The correlation between watershed impervious cover and stream indicators is due to the relationship between impervious cover and stormwater runoff, since streams and receiving water bodies are directly influenced by stormwater quantity and quality. Although well-defined imperviousness thresholds are difficult to recommend, research has generally shown that when impervious cover in a watershed reaches between 10 and 25 percent, ecological stress becomes clearly apparent. Between 25 and 60 percent, stream stability is reduced, habitat is lost, water quality becomes degraded, and biological diversity decreases (NRDC, 1999). Watershed imperviousness in excess of 60 percent is generally indicative of watersheds with significant urban drainage. Figure 7-5 illustrates this effect. These research findings have been integrated into a general watershed planning model known as the impervious cover model (ICM) (CWP, 2003). The ICM has also been confirmed locally in Connecticut by the CTDEP, which has determined a statewide impervious cover threshold of 12 percent for aquatic life impairment (Belucci, CTDEP, 2007).

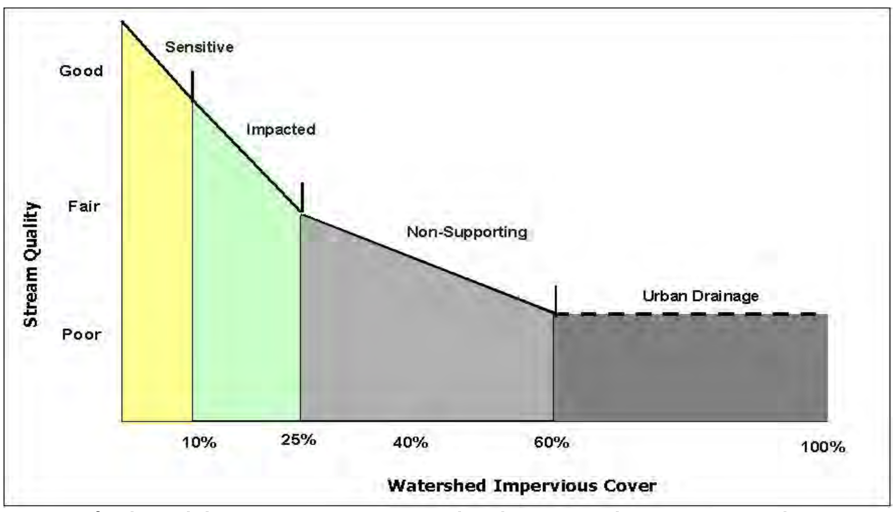


Figure 7-5: Relationship Between Watershed Imperviousness and Stream Health

Source: www.cwp.org

A GIS-based impervious cover analysis was performed for the Hockanum River watershed and including the Tankerhoosen River watershed by staff from the Department of Natural Resources Management and Engineering at the University of Connecticut (Civco, 2005). The satellite-derived land cover data described previously were used in the analysis. This technique, known as "direct impervious surface modeling", extracted impervious surface data directly from 2002 Landsat imagery to estimate the amount of impervious surface within each pixel. The DEP GIS basin layer was used to calculate the percent of imperviousness by basin. Figure 7-5 graphically summarizes the results of this analysis.

The overall imperviousness of the Tankerhoosen River watershed is estimated at approximately 9.7% (Table 7-5). This level of impervious cover is slightly below the CTDEP aquatic life impairment threshold of approximately 12%, where ecological stress and stream impacts become apparent. As shown in Figure 7-6, impervious cover in much of the central and southern portions of the watershed (Upper Tankerhoosen River and Railroad Brook watersheds) is less than 5%, consistent with the high percentage of forest cover and conservation land in these areas. The headwater tributaries of the Tankerhoosen River, specifically Gages Brook, are estimated to have approximately 11.5% impervious cover, while localized subwatershed areas around Bolton Notch Pond, Walker Reservoir, and Dobsonville Pond have impervious cover near or above 20%.

Table 7-5: Percent Impervious Cover – Tankerhoosen Watershed

Subwatershed	Percent Impervious Cover
Bolton Notch Pond	16.6 %
Clarks Brook	17.2 %
Gages Brook	11.5 %
Gages Brook South Tributary	11.3 %
Lower Tankerhoosen River	15.8 %
Middle Tankerhoosen River	12.9 %
Railroad Brook	1.7 %
Tucker Brook	8.1 %
Upper Tankerhoosen River	4.5 %
Walker Reservoir	19.9 %
Total	9.7 %

The results of this analysis provide an initial diagnosis of potential stream and receiving water quality within the watershed study area. The analysis method and ICM are based on several assumptions and caveats, which limits its application to screening-level evaluations. Some of the assumptions of the ICM include:

- Requires accurate estimates of percent impervious cover, which is defined as the total amount of impervious cover over a subwatershed area. The resolution of the land cover data used in the evaluation is relatively coarse, although sufficient for screening analysis.
- Predicts potential rather than actual stream quality.
- Does not predict the precise score of an individual stream quality indicator but rather predicts the average behavior of a group of indicators over a range of impervious cover.
- The 10 and 25 % thresholds are approximate transitions rather than sharp breakpoints.
- The ICM has not been validated for lakes, reservoirs, aquifers, and estuaries.
- Does not currently predict the impact of watershed best management practices (treatment or non-structural controls).
- Does not consider the geographic distribution of the impervious cover relative to the streams and receiving waters. Effective impervious cover (impervious cover that is hydraulically connected to the drainage system) has been recommended as a better metric, although determining effective impervious cover requires extensive and often subjective judgment as to whether it is connected or not.
- Impervious cover is a more robust and reliable indicator of overall stream quality beyond the 10 percent threshold. The influence of impervious cover on stream quality is relatively weak compared to other potential watershed factors such as percent forest cover, riparian community, historical land use, soils, agriculture, etc. for impervious cover less than 10 percent.

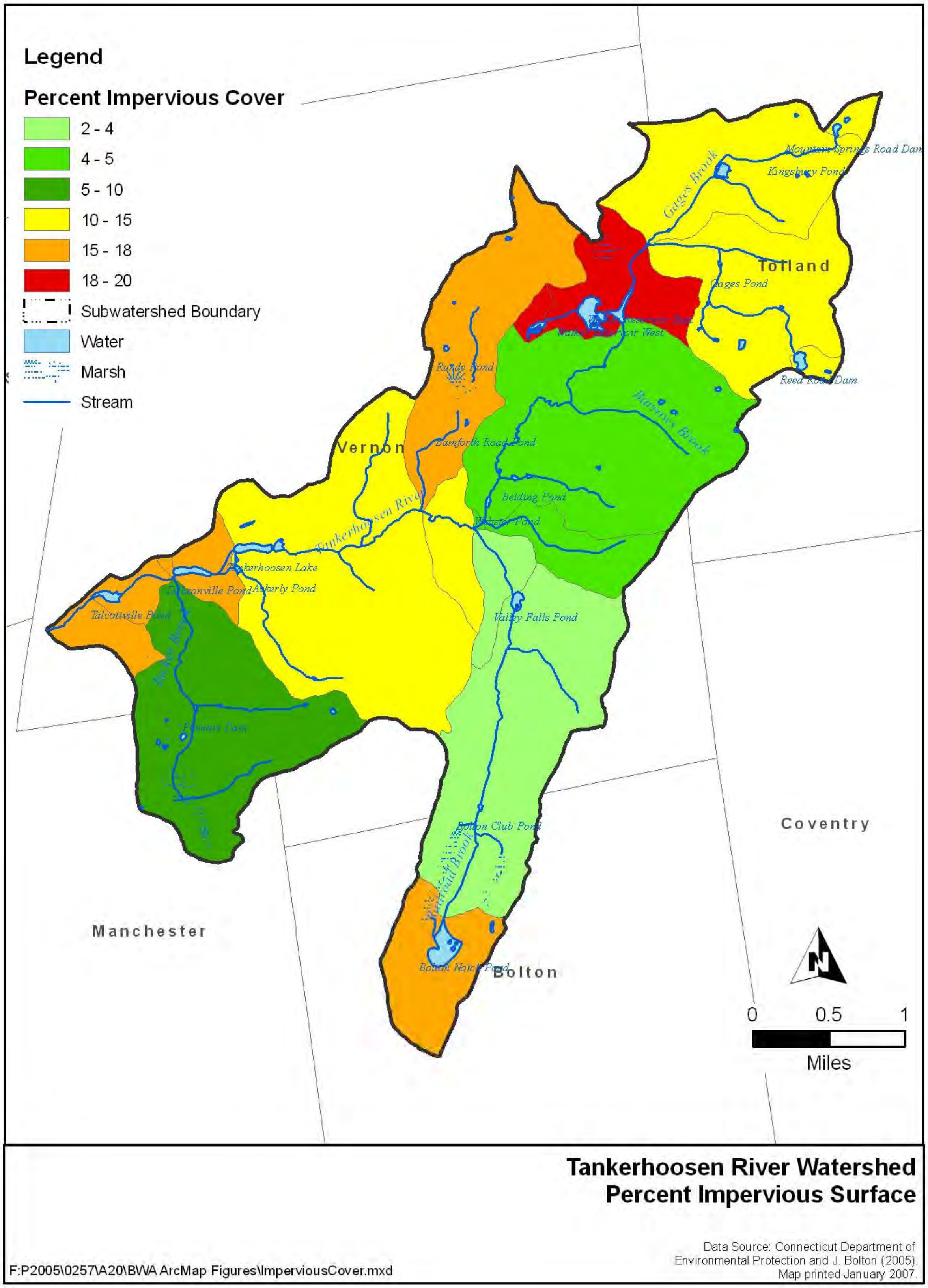


Figure 7-6: Current Impervious Cover by Subwatershed

7.2 Future Conditions

A watershed buildout analysis was also conducted as part of this assessment to assist in the identification of subwatersheds with the highest restoration potential as well as the greatest vulnerability. The purpose of the analysis is to estimate the future land use and impervious cover conditions of the watershed as a result of maximum development allowed by the current zoning within the watershed.

7.2.1 Land Use

Watershed lands that could be developed in the future (i.e., "developable" land) were subdivided into two categories, based on the CRCOG parcel-based land use data:

- New Development - areas that are currently undeveloped and could become new developments in the future. Land designated as "new development" includes those parcels that are designated as "undeveloped" and "resource/recreation" in the CROCG land use data and not identified as committed open space.

- Redevelopment - areas that are currently underdeveloped and could be redeveloped with a higher intensity land use in the future. Land designated for "redevelopment" were limited to single-family residential parcels in the CRCOG land use data that could be subdivided and/or redeveloped in the future.

Areas having the following physical and/or regulatory constraints were also removed from consideration for future development or redevelopment: water bodies, wetland soils, and soils whose slope characteristics defined by NRCS exceed 15% (i.e., steep slope soils). Resulting fragments of land smaller than ¼-acre in size for new development and 3 acres in size for redevelopment were also removed from the analysis. Table 7-6 and Figure 7-7 summarize the amount of developable land by subwatershed, including the new development and redevelopment categories.

Table 7-6: Developable Land – Tankerhoosen Watershed

Subwatershed	New Development (acres)	New Development Percent in Subwatershed	Redevelopment (acres)	Redevelopment Percent in Subwatershed
Bolton Notch Pond	49	14.3 %	11	3.2 %
Clarks Brook	57	8.8 %	52	8.1 %
Gages Brook	129	18.5 %	72	10.3 %
Gages Brook South Tributary	123	18.1 %	102	15.0 %
Lower Tankerhoosen River	91	28.5 %	17	5.4 %
Middle Tankerhoosen River	127	8.0 %	141	8.9 %
Railroad Brook	212	17.6 %	172	14.3 %
Tucker Brook	122	13.1 %	89	9.5 %
Upper Tankerhoosen River	238	16.1 %	150	10.2 %
Walker Reservoir	108	31.3 %	13	3.8 %
Total	1257	15.3 %	820	10.0 %

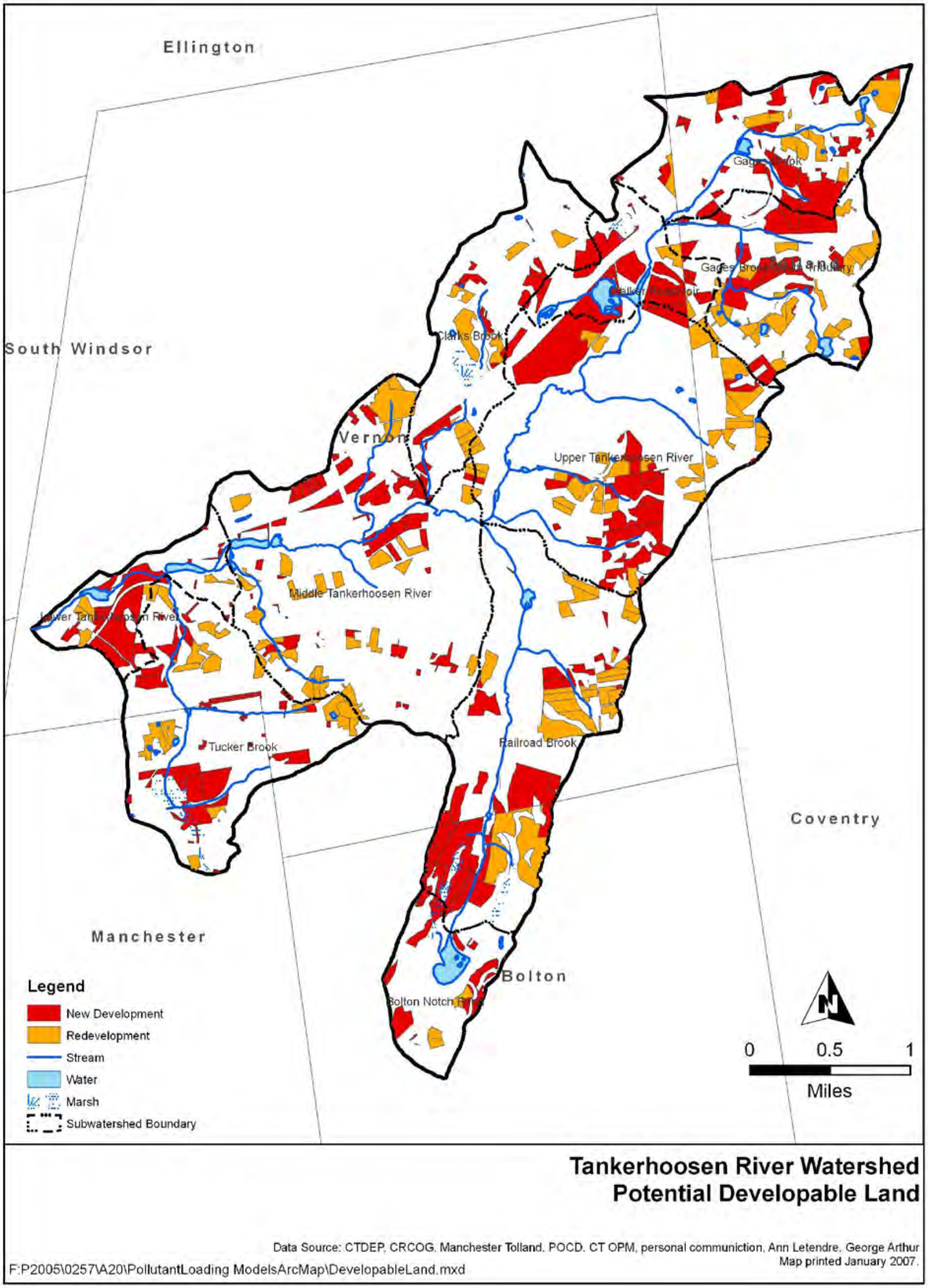


Figure 7-7: Developable Land – Tankerhoosen River Watershed

The future land use buildout scenario was estimated by assigning new land uses to developable areas (See Section 7.2.1), while maintaining the existing land uses for developed and unbuildable land (wetland soils, steep slope soils, etc.). The developable areas were assigned a future land use based on maximum degree of development allowed by the existing zoning category. Table 7-7 presents the future land use category assigned to each developable parcel based on the zoning category. This analysis assumes development of Act 490 parcels consistent with the underlying zoning and does not account for future zone changes or future land development regulatory changes.

Table 7-7: Assigned Future Land Use Category

Zoning Category	Assigned Future Land Use
1-3 Unit Residential, High Density	Condominium
1-3 Unit Residential, Medium Density	Three Family
1-3 Unit Residential, Medium-Low Density	Two Family
1-3 Unit Residential, Low Density	One Family
Cluster/Open Space Residential	One-Family
Industrial	Industrial
Multi-Family	Multi-Family
Planned Area Development Including Residential	Mixed Use
Planned Industrial	Industrial
Planned Residential	Multi-Family
Town Center	Mixed Use
Town Scale Commercial	Commercial

The results of the buildout analysis are summarized in Table 7-8, which compares acreage of existing and future land use in the watershed. The most significant potential land use change is in the residential land use categories, which is predicted to increase by approximately 15% watershed-wide. The area of resource/recreation and undeveloped land is predicted to decrease by approximately 15% watershed-wide, while commercial and industrial land are predicted to increase by approximately 3%.

Table 7-8: Existing and Future Land Use – Tankerhoosen Watershed

Land Use Type	$Acres_{Existing}$	Percent of $Basin_{Existing}$	$Acres_{Future}$	Percent of $Basin_{Future}$	Relative Percent Change
Agriculture	103	1 %	89	1 %	0
One Family	3160	38 %	3415	42 %	4%
Two Family	48	<1 %	811	10 %	10%
Three Family	2	<1 %	3	<1 %	0
Multi Family	39	<1 %	60	1 %	1%
Condominium	165	2 %	177	2 %	0
Group Quarters	12	<1 %	12	<1 %	0
Commercial	110	1 %	206	3 %	2%
Retail	88	1 %	88	1 %	0
Mixed Use	3	<1 %	33	<1 %	0
Industrial	183	2 %	270	3 %	1%

Land Use Type	$Acres_{Existing}$	Percent of $Basin_{Existing}$	$Acres_{Future}$	Percent of $Basin_{Future}$	Relative Percent Change
Government/Non-Profit	102	1 %	102	1 %	0
School	26	<1 %	26	<1 %	0
Cemetery	22	<1 %	14	<1 %	0
Health/Medical	6	<1 %	6	<1 %	0
Resource/Recreation	2398	29 %	1787	22 %	-7%
Undeveloped	851	10 %	233	3 %	-7%
Right-of-way	770	9 %	770	9 %	0
Water	77	<1 %	77	<1 %	0
Unknown	61	<1 %	46	<1 %	0

7.2.2 Impervious Cover

The watershed buildout analysis was used in conjunction with the existing conditions impervious cover analysis (Section 7.1.3) to estimate future impervious cover in the Tankerhoosen River subwatersheds. To complete this analysis, impervious cover was included as a parameter in the pollutant load model described in Section 8.1. Each urban land use type was assigned an impervious cover coefficient based on literature values (see Table 2 in Appendix B). Land use data for both existing and buildout conditions were then entered into the model to determine the change in impervious cover for each subwatershed. The predicted change in impervious cover was then added to the existing impervious cover estimates described in Section 7.1.3 to estimate future impervious cover.

Table 7-9 presents estimates of existing and future impervious cover (Figure 7-8) by subwatershed. The shaded cells in the table highlight the subwatersheds in which future impervious cover is predicted to approach or exceed either the "sensitive" (10% to 12%) or "impacted" (25%) threshold values as described by the Impervious Cover Model.

Table 7-9: Percent Impervious Cover – Existing and Future Conditions

Subwatershed	Existing Percent Impervious Cover	Future Percent Impervious Cover	Percent Change ($IC_{Future} - IC_{Existing}$)
Bolton Notch Pond	16.6 %	18.9 %	2.3 %
Clarks Brook	17.2 %	20.6 %	3.4 %
Gages Brook	11.5 %	14.2 %	2.7 %
Gages Brook South Tributary	11.3 %	13.5 %	2.2 %
Lower Tankerhoosen River	15.8 %	23.0 %	7.2 %
Middle Tankerhoosen River	12.9 %	15.5 %	2.6 %
Railroad Brook	1.7 %	3.4 %	1.7 %
Tucker Brook	8.1 %	10.3 %	2.2 %
Upper Tankerhoosen River	4.5 %	4.7 %	0.2 %
Walker Reservoir	19.9 %	29.13 %	9.2 %
Total	9.87 %	12.47 %	2.6 %

It is significant to note that, based on this analysis, the overall impervious cover in the Tankerhoosen River watershed is predicted to increase from less than 10% to greater than

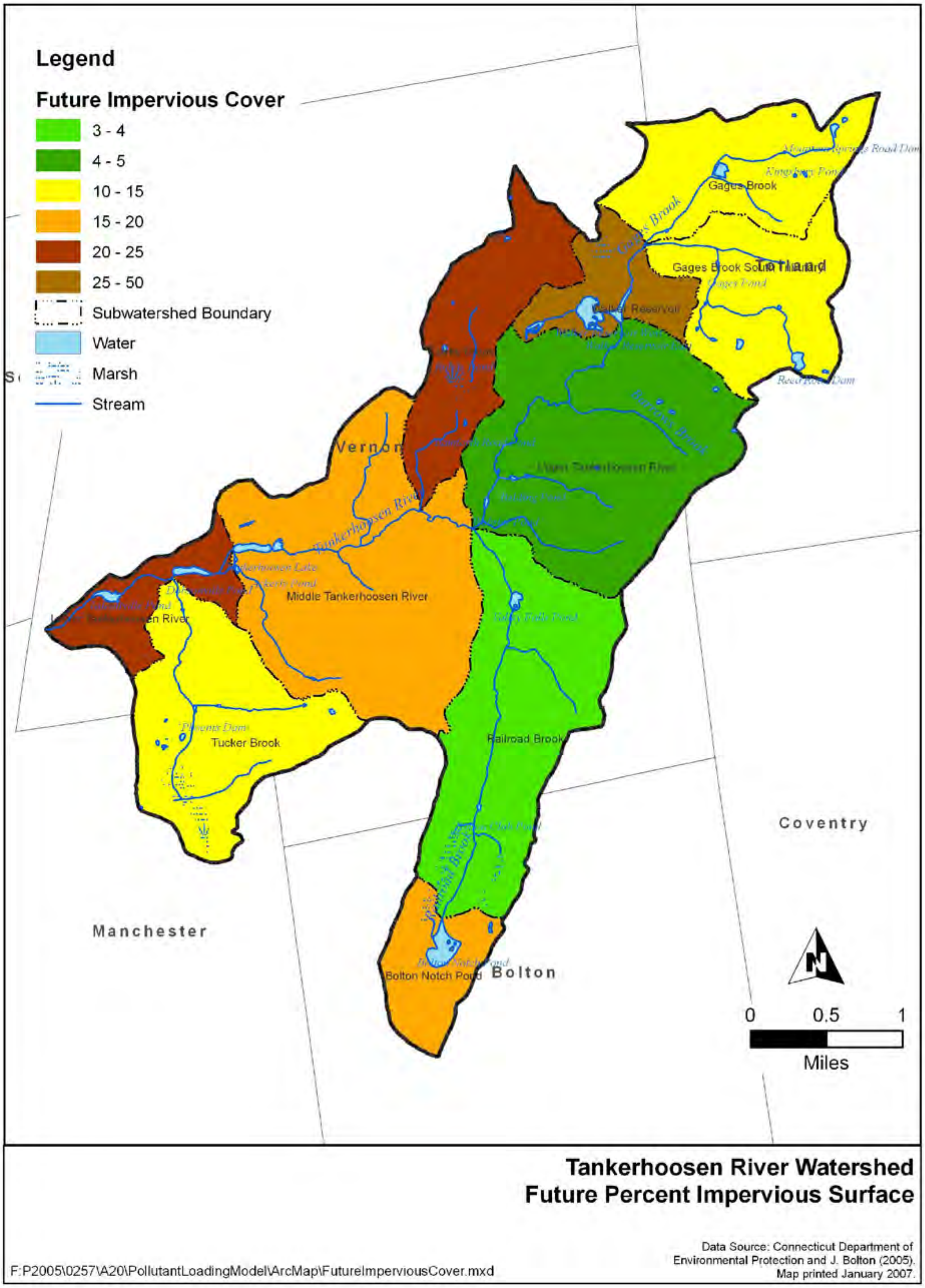


Figure 7-8: Future Impervious Cover – Tankerhoosen River Watershed

12%, which is considered impacted (see Figure 7-5). The largest change in impervious cover is predicted in the Walker Reservoir subwatershed, where imperviousness could increase from approximately 20%, or "impacted," to approximately 29%, or "non-supporting." Additionally, the impervious cover in Gages Brook and the associated Gages Brook South Tributary subwatersheds, both of which are important headwater streams, is predicted to cross the state-wide 12% sensitive threshold value.

Another useful metric was developed by Goetz et al. (2003) for the Chesapeake Bay region, which combines subwatershed impervious cover and tree cover within the 100-foot stream buffer. Each of the subwatersheds within the Tankerhoosen River Basin was analyzed with regard to the combined impervious cover/riparian zone metric, which is summarized in the following matrix by Goetz et al. (2003).

Stream Health	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Stream Buffer
Excellent	< = 6%	>=65%
Good	6-10%	60-65%
Fair	10-25%	40-60%
Poor	> 25%	<40%

Natural vegetation was determined using the CLEAR land cover data and included the deciduous forest, coniferous forest, forested wetland, and non-forested wetland categories. The following table presents the results from the combined impervious cover/riparian zone metric.

Table 7-10: Impervious Cover/Riparian Zone Metric – Existing and Future Conditions

Subwatershed	Existing		Future	
	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Stream Buffer	% Watershed Impervious Cover	% Natural Vegetation in 100-ft Stream Buffer
Bolton Notch Pond	16.6 %	40.4 %	18.9 %	39.8 %
Clarks Brook	17.2 %	51.9 %	20.6 %	38.0 %
Gages Brook	11.5 %	59.5 %	14.2 %	50.1 %
Gages Brook South Tributary	11.3 %	69.6%	13.5 %	40.2 %
Lower Tankerhoosen River	15.8 %	42.7 %	23.0 %	26.0 %
Middle Tankerhoosen River	12.9 %	49.7 %	15.5 %	41.8 %
Railroad Brook	1.7 %	89.4 %	3.4 %	73.7 %
Tucker Brook	8.1 %	65.5 %	10.3 %	49.6 %
Upper Tankerhoosen River	4.5 %	84.6 %	4.7 %	76.3%
Walker Reservoir	19.9 %	41.2 %	29.13 %	31.8 %

Overall, most of the Tankerhoosen River subwatersheds are currently categorized as "fair" to "good" based on the riparian zone metric published by Goetz et al. (2003), while several of the key headwater streams, including Railroad Brook and the Upper Tankerhoosen River, fall into the highest category. Comparison between the existing and future ratings indicates that four of the ten subwatersheds (Clarks Brook, Gages Brook South Tributary, Lower Tankerhoosen River, and Tucker Brook) are predicted to experience a decline in stream health as a result of future development and, in particular, development within the riparian corridor.

8.0 POLLUTANT LOADING

A pollutant loading model was developed using the land use/land cover data described in Section 7.0. The model was used to compare existing nonpoint source (NPS) pollutant loads from the watershed to projected future pollutant loads that would occur under a watershed buildout scenario. It is important to note that the results of this screening-level analysis are intended for the purposes of comparing existing and future conditions and not to predict future water quality. This section summarizes the methods and results of the analysis, which are presented in greater detail in Appendix B.

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 4.0, was used for this analysis. This model was developed for US EPA by Tetra Tech in EPA Region 5 and has since been modified for use in other areas of the country. The model calculates watershed pollutant loads for sediment and nutrients based on land use-related pollutant sources, including urban runoff, septic system failures, stream bank erosion, and agricultural activities. The model also allows simulation of best management practices (BMPs) and Low Impact Development (LID) practices to reduce pollutant loads.

Data obtained as part of the Land Use/Land Cover analysis presented in Section 7.0 were used to generate model inputs. Several other model parameters were specified for each pollutant and subwatershed, including:

- Event Mean Concentrations (EMCs), which are literature values for the mean concentration of a pollutant in stormwater runoff for each land use, and
- Curve Number (CN), which is a measure of the runoff potential of the land surface and is a function of soil type, cover condition, and slope.

The model was applied to each subwatershed to estimate pollutant loads for each subwatershed under existing land use and future land use scenarios, as described in Section 7.0. The existing and future pollutant loads were compared to assess anticipated changes in loads for each subwatershed. Table 8-1 presents the results of this analysis. Results are shown in terms of increase in pollutant loading rate (the mass of pollutant to be discharged from each acre of land in a watershed) and percent increase in pollutant load (based on the total pollutant discharge from each of the watersheds).

Table 8-1: Projected Pollutant Loading Rate and Load Increases

Watershed	Loading Rate Increase (Load Increase per Acre, mass [lb or ton] / ac-yr)				Load Increase (%) (Total for Each Watershed)			
	N	P	BOD	Sediment	N	P	BOD	Sediment
Bolton Notch Pond (318 ac)	0.66	0.10	2.7	0.012	9.6%	8.0%	10.9%	7.7%
Clarks Brook (647 ac)	0.91	0.13	3.9	0.017	14.1%	12.9%	16.1%	11.7%
Gages Brook (695 ac)	1.29	0.19	5.6	0.027	19.4%	17.0%	21.5%	16.7%
Gages Brook South Tributary (680 ac)	0.73	0.11	3.1	0.014	12.2%	10.2%	14.1%	10.5%
Lower Tankerhoosen River (306 ac)	1.31	0.10	6.3	0.022	20.0%	8.9%	27.6%	14.7%
Middle Tankerhoosen River (1570 ac)	0.63	0.07	3.1	0.008	10.6%	7.6%	14.2%	5.8%
Railroad Brook (1203 ac)	0.89	0.06	4.3	0.015	56.8%	20.3%	69.8%	46.4%
Tucker Brook (934 ac)	0.67	0.04	3.3	0.012	14.1%	5.3%	18.0%	9.4%
Upper Tankerhoosen River (1472 ac)	0.24	0.05	1.1	0.003	9.3%	11.1%	11.2%	6.0%
Walker Reservoir (322 ac)	1.86	0.28	8.6	0.036	25.8%	23.3%	34.6%	21.6%
Total (8149 ac)	0.77	0.09	3.5	0.013	16.0%	11.4%	19.9%	12.0%

Several of the subwatersheds are predicted to experience significantly higher increases in pollutant loads and loading rates under a watershed buildout scenario. These include:

- *Gages Brook*. The existing conditions pollutant load model indicates that this subwatershed is characterized by both relatively high total pollutant loads and pollutant loading rates, with approximately 70% urban land use, the largest amount of industrial land use, and the second-highest commercial land use composition in the entire watershed. The buildout condition of this watershed is projected to result in a 19% increase in urban land use with a corresponding decrease in forest; and the new urban land is likely to consist of new residential and industrial development. As such, relatively large loads and loading rate increases may occur.

- *Lower Tankerhoosen River.* The existing conditions pollutant load model for this subwatershed predicts relatively small loads (since the watershed area is small) and moderate loading rates. Under a buildout scenario, this subwatershed is projected to result in more than a 20% increase in nitrogen and BOD loads. The resulting loading rates for these parameters are projected to be the second highest of the Tankerhoosen River subwatersheds.

- *Railroad Brook.* The projected buildout pollutant loadings in this subwatershed for nitrogen and BOD are anticipated to increase by approximately 57% and 70%, respectively. Significant increases are also anticipated in phosphorus and sediment loads. Currently, the Railroad Brook sub watershed is heavily forested, with comparatively little development. Several large tracts of land within this subwatershed are potentially available for future development, especially in Bolton and South Vernon, which makes this watershed vulnerable to potentially significant pollutant load increases.

- *Walker Reservoir.* The existing conditions pollutant loading model suggests that this subwatershed has some of the highest levels of pollutant loads within the overall Tankerhoosen River watershed. Potential land use changes in this subwatershed include significant areas of new residential and mixed-use development, much of which is located adjacent to Walker Reservoir. These changes are predicted to result in the greatest increases in pollutant loading rates for all of the parameters evaluated.

9.0 COMPARATIVE SUBWATERSHED ANALYSIS

A Comparative Subwatershed Analysis was performed for the Tankerhoosen River subwatersheds to identify the subwatersheds with the greatest vulnerability and restoration potential. Subwatershed "metrics" were used to conduct this analysis. Metrics are numeric values that characterize the relative vulnerability and restoration potential of a subwatershed. The results of this analysis will be used to prioritize field assessment efforts in future phases of this study and to guide plan recommendations.

The analysis involves a screening level evaluation of selected subwatershed metrics that are derived by analyzing available GIS layers and other subwatershed data sources. The basic approach used to conduct the Comparative Subwatershed Analysis consisted of:

1. Delineation of subwatershed boundaries and review of available metric data.
2. Selection and calculation of metrics that best describe subwatershed vulnerability and restoration potential. (The metrics used to rank subwatershed vulnerability were selected separately from the metrics used to rank subwatershed restoration potential.)
3. Developing weighting and scoring rules to assign points to each metric.
4. Computing aggregate scores and developing initial subwatershed rankings.

Subwatersheds with higher aggregate "vulnerability" scores are more sensitive to future development and should be the focus of watershed conservation efforts to maintain existing high-quality resources and conditions. Subwatersheds with higher aggregate "restoration potential" scores are more likely to have been impacted and have greater potential for restoration to improve upon existing conditions. This approach enables watershed planners to allocate limited resources on subwatershed where restoration and conservation efforts have the greatest chances of success. The subwatersheds used in this analysis are those identified in Section 5.1 of this document.

The following sections describe the metrics used and the rationale for their selection, how the various metrics were calculated, and the results of the evaluation. Available GIS and other data were used to compute the value of each metric.

Table 9-1: Summary of Subwatershed Vulnerability Metrics

Subwatershed Metric	How Metric is Measured	Indicates Higher Vulnerability Potential When	Metric Points
1. Impervious Cover Change	% increase in impervious cover in subwatershed	Increase in IC is high, suggesting greater development potential and stream impacts	Award 1 pt for each 1% increase in impervious cover
2. Impervious Cover Threshold	Comparison of current and future IC relative to ICM threshold	Predicted IC crosses "impacted" (12%) threshold, development could result in significant stream impacts	Award 5 pts for each exceedance of the 12% threshold
3. Stream Order	% of subwatershed consisting of 1st or 2nd order streams	Subwatershed consists of more lower order streams, vulnerability of headwater streams for habitat and water quality protection	Award 6 pts if 100% of streams are 1st and 2nd order; 4 pts if 50% are 1st and 2nd order; 2 pts if 33% are 1st and 2nd order; 0 pts if 0% are 1st and 2nd order
4. Pollutant Loading	% increase in pollutant loading in subwatershed	Increase in pollutant loading is high, suggesting water quality impacts from future development	Award 1 pt for each pollutant loading parameter > 10% and 3 pts for each parameter >20%
5. Industrial/ Commercial Land	% of subwatershed as industrial or commercial land	Industrial/commercial land is high, greater potential for water quality impacts from pollutant hot spot	Award 1 pt for each 2% of subwatershed classified as industrial or commercial/retail
6. Forest Cover	% of subwatershed with developable forest cover	Area of developable forest cover is high, potential for significant future reductions in forested land	Award 1 pt for each 5% of subwatershed with developable forest cover
7. Stream Corridor Forest Cover	% of stream corridor that is forested	Corridor forest cover is high, potential for significant future reductions in forested riparian areas if public ownership of corridor is low	Add 1 pt for each 10% increase in forest cover
8. Public Ownership of Stream Corridor	% of stream corridor that is publicly owned	Public ownership is low (see metric 7)	Add 1 pt for each 10% reduction of stream corridor in public ownership
9. Road Crossings	number of road crossings / square mile	Number of road crossings is high, greater potential for direct stormwater discharges from roadways	<1 = 0pts; 1 to 5 = 1 pts; 5 to 8 = 3 pts; 9 to 12 = 5 pts; 13-15 = 7pt; >15 = 10 pts
10. Developed Areas with Septic	% of subwatershed served by septic	Area served by septic is high, indicating potential for pollutant loadings from failing septic systems	Award 1 pt for each 5% of subwatershed area served by septic
11. Drinking Water Resources	Acreage of developable land within a public drinking water supply area	Area of developable land is high, greater potential for impacts to sensitive surface and groundwater drinking water supplies	Award 3 pts for each subwatershed within an aquifer protection area

9.1 Priority Subwatersheds for Conservation

The results of the subwatershed vulnerability analysis are summarized in Table 9-2.

Table 9-2: Results of Subwatershed Vulnerability Analysis

Subwatershed	Impervious Cover Change	Impervious Cover Threshold	Stream Order	Pollutant Loading	Industrial/ Commercial Land	Developable Forest Cover	Stream Corridor Forest Cover	Public Ownership of Stream Corridor	Road Crossings	Developed Areas Served by Septic	Drinking Water Resources	Total
Bolton Notch Pond	2	10	6	1	7	2	3	3	0	5	0	41
Clarks Brook	3	10	6	4	7	2	5	5	1	4	0	47
Gages Brook	3	5	6	6	11	4	6	6	3	5	0	55
Gages Brook South Tributary	2	5	6	4	1	5	6	5	3	5	0	42
Lower Tankerhoosen River	7	10	0	7	2	5	4	5	7	5	0	53
Middle Tankerhoosen River	3	10	2	2	2	2	4	5	3	3	3	38
Railroad Brook	2	0	6	12	0	6	9	0	5	1	0	40
Tucker Brook	2	0	6	2	0	3	5	6	3	2	0	28
Upper Tankerhoosen River	0	0	4	2	0	4	8	3	3	3	0	27
Walker Reservoir	9	10	4	4	2	3	2	5	10	6	0	56

As shown in Table 9-2, the following subwatersheds are considered most vulnerable to future development impacts and should be given highest priority for conservation efforts to maintain existing resource conditions:

- Clarks Brook,
- Gages Brook,
- Gages Brook South Tributary,
- Lower Tankerhoosen River,
- Walker Reservoir.

Table 9-3: Summary of Subwatershed Restoration Potential Metrics

Subwatershed Metric	How Metric is Measured	Indicates Higher Restoration Potential When	Metric Points
1. Existing Impervious Cover	% impervious cover in subwatershed	Current impervious cover is low, suggesting range of possible sites for storage retrofits and stream repairs	<10% = 10 pts; 10 to 15% = 5 pts; >15% = 1 pt
2. Publicly-owned land	% of subwatershed that is publicly owned	Public land ownership is high, providing range of potential sites for restoration practices	Award 1 pt for each 2.5% of subwatershed in public ownership
3. Industrial Land	% of subwatershed that is industrial land	Industrial land is high, suggesting potential for source controls, discharge prevention, and on-site retrofits	Award 1 pt for each 2% of subwatershed classified as industrial
4. Forest Cover	% forest cover in subwatershed	Forest cover is low, suggesting potential for upland and riparian reforestation	<35% = 7pts; 36 to 50% = 5 pts; 50 to 70% = 3 pts; >70% = 1pt
5. Wetland Cover	% of subwatershed that is wetlands	Wetland cover is high, suggesting potential for wetland and riparian restoration	Award 1 pt for each 2% of subwatershed area
6.Development Potential	% of developable land in subwatershed	No more development is expected; stable conditions increase feasibility of stream repairs and storage retrofits	30 to 35% = 1pts; 25 to 30% = 4 pts; 20 to 25% = 7 pts; 15 to 25% = 10pt
7. Stream Density	stream miles / square mile	Stream density is high, suggesting greater feasibility of corridor practices	Award 1 pt for each 10% increase in stream density from watershed average of 1.3 stream miles / square mile
8. Stream Corridor Forest Cover	% of stream corridor that is forested	Corridor forest cover is low, suggesting feasibility of riparian reforestation and stream repairs	Add 1 pt for each 10% reduction in forest cover
9. Public Ownership of Corridor	% of stream corridor that is publicly owned	Public corridor ownership is high, suggesting greater feasibility of corridor practices	Add 1 pt for each 10% of stream corridor in public ownership
10. Road Crossings	number of road crossings / square mile	Number of road crossings is high, suggesting greater potential for stream repairs, culvert modifications	<1 = 0pts; 1 to 5 = 1 pts; 5 to 8 = 3 pts; 9 to 12 = 5 pts; 13-15 = 7pt; >15 = 10 pts
11. Developed Areas with Septic	% of subwatershed that is served by septic	Area served by septic is high, suggesting greater potential for septic system upgrades	Award 1 pt for each 5% of subwatershed area served by septic
12. Water Quality Impairments	number of water quality impairments / square mile	Number of water quality impairments is high, suggesting regulatory need to focus on WQ improvements	Award 3 pts for each water quality impairment identified

9.2 Priority Subwatersheds for Restoration

The results of the subwatershed restoration potential analysis are summarized in Table 9-4.

Table 9-4: Results of Subwatershed Restoration Potential Analysis

Subwatershed	Existing Impervious Cover	Publicly-owned Land	Industrial Land	Forest Cover	Wetland Cover	Development Potential	Stream Density	Stream Corridor Forest Cover	Public Ownership of Stream Corridor	Road Crossings	Developed Areas Served by Septic	Water Quality Impairments	Total
Bolton Notch Pond	1	1	1	5	3	10	0	6	6	0	5	0	38
Clarks Brook	1	10	5	7	8	10	0	4	11	1	4	0	60
Gages Brook	5	12	6	5	8	4	10	3	12	3	5	6	79
Gages Brook South Tributary	5	3	0	3	3	1	14	2	9	3	5	9	57
Lower Tankerhoosen River	1	6	1	5	1	1	15	5	11	7	5	6	64
Middle Tankerhoosen River	5	6	1	5	6	10	5	5	10	5	3	0	61
Railroad Brook	10	0	0	1	6	1	9	0	0	5	1	0	34
Tucker Brook	10	10	0	5	6	7	11	4	11	1	2	0	66
Upper Tankerhoosen River	10	3	0	1	7	4	12	1	6	3	3	3	52
Walker Reservoir	1	10	1	7	4	1	0	7	9	10	6	0	55

As shown in Table 9-4, the following subwatersheds should be given highest priority for restoration potential to improve upon existing conditions:

- Clarks Brook,
- Gages Brook,
- Lower Tankerhoosen River,
- Middle Tankerhoosen River,
- Tucker Brook.

Based on the CSA results, the following subwatersheds are recommended for detailed assessment and planning:

- Clarks Brook,
- Gages Brook,
- Gages Brook South Tributary,
- Lower Tankerhoosen River,
- Middle Tankerhoosen River,
- Tucker Brook,
- Walker Reservoir.

10.0 REFERENCES

Baystate Environmental Consultants, Inc. (2004). *Watershed Management Plan for Tankerhoosen Lake.*

Bell, M. (1985). *The Face of Connecticut*. Connecticut Geological and Natural History Survey of Connecticut. Bulletin 110. Hartford, Connecticut.

Center for Land Use Education and Research (2007) *The Status of Connecticut's Coast Riparian Corridors: Research Summary.*

Civco, D. (2005). *Hockanum River Watershed Percent Imperviousness by Basin*. Department of Natural Resources Management and Engineering at the University of Connecticut. GIS Map prepared by J. Bolton. March 2005.

Comins, Patrick (1999). Breeding Landbird Survey Freja Park/Bolton Notch State Park. Town of Bolton Conservation Commission.

Connecticut Department of Environmental Protection. (2002). *Surface Water Quality Standards* (Effective December 17, 2002). *Ground Water Quality Standards* (Effective April 12, 1996).

Connecticut Department of Environmental Protection (2006). *2006 Listing of Connecticut Waterbodies Not Meeting Water Quality Standards.*

Connecticut Ecosystems, LLC (August 2005). Town of Vernon Vernal Pool Study.

Connecticut River Watch Program (May 2000). *Hockanum River Stream Walk Summary Report*. Middletown, Connecticut.

Connecticut River Watch Program (September 2001). *Hockanum River Stream Walk Summary Report*. Middletown, Connecticut.

Connecticut River Watch Program (May 2004). *Hockanum River Rapid Bioassessment Summary Report*. Middletown, Connecticut.

Connecticut River Watch Program (March 2005). *Hockanum River Rapid Bioassessmet Summary Report*. Middletown, Connecticut.

Fuss & O'Neill, Inc. (2005). *The Hockanum River State of the Watershed Report*. Prepared for the North Central Conservation District, Inc. December 2005.

Fuss & O'Neill, Inc. (2007). *Tankerhoosen River Watershed Water Quality Monitoring Study.* Prepared for the Friends of the Hockanum River Linear Park of Vernon, Inc. March 2007.

Gibbons, J. and Gibbons, G. (1992). *The Coginchaug River Greenway – Proposed Management Plan*. University of Connecticut Cooperative Extension System. Haddam, Connecticut.

Goetz, S.J., R.K. Wright, A.J. Smith, E. Zineckerb and E. Schaubb. 2003. *IKONOS imagery for resource management: Tree cover, impervious surfaces, and riparian buffer analyses in the mid-Atlantic region.* Remote Sensing of Environment 88 (2003) 195 208.

NQQD (2004). *Findings from the National Stormwater Quality Database*, Research Progress Report. Prepared by the Center for Watershed Protection.

Nationwide Urban Runoff Program (1983). *Results of the Nationwide Urban Runoff Program.* U.S. Environmental Protection Agency Water Planning Division, PB 84-185552, Washington, D.C.

Prisloe, Michael, Emily Hoffhine Wilson, Chester Arnold (2003). *Refinement of Population-Calibrated Land-Cover-Specific Impervious Surface Coefficients for Connecticut.* Final Report, DEP Project 01-08 Task #6. University of Connecticut Middlesex County Extension Center, Haddam, CT. Accessed at http://www.nemo.uconn.edu/tools/impervious_surfaces/literature.htm on March 12, 2008.

Sexton, Karen (1993). *Vascular Plant Inventory of the Valley Falls/Bolton Notch Watershed.*

Seymour, Jane and Friends of the Hockanum River Linear Park of Vernon, Inc. (2004). *Wildlife Surveys at Selected Locations within the Tankershoosen Watershed.* Vernon, Connecticut.

Sleavin, William J., Daniel L. Civco, Sandy Prisloe, Laurie Giannotti, (2000). *Measuring Impervious Surfaces for Non-Point Source Pollutant Modeling.* Proceedings of the 2000 ASPRS Annual Convention. Accessed at http://www.nemo.uconn.edu/tools/impervious_surfaces/literature.htm on March 12, 2008.

Tetra Tech., Inc. *Spreadsheet Tool for the Estimation of Pollutant Load (STEPL). Version 4.0.* Developed for the U.S. EPA

United States Environmental Protection Agency (EPA). 2005. *Waste Cleanup & Reuse in New England: Precision Plating Corp*. URL: www.epa.gov/region1/superfund/sites/precision.

University of Connecticut Center for Land Use Education and Research (CLEAR). Connecticut's Changing Landscape – Statewide Land Cover. URL: www.clear.uconn.edu/projects/landscape/statewide_landcover.htm.

Watershed Treatment Model (2001). *Watershed Treatment Model User's Guide - Version 3.1.* Prepared by the Center for Watershed Protection.

APPENDIX A

SPECIES LIST
BELDING WILDLIFE MANAGEMENT AREA

APPENDIX A

FLORA OF BELDING WMA.

Club Mosses
Club-moss family (Lycopodiaceae)
Tree club moss (*Lycopodium obscurum*)

Ferns
Bracken Fern Family (Dennstaedtiaceae)
Hay-scented fern (*Dennstaedtia punctilobula*)
Bracken fern (*Pteridium aquilinum*)

Wood fern family (Dryopteridaceae)
Sensitive fern (*Onoclea sensibilis*)
Spinulose wood fern (*Dryopteris spinulosa*)
Christmas fern (*Polystichum acrosticoides*)
Rock polypody (*Polypodium virginianum*)

Royal fern family (Osmundaceae)
Cinnamon fern (*Osmunda cinnamomea*)
Interrupted fern (*Osmunda claytoniana*)
Royal fern (*Osmunda regalis*)

Maidenhair Fern family (Pteridaceae)
Maidenhair fern (*Adiantum pedatum*)

Marsh Fern family (Thelypteridaceae)
New York fern (*Thelypteris noveboracensis*)

Gymnosperms
Pine family (Pinaceae)
Eastern white pine (*Pinus strobes*)
Eastern red cedar (*Juniperus virginiana*)
Red pine (*Pinus resinosa*)
Pitch pine (*Pinus rigida*)
Eastern hemlock (*Tsuga Canadensis*)
Norway spruce (*Picea abies*)

Angiosperms (Flowering plants)

Magnolia family (Magnoliaceae)
Tulip tree (*Liriodendron tulipifera*)

Laurel family (Lauraceae)
Northern spicebush (*Lindera benzoin*)
Sassafras (*Sassafras albidum*)

Barberry family (Berberidaceae)
Japanese barberry (*Berberis thunbergii*)

Buttercup family (Ranunculaceae)
Wood anemone (*Anemone quinquefolia*)
Rue anemone(*Thalictrum thalictroides*)
Goldthread (*Coptis groenlandica*)
Kidneyleaf buttercup (*Ranunculus abortivus*)
American pokeweed (*Phytolacca Americana*)

Buckwheat family (Polygonaceae)
Arrow-leaf tearthumb (*Polygonum sagittatum*)

Witch-hazel family (Hamamelidaceae)
Witchhazel (*Hamamelis virginiana*)

Plane-tree family (Plantanaceae)
American sycamore (*Platanus occidentalis*)

Beech family (Fagaceae)
Black oak (*Quercus velutina*)
Red oak (*Quercus rubra*)
White oak (*Quercus alba*)
Scarlet oak (*Quercus coccinea*)
American chestnut (*Castanea dentata*)
American beech (*Fagus grandifolia*)

Birch family (Betulaceae)
Speckled alder (*Alnus rugosa*)
Black birch (*Betula lenta*)
Gray birch (*Betula populifolia*)
Paper birch (*Betula papyrifera*)
Yellow birch (*Betula alleghaniensis*)

Bayberry family (Myricaceae)
Sweetfern (*Comptonia peregrina*)

Walnut family (Juglandaceae)
Pignut hickory (*Carya glabra*)
Shagbark hickory (*Carya ovata*)

(Hypericaceae)
St. John's wort (*hypericum perforatum*)

Wintergreen family (Pyrolaceae)
Shinleaf (*Pyrola elliptica*)
Spotted wintergreen (*Chimaphila maculata*)

Indianpipe (*Monotropa uniflora*)
Pinesap (*Monotropa hypopithys*)

Heath family (Ericaceae)
Eastern teaberry (*Gaultheria procumbens*)
Black huckleberry (*Gaylussacia baccata*)
Mountain laurel (*Kalmia angustifolium*)
Pinxter flower (*Rhododendron nudiflorum*)
Highbush blueberry (*Vaccinium corymbosum*)
Lowbush blueberry (*Vaccimium angustifolium*)

Primrose family (Primulaceae)
Starflower (*Trientalis borealis*)
Whorled loosestrife (*Lysimachia quadrifolia*)

Violet family (Violaceae)
Common blue violet (*Viola papilionaceae*)
Northern white violet (*Viola pallens*)
Sweet white violet (*Viola blanda*)
Field violet (*Viola arvensis*)

Willow family (Salicaceae)
Quaking aspen (*Populus tremuloides*)

Cucumber family (Cucurbitaceae)
Bur cucumber (*echinocystis lobata*)

Elm family (Ulmaceae)
American elm (*Ulmus americana*)

Rose family (Rosaceae)
White meadowsweet (*Siriea latifolia*)
Steeplebush (*Spirea tomentosa*)
Blackberry (*Rubus allegheniensis*)
Raspberry (*Rubus occidentalis*)
Multiflora Rose (*Rosa multiflora*)
Strawberry (*Fragaria virginiana*)
Black cherry (*Prunus serotina*)
Apple (*Prunus malus*)

Pea family
Hop clover (*Trifolium aureum*)
Red clover (*Trifolium pretense*)
Cow vetch (*Viccia cracca*)

Maple family
Sugar maple (*Acer saccharum*)
Red maple (*Acer rubrum*)

Cashew family (Anacardiaceae)
Staghorn sumac (*Rhus typhina*)
Poison ivy (*Toxicodendron radicans*)

Touch-me-not Family (Balsaminaceae)
Spotted touch-me-not (*Impatiens capensis*)

Milkwort family (Polygalaceae)
Fringed polygala (*Polygala paucifolia*)
Field milkwort (*Polygala sanguinea*)

Staff-tree family (Celastraceae)
Winged euonymus (*Euonymus alatus*)
Asiatic bittersweet (*Celastrus orbiculatus*)

Holly family (Aquifoliaceae)
Winterberry (*Ilex verticillata*)

Oleaster family (Eleagnaceae)
Autumn olive (*Eleagnus umbellate*)
Russian olive (*Eleagnus angustifolium*)

Grape family (Vitaceae)
Virginia creeper (*Parthenocissus quinquefolia*)
Fox Grape (*Vitis labrusca*)

Dogwood family (Cornaceae)
Silky dogwood (*Cornus amomum*)

Ginseng family (Araliaceae)
Ginseng (*Panax quinquefolium*)
Dwarf ginseng (*Panax trifolium*)

Carrot family (Apiaceae)
Queen Anne's Lace (*Daucus carota*)

Honeysuckle family (Caprifoliaceae)
Tartarian Honeysuckle (*Lonicera tatarica*)
Elderberry (*Sambucus canadensis*)
Maple-leaved viburnum (*Viburnum acerifolium*)
Arrowwood (*Viburnum dentatum*)

Aster family (Asteraceae)
Yarrow (*Achillea millefolium*)
New York Aster (*Aster novi-belgii*)
Oxeye daisy (*Chrysanthemum lleucanthemum*)
Bull thistle (*Cirsium vulgare*)

Joe-Pye weed (*Eupatorium maculata*)
Black-eyed Susan (*Rudbeckia hirta*)
Rough-stemmed goldenrod (*Solidaga rugosa*)
Common dandelion (*Taraxacum officinale*)
Pineapple weed (*Matricaria matricarioides*)
Horseweed (*Erigeron canadensis*)

<u>Bedstraw family</u> (Rubiaceae)
Bluets (*Houstonia caerulea*)
Partridgeberry (*Mitchella repens*)

<u>Dogbane family</u> (Apocynaceae)
Periwinkle (*Vinca minor*)
Common milkweed (*Asclepias syriaca*)

<u>Nightshade family</u> (Solanaceae)
Bittersweet nightshade (*Solanum dulcamara*)
Jimsonweed (*Datura stramonium*)

<u>Olive family</u> (Oleaceae)
White ash (*Fraxinus americana*)

<u>Figwort family</u> (Scrophulariaceae)
Blue toadflax (*Linaria canadensis*)
Butter-and-eggs (*Linaria vulgaris*)
Monkey flower (*Mimulus ringens*)
Common mullein (*Verbascum thapsus*)
Thyme-leaved speedwell (*Verbascum serpyllifolia*)

<u>Mint family</u> (Lamiaceae)
Heal-all (*Prunella vulgaris*)
Wild mint (*mentha arvensis*)

<u>Melanthium family</u> (Melanthiaceae)
False hellebore (*Veratrum nigrum*)

<u>Trillium family</u> (Trilliaceae)
Purple trillium (*Trillium erectum*)
Nodding trillium (*Trillium cernuum*)

<u>Lily family</u> (Liliaceae)
Canada Mayflower (*Maianthemum canadense*)
False Solomon's seal (*Smilacina racemosa*)
Smooth Solomon's seal (*Polygonatum biflorum*)
Trout lily (*Erythronium americanum*)
Indian cucumber root (*Medeola virginiana*)

<u>Catbrier family</u> (Smilaceae)

Greenbrier (*Smilax rotundifolia*)

<u>Orchid family</u> (Orchidaceae)
Nodding ladies' tresses (*Spiranthes cernua*)
Pink lady's slipper (*Cypripedium acaule*)
Rattlesnake plantain (*Goodyera pubescens*)

<u>Asparagus family</u> (Asparagaceae)
Asparagus (*Asparagus officinalis*)

<u>Spiderwort family</u> (Commelinaceae)
Asiatic dayflower

<u>Rush family</u> Juncaceae
Canadian rush (*Juncus canadensis*)
Common rush (*Juncus effusus*)
Poverty rush (*Juncus tenuis*)

<u>Sedge family</u> (Cyperaceae)
Yellow nutsedge (*Cyperus esculentus*)
Fringed sedge (*Carex crinita*)
Greater bladder sedge (*Carex intumescens*)
Shallow sedge (*Carex lurida*)
Pennsylvania sedge (*Cares pensylvanica*)
Tussock sedge (*Carex stricta*)
Green bulrush (*Scirpus atrovirens*)
Wool grass (*Scirpus cyperinus*)
Panicled bulrush (*Scirpus microcarpus*)
Fox sedge (*Carex vulpinoidea*) - Metzler

<u>Grass family</u> (Poaceae)
Orchard grass (*Dactylis glomerata*)
Crabgrass (*Digitaria sanguinalis*)
Witch grass (*Panicum capillare*)
Reed canary grass (*Phalaris arundinaceae*)
Green foxtail (*Setaria viridis*)
Velvet grass (*Holcus lanatus*) – Metzler
Timothy (*Phleum pretense*) – Metzler
Cheatgrass (*Bromus tectorum*) – Metzler
Sweet vernal grass (*Anthoxanthum odoratum*) - Metzler

<u>Water plantain family</u> Alismataceae
Arrowhead (*Sagittaria latifolila*)

<u>Arum family</u> (Araceae)
Skunk cabbage (*Symplocarpus foetidus*)
Jack-in-the-pulpit (*Arisaema triphyllum*)

Cat-tail family (Typhacea)
Common cattail (*Typha latifolia*)

FAUNA OF BELDING W MA.

INVERTEBRATES
Annelids
Earthworm (*Oligochaeta*)
Leech (*Hirudinea*)

Crustaceans
Crayfish (*Decapoda*)

Molluscs
Pea clam (*Sphaeriidae*)
Eastern pearlshell (*Margaritifera margaritifera*)
Eastern elliptio (*Elliptio complanata*)
Lymnaid snail (*Pseudosuccinea columella*)
Planorbid snail (*Helisoma*)

Insects
Mayflies (Ephemeroptera)
Drunella (*Ephemerellidae*)
Flat-head mayfly (*Heptageniidae:Epeorus*)
Stenonema (*Heptageniidae*)
Baetidae

True flies (Diptera)
Midge (*Chironomidae*)
Dance fly (*Empididae*)
Sand fly (*Psychodidae*)
Black fly (*Simuliidae*)
Crane fly (*Tipulidae*)
Phantom crane fly (*Ptychopteridae :Bittacomorpha clavipes*)

Stoneflies (Plecoptera)
Chloroperlidae
Glossosomatidae
Nemouridae
Peltoperlidae
Perlidae
Perlodidae

Caddisflies (Trichoptera)

Chimarra
Hydropsychidae
Lepidostoma
Limnephilidae
Philopotamidae
Rhyacophila

Dobsonflies and fishflies (Megloptera)
Corydalus
Nigronia

Beetles (Coleoptera)
Predaceous diving beetle (*Dytiscidae*)
Water beetle (*Elmidae*)
Water scavenger beetle (*Hydrophilidae*)
Water penny beetle (*Psephenidae*)
Scarab beetle (*Scarabaeidae*)
Green tiger beetle (*Cicindela sexguttata*)
Burying beetle (*Nicrophorus arbicollis*)

ODONATA
Damselflies
River jewelwing (*Calopteryx maculata*)
Ebony jewelwing (*Calopteryx aequibilis*)
Elegant spreadwing (*Lestes inaequalis*)
Fragile forktail (*Ischnura posita*)

Dragonflies
Brown darner (*Boyeria vinosa*)
Common green darner (*Anax junius*)
Spangled skimmer (*Libellula cyanea*)
Yellow-legged meadowhawk (*Sympetrum vicinum*)
Banded-winged meadowhawk (*Sympetrum semicinctum*)
Cherry-faced meadowhawk(*Sympetrum internum*)
Clubtail (Gomphidae)

Lepidoptera

Butterflies

Peck's skipper (*Polites peckius*)
Crossline skipper (*Polites origenes*)
Delaware skipper (*Anatrytone logan*)
Tiger swallowtail (*Papilio glaucus*)
Spicebush swallowtail (*Papilio Troilus*)
Cabbage butterfly (*Pieris rapae*)
Clouded sulphur (*Colias philodice*)
Small copper (*Lycaena phlaeas*)
Eastern tailed blue (*Everes comyntas*)
Spring azure (*Celastrina "ladon"*)
Red-spotted purple (*Limenitis arthemis*)
Great spangled fritillary (*Speyeria cybele*)
Pearl crescent (*Phyciodes tharos*)
Monarch (*Danaus plexippus*)
Viceroy (*Limenitis archippus*)

Moths

Garden tortrix (*Ptycholoma peritana*)
Lesser maple spanworm moth (*Itame pustularia*)
Blurry chocolate angle (*Semiothisa transitaria*)
Minor angle (*Semiothisa minorata*)
Four-spotted angle (*Semiothisa quadrinotaria*)
White spring moth (*Lomographa vestaliata*)
Lesser grapevine looper moth (*Eulithis diversilineata*)
Greater grapevine looper moth (*Eulithis gracilineata*)
Sweetfern geometer (*Cylophora pendulinaria*)
Cross-lined wave (*Calothysanis amaturaria*)
Red twin spot (*Xanthorhoe ferrugata*)
White-striped black (*Trichodezia albovittata*)
Brown bark carpet (*Horisme intestinata*)
Black-rimmed prominent (*Pheosia rimosa*)
Painted lichen moth (*Hypoprepia fucosa*)
Clymene moth (*Haploa clymene*)
Harnessed moth (*Apantesis phalerata*)
Pink-shaded fern moth (*Callopistria mollissima*)
Copper underwing (*Amphipyra pyramidoides*)
Common pinkband (*Ogdoconta cinereola*)
Eight-spotted forester (*Alypia octomaculata*)
Pink-barred lithacodia (*Lithacodia carneola*)
Decorated owlet (*Pangrapta decoralis*)
Spotted grass moth (*Rivula propinqualis*)
American idia (*Idia americalis*)
Common idia (*Idia aemula*)
Early zanclognatha (*Zanclognatha cruralis*)

Morbid owlet (*Chytolita morbidalis*)
Dark-spotted palthis (*Palthis angulalis*)

FISH
American Eel (*Anguilla rostrata*)
Bluegill (*Lepomis macrochirus*)
Brook Trout (*Salvelinus fontinalis*)
Blacknose Dace (*Rhinichthys atratulus*)
Brown Trout (*Salmo trutta*)
Chain Pickerel (*Esox Niger*)
Fallfish (*Semotilus corporalis*)
Golden Shiner (*Notemigonus crysoleucas*)
Longnose Dace (*Rhinichthys cataractae*)
Largemouth Bass (*Micropterus salmoides*)
Rainbow Trout (*Oncorhynchus mykiss*)
Tessellated darter (*Etheostoma olmstedi*)
White Sucker (*Catostomus commersoni*)
Yellow Perch (*Perca flavescens*)

AMPHIBIANS
American toad (*Bufo americanus*)
Gray treefrog (*Hyla versicolor*)
Northern spring peeper (*Pseudacris c. crucifer*)
Bullfrog (*Rana catesbeiana*)
Green frog (*Rana clamitans melanota*)
Pickerel frog (*Rana palustris*)
Wood frog (*Rana sylvatica*)
Northern Redback salamander (*Plethodon cinereus*)
Spotted salamander (*Ambystoma maculatum*)
Northern two-lined salamander (*Eurycea bislineata*)
Red-spotted newt (*Notophthalmus v. viridescens*)

REPTILES
Painted turtle (*Chrysemys picta*)
Eastern box turtle (*Terrapene c. carolina*)
Eastern milk snake (*Lampropeltis t. triangulum*)
Eastern garter snake (*Thamnophis s. sirtalis*)

BIRDS
Ciconiiformes
Great Blue Heron (*Ardea herodias*)
Turkey Vulture (*Cathartes aura*)
Falconiformes
Red-tailed Hawk (*Buteo jamaicensis*)
Broad-winged hawk (*Butea platypterus*)
Cooper's hawk (*Accipiter cooperii*)
Sharp-shinned hawk (*Accipiter striatus*)
Gallifomes
Wild Turkey (*Meleagris gallopavo*)
Charadriiformes
American woodcock (*Scolopax minor*)
Killdeer (*Charadrius vociferus*)
Columbiformes
Mourning Dove (*Zenaida macroura*)
Cuculiformes
Yellow-billed cuckoo (*Coccyzus americanus*)
Strigiformes
Barred Owl (*Strix varia*)
Great horned owl (*Bubo virginianus*)
Apodiformes
Chimney Swift (*Chaetura pelagica*)
Coraciiformes
Belted Kingfisher (*Ceryle alcyon*)
Piciformes
Downy Woodpecker (*Picoides pubescens*)
Hairy woodpecker (*Picoides villosus*)
Red-bellied Woodpecker (*Melanerpes carolinus*)
Pileated woodpecker (*Dryocopus pileatus*)
Yellow-shafted Flicker (*Colaptes auratus*)
Passeriformes
Tyrannidae
Eastern Wood-Pewee (*Contopus virens*)
Eastern Phoebe (*Sayornis phoebe*)
Great Crested Flycatcher (*Myiarchus crinitus*)
Olive-sided flycatcher (*Nuttallornis borealis*)
Eastern Kingbird (*Tyrannus tyrannus*)
Vireonidae
Red-eyed Vireo (*Vireo olivaceus*)
Warbling Vireo (*Vireo gilvus*)
Yellow-throated vireo (*Vireo flavifrons*)
Corvidae
Common raven (*Corvus corax*)
American Crow (*Corvus brachyrhynchos*)
Blue Jay (*Cyanocitta cristata*)

Hirundidae
Tree Swallow (*Iridoprocne bicolor*)
Barn Swallow (*Hirundo rustica*)
Paridae
Black-capped Chickadee (*Poecile atricapillus*)
Tufted Titmouse (*Baeolophus bicolor*)
Sittidae
Red-breasted Nuthatch (*Sitta carolensis*)
White-breasted Nuthatch (*Sitta Canadensis*)
Certhiidae
Brown creeper (*Certhia familiaris*)
Troglodytidae
Carolina Wren (*Thryothorus ludovicianus*)
House Wren (*Troglodytes aedon*)
Turdidae
Eastern Bluebird (*Sialia sialis*)
Swainson's thrush (*Catharus ustulatus*)
Veery (*Catharus fuscescens*)
Wood Thrush (*Hylocichla mustelina*)
American Robin (*Turdus migratorius*)
Mimidae
Gray Catbird (*Dumetella carolinensis*)
Northern Mockingbird (*Mimus polyglottos*)
Brown Thrasher (*Toxostoma rufum*)
Bombycillidae
Cedar Waxwing (*Bombycilla cedrorum*)
Parulidae
Blue-winged Warbler (*Vermivora pinus*)
Nashville warbler (*Vermivora ruficapilla*)
Northern parula (*Parula americana*)
Yellow Warbler (*Dendroica petechia*)
Chestnut-sided warbler (*Dendroica pensylvanica*)
Yellow-rumped warbler (*Dendroica coronata*)
Black-throated green warbler (*Dendroica virens*)
Pine Warbler (*Dendroica pinus*)
Prairie warbler (*Dendroica discolor*)
Palm warbler (*Dendroica palmarum*)
Blackpoll warbler (*Dendroica striata*)
Blackburnian warbler (*Dendroica fusca*)
Cerulean warbler (*Dendroica cerulean*)
Black-and-white warbler (*Mniotilta varia*)
American redstart (*Setophaga ruticilla*)
Ovenbird (*Seirus aurocapillus*)
Louisiana waterthrush (*Seiurus motacilla*)
Common Yellowthroat (*Geothlypis trichas*)
Canada warbler (*Wilsonia canadensis*)

Thraupidae
Scarlet Tanager (*Piranga olivacea*)
Emberizidae
Eastern Towhee (*Pipilo erythrophthalmus*)
Chipping Sparrow (*Spizella passerina)*
White-throated sparrow (*Zonotrichia albicollis*)
Song Sparrow (*Melospiza melodia*)
Dark-eyed junco (*Junco hyemalis*)
Cardinalidae
Northern Cardinal (*Cardinalis cardinalis*)
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)
Indigo Bunting (*Passerina cyanea*)
Icteridae
Red-winged Blackbird (*Agelaius phoeniceus*)
Common Grackle (*Quiscalus quiscula*)
Brown-headed Cowbird (*Molothrus ater*)
Baltimore Oriole (*Icterus galbula*)
Fringillidae
American Goldfinch (*Carduelis tristis*)

MAMMALS
Short-tailed shrew (*Blarina brevicauda*)
Red-backed vole (*Clethrionomys gapperi*)
Meadow vole (*Microtus pennsylvanicus*)
Deer mouse (*Peromyscus leucopus*)
Jumping mouse (Zapodidae)
Chipmunk (*Tamiasciurus hudsonicus*)
Gray squirrel (*Sciurus carolinensis*)
Red squirrel (*Tamiasciurus hudsonicus*)
Muskrat (*Odontra zibethicus*)
Porcupine (*Erethizon dorsatum*)
Eastern cottontail rabbit (*Sylvilagus floridanus*)
Gray fox (*Urocyon cinereoargenteus*)
Raccoon (*Procyon lotor*)
Short-tailed weasel (*Mustela erminae*)
Fisher (*Martes pennanti*)
Striped skunk (*Mephitis mephitis*)
White-tailed deer (*Odocoileus virginianus*)

APPENDIX B

POLLUTANT LOADING EVALUATION

Pollutant Loading Analysis
Tankerhoosen River Watershed
Baseline Assessment

1.0 INTRODUCTION

A pollutant loading analysis was performed for the Tankerhoosen River watershed in support of the Baseline Watershed Assessment to assess the potential for increases in nonpoint source (NPS) pollutant loads. The model was used to compare existing nonpoint source (NPS) pollutant loads from the watershed to projected future pollutant loads that would occur under a watershed buildout scenario. The predicted change in pollutant loadings in each of the subwatersheds was then examined to assess their relative vulnerability to future development.

2.0 MODEL DESCRIPTION

A pollutant loading model was developed using the land use/land cover data described in Section 7.0 of the Baseline Watershed Assessment report (Fuss & O Neill 2008). The model was used to compare pollutant loadings from the watershed under existing land use conditions to future pollutant loadings under a watershed buildout scenario. It is important to note that the results of this screening-level analysis are intended for the purposes of comparing existing to future conditions and not to predict future water quality.

The Spreadsheet Tool for the Estimation of Pollutant Load (STEPL), Version 4.0, was used for this analysis. This model was developed for US EPA by Tetra Tech in EPA Region 5 and has since been modified for use in other areas of the country. The model calculates watershed pollutant loads based on land use-related pollutant sources, including urban runoff, septic system failures, stream bank erosion, and agricultural activities. The model also allows simulation of best management practices (BMPs) and Low Impact Development (LID) practices to reduce pollutant loads.

The focus of the Tankerhoosen watershed pollutant loading model was future development of presently undeveloped land and re-development of developed land with higher-intensity land uses (See Section 7.2 of Fuss & O Neill 2008), since these are likely sources of increased pollutant loads. Agricultural NPS pollutant loadings were not considered in the analysis since agricultural land comprises a very small percentage of the land uses within the watershed.

The pollutants modeled in this analysis are the default pollutants contained in the STEPL model: total phosphorus, total nitrogen, biological oxygen demand, and total suspended solids. These pollutants are the major parameters of concern in environmental systems.

Nitrogen and phosphorus are nutrients that promote the growth of algae and plants in water. When this biomass dies and settles to the bottom of water bodies, its decomposition consumes oxygen which is needed by other organisms for survival. Nitrogen is generally present in relatively small quantities compared to other nutrients in salt water systems, such as Long Island Sound, so limiting its concentration limits the growth of algae. In fresh water systems, such as the stream and impoundments in the Tankerhoosen River watershed, phosphorus is the nutrient that is relatively scarce and thus limits algal growth.

Biological oxygen demand (BOD) is a measure of the amount of oxygen that a pollutant consumes as it decomposes (e.g., one pound of BOD consumes one pound of oxygen). A given BOD loading to a water body effectively consumes an equivalent amount of oxygen from that water body, making it unavailable to aquatic organisms.

Total suspended solids (TSS) is a measure of both biodegradable and mineral sediment. Its discharge to a water body results in turbidity and sedimentation. TSS may also have secondary effect; biodegradable TSS exerts a BOD load, and mineral TSS can be associated with particulate phosphorus.

3.0 MODEL PARAMETER SELECTION

STEPL uses algorithms that calculate nutrient and sediment loads from different land uses to determine watershed pollutant loadings. The user specifies several model parameters for each land use in the watershed that are used to estimate runoff quantity and pollutant levels. These parameters include:

- Event Mean Concentrations (EMCs), which are literature values for the mean concentration of a pollutant in stormwater runoff for each land use, and
- Curve Number (CN), which is a measure of the runoff potential of the land surface and is a function of soil type, cover condition, and slope.

The model uses these parameters to estimate the runoff quantity and pollutant loading using data specific to each subwatershed, supplied by the user, as well as default climate data for the subject county In addition to these parameters, the model includes percent impervious surface values for each land use. As part of this project, the model was modified to accept user-specified impervious surface values for each land use.

A literature review was conducted to determine EMCs values for use in the study. STEPL includes default EMC values for each land use within the watershed. Since comparison between existing and proposed watershed conditions is the focus of this project, EMC values were selected to reflect the relative difference in NPS pollutant characteristics between the existing and future land use. Table 1 shows EMC values from several sources for the pollutants of interest.

Table 1. Runoff Event Mean Concentrations (EMCs)

Source	Pollutant	Land Use										
		Cropland	Open Space	Commercial	High Density Residential	Institutional	Industrial	Low Density Residential	Forest	Transport	Vacant	Units
STEPL	N	1.9	1.5	2	2.2	1.8	2.5	2.2	0.2	3	1.5	mg/L
	P	0.3	0.15	0.2	0.4	0.3	0.4	0.4	0.1	0.5	0.15	mg/L
	BOD	4	4	9.3	10	7.8	9	10	0.5	9.3	4	mg/L
	TSS	-	70	75	100	67	120	100	-	150	70	mg/L
NSQD	N*	-	1.2	2.2	2	-	2.1	-	-	2.3	-	mg/L
	P	-	0.25	0.22	0.3	-	0.26	-	-	0.25	-	mg/L
	BOD	-	4.2	11.9	9	-	9	-	-	8	-	mg/L

Source	Pollutant	Land Use										
		Cropland	Open Space	Commercial	High Density Residential	Institutional	Industrial	Low Density Residential	Forest	Transport	Vacant	Units
	TSS	-	51	43	48	-	77	-	-	99	-	mg/L
NURP	N*	-	1.5	1.75	2.6	-	-	-	-	-	-	mg/L
	P	-	0.1	0.201	0.38	-	-	-	-	-	-	mg/L
	BOD	-	-	9.3	10	-	-	-	-	-	-	mg/L
	TSS	-	70	57	101	-	-	-	-	-	-	mg/L
WTM	N*	-	-	2	2	-	-	2	-	2	-	mg/L
	P	-	-	0.26	0.26	-	-	0.26	-	0.26	-	mg/L
	BOD	-	-			-	-		-		-	mg/L
	TSS	-	-	55	55	-	-	55	-	55	-	mg/L
BEC	N*	-	-	13.7	13.7	-	10.6	10.0	-	-	-	kg/ha/yr
	P	-	-	2.7	2.7	-	2.6	1.9	-	-	-	kg/ha/yr
	BOD	-	-			-			-	-	-	kg/ha/yr
	TSS	-	-	748.0	748.0	-	802.5	456.0	-	-	-	kg/ha/yr
Selected	N*	1.9	1.5	2.2	2	1.8	2.5	1.8	0.2	3	1.5	mg/L
	P	0.3	0.15	0.4	0.2	0.3	0.4	0.3	0.1	0.5	0.15	mg/L
	BOD	4	4	10	9.3	7.8	9	7.8	0.5	9.3	4	mg/L
	TSS	-	70	100	75	67	120	67	-	150	70	mg/L

See References for Source Information

The majority of selected values were obtained from STEPL, with adjustments to ensure consistency with other sources. These adjustments include exchanging the multi-family and commercial values, since development included in the multi-family category is assumed to be less intensive in the Tankerhoosen watershed (See Section 4.0) than typical, and since the default commercial sediment EMC value was lower than sediment levels of other less sediment-intensive land uses. Similarly, since the single-family land use category selected for the watershed includes only large lot residential areas, the selected EMCs for these areas were reduced to Institutional land use levels.

As part of this project, the impervious surface coefficients in STEPL were adjusted for use in generating existing and proposed impervious surface estimates. The default factors, literature values for factors, and selected factors are presented in Table 2.

Table 2. Impervious Surface Coefficients

	Impervious Cover Coefficients		
Land Use	STEPL	NEMO[1]	Selected
Commercial	0.85	0.205 - 0.557	0.50
Industrial	0.70	0.264 - 0.557	0.40
Institutional	0.50	-	0.30
Transportation	0.95	0.433	0.43
Multi-family	0.75	0.09 - 0.39	0.24
Single-family	0.30	0.065 - 0.12	0.10
Vacant (developed)	0.70	-	0.41
Open Space	0.01	0.001 - 0.094	0.01

[1]*Sleavin et al. (2000) and Prisloe et al. (2003)*

The STEPL model also includes input parameters related to failing septic systems in the watershed. Parameters include the typical population per household and septic system failure rate. Default values were used for the typical population per household and septic system failure rate due to the limited availability of local data.

4.0 MODEL INPUT DATA

Land use/land cover data that is described in Section 7.0 of the Baseline Watershed Assessment was adapted for integration into the STEPL model. Data was prepared in this manner for both the existing conditions and future conditions (watershed buildout) pollutant loading scenarios. STEPL allows fewer land use categories than contained in the land use/land cover data obtained from other sources, so several data categories were combined for use in the model. Table 3 summarizes the assignment of STEPL land use categories for each of the land use/land cover data categories.

Table 3. Source Data - STEPL Category Correlation

Data Category	STEPL Category
Agriculture	Cropland
Cemetery	Open Space (urban)
Commercial	Commercial (urban)
Condominium	Multi-family (urban)
Government/Non-Profit	Institutional (urban)
Group Quarters	Institutional (urban)
Health/Medical	Institutional (urban)
Industrial	Industrial (urban)
Mixed Use	Commercial (urban)
Multi-Family	Multi-family (urban)
One Family	Multi- or Single-family (urban)
Resource/Recreation	Forest
Retail	Commercial (urban)
ROW	Transportation (urban)
School	Institutional (urban)
Three Family	Multi-family (urban)
Two Family	Multi-family (urban)
Undeveloped	Forest
Unknown	Vacant - Developed (urban)
Water	Not Considered

STEPL defines urban land uses differently from agriculture and forest. All urban land uses are lumped into a single land use category, and urban land cover characteristics are distinguished based on land use subcategories, which include commercial, industrial, institutional, transportation, multi-family residential, single-family residential, urban cultivated, vacant (developed), and open space land uses. Since the source land use data included many residential land use categories and STEPL only provides two residential categories, residential uses for all but the largest single-family residential parcels was included in the multi-family category. The Tankerhoosen River watershed has large areas of rural-residential land use with parcel sizes of greater than 2 acres. As such, parcels smaller than two acres were considered to be high density residential and parcels larger than two acres were considered low density residential. Table 4 summarizes the composition of single-family residential land use based on parcel size ranges.

Table 4. Composition of Single-Family Residential Land Use Based on Parcel Size

Watershed	0 - 22k sf	22k sf - 2 ac	2 - 5 acres	> 5 acres
Bolton Notch Pond	3.2%	49.7%	47.1%	0.0%
Clarks Brook	21.4%	36.0%	18.0%	24.6%
Gages Brook	11.4%	37.8%	25.4%	25.4%
Gages Brook South Tributary	0.9%	47.4%	33.6%	18.1%
Lower Tankerhoosen River	21.4%	43.9%	34.4%	0.3%
Middle Tankerhoosen River	13.6%	60.3%	15.7%	10.5%
Railroad Brook	0.2%	45.9%	53.7%	0.2%
Tucker Brook	22.0%	54.4%	11.1%	12.6%
Upper Tankerhoosen River	1.0%	79.9%	18.8%	0.3%
Walker Reservoir	17.0%	43.2%	24.0%	15.7%

Septic system data is also required for the STEPL model. Sewer service area GIS data from Connecticut DEP was used to screen out developed parcels in the Tankerhoosen watershed; parcels located completely outside of mapped sewer service areas were assumed to be served by septic systems. The resulting number of developed parcels without sewer service were divided into residential systems (single-family through multi-family systems) and other developed systems (including condominiums, industrial, commercial, and institutional systems). The residential systems were assumed to have similar characteristics and the other developed systems were assumed to be approximately 5 times the size of the residential systems, on average (this factor was estimated based on the total land area feeding these systems and an estimated intensity of use).

Hydrologic Soil Group (HSG) data are also required by the model. This data, which is available from the U.S. Natural Resource Conservation Service (NRCS), describes the infiltration characteristics of most soils in the county. Identifiers for the soil groups range from Type A soils, including sands and other soils that are very well drained and result in little runoff, to Type D soils, which are poorly drained, often being compacted, having high clay content and high groundwater levels. Soils data were compiled for each subwatershed and assimilated into an average HSG value. Each subwatershed was found to have Type B soil characteristics, on average, with the exception of the Gages Brook subwatershed, which was found to have Type C soil characteristics.

5.0 CURRENT POLLUTANT LOADINGS

5.1 Input

The following land use data were entered into the STEPL spreadsheet to create an existing conditions pollutant loading model. These inputs were reduced form the data presented in Section 7.1 of the Baseline Watershed Assessment. In general, agricultural land use (i.e. cropland) was the least common of the non-urban uses. In most subwatersheds, urban uses dominate, although forests compose more than half of the land area in the Railroad Brook and Upper Tankerhoosen River watersheds.

Table 5. Land Use Input Data

Watershed	Land Use Area (ac)				Land Use Area Composition		
	Urban	Cropland	Forest	Total	Urban	Cropland	Forest
Bolton Notch Pond	183.9	0.0	134.7	318.6	58%	0%	42%
Clarks Brook	533.3	3.6	110.5	647.4	82%	1%	17%
Gages Brook	485.8	28.2	181.5	695.5	70%	4%	26%
Gages Brook South Tributary	491.3	5.7	183.3	680.3	72%	1%	27%
Lower Tankerhoosen River	179.4	0.0	127.1	306.5	59%	0%	41%
Middle Tankerhoosen River	1185.5	22.6	362.4	1570.5	75%	1%	23%
Railroad Brook	377.6	0.0	825.3	1202.8	31%	0%	69%
Tucker Brook	648.8	43.0	241.8	933.5	69%	5%	26%
Upper Tankerhoosen River	519.2	0.0	952.6	1471.9	35%	0%	65%
Walker Reservoir	192.2	0.0	129.8	322.0	60%	0%	40%

Table 6 presents the composition of the urban land use areas listed in Table 5. In general, residential land use is the most prevalent in the urbanized areas, although transportation corridors are the predominant urban land use in the Bolton Notch Pond and Lower Tankerhoosen River watersheds, and comprise greater than 20% of urban land use in three of the ten watersheds.

Table 6. Urban Land Use Composition

Watershed	Urban Land Use Composition (%)							
	Com.	Ind.	Inst.	Trans.	Dense Res.	Rural Res.	Vacant	Open Space
Bolton Notch Pond	25.5	2.1	5.7	29.4	17.6	15.7	4.0	0.0
Clarks Brook	4.2	11.9	0.3	13.9	49.7	18.6	1.4	0.0
Gages Brook	13.7	16.7	8.8	7.7	27.5	25.0	0.0	0.6
Gages Brook South Tributary	2.4	0.0	4.0	19.7	35.4	37.9	0.6	0.0
Lower Tankerhoosen River	4.3	4.1	9.8	32.6	30.6	14.1	2.0	2.5
Middle Tankerhoosen River	2.7	1.9	1.8	17.9	55.8	18.5	1.0	0.4
Railroad Brook	0.0	0.0	0.0	4.5	43.4	50.7	1.4	0.0
Tucker Brook	0.3	0.0	4.5	11.9	63.9	19.3	0.1	0.0
Upper Tankerhoosen River	0.0	0.0	0.7	13.6	66.9	15.1	3.3	0.4
Walker Reservoir	6.3	2.7	0.0	37.8	39.4	11.5	2.3	0.0

Table 7 presents the total estimated number of septic systems in the Tankerhoosen River watershed, determined using the methods described in Section 4.0. Septic systems are assumed to be present at lots not included in or abutting the sewer service area shown in the Baseline Watershed Assessment report. As discussed in Section 4.0, "other" septic systems includes septic systems for land uses other than single-family and multi-family residential land uses, such as condominiums, group quarters, commercial, industrial parcels. These systems are assumed to serve an equivalent population of 5 times a residential system on average. Note that these septic system estimates and are intended only for estimating increases in NPS pollutant loads and should not be used for other purposes.

Table 7. Estimated Number of Septic Systems

Watershed	Number of Septic Systems		
	Residential	Other	Equivalent Total
Bolton Notch Pond	43	2	53
Clarks Brook	108	8	148
Gages Brook	81	1	86
Gages Brook South Tributary	236	4	256
Lower Tankerhoosen River	43	1	48
Middle Tankerhoosen River	169	7	204
Railroad Brook	76	0	76
Tucker Brook	98	0	98
Upper Tankerhoosen River	198	3	213
Walker Reservoir	42	2	52

5.2 Results

Table 8 presents total estimated loadings of total nitrogen, total phosphorus, BOD, and TSS for each subwatershed, as well as the loading rate for each subwatershed. In terms of total existing loads, the largest loads of pollutants originate in the Middle Tankerhoosen River, Gages Brook, Gages Brook South Tributary, Clarks Brook, and Tucker Brook subwatersheds. As such, pollutants from these areas are likely to have the largest effect on water quality in the Tankerhoosen River.

Since some of these watersheds are large compared to others, it is useful to look at the data in terms of the loading rate, which is the load of pollutant per unit land area. A high loading rate indicates dense pollutant sources, which suggests that implementation of best management practices (BMPs) in these areas would be more effective in reducing pollutant loads. Pollutant loading rates are relatively uniform between many of the watersheds. Outstanding loading rates include those from Railroad Brook and the Upper Tankerhoosen River, which are significantly lower than rates from other subwatersheds, and those from the Walker Reservoir, which are significantly elevated compared to loads from other subwatersheds. The highlighting in Table 8 identifies subwatersheds with high (orange), moderate (yellow), and low (green) pollutant loadings.

Table 8. Estimated Existing Pollutant Loads

Watershed	N lb/yr	P lb/yr	BOD lb/yr	Sediment t/yr	N lb/ac-yr	P lb/ac-yr	BOD lb/ac-yr	Sediment t/ac-yr
Bolton Notch Pond (318 ac)	2175	385	7895	51	6.8	1.2	24.8	0.2
Clarks Brook (647 ac)	4157	669	15686	92	6.4	1.0	24.2	0.1
Gages Brook (695 ac)	4640	787	18084	115	6.7	1.1	26.0	0.2
Gages Brook South Tributary (680 ac)	4062	720	14877	89	6.0	1.1	21.9	0.1
Lower Tankerhoosen River (306 ac)	2009	343	6987	47	6.6	1.1	22.8	0.2

Watershed	N lb/yr	P lb/yr	BOD lb/yr	Sediment t/yr	N lb/ac-yr	P lb/ac-yr	BOD lb/ac-yr	Sediment t/ac-yr
Middle Tankerhoosen River (1570 ac)	9364	1473	34764	216	6.0	0.9	22.1	0.1
Railroad Brook (1203 ac)	1890	359	7451	40	1.6	0.3	6.2	0.0
Tucker Brook (934 ac)	4481	699	17014	118	4.8	0.7	18.2	0.1
Upper Tankerhoosen River (1472 ac)	3868	683	14562	82	2.6	0.5	9.9	0.1
Walker Reservoir (322 ac)	2312	390	7965	54	7.2	1.2	24.7	0.2
Total (8149 ac)	38960	6509	145286	903	4.8	0.8	17.8	0.1

- *Bolton Notch Pond*. Although this subwatershed is the second smallest in the study area, it is characterized by the second highest nitrogen loading rate, is tied for the highest phosphorus and sediment loading rate, and has the third highest BOD loading rate. These high values reflect the large composition of commercial land use (approximately 26%) and transportation land use (approximately 29%) in the subwatershed.

- *Gages Brook*. This watershed is characterized by both relatively high total pollutant loads and pollutant loading rates. This watershed is 70% urban land, and has the highest industrial land use composition and second-highest commercial land use composition.

- *Middle Tankerhoosen River*. This watershed has moderate pollutant loading rates. Although it is the largest subwatershed in the study area, it also has total pollutant loads that are approximately twice as high as those of other large subwatersheds.

- *Walker Reservoir*. Although the Walker Reservoir subwatershed is similar in size to the Bolton Notch Pond subwatershed, its pollutant loading rates for nitrogen, phosphorus, and sediment are significantly higher. These loading rates reflect the highly urbanized nature of this subwatershed, which also has the highest percentage of transportation land use.

5.3 Discussion

The sources of pollutants in the watershed are generally associated with urban land use, as presented in Table 9. Note that urban areas are estimated to account for between 80% and 95% of the NPS pollutant load in the watershed, although urban uses comprise only 59% of the total watershed land use area (See Table 5)

Table 9. Pollutant Source by Land Use

Source	N Load	P Load	BOD Load	Sediment Load
Urban	91.9%	81.5%	93.1%	88.6%
Cropland	1.9%	2.6%	1.0%	7.8%
Forest	2.3%	6.7%	1.5%	3.6%
Septic	3.9%	9.2%	4.3%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

By subdividing the urban pollutant loads into the distinct urban categories that were included in the model (See Table 10), it is apparent that transportation land use accounts for the largest NPS pollutant loads in the watershed, with higher-density residential use being the second largest source of pollutant loads. Higher-density residential land use is a significant source since it is the predominant land use in the watershed (See Table 6). Transportation use is a significant source since it has the highest pollutant EMCs, and commercial uses are a significant source for the same reason (See Table 1).

Table 10. Pollutant Loads and Sources for Urban Categories

Urban Land Use	N Load	P Load	BOD Load	Sediment Load	N Load	P Load	BOD Load	Sediment Load
	lb/year	lb/year	lb/year	tons/year	%	%	%	%
Commercial	2242	408	10191	51	6%	8%	8%	6%
Industrial	1898	304	6834	46	5%	6%	5%	6%
Institutional	1061	177	4596	20	3%	3%	3%	2%
Transportation	17400	2900	53938	435	49%	55%	40%	54%
Dense Residential	9890	989	45990	185	28%	19%	34%	23%
Rural Residential	2970	495	12871	55	8%	9%	10%	7%
Vacant	297	30	792	7	1%	1%	1%	1%
Open Space	39	4	103	1	0%	0%	0%	0%

6.0 FUTURE POLLUTANT LOADINGS

6.1 Input

Future land use estimates, presented in Table 11, were used in the STEPL model to simulate a watershed buildout scenario. Also summarized in Table 11 is the predicted "increase" in urban land use for each subwatershed. These model inputs were derived form the data presented in Section 7.2 of the Baseline Watershed Assessment report. Much of the future developed area in the watershed is currently forested, such that the increase in urban area for each subwatershed includes a corresponding reduction in forested land.

Table 11. Land Use Input Data

Watershed	Land Use Area (ac)			Land Use Composition)			Urban Increase
	Urban	Cropland	Forest	Urban	Cropland	Forest	
Bolton Notch Pond	233.3	0	85.3	73%	0%	27%	15%
Clarks Brook	590.4	2.4	54.6	91%	0%	8%	9%
Gages Brook	614.4	28.2	52.9	88%	4%	8%	19%
Gages Brook South Tributary	614.3	5.7	60.3	90%	1%	9%	18%
Lower Tankerhoosen River	270.7	0	35.8	88%	0%	12%	30%
Middle Tankerhoosen River	1312.5	10.1	247.9	84%	1%	16%	8%
Railroad Brook	589.9	0	612.9	49%	0%	51%	18%
Tucker Brook	771.2	43.0	119.3	83%	5%	13%	13%
Upper Tankerhoosen River	746.1	0	725.7	51%	0%	49%	15%
Walker Reservoir	296.4	0	25.7	92%	0%	8%	32%

Table 12 summarizes a break-down of the urban land uses presented in Table 5. Much of the future development and redevelopment is anticipated in areas that are currently zoned for residential uses. As such, residential land use is likely to become a larger percentage of urban land use in many of the subwatersheds.

Table 12. Urban Land Use Composition

Watershed	Urban Land Use Composition (%)							
	Com.	Ind.	Inst.	Trans.	Dense Res.	Rural Res.	Vacant	Open Space
Bolton Notch Pond	20.2	6.5	4.5	23.2	16.0	26.6	3.1	0.0
Clarks Brook	6.0	15.2	0.3	12.6	57.1	7.6	1.3	0.0
Gages Brook	15.6	16.8	7.0	6.1	23.2	30.8	0.0	0.5
Gages Brook South Tributary	2.6	3.5	3.2	15.7	30.3	44.2	0.5	0.0
Lower Tankerhoosen River	3.5	2.7	6.5	21.6	59.8	2.8	1.3	1.6
Middle Tankerhoosen River	5.9	1.7	1.6	16.1	67.5	6.0	0.9	0.4
Railroad Brook	0.0	0.0	0.0	2.9	86.1	10.1	0.9	0.0
Tucker Brook	0.2	0.0	3.8	10.0	81.5	4.4	0.1	0.0
Upper Tankerhoosen River	0.0	0.0	0.5	9.5	33.9	55.0	0.9	0.3
Walker Reservoir	15.1	3.7	0.0	24.5	36.9	19.8	0.1	0.0

Table 13 presents the total estimated number of existing and future septic systems in the Tankerhoosen River watershed, determined using the methods described in Section 4.0. Septic systems are assumed to be present at lots not included in or abutting the sewer service area shown in the Baseline Watershed Assessment report. As discussed in Section 4.0, "other" septic systems includes septic systems for land uses other than single-family and multi-family residential land uses, such as condominiums, group quarters, commercial, industrial parcels. These systems are assumed to serve an equivalent population of 5 times a residential system on average.

Table 13. Estimated Number of Septic Systems

Watershed	Existing Equivalent Total	Future Residential Systems	Other Future Systems	Future Equivalent Total
Bolton Notch Pond	53	8		61
Clarks Brook	148	3	9	196
Gages Brook	86	5		91
Gages Brook South Tributary	256	14	1	275
Lower Tankerhoosen River	48	4		52
Middle Tankerhoosen River	204	11	9	260
Railroad Brook	76	26		102
Tucker Brook	98	6		104
Upper Tankerhoosen River	213	19		232
Walker Reservoir	52	7	1	64

6.2 Results

Table 14 presents projected future pollutant loads under a watershed buildout scenario. An increase in pollutant loads is predicted in all subwatersheds. The Railroad Brook subwatershed is predicted to have the highest increase in nitrogen, BOD, and sediment loads. Large increases are also predicted in nitrogen, phosphorus, and BOD in the Middle Tankerhoosen River subwatershed. The largest phosphorus increases are predicted in the Gages Brook subwatershed.

Table 14. Projected Future Pollutant Loads and Load Increases

	Total Future Load				Projected Load Increase			
	N	P	BOD	Sediment	N	P	BOD	Sediment
Watershed	lb/yr	lb/yr	lb/yr	t/yr	lb/yr	lb/yr	lb/yr	t/yr
Bolton Notch Pond (318 ac)	2384	416	8752	54	209	31	857	4
Clarks Brook (647 ac)	4745	756	18205	103	588	87	2519	11
Gages Brook (695 ac)	5538	921	21973	134	898	134	3888	19
Gages Brook South Tributary (680 ac)	4559	793	16976	98	497	73	2099	9
Lower Tankerhoosen River (306 ac)	2410	374	8916	53	401	31	1929	7
Middle Tankerhoosen River (1570 ac)	10357	1585	39700	229	993	112	4936	13
Railroad Brook (1203 ac)	2964	432	12652	59	1074	73	5201	19
Tucker Brook (934 ac)	5111	736	20084	129	630	37	3071	11
Upper Tankerhoosen River (1472 ac)	4228	759	16194	87	360	76	1632	5
Walker Reservoir (322 ac)	2909	481	10718	66	598	91	2754	12
Total (8149 ac)	45207	7252	174172	1011	6248	743	28886	109

Table 15 presents the projected future pollutant loads in terms of the projected load increase based on existing loads (percent increase) and loading rate increase for each subwatershed. These criteria were selected to determine the most significant changes in watershed loadings since they control for the existing load quantities (percent increase) and watershed size (rate increase). The highlighting in Table 15 identifies areas with the high (orange), moderate (yellow), and low (green) pollutant loadings or loading rates in the Tankerhoosen River watershed.

Table 15. Projected Pollutant Loading Rate Increases and Load Increases

	Projected Future Loading Rate Increase				Projected Load Increase			
	N	P	BOD	Sediment	N	P	BOD	Sediment
Watershed	lb/ac-yr	lb/ac-yr	lb/ac-yr	lb/ac-yr	lb/yr	lb/yr	lb/yr	t/yr
Bolton Notch Pond (318 ac)	0.66	0.10	2.7	0.012	9.6%	8.0%	10.9%	7.7%
Clarks Brook (647 ac)	0.91	0.13	3.9	0.017	14.1%	12.9%	16.1%	11.7%
Gages Brook (695 ac)	1.29	0.19	5.6	0.027	19.4%	17.0%	21.5%	16.7%
Gages Brook South Tributary (680 ac)	0.73	0.11	3.1	0.014	12.2%	10.2%	14.1%	10.5%
Lower Tankerhoosen River (306 ac)	1.31	0.10	6.3	0.022	20.0%	8.9%	27.6%	14.7%
Middle Tankerhoosen River (1570 ac)	0.63	0.07	3.1	0.008	10.6%	7.6%	14.2%	5.8%
Railroad Brook (1203 ac)	0.89	0.06	4.3	0.015	56.8%	20.3%	69.8%	46.4%
Tucker Brook (934 ac)	0.67	0.04	3.3	0.012	14.1%	5.3%	18.0%	9.4%

Watershed	Projected Future Loading Rate Increase				Projected Load Increase			
	N	P	BOD	Sediment	N	P	BOD	Sediment
	lb/ac-yr	lb/ac-yr	lb/ac-yr	lb/ac-yr	lb/yr	lb/yr	lb/yr	t/yr
Upper Tankerhoosen River (1472 ac)	0.24	0.05	1.1	0.003	9.3%	11.1%	11.2%	6.0%
Walker Reservoir (322 ac)	1.86	0.28	8.6	0.036	25.8%	23.3%	34.6%	21.6%
Total (8149 ac)	0.77	0.09	3.5	0.013	16.0%	11.4%	19.9%	12.0%

Several of the subwatersheds are predicted to experience significantly higher increases in pollutant loads and loading rates under a watershed buildout scenario. These include:

- *Gages Brook*. The existing conditions pollutant load model indicates that this subwatershed is characterized by both relatively high total pollutant loads and pollutant loading rates, with approximately 70% urban land use, the largest amount of industrial land use, and the second-highest commercial land use composition in the entire watershed. The buildout condition of this watershed is projected to result in a 19% increase in urban land use with a corresponding decrease in forest; and the new urban land is likely to consist of new residential and industrial development. As such, relatively large loads and loading rate increases may occur.

- *Lower Tankerhoosen River.* The existing conditions pollutant load model for this subwatershed predicts relatively small loads (since the watershed area is small) and moderate loading rates. Under a buildout scenario, this subwatershed is projected to result in more than a 20% increase in nitrogen and BOD loads. The resulting loading rates for these parameters are projected to be the second highest of the Tankerhoosen River subwatersheds.

- *Railroad Brook.* The projected buildout pollutant loadings in this subwatershed for nitrogen and BOD are anticipated to increase by approximately 57% and 70%, respectively. Significant increases are also anticipated in phosphorus and sediment loads. Currently, the Railroad Brook sub watershed is heavily forested, with comparatively little development. Several large tracts of land within this subwatershed are potentially available for future development, especially in Bolton and South Vernon, which makes this watershed vulnerable to potentially significant pollutant load increases.

- *Walker Reservoir.* The existing conditions pollutant loading model suggests that this subwatershed has some of the highest levels of pollutant loads within the overall Tankerhoosen River watershed. Potential land use changes in this subwatershed include significant areas of new residential and mixed-use development, much of which is located adjacent to Walker Reservoir. These changes are predicted to result in the greatest increases in pollutant loading rates for all of the parameters evaluated.

7.0 REFERENCES

Baystate Environmental Consultants, Inc. (2004). *Watershed Management Plan for Tankerhoosen Lake.*

Fuss & O Neill, Inc. (2008) Baseline Watershed Assessment for the Tankerhoosen River Watershed. Prepared for the Friends of the Hockanum River Linear Park of Vernon, Inc.

NQQD (2004). *Findings from the National Stormwater Quality Database*, Research Progress Report. Prepared by the Center for Watershed Protection.

NURP (1983). *Results of the Nationwide Urban Runoff Program.* U.S. Environmental Protection Agency Water Planning Division, PB 84-185552, Washington, D.C.

Prisloe, Michael, Emily Hoffhine Wilson, Chester Arnold (2003). *Refinement of Population-Calibrated Land-Cover-Specific Impervious Surface Coefficients for Connecticut.* Final Report, DEP Project 01-08 Task #6. University of Connecticut Middlesex County Extension Center, Haddam, CT. Accessed at http://www.nemo.uconn.edu/tools/impervious_surfaces/literature.htm on March 12, 2008.

Tetra Tech., Inc. *Spreadsheet Tool for the Estimation of Pollutant Load (STEPL). Version 4.0.* Developed for the U.S. EPA

University of Connecticut Center for Land Use Education and Research (CLEAR). Connecticut's Changing Landscape – Statewide Land Cover. URL: www.clear.uconn.edu/projects/landscape/statewide_landcover.htm.

WTM (2001). *Watershed Treatment Model User's Guide - Version 3.1.* Prepared by the Center for Watershed Protection.

Watershed Field Inventories and Land Use Regulatory Review Tankerhoosen River Watershed

Friends of the Hockanum River
Linear Park of Vernon, Inc.

In Association With:

Town of Vernon
North Central Conservation District
Rivers Alliance of Connecticut
Hockanum River Watershed Association
Belding Wildlife Management Area

Vernon, CT

October 2008

FUSS & O'NEILL
Disciplines to Deliver

Fuss & O'Neill, Inc.
78 Interstate Drive
West Springfield, MA 01089

WATERSHED FIELD INVENTORIES AND
LAND USE REGULATORY REVIEW
Tankerhoosen River Watershed

TABLE OF CONTENTS

WATERSHED FIELD INVENTORIES AND
LAND USE REGULATORY REVIEW
Tankerhoosen River Watershed

TABLE OF CONTENTS
(continued)

1.0 INTRODUCTION

The Friends of the Hockanum River Linear Park of Vernon, Inc. (the "Friends") has retained Fuss & O Neill to prepare a Watershed Management Plan for the Tankerhoosen River watershed. The Watershed Management Plan will be developed through a collaborative effort with a Technical Advisory Committee consisting of the Friends, the Town of Vernon (Planning Department and Conservation Commission), the North Central Conservation District, the Hockanum River Watershed Association, Rivers Alliance of Connecticut, and the Belding Wildlife Trust. The Plan will identify action items to be implemented by the municipalities and private groups which will protect and improve the health of the Tankerhoosen River watershed.

There are two key reports that provide the basis for recommendations in the Watershed Management Plan: 1) Baseline Watershed Assessment and 2) Watershed Field Inventories and Regulatory Review. The Baseline Watershed Assessment (Fuss & O Neill, May 2008) evaluates the existing conditions of natural resources and pollutant sources in the watershed to prioritize watershed protection and restoration strategies. This report, the Watershed Field Inventories and Land Use Regulatory Review, describes the stream corridor and upland assessments conducted by Fuss & O Neill to identify and evaluate pollutant sources in the watershed, as well as, review of local zoning and land use regulations for selected towns within the Tankerhoosen River watershed. Findings of the Baseline Watershed Assessment and the Watershed Field Assessment and Land Use Regulatory Review will serve as the basis for development of a watershed management plan for the Tankerhoosen River.

2.0 WATERSHED FIELD INVENTORIES

Field inventories were performed during summer 2008 to further assess existing watershed conditions and potential sources of pollution. The field inventories are screening level tools for locating potential pollutant sources and environmental problems in a watershed along with possible locations where restoration opportunities and mitigation measures can be implemented. The field inventories included selected stream corridors and upland areas within priority subwatersheds, which were identified in the Baseline Watershed Assessment report based on a comparative subwatershed evaluation that considered vulnerability to future development impacts and restoration potential to improve upon existing conditions. Field inventories were performed within the following priority subwatersheds (Figure 1):

- Clarks Brook,
- Gages Brook,
- Gages Brook South Tributary,
- Lower Tankerhoosen River,
- Middle Tankerhoosen River,
- Tucker Brook,
- Walker Reservoir.

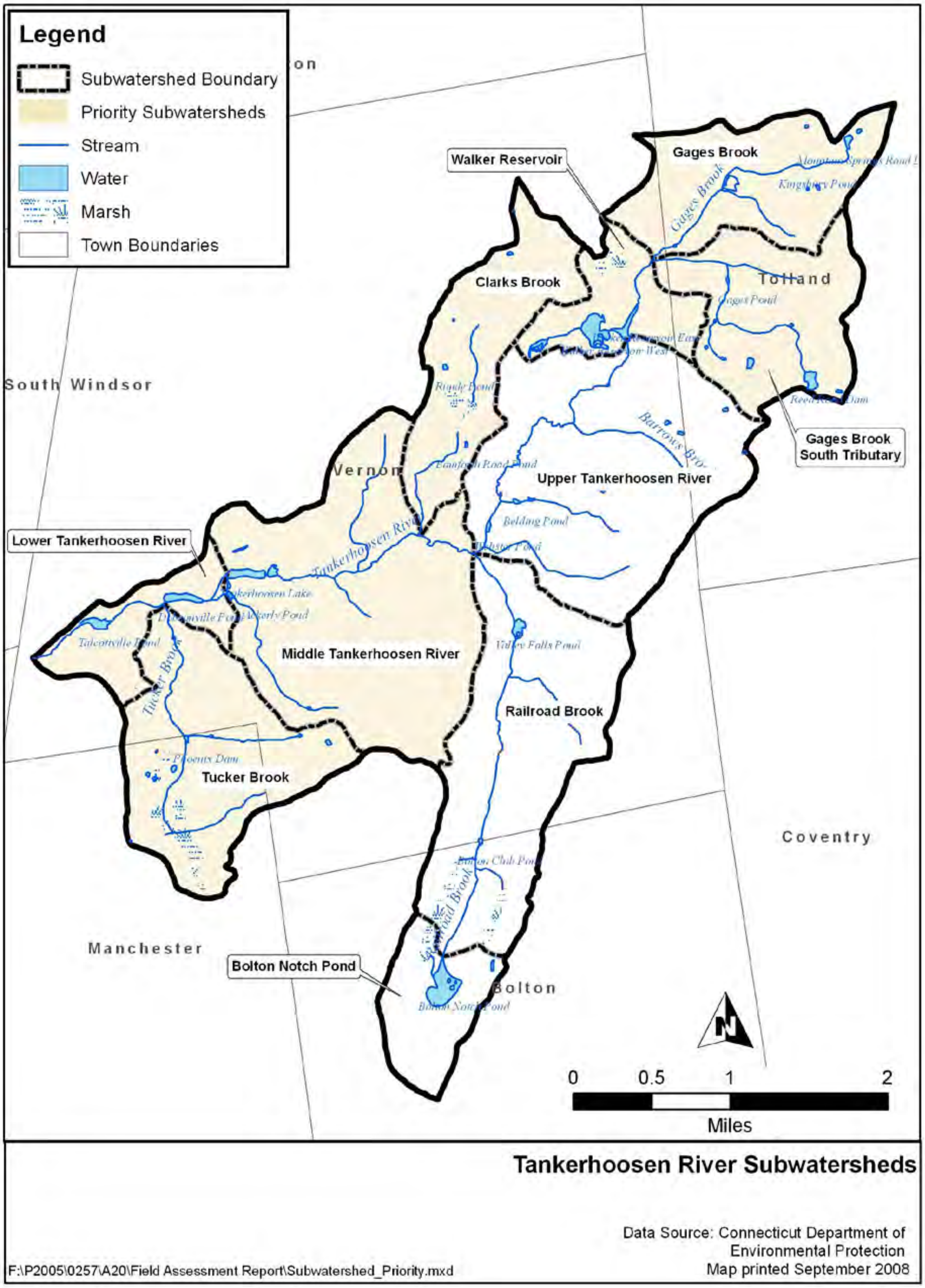


Figure 1. Tankerhoosen River Watershed

The stream corridor assessment procedure used in this study is adapted from the U.S. EPA Rapid Bioassessment (RBA) protocol (EPA, 1999) and the Center for Watershed Protection's Unified Stream Assessment (USA) method (CWP, 2005). Upland areas and activities that may impact stream quality were also assessed using methods adapted from the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance (USSR) techniques (CWP, 2005). The upland assessments included inventories of selected representative residential neighborhoods, streets and storm drainage systems, and land uses with higher potential pollutant loads (i.e., "hotspot" land uses). Field assessment efforts were targeted on stream segments and upland areas with the greatest potential for direct impacts to the streams. These areas were identified through aerial and land use mapping. To the extent possible, efforts were also focused on publicly-owned land, which typically offers greater opportunities for retrofits and mitigation projects as opposed to privately-owned land.

During the field inventories, crews assessed approximately 8.7 miles of stream corridors, six potential hotspot locations, five representative residential neighborhoods, and a number of streets and storm drainage systems associated with the residential neighborhoods and hotspot land uses. Field inventory nomenclature used throughout this report is summarized in Table 1. Copies of completed field assessment forms are provided in Appendix A (stream corridor assessments) and Appendix B (upland assessments). Photographs of specific or representative pollutant sources and problem areas are included throughout this document for illustrative purposes. All of the photographs taken during the field inventories are included on a CD in Appendix C.

Table 1: Field Inventory Nomenclature

Subwatershed	Abbreviation
Clarks Brook	CB
Lower Tankerhoosen River	LTR
Middle Tankerhoosen River	MTR
Walker Reservoir	WR
Gages Brook	GB
Gages Brook South Tributary	GBST
Tucker Brook	TB
Stream Corridor Assessment	**Abbreviation**
Reach Level Assessment	RCH
Channel Modification	CM
Severe Bank Erosion	ER
Impacted Buffer	IB
Stormwater Outfall	OT
Stream Crossing	SC
Trash & Debris	TB
Utilities	UT
Upland Assessment	**Abbreviation**
Hotspot Investigation	HSI
Neighborhood Site Assessment	NSA
Streets and Storm Drains	SSD

2.1 Summary of Findings

A variety of common issues and problems were identified during the field inventories. Some prevalent issues throughout the watershed are described below. These findings will be used to develop recommendations for the Watershed Management Plan.

- Overall in-stream habitat in the assessed reaches was mixed. Some of the assessed reaches have high quality habitat, with riparian cover, good floodplain connection, varied substrate, and significant stream shading. In other segments, in-stream habitat is marginal to poor due to bank erosion, buffer encroachment, trash and debris, lack of shading, and in-stream sedimentation. However, the majority of the stream reaches assessed appear to be either supporting biological communities (fish, frogs, birds, etc.) or sufficient to support such communities. Many potential barriers to fish passage were observed throughout the watershed, including perched culverts, culverts with very shallow flow, and natural and manmade dams. Therefore, the impact of potential fish barriers and the feasibility of fish barrier removal efforts should be investigated further.

- Stream buffer encroachments are prevalent along stream corridors in or near areas of residential and commercial development. Residential lawns and some commercial lawns extend down to the banks of the stream in many areas, particularly in residential back yards. Yard waste such as grass clippings, leaves, and brush and waste materials were also common occurrences in and near these areas where easy access exists to the streams. Education, signage, stream buffer regulations, and stream cleanups are potential approaches for improving buffer management.

- Residential areas appear to contribute significant quantities of rooftop runoff to the storm drainage system, particularly in medium and high-density residential neighborhoods with smaller yards. Many small outfall pipes were observed from the backyards of residential areas, which are presumably associated with foundation drains, yard drains, or roof downspouts. Opportunities exist to disconnect residential rooftop runoff from the storm drainage system and reduce the quantity of runoff by redirecting the runoff to pervious areas or through the use of rain barrels or rain gardens.

- Numerous outfalls were observed from virtually all of the land uses encountered during the stream assessments. Many appear to be associated with sources having low potential for water quality impacts (i.e., residential foundation drains), while others were of unknown origin and should be the focus of future investigation. A watershed-wide illicit discharge investigation is recommended in targeted areas and land uses.

- Invasive species (phragmites, cattails, reed canary grass, etc.) were observed in stream corridors in many areas of the watershed. Invasive species management should be incorporated into stream corridor restoration activities.

- Parking lots associated with apartment complexes, institutional land uses (schools), and commuter lots are potential candidates for stormwater retrofits to reduce site runoff and improve water quality through the use of bioretention, water quality swales, buffer strips/level spreaders, and other small-scale LID approaches.

- The field assessments identified very little evidence of storm drain stenciling or watershed stewardship signage, with the exception of a residential subdivision in the Tucker Brook subwatershed.

- Most of the developed areas surveyed have inadequate stormwater quality controls. Many of the residential developments were constructed prior to the advent of modern stormwater quality regulations and design requirements. Therefore, most of the development observed in the watershed employs traditional curb and gutter storm drainage collection systems with little, if any, stormwater management beyond detention basins for peak flow control. In most cases, the stormwater management controls that were observed at newer developments were not being maintained.

- No Low Impact Development (LID) design practices were observed in the watershed. With the recent shift toward LID site design and stormwater management requirements, as demonstrated by the Town of Tolland's new LID regulations and design manual, the watershed is an ideal candidate to showcase LID practices for both new development and retrofit applications. Local LID demonstration sites are a valuable tool for public education and promoting the widespread use of such practices. Incorporating LID into town projects, including roadway projects, can also serve as a proactive model for private development.

- Stormwater runoff from Interstate 84, other state roads such as Route 30 and 31, and local roads typically receives little or no treatment prior to discharge. Such discharges are a source of sediment and other pollutants to the receiving water bodies. Opportunities exist for stormwater retrofits at roadway stormwater outfalls

- Relatively isolated areas of moderate to severe streambank erosion were observed throughout the assessed portions of the watershed. Most of these areas are located at or downstream of stormwater outfalls in developed areas of the watershed. Access to many of these areas is limited; therefore, potential candidate sites for bank stabilization projects should be evaluated further for overall feasibility.

- Very few active construction sites were observed in the watershed. However, a large amount of developable land exists in the watershed, and future construction activity is a major potential source of polluted runoff. Approaches for stronger soil erosion and sedimentation controls include regulating building envelopes, encouraging property owners to minimize clearing for other purposes, and requiring drainage review for activities that disturb less than ½ acre.

- Due to limited project funding, not all stream segments in the priority subwatersheds were assessed, and other subwatersheds (Railroad Brook, Bolton Notch Pond, and Upper Tankerhoosen River) were not assessed as they were determined to be less vulnerable to future development impacts. A schedule should be established for assessing the remaining stream segments and subwatersheds.

The following sections present a more detailed discussion of the stream corridor and upland assessment methods and findings.

2.2 Stream Corridor Assessment

Stream corridors within the Tankerhoosen River watershed were assessed during June 3 through 6, 2008, and on July 2 and 10, 2008. The weather on these days was sunny, overcast or partly cloudy and not raining, with the exception of June 4, which had intermittent and heavy rain at times. Field crews consisted of staff from Fuss & O Neill, the North Central Conservation District, and volunteers with Friends of the Hockanum River Linear Park of Vernon. Stream corridors were assessed along selected reaches within priority subwatersheds using methods adapted from the U.S. EPA Rapid Bioassessment (RBA) protocol (EPA, 1999) and the Center for Watershed Protection's Unified Stream Assessment (USA) (CWP, 2005).

The stream assessment method used in this study is a continuous stream walk method that identifies and evaluates the following impact conditions for each reach:

- Outfalls (OT), including stormwater and other manmade point discharges;
- Severe Bank Erosion (ER), such as bank sloughing, active widening, and incision;
- Impacted Buffer (IB), which is a narrowing or lack of natural vegetation;
- Utilities in the stream corridor (UT), such as leaking or exposed pipes;
- Trash and Debris (TR), such as drums, yard waste, and other illegal dumping;
- Stream Crossings (SC), which are hard objects, whether natural or artificial, that restrict or constrain the flow of water. These may include bridges, culverts, dams, and falls;
- Channel Modification (CM), where the stream bottom, banks, or direction have been modified;
- Miscellaneous (MI), other impacts or features not otherwise covered; and
- Reach Level Assessment (RCH), the average characteristics of each reach.

The stream assessment method also includes a semi-quantitative scoring system as part of the reach level assessment to evaluate the overall condition of the stream, riparian buffer, and floodplain, based on a consideration of in-stream habitat, vegetative protection, bank erosion, floodplain connection, vegetated buffer width, floodplain vegetation and habitat, and floodplain encroachment.

Field data forms were completed for each stream reach assessed (Appendix A). The information was entered into a database and used to quantify the overall condition of stream corridors in the watershed, compare subwatersheds within the watershed to each other, and prioritize areas for restoration, stormwater retrofit, land preservation, and other stewardship opportunities.

Stream reaches were assigned a subwatershed abbreviation followed by a two-digit numerical identifier. Reaches were generally numbered sequentially from downstream to upstream when in series and west to east upstream from confluences. A reach was considered to be a stream segment with relatively consistent geomorphology and surrounding land use, and generally less than one-half mile in length. Features noted at reach junctions (e.g., culvert crossings) were associated with the downstream reach. Impact conditions within each reach were numbered sequentially with an abbreviation followed by a two-digit number. For example, the second stream crossing in a reach would have the identifier SC-02.

Forty-one stream reaches were evaluated in the Tankerhoosen River watershed using this stream assessment protocol. Table 2 summarizes the number of impact conditions identified and reach level assessments that were performed within each subwatershed.

Table 2: Number of Reach Level Assessments Performed and Impact Conditions Identified

Subwatershed	RCH	CM	ER	IB	OT	SC	TD	UT
Clarks Brook	5	--	2	--	10	8	2	--
Lower Tankerhoosen River	1	--	--	--	1	1	--	--
Middle Tankerhoosen River	5	--	1	--	14	5	7	--
Walker Reservoir	5	--	--	--	6	6	--	--
Gages Brook	12	1	8	5	21	12	3	1
Gages Brook South Trib.	7	1	1	1	3	8	--	--
Tucker Brook	6	--	2	4	9	9	3	--

Reach level assessment scores were assigned by field crews based upon the overall stream, buffer, and floodplain conditions. A subjective determination of eight criteria is assessed on a scale of 0 to 20; 0 relating to poor conditions and 20 being optimal conditions. The total of these scores provides a quantitative index of overall stream health and condition. The maximum possible number of points that would be assigned for a fully optimal stream reach is 160 points.

Streams were assessed relative to a base condition, which for this study, is the highest scoring stream reach in the Tankerhoosen River watershed (153 points). All other assessed stream reaches were assigned a numerical score and categorized relative to the base score of 153 points (Table 3). Reaches scoring greater than 90% of the base condition (138 points) are considered "excellent", between 75% and 90% of the base condition are categorized as "good", between 55% and 75% of the base condition are categorized as "fair", between 35% and 55% of the base condition are categorized as "poor", and less than 35% of the base condition are categorized as "very poor". Table 4 summarizes stream reach assessment scores and classifications for the assessed stream reaches.

Table 3: Stream Reach Classifications

Category	Percentile	Point Threshold
Excellent	90%	≥138
Good	75%	≥115
Fair	55%	≥84
Poor	35%	≥54
Very Poor	<35%	<54

Table 4: Stream Reach Assessment Scores and Classifications

Excellent		Good		Fair		Poor		Very Poor	
Reach ID	Score	Reach ID	Score	Reach ID	Score	Reach ID	Score	Reach ID	Score
MTR-08	153	GBST-02	127	GB-09	114	TB-04B	83	GB-05B	53
GB-10	146	GB-02	120	GBST-03	111	MTR-01	82	WR-01	35
GBST-04A	146	GBST-09B	120	LTR-03	111	GB-04	80		
GBST-01	145	TB-02	119	GB-07	105	WR-02	80		
MTR-07	139	GBST-04B	117	CB-03	104	WR-04	76		
CB-04	138	TB-01	116	GB-01	102	GB-03B	72		
		GB-08	115	GB-03A	97	GBST-09A	59		
				MTR-09	94				
				GB-05A	93				
				CB-02	93				
				TB-03	92				
				TB-04A	92				
				WR-03	91				
				GB-06	88				
				MTR-02	87				
				CB-01	85				
				WR-05	84				
Note: TB04C and CB-05 were not scored during the reach level assessment									

As depicted in Figure 2, MTR-08 is the highest rated stream reach due to good riparian cover and bed material. WR-03 is considered fair due to the presence of invasive species within the riparian corridor. TB-04B and GB-05B are poor and very poor, respectively, because of poor channel characteristics, outfalls, stream crossings, trash and debris and lack of stream buffer and stream bank erosion in the case of GB-05B.

The following sections summarize the major issues identified during the stream corridor assessments for each priority subwatershed. Specific locations are identified according to the stream reach and impact condition IDs described previously. Identification of "right" and "left" stream banks is from the observer's perspective facing downstream.

Figure 2: Examples of Stream Reaches in Various Classification Categories

2.2.1 Clarks Brook

Clarks Brook is a tributary of the Tankerhoosen River that flows into the Middle Tankerhoosen River subwatershed. Clarks Brook is divided into five stream segments, labeled CB-01 through CB-05 (Figure 3). All five stream segments were assessed. Segments CB-01 through CB-03 were inventoried on July 2, 2008, while segments CB-04 and CB-05 were assessed on July 10, 2008. Land use in this subwatershed includes residential, commercial/industrial, retail, and some undeveloped land. Interstate 84 crosses Clarks Brook in the southern portion of the watershed.

CB-01
Stream segment CB-01 begins at the mouth of Clarks Brook and continues upstream to Bolton Road. The surrounding land use is primarily forested and open fields, with one residence along the left bank.

- RCH – The overall stream conditions are optimal to suboptimal with the exception of bank vegetative protection which is rated as poor due to lack of stream buffer along portions of the left bank. The dominant bed substrate is cobble; there are no attached or floating plants in the stream; wildlife such as fish, frogs, and birds are present; and the stream is approximately 50 percent shaded. The reach has good accessibility.

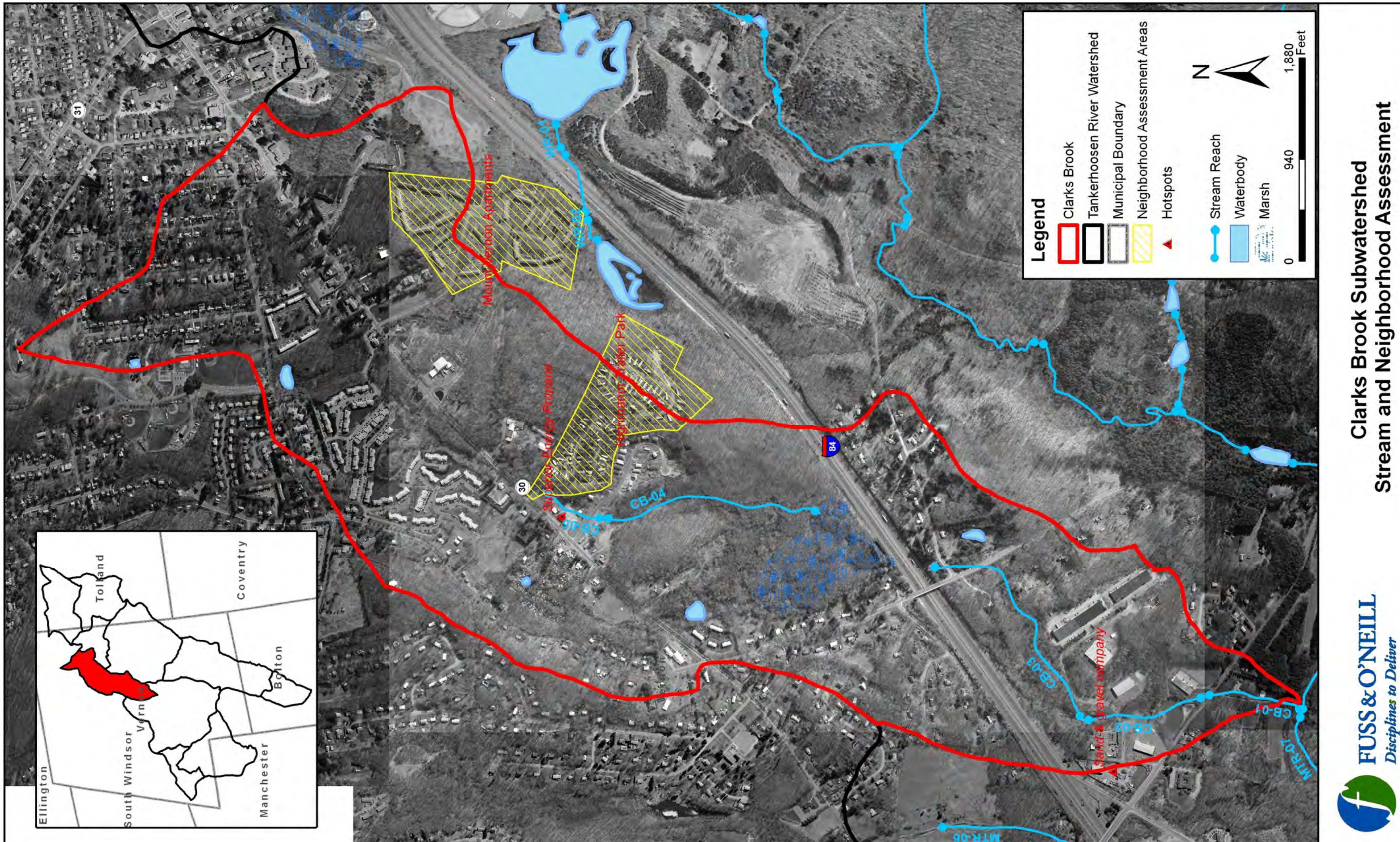


Figure 3. Clarks Brook Subwatershed Field Assessment Locations

- OT – The reach contains several outfall pipes, including several 4-inch plastic pipes which are believed to be connected to residential foundation drains or roof downspouts (no dry weather flows observed) and two 18-inch outfalls conveying roadway drainage (no dry weather flows observed). None of the observed outfall pipes appears to be contributing dry weather discharges or causing stream bank erosion.

- SC – Clarks Brook crosses under Bolton Road within a 5.5-foot circular concrete culvert. The upstream side of the culvert was partially blocked by brush and debris, and the concrete on the inside of the culvert is deteriorating. The sharp drop in elevation immediately downstream of the culvert creates a "perched" condition and a physical barrier to fish passage. This culvert is a potential candidate for fish barrier removal to address the perched outlet and cleaning/repair.

CB-02

Stream segment CB-02 flows along a baseball field and industrial properties, from Bolton Road to Industrial Park Road. The stream enters a culvert prior to Industrial Park Road and re-emerges on the other side of the road.

- RCH – The stream conditions are generally suboptimal to marginal. The instream habitat is considered optimal while the floodplain connection, vegetated buffer width, floodplain habitat and floodplain encroachment received a marginal rating. Clarks Brook flows at 100 percent of the channel width in this section, with clear water and some attached plants in the stream. The dominant substrate is sand and cobble and there is evidence of sediment deposition.

- OT – There are three outfalls along this reach. The first, OT-01, is a plastic pipe on the right bank originating from the parking lot of an adjacent industrial facility, was observed to have a trickle of discharge and brown benthic growth on the pipe. Outfall OT-02 is an earthen open channel approximately 4 feet deep and 5 feet wide. A trickle of discharge was also observed in the channel. The final outfall, OT-03, is a 4-inch diameter plastic pipe on the right back. No flow or microbial growth/discoloration was observed from the pipe.

- ER – Some moderate, isolated bank erosion was observed on the left bank. This area is a potential candidate for bank stabilization.

- SC – An approximately 400-foot long circular culvert conveys Clarks Brook under a parking lot. The triple barrel metal culverts are 2 feet in diameter. The outlets of the culverts are perched slightly above elevation of the stream bottom. This culvert is a potential candidate for fish barrier removal to address the perched outlet.

- TR – Significant quantities of trash and debris (an estimated 1 pickup truck load) were observed including tires, automotive waste, appliances and a closed 55-gallon drum of unknown contents. The debris and waste materials should be removed and disposed in accordance with applicable local, state, and federal regulations.


Trash and debris along reach CB-02

CB-03
Reach CB-03 begins on the north side of Industrial Park Road, continues through the underpass of Bamforth and Baker Roads, and ends at Interstate 84. The stream passes through mostly forested areas, although the stream also flows along an industrial park for a short distance and then under the two roads.

- RCH – The stream conditions are generally rated suboptimal. The in-stream habitat and floodplain vegetation are rated optimal. The vegetative protection, bank erosion, floodplain connection, habitat and encroachment are considered suboptimal. The bank erosion on the left bank and buffer width on the right bank are considered marginal. The stream flows at 75-100% of the channel width, which is dominated by boulder substrate. The water is clear with no aquatic plants in the stream, and the stream surface is mostly shaded. Access to the reach is rated fair or difficult.

- OT – There are two outfalls along this reach. OT-01 is a drainage channel, originating from a wooded area adjacent to Interstate 84, approximately 1 foot deep and 2 feet wide. OT-02 is an 18-inch concrete drainage outfall pipe with moderate flow.

- ER – An approximately 30-foot long area of severe bank erosion was observed on the left bank downstream of a wooden foot bridge. The area has good access for construction equipment for potential restoration of the bank. This area is a potential candidate for bank stabilization.

- SC – Stream crossing SC-01 is a wooden foot bridge over Clarks Brook. Debris under the bridge is causing partial blockage of the stream. Removal of the debris is recommended. Crossing SC-02 is a circular culvert below Bamforth Road. The double metal barrels are approximately 4.5 feet in diameter and 60 feet long. The culvert outlet is elevated above the elevation of the stream bed, restricting fish passage. This culvert is a potential candidate for fish barrier removal to address the perched outlet. The third stream crossing in this segment is SC-03, which conveys flow underneath

Baker Road inside a circular double barrel metal culvert. The culverts are 4 feet in diameter and approximately 100 feet in length.

Bamforth Road crossing (perched culvert) along reach CB-03

- TR – Automotive debris was observed along the stream near a residential area, and should be removed as part of a stream cleanup in this reach.

CB-04

Stream segment CB-04 extends from the wetlands on the northern side of Interstate 84 through a forested area and ending at the edge of a residential neighborhood at Rockledge Drive.

- RCH – This segment is rated as optimal using the stream assessment criteria in every category except floodplain habitat, which is rated suboptimal. The dominant substrate is cobble, the water is clear and there are no aquatic plants in the stream. There is evidence of fish, frogs and songbirds and the stream is mostly shaded. There is some evidence of sediment deposition in the stream channel.

- OT – A 12-inch concrete outfall pipe is located on the right bank near Rockledge Drive. The pipe is surrounded by dense knotweed and appears to originate from the adjacent residential area. A trickle of flow was observed, and the flow appeared to be cloudy and orange in color.

- SC – There are several stream crossings along Clarks Brook in this segment. The first two crossings consist of a low-head concrete dam located immediately upstream of an approximately 4-foot diameter concrete culvert, which is located below a forested dirt road. The concrete dam and forest road culvert (perched approximately 3 to 4 inches above the elevation of the streambed at the culvert outlet, and having very shallow flow) are potential barriers to fish passage. Both are potential candidates for fish barrier removal. The third crossing is a concrete culvert below Rockledge Drive. Both culverts identified in this reach showed evidence of cracking and deterioration, and should be evaluated for potential repair or replacement.

CB-05

The most upland reach in Clarks Brook, CB-05, could not be visually assessed because the segment flows entirely belowground in a culvert system. The flow is directed below a commercial building occupied by Superior Energy Propane and continues to flow through the culvert for approximately 650 feet, parallel to Route 30 until re-emerging on the north side of Middle Terrace. Historical filling of the Superior Propane site appears to have occurred, as evidenced by water seepage from the ground surface at the southeast corner of the site and the presence of a significant stand of phragmites adjacent to the site. A storm drain exists on the site. Representatives from Superior Propane indicated a desire to pave additional areas of the site and/or divert the water on the site to alleviate the wet soil conditions. This site should be further investigated to better define potential impacts of the historical filling, current drainage issues, and plans for additional site development.

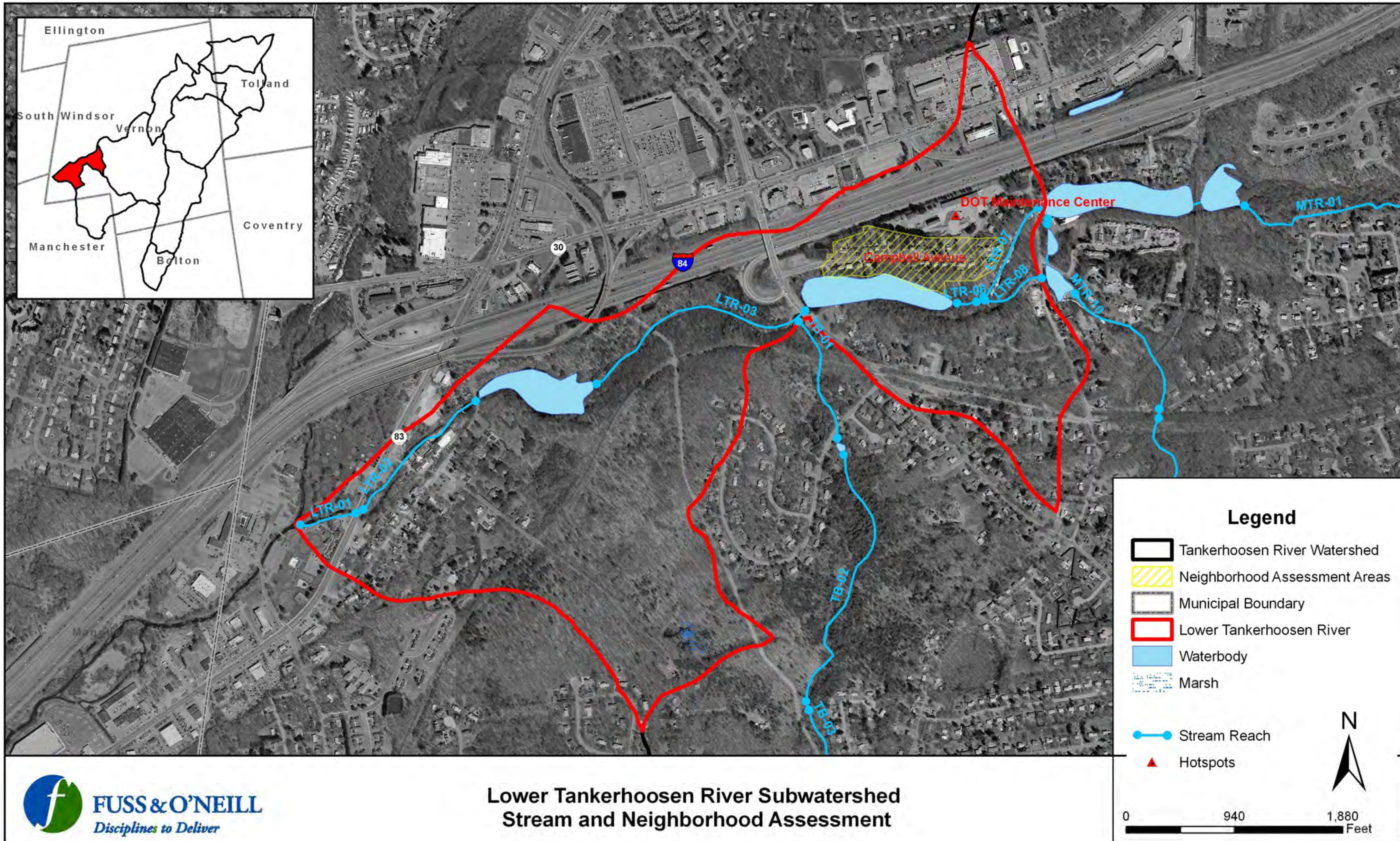
2.2.2 Lower Tankerhoosen River

The Lower Tankerhoosen River subwatershed is the outlet for the main stem of the Tankerhoosen River prior to its confluence with the Hockanum River and is fed directly by Tucker Brook and the Middle Tankerhoosen River (Figure 4). Only stream segment LTR-03 was assessed in this subwatershed (on June 5, 2008) due to limited time and staff availability.

LTR-03

Stream segment LTR-03 is approximately 0.5 mile long and extends east to west, parallel to Interstate 84, from the inlet to Talcottville Pond through a forested area to the Dobsonville Pond dam and Dobson Road. The width of the stream varies from 20 feet to 50 feet and the upstream end of the segment near the dam has very steep banks.

The upstream side of Dobsonville Pond dam at the upstream limit of reach LTR-03. The photograph is taken near the confluence with reach TB-01.



Lower Tankerhoosen River Subwatershed
Stream and Neighborhood Assessment

Figure 4. Lower Tankerhoosen River Subwatershed Field Assessment Locations

- RCH – The reach level assessment characterized this segment as generally suboptimal. The vegetated buffer width and floodplain vegetation is rated as optimal. The surrounding forested land provides good stream habitat. The beginning and end of the stream segment are altered by the manmade impoundments at both ends. The stream flows at 75 to 100% of the channel width and the substrate is dominated by cobble. The water is somewhat cloudy and has a naturally stained color. There are no plants in the stream and the surface is mostly shaded. The most significant issue observed along this reach is a stormwater detention basin associated with runoff from Interstate 84.

- OT – A stormwater outfall pipe conveys stormwater runoff from Interstate 84 to a detention basin located adjacent to the stream. The inside of the outfall pipe was observed to have an orange, rusty color, and an oily stain. A rusty, oily sludge was observed in the bottom of the detention basin. No standing water or discharge from the basin was observed at the time of the inspection. A discharge investigation is recommended to observe the basin function during wet weather and assess possible pollutant contribution to the stream. The basin and stormwater discharge is a potential stormwater retrofit candidate.

- SC – The dams that impound Dobsonville Pond and Talcotville Pond are potential barriers to fish passage. According to the CTDEP Inland Fisheries Division, there are currently no diadromous fish (herring, shad) passage plans for these dams (Murphy, personal communication, September 24, 2008). There has been an effort in recent years to provide American eel passage at inland dams when there is a need and opportunity. An assessment of the lower reaches of the Tankerhoosen River is recommended to evaluate the presence of American eel and other resident fish populations, as well as the potential benefit of providing fish passage for these dams. Based on the assessment findings, fish passage for the resident fish population in the lower Tankerhoosen River could be incorporated into future dam repair projects.

2.2.3 Middle Tankerhoosen River

Reaches in this subwatershed are labeled MTR-01 through MTR-12. Stream assessments were conducted on representative reaches including MTR-01, MTR-02, MTR-07, MTR-08 and MTR-09 (<u>Figure 5</u>). Segments MTR-01, MTR-02 and portions of MTR-09 were inventoried on June 4, 2008, while the remaining segments were assessed on June 5, 2008. Residential use is the dominant land use in the subwatershed, and Interstate 84 traverses the northern portion of the subwatershed. The Upper Tankerhoosen River and Clarks Brook drain to the Middle Tankerhoosen River, which feeds the Lower Tankerhoosen River.

MTR-01
This stream segment begins at the inlet to Tankerhoosen Lake and ends at the confluence of segments MTR-02 and MTR-09. The stream flows parallel to the back yards of a residential neighborhood

- RCH – The reach level assessment indicates suboptimal in-stream habitat, vegetative protection, bank erosion and floodplain connection. The overall buffer and floodplain conditions are generally marginal, with limited vegetative buffer width, floodplain

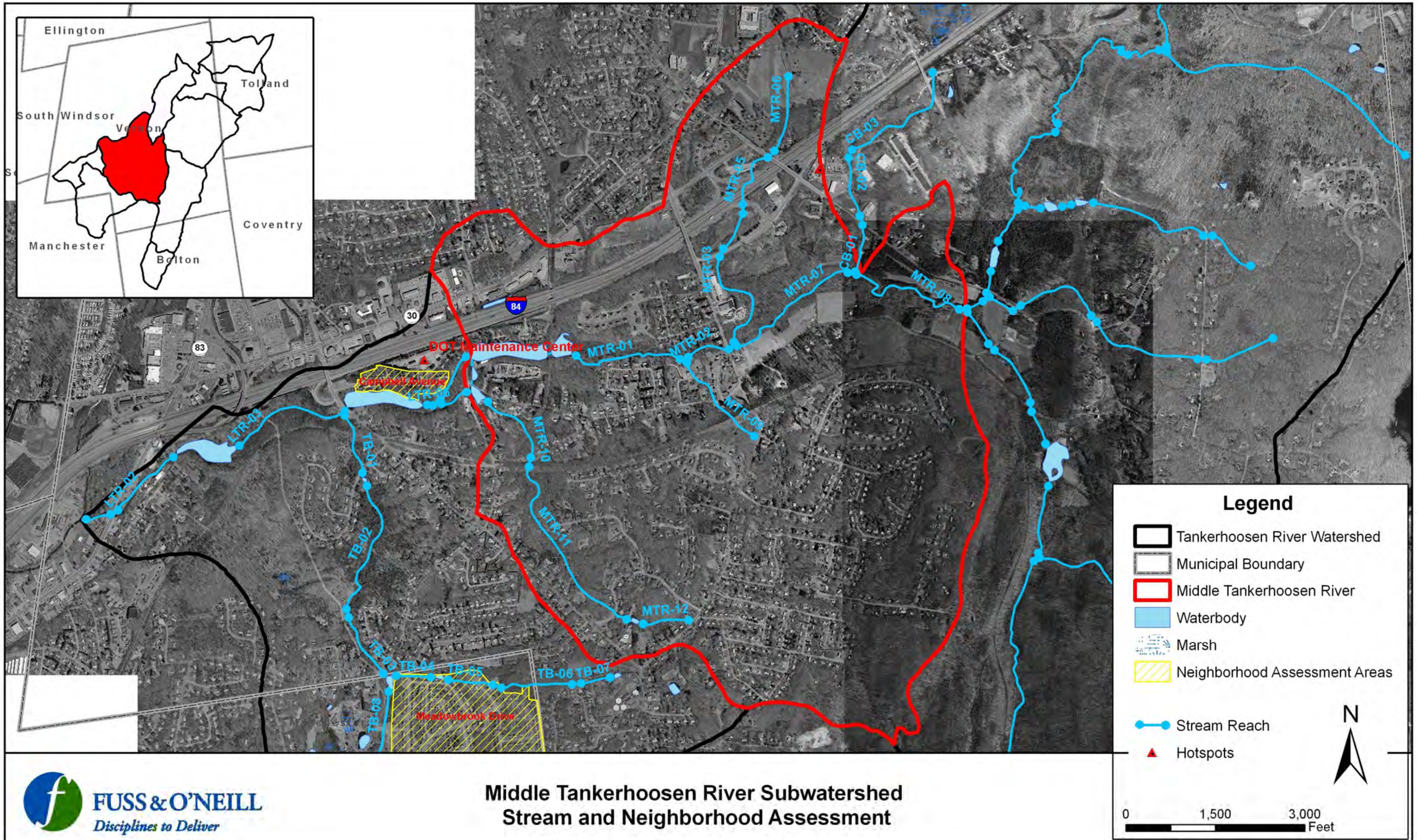


Figure 5. Middle Tankerhoosen River Subwatershed Ffield Aassessment Locations

vegetation and habitat and moderate floodplain encroachment. The dominant in-stream substrate is gravel and cobble, and 50 percent of the stream surface is shaded.

Stream segment MRT-01 has areas with little or no vegetative buffer.

- OT – Four outfalls were observed along the left bank of the stream. Three of the outfalls are storm drainage pipes that convey stormwater runoff from the adjacent residential development. Sediment accumulation was observed at the outlets of several of the outfalls. An ABS outfall pipe was observed behind a residence. The pipe was submerged below the stream water surface at the time of the inspection. The source of this pipe and the nature of the potential discharge from the pipe should be investigated further.

- TR – Three instances of trash and/or debris were observed along this segment. TR-01 is a commercial-grade 55-gallon plastic drum located within the stream. The contents of the drum could not be determined. TR-02 consists of brush and debris stockpiled along the bank of the stream. The material was placed by the Town of Vernon following removal of a beaver dam, but never removed. TR-03 consists of approximately 16 plastic buckets that are submerged or partially submerged below the water surface of the stream. The contents of the buckets are unknown. Both areas should be the focus of stream cleanup efforts.

- IB – The left bank along much of the stream segment consists of residential lawns immediately adjacent to the stream, with little or no stream buffer. Stream bank erosion was observed in some areas along the left bank, including evidence of animal burrows in the stream bank below the exposed roots of the lawn.

MTR-02

Reach MTR-02 begins at the confluence with MTR-09 and ends at Tunnel Road. This braided stream segment also flows adjacent to residential properties.

- RCH – The right bank consists primarily of residential lawns with little or no buffer, while the left bank has a modest vegetated buffer consisting of shrubs and mature forest. The in-stream flow fills the channel, and the substrate is dominated by gravel. There are no aquatic plants in the stream, and the water surface is approximately 50 percent shaded. Sediment deposits were observed in areas of the stream channel. Generally, the stream ranges from suboptimal to marginal for overall stream conditions and buffer and floodplain conditions. The left bank is characterized as optimal for bank erosion and vegetated buffer width. The right bank has poor vegetative protection.

- OT – A 14-inch diameter concrete pipe conveys stormwater runoff from Tunnel Road. No dry-weather flow or other visible evidence of pollution was observed.

- SC – Twin box culverts carry flow below Tunnel Road. The culverts are concrete, approximately 4 feet in diameter and 13 feet in length.

MTR-07

This segment begins at Tunnel Road and ends at the confluence of the Tankerhoosen River and Clarks Brook. The primary land use along stream segment MTR-07 is forested and agricultural land, with a small area of adjoining residential land near Tunnel Road.

- RCH – The reach level assessment identifies this segment as generally optimal, with high ratings for overall stream conditions and buffer and floodplain conditions. The reach is dominated by gravel and cobble substrate, clear water, no in-stream vegetation, observed fish and terrestrial wildlife, and a mostly shaded stream.

MTR-08

Segment MTR-08 begins at the confluence of Clarks Brook and the Tankerhoosen River and ends at the confluence of Railroad Brook and the Tankerhoosen River. The surrounding land use is forest or cleared fields.

- RCH – This segment is characterized by gravel and cobble substrate, no attached or floating aquatic plants, wildlife including fish, deer, raccoon, and songbirds, and the stream is mostly shaded. Some evidence of channel widening was observed. The overall stream, buffer and floodplain conditions are rated as optimal.

MTR-09

Stream segment MTR-09 is a tributary of the Tankerhoosen River that begins at the main stem of the Tankerhoosen River and extends upstream, crossing Warren Avenue and ultimately ending at Tunnel Road. The surrounding land uses are residential, forested, and wetlands, including a section of the Rails to Trails.

- RCH – The reach level assessment rates this segment as suboptimal to marginal. Bank erosion and floodplain connection for the reach is rated as marginal. The floodplain habitat and encroachment are also at a marginal level. The dominant substrates are sand, gravel and cobble. There are no aquatic plants in the stream, and the water surface is mostly shaded. There is evidence of bank scour along the reach. Issues identified along this reach include stormwater outfalls, severe bank erosion, stream crossings, and trash and debris.

- OT – A total of 10 stormwater outfalls were identified along this reach. A majority of the outfall pipes are smaller than 8 inches in diameter, appear to be residential foundation drains, and do not warrant further investigation. Several of the outfall pipes are associated with the roadway drainage system. There are two 2-foot diameter pipes along the left bank which do not have dry-weather discharge and are clean and not submerged. A black ABS pipe observed in the stream appeared to originate from a residence along Warren Avenue. A trickle of flow was observed from the pipe, and brown sediment accumulation was observed in the stream near the outfall. The source of this pipe and the nature of the potential discharge from the pipe should be investigated further.

- ER – An area of bank erosion was observed along the left bank, measuring approximately 20 feet in length and 6 feet high. The erosion severity is moderate and there is good access to the bank from the residential areas north of Warren Avenue. This area is a potential candidate for bank stabilization.

- SC – There are two road crossings and a rail crossing along this reach. The stone blocks on the outside of the Rails to Trails culvert crossing are partially dislodged and in need of repair. The Tunnel Road stream crossing has debris partially blocking the outlet of the culvert. The outlet of a concrete box culvert located north of Warren Avenue is perched approximately 14 inches above the elevation of the stream bed and is a potential barrier to fish passage. This culvert is a potential candidate for fish barrier removal to address the perched outlet.

The Tunnel Road stream crossing (A) and the Rails to Trails crossing (B).

- TR – Four instances of trash and debris were noted along this stream segment. Three consist of minor quantities of yard waste, while the fourth consists of approximately 2 to 3 pickup truckloads of leaves, logs, tree stumps and tires. This stream segment is a potential candidate for a stream cleanup.

2.2.4 Walker Reservoir

Reaches assessed in this watershed include WR-01 through WR-05 (Figure 6). Land use in this watershed includes a former outdoor sports complex, a Connecticut Department of

Transportation (ConnDOT) commuter parking lot, the Interstate 84 and Route 31 interchange, and several residential areas. The water bodies along the stream reaches in this subwatershed, including Walker Reservoir East and West, receive upstream flow Gages Brook and the Gages Brook South Tributary, as well as runoff from Interstate 84, Route 31, and residential developments. Segments WR-03 and WR-05 were assessed on June 3, 2008, while the remaining segments were inventoried on June 4, 2008.

WR-01
This reach is located between Walker Reservoir West and Interstate 84, and receives flow from an upstream pond and the highway. The stream is braided and is surrounded primarily by forested land.

- RCH - The reach is generally braided with a sandy bottom and a mostly-shaded stream surface. Channel widths were variable due to the braided nature of the stream, with the flow containing less than 25 percent of the channel width. Stream condition metrics in this reach are extremely poor with little habitat potential. Buffer metrics were somewhat better, with suboptimal (25-50 feet) width and mature forest vegetation. No notable floodplain was present.

- OT - A drainage ditch outfall originating from Interstate 84 is present near the upstream end of the reach. The channel contained excessive debris that should be removed. There was no flow when it was observed.

- SC - A stream crossing is present below Route 84. The 24-inch, steeply-sloped, corrugated metal pipe conveys flow from an upstream pond and reach WR-02 located north of the highway. The culvert is acting as grade control and has significant accumulated debris near its outlet. This reach also includes a chain link fence associated with the highway that has significant accumulated debris on the upstream side of the stream. The debris should be removed.

WR-02
This reach is located immediately upstream of the Interstate 84 culvert crossing and downstream of a pond, and situated at the southern end of the Mount Vernon Apartments.

- RCH - This reach is mostly shaded with a variable bottom of gravel, sand, and cobble. In stream habitat and vegetative protection was generally marginal, with suboptimal bank stability and floodplain connection. Buffer and floodplain condition was generally suboptimal to marginal, with significant impacts from human activities and little habitat diversity.

- SC –The Interstate 84 stream crossing described above is located at the downstream end of this reach. Generally, stream crossings separating reaches were considered to be associated with the downstream reach. However, the characteristics of the culvert inlet differ from the outlet; the upstream inlet is a 4-foot diameter pipe while the outlet is a 2-foot diameter pipe. A transition is suspected to occur at some point within the crossing.

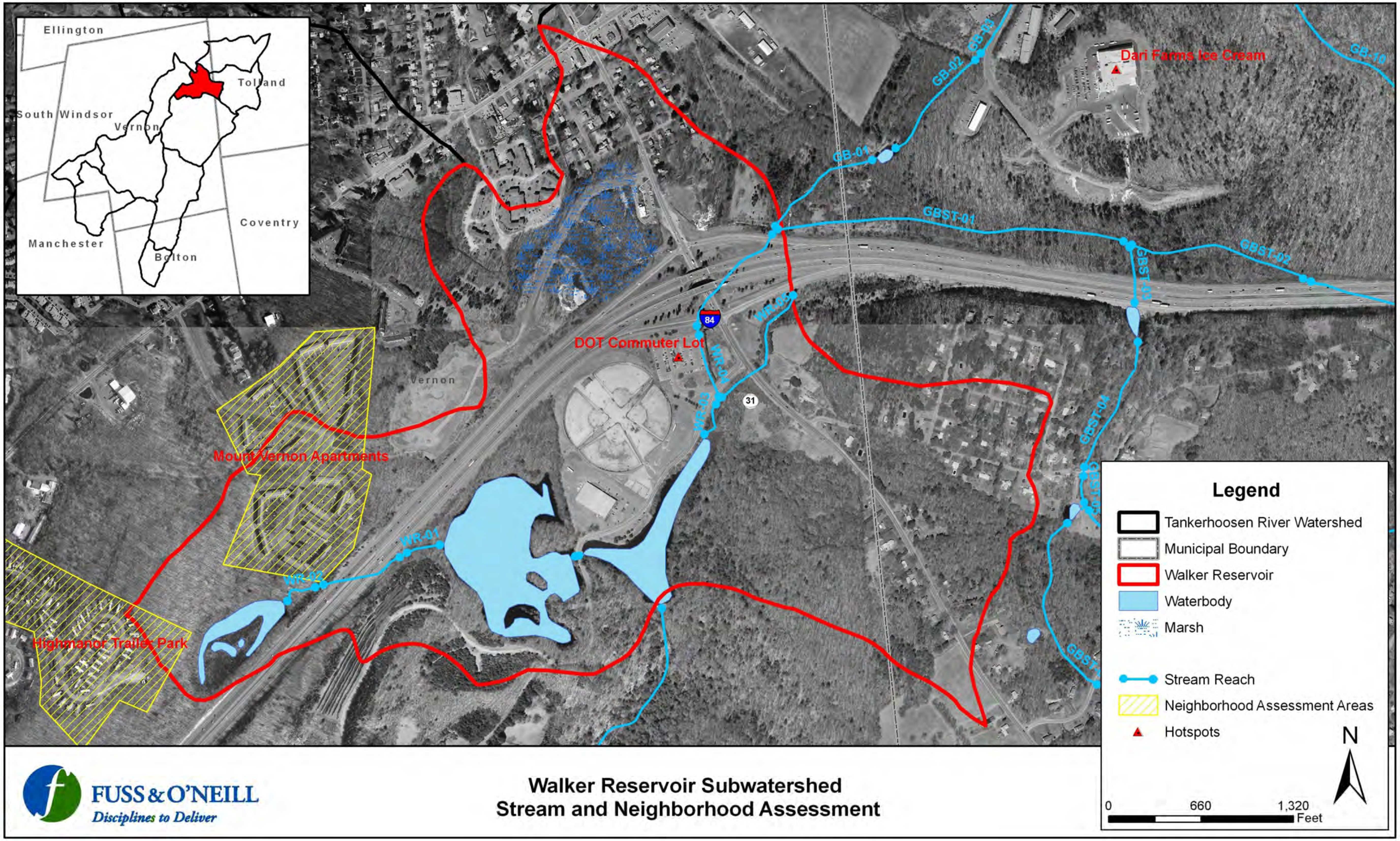


Figure 6. Walker Reservoir Subwatershed Field Aassessment Locations

WR-03

This stream reach connects Walker Reservoir East with reaches WR-04 and WR-05 and runs parallel to the east side of Reservoir Road, opposite the former outdoor sports complex.

- RCH - This reach is mostly shaded and includes a bottom of fine material including silts, clays, and sand. The reach is variable in width and depth, but is generally well shaded. A variety of wildlife was observed, including fish, beaver, deer, snails, and birds. Evidence of channel widening and sediment deposition was observed. The overall stream condition is generally suboptimal, with the in-stream habitat, vegetated buffer width on the right bank and floodplain encroachment rated as marginal.

- SC – A 4.5-foot diameter circular metal pipe is located on the right bank near the upstream end of the reach. The culvert appears to originate from stream reach WR-04 and crosses under Reservoir Road.

WR-04

The stream reach WR-04 begins on the south side of Reservoir Road at the confluence of segments WR-03 and WR-05. WR-04 is a drainage ditch that flows parallel to the commuter parking lot between the Interstate 84 off-ramp at Exit 67 and Reservoir Road.

- RCH – Stormwater runoff from the commuter parking lot discharges directly into the stream through an outfall. The channel near the commuter lot contains significant invasive wetland vegetation (cattails and reed canary grass). The stream assessment rated this segment as generally suboptimal to marginal. The channel substrate is fine material including silt/clay and sands (sediment deposition). The water is observed to be turbid and there are some aquatic plants in the stream, which is partially shaded. The stream segment is readily accessible from the adjacent commuter parking lot.

- OT – The outfall that drains the commuter parking lot discharges to the stream through a 3-foot diameter concrete pipe. This outfall is a potential stormwater retrofit candidate to treat runoff from the parking lot.

- SC – Stream crossing SC-01 conveys flow below Reservoir Road and consists of a circular 4.5-foot diameter circular metal pipe. The pipe inlet is partially clogged with autumn olive and maintenance should be performed to remove the blockage. The second stream crossing in this segment, SC-02, is at the upstream end of the segment and crossed underneath the off-ramp for Exit 67 on Interstate 84. The culvert is circular with a diameter of 4 feet. There is evidence of sediment deposition, but otherwise the culvert is in good condition.

WR-05

Segment WR-05 is located between the confluence of WR-04 and WR-03 on the south side of Reservoir Road and the on-ramp for Exit 67 on Interstate 84. The stream flows in a southwesterly direction along this reach, crossing under Route 31 (Mile Hill Road).

- RCH – This segment is rated as suboptimal in the categories of in-stream habitat, vegetative protection and bank erosion, and rated as poor floodplain connection. The buffer conditions are generally marginal and there is extensive floodplain encroachment. The surrounding land use includes public roads (Interstate 84 and Route 31) and a portion of the commuter parking lot. There is a small vegetated buffer along the stream corridor on the upstream portion of the stream segment, although beyond the buffer are cleared fields. The dominant substrates are sand and gravel, with limited cobble. There is evidence of fish, raccoon, great blue heron and Canada geese in the stream corridor. The stream has evidence of sediment deposition and portions have been channelized.

- OT – Stormwater outfall OT-01 is an earthen channel located on the left bank upstream of the Route 31 crossing. The channel originates from an adjacent residential property and was observed to have significant (3 to 4 feet deep) headcutting (erosion of the channel progressing upstream). A moderate flow of clear water was discharging from the channel at the time of the inspection. The property owner indicated that the source of the flow is groundwater seepage and surface runoff from upgradient areas. A discharge investigation is recommended, and this channel is a potential candidate for stream bank stabilization. The second outfall, OT-02, is a paved asphalt channel on the right bank, 8-inches deep and approximately 3 feet wide. The channel conveys road runoff.

Eroded channel and discharge from a residential property.

- SC – Two stream crossings were identified along this reach. SC-01 is the stream crossing underneath Route 31 (Mile Hill Road), and SC-02 is the culvert underneath the on-ramp for I-84. Both crossings consist of twin concrete box culverts approximately 6 feet wide and 9 feet in height. Both have embedded bottoms. Sediment deposition was observed in the stream channel at both locations, which is believed to originate from Interstate 84 and channel erosion described above.

Twin box culvert along reach WR-05 underneath the onramp for I-84.

2.2.5 Gages Brook

A total of 2.2 stream miles were assessed in Gages Brook (Figure 7), including segments GB-01 through GB-10, during June 3 through 5, 2008. The primary land uses in this subwatershed include commercial development along Route 30, industrial uses associated with the Tolland Industrial Park, and residential and forested areas in the eastern portions of the watershed. The Gages Brook stream assessments performed for this study augment previous stream surveys performed by the North Central Conservation District in October 2007 between the Tolland Agricultural Center footbridge and Industrial Park Road West.

GB-01

This primarily forested reach of approximately 0.18 miles is the downstream-most reach of Gages Brook and extends from the Interstate 84 culvert crossing to the footbridge behind the Tolland Agricultural Center (TAC).

- RCH - The reach was mostly shaded, with optimal habitat, and vegetation and floodplain characteristics ranging between suboptimal and marginal.

- OT - Two outfalls were identified, both of which are believed to be drainage ditches associated with Interstate 84 located just upstream of the highway. Little discharge was present despite intermittent rain over the previous 1 to 2 days. The drainage ditches are potential candidates for stormwater quality retrofits.

- ER - Two areas of severe bank erosion were identified. ER-01 included a 300-ft length of severe bank scour downstream of one of the outfalls described above. In a small section (30-40 feet), the stream was flowing mostly within an undercut section of the back, such that the channel bottom was mostly dry. ER-01 appeared to be located on private property and would be difficult to access. ER-02 included a 150-ft section of undercut bank at a 90-degree bend where the stream enters CM-01. ER-01 may be located on State property but may also be difficult to access. While both areas of erosion are in need of restoration, limited site access may make bank stabilization impractical.

- CM – An approximately 200-foot long section of stream immediately upstream of the Interstate 84 crossing appeared to be straightened, disconnected from the floodplain, and modified to create a riprap-lined channel with trapezoidal cross section.

- TR - A deposit of brush, logs, and disassembled fencing was observed immediately adjacent to the stream less than 100 feet downstream of the footbridge at the TAC grounds. The material should be removed during a stream cleanup.

GB-02
This reach of approximately 0.17 miles continues upstream from the TAC footbridge northeast to a transition from forest to old field. The reach is generally wooded with significant wetlands located in the floodplain.

- RCH - The stream is mostly shaded with some evidence of sediment deposition. In-stream habitat was marginal, with other in-stream metrics ranging from suboptimal to optimal. The reach includes a high-quality buffer and good floodplain connection, with associated metrics ranging from suboptimal to optimal.

- TR - A small quantity of automotive debris was observed and should be removed. Access is difficult, although cleanup would be straightforward.

Trash and debris in stream segment GB-02

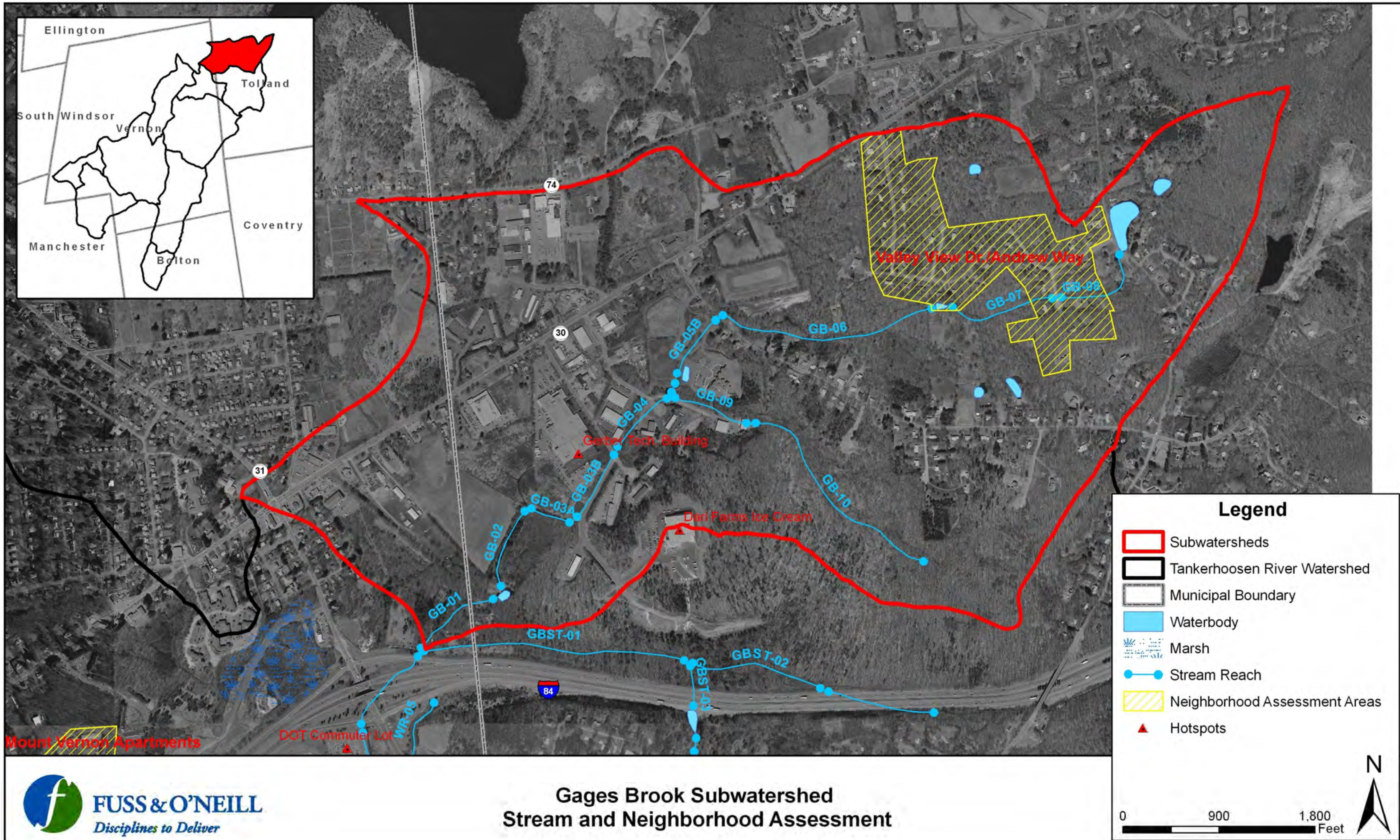


Figure 7. Gages Brook Ssubwatershed Field Assessment Locations

GB-03A

This reach begins where GB-02 emerges from the forest and extends east, with the forest to the south and the old field to the north, ending at Gerber Drive in the Tolland Industrial Park.

- RCH - The reach is mostly shaded with old field to the right and forest to the left. Bed scour and bank scour were observed in some areas. Most stream, buffer, and watershed condition metrics were in the marginal to suboptimal range, with low-end marginal habitat and marginal floodplain connection. However, there was little floodplain encroachment, and the vegetated buffer was high-end suboptimal to optimal in condition.

- OT - A wet stormwater basin associated with the industrial park discharges to the stream at the upstream end of the reach. Dense vegetation was growing in the riprap and erosion was present on the adjacent downstream bank in GB-03A

- ER - An approximately 100-foot long area of bank scour was observed in a straight section of the right bank. The severity of the erosion was relatively minor and appeared to originate downstream of OT-01. Access to this area is fair, although it is likely in private ownership.

- SC - A stream crossing is present below Gerber Drive and consists of two elliptical corrugated metal culverts. Fish passage may be difficult through these culverts due to shallow depth of flow during low-flow conditions.

GB-03B

This reach of approximately 0.14 miles runs parallel and adjacent to Gerber Drive between the crossings at Gerber Drive and Industrial Park Road West. The reach is located in a narrow, modified channel between the road/retaining wall and the parking lot of an adjacent industrial facility.

- RCH - Stream condition metrics in this reach were generally suboptimal. Buffer and floodplain metrics were marginal to poor since significant encroachment is present on both sides of the stream. Artificial fish habitats (lunkers) were found along the stream banks, and fish were observed in the stream as well as evidence of raccoons and songbirds in the stream corridor.

- OT - Four outfalls were present in this reach, including two paved asphalt swales ("leakoffs") directing surface runoff to the stream from adjacent parking lots, a 12-inch concrete pipe originating from the parking lot of an adjacent industrial facility, and a 24-inch concrete pipe suspected to be associated with the roadway drainage system. Significant trash was present at the outlet of one of the leakoffs.

- IB – The majority of the stream reach has limited and highly impacted stream buffers. At the downstream end of the reach, a retaining wall is located along the top of the right bank, and industrial parking lots are located close to the left bank. Due to the limited area on both sides of the stream, there is low potential for stream restoration along this reach.


Concrete retaining wall adjacent to Gerber Drive along segment GB-03B

- SC - The reach terminates at the Industrial Park Road West stream crossing, which consists of three 72-inch corrugated metal pipe culverts. The left barrel was slightly out of round. The majority of flow was through the left barrel; the bottom of the center barrel was dry, and the right barrel appeared to have some backflow. The flow depth in these culverts may be insufficient for effective fish passage during low-flow conditions. This crossing is a potential candidate for fish barrier removal. The inlet of the culverts was partially obstructed by brush and debris, which should be removed.

GB-04

Reach GB-04 is located between Industrial Park Road West and Industrial Park Road East. The reach includes numerous outfalls and significant sedimentation.

- RCH - The reach is mostly shaded, although the buffer is significantly impacted on both sides. Stream condition metrics were generally within the suboptimal range, although poor floodplain connection was observed. The vegetated buffer width is suboptimal on the left and marginal on the right, and the vegetation quality is at the lower limit of the suboptimal range. Both the floodplain habitat and floodplain encroachment metrics were poor.

- OT - Six outfalls were observed in this reach, originating from the industrial areas or associated roadways. These included an 8-inch corrugated metal pipe, a 6-inch plastic pipe, a 7-inch plastic pipe (OT-03) with some sediment deposition immediately downstream, a 12-inch concrete pipe draining a parking lot, a double 42-inch culvert that conveys roadway storm drainage, and a 24-inch concrete pipe conveying roadway drainage to the stream. The source of the sedimentation at OT-03 should be investigated.

- SC - This crossing includes triple 72-inch culverts below Industrial Park Road East. The depth in one pipe was approximately 6-12 inches, while the other two barrels were blocked with leaves, branches and sediment. The blockage should be cleared by removing the material.

GB-05A

This reach continues upstream from GB-04 to GB-05B. The reach GB-05 was subdivided into two separate reaches because the confluence of GB-09 and GB-04 occurred a few hundred feet upstream of the location shown in the original mapping (the figure shows the updated reach segments).

- RCH - This reach is mostly shaded with a gravel and cobble bottom, with some sedimentation and bank scour observed. In-stream habitat was optimal, with a mix of stable and naturally occurring substrate and habitat conditions. The majority of the remaining stream, floodplain, and buffer condition metrics were in the suboptimal range, although with marginal floodplain connection and encroachment.

- OT - One outfall pipe was observed on the left bank just upstream of Industrial Park Road East and appeared to originate from an adjacent industrial area.

GB-05B

This reach extends from the confluence of GB-05A and GB-09 upstream to Old Post Road. The stream passes through the landscaped grounds of a technology company and much of the reach is unshaded. This reach may provide an opportunity for bank stabilization and stream buffer restoration, since it appears to be located on land owned by a single (although private) owner. Community garden plots were observed adjacent to the stream, and solar panels were being constructed on-site, indicating that the owner may be environmentally-motivated. A wet stormwater basin is located on the property between an on-site parking lot and the stream.

- RCH - Stream condition metrics in this reach are generally suboptimal to poor, with little or no vegetative buffers, significant erosion problems, and little floodplain or floodplain connection. Water from the stream appears to be diverted through the on-site stormwater basin via a catch basin diversion structure. Buffer and floodplain condition metrics were marginal to poor, with narrow vegetated buffer width (10-25 feet) floodplain vegetation consisting of turf, little or no wetland habitat, and significant floodplain encroachment.

- OT - An 8-inch PVC outfall was observed originating from the on-site stormwater basin. Bank erosion and riprap was observed at the outfall. Some debris was present at the outfall, including pieces of plastic pipe.

- ER - A significant area of bank erosion was observed in a bend in the stream. The erosive cut was approximately 5.5 feet in height and greater than 100 feet in length. This area is a potential candidate for stream bank stabilization.

Stream segment GB-05B showing limited vegetative buffer and a small footbridge crossing the stream.

- IB – Little or no vegetative buffer exists along the stream through the commercial/office building site. Mowed lawn borders much of the stream on both sides, and several footbridges have been constructed over the stream. This stream segment is a potential candidate for stream buffer restoration.

Stream segment GB-05B showing area of stream bank erosion.

- SC - Two stream crossings were observed, including a 36-inch culvert below the facility access road and a 50-inch culvert below Old Post Road. Both culverts are perched on the downstream side approximately 2 to 4 inches above the bottom of the stream, and both have very shallow flow (less than 1 inch), which presents a barrier to fish passage.

The former appeared to be in good condition and the latter appeared to have been recently slip-lined. These culverts are potential candidates for fish barrier removal.

GB-06
This reach of approximately 0.4 miles in length continues from Old Post Road to a former pond located south of a residential subdivision on Valley View Drive.

- RCH - The reach was mostly shaded with a bottom of gravel, cobbles, and boulders. Evidence of downcutting was present along much of the reach since many of the boulders were sharp-edged. In general, stream condition metrics were marginal or poor, with significant erosion, marginal vegetative protection, and marginal floodplain connection due to downcutting. Overall buffer and floodplain characteristics were generally suboptimal, with a relatively wide buffer of young forest and a mix of wetland and upland habitat.

- OT - Three outfalls were present at the downstream terminus of the reach. These included 12-inch and 15-inch storm lines and a paved asphalt leakoff conveying stormwater runoff to the stream.

- ER - Numerous areas of significant erosion were identified along this stream segment. Three areas of bank scour on the outside banks of bends were observed. One area included a low-head concrete dam where the stream eroded the abutment, creating a bypass channel around the structure. The last area included active downcutting ending at a nick point behind several residences at the terminus of the reach. These areas are potential candidates for stream bank stabilization.

Stream segment GB-06 showing area of stream bank erosion.

- IB – An impacted buffer was observed at the terminus of GB-06 near a footbridge on private property. Residential landscape vegetation (pachysandra) was observed growing up to the bank's edge.

- SC - Three stream crossings were present in this reach, each of which likely prevents upstream fish passage. The first is located adjacent to Old Post Road at the downstream end of the reach. This crossing consists of an embankment such as a dam or railroad grade that does not include a culvert or opening. The stream appeared to be flowing through interstices in the embankment. The second crossing consisted of a dam with a total hydraulic drop of approximately 9 feet. The third crossing is a former road with a corrugated metal pipe culvert and a drop at the culvert outlet of approximately 5 inches. These crossings are potential candidates for dam removal and/or fish barrier removal.

GB-07

This reach of approximately 0.2 miles in length continues upstream to the east from GB-06 to Andrew Way. The stream corridor is generally forested, surrounded by residential development along Valley View Drive, Andrew Way, and Old Post Road.

- RCH - The reach is mostly shaded with a bottom of cobbles and boulders. Typical channel dynamics include downcutting and bed scour. The reach is mostly shaded. Stream conditions were generally within the suboptimal to marginal range, while buffer and floodplain characteristics were generally optimal to the high end of suboptimal.

- IB – Similar to the residential encroachment observed in reach GB-06, an isolated area of pachysandra and lawn were present on both sides of the stream where the stream enters SC-01.

- SC - This crossing includes an approximately 200-foot long, 24-inch concrete culvert below Andrew Way. A series of small drops (approximately 24 inches) were present downstream of the outlet. These drops were resulting from the boulders lining the channel. These drops and shallow flow in the culvert under low-flow conditions would likely limit upstream fish passage. This culvert is a potential candidate for fish barrier removal.

GB-08

This reach of 0.15 miles is the uppermost stream segment on Gages Brook, which is located between Andrew Way and a privately-owned pond situated north of Mountain Spring Road. The stream segment flows primarily through residential and forested areas.

- RCH - This reach is mostly shaded with a sand and gravel bottom and a stable channel with little noticeable erosion. Stream condition metrics are within the suboptimal range in this reach, while buffer and floodplain connection generally are within the optimal and suboptimal ranges.

- OT - An outfall was identified adjacent to a residence near the downstream limit of this reach. The outfall consisted of a 2.5-inch diameter PVC pipe with a screen projecting over the water surface by approximately 6 inches. The pipe may be the outlet of a foundation or yard drain.

- IB - Residences and lawn are located adjacent to the stream for approximately 300 feet on both sides of the stream near the downstream end of the reach.

- SC - The upstream limit of this reach consists of a low-head dam with an outlet weir discharging directly to an 18-inch concrete culvert below Mountain Spring Road.

- TR - An area of trash and debris was observed in the stream and buffer (right side) near the outlet of SC-01. Observed debris consisted of a tire, two 55-gallon drums (partially crushed with holes) and a bathtub. This debris should be removed and disposed of properly.

GB-09
This 0.15 mile reach parallels an access road and industrial facility located at the end of Industrial Park Road East.

- RCH - This reach has a gravel and cobble bottom, is mostly shaded, and has evidence of downcutting, bed scour, and bank failure. In-stream habitat is generally optimal to the high end of suboptimal. Buffer and floodplain characteristics are generally suboptimal to marginal due to the reach's incised nature and industrial land use along the left side.

- OT - This reach includes two outfalls. The first is a paved asphalt leakoff from a parking lot paired with a 6-inch PVC outfall causing slight bank erosion. The other outfall, OT-02, is an 18-inch plastic pipe discharging from the direction of the industrial facility. There was significant iron staining around this outfall. The source of the discoloration should be investigated.

- SC - A small dam is present in this reach, consisting of a weir with a drop of approximately 32 inches. Immediately downstream of the weir an area of soil has been undercut by the stream, forming a natural culvert, although one that is unlikely to significantly alter passage during low flow conditions.

GB-10
This reach of approximately 0.43 miles extends from the upstream limit of GB-09 into an extensive wetland complex where the stream originates in an area of groundwater seeps. This reach passes through a recently-constructed subdivision off of Old Post Road that does not appear on the aerial photos in the project mapping.

- RCH - This reach is mostly shaded with a gravel and cobble bottom and included some evidence of downcutting and sedimentation. The overall stream, buffer, and floodplain conditions were in the optimal range for every metric. The majority of the stream is surrounded by an extensive old-forest/wetland complex that is well connected to the stream channel. There is little evidence of encroachment except at the subdivision crossing.

- OT - One stormwater outfall to the stream was identified. The outfall originates from a new subdivision road and discharges to a stormwater basin/constructed wetland. The basin contained a significant quantity of leaves and other sediment. Stormwater discharged to the buffer of the stream via overland flow and continued to the stream. There appeared to be potential for future erosion where overland flow is occurring. Two other stormwater basins associated with this subdivision were observed, but the outfall locations could not be identified.

- SC - A new stream crossing was observed under the subdivision road, consisting of a 24-inch concrete pipe. A boulder was present below the flared-end outlet. The culvert outlet is perched several inches above the stream bed, and the depth of flow in the pipe was approximately 1-inch. Due to the headwater location of the culvert, upstream fish passage is unlikely to be an issue in this portion of the watershed.

New stream crossing on segment GB-10.

2.2.6 Gages Brook South Tributary

An unnamed tributary to Gages Brook (referred to as the Gages Brook South Tributary in this study) drains an area located south of the Gages Brook subwatershed. Reaches GBST-01 through GBST-04B and GBST-09A and GBST-09B were assessed on June 5, 2008, totaling approximately 1.3 stream miles (Figure 8). The subwatershed is bisected by Interstate 84 and contains forested and residential land uses.

GBST-01
This reach is approximately 0.5 mile in length and extends along Interstate 84 in an area that is otherwise relatively undeveloped.

- RCH - The stream is well-shaded, has a cobble and gravel bottom, and was found to be in optimal condition in terms of both overall stream, buffer, and floodplain characteristics. Evidence of downcutting, sedimentation, and scour were observed in some areas, but in general the reach is well-connected to the floodplain and appeared to provide optimal wildlife habitat and vegetation conditions. Moss was observed on portions of the stream banks where erosion had occurred, indicating that the banks have since stabilized.

GBST-02

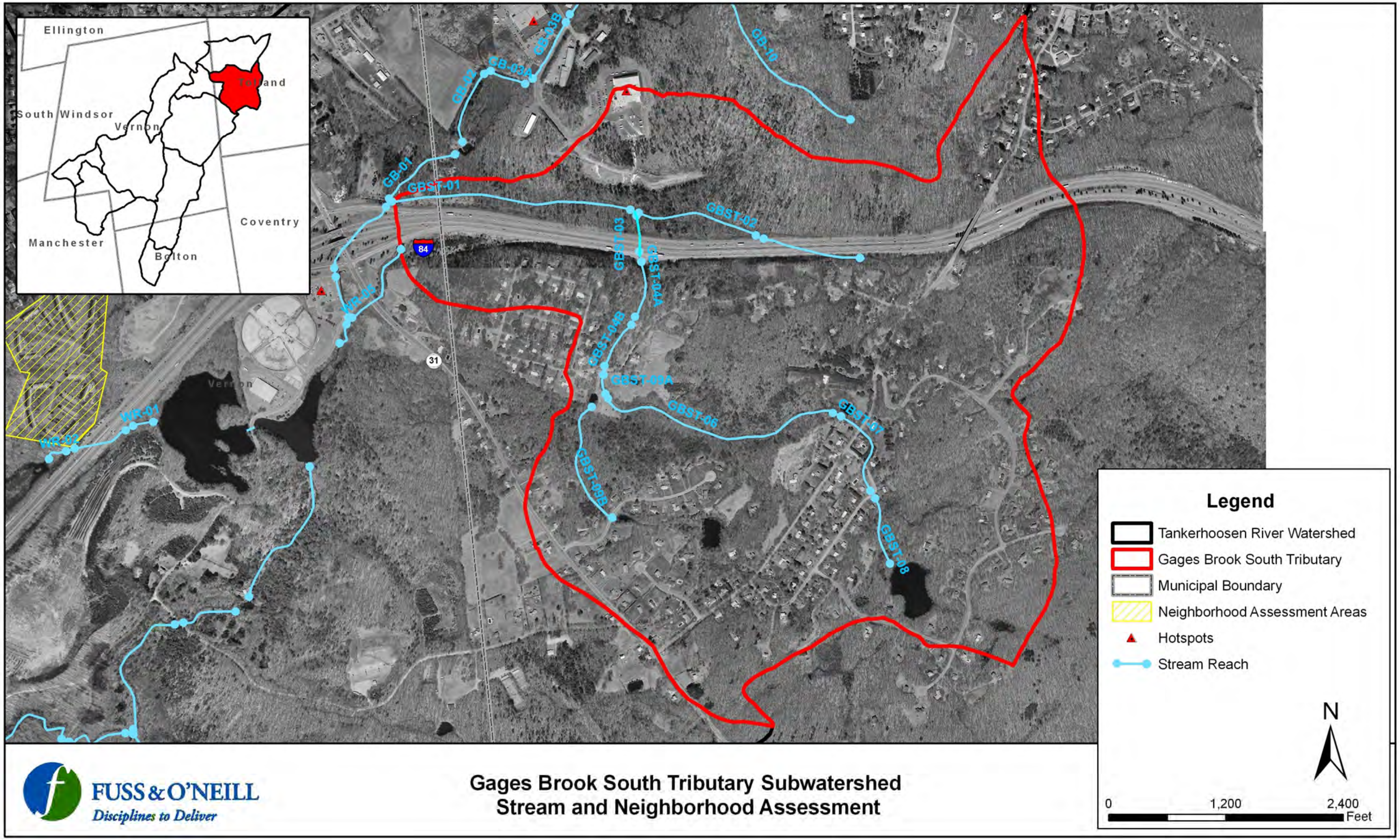
This reach of approximately 0.26 miles begins at its confluence of GBST-03 and continues upstream to the east generally running parallel to Interstate 84. The upstream end is a pair of culverts, one of which conveys the stream below Interstate 84 and the other which parallels the highway.

- RCH - This reach includes a bottom of gravel, cobbles, and boulders and has portions that are downcut and channelized. This reach is mostly shaded and was evaluated to be in the suboptimal range for most stream condition metrics. However, vegetative protection of the banks was generally optimal, as was the vegetated buffer width, floodplain vegetation, and floodplain habitat in most areas. Encroachments on the stream's buffer and floodplain were limited to an area where the stream was channelized along Interstate 84.

- OT - Several outfalls were identified along this reach. Each appeared to be associated with drainage from Interstate 84. Discharges were observed from both OT-02 and OT-03, and although rain fell the previous day. Significant sediment accumulation was observed at the outlet of OT-03 and SC-01. No discharge was present from OT-01, although significant erosion was present downstream of this outfall, which discharges approximately 300 feet from the wetland surrounding the reach. Minor bank erosion was observed downstream of OT-02.

- SC - This stream crossing conveys the tributary below Interstate 84. The crossing is a concrete culvert several hundred feet long. The crossing is partially blocked by accumulated sediment.

Stream crossing (SC-01) below I-84 and outfall (OT-03) along reach GBST-02.



Gages Brook South Tributary Subwatershed
Stream and Neighborhood Assessment

Figure 8. Gages Brook South Tributary Subwatershed Field Assessment Locations

- CM - The channel of GBST-02 has been modified significantly at the upstream end of the reach, which is channelized parallel to Interstate 84 for a length of approximately 700 feet. The channel is a uniform trapezoidal cross-section disconnected from a floodplain and lined with stone riprap.

GBST-03
This is a short reach located between GBST-01 and GBST-04A, which flows below Interstate 84.

- RCH - The reach has a relatively steep bottom of boulders, cobble, and sand, and is well-shaded. Stream condition metrics are generally in the suboptimal range since some bank erosion was observed, and the area was generally well vegetated, although modification of the banks was evident. Buffer and floodplain condition metrics were generally suboptimal as well, although the floodplain appeared to be an even mix of wetland and non-wetland habitats with evidence of standing water (optimal) and to have significant encroachment (marginal).

- SC - The stream crossing below Route 84 is a significant restriction to the upstream passage of fish. The 48-inch diameter concrete pipe has drop of approximately 4 feet at its outlet, and a series of boulders located downstream yield an additional stepped drop of approximately 10 feet. Additionally, the flow of water in the pipe was shallow. Despite these fish passage restrictions, this crossing is an unlikely restoration candidate since the pipe is below Interstate 84.

GBST-04A
This reach continues upstream from the Interstate 84 crossing to a small dam behind a residence. The field team observed a definitive break in stream and floodplain characteristics at this dam. The reach passes through an area of residential land use. Some evidence of downcutting was observed.

- RCH - This reach is generally well-shaded and has a variable bottom with some silt and clay along the downstream portion and with cobbles and boulders upstream. The downstream portion appeared to be a pond that has filled with sediment. Stream condition metrics were all within the optimal range. Overall buffer and floodplain conditions were also optimal, although floodplain was only present in a limited area.

- OT - A riprap drainage ditch along Route 84 discharges to the stream near its southern end.

- SC - A low-head dam crossing the stream was defined as the upstream limit of this reach. The dam includes a drop of approximately 42 inches.

GBST-04B
This reach continues from GBST-04A to the downstream limit of GBST-06 and GBST-09. The reach passes behind several residences and includes a pond filled with sediment at its lower limit.

- RCH - This reach is mostly shaded with a variable bottom of generally fine material (silt/clay, sand, and gravel). In-stream habitat was marginal, and dense invasive vegetation was present on both banks. Floodplain connection was optimal, however, since the stream was not deeply incised and high flows could easily enter the floodplain.

View of reach GBST-04B

- IB - Impacted buffer was present near the downstream end of this reach. In this area, the left bank is forested, although the right bank is vegetated with turf, lawn, and shrubs. A single-family home was also located near the stream.

- SC - The upstream limit of this reach is located at Loehr Road. The stream flows below the road through a 60-inch corrugated metal pipe. The pipe was deformed at the downstream end, but the invert was inundated by tailwater, indicating that fish passage may be possible.

GBST-09A

The downstream end of this reach is located at its confluence with GBST-06 prior to entering the culvert GBST-04B SC-01. The reach is short in length, receiving the discharge from a small privately-owned pond.

- RCH - This reach includes a bottom of cobbles and boulders and appeared to be channelized. The reach is partially-shaded. Stream metrics were generally in the suboptimal to marginal range, although poor floodplain connection was observed. The channel has a buffer consisting of shrubs and brush. Little floodplain is present with poor habitat and connection to the stream.

- SC - Two stream crossings are present in this reach. One (SC-01) includes double 16-inch HDPE culverts below an unpaved road. The culvert slope is relatively flat but has a shallow water depth that would be unlikely to allow fish passage. SC-02 includes the dam for a small pond. The discharge of the pond could not be viewed, but is likely to be a significant barrier to fish passage.

GBST-09B
This reach begins from the inlet of the pond at the upstream end of GBST-09A and continues upstream to another pond located at the Tolland Farms Road residential subdivision.

- RCH - The reach is mostly shaded with a bottom of gravel, cobbles, and boulders. The stream is downcut and has areas of bank failure and bank scour. As a result, stream condition metrics were generally within the suboptimal range, although floodplain connection was poor. The majority of the buffer and floodplain metrics were found in the optimal range, with ideal vegetated buffer of mature forest and very little floodplain encroachment, although floodplain habitat consisted of a mix of wetland and upland without ponded water (suboptimal).

- OT - No outfalls were observed along this reach. However, stormwater runoff from the residential subdivisions on Tolland Farms Road, Deer Meadow and Reed Road is believed to ultimately drain to this reach of the Gages Brook South Tributary. The pond located upstream of Tolland Farms Road may provide some attenuation of peak flows and stormwater quality renovation for this upstream drainage area.

- ER - Significant bank erosion was observed on the outside bank of two adjacent bends, each section of erosion being approximately 80 feet in length and 6 to 7 feet in height. This area is a potential candidate for bank stabilization, although site access is difficult in this area.

- SC - Two stream crossings were observed along this reach. SC-01 included three 15-inch concrete pipes below an unpaved, likely privately-owned, road. The slope of the pipes is moderate, and a drop of approximately 5 inches is present on the downstream end, which is a barrier to fish passage. Limited access, private property ownership, and headwater location make this culvert a poor candidate for fish barrier removal. SC-02 is a 24-inch culvert below Tolland Farms Road. This culvert receives discharge from the control structure of the upstream pond.

2.2.7 Tucker Brook

Tucker Brook is a tributary of the lower Tankerhoosen River. The Tucker Brook subwatershed includes portions of Vernon and Manchester. The predominant land uses in the Tucker Brook subwatershed are residential and forested land. Reaches assessed in this subwatershed include TB-01, TB-02, TB-03, and TB-04 (Figure 9).

TB-01
This lower reach extends from the confluence with the Tankerhoosen River upstream to Brookview Drive. Partially demolished cement building foundations and stream crossings from demolished industrial-era infrastructure remain along the downstream portion of the stream. The upper portion of the reach has significant stream buffers, native vegetation, stream shading and flood plains.

Examples of impacted buffers along reach TB-01. A cement retaining wall (A) for the street and bridge on the right bank near the confluence with the Tankerhoosen River and partially demolished cement infrastructure along the banks (B).

- RCH – The reach is mostly shaded with native vegetation, has no attached or floating plants in the stream, and has a sand and cobble substrate bed. There is evidence of bed scour, bank failure and sedimentation along the reach. The overall stream, buffer and floodplain conditions are rated in the suboptimal range.

- OT – A 12-inch circular outfall pipe was observed on the right bank, although was not submerged and did not have flow. A possible earthen-type stormwater outfall was identified on the left bank which could collect storm drainage from the highway, but was not flowing during the assessment.

- ER – Bank failure and scour is present on the right bank along an approximately 50-foot meandering portion of the stream. The bank is currently stabilized by tree roots and other hanging woody debris. The bank appears to be stable.

- IB – There is a bridge abutment on the right bank of Tucker Brook at the confluence with the lower Tankhoosen River. The Dobson Road overpass abutment extends approximately 40 feet upstream and is approximately 10 feet from the stream bank. The stream banks and riparian area along the downstream end of the reach at the confluence with the Tankerhoosen River lack a tree canopy; the stream is unshaded in this area. This area is a potential candidate for reforestation.

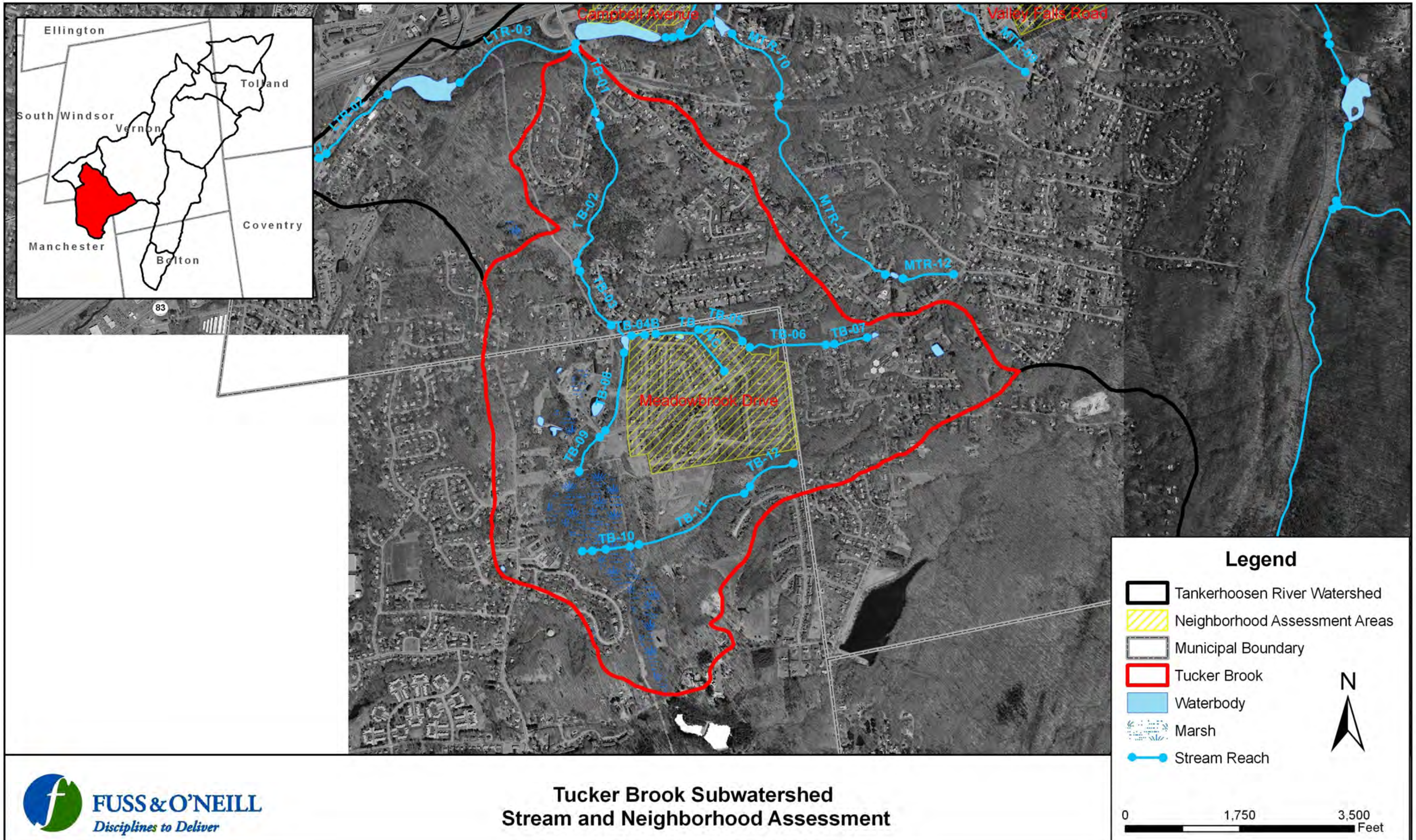


Figure 9. Tucker Brook Subwatershed Field Assessment Locations

The left and right streambanks along the lower portion of Tucker Brook (foreground) at the confluence with the Tankerhoosen River (background) are potential candidates for reforestation.

- SC – Four stream crossings exist along this reach. SC-01 is an abandoned concrete abutment which was formally a road crossing. The stream crossing has a natural bed so is not an impediment to fish passage, although is a floodplain encroachment concern. SC-02 is a large arch-shaped railroad crossing constructed of stone which is approximately 125 feet long. The archway is in good condition but creates a barrier to fish passage and is suffering from downstream scour. SC-03 is an open-bottom box culvert with some evidence of downstream scour. The final stream crossing, SC-04, is at the upstream end of the reach and consists of a double barrel 6-foot concrete culvert below Brookview Drive. The circular culverts are in good condition although there is downstream pooling and scouring. The boulders placed in the stream for energy dissipation may serve as a barrier to fish passage. Crossings SC-03 and SC-04 are potential candidates for fish barrier removal.

TB-02

A reach level assessment was conducted for this section by examining characteristics of the downstream end, and not traversing the entire reach. The land use around this reach is forested, the stream is mostly shaded, the dominant bed substrate is sand and cobble, and the base flow is less than 25% of the channel width. The overall stream conditions are optimal for bank erosion and floodplain and suboptimal for instream habitat and vegetative protection. There is optimal buffer width along the stream and suboptimal floodplain characteristics.

Arch-type railroad crossing (SC-02) constructed of stone and extending approximately 125 feet. The crossing may prevent fish passage and is suffering from downstream scour evidenced by the large pool shown in the photograph.

TB-03

This stream segment is adjacent to a residential neighborhood (on Ironwood Drive) along the right bank and a gas pipeline corridor along the left bank.

- RCH – Overall stream conditions in this section are rated marginal to suboptimal. The vegetative buffer limited due to the close proximity of private residential properties. The stream is flowing at almost 100% of the channel width, is mostly shaded, and has a variable bed substrate consisting of silt, sand, gravel and cobble. There is evidence of downcutting, aggrading, bank failure and scour.

- OT – A drainage outfall conveying roadway runoff is located at the upstream end of the reach near Phoenix Street. No dry weather flow was observed.

- ER – Bank failure and scour were observed in several meanders along the right stream bank, totaling approximately 125 feet in length. A privately owned shed is located approximately 3 feet from the edge of the bank and is in danger of being damaged by further erosion. This site is a potential candidate for bank stabilization.

- IB – Three areas of buffer impacts were noted along this reach. IB-01 is on the right bank and approximately 50 feet long. Dense non-native vegetation associated with a residential backyard is growing on the stream bank. IB-02 and IB-03 are areas along the left stream bank with a reduced buffer resulting from vegetation clearing in the gas pipeline right-of-way.

This section of river is abutted by residential properties along the right bank and has an impacted buffer on this side of the stream from lawn vegetation and items such as this shed.

- SC – The first stream crossing, SC-01, consists of a small manmade dam constructed of boulders and cinder blocks. The dam is approximately 1 foot high and spans the width of the stream. SC-02 is a 48-inch concrete culvert below Phoenix Street. The crossing is in good condition and not a barrier to fish passage.

TB-04A

Stream segment TB-04 was further subdivided into three smaller segments based on field conditions at the time of the surveys. Segment TB-04A begins at the Phoenix Street crossing and ends approximately 500 feet upstream at a beaver dam.

- RCH – The reach level assessment revealed invasive species along the stream, a silt and sand-dominated bed substrate, and mostly shaded stream. There is marginal in-stream habitat, vegetative protection and floodplain characteristics. The bank erosion and floodplain characteristics are optimal due to low banks and wide floodplain. The buffer width is suboptimal because a pumping station and Phoenix Street are in close proximity to the stream.

TB-04B

Stream segment TB-04B is a short segment which begins at the boundary of the Meadowbrook Drive neighborhood and flows to the inlet of the pond created by the beaver dam. This stream segment is characterized by significant growth of invasive species. A stormwater basin associated with the adjacent residential subdivision discharges to this section of the stream.

- RCH – The reach level assessment characterized the stream conditions in this section as suboptimal to marginal due to a lack of vegetative protection along the banks, little in-stream habitat and some bank erosion. The overall buffer and floodplain condition ranges from poor floodplain habitat to suboptimal floodplain vegetation. There is some floodplain encroachment along the reach. The dominant substrate is silt/clay and gravel, and the water is naturally stained. The largest issue observed in the stream segment is the presence of invasive species which are growing over the stream.

- OT – Stormwater outfall OT-01 flows from the stormwater basin that serves the upland residential neighborhood. The outfall is a circular concrete pipe, 18 inches in diameter. Dry weather flow was observed, although the pipe is partially submerged in the stream. There is evidence of bank erosion at the outlet of the pipe and the basin appears to be in need of regular maintenance, including detailed inspection to further assess the condition of the basin.

- TR – A small amount of yard waste (TR-01) was observed along the right bank. The debris consists of grass and brush clippings.

TB-04C

Stream segment TB-04C continues through the Meadowbrook Drive subdivision, ending at a system of 6 culverts which cross under Meadowbrook Drive.

- RCH – The stream segment flows behind houses, often adjacent to the property line. The close proximity of the stream to these residences has resulted in numerous stormwater outfalls, impacted buffers, stream crossings, and occurrences of trash and debris in the stream.

- OT – There are five stormwater outfalls along this reach, ranging in size from 4 to 8-inch diameter pipes. The outfalls appear to be associated with residential yard drains, foundation drains, or roof downspouts. All but one outfall pipe had dry weather flow at the time of inspection. The flowing outfall, OT-04, had a trickle of orange discharge, which may be naturally-occurring iron precipitate associated with groundwater discharge. A discharge investigation is recommended nevertheless to confirm the source of the discharge.

Outfall pipe originating from a residential property on the left bank of segment TB-04C.

- IB – There are two areas of stream buffer impacts along this stream segment. Both consist of residential lawn or scrub/shrub vegetation adjacent to the stream. Stream buffer restoration potential is limited due to private land ownership.

- SC – There are two manmade dams and one road crossing along this segment. The road crossing forms the upstream end of this segment, and consists of 6 metal arch culverts approximately 13 feet in diameter and 5 feet in height. The culverts extend approximately 70 feet in length under Meadowbrook Drive. The other two stream crossings are manmade dams; one is a stone dam that creates a pool and cascade downstream. The second dam creates a waterfall and redirects the stream sharply. Both dams are physical barriers to upstream fish passage and should be considered potential candidates for removal, although private land ownership may limit this potential.

- TR – There are two instances of trash and debris along this segment. Both are piles of yard waste, including a tree that has been cut into logs and a pile of leaves and yard clippings.

2.3 Upland Assessment

Fuss and O Neill conducted upland assessments in the Tankerhoosen watershed on July 16, 2008. The field observations assist in identifying pollution prevention and potential restoration opportunities at hotspot land uses and residential neighborhoods in the watershed. Factors that were considered when determining which hotspots and neighborhood areas to prioritize for assessment include:

- Stream condition (assessed during stream corridor inventory),
- Site proximity to the stream,
- Land use type and development density,
- Land ownership,
- Restoration potential.

The assessment framework was adapted from the Unified Subwatershed and Site Reconnaissance (USSR) method developed by the Center for Watershed Protection. USSR is a "windshield survey" evaluation method in which field crews drive and walk through areas of the watershed to quickly identify pollution prevention and restoration opportunities. The three major components to the upland assessments conducted in the Tankerhoosen watershed are: hotspots, residential neighborhoods, and streets and storm drains. Field data forms that were completed during the assessments are provided in Appendix B.

2.3.1 Hotspot Site Investigation

Hotspot site investigations were conducted for six representative sites with a high potential to contribute polluted stormwater runoff to the storm drain system and receiving streams. The purpose of the investigation was to qualitatively assess the potential for stormwater pollution from previously identified commercial, industrial, municipal or transport-related sites. The hotspot investigation was limited in scope to representative hotspot facilities in order to evaluate and illustrate common issues. The investigation was not intended to be an exhaustive review of all potential hotspot facilities in the entire watershed nor a detailed inspection or audit of each facility, which are beyond the scope of this study.

The hotspots examined in the field were located within the Lower Tankerhoosen River, Walker Reservoir, Clarks Brook, and Gages Brook subwatersheds. Representative priority hotspots were selected to cover a range of watersheds and land uses, including three industrial sites, one commercial site, one transportation-related site, and one state/municipal site. Sites are identified by the watershed abbreviation, followed by "HSI" and a numeric identifier. Table 5 summarizes the selected hotspots that were evaluated. Several of the sites that were investigated are privately owned, and field crews were unable to gain full access to the sites to closely evaluate the storm drainage and other site characteristics.

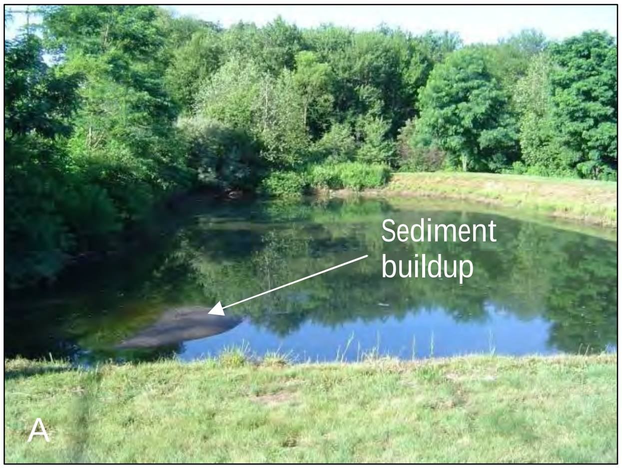
Table 5: Hotspot Site Investigation Summary

Site ID (Watershed)	Land Use Category	Description of Site Operations
GB-HSI-01 (Gages Brook)	Industrial	Industrial Park – Gerber Technologies Office Building
GB-HSI-02 (Gages Brook)	Industrial	Dari Farms Ice Cream Distribution Center
WR-HIS-01 (Walker Reservoir)	Transport-related	ConnDOT Commuter Lot
CB-HIS-01 (Clarks Brook)	Commercial	Superior Energy – Propane
CB-HIS-02 (Clarks Brook)	Industrial	Sand, gravel, construction storage/processing facility
LTR-HIS-01 (Lower Tankerhoosen River)	State/Municipal	ConnDOT Maintenance and Service Center

Gerber Technologies Office Building

The Gerber Technologies office building is located in the Tolland Industrial on Industrial Park Road West. The site is located adjacent to Gages Brook (see stream assessment discussion in Section 2.2.5). The office building has landscaped areas around the building with shrubs and turf lawn. The site is characterized by a large amount of impervious cover, consisting of building roof areas and parking lots. Approximately 100 vehicles were parked in the employee parking lots at the time of the inspection. Stormwater runoff from the site appears to discharge to the stormwater basin located near the southern limit of the site. The stormwater basin is a wet pond design containing a permanent pool of water and is approximately 70 feet wide by 140 feet long. The basin contained accumulated sediment captured from the site runoff. The basin outfall discharges to Gages Brook via a riprap spillway.

The stormwater basin that receives runoff from the Gerber Technologies facility incorporates many of the recommended elements to meet current stormwater quantity and quality design criteria. However, the basin is also in need of maintenance as demonstrated by the sediment accumulation near the center of the basin and the overgrown woody vegetation at the overflow spillway. Existing stormwater basins such as this one may also be good retrofit candidate to improve treatment effectiveness by incorporating a sediment forebay at the basin inlet, which may also facilitate routine sediment removal.



Stormwater basin at the Gerber Technologies facility on Industrial Park Road West. Sediment has built up near the center of the basin (A) and the basin overflow spillway is overgrown with vegetation (B).

Dari Farms Ice Cream Distribution Facility

The Dari Farms distribution facility is also located in the Tolland Industrial Park on Research Way/Gerber Drive near the divide between the Gages Brook and Gages Brook South Tributary subwatersheds. The facility is estimated to be less than 5 years old, as evidenced by the facility's modern pollution prevention site design elements including a covered fueling station, no visible outdoor storage of materials, and well maintained landscaping on the grounds. Possible pollution sources to the storm drainage system are the runoff from the large impervious areas on the site (the roof and parking areas) and potential vehicle fluids from truck fueling activities and employee vehicles. It could not be determined whether stormwater is managed on-site, by the downgradient stormwater basin near the Gerber Technologies facility, or both. The site did not appear to incorporate Low Impact Development (LID) design features such as vegetated swales or parking lot bioretention. New commercial/industrial facilities with significant impervious area, such as this one, are potential candidates for on-site LID and stormwater treatment practices to reduce runoff volume and pollutant loads.

The Dari Farms Ice Cream Distribution Facility has a covered fueling station and landscaped grounds (shown in the foreground).

ConnDOT Commuter Parking Lot

The hotspot investigation included the Connecticut Department of Transportation commuter parking lot at exit 67 of Interstate-84, which is located in the Walker Reservoir subwatershed (see stream assessment discussion in Section 2.2.4). Approximately 150 vehicles were parked at the lot during the site visit, which occurred on a weekday during mid-day. The site is contains significant impervious cover and high-intensity vehicle usage and is therefore a source of automobile-related stormwater pollutants including hydrocarbons, sediment, and metals. The entire parking lot drains to a double catch basin located on the southeastern side of the lot. The catch basin discharges through a short wetland corridor and subsequently to the stream segment located upstream of Reservoir Road and Walker Reservoir East. An easily accessible grass strip exists between the paved lot and the adjacent wetland and stream corridor. This site is a potential stormwater retrofit candidate (bioretention or water quality swale) to encourage infiltration and provide additional treatment for the parking lot runoff.

The southeastern side of the Interstate 86 Exit 67 commuter parking lot showing the edge of the lot on the left side of the photograph and the wetland corridor on the right side. The center of the photograph shows the easily accessible and open area for a potential stormwater retrofit.

Superior Energy

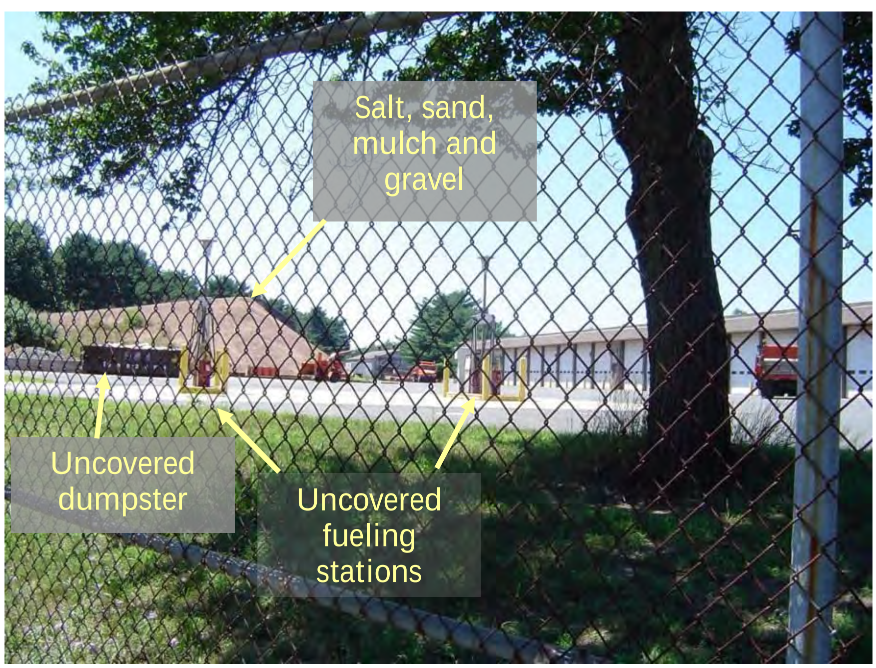
Superior Energy is a propane gas and related equipment distributor located on Hartford Turnpike (Route 30) in Vernon. The site is located within the Clarks Brook subwatershed (see stream assessment discussion in Section 2.2.1) near the headwaters of Clarks Brook. The property consists of a retail store, a paved parking lot for delivery trucks, and outdoor storage of propane tanks. It is unknown if vehicle maintenance or fueling occurs on-site. As described previously, the site appears to have been modified in the past through grading/filling based on an inspection of the existing site drainage and discussions with facility personnel. This site should be further investigated to better define potential impacts of the historical filling, current drainage issues, and plans for additional site development.

Sand & Gravel Facility

The facility is located on Clark Road at the western end of Industrial Park Road and near the western limit of the Clarks Brook subwatershed. Facility operations appear to include storage and processing of sand, gravel and other construction materials. The site contains one building, which is assumed to be an office and/or maintenance area. The majority of the site consists of an unpaved yard used for the storage of sand and gravel piles and equipment to process the materials and load transport vehicles. The site contains numerous potential sources of sediment and other pollutants associated with the sand and gravel stockpiles, heavy equipment and vehicles, waste construction materials stored outdoors, and pipes and debris in the yard. Sand and gravel operations such as this should employ stormwater pollution prevention practices and source controls as required by the DEP *General Permit for Stormwater Discharges Associated with Industrial Activity*, in addition to stormwater treatment practices to reduce sediment and hydrocarbon loadings in site stormwater runoff.

DOT Maintenance Service Center

The State of Connecticut operates a Department of Transportation Maintenance Service Center for District #1 located on Campbell Avenue in Vernon, which is located in the Lower Tankerhoosen River subwatershed. The facility has an office building, garages for vehicle storage and maintenance, a small parking lot, outdoor storage of sand, salt, gravel and mulch, and an uncovered outdoor fueling station. Vehicle maintenance activities and outdoor vehicle fueling are potential sources of stormwater pollution, in addition to the outdoor stockpile storage. A rolloff dumpster was observed to be overflowing and uncovered at the time of the windshield survey. Municipal and state-operated highway maintenance facilities such as this should employ source controls, pollution prevention, and stormwater treatment practices as necessary in accordance with the DEP *General Permit for Stormwater Discharges Associated with Industrial Activity*.



ConnDOT District #1 Maintenance Service Center, Campbell Avenue

2.3.2 Neighborhood Source Assessment

Stormwater runoff from existing residential neighborhoods and future residential development in the watershed is an important consideration for this study, since approximately 40 percent of the Tankerhoosen River watershed consists of residential land use and future buildout of the watershed could result in conversion of an additional 10 percent of the watershed to residential land use. Neighborhood source assessments were conducted on July 16, 2008 to evaluate pollution source areas, stewardship behaviors, and residential restoration opportunities within individual residential neighborhoods throughout the watershed. The residential behaviors that contribute to stormwater quality were assessed by considering the following source areas for "average" neighborhoods throughout the subwatershed:

- Yards and Lawns;
- Driveways, Sidewalks, and Curbs;
- Rooftops;
- Common Areas.

Neighborhoods were selected for assessment based on their proximity to stream corridors and their overall potential to contribute pollutants to the stream. The selected neighborhoods include a variety of residential types, including low- and high-density single-family residential and multi-family residential (apartments and condos). One field sheet was completed for each neighborhood assessed. The selected neighborhoods are located in the Tucker Brook, Lower Tankerhoosen River, Clarks Brook, Walker Reservoir, and Gages Brook subwatersheds, as summarized in Table 6.

Each neighborhood was assigned a score for pollution severity and restoration potential. Pollution severity is a measure of how much nonpoint source pollution a neighborhood is likely generating based on easily observable features such as lawn care practices, drainage patterns, oil stains, etc. Restoration potential is a measure of the feasibility of on-site retrofits or behavior changes based on available space, number of opportunities, presence of a strong homeowners association, and other factors.

Table 6: Neighborhood Source Assessments Conducted in the Tankerhoosen River Watershed

Neighborhood/Subdivision Name	Subwatershed	Residential Type	Pollution Severity	Restoration Potential
Mount Vernon Apartments	Walker Reservoir	Multi-family	Moderate	Moderate
Campbell Avenue	Lower Tankerhoosen River	High-density, single-family	Moderate	Low
Valley View Drive/Andrew Way	Gages Brook	Medium-density, single-family	None	Low
High Manor Mobile Home Park	Clarks Brook	High-density, single-family	Moderate	Moderate
Meadowbrook Drive	Tucker Brook	Medium-density, single-family with open space areas	None	Low

Mount. Vernon Apartments

The Mount Vernon apartments are a 33-acre multi-family housing complex situated between Hartford Turnpike (Route 30) and Interstate 84 in the Walker Reservoir subwatershed. The apartments are served by outdoor surface parking lots in front of each building. Site imperviousness is estimated at approximately 50 percent. Runoff downspouts are connected directly to the site stormwater drainage system, and parking areas are served by traditional curb and gutter drainage. The complex is generally well-maintained, with generally clean gutters, catch basins, and parking areas. Some oil staining was observed on the pavement within individual parking stalls. The overall pollution severity is rated as moderate due to the large amount of directly connected impervious area and potential pollutant sources from parking areas. This site is a potential retrofit candidate to reduce stormwater runoff from the site, including disconnecting downspouts from the storm drainage system and redirecting them to pervious grass areas, rain barrels/cisterns, and rain gardens. Multi-family parking lots, such as the parking lots at this complex, may also be good candidates for stormwater retrofits. The following photograph depicts an existing landscaped area adjacent to the parking lot that could potentially function as a bioretention/rain garden.

The Mount Vernon apartment complex buildings showing clean and well-maintained parking areas and landscaping (A) and a landscaped area that has the potential to be used as a rain garden (B).

Campbell Avenue

The Campbell Avenue residential development is a 13-acre neighborhood of single family homes on approximately ¼ acre lots. The neighborhood is located off of Dobson Avenue and is situated between Interstate 84 and the ConnDOT Maintenance Service Center to the north and Dobsonville Pond to the south. The age of the neighborhood is estimated as approximately 50 years. Almost none of the homes has a garage, and nearly all have impervious driveways connected to the street curb and gutter drainage system. No on-site or centralized stormwater management practices were observed, other than curb and gutter drainage. Most of the homes have downspouts that are directed to pervious lawn areas near the house. Landscaping practices were minimal. This type of older, high density single family residential neighborhood has limited potential for stormwater retrofits due to limited land area.

Valley View Drive/Andrew Way

The Valley View Drive/Andrew Way neighborhood is approximately 55 acres in size and located near the headwaters of Gages Brook. The neighborhood is approximately 25 years old and consists of single family homes occupying approximately 1-acre lots. Most of the homes have garages and a high percentage of the lots are covered by lawn (60%) and landscaped areas (20%). The subdivision is served by traditional curb and gutter drainage. No centralized stormwater management measures were observed. Approximately three quarters of the roof downspouts are connected to adjacent pervious areas. Overall, the neighborhood was rated as having low pollution potential and limited potential for stormwater retrofits.

A typical lot in the Valley View Drive/Andrew Way neighborhood.

High Manor Mobile Home Park

High Manor Mobile Home Park is an approximately 28-acre neighborhood located in the Clarks Brook subwatershed, situated between Route 30 and Interstate 84. The park is believed to have been developed in the 1970s. The average lot in the neighborhood has approximately 40 percent impervious cover, including the home and driveway, 40 percent grass cover, and 20 percent landscaped area. Approximately 90 percent of the homes have roof downspouts that discharge to lawns. The streets have traditional curb and gutter drainage, and storm drain inlets were observed to be clean. No centralized stormwater management measures were observed.

A street view of the High Manor Mobile Home Park showing turf lawns with some mature trees on the properties.

Meadowbrook Drive

The Meadowbrook Drive neighborhood is an approximately 100-acre residential neighborhood in the northeast corner of Manchester. The neighborhood is situated in the central portion of the Tucker Brook subwatershed, and Tucker Brook flows partially through and along the north and west sides of the development (see stream assessment discussion in Section 2.2.7). The subdivision is estimated as approximately 10 years old, and the average lot size for the single family homes in the subdivision is approximately ½ acre. All of the homes have garages. The driveway, sidewalks and curb areas are clean and dry. A majority of the homes have roof downspouts that discharge to pervious lawn areas. The street storm drains are stenciled. An approximately 1-acre wet stormwater basin near the corner of Yale and Chatham Drives receives runoff from the subdivision storm drainage system. The basin outlet discharges to Tucker Brook. At the time of the inspection the stormwater basin outlet was observed to be overgrown with vegetation, and stream bank erosion was observed at the outfall to the stream. As noted in Section 2.2.7, the basin appears to be in need of regular maintenance. Buffer encroachment, stream crossings, residential drain outfalls, and yard waste dumping were common in residential areas along the stream corridors in this subdivision.

Typical conditions in the Meadowbrook Drive neighborhood showing landscaping, lot sizes, and general cleanliness.

2.3.3 Streets and Storm Drain Assessment

Urban streets and storm drains can be a source of stormwater pollutants if not maintained on a regular basis. The condition of the local road and storm drain infrastructure can be assessed to determine if existing maintenance practice could reduce pollutant accumulation. Selected streets and storm drains were assessed during the upland field inventories conducted on July 16, 2008. Most of the streets and storm drains that were assessed are located in or near hotspot or neighborhood source assessment locations. Findings of the street and storm drain assessment are summarized below. Photographs of the storm drains and the street conditions evaluated are provided as Table 7, and the completed field forms are included in Appendix B.

Table 7: Streets and Storm Drain Assessment Photographs

Location	Storm Drains		Streets
Campbell Avenue			
Mount Vernon Apartments			
Valley View Drive/Andrew Way			
High Manor Mobile Home Park			
Gerber Technologies			
Clark Road Industrial Park			[No photo]

Most of the streets were clean, free of sediment and debris, and in good condition. The one exception is Industrial Park Road in the Clark Road Industrial Park where roads were observed to be in poor condition (cracked, broken, and sediment accumulation). Storm drains along Industrial Park Road were also partially obstructed with sediment, leaves, trash, and one of the catch basins had standing water above the elevation of the stream water surface, indicating blockage of the outlet pipe. Many of the inspected catch basins had varying degrees of sediment accumulation and nearly all could benefit from increased clean-out and street sweeping. With the exception of the Meadowbrook Drive subdivision in the Tucker Brook subwatershed, none of the storm drains observed during the field assessments were stenciled.

3.0 LAND USE REGULATORY REVIEW

3.1 Introduction

Municipal land use regulations control patterns of new development and redevelopment and can play a significant role in protecting water quality and other natural resources in a watershed. These commonly include local plans of conservation and development, zoning regulations, subdivision regulations, inland wetland regulations, and stormwater regulations, all of which influence the type and density of development that can occur within a watershed. Local land use regulations often vary by town within a watershed, and regulations are periodically revised in response to development pressure, shifts in attitude toward natural resource protection, and political and socioeconomic factors.

A key element in the development of a Watershed Management Plan is to identify potential land use regulatory mechanisms (i.e., new or modified land use regulations) that can be implemented by the watershed towns to strengthen existing land use controls and better protect natural resources within the watershed. Many Connecticut communities are in the process of developing new or modified land use regulations that incorporate Low Impact Development (LID) and related stormwater management approaches to address stormwater quantity and quality objectives. Communities in urbanized areas are also faced with a mandate to meet State and Federal Phase II stormwater permit requirements under the National Pollutant Discharge Elimination System (NPDES) program, as well as addressing local concerns about the damaging effects of increased impervious cover and uncontrolled stormwater runoff from land development and suburban sprawl. An opportunity exists for the watershed towns to develop revised and/or new regulatory mechanism to satisfy Phase II stormwater requirements, while also protecting water quality and other natural resources in the Tankerhoosen River watershed.

This section summarizes the following information:

1. Existing municipal land use planning entities and regulations for each of the watershed communities based on information obtained from a land use questionnaire conducted by the North Central Conservation District in 2005 as part of the *Hockanum River State of the Watershed Report* (Fuss & O Neill, 2005). The information was updated where necessary to reflect current conditions.

2. Existing land use regulations and related planning documents that pertain to stormwater management and natural resource protection issues, as well as potential approaches for developing regulatory mechanisms to incorporate improved stormwater

management, including LID concepts and opportunities to reduce impervious cover, into the local land use regulations. The regulatory review was performed for the towns of Tolland and Vernon because they comprise the majority of the land area in the Tankerhoosen River watershed and have the greatest potential for future development.

3.2 Summary of Municipal Land Use Planning Entities and Regulations

The 2005 land use questionnaire provided information from the watershed municipalities on the current land use regulations in each town, including information on wetlands and watercourses regulations, zoning regulations, plans of development, open space planning, and stormwater regulations. The following paragraphs summarize information obtained from the questionnaire.

Local land use regulations are administered by various Town commissions, boards, and agencies. Land use commissions in the Tankerhoosen River watershed communities are summarized below (Table 8).

Table 8: Tankerhoosen River Watershed Land Use Commissions

Town	Land Use Commissions
Manchester	• Planning and Zoning Commission (acts as Inland Wetlands and Watercourses Agency) • Zoning Board of Appeals
Vernon	• Planning and Zoning Commission • Inland Wetlands and Watercourses Agency • Conservation Commission • Design Review Board • Open Space Task Force
Tolland	• Planning and Zoning Commission • Inland Wetlands and Watercourses Commission • Conservation Commission • Design Advisory Board
Bolton	• Planning and Zoning Commission • Inland Wetlands Commission • Conservation Commission • Open Space Preservation, Acquisition, and Conservation Committee

Source: Hockanum River –State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005

Table 9 summarizes the current plan of development, subdivision, inland wetlands, zoning, floodplain management, and stormwater regulations for the watershed towns. The table lists the last revision date for the applicable land use regulations.

Table 9: Municipal Land Use Regulations

Regulation	Manchester	Vernon	Tolland	Bolton
Plan of Development	2004	2001	1999	1990
Subdivision Regulations	2005	2007	2008	2004
Wetlands Regulations	2007	2006	2007	2006
Zoning Regulations	2008	2006	2008	2005
Floodplain Management	1994	In Zoning Regs.	None	2005
Stormwater Regulations	2004 Connecticut Stormwater Quality Manual	In Zoning Regs.	2008 (LID)	2004

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005

Inland Wetlands & Watercourses

Regulating activity with the potential to affect wetlands and watercourses is an essential component in preserving or improving the water quality and overall health of the Tankerhoosen River. In Connecticut, the Inland Wetlands and Watercourses Act requires that each municipality establish an Inland Wetlands and Watercourses Agency or Commission and local regulations regulating private and municipal work located in or affecting wetlands or watercourses. Each of the surveyed watershed towns has an inland wetlands agency, and each town has defined an upland review area, or distance from wetlands and watercourses that is subject to review. Three of the four watershed towns indicated that they have identified wetlands or watercourses that are impaired or that require restoration or require special protection. Table 10 summarizes the regulating agencies, upland review areas, and identified wetlands and watercourses of special significance for the surveyed watershed towns.

Table 10: Inland Wetlands and Watercourses Regulations

Town	Regulating Agency	Upland Review Area	Wetlands and Watercourses of Special Significance
Manchester	Planning & Zoning Commission	50 ' wetlands and watercourses	None identified
Vernon	Inland Wetlands & Watercourses Agency	100 ' wetlands 200 ' designated watercourses	• Vernal pools on Box Mountain Road • Tankerhoosen River • Hockanum River • Belding Preserve and Wildlife Management Areas
Tolland	Inland Wetlands & Watercourses Commission	50 ' wetlands 100 ' watercourses	Preliminary*

Town	Regulating Agency	Upland Review Area	Wetlands and Watercourses of Special Significance
Bolton	Inland Wetlands Commission, Conservation Commission	100 'wetlands and watercourses	Yes*

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005
*Information available from the individual towns.

Stormwater Management and Soil Erosion and Sediment Control

Development of the landscape with impervious surfaces can alter the hydrology of a watershed and has the potential to adversely affect water quality and aquatic habitat. As a result of development, vegetated and forested land that consists of pervious surfaces is largely replaced by land uses with impervious surfaces. This transformation increases the amount of stormwater runoff from a site, decreases infiltration and groundwater recharge, and alters natural drainage patterns. Natural pollutant removal mechanisms provided by on-site vegetation and soils have less opportunity to remove pollutants from stormwater runoff. During construction, soils are also exposed to rainfall, which increases the potential for erosion and sedimentation. Development can also introduce new sources of pollutants from everyday activities associated with residential, commercial, and industrial land uses.

Stormwater runoff both during construction and following completion of construction for new development and redevelopment projects is regulated at the local and state levels. All of the watershed towns have erosion and sediment control regulations as mandated by the Soil Erosion and Sediment Control Act. Most Connecticut municipalities have adopted regulations requiring that a soil erosion and sediment control plan be submitted with any application for development within the municipality when the disturbed area of such development is more than one-half acre. Projects that disturb greater than 5 acres of land are subject to regulation under the DEP General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities. This permit applies to discharges of stormwater and dewatering wastewaters from construction activities including, but not limited to, clearing, grading, and excavation that result in the disturbance of 5 or more acres of total land area on a site. Pursuant to Phase II of the NPDES Stormwater Program, construction activities disturbing between 1 and 5 acres have been delegated by DEP to the municipalities provided that the erosion and sediment control plan is reviewed and receives approval from the town, under the Soil Erosion and Sedimentation Control Act.

Post-construction stormwater quantity and quality are also regulated by the watershed municipalities through municipal planning and zoning and inland wetlands and watercourses regulations. All of the watershed towns are subject to the requirements of the NPDES Phase II stormwater program, which is regulated under the DEP General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit). The MS4 General Permit regulates the quality of municipal stormwater discharges and requires the creation of a Stormwater Management Plan that addresses the following six minimum control measures:

1. Public education and outreach on storm water impacts required throughout the entire municipality;

2. Public involvement/participation required throughout the entire municipality;
3. Illicit discharge detection and elimination required throughout the entire municipality including mapping all storm water discharges from a pipe or conduit with a diameter of 15 inches or greater (or equivalent cross-sectional area) owned or operated by the municipality;
4. Construction site storm water runoff control required throughout the entire municipality;
5. Post-construction storm water management in new development and redevelopment; and
6. Pollution prevention/good housekeeping for municipal operations.

The DEP *Connecticut Stormwater Quality Manual* provides guidance on the measures necessary to protect the waters of the State of Connecticut from the adverse impacts of post-construction stormwater runoff. It is intended for use as a planning tool and design guidance document by the regulated and regulatory communities involved in stormwater quality management in Connecticut. The manual provides uniform guidance for developers, engineers, and review agencies on the selection, design, and application of stormwater control measures. All of the watershed towns in the Tankerhoosen River watershed have indicated that they use the stormwater manual in reviewing development proposals for stormwater management issues.

The Town of Tolland recently (February 2008) amended its zoning and subdivision regulations to require that Low Impact Development (LID) techniques be implemented on all development to protect high quality wetlands, watercourses, open water bodies and other sensitive areas from the impacts of point and nonpoint sources of stormwater due to land development projects. Tolland also developed a companion LID design manual.

Open Space

Open space plays a critical role in protecting and preserving the health of a watershed by limiting development and impervious coverage, preserving natural pollutant attenuation characteristics, and supporting other planning objectives such as farmland preservation, community preservation, and passive recreation. Open space includes preserved natural areas as well as lightly developed parks and playgrounds. While approximately 40 percent of the Tankerhoosen River watershed consists of undeveloped land uses, much of this land is not considered open space because it may be privately owned and ultimately developed. Protected open space areas include deeded open space that is privately owned, parcels owned by land trusts, state and federally-owned land, land owned by water companies, and municipal park land. Such land is protected against future development. Each of the watershed towns has prepared an open space plan for their respective communities (Table 11).

Table 11. Status of Municipal Open Space Plans
in the Tankerhoosen River Watershed

Town	Open Space Plan
Manchester	2004
Vernon	2002
Tolland	2006
Bolton	2004

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005

In addition to the designation of protected open space through donation, purchase of land by a town, conservation or land trusts, or other private and/or public agencies, towns also require that some land be dedicated as open space with the development of new subdivisions. The subdivision regulations of all of the towns in the Tankerhoosen River watershed require the set aside of a percentage of new subdivisions as open space, and all but Manchester have provisions for fee-in-lieu-of open space. Table 12 summarizes responses from the surveyed watershed communities regarding their current open space regulations.

A majority of the surveyed watershed towns also allow "cluster development" and "open space subdivisions" in their subdivision regulations. These are compact forms of development that concentrate density in one portion of the site in exchange for reduced density elsewhere, thereby reducing overall site imperviousness and associated stormwater impacts and potentially avoiding development in sensitive areas of a site.

Table 12. Open Space Regulations

Town	Allow 'Cluster' Development	Allow 'Open Space' Subdivisions	Subdivision Open Space	
			Required	Fee in lieu of
Manchester	Yes	No	Yes, 6%	No
Vernon	Yes	No	Yes	Yes
Tolland	Yes	Yes	Yes, 10%	Yes
Bolton	Yes	Yes	Yes	Yes

Source: Hockanum River – State of the Watershed Land Use Questionnaire, North Central Conservation District, 2005

3.3 Summary of Existing Regulations and Preliminary Recommendations

The following policy, regulatory and planning documents were reviewed for the towns of Vernon and Tolland relative to stormwater management and natural resource protection:

- Subdivision Regulations,
- Zoning Regulations,
- Inland Wetland and Watercourses Regulations,
- Plan of Conservation and Development/Open Space Plan.

3.3.1 Town of Vernon

The Town of Vernon has a number of land use regulations that regulate construction and post-construction stormwater runoff from new development and redevelopment activities, and provide for protection of natural resources. The local regulations are particularly strong in terms of erosion and sediment control (as well as consistent between the various regulations), open space protection, and regulating activities that can potentially affect wetlands and watercourses, including requirements for watercourse buffers. However, there are several areas where the regulations and design standards and guidance could be strengthened through amendments or new regulations to clarify and strengthen stormwater management requirements and better promote the use of LID principles.

This section contains preliminary recommendations for the town of Vernon based on the review of the existing land use regulations and planning documents. The recommendations in this section are a summary of the more detailed regulatory review, which is provided in a technical memorandum dated June 9, 2008 (Appendix D).

1. Town Design Manual

- Develop a Town stormwater and LID design manual. A local manual should reference applicable sections of the Connecticut Stormwater Quality Manual to take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town (see Recommendation 2). The Town land use regulations should also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the land use regulations.

- Include a section of the design manual that addresses stormwater retrofits for redevelopment and drainage system upgrade and maintenance projects. Stormwater retrofits for residential and commercial redevelopment projects are an important element for the Town's stormwater management strategy given the level of existing development in the Town. Stormwater retrofits also present an opportunity to implement lot-level LID strategies as opposed to larger end-of-pipe controls where land may not be available for stormwater management facilities.

- Incorporate/reference stormwater quantity and conveyance sections of the Connecticut DOT Drainage Manual for consistency with state drainage standards.

2. Stormwater Management Standards

- Develop and incorporate into the Town stormwater design manual a set of stormwater management standards, which would become regulatory standards referenced by the existing Town land use regulations and/or new stormwater ordinance (see Recommendation 3). Development of stormwater management standards would allow Vernon to establish clearer, specific standards that all projects must meet in order to obtain local land use permits. The stormwater standards could include LID requirements, complement the hydrologic sizing criteria in the *Connecticut Stormwater Quality Manual* and be tailored (using variable minimum performance standards) to protect specific water bodies or sensitive resources in the Town of Vernon. An example set of stormwater management standards is included with the full memorandum in Appendix D.

3. New or Modified Stormwater Regulations

- Develop and implement new or revised stormwater regulations to 1) satisfy Phase II Stormwater Program regulatory requirements, 2) encourage or require LID principles to be implemented for development projects in Vernon, and 3) address other local drainage and natural resource protection issues identified by the Town. Two potential approaches have been identified – 1) a new stand-alone stormwater ordinance, or 2) addition/amendments to the existing Zoning Regulations.

- Form an advisory committee or workgroup consisting of representatives from the various land use commissions and selected Town departments to further evaluate and select the best approach for Vernon, including key decisions regarding:

    - If a new, stand-alone stormwater ordinance is selected, which department or commission will have responsibility for administering the program (i.e., the "Stormwater Authority")?
    - Which projects and activities will the new ordinance apply to (i.e., applicability)?
    - How will applications be received and reviewed?
    - Who will be responsible for inspections and enforcement?
    - Will additional staff be required to handle the increased workload to review and process applications?

3.3.2 Town of Tolland

Zoning and Subdivision Regulations

The Town of Tolland recently amended its zoning and subdivision regulations to:

1. Incorporate Low Impact Development (LID) principles. The Town also developed a companion LID Design Manual that provides recommendations for site design, road design, and stormwater management.
2. Create a natural Resource and Wildlife Protection Overlay Zone around sensitive habitat areas and steep slopes throughout the town.
3. Adopt density-based zoning to replace the minimum lot size requirements.

Tolland is one of the first towns in Connecticut to adopt comprehensive LID regulations. The regulations are a good model for the other watershed communities to require the use of LID practices. The regulations are currently in the early stages of implementation. The Town should continue to monitor the effectiveness of the LID regulations as development projects subject to the new regulations are designed, reviewed, and constructed.

Consistent with the recommendations for the Town of Vernon, Tolland should also consider adopting a River Protection Overlay District for the Tankerhoosen River (Gages Brook). Such a district would establish a contiguous and parallel buffer strip on either side of the river and would supplement the underlying zoning regulations, with the added provision that the land within the buffer areas and the river itself would remain in a natural, undisturbed state.

Inland Wetlands and Watercourses Regulations

The Inland Wetlands and Watercourses regulations were amended in 2007, and are in accordance with the Connecticut General Statues. The regulations define an Upland Review Area extending a minimum 50 feet from the edge of a wetlands and/or watercourse and a extending a minimum of one hundred 100 feet from any watercourse, including intermittent watercourses. The width of the Upland Review Area may be doubled in cases where the slopes bordering the wetland and/or watercourse are in excess of 15%, the presence of highly erodible soils, or unique and/or easily damaged wetland ecosystems exist.

Permit application requirements include documentation that proposed stormwater quality management systems, at a minimum, conform to the "2004 Connecticut Stormwater Quality Manual", as amended. The Inland Wetlands and Watercourses Regulations should be revised to require that projects also meet the design requirements contained in the Tolland LID Design Manual, for consistency with the zoning and subdivision regulations and to promote the use of LID. The town should also consider incorporating more explicit watercourse buffer requirements, including minimum buffer widths, similar to the watercourse buffer provisions in the Town of Vernon Inland Wetlands and Watercourses Regulations.

Plan of Conservation and Development

The Tolland Planning & Zoning Commission is in the process of updating the 1999 Plan of Conservation & Development (POCD) in accordance with the Connecticut General Statutes which requires the plan to be updated every ten years. The plan will establish a common vision for the future of the community and determine policies that will help attain that vision. The plan will address a range of themes, including natural resources, open space, utility infrastructure, and community development.

The Town's planning consultant has prepared draft recommendations related to conservation issues as part of the POCD update process. The recommendations address surface and groundwater quality, important habitat areas, drainage issues, green infrastructure, and open space protection. Some of the key recommendations for natural resource protection that also apply within the Tankerhoosen River watershed include (Planimetrics, 2008):

- Future development should occur in a manner and in locations that are environmentally sustainable,

- Impacts from existing development should be minimized through education, incentives, and town leadership.

Open Space and Conservation Plan

The 2006 Tolland Open Space and Conservation Plan inventoried natural resources throughout the town, including wetlands, rivers and streams, lakes and ponds, vernal pools, water supply watersheds, forest resources, and wildlife resources. In addition to the Open Space and Conservation Plan, the town has also completed or is implementing the following open space preservation activities (Planimetrics, 2008):

- Establishing an Open Space Acquisition Fund,
- Setting up a structured process for open space procurement and management,
- Promoting the use of open space, with trail maps and programmed activities,
- Tapping into a volunteer group for maintenance (Tolland Conservation Corps).

4.0 REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Fuss & O Neill, Inc. 2005. Hockanum River State of the Watershed Report. North Central Conservation District, Inc.

Kitchell, A. and T. Schueler. 2005. Urban Subwatershed Restoration Manual No. 10: Unified Stream Assessment: A User's Manual (Version 2.0). Center for Watershed Protection.

Planimetrics. 2008. Draft Conservation Issues, Booklet #4, Town of Tolland Plan of Conservation and Development.

Wright, T., Swann, C., Cappiella, K. and T. Schueler. 2005. Urban Subwatershed Restoration Manual No. 11: Unified Subwatershed and Site Reconnaissance: A User's Manual (Version 2.0) Center for Watershed Protection.

APPENDIX A

Stream Corridor Assessment Field Forms and Data

Reach Level Assessment **RCH**

SURVEY REACH ID: CB01	**WTRSHD/SUBSHD:** Clarks Brook	**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends

START **TIME:** 9 : 38 AM/PM **LMK:** ____ **LAT** 41 ° 49 ' 49.4 " **LONG** 72 ° 27 ' 23.5 " **DESCRIPTION:**	*END* **TIME:** ___ : ___ AM/PM **LMK:** ____ **LAT** 4_ ° 49 ' 57.5 " **LONG** 72 ° 27 ' 19.7 " **DESCRIPTION:** Bolton Rd crossing	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☑ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☑ Urban/Residential ☐ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☑ Fish ☐ Beaver ☐ Deer
☐ Snails ☑ Other: Frog + Birds

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☑ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

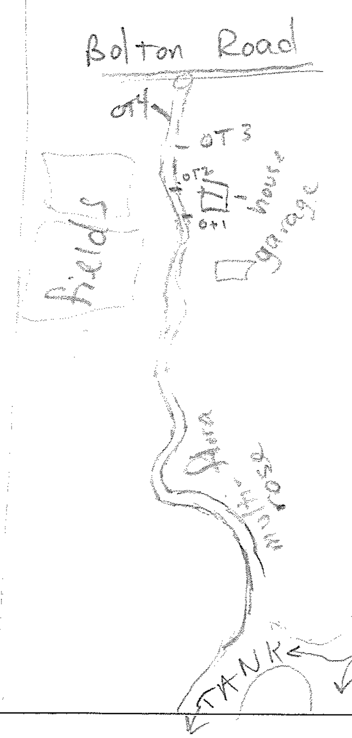
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 3 (ft)
Top 4 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

	Overall Stream Condition			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat (*May modify criteria based on appropriate habitat regime*)	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection (*score each bank, determine sides by facing downstream*)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	Overall Buffer and Floodplain Condition			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 43 /80 + Buffer/Floodplain: 33 /80 = **Total** Survey Reach 76 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB01	**TIME:** 10 : 48 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 10 (2403)
SITE ID (*Condition-#*): **OT-** 03	**LAT** 41 ° 49 ' 57.2 " **LONG** 72 ° 72 ' 20.2 "	**LMK** ____	**GPS:** (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY

COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☑ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ________ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ____________

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7/ 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB9	**TIME:** 10 : 50 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 11 (2404)
SITE ID (*Condition-#*): **OT-** 04	**LAT** 41 ° 49 ' 57.1 " **LONG** 72 ° 27 ' 20.2 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ______ (in)
Width (Top): ______ (in)
" (Bottom): ______ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: __________ ft Type of existing vegetation:____________________ Slope: __________ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:______________________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7 / 02 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB01	**TIME:** 10 : 37 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 8 (2401)	
SITE ID (*Condition-#*): **OT-** 1	**LAT** 41° 49' 58.6" **LONG** -72° 27' 20.4" **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☑ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ____________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Charles Brook		**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB01	**TIME:** 10 : 40 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 9 (2402)
SITE ID (*Condition-#*): **OT-** 2	**LAT** 41 ° 49 ' 55.8 " **LONG** 72 ° 27 ' 20.5 "	**LMK**_____	**GPS:** (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: _____ (in) Width (Top): _____ (in) " (Bottom): _____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☑ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7 / 2 / 08	**ASSESSED BY:** Frilncls
SURVEY REACH ID: CB 01	**TIME:** 11 : 00 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 12 (2405)
SITE ID: (*Condition-#*) SC-01	**LAT** 41 ° 49 ' 51.1 " **LONG** 72 ° 27 ' 20.2 " **LMK** ____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 5.5 (ft)
Height: ______ (ft)
Culvert length: 34 (ft)
Width: ______ (ft)
Roadway elevation: 2 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☑ Flat ☐ Slight ($2^{\circ} - 5^{0}$) ☐ Obvious ($>5^{0}$)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☑ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other: concrete wearing away

IS SC ACTING AS GRADE CONTROL ☐ No ☑ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: _____ (in)
☐ Flow too shallow Water Depth: _____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: CB02	**WTRSHD/SUBSHD:** Clarks Brook	**DATE:** 7/2/08	**ASSESSED BY:** Friends

START TIME: 11:08 AM/PM LMK: ____	*END* TIME: ___:___ AM/PM LMK: ____	**GPS ID:**
LAT 41°49'58.0" LONG 72°27'20.2"	LAT 41°50'10.7" LONG 72°27'23.9"	
DESCRIPTION:	**DESCRIPTION:**	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☑ Partly cloudy

SURROUNDING LAND USE: ☑ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☑ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☑ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☑ some ☐ lots
Floating: ☐ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☑ Fish ☐ Beaver ☐ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☑ Sed. deposition ☐ Channelized
☐ Unknown

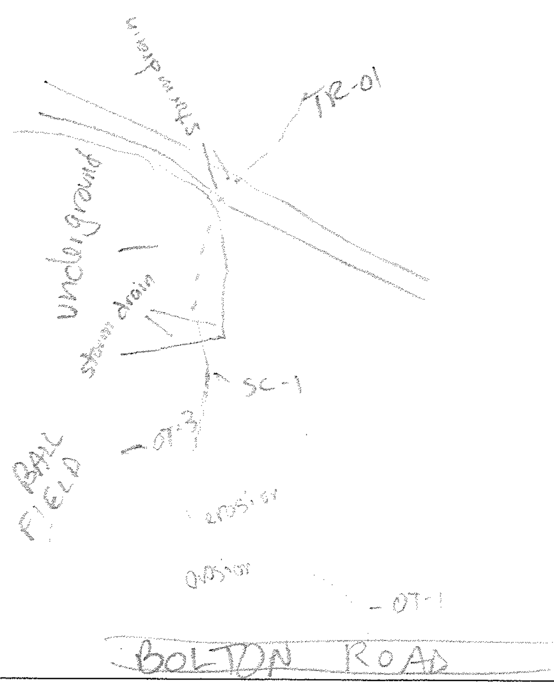
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 6 (ft)
RT bank 7 (ft)
Width: Bottom 6 (ft)
Top 7 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4 (circled)	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 63 /80 + Buffer/Floodplain: 40 /80 = **Total** Survey Reach 93 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB 02	**TIME:** 11 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 16, 17 (2409 2410)
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 49 ' 58.3 " **LONG** 72 ° 27 ' 20.1 "	**LMK** ____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☑ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 6 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

☐ Open channel — ☐ Concrete ☐ Earthen ☐ Other: — ☐ Trapezoid ☐ Parabolic ☐ Other: — Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in) — *NOT APPLICABLE*

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☑ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description: ________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7/2/08	**ASSESSED BY:**
SURVEY REACH ID: CB02 / **TIME:** 11:50 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 20 (2413)	
SITE ID (*Condition-#*): **OT-** 2 / **LAT** 41° 50' 01.8" **LONG** 72° 27' 21.5" **LMK** ____	**GPS:** (*Unit ID*)	

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [x] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [ ] Closed pipe
MATERIAL: [ ] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:
SHAPE: [ ] Single [ ] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:
DIMENSIONS: Diameter:____(in)
SUBMERGED: [ ] No [ ] Partially [ ] Fully

TYPE: [x] Open channel
MATERIAL: [ ] Concrete [x] Earthen [ ] Other:
SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:
Depth: 48 (in)
Width (Top): 60 (in)
" (Bottom):____(in)
NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [ ] None [x] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [ ] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[x] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[x] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[x] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [ ] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:______________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled?
[ ] Yes [ ] No [ ] Not investigated
Land Use description:______________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Clarks		**DATE:** 7/2/08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB 02	**TIME:** 12:08 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 21	
SITE ID (*Condition-#*): **OT-** 03	**LAT** 41° 50' 03.3" **LONG** 72° 27' 23.3" **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☐ No ☑ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☑ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:____________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH: CB02	**TIME:** 11 : 30 AM/PM	**PHOTO ID** (CAMERA-PIC #): /# 19 (2412)	
SITE ID: (*Condition-#*) ER- 01	*START* LAT 41 ° 50 ' 01.2 " LONG 72 ° 27 ' 20.4 " LMK ____		**GPS:** (*Unit ID*)
	END LAT ___ ° ___ ' ___ " LONG ___ ° ___ ' ___ " LMK ____		

PROCESS: ☐ Currently unknown

☐ Downcutting	☐ Bed scour
☐ Widening	☐ Bank failure
☐ Headcutting	☑ Bank scour
☐ Aggrading	☐ Slope failure
☐ Sed. deposition	☐ Channelized

BANK OF CONCERN: ☑ LT ☐ RT ☐ Both (*looking downstream*)

LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT ____ ft	and/or RT ____ ft	Bottom width ____ ft
Bank Ht	LT ____ ft	and/or RT ____ ft	Top width ____ ft
Bank Angle	LT ____ °	and/or RT ____ °	Wetted Width ____ ft

LAND OWNERSHIP: ☐ Private ☐ Public ☑ Unknown **LAND COVER:** ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☑ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks	**DATE:** 7/2/08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB02 **TIME:** 12:15 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 22 (2415)
SITE ID: (*Condition-#*) SC- 01 **LAT** 41° 50' 02.9" **LONG** 72° 27' 22.7"	**LMK**____	**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other: parking lot

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☑ Triple ☐ Other:

MATERIAL: ☐ Concrete ☑ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☑ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 2 (ft)
Height: ____ (ft)
Culvert length: 400 (ft)
Width: ____ (ft)
Roadway elevation: 13 (ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☑ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☑ Yes ☐ Unknown 3" 8" 18"

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ____ (in)
☐ Flow too shallow Water Depth: ____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*) ?

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Clark	**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB02 — **TIME:** 12:35 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 24 (2417)	
SITE ID: (*Condition-#*) TR- 01	**LAT** 41 ° 50 ' 07.5 " **LONG** 72 ° 27 ' 22.9 " **LMK** ____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**			**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☑ Industrial	☐ Plastic	☐ Paper	☐ Metal	☑ Unknown	☑ Stream	☐ Public ☑ Unknown
☐ Commercial	☑ Tires 6	☐ Construction	☐ Medical	☐ Flooding	☐ Riparian Area	☐ Private
☑ Residential	☐ Appliances	☐ Yard Waste appliance		☐ Illegal dump	☐ Lt bank	**AMOUNT** (*# Pickup truck loads*): 1
	☑ Automotive	☐ Other: 55 gal drum		☐ Local outfall	☐ Rt bank	

POTENTIAL RESTORATION CANDIDATE ☑ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal

EQUIPMENT NEEDED : ☐ Heavy equipment ☐ Trash bags ☑ Unknown

WHO CAN DO IT: ☐ Volunteers ☐ Local Gov ☐ Hazmat ? Team ☐ Other

DUMPSTER WITHIN 100 FT: ☑ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5	4 3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment

RCH

Survey Reach ID: CB03	**Wtrshd/Subshd:** Clarks Brook	**Date:** 7/2/08	**Assessed by:** Friends

Start Time: 12:45 AM/PM ~~AM~~ LMK: ____	*End* Time: ___:___ AM/PM LMK: ____	GPS ID:
Lat 41° 50' 10.7" Long 72° 27' 23.9"	Lat ___° ___' ___" Long ___° ___' ___"	
Description:	Description:	

Rain in last 24 hours ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

Present conditions ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☑ Partly cloudy

Surrounding land use: ☑ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

Average Conditions *(check applicable)*

Base Flow as % Channel Width ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☑ 75-100%

Dominant Substrate
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☑ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

Water Clarity ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

Aquatic Plants in Stream
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

Wildlife in or Around Stream (Evidence of)
☑ Fish ☐ Beaver ☐ Deer
☐ Snails ☐ Other: striders

Stream Shading (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

Channel Dynamics
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☑ Bank scour
☐ Aggrading ☐ Slope failure
☐ Unknown ☐ Sed. deposition ☐ Channelized

Channel Dimensions *(Facing downstream)*
Height: LT bank ______(ft)
RT bank ______(ft)
Width: Bottom 8 (ft)
Top 15 (ft)

Reach Accessibility

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

(2 circled)

Reach Sketch and Site Impact Tracking

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

Notes: *(biggest problem you see in survey reach)*

Reported to authorities ☐ Yes ☐ No

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 51 /80 + Buffer/Floodplain: 53 /80 = **Total** Survey Reach 104 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB03	**TIME:** 12 : 55 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 27 (2421)	
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 50 ' 11.3 " **LONG** 72 ° 27 ' 23.4 " **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☑ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: ____ (in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully

TYPE: ☑ Open channel

MATERIAL: ☐ Concrete ☑ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: 3-12 (in)
Width (Top): 24 (in)
" (Bottom): 6 (in)

NOT APPLICABLE

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description: ____________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3	2 1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Clarks Brook		**DATE:** 7/ 2 /08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB03	**TIME:** 1 :06 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 28	
SITE ID (*Condition-#*): **OT-**02	**LAT** 41 ° 50 ' 12.0 " **LONG** 72 ° 27 ' 17.2 " **LMK**____		**GPS:** (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☑ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☑ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☑ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:______________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7/2/08	**ASSESSED BY:** Friends
SURVEY REACH: CB03	**TIME:** 1:23 AM/PM	**PHOTO ID** (CAMERA-PIC #): /# 29 (2424)

SITE ID: (*Condition-#*) ER- 01	*START* **LAT** 41 ° 50 ' 13.1 " **LONG** 72 ° 27 ' 12.4 " **LMK** ___ *END* **LAT** ___ ° ___ ' ___ " **LONG** ___ ° ___ ' ___ " **LMK** ___	**GPS:** (*Unit ID*)

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition

☐ Bed scour ☑ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

BANK OF CONCERN: ☑ LT ☐ RT ☐ Both (*looking downstream*)

LOCATION: ☑ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT 30 ft	and/or RT ___ ft	Bottom width	___ ft
Bank Ht	LT 20 ft	and/or RT ___ ft	Top width	___ ft
Bank Angle	LT ___ °	and/or RT ___ °	Wetted Width	___ ft

LAND OWNERSHIP: ☐ Private ☐ Public ☑ Unknown **LAND COVER:** ☑ Forest ☐ Field/Ag ☑ Developed: near ind pk.

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☑ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe): ?

EXISTING RIPARIAN WIDTH: ☑ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB03	**TIME:** 1:33 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 31 (2426)
SITE ID: (*Condition-#*) SC- 01	**LAT** no signal ° ' " **LONG** ° ' " **LMK**	**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other: foot bridge

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☑ Other: wood

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ____(ft)
Height: ____(ft)
Culvert length: ____(ft)
Width: ____(ft)
Roadway elevation: ____(ft)

CONDITION: (*Evidence of...*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☑ Other: remove debris

IS SC ACTING AS GRADE CONTROL ☑ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☑ Partial ☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ____ (in)
☐ Flow too shallow Water Depth: ____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

(2 circled)

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7 / 2 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB03 — **TIME:** 1 : 50 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 32 (2427)
SITE ID: (*Condition-#*) SC-02 — **LAT** 41 ° 50 ' 17.2 " **LONG** 72 ° 27 ' 04.2 " **LMK**____		**GPS** (*Unit ID*)

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY	**SHAPE:** [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [x] Circular [ ] Other:	**# BARRELS:** [ ] Single [x] Double [ ] Triple [ ] Other:	**MATERIAL:** [ ] Concrete [x] Metal [ ] Other:	**ALIGNMENT:** [x] Flow-aligned [ ] Not flow-aligned [ ] Do not know	**DIMENSIONS:** (*if variable, sketch*) Barrel diameter: 4.5 (ft) Height: ____ (ft) Culvert length: 60 (ft) Width: ____ (ft) Roadway elevation: 20 (ft)
	CONDITION: (*Evidence of...*) [ ] Cracking/chipping/corrosion [ ] Downstream scour hole [ ] Sediment deposition [ ] Failing embankment [ ] Other (*describe*):			**CULVERT SLOPE:** [ ] Flat [ ] Slight ($2^{\circ} - 5^{0}$) [ ] Obvious ($>5^{\circ}$)	

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit
[ ] no [x] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [ ] No [x] Yes [ ] Unknown 6"

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
[ ] Total [ ] Partial
[ ] Temporary [ ] Unknown

CAUSE:
[ ] Drop too high Water Drop: ______ (in)
[ ] Flow too shallow Water Depth: ______ (in)
[ ] Other:

BLOCKAGE SEVERITY: *(circle #)*

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES [ ] YES [ ] NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7/2/08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB03	**TIME:** 2:06 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 33 (2428)
SITE ID: (*Condition-#*) SC-03	**LAT** 41 ° 50 ' 20.2 " **LONG** 72 ° 27 ' 04.2 " **LMK** ____	**GPS** (*Unit ID*)

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [x] Circular [ ] Other:

 # BARRELS: [ ] Single [x] Double [ ] Triple [ ] Other:

MATERIAL: [ ] Concrete [x] Metal [ ] Other:

ALIGNMENT: [x] Flow-aligned [ ] Not flow-aligned [ ] Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4 (ft)
Height: ______ (ft)
Culvert length: 100 (ft)
Width: ______ (ft)
Roadway elevation: 25 (ft)

CONDITION: (*Evidence of…*) [ ] Cracking/chipping/corrosion [ ] Downstream scour hole [ ] Sediment deposition [ ] Failing embankment [ ] Other (*describe*):

CULVERT SLOPE: [x] Flat [ ] Slight ($2^{\circ} - 5^{\circ}$) [ ] Obvious ($>5^{\circ}$)

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit
[ ] no [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [x] No [ ] Yes [ ] Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: [ ] Total [ ] Partial [ ] Temporary [ ] Unknown

CAUSE: [ ] Drop too high Water Drop: ______ (in) [ ] Flow too shallow Water Depth: ______ (in) [ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH: cobble substrate

REPORTED TO AUTHORITIES [ ] YES [ ] NO

Trash and Debris

TR

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7/2/08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB03 **TIME:** 1:23 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 30 (2425)	
SITE ID: (*Condition-#*) TR-01	LAT 41° 50' 13.1" LONG 72° 27' 12.4" LMK _____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**			**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial	☐ Plastic	☐ Paper	☐ Metal	☐ Unknown	☑ Stream	☐ Public ☑ Unknown
☐ Commercial	☐ Tires	☐ Construction	☐ Medical	☐ Flooding	☐ Riparian Area	☐ Private
☑ Residential	☐ Appliances	☐ Yard Waste		☑ Illegal dump	☐ Lt bank	**AMOUNT** (*# Pickup truck loads*): 1
	☑ Automotive	☑ Other:		☐ Local outfall	☐ Rt bank	

POTENTIAL RESTORATION CANDIDATE ☑ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☑ Unknown	**DUMPSTER WITHIN 100 FT:**
	WHO CAN DO IT: ☑ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	☑ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5	4 3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: CB04	**WTRSHD/SUBSHD:** Clarks Brook	**DATE:** 7/10/08	**ASSESSED BY:** Friends

START **TIME:** 10:34 AM/PM (AM circled) **LMK:** ____	*END* **TIME:** 12:02 AM/PM (PM circled) **LMK:** ____	**GPS ID:**
LAT 41° 50' 32.1" **LONG** 72° 27' 01.2"	**LAT** 41° 50' 53.9" **LONG** 72° 26' 58.6"	
DESCRIPTION: Outlet to sedge wetland tussock, winterberry, sensitive, skunk [illegible]	**DESCRIPTION:** road crossing, knotweed, m-f rose	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☑ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☑ Other: I-84

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☑ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☑ Fish ☐ Beaver ☐ Deer
☐ Snails ☑ Other: Songbirds, frog

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Unknown ☑ Sed. deposition ☐ Channelized

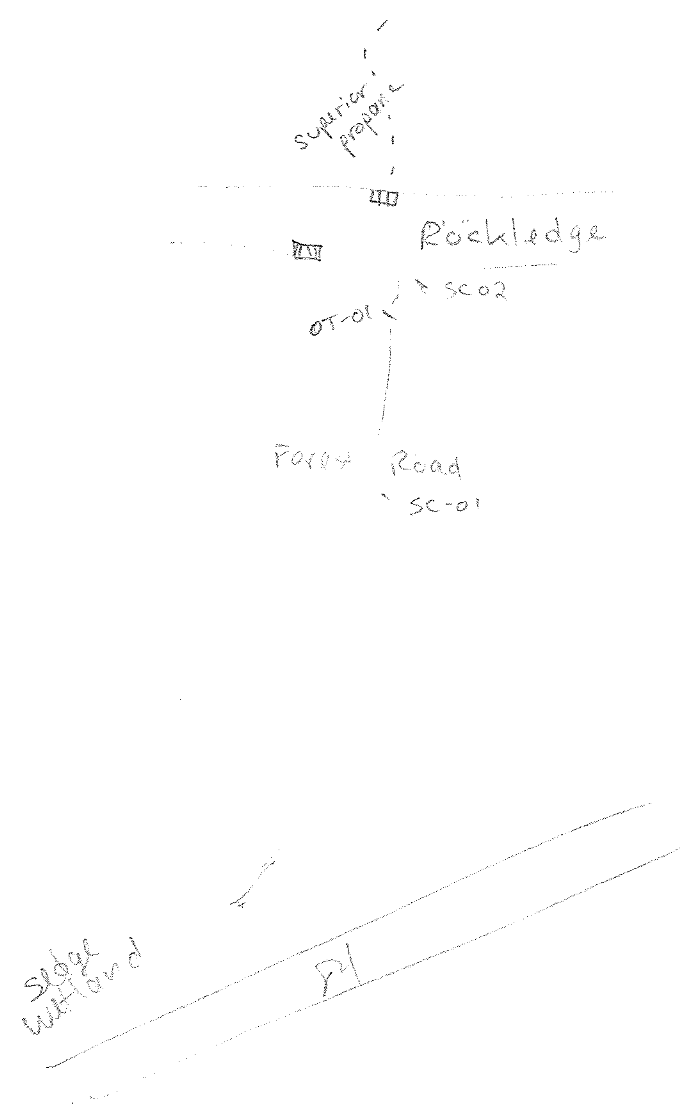
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 1 (ft)
RT bank 1 (ft)
Width: Bottom 4 (ft)
Top 5 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1 (circled)

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 72 /80 + Buffer/Floodplain: 56 /80 = **Total** Survey Reach 128 /160

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks Brook **DATE:** 7/10/08 **ASSESSED BY:** Friends

SURVEY REACH ID: CB04 **TIME:** 11:20 AM/PM **PHOTO ID:** (Camera-Pic #) /# 5

SITE ID: (Condition-#) SC-01 **LAT** 41° 50' 47.9" **LONG** 72° 26' 56.3" **LMK**_____ **GPS** (Unit ID)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☑ Other: Forest Road

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4 (ft)
Height: _____ (ft)
Culvert length: 50 (ft)
Width: _____ (ft)
Roadway elevation: 0-3.5 (ft)

CONDITION: (*Evidence of...*)
☑ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☑ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☑ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☑ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: 3.5 (in)
☐ Flow too shallow Water Depth: _____ (in)
☐ Other:

BLOCKAGE SEVERITY: *(circle #)*

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Clarks Brook	**DATE:** 7 / 10 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: CB04	**TIME:** 12 : 02 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) SC-02	**LAT** 41 ° 50 ' 53.9 " **LONG** 72 ° 26 ' 58.6 " **LMK**_____	**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☑ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 3 (ft)
Height: ________(ft)
Culvert length: ________(ft)
Width: ________(ft)
Roadway elevation: 7 (ft)

CONDITION: (*Evidence of…*)
☑ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☑ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☑ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☑ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Clarks Brook | **DATE:** 7 / 10 / 08 | **ASSESSED BY:** Friends

SURVEY REACH ID: CB 04 | **TIME:** 11 : 50 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /# 7

SITE ID (*Condition-#*): OT- 01 | **LAT** 41 ° 50 ' 53.5 " **LONG** 72 ° 26 ' 58.6 " **LMK**____ | **GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☑ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☑ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 12 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

☐ Open channel — ☐ Concrete ☐ Earthen ☐ Other: — ☐ Trapezoid ☐ Parabolic ☐ Other: — Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in) — NOT APPLICABLE

CONDITION: ☐ None ☑ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☑ Other: Rust

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☑ Other: surrounded by dense knotweed

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☑ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☑ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☑ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☑ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☑ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation: Knotweed Slope: 45 °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☑ Not investigated
Land Use description: Forested to residential
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: CB05	**WTRSHD/SUBSHD:** Clarks Brook	**DATE:** 7/10/08	**ASSESSED BY:** Friends

START **TIME:** ___:___ AM/PM **LMK:** ______
LAT ___° ______' ______" **LONG** ___° ______' ______"
DESCRIPTION: Underground

END **TIME:** ___:___ AM/PM **LMK:** ______
LAT ___° ______' ______" **LONG** ___° ______' ______"
DESCRIPTION: Lawn ?

GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☐ some ☐ lots
Floating: ☐ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☐ Fish ☐ Beaver ☐ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank ___________(ft)
RT bank ___________(ft)
Width: Bottom ___________(ft)
Top ___________(ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.

5 4 3 2 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

NOTES: *(biggest problem you see in survey reach)*

Stream is entirely underground
Superior propane has been trying to pave divert. Previous owners said to have raised land at least 4'

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION

	Optimal	Suboptimal	Marginal	Poor
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION

	Optimal	Suboptimal	Marginal	Poor
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Reach Level Assessment **RCH**

SURVEY REACH ID: GBST-01	**WTRSHD/SUBSHD:** Gages South Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:**

START TIME: 11 : 07 AM/PM LMK: ____	*END* TIME: 11 : 40 AM/PM LMK: ____	**GPS ID:**
LAT 41 ° 51 ' 25.9 " LONG 72 ° 25 ' 31.2 "	LAT 41 ° 51 ' 16.6 " LONG 72 ° 25 ' 04.3 "	
DESCRIPTION:	**DESCRIPTION:**	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☑ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☑ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☑ Bank scour
☑ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

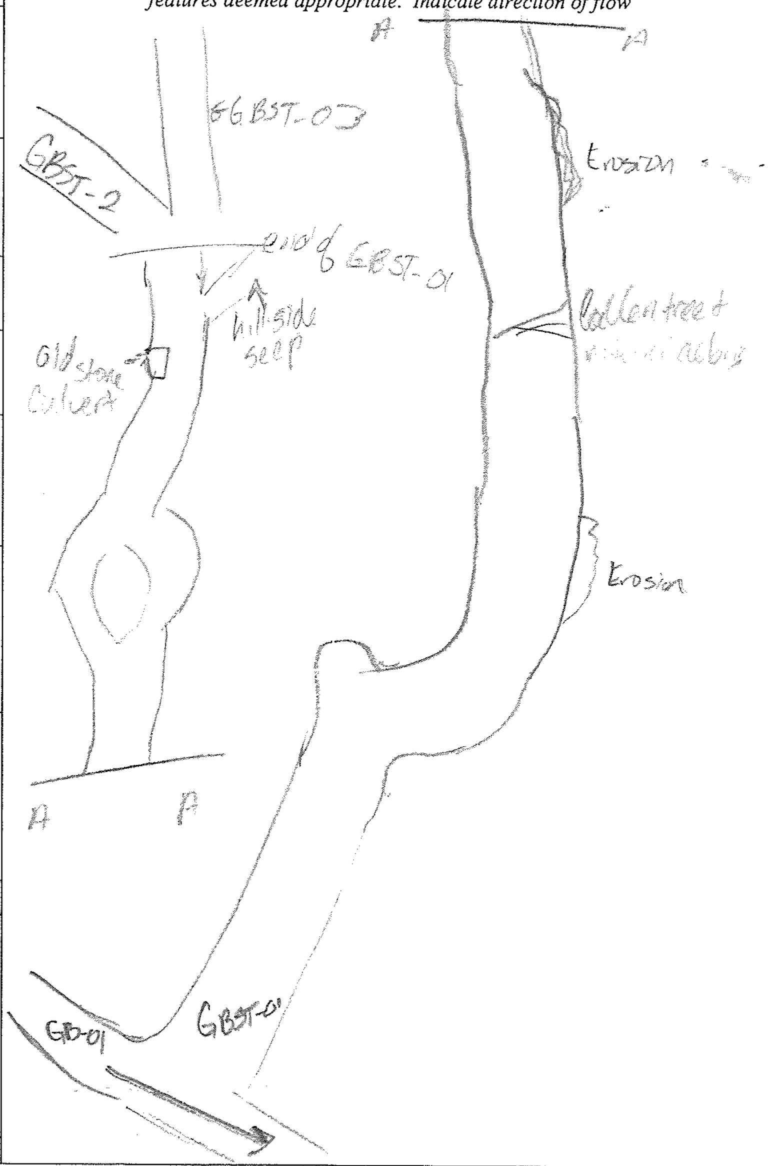
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 6 (ft)
Top 12 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION

	Optimal	Suboptimal	Marginal	Poor
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION

	Optimal	Suboptimal	Marginal	Poor
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Reach Level Assessment **RCH**

SURVEY REACH ID: GBST-02	**WTRSHD/SUBSHD:** Gages Bk S Trib	**DATE:** 6/5/08	**ASSESSED BY:**
START **TIME:** 11:50 AM/PM **LMK:** ____ **LAT** 41° 51' 16.6" **LONG** 72° 25' 04.3" **DESCRIPTION:**	*END* **TIME:** 12:45 AM/PM **LMK:** ____ **LAT** 41° 51' 17.0" **LONG** 72° 24' 39.8" **DESCRIPTION:**		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☑ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other: Highway

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☑ 50%-75% ☐ 75-100%

DOMINANT SUBSTRATE ☐ Silt/clay (fine or slick) ☐ Sand (gritty) ☑ Gravel (0.1-2.5") ☑ Cobble (2.5 –10") ☑ Boulder (>10") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☑ none ☐ some ☐ lots Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☑ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other: snake

STREAM SHADING (water surface) ☑ Mostly shaded (≥75% coverage) ☐ Halfway (≥50%) ☐ Partially shaded (≥25%) ☐ Unshaded (< 25%)

CHANNEL DYNAMICS ☑ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☑ Bank scour ☐ Slope failure ☑ Channelized ☐ Unknown

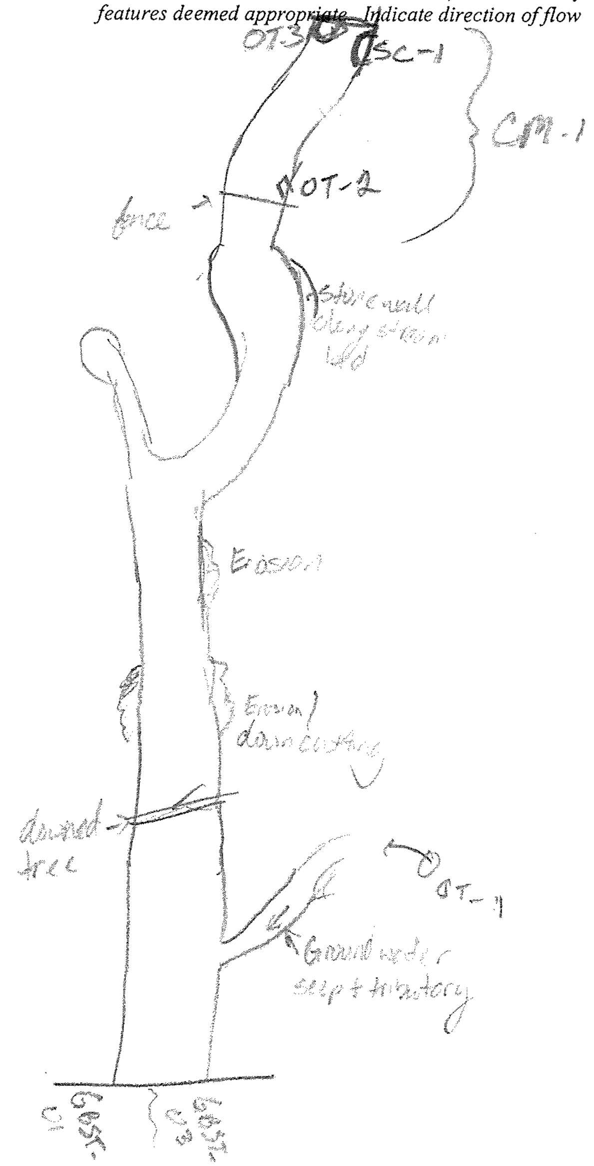
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)* Height: LT bank 2.5 (ft) RT bank 2.5 (ft) Width: Bottom 6 (ft) Top 12.5 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2 (circled)	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: ______ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach ______ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: [illegible] South trib	**DATE:** 6/5/08	**ASSESSED BY:** DCB
SURVEY REACH ID: GBST-02 **TIME:** 12:30 AM/PM	**PHOTO ID:** (Camera-Pic #) DB Canon /# 1834	
SITE ID (Condition-#): OT-02 **LAT** 41° 51' 17.1" **LONG** 72° 24' 49.3"	**LMK** ____	**GPS:** (Unit ID)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [ ] Trickle [x] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [x] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [x] Single [x] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: [x] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [ ] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [x] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY	
COLOR:	[x] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
TURBIDITY:	[x] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
FLOATABLES:	[x] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [x] Bank Erosion [x] Other: D.S. erosion in trib

POTENTIAL RESTORATION CANDIDATE [x] Discharge investigation [ ] Stream daylighting [x] Local stream repair/outfall stabilization [ ] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation: ____________ Slope: ______°

If yes for stormwater:

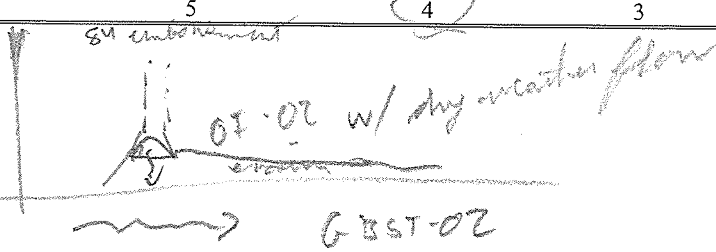
Is stormwater currently controlled? [ ] Yes [ ] No [x] Not investigated

Land Use description: Highway 84

Area available:

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gages Bk S. Trib		**DATE:** 6 / 5 / 08	**ASSESSED BY:**
SURVEY REACH ID: GBST-02	**TIME:** 12 : 35 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1835	
SITE ID (*Condition-#*): OT- 03	**LAT** 41 ° 61 ' 17.0 " **LONG** 72 ° 24 ' 34.8 " **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☑ Head

FLOW: ☐ None ☐ Trickle ☑ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☑ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 24 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

~~NOT APPLICABLE~~

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☑ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

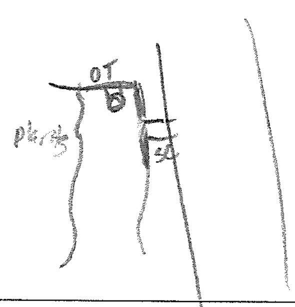
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:______________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Channel Modification

CM

WATERSHED/SUBSHED: Gayes Bk S. Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JHW
SURVEY REACH ID: GBST-02	**TIME:** 12 : 40 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) #1835

SITE ID: (*Condition-#*) CM- 1	*START* **LAT** 41 ° 51 ' 17.1 "	**LONG** 72 ° 24 ' 49.3 "	**LMK** 8" RCP	**GPS:** (*Unit ID*) 3
	END **LAT** 41 ° 51 ' 17.0 "	**LONG** 72 ° 24 ' 39.8 "	**LMK** I 84	

TYPE: ☒ Channelization ☐ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL:			**DIMENSIONS:**
☐ Concrete ☐ Gabion	Does channel have perennial flow?	☒ Yes ☐ No	Height 6 (ft)
☒ Rip Rap ☐ Earthen	Is there evidence of sediment deposition?	☒ Yes ☐ No	Bottom Width 5 (ft)
☐ Metal	Is vegetation growing in channel?	☒ Yes ☐ No	Top Width: 15 (ft)
☐ Other:	Is channel connected to floodplain?	☐ Yes ☒ No	Length: see GPS coord (ft)

BASE FLOW CHANNEL

Depth of flow 8 (in)

Defined low flow channel? ☐ Yes ☒ No

% of channel bottom 100 %

ADJACENT STREAM CORRIDOR

Available width LT <20 (ft) RT 100+ (ft)

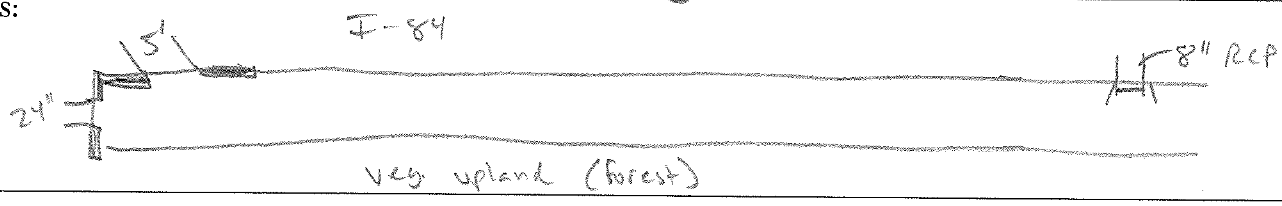
Utilities Present? ☐ Yes ☒ No

Fill in floodplain? ☐Yes ☒ No

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design ☐ Can't tell ☐ no ☐ De-channelization ☐ Fish barrier removal ☒ Bioengineering

CHANNEL-IZATION SEVERITY: (*Circle #*)	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3 (circled)	2 1

NOTES:



Storm Water Outfalls

OT

WATERSHED/SUBSHED: GBST-02 | **DATE:** 6/5/08 | **ASSESSED BY:** DRB

SURVEY REACH ID: | **TIME:** 12:10 AM/PM (PM circled) | **PHOTO ID:** (Camera-Pic #) /# 1829

SITE ID (Condition-#): OT-01 | **LAT** ___ ° 300 FT SOUTH OF SEEP (SEE PHOTO FOR CONFLUENCE) " **LONG** ___ ° ___ " **LMK** ___ | **GPS:** (Unit ID)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☒ Concrete ☒ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☒ Circular ☒ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ___ (in) Width (Top): ___ (in) " (Bottom): ___ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☒ Oily ☒ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☒ Excessive Sedimentation ☐ Needs Regular Maintenance ☒ Bank Erosion ☐ Other:

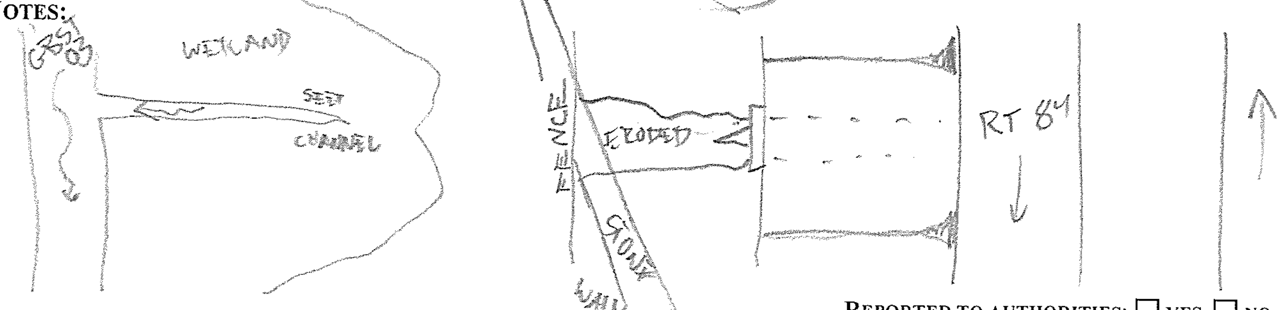
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☒ Local stream repair/outfall stabilization ☐ no ☒ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ___ ft Type of existing vegetation: ___ Slope: ___ °

If yes for stormwater:
Is stormwater currently controlled? ASSUMED
☐ Yes ☒ No ☐ Not investigated
Land Use description: HIGHWAY / 84
Area available:

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4 — 3 (circled)	2 — 1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Gages Bk South Trib | **DATE:** 6/5/06 | **ASSESSED BY:** DRB

SURVEY REACH ID: GBST-02 | **TIME:** 12:40 AM/PM | **PHOTO ID:** (Camera-Pic #) DBCanon /# 1835

SITE ID: (Condition-#) SC-01 | **LAT** 41° 51 ' 27.0" **LONG** 72° 24 ' 39.8" | **LMK** ____ | **GPS** (Unit ID)

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [x] Circular [ ] Other:

 # BARRELS: [x] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [x] Concrete [ ] Metal [ ] Other:

ALIGNMENT: [ ] Flow-aligned [x] Not flow-aligned [ ] Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 5 (ft)
Height: ____ (ft)
Culvert length: >200 (ft)
Width: ____ (ft)
Roadway elevation: 4 (ft)

CONDITION: (*Evidence of...*)
[ ] Cracking/chipping/corrosion [ ] Downstream scour hole
[ ] Sediment deposition [ ] Failing embankment
[x] Other (*describe*): apparently good

CULVERT SLOPE: [x] Flat [ ] Slight (2° – 5°) [ ] Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit
[x] no [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [x] No [ ] Yes [ ] Unknown

If yes for fish barrier

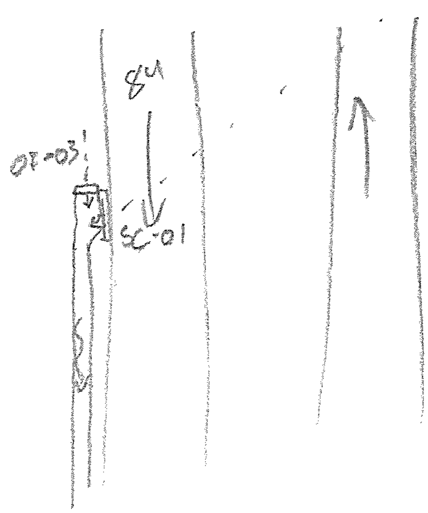
EXTENT OF PHYSICAL BLOCKAGE:
[ ] Total [ ] Partial
[ ] Temporary [ ] Unknown

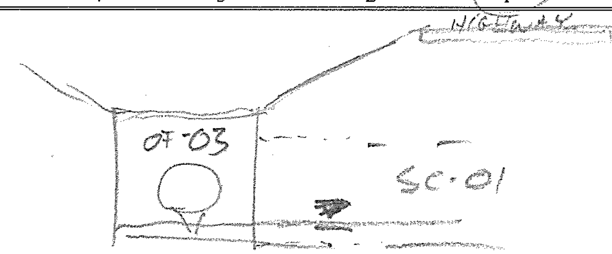
CAUSE:
[ ] Drop too high Water Drop: ____ (in)
[ ] Flow too shallow Water Depth: ____ (in)
[ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:





REPORTED TO AUTHORITIES [ ] YES [ ] NO

Reach Level Assessment

RCH

SURVEY REACH ID: GBST-03	**WTRSHD/SUBSHD:** Gages Brook	**DATE:** 6/5/08	**ASSESSED BY:** DRB
START TIME: 11:30 (AM)/PM LMK: ____ LAT 41° 51' 16.6" LONG 72° 25' 04.3" DESCRIPTION: conf. of GBSTs 01, 02, & 03	*END* TIME: __:__ AM/PM LMK: ____ LAT 41° 51' 17.8" LONG 72° 25' 04.6" DESCRIPTION: SC-01		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☒ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☒ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☒ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☒ Cobble (2.5 –10")
☒ Sand (gritty) ☒ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☐ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS NONE
☐ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition
☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

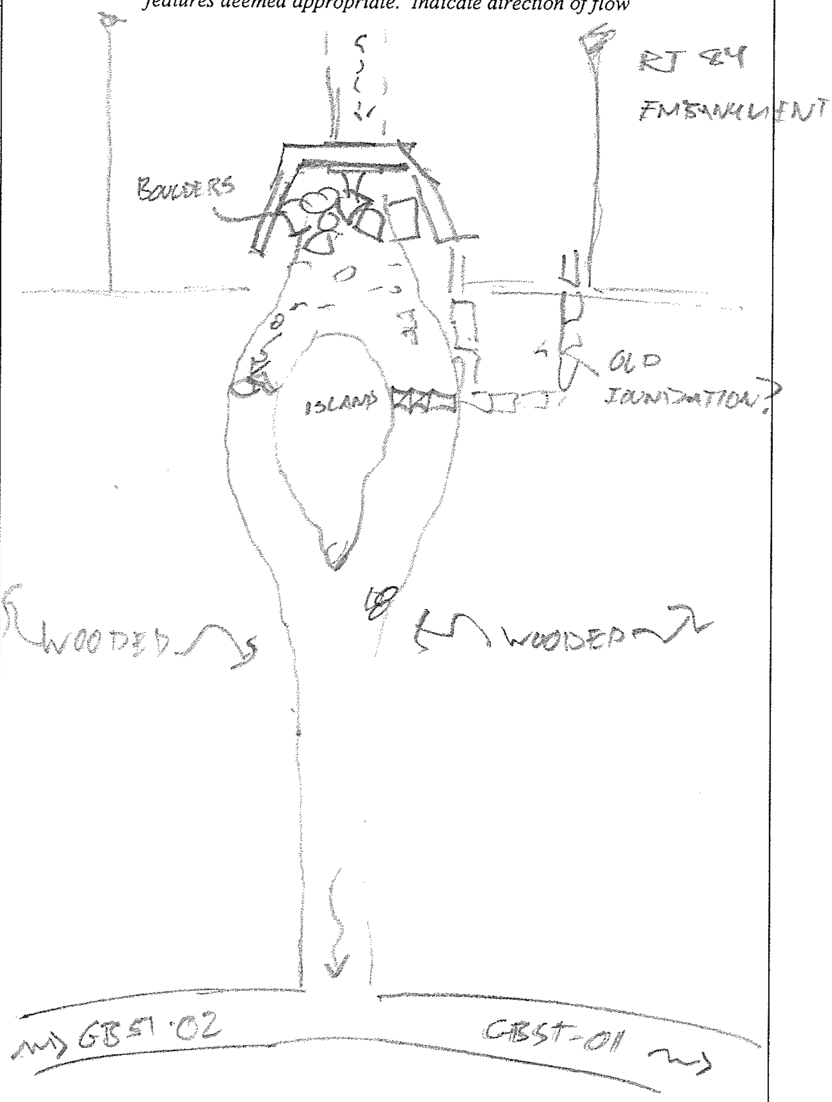
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.5 (ft)
RT bank 2.5 (ft)
Width: Bottom 12 (ft)
Top 16 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

CULVERTIZATION @ HWY

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Stream Crossing **SC**

WATERSHED/SUBSHED: [illegible] | **DATE:** 6 / 5 / 08 | **ASSESSED BY:** DRB

SURVEY REACH ID: GBST-03 | **TIME:** 11 : 50 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /# 1826 + 27

SITE ID: (*Condition-#*) SC-01 | **LAT** 40° 51 ' 17.8 " **LONG** 72° 25 ' 04.6 " **LMK** ____ | **GPS** (*Unit ID*)

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [x] Circular [ ] Other:

 # BARRELS: [x] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [ ] Concrete [x] Metal [ ] Other:

ALIGNMENT: [x] Flow-aligned DS [ ] Not flow-aligned [x] Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4 (ft)
Height: ______ (ft)
Culvert length: >250 (ft)
Width: ______ (ft)
Roadway elevation: 30 (ft)

CONDITION: (*Evidence of…*)
[ ] Cracking/chipping/corrosion [ ] Downstream scour hole
[ ] Sediment deposition [ ] Failing embankment
[x] Other (*describe*): FINE

CULVERT SLOPE: [ ] Flat [ ] Slight (2° – 5°) [x] Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit
[x] no [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [ ] No [x] Yes [ ] Unknown

If yes for fish barrier

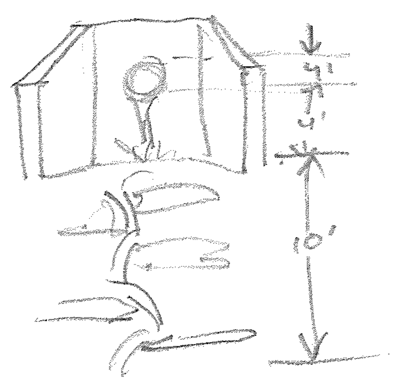
EXTENT OF PHYSICAL BLOCKAGE:
[x] Total [ ] Partial
[ ] Temporary [ ] Unknown

CAUSE:
[x] Drop too high Water Drop: 48 (in)
[ ] Flow too shallow Water Depth: ______ (in)
[ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES [ ] YES [ ] NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GBST-04A	**WTRSHD/SUBSHD:** Goggs Bk. South Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:**
START **TIME:** 2 : 35 AM/PM **LMK:** ____ **LAT** 41 ° 51 ' 14.1 " **LONG** 72 ° 25 ' 05.5 " **DESCRIPTION:**	*END* **TIME:** 3 : 05 AM/PM **LMK:** ____ **LAT** 41 ° 51 ' 07.4 " **LONG** 72 ° 25 ' 05.5 " **DESCRIPTION:**		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☑ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE (at lower end)
☑ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☑ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☑ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☑ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

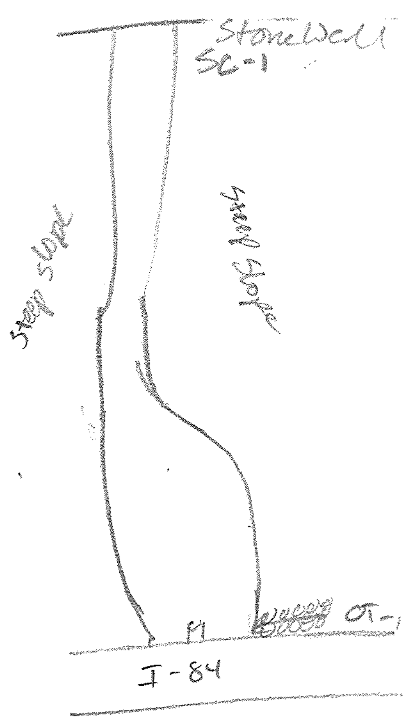
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 4 (ft)
RT bank 4 (ft)
Width: Bottom 10 (ft)
Top 30 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition

	Optimal	Suboptimal	Marginal	Poor
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection No floodplain except @ beginning	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition

	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gates Brook South Trib
DATE: 6/5/08
ASSESSED BY:

SURVEY REACH ID: GBST-04A
TIME: 2:40 AM/PM
PHOTO ID: (*Camera-Pic #*) Canon /# 1838

SITE ID (*Condition-#*): OT-1
LAT 41° 51' 14.1" **LONG** 72° 25' 05.5"
LMK____
GPS: (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE:
- ☐ Closed pipe
  - **MATERIAL:** ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:
  - **SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
  - **DIMENSIONS:** Diameter:____(in)
  - **SUBMERGED:** ☐ No ☐ Partially ☐ Fully
- ☑ Open channel
  - **MATERIAL:** ☐ Concrete ☐ Earthen ☐ Other: riprap
  - **SHAPE:** ☐ Trapezoid ☐ Parabolic ☐ Other:
  - **DIMENSIONS:** Depth: 2.5 (in); Width (Top): 8 (in); " (Bottom): 3 (in)
  - NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

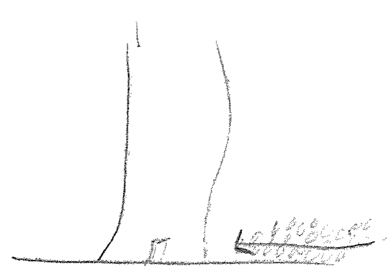
If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:________________
Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.

5 — 4 — **3** (circled) — 2 — 1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Green Brook South Fork		**DATE:** 6 / 5 / 08	**ASSESSED BY:** DBB
SURVEY REACH ID: OBST-04A	**TIME:** 2 : 25 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1841	
SITE ID: (*Condition #*) SC-01	**LAT** 41 ° 51 ' 078 " **LONG** 79 ° 25 ' 055 " **LMK**_____		**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: __________(ft)
Height: __________(ft)
Culvert length: __________(ft)
Width: __________(ft)
Roadway elevation: __________(ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☒ Local stream repair ☒ Other: Sediment removal

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

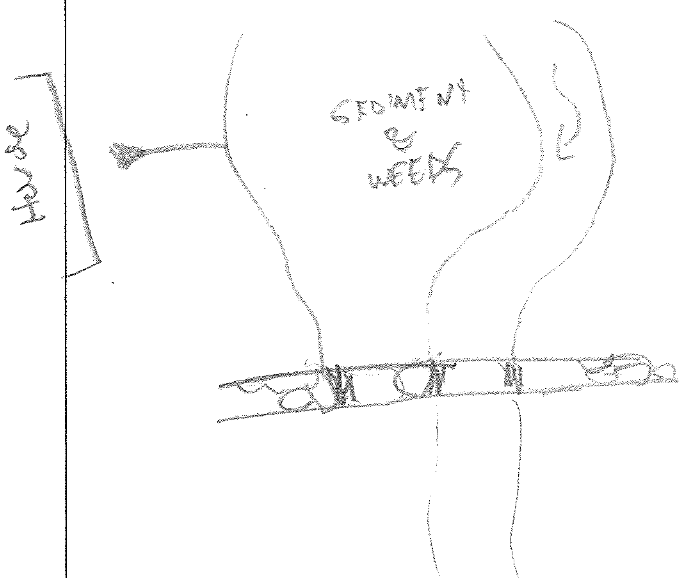
EXTENT OF PHYSICAL BLOCKAGE:
☒ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☒ Drop too high Water Drop: 42 (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GBSI-04B	**WTRSHD/SUBSHD:** Gates Bk South Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:** DRB

START TIME: 2:25 AM/PM LMK: ____ LAT 41° 51' 01.9" LONG 72° 25' 05.5" DESCRIPTION:	*END* TIME: __:__ AM/PM LMK: ____ LAT 41° 51' 03.1" LONG 72° 25' 08.9" DESCRIPTION:	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☒ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☒ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☒ 50%-75% ☐ 75-100%

DOMINANT SUBSTRATE
☒ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☒ Deer
☐ Snails ☒ Other: FOX sighted

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☒ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

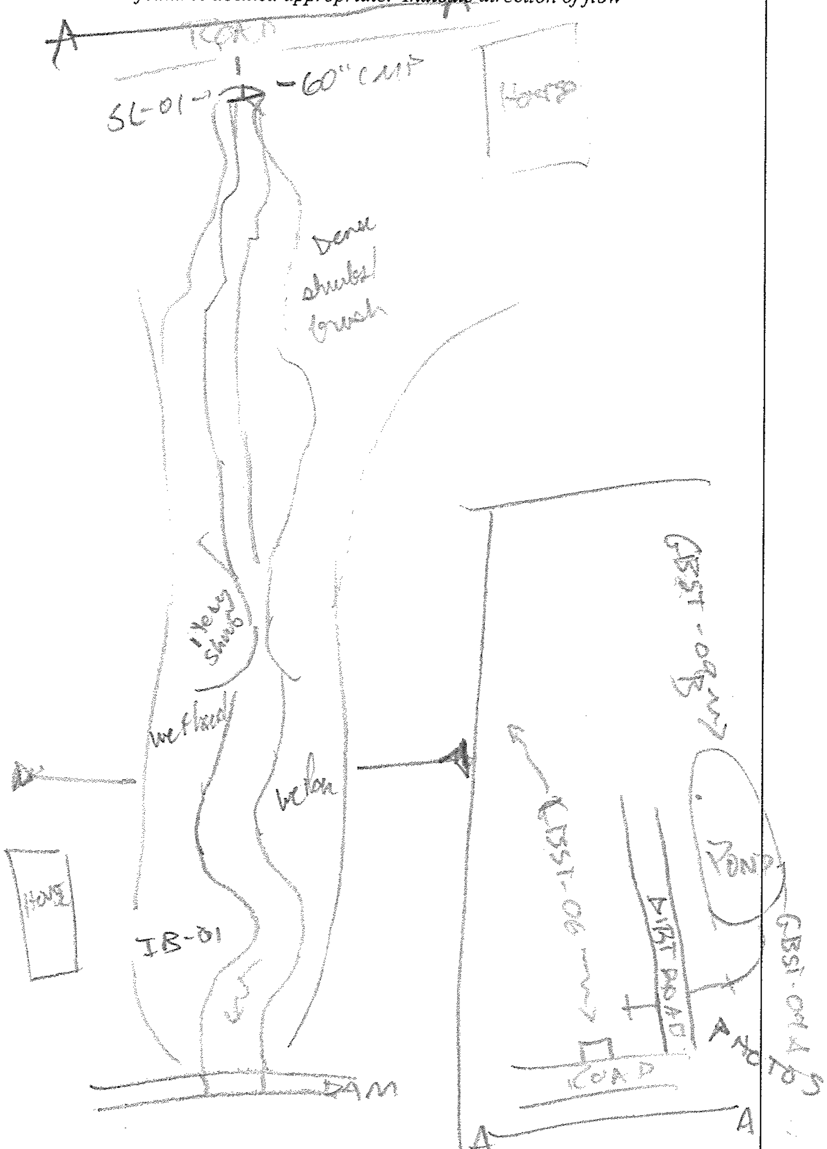
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 2 (ft)
Width: Bottom 7 (ft)
Top 20 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition	Optimal	Suboptimal	Marginal	Poor
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Impacted Buffer **IB**

WATERSHED/SUBSHED: Goshen Bk South Trib		**DATE:** 6 / 5 / 08	**ASSESSED BY:** DRB
SURVEY REACH: GBST-04B	**TIME:** 2 : 30 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# none
SITE ID: (*Condition-#*) IB- 61	*START* LAT 41 ° 51 ' 07.9 " LONG 72 ° 25 ' 055 " LMK ____ *END* LAT ___ ° ___ ' ___ " LONG ___ ° ___ ' ___ " LMK ____		**GPS:** (*Unit ID*)

IMPACTED BANK: ☐ LT ☒ RT ☐ Both

REASON INADEQUATE: ☒ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☒	☐	☐	☐	☐: UNKNOWN
RT Bank	☒	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☒	☐:
RT Bank	☐	☐	☒	☐	☒	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☒ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full **WETLANDS PRESENT?** ☐ No ☒ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☐ Greenway design ☒ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

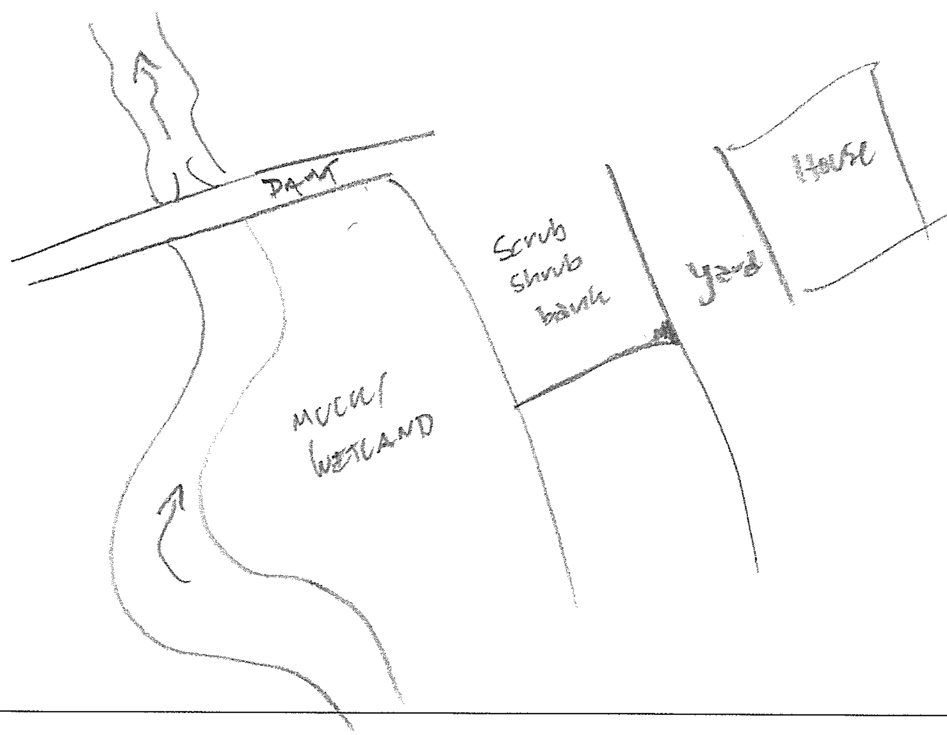
	LT BANK	RT
Length (ft):	unnecessary	300
Width (ft):	↓	20

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☒ Other: structure, property ownership

NOTES:



Stream Crossing **SC**

WATERSHED/SUBSHED: Goose Brook South Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:**
SURVEY REACH ID: GBST-04B	**TIME:** 3 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 43
SITE ID: (*Condition-#*) SC-01	**LAT** 41 ° 51 ' 03.1 " **LONG** 72 ° 25 ' 08.9 " **LMK**____	**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☑ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 5 (ft)
Height: 5 (ft)
Culvert length: 40 (ft)
Width: 5 (ft)
Roadway elevation: 10 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*): rusting

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☑ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

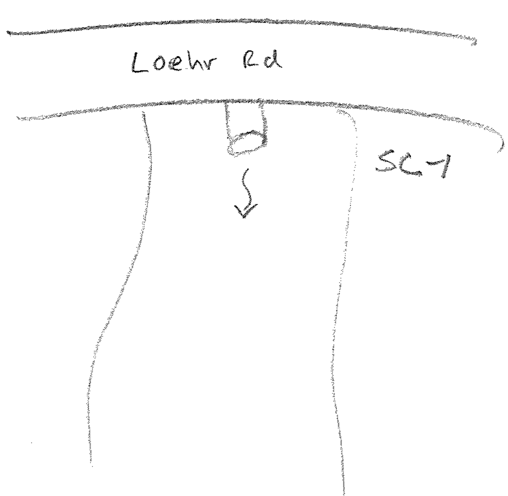
EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GBST-9A	**WTRSHD/SUBSHD:** Gages Bk S. Trib	**DATE:** 6/5/08	**ASSESSED BY:** DB JHW SM

START TIME: ___:___ AM/PM LMK: ______	*END* TIME: ___:___ AM/PM LMK: ______	**GPS ID:**
LAT 41 ° 51 ' 03.1 " LONG 72 ° 25 ' 06.9 "	LAT 41 ° 51 ' 00.7 " LONG 72 ° 25 ' 10.7 "	
DESCRIPTION:	DESCRIPTION:	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☑ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☑ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☑ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☑ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☑ Fish ☐ Beaver ☑ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☑ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☑ Channelized
☐ Unknown

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 5 (ft)
RT bank 5 (ft)
Width: Bottom 3 (ft)
Top 12 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2 (circled)	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Stream Crossing **SC**

WATERSHED/SUBSHED: Gayes Bk S. Trib	**DATE:** 6 / 5 /08	**ASSESSED BY:**
SURVEY REACH ID: GBST-9A	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 1844
SITE ID: (*Condition-#*) SC-1	**LAT** 41 ° 51 ' 02.6 " **LONG** 72 ° 25 ' 10.2 " **LMK**_____	**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☐ Single ☑ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☑ Other: Plast.

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 16" ~~(ft)~~
Height: ______(ft)
Culvert length: 30 (ft)
Width: 10 (ft)
Roadway elevation: 4 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

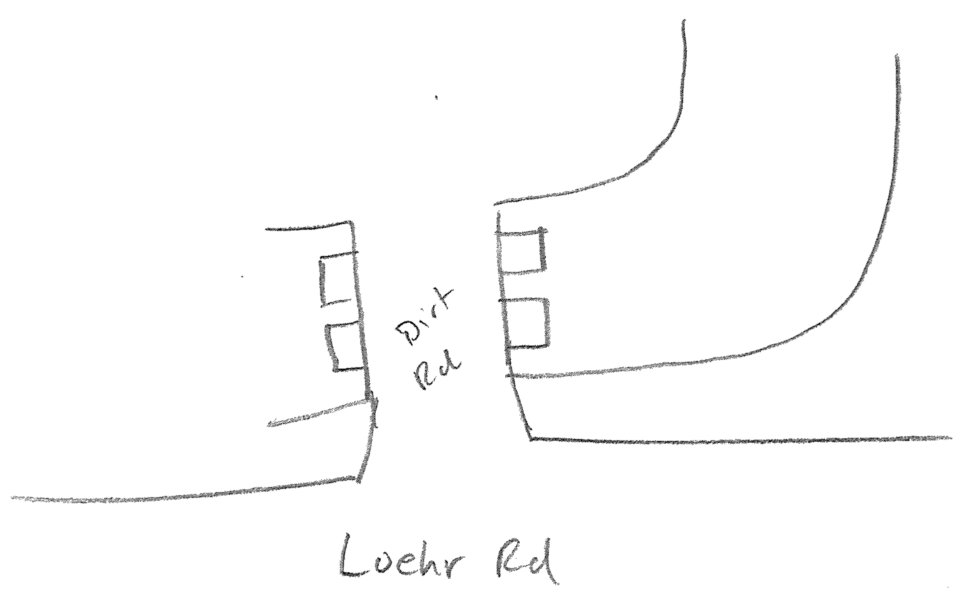
EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Gayes Bk S Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JHW
SURVEY REACH ID: GBST-9A **TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 1846-48
SITE ID: (*Condition-#*) SC- 2 **LAT** 41 ° 51 ' 00.7 " **LONG** 72 ° 25 ' 10.7 "	**LMK**_____	**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: unk (ft)
Height: unk (ft)
Culvert length: 50 (ft)
Width: unk (ft)
Roadway elevation:_____(ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

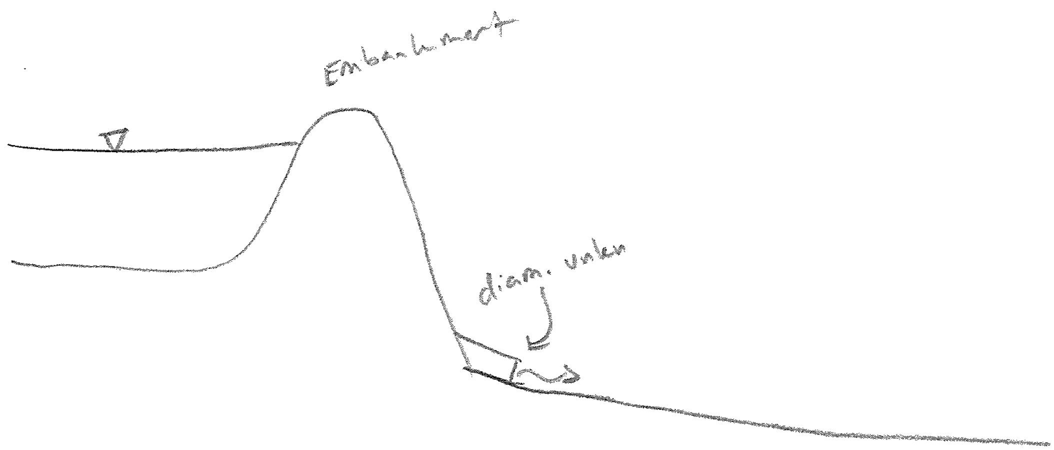
EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: _____ (in)
☐ Flow too shallow Water Depth: _____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment

RCH

SURVEY REACH ID: GBST-09b	**WTRSHD/SUBSHD:** Gages Brook South Trib	**DATE:** 6 / 5 / 08	**ASSESSED BY:**
START TIME: 3 : 45 AM/PM (PM circled) LMK: ____ LAT 41 ° 50 ' 58.7 " LONG 72 ° 25 ' 11.5 " DESCRIPTION:	*END* TIME: 4 : 22 AM/PM (PM circled) LMK: ____ LAT 41 ° 50 ' 49.5 " LONG 72 ° 25 ' 04.1 " DESCRIPTION:		GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☑ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☑ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☑ Fish ☐ Beaver ☑ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Downcutting ☐ Bed scour
☐ Widening ☑ Bank failure
☐ Headcutting ☑ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

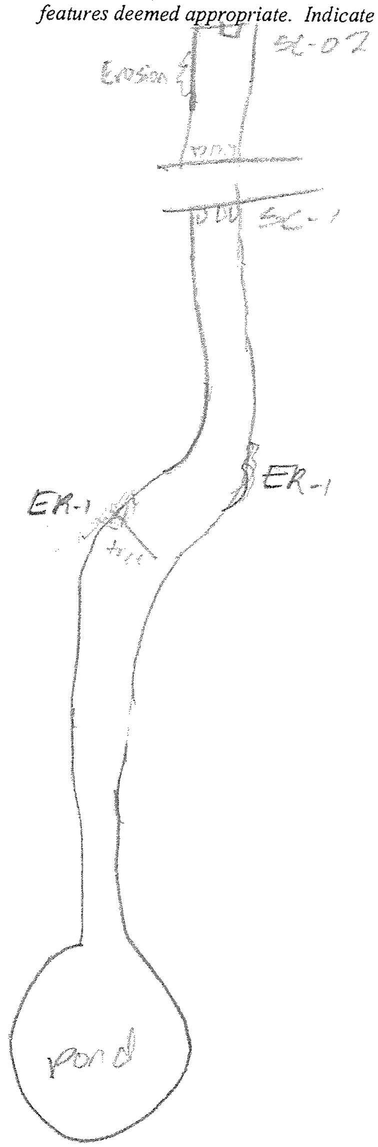
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 6 (ft)
RT bank 6 (ft)
Width: Bottom 6 (ft)
Top 18 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (circled) 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition	Optimal	Suboptimal	Marginal	Poor
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Goges Bk South Trib 6/5/08 DRB ER

GBST-09B 4:00 DBCanon 1852

ER-01 41°50' 53.8" 72° 25' 12.0"

other severe erosion 41°50'50.1" 72°25'09.7"

Bank Scour/Failure

Bank of concern: outside corner of meander

Length 2 sections 80' each

other smaller, older sections

Bot width = 8'

Top w = 25'

wetted w = 3'

Forest

Bank stabilization, grade control

No threat to property

scour height = 7 ft max

existing riparian width = 100+ ft

erosion severity = 4

Access = 1

Stream Crossing **SC**

WATERSHED/SUBSHED: Cross Brook South Trib | **DATE:** 6 / 5 / 08 | **ASSESSED BY:**

SURVEY REACH ID: GBST-02B | **TIME:** 4 : 12 AM/PM | **PHOTO ID:** (*Camera-Pic #*) Canon /# 1853

SITE ID: (*Condition-#*) SC-01 | **LAT** 41 ° 50 ' 506 " **LONG** 72 ° 25 ' 41.0 " **LMK**_____ | **GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☑ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 15 in (ft)
Height: 15 in (ft)
Culvert length: 11 (ft)
Width: 15 in (ft)
Roadway elevation: 3 (ft)

CONDITION: (*Evidence of…*) ☑ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☑ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ no ☐ Fish barrier removal ☑ Culvert repair/replacement ☐ Upstream storage retrofit ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

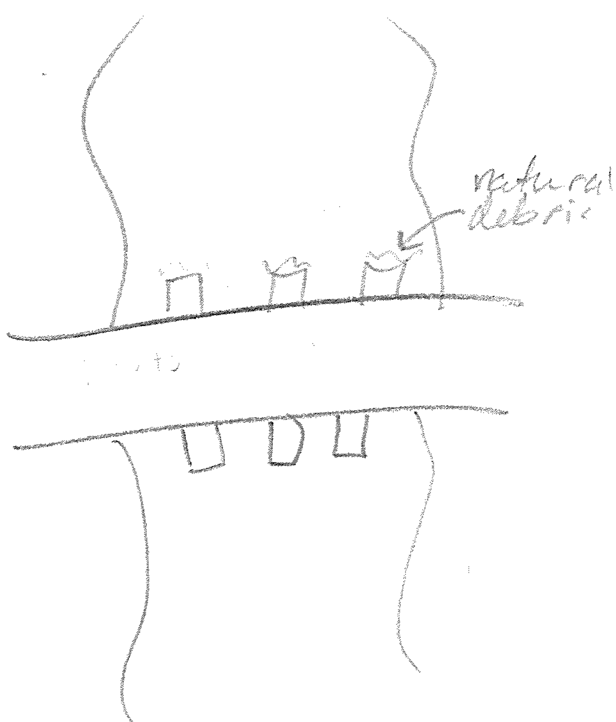
EXTENT OF PHYSICAL BLOCKAGE: ☑ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE: ☑ Drop too high Water Drop: 5 (in) ☐ Flow too shallow Water Depth:______ (in) ☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

SC Gages Brook South Trib

GBST.09B 4:15pm 6/5/06 Canon. 57-58
SC-02 Lat. 41°51'49.5" Long. 72°25'09.1"

Type: road crossing
Shape: bottomless Barrel: one material: concrete Alignment: flow al.

Dimensions:

Diameter: 24in
Culvert Lenght: 100ft
Roadway elevation: 35ft

Condition: Chipping Culvert slope: 2.5°

Restoration candidate: No

Blockage severity: 4

Water Drop: 40ft

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-01	**WTRSHD/SUBSHD:** Gages	**DATE:** 6/5/08	**ASSESSED BY:**
START TIME: 9:23 AM/PM (AM circled) LMK: ___ LAT 41° 51' 20.5" LONG 72° 25' 37.1" **DESCRIPTION:**	*END* TIME: 10:32 AM/PM LMK: ___ LAT 41° 51' 25.6" LONG 72° 25' 29.1" **DESCRIPTION:**		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☑ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☑ Fish ☐ Beaver ☑ Deer
☐ Snails ☐ Other: raccoon etc

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☑ Bank failure
☐ Headcutting ☑ Bank scour
☑ Aggrading ☐ Slope failure
☐ Sed. deposition ☑ Channelized

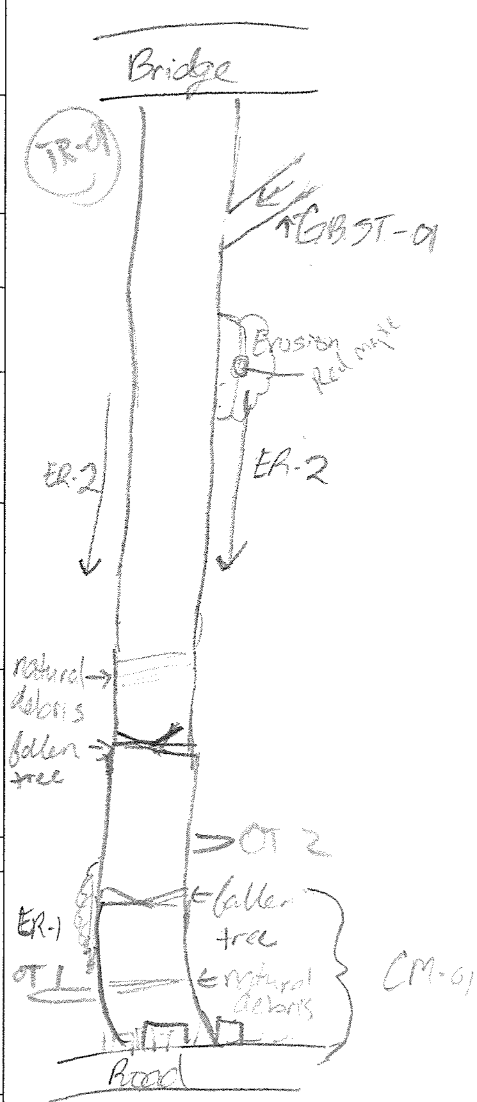
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 4 (ft)
RT bank 4 (ft)
Width: Bottom 12 (ft)
Top 20.25 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3	2 (circled) 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB, SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*
Consider making pre tributary part of GB02?

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition

	Optimal	Suboptimal	Marginal	Poor
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition

	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Trash and Debris

TR

WATERSHED/SUBSHED: Gorges	**DATE:** 6/5/08	**ASSESSED BY:**
SURVEY REACH ID: GB-01 **TIME:** 9:33 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1810	
SITE ID: (*Condition-#*) **TR-**01 **LAT** ___°___'___" **LONG** ___°___'___" **LMK** ___		**GPS:** (*Unit ID*)

Entered as Industrial

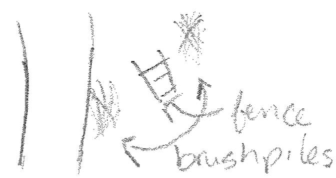
...AL:		**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
	☐ Paper ☑ Metal	☐ Unknown	☐ Stream	☑ Public ☐ Unknown
☐ Comm...	☑ Construction ☐ Medical	☐ Flooding	☐ Riparian Area	☑ Private on border
☐ Residential	☐ Appliances ☑ Yard Waste	☑ Illegal dump	☐ Lt bank	**AMOUNT** (*# Pickup truck loads*): 3
Institutional	☐ Automotive ☐ Other: sticks, brush, (wood) fence	☐ Local outfall	☑ Rt bank	

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☑ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☑ Heavy equipment ☐ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☑ No ☐ Unknown
	WHO CAN DO IT: ☑ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5	4 3	2 1

NOTES:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Channel Modification

CM

WATERSHED/SUBSHED: Conges		**DATE:** 6 / 5 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB-01	**TIME:** 10 : 18 AM/PM	**PHOTO ID:** (Camera-Pic #) Canon /# 1815	
SITE ID: (Condition-#) CM-01	*START* **LAT** 41 ° 51 ' 22.4 " **LONG** 72 ° 25 ' 37.2 " **LMK** ____		**GPS:** (Unit ID)
	END **LAT** 41 ° 51 ' 20.5 " **LONG** 72 ° 25 ' 37.1 " **LMK** ____		

TYPE: ☑ Channelization ☑ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL:			**DIMENSIONS:**
☐ Concrete ☐ Gabion	Does channel have perennial flow?	☑ Yes ☐ No	Height 7 (ft)
☑ Rip Rap ☐ Earthen	Is there evidence of sediment deposition?	☑ Yes ☐ No	Bottom Width 14 (ft)
☐ Metal	Is vegetation growing in channel?	☑ Yes ☐ No	Top Width: 32 (ft)
☐ Other:	Is channel connected to floodplain?	☐ Yes ☑ No	Length: 200 (ft)

BASE FLOW CHANNEL

Depth of flow 12 in (in)

Defined low flow channel? ☑ Yes ☐ No

% of channel bottom 89 %

ADJACENT STREAM CORRIDOR

Available width LT 100+ (ft) RT 100+ (ft)

Utilities Present? ☐ Yes ☑ No

Fill in floodplain? ☑ Yes ☐ No

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design ☑ Can't tell

☐ no ☐ De-channelization ☐ Fish barrier removal ☐ Bioengineering

CHANNEL-IZATION SEVERITY: (*Circle #*)	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3	2 1

NOTES:

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gorges	**DATE:** 6/5/08	**ASSESSED BY:** DBB
SURVEY REACH ID: GB-01 — **TIME:** 10:36 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon /# 1817	
SITE ID (*Condition-#*): OT-02 — **LAT** 41° 51' 21.1" **LONG** 72° 25' 36.9"	**LMK**_____	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [x] None [ ] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [ ] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [ ] Single [ ] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter:_____(in)

SUBMERGED: [ ] No [ ] Partially [ ] Fully

TYPE: [x] Open channel

MATERIAL: [ ] Concrete [x] Earthen [ ] Other: RIPRAP

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

DIMENSIONS: Depth: 3 ~~(in)~~ ft; Width (Top): 12 ~~(in)~~; " (Bottom): 6 ~~(in)~~

NOT APPLICABLE

CONDITION: [ ] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [x] Other: Dense veg., irreg. bottom

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [ ] None [ ] Normal [ ] Inhibited [x] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [ ] None [ ] Brown [ ] Orange [ ] Green [ ] Other: NA

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [x] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:

Length of vegetative cover from outfall: __________ft Type of existing vegetation:____________________ Slope: __________°

If yes for stormwater:

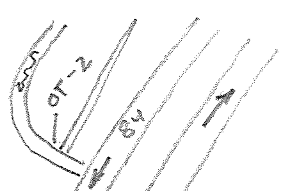
Is stormwater currently controlled? assumed — [ ] Yes [x] No [x] Not investigated

Land Use description: Transportation (RT 84)

Area available: Acres

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4 — 3	2 — 1

SKETCH/NOTES:



Note: GIS data shows GBST is the location of this ditch. In reality, GBST & GB Conflow near other end of GB-01

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Gages Bk	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JHW
SURVEY REACH ID: GB-01 — **TIME:** 10 : 25 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 1818
SITE ID (*Condition-#*): **OT-** 1 — **LAT** 41 ° 51 ' 20.9 " **LONG** 72 ° 25 ' 37.5 "	**LMK** ____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☐ None ☒ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe
- **MATERIAL:** ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:
- **SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
- **DIMENSIONS:** Diameter: ____ (in)
- **SUBMERGED:** ☐ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel
- **MATERIAL:** ☐ Concrete ☒ Earthen ☐ Other:
- **SHAPE:** ☒ Trapezoid ☐ Parabolic ☐ Other:
- **DIMENSIONS:** Depth: 6 (in) Width (Top): 36 (in) " (Bottom): 18 (in)
- NOT APPLICABLE

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☒ Other: Vegetated

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

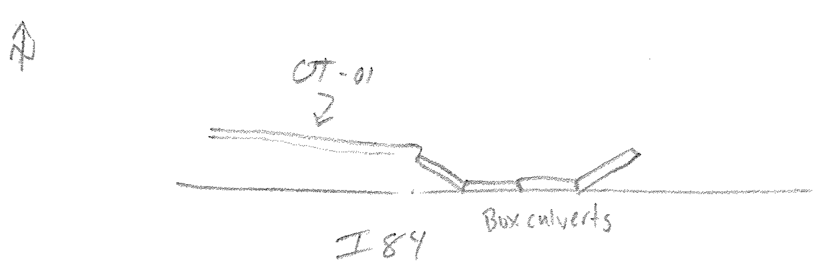
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:______________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:______________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3	2 — 1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Goges Brook		**DATE:** 6/5/08	**ASSESSED BY:** DRB
SURVEY REACH: GB-01	**TIME:** 10:00 AM/PM	**PHOTO ID** (CAMERA-PIC #): /# 1811 1812	
SITE ID: (*Condition-#*) ER- 01	*START* LAT 41° 51' 24.5" LONG 72° 25' 32.2" LMK ____ *END* LAT 41° 51' 28.6" LONG 72° 25' 34.3" LMK ____	**GPS:** (*Unit ID*)	

PROCESS: ☐ Currently unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☒ Bank failure
☐ Headcutting ☒ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☒ RT ☒ Both (*looking downstream*)
LOCATION: ☐ Meander bend ☒ Straight section ☐ Steep slope/valley wall ☐ Other:
slight meanders forming
DIMENSIONS:
Length (*if no GPS*) LT____ft and/or RT____ft
Bank Ht LT____ft and/or RT____ft
Bank Angle LT____° and/or RT____°
Bottom width 6-15 ft
Top width 10-20 ft
Wetted Width 6-12 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☐ Unknown
LAND COVER: ☒ Forest ☐ Field/Ag ☐ Developed:

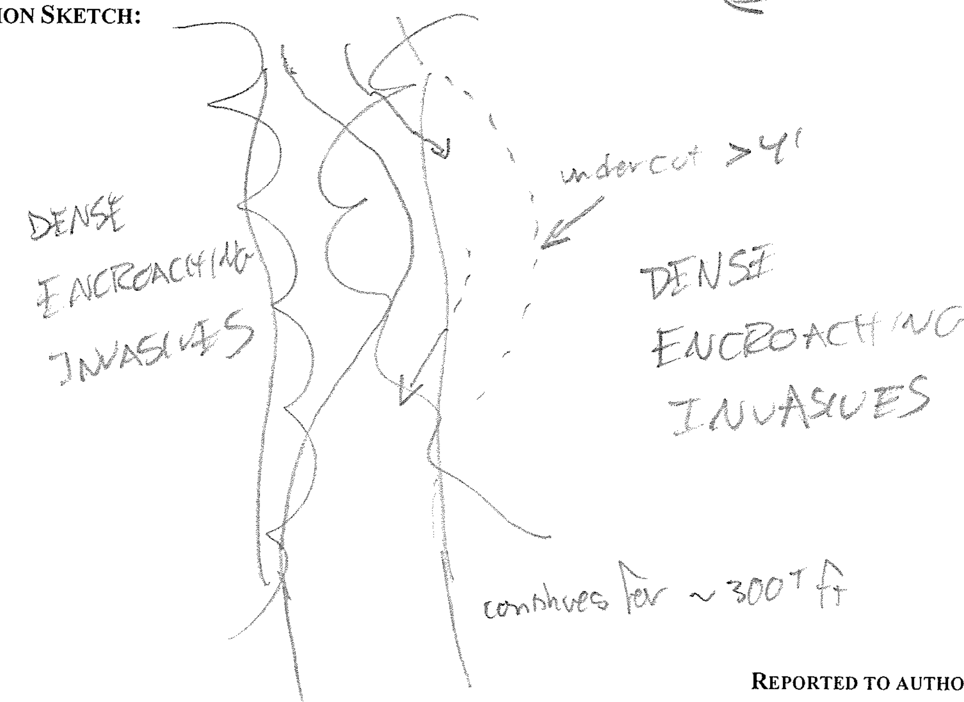
POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☒ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☒ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Gages Brook		**DATE:** 6 / 5 / 08	**ASSESSED BY:** DEB
SURVEY REACH: GB-01	**TIME:** 10 : 10 AM/PM	**PHOTO ID** (CAMERA-PIC #): DB(card)# 1815	
SITE ID: (*Condition-#*) ER-01	*START* **LAT** 41 ° 51 ' 22.4 " **LONG** 72 ° 25 ' 31.2 " **LMK** ____		**GPS:** (*Unit ID*)
	END **LAT** ___ ° ___ ' ___ " **LONG** ___ ° ___ ' ___ " **LMK** ____		

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition

☐ Bed scour ☐ Bank failure ☒ Bank scour ☐ Slope failure ☐ Channelized

BANK OF CONCERN: ☐ LT ☒ RT ☐ Both (*looking downstream*)

LOCATION: ☒ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*) LT ____ ft and/or RT 150 ft — Bottom width 10 ft

Bank Ht LT ____ ft and/or RT ____ ft — Top width 25 ft

Bank Angle LT ____ ° and/or RT ____ ° — Wetted Width 10 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☐ Unknown **LAND COVER:** ☒ Forest ☐ Field/Ag ☐ Developed:

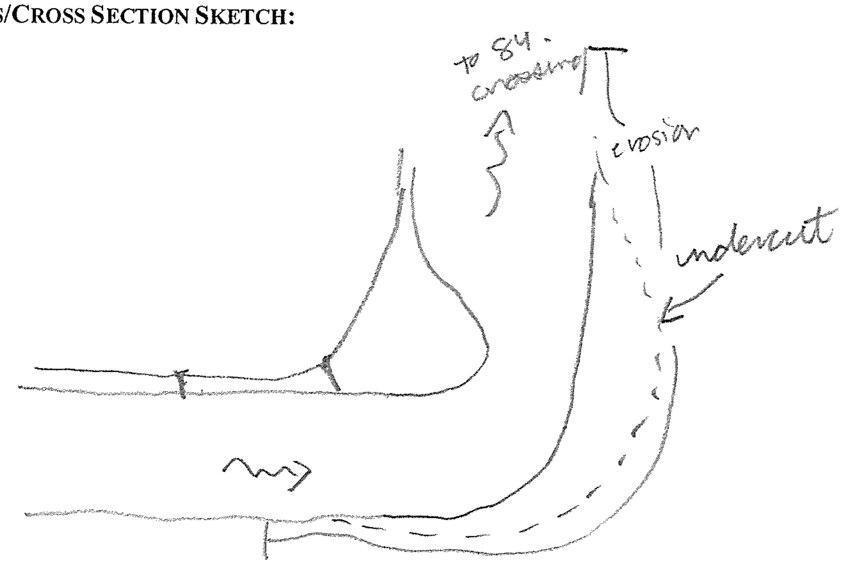
POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☒ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☒ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 — 4	3 — 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 — 4	3 — 2	1

NOTES/CROSS SECTION SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-02	**WTRSHD/SUBSHD:** Gates Brook	**DATE:** 6/3/08	**ASSESSED BY:** TEAM (ALL)
START **TIME:** 10:30 AM/PM **LMK:** ___ **LAT** 41° 51' 26.1" **LONG** 72° 25' 29.4" **DESCRIPTION:** FOOTBRIDGE @ TAC		*END* **TIME:** ___:___ AM/PM **LMK:** ___ **LAT** 41° 51' 32.9" **LONG** 72° 25' 24.2" **DESCRIPTION:** BARB WIRE FENCE	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☒ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: WETLAND

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☒ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE GRAVEL/ COBBLE IN SOME PLACES
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10") ☒ Sand (gritty) ☐ Boulder (>10") ☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☐ some ☒ lots
Floating: ☐ none ☐ some ☒ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☒ Deer ☐ Snails ☐ Other: Racoon, Birds, Songs

STREAM SHADING (water surface) ☒ Mostly shaded (≥75% coverage) ☐ Halfway (≥50%) ☐ Partially shaded (≥25%) ☐ Unshaded (< 25%)

CHANNEL DYNAMICS ☐ Unknown ☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☒ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2 (ft)
RT bank 2 (ft)
Width: Bottom 6 (ft)
Top 10 (ft)

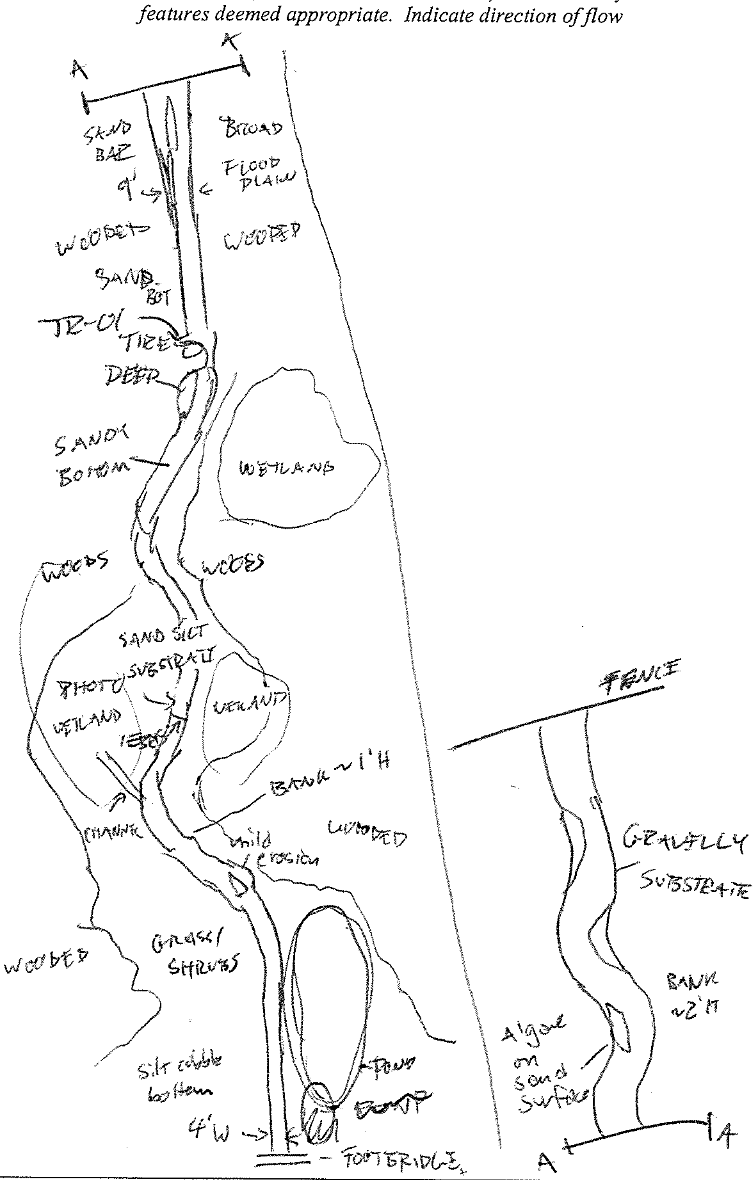
REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

2 circled.

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Trash and Debris

TR

WATERSHED/SUBSHED: Gages Brook	**DATE:** 6 / 3 / 08	**ASSESSED BY:** DRB
SURVEY REACH ID: GB-02	**TIME:** 11 : 11 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 1708
SITE ID: (*Condition-#*) TR- 01	**LAT** 41 ° 51 ' 28.8 " **LONG** 72 ° 25 ' 22.8 " **LMK** ____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**			**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial	☐ Plastic	☐ Paper	☐ Metal	☐ Unknown	☒ Stream	☐ Public ☐ Unknown
☐ Commercial	☒ Tires	☐ Construction	☐ Medical	☒ Flooding	☐ Riparian Area	☒ Private
☒ Residential	☐ Appliances	☐ Yard Waste		☒ Illegal dump	☐ Lt bank	**AMOUNT** (*# Pickup truck loads*): 1 load
	☒ Automotive	☐ Other:		☐ Local outfall	☐ Rt bank	

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☒ no ☒ Other: Could be cleaned in ~1 hr w/ 1-2 people

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☒ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:**
	WHO CAN DO IT: ☒ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	☐ Yes ☒ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access		A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5	4	3	2	1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-03A	**WTRSHD/SUBSHD:** Gages	**DATE:** 6 / 3 / 08	**ASSESSED BY:**
START TIME: 12 : 18 AM/PM LMK: 0 LAT 41 ° 51 ' 32.9 " LONG 72 ° 25 ' 24.2 " DESCRIPTION: BARB WIRE FENCE	*END* TIME: 1 : 20 AM/PM LMK: ______ LAT 41 ° 51 ' 32.7 " LONG 75 ° 25 ' 12.9 " DESCRIPTION: END AT DOUBLE CULVERT		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☑ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☑ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☑ Other: OLD FIELD

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☒ 75-100%

DOMINANT SUBSTRATE parent clay exposed
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☑ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☒ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) Raccoon / American Toad
☑ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other: songbirds

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☒ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☒ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

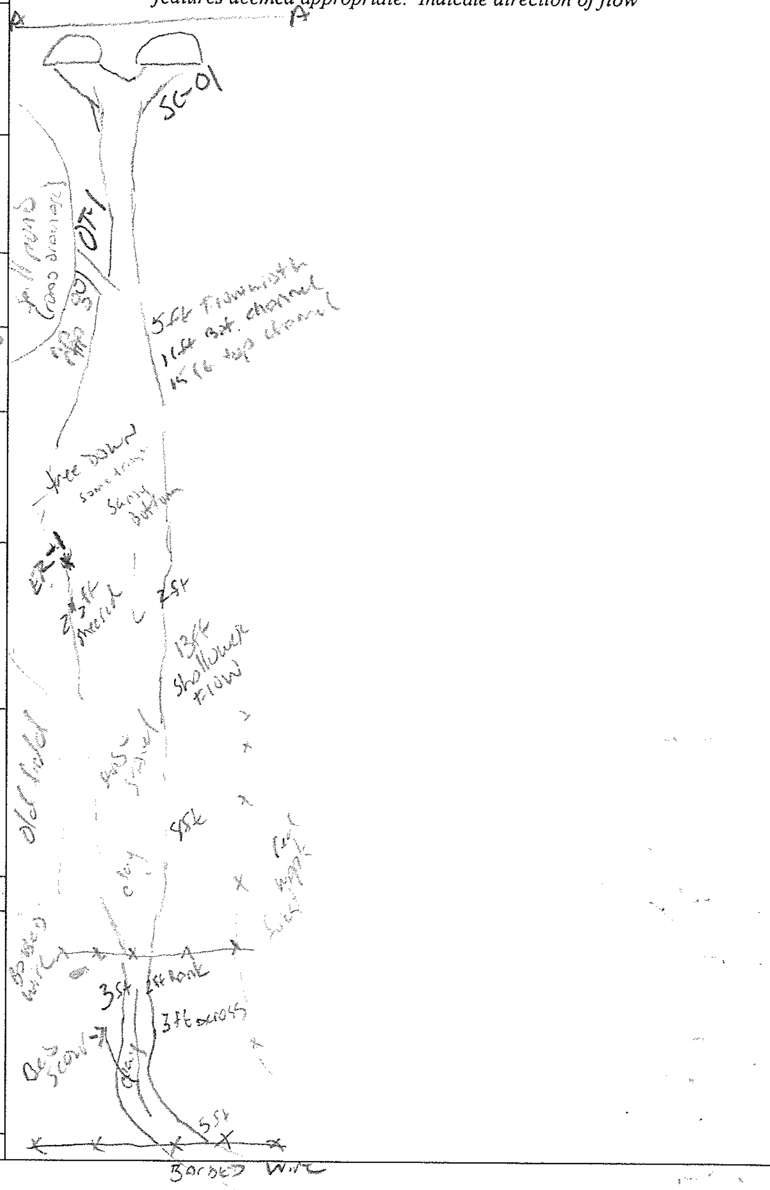
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.75 (ft)
RT bank 2.0 (ft)
Width: Bottom 8-9 (ft)
Top 11 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.		Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5	④	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB, SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Gages		**DATE:** 6 / 3 / 08	**ASSESSED BY:**
SURVEY REACH: GB-03A	**TIME:** 12 : 30 AM/PM	**PHOTO ID** (CAMERA-PIC #): 17/11 /#	
SITE ID: (*Condition-#*) **ER-** 01	*START* **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___		**GPS:** (*Unit ID*)
	END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___		

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☒ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☒ RT ☐ Both (*looking downstream*)
LOCATION: ☐ Meander bend ☒ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT ____ ft	and/or RT 100 ft	Bottom width ____ ft
Bank Ht	LT ____ ft	and/or RT 3 ft	Top width ____ ft
Bank Angle	LT ____ °	and/or RT 60 °	Wetted Width ____ ft

LAND OWNERSHIP: ☐ Private ☐ Public ☒ Unknown **LAND COVER:** ☒ Forest LT ☒ Field/Ag RT ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☒ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gorges	**DATE:** 6 / 3 / 05	**ASSESSED BY:**
SURVEY REACH ID: 63.03A — **TIME:** 12 : 55 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1715	
SITE ID (*Condition-#*): OT-____ — **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____		**GPS:** (*Unit ID*)

BANK: [ ] LT [x] RT [ ] Head

FLOW: [ ] None [x] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [ ] Closed pipe / [x] Open channel

MATERIAL: [ ] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:
no pipe visible
[ ] Concrete [ ] Earthen [x] Other: RipRap

SHAPE: [ ] Single [ ] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:
[ ] Trapezoid possibly has this shape [ ] Parabolic [ ] Other:

DIMENSIONS: Diameter:____(in)
Depth: 1.5 ~~(in)~~ ft
Width (Top): 30 ~~(in)~~ ft
" (Bottom): 16.5 ~~(in)~~ ft

SUBMERGED: [ ] No [ ] Partially [ ] Fully
NOT APPLICABLE

CONDITION: [ ] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [x] Other: Vegetated

ODOR: [ ] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [x] Sulfide [ ] Other:

DEPOSITS/STAINS: [ ] None [ ] Oily [ ] Flow Line [ ] Paint [x] Other:

VEGGIE DENSITY: [ ] None [x] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[x] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[x] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[x] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [x] Other: Vegetation in RipRap

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [x] Local stream repair/outfall stabilization
[ ] no [ ] Storm water retrofit [x] Other: Floatables Control? trash clean-up

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______°

If yes for stormwater:
Is stormwater currently controlled? Land Use description:______________
[ ] Yes [ ] No [ ] Not investigated Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Gores		**DATE:** 6 / 3 / 08	**ASSESSED BY:** Team
SURVEY REACH ID: GB03A	**TIME:** 1 : 05 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC- 01	**LAT** 41° 51 ' 32.7 " **LONG** 75 ° 25 ' 17.9 " **LMK**_____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☑ Arch ☐ Box ☐ Circular ☐ Other: ☐ Bottomless ☑ Elliptical

 # BARRELS: ☐ Single ☑ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☑ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 7 ft (ft)
Height: 48 in (ft)
Culvert length: 75-100 (ft)
Width: 7 (ft)
Roadway elevation: 14 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☑ Other (*describe*): rusting

CULVERT SLOPE: ☑ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☑ Other: lack of depth for flow

IS SC ACTING AS GRADE CONTROL ☐ No ☑ Yes ☐ Unknown

If yes for fish barrier

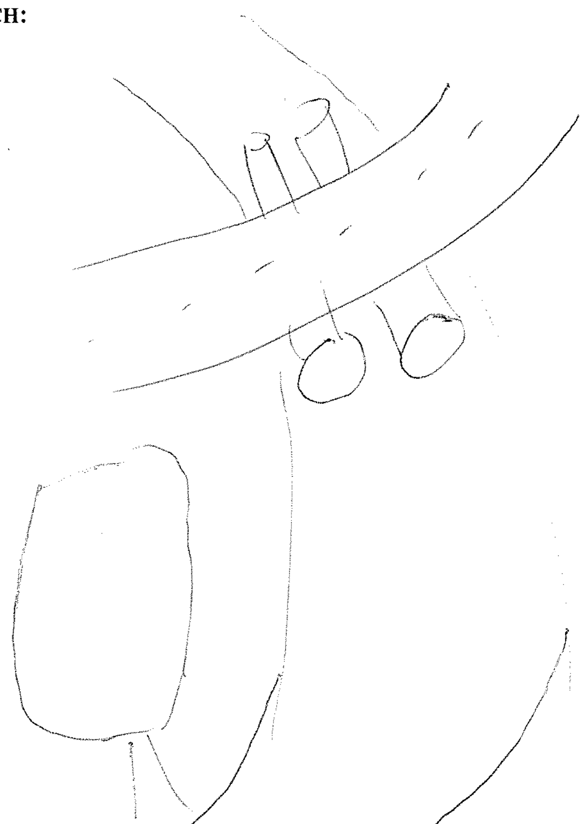
EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☑ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ____ (in)
☑ Flow too shallow Water Depth: 1.5 (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-03B	**WTRSHD/SUBSHD:** Gages Bk	**DATE:** 6 / 3 / 08	**ASSESSED BY:** DB JW SM
START TIME: 3 : 13 AM/PM (PM circled) LMK: ____ LAT 41 ° 51 ' 32.7 " LONG 72 ° 25 ' 12.9 " DESCRIPTION: SC-01 (GB-03A)		*END* TIME: 4 : 06 AM/PM LMK: ____ LAT 41 ° 51 ' 37.5 " LONG 72 ° 25 ' 14.5 " DESCRIPTION: SC-01 (GB-3B)	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☒ Industrial ☒ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☑ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Sand (gritty) ☑ Gravel (0.1-2.5") ☑ Cobble (2.5 –10") ☐ Boulder (>10") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☑ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☑ Fish ☐ Beaver ☐ Deer ☐ Snails ☐ Other: racoon songbirds

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition
☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☑ Channelized

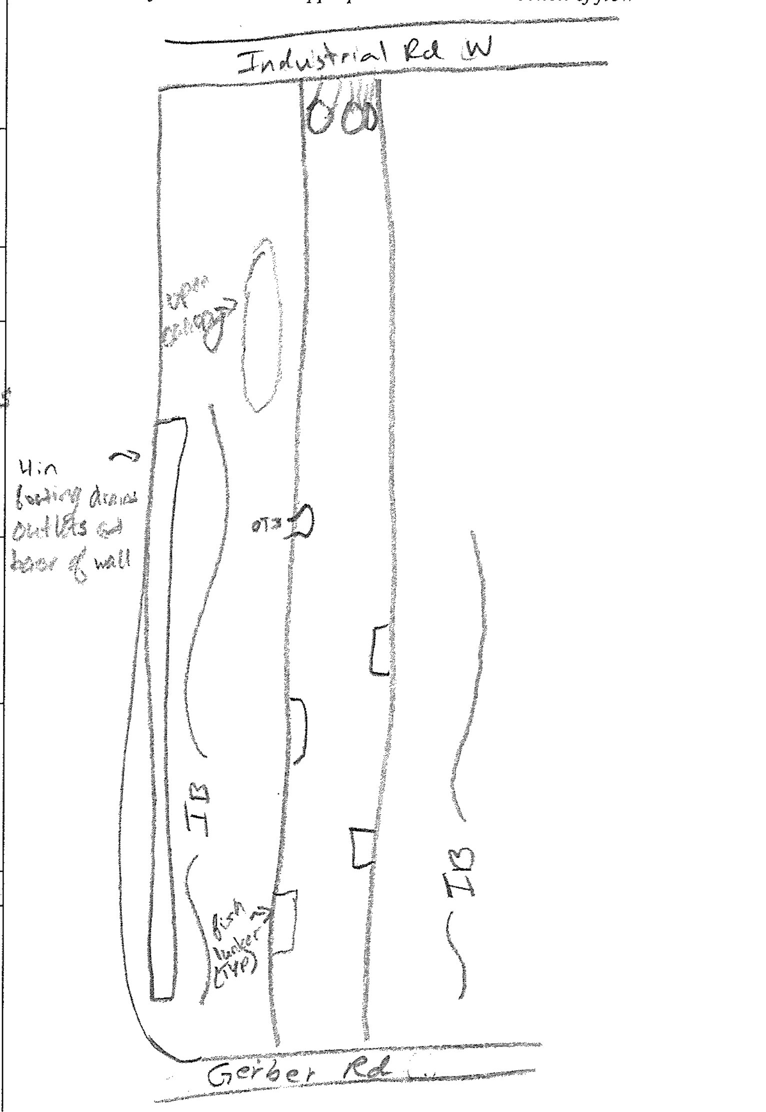
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.5 (ft)
RT bank 1.5 (ft)
Width: Bottom 4 (ft)
Top 12 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4 (circled)	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*
Channelization, impacted buffer + trash

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Goggs Bk		**DATE:** 6 / 3 / 08	**ASSESSED BY:** DEB
SURVEY REACH ID: GB-03B	**TIME:** 3 : 40 AM/(PM)	**PHOTO ID:** (*Camera-Pic #*) /# 1724	
SITE ID (*Condition-#*): OT-02	**LAT** 41 ° 51 ' 31.9 " **LONG** 72 ° 25 ' 16.1 " **LMK**____		**GPS:** (*Unit ID*) DEB GARVIN

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe — **MATERIAL:** ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other: — **SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other: — **DIMENSIONS:** Diameter:____ (in) — **SUBMERGED:** ☐ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel — **MATERIAL:** ☐ Concrete ☐ Earthen ☒ Other: ASPHALT — **SHAPE:** ☐ Trapezoid ☒ Parabolic ☐ Other: — Depth: 4 (in) Width (Top): 3 (in) " (Bottom):____ (in) — NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☒ Other: LEAVES & TRASH

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☒ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

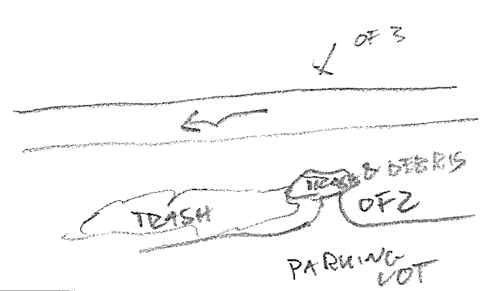
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other: TRASH REMOVAL

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☒ No ☒ Not investigated
Land Use description: INDUSTRIAL PARKING LOT
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 (2)	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Grages Bk	**DATE:** 6 / 3 / 06	**ASSESSED BY:** DEB
SURVEY REACH ID: GS-03B **TIME:** 3 : 25 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon /# 1722	
SITE ID (*Condition-#*): OT-01	**LAT** 41 ° 51 ' 37.1 " **LONG** 72 ° 25 ' 17.3 " **LMK** ____	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [x] None [ ] Trickle [ ] Moderate [ ] Substantial [x] Other: WET

TYPE: [x] Closed pipe

MATERIAL: [x] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [ ] Single [x] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 12 (in)

SUBMERGED: [x] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [x] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [x] Green [x] Other: MOSS

POOL QUALITY: [ ] No pool [x] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

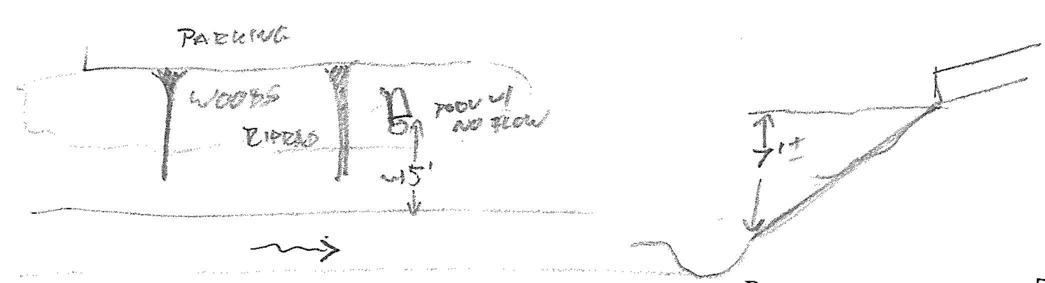
POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [ ] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ________ °

If yes for stormwater:
Is stormwater currently controlled? [ ] Yes [ ] No [x] Not investigated
Land Use description: Industrial parking lot
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: [ ] YES [x] NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED:		DATE: 6 / 3 / 08	ASSESSED BY: Team
SURVEY REACH ID: GB-3B	TIME: 3 : 40 AM/PM	PHOTO ID: (Camera-Pic #) 1725 /#	
SITE ID (Condition-#): OT- 3	LAT 41° 51 ' 352" LONG 72° 25 ' 16.3" LMK____		GPS: (Unit ID)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 24 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____(in) Width (Top):____(in) " (Bottom):____(in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☑ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☑ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☑ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:______________ Slope: ______°

If yes for stormwater:

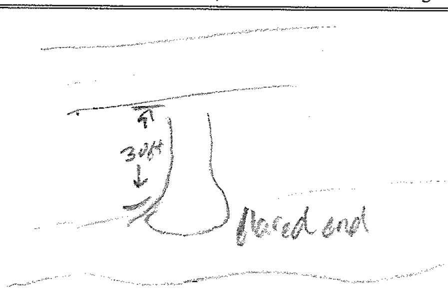
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:____________________

Area available:

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED: Gages Brook		**DATE:** 6 / 5 / 08	**ASSESSED BY:** DRB
SURVEY REACH: GB - 03B	**TIME:** 3 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1719, 1720	
SITE ID: (*Condition-#*) IB- 01	*START* LAT ___° ___' ___" LONG ___° ___' ___" LMK ___ *END* LAT ___° ___' ___" LONG ___° ___' ___" LMK ___		**GPS:** (*Unit ID*) DB GARVIN

IMPACTED BANK: ☐ LT ☐ RT ☒ Both

REASON INADEQUATE: ☐ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☒ Other: Retaining wall ~8' from RT BANK

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☒ : INDUSTRIAL
RT Bank	☐	☐	☐	☐	☒ : INDUSTRIAL

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☒	☒ : RIPRAP
RT Bank	☐	☐	☐	☐	☒	☒	☒ : Retaining wall

INVASIVE PLANTS: ☐ None ☐ Rare ☒ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☒ Full

WETLANDS PRESENT? ☐ No ☒ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☐ Greenway design ☐ Natural regeneration ☒ Invasives removal ☒ no LOW QUALITY CANDIDATE ☒ Other: FISH REFUGE ALREADY PROVIDED

RESTORABLE AREA

	LT (BANK)	RT
Length (ft):	~400'	~100-200'
Width (ft):	~20'	10-15'

REFORESTATION POTENTIAL: (*Circle #*)

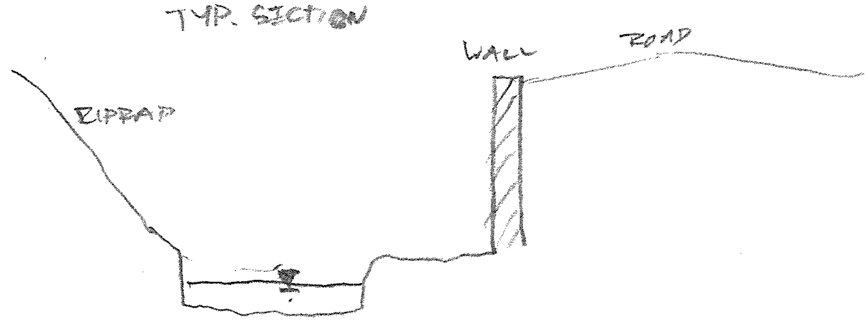
Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	**(2)**	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☒ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

TYP. SECTION

(facing U/S)



Stream Crossing **SC**

WATERSHED/SUBSHED:		DATE: 6 / 3 / 08	ASSESSED BY: Team
SURVEY REACH ID: GB-3B	TIME: 3 : 53 AM/PM	PHOTO ID: (Camera-Pic #) 1727 /#	
SITE ID: (Condition-#) SC- 1	LAT 41 ° 51 ' 375 " LONG 72 ° 25 ' 145 " LMK____		GPS (Unit ID)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

BARRELS: ☐ Single ☐ Double ☑ Triple ☐ Other:

MATERIAL: ☐ Concrete ☑ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 6 ft (ft)
Height: 6 ft (ft)
Culvert length: 50 (ft)
Width: 6 ft (ft)
Roadway elevation: 10 (ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☑ Other (*describe*): lining off bottom, some rusting

CULVERT SLOPE: ☑ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☑ Partial
☐ Temporary ☐ Unknown

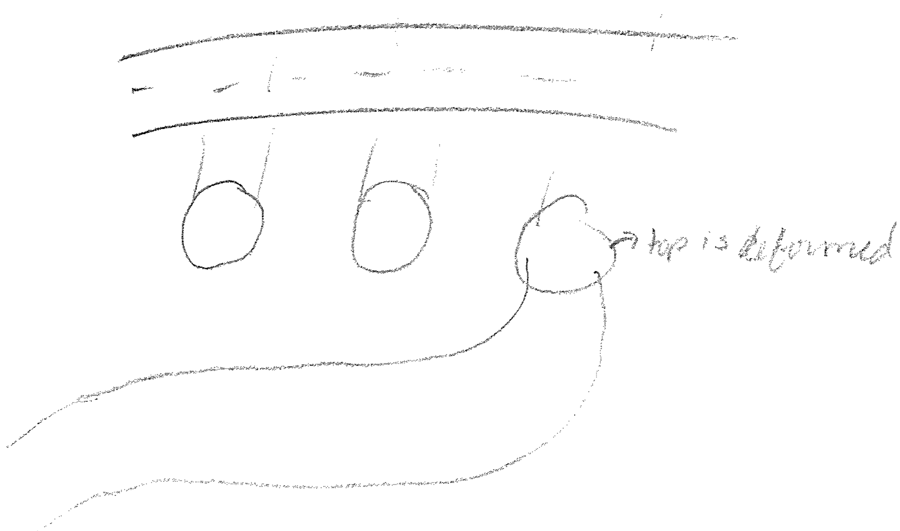
CAUSE:
☐ Drop too high Water Drop: ______ (in)
☑ Flow too shallow Water Depth: 4 (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-4	**WTRSHD/SUBSHD:** Gages Brook	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Team
START **TIME:** 7 : 10 AM/PM (AM circled) **LMK:** ____ **LAT** 41 ° 55 ' 58.9 " **LONG** 72 ° 20 ' 48.9 " **DESCRIPTION:**	*END* **TIME:** 7 : 45 AM/PM (AM circled) **LMK:** ____ **LAT** 41 ° 51 ' 43.8 " **LONG** 72 ° 25 ' 11.1 " **DESCRIPTION:** Photo 1738		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☒ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☒ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☒ Industrial ☒ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☒ Fish ☐ Beaver ☐ Deer ☐ Snails ☒ Other: racoon, song birds

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Unknown ☒ Aggrading ☐ Slope failure
☐ Sed. deposition ☒ Channelized

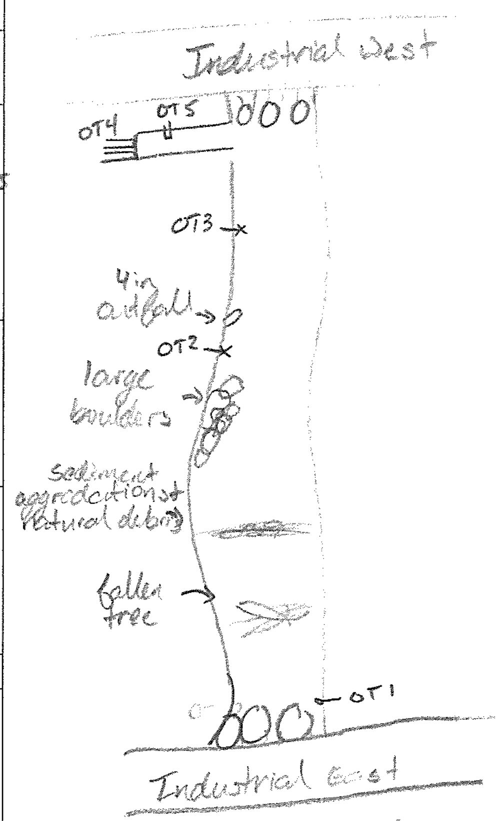
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2 (ft)
RT bank 3 (ft)
Width: Bottom 10 (ft)
Top 18 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4 (circled)	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls

OT

WATERSHED/SUBSHED: GB-04 Gays BK **DATE:** 6 / 4 / 08 **ASSESSED BY:** DRB

SURVEY REACH ID: GB-04 **TIME:** 7 : 10 AM/PM **PHOTO ID:** (*Camera-Pic #*) DB Camera /# 1728 1730

SITE ID (*Condition-#*): **OT-** 01 **LAT** 46 ° 55 ' 58.9 " **LONG** 12 ° 20 ' 48.9 " **LMK** ____ **GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☒ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 8 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☒ Other: Ditch discharge

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☒ Other: None

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☒ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

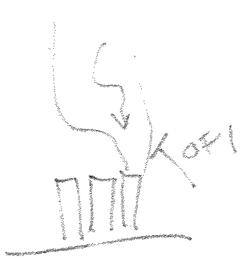
Is stormwater currently controlled? ☐ Yes ☐ No ☒ Not investigated

Land Use description: Industrial / Roadway

Area available: ON EMBANKMENT OR Manhole retrofit

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



viewed culvert at end of day yesterday
had no dry weather
flow

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED:	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB - 4 **TIME:** 7 : 30 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): **OT-** 2 **LAT** 41 ° 51 ' ___ "	**LONG** 72 ° 25 ' 12.2 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☑ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 6 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☑ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: GAGES BK	**DATE:** 6 / 4 / 08	**ASSESSED BY:** TRR
SURVEY REACH ID: GB-04 **TIME:** 7 : 30 AM/PM	**PHOTO ID:** (*Camera-Pic #*) NB CAN ## 1736	
SITE ID (*Condition-#*): **OT-** 03 **LAT** 41 ° 51 ' 42.8 " **LONG** 72 ° 25 ' 11.9 " **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe | ☐ Open channel

MATERIAL: ☐ Concrete ☐ Metal ☒ PVC/Plastic ☐ Brick ☐ Other: | ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other: | ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Diameter: 18 (in) | Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully | NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☒ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☒ Other: SED. IN STREAM D.S.

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☒ Bank Erosion ☒ Other: SLIGHT SEDIMENTATION

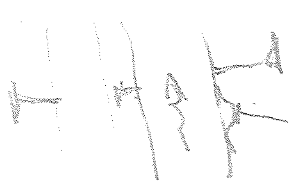
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☒ Local stream repair/outfall stabilization ☐ no SLIGHT → ☒ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ____ ft Type of existing vegetation: ____ Slope: ____ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☒ Not investigated
Land Use description: Industrial / Road
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



Dry weather discharge status unknown

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: GAGES BK	**DATE:** __/__/__	**ASSESSED BY:**
SURVEY REACH ID: GB-04 **TIME:** __:__ AM/PM	**PHOTO ID:** (*Camera-Pic #*) Dresbaum /# 1726	
SITE ID (*Condition-#*): OT-04A **LAT** 41° 51' 36.2" **LONG** 72° 25' 15.0"	**LMK** ____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 12 (in) FLARED END

SUBMERGED: ☐ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ___ (in) Width (Top): ___ (in) " (Bottom): ___ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☒ Other: SEDIMENT

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☒ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☒ Other: LEAVES

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: _____ ft Type of existing vegetation: _____ Slope: ____ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☒ No ☐ Not investigated

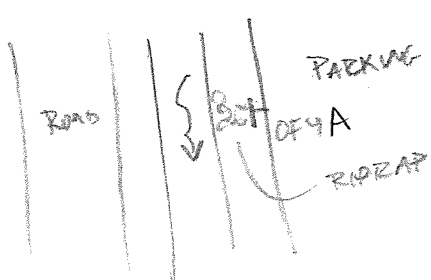
Land Use description: Industrial

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5	4	3	2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: GB	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB-04 / **TIME:** 7:45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DBCam /# 1737, 1759	
SITE ID (*Condition-#*): OT- 4B / **LAT** 41° 51 ' 43.8 " **LONG** 72° 25 ' 11.1 "	**LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☒ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☒ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 42 (in)

SUBMERGED: ☐ No ☒ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☒ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

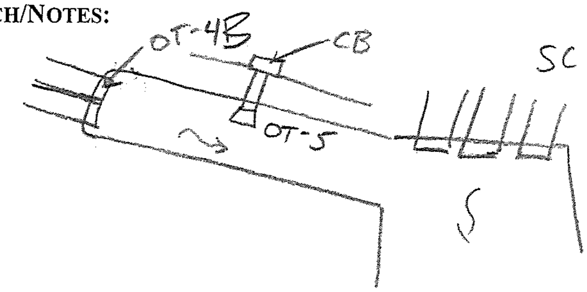
POTENTIAL RESTORATION CANDIDATE ☒ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ______ ft Type of existing vegetation: __________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description: __________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4 3	2 1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED:	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB-04 · **TIME:** 7 : 45 AM/PM	**PHOTO ID:** *(Camera-Pic #)* DBCowan /# 1739	
SITE ID *(Condition-#)*: **OT-** 5 · **LAT** 41° 51' 43.8" **LONG** 72° 85' 11.1"	**LMK**____	**GPS:** *(Unit ID)*

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☒ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 24 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ______ ft Type of existing vegetation: __________ Slope: ______ °

If yes for stormwater:

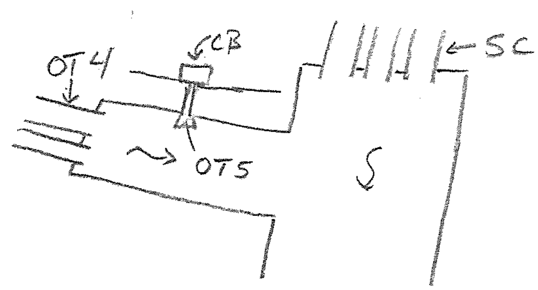
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: __________

Area available:

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Gorges	**DATE:** 6 / 4 / 08	**ASSESSED BY:** DB
SURVEY REACH ID: GB-04 **TIME:** 7 : 45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DR Canon /# 1738	
SITE ID: (*Condition-#*) SC- 01 **LAT** 41 ° 51 ' 43.8 " **LONG** 72 ° 25 ' 11.1 " **LMK**_____		**GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☒ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☒ Triple ☐ Other:

MATERIAL: ☐ Concrete ☒ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 70 in (ft)
~~Height:~~ _______ (ft)
Culvert length: 50-60 (ft)
Width: _______ (ft)
Roadway elevation: 11 (ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☒ Sediment deposition ☐ Failing embankment
☒ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☒ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☒ Partial
☒ Temporary ☐ Unknown
leaves, branches, sediment blockage of 2 of the 3 barrels
CAUSE:
☐ Drop too high Water Drop: ______ (in)
☒ Flow too shallow Water Depth: 6-12 (in)
☐ Other:

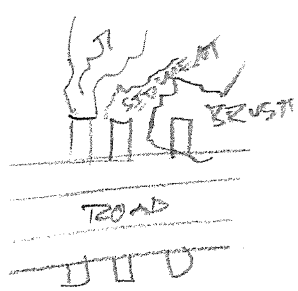
BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

Note: wet weather flow making stream deeper



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

Survey Reach ID: GB-05A	**Wtrshd/Subshd:** Gages Bk	**Date:** 6 / 4 / 08	**Assessed by:** Kem
Start Time: 9 : 00 AM/PM (AM circled) LMK: ___ Lat 41° 51' 43.9" Long 72° 25' 11.2" Description:		*End* Time: 9 : 25 AM/PM (AM circled) LMK: ___ Lat 41° 51' 44.4" Long 72° 25' 07.2" Description:	**GPS ID:**

Rain in last 24 hours ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

Present conditions ☐ Heavy rain ☑ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

Surrounding land use: ☑ Industrial ☑ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☑ Other: field

Average Conditions *(check applicable)*

Base Flow as % Channel Width ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

Dominant Substrate
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

Water Clarity ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

Aquatic Plants in Stream Attached: ☐ none ☑ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

Wildlife in or Around Stream (Evidence of) ☑ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other:

Stream Shading (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

Channel Dynamics
☐ Unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☑ Bank scour
☑ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

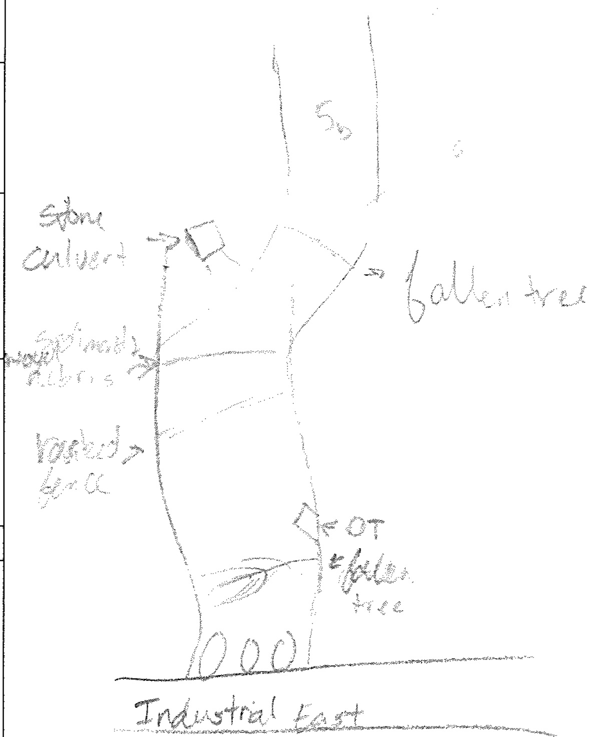
Channel Dimensions *(Facing downstream)*
Height: LT bank 3.5 (ft)
RT bank 3.5 (ft)
Width: Bottom 7 (ft)
Top 15 (ft)

Reach Accessibility

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (circled) 2	1

Reach Sketch and Site Impact Tracking

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



Notes: *(biggest problem you see in survey reach)*

none

Reported to authorities ☐ Yes ☐ No

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: GAGES BK		**DATE:** 6 / 4 / 09	**ASSESSED BY:** DRB
SURVEY REACH ID: GB-05A	**TIME:** 9 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DRC mon/# 1741	
SITE ID (*Condition-#*): OT- 01	**LAT** __ ° __ ' see photo 109 " **LONG** __ ° __ ' __ "	**LMK** ___	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [ ] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [x] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [x] Single [x] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 12 (in)

SUBMERGED: [ ] No [x] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

Depth: ___ (in) Width (Top): ___ (in) " (Bottom): ___ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [ ] None [ ] Oily [ ] Flow Line [ ] Paint [x] Other: BUBBLES

VEGGIE DENSITY: [ ] None [x] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [ ] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [x] Other: BUBBLES

FOR FLOWING ONLY		
	COLOR:	[x] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[x] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[x] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [x] Other: Some sediment

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [x] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:

Length of vegetative cover from outfall: ___ ft Type of existing vegetation: ___ Slope: ___ °

If yes for stormwater:

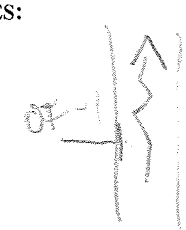
Is stormwater currently controlled? [ ] Yes [ ] No [x] Not investigated

Land Use description: Industrial

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



minor wet weather discharge

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Reach Level Assessment

RCH

SURVEY REACH ID: GB-05B	**WTRSHD/SUBSHD:** Goffes Blk	**DATE:** 6 / 4 / 08	**ASSESSED BY:**

START TIME: 2 : 10 AM/PM (PM circled) LMK: ____ LAT 41 ° 51 ' 44.9 " LONG 72 ° 25 ' 06.3 " DESCRIPTION: Photo 1767	*END* TIME: 2 : 45 AM/PM (PM circled) LMK: ____ LAT 41 ° 51 ' 51.5 " LONG 72 ° 25 ' 02.5 " DESCRIPTION:	GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☑ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☑ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☑ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☑ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Bed scour
☑ Widening ☑ Bank failure
☐ Headcutting ☑ Bank scour
☐ Aggrading ☑ Slope failure
☐ Sed. deposition ☐ Channelized

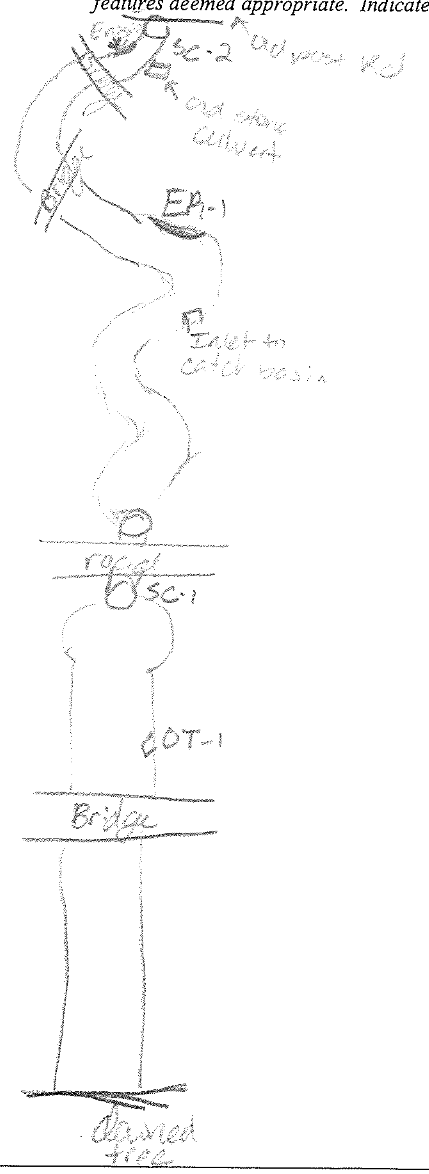
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.5 (ft)
RT bank 2.5 (ft)
Width: Bottom 3.5 (ft)
Top 12 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5	4 3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION

	Optimal	Suboptimal	Marginal	Poor
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION

	Optimal	Suboptimal	Marginal	Poor
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gages Bk		**DATE:** 6/4/08	**ASSESSED BY:** DRB
SURVEY REACH ID: GB-05B	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon /# 1768	
SITE ID (*Condition-#*): OT-01	**LAT** 41° 57' 45.2" **LONG** 72° 25' 06.3" **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☐ Head

FLOW: ☐ None [X] Trickle ☐ Moderate ☐ Substantial [X] Other: Very slight

TYPE: [X] Closed pipe

MATERIAL: ☐ Concrete ☐ Metal [X] PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single [X] Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 8 (in)

SUBMERGED: [X] No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [X] None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: [X] No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily [X] Flow Line ☐ Paint [X] Other: Mildew mold

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited [X] Excessive ☐ Other:

PIPE BENTHIC GROWTH: [X] None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: [X] No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown [X] Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	[X] None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque Difficult to tell due to low Q
	FLOATABLES:	[X] None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) [X] Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance [X] Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting [X] Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? [X] Yes ☐ No ☐ Not investigated

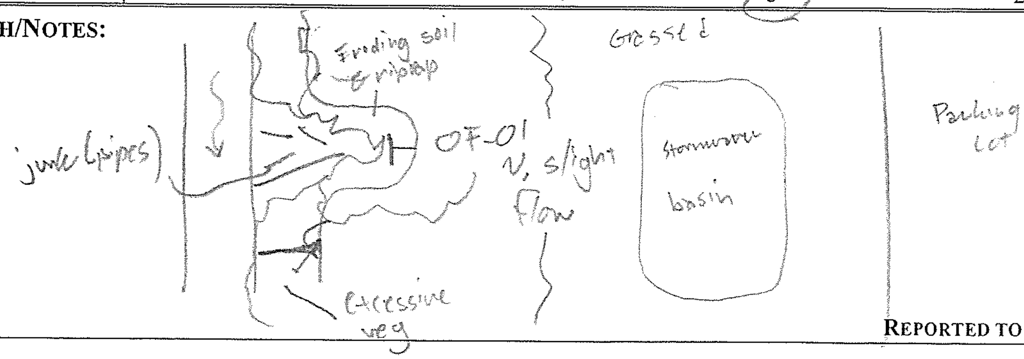
Land Use description: Commercial/Industrial (software co.)

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5 4	3 2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES [X] NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: GAGES BK		**DATE:** 6 / 4 / 08	**ASSESSED BY:** DEB
SURVEY REACH: GB-05B	**TIME:** 2:20 AM/PM	**PHOTO ID** (CAMERA-PIC #): DB Canon/# 1774	
SITE ID: (*Condition-#*) ER- 01	*START* LAT 41 ° 51 ' 46.7 " LONG 72 ° 25 ' 04.3 " LMK ____		**GPS:** (*Unit ID*)
	END LAT 41 ° 51 ' 49.2 " LONG 72 ° 25 ' 04.3 " LMK ____		

PROCESS: ☐ Currently unknown
☐ Downcutting
☒ Widening
☐ Headcutting
☐ Aggrading
☐ Sed. deposition
☐ Bed scour
☐ Bank failure
☒ Bank scour erosion
☒ Slope failure
☐ Channelized

BANK OF CONCERN: ☒ LT ☐ RT ☐ Both (*looking downstream*)
LOCATION: ☒ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:
DIMENSIONS:
Length (*if no GPS*) LT____ft and/or RT____ft — Bottom width 3 ft
Bank Ht LT 5.5 ft and/or RT 2 ft — Top width 8 ft
Bank Angle LT____° and/or RT____° — Wetted Width 3.5 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☐ Unknown
LAND COVER: ☐ Forest ☐ Field/Ag ☒ Developed: GRASSED BLDG GROUNDS (LANDSCAPED, PRIVATE PARK)

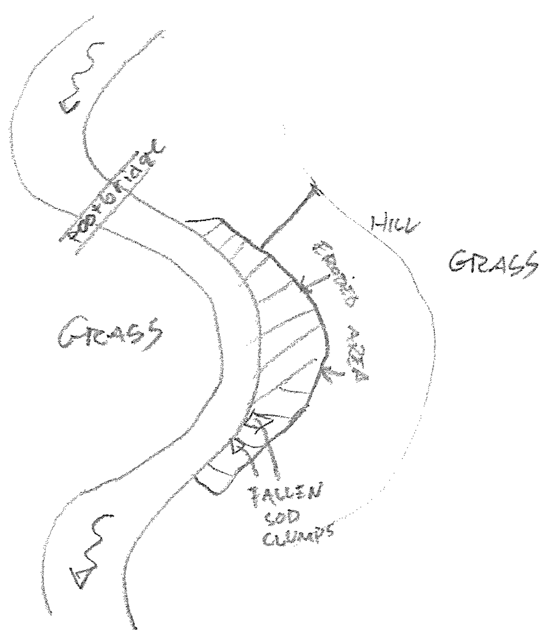
POTENTIAL RESTORATION CANDIDATE: ☒ Grade control ☒ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☒ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 — 4 (circled)	3 — 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 — 4 (circled)	3 — 2	1

NOTES/CROSS SECTION SKETCH:



Note: Property owner appears to be software company. Workers installing solar panels nearby. Owner may be amenable to being a restoration project partner (conjecture). Could also engage in riparian restoration.

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Graes	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB-5B · **TIME:** 2 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1769	
SITE ID: (*Condition-#*) SC-02 · **LAT** 41 ° 51 ' 47.1 "	**LONG** 72 ° 25 ' 06.2 " **LMK**____	**GPS** (*Unit ID*)

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [x] Circular [ ] Other:

 # BARRELS: [x] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [x] Concrete [ ] Metal [ ] Other:

ALIGNMENT: [x] Flow-aligned [ ] Not flow-aligned [ ] Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 3 (ft)
Height: 3 (ft)
Culvert length: 50 (ft)
Width: 3 (ft)
Roadway elevation: 7 (ft)

CONDITION: (*Evidence of…*)
[ ] Cracking/chipping/corrosion [ ] Downstream scour hole
[ ] Sediment deposition [ ] Failing embankment
[ ] Other (*describe*): good

CULVERT SLOPE: [x] Flat [ ] Slight (2° – 5°) [ ] Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit
[x] no [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [x] No [ ] Yes [ ] Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
[ ] Total [x] Partial
[ ] Temporary [ ] Unknown

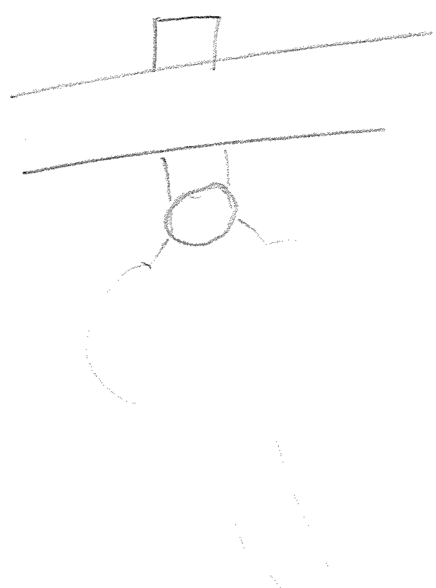
CAUSE:
[x] Drop too high Water Drop: 3-4 (in)
[x] Flow too shallow Water Depth: <1 (in)
[ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

5	4	3	2	1
A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.		A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.		A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

(3 circled)

NOTES/SKETCH:



REPORTED TO AUTHORITIES [ ] YES [ ] NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Goges	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB-05B **TIME:** 2 : 40 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1775	
SITE ID: (*Condition-#*) SC-02 **LAT** 41 ° 51 ' 51.5 " **LONG** 72 ° 25 ' 00.5 " **LMK**_____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☑ Other: Plastic

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 40 in (ft)
Height: 40 in (ft)
Culvert length: 40 (ft)
Width: 40 in (ft)
Roadway elevation: 9 (ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☑ Other (*describe*): good

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☑ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

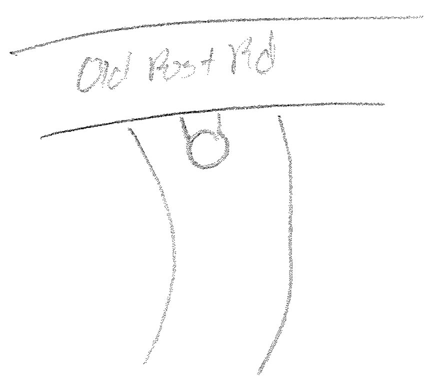
EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☒ Partial ☐ Temporary ☐ Unknown

CAUSE: ☒ Drop too high Water Drop: 2 (in) ☒ Flow too shallow Water Depth: <1 (in) ☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-6	**WTRSHD/SUBSHD:** Gogins Rd	**DATE:** 6 / 4 / 05	**ASSESSED BY:**

START **TIME:** 3 : 00 AM/PM **LMK:** ____ **LAT** 41 ° 51 ' 51.5 " **LONG** 72 ° 25 ' 02.5 " **DESCRIPTION:** Photo 176	*END* **TIME:** 4 : 35 AM/PM **LMK:** ____ **LAT** 41 ° 51 ' 51.9 " **LONG** 72 ° 24 ' 31.0 " **DESCRIPTION:**	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☑ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☑ Sand (gritty) ☑ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☑ Fish ☐ Beaver ☑ Deer
☐ Snails ☐ Other: crayfish

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☑ Headcutting ☑ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

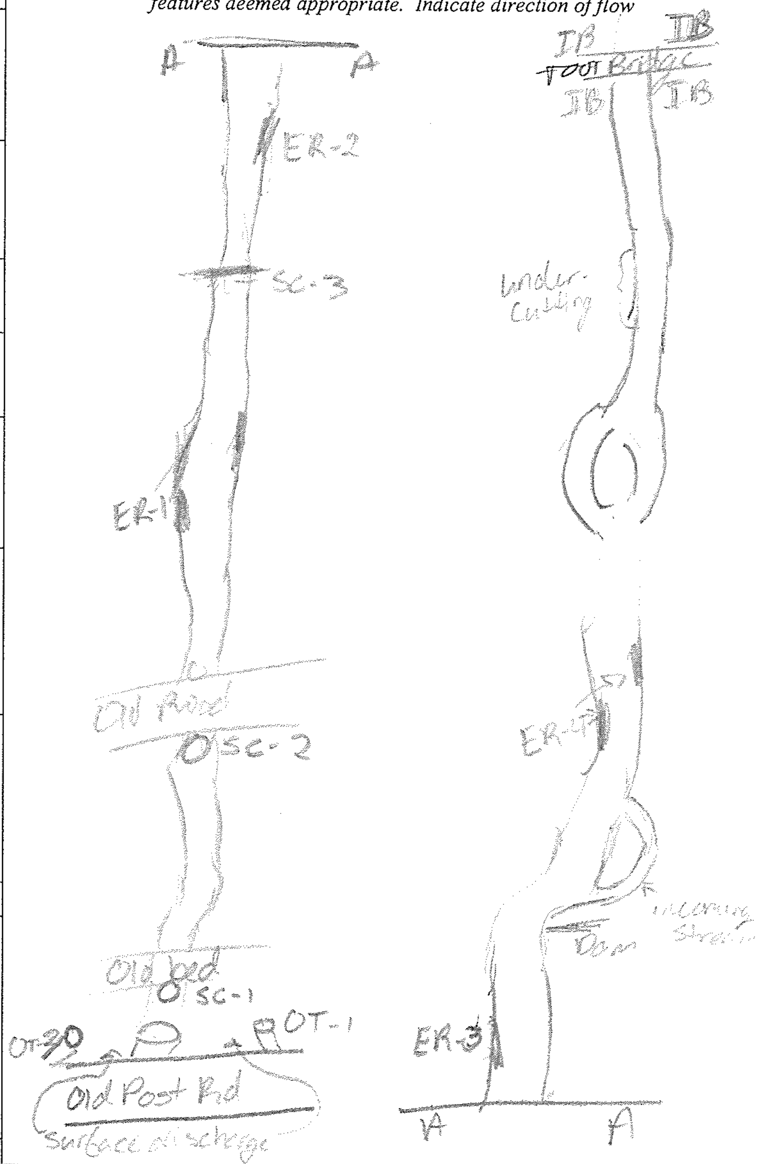
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 5 (ft)
Top 10 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3	2 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Goffe Bk	**DATE:** 6 / 4 / 08	**ASSESSED BY:** DEB
SURVEY REACH ID: GB-06 / **TIME:** 3 : 00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 1716	
SITE ID (*Condition-#*): OT-02 / **LAT** 41 ° 51 ' 51.7 " **LONG** 72 ° 25 ' 02.5 " **LMK**____		**GPS:** (*Unit ID*)

BANK: [ ] LT [x] RT [ ] Head

FLOW: [x] None [ ] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [x] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [x] Single [x] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 12 (in)

SUBMERGED: [x] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [ ] None [ ] Oily [ ] Flow Line [ ] Paint [x] Other: Sand/sediment

VEGGIE DENSITY: [ ] None [x] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [ ] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [x] Other: sand

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [x] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

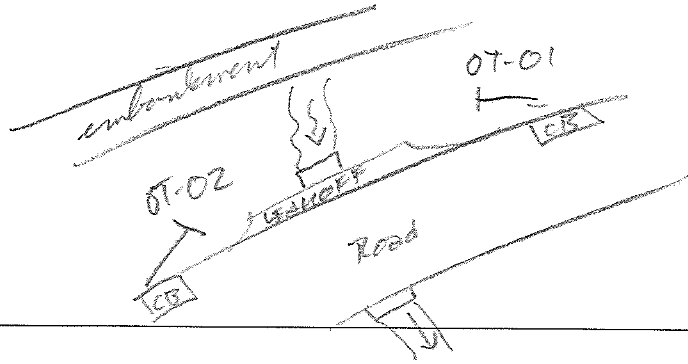
POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [x] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________ °

If yes for stormwater:
Is stormwater currently controlled? [ ] Yes [x] No [ ] Not investigated
Land Use description:________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: GAGES BK		**DATE:** 6 / 4 / 08	**ASSESSED BY:** DKB
SURVEY REACH ID: GB-06	**TIME:** 3 : 00 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 1776
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 51 ' 51.7 " **LONG** 72 ° 25 ' 02.5 " **LMK** ____		**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [x] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [x] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [x] Single [x] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 15 (in)

SUBMERGED: [x] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [ ] None [x] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [ ] No pool [ ] Good [ ] Odors [x] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [x] Other: Sediment

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [x] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [x] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[x] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [x] no [ ] Storm water retrofit [ ] Other:

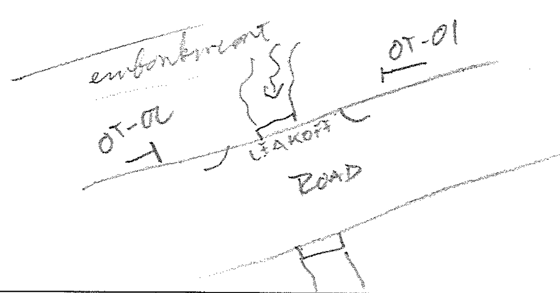
If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? [ ] Yes [x] No [ ] Not investigated
Land Use description: local 2 lane striped road
Area available: very small

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5	4	3	2	1

SKETCH/NOTES:



Road & outfalls appear to have been recently reconstructed.

REPORTED TO AUTHORITIES: [ ] YES [x] NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Goges Bk		**DATE:** 6/4/08	**ASSESSED BY:** DZB
SURVEY REACH ID: GB-06	**TIME:** 3:00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 1776	
SITE ID (*Condition-#*): **OT-** 02A	**LAT** 41° 51' 51.7" **LONG** 72° 25' 02.5" **LMK**____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☒ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter:____ (in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☒ Other: ASPHALT

SHAPE: ☒ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: 6 (in) Width (Top): 10 ~~(in)~~ ft " (Bottom): 11 (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______°

If yes for stormwater:

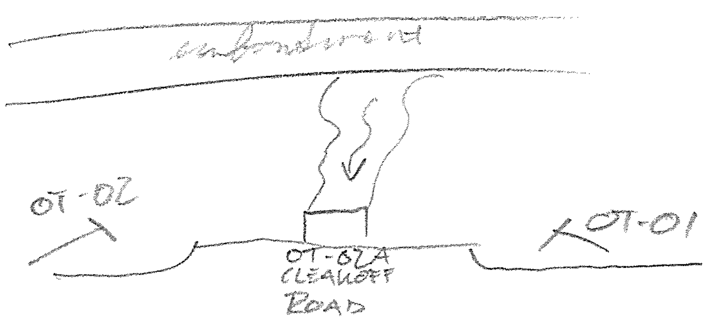
Is stormwater currently controlled? ☐ Yes ☒ No ☐ Not investigated

Land Use description:______________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Gages Brook		**DATE:** 6 / 4 / 08	**ASSESSED BY:** JHW
SURVEY REACH: GB-06	**TIME:** 3:15 AM/PM	**PHOTO ID** (CAMERA-PIC #): F10 /# 1781	
SITE ID: (*Condition-#*) ER- 1	*START* LAT 41° 51' 50.2" LONG 72° 24' 55.8" LMK ____		**GPS:** (*Unit ID*)
	END LAT 41° 51' 54.7" LONG 72° 24' 54.7" LMK ____		

PROCESS: ☐ Currently unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition
☐ Bed scour ☐ Bank failure ☒ Bank scour ☒ Slope failure ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both (*looking downstream*)
LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:
DIMENSIONS:
Length (*if no GPS*) LT ____ ft and/or RT ____ ft | Bottom width 10 ft
Bank Ht LT 8 ft and/or RT 6 ft | Top width 30 ft
Bank Angle LT 50 ° and/or RT 30 ° | Wetted Width 8 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☐ Unknown
LAND COVER: ☒ Forest ☐ Field/Ag ☐ Developed:

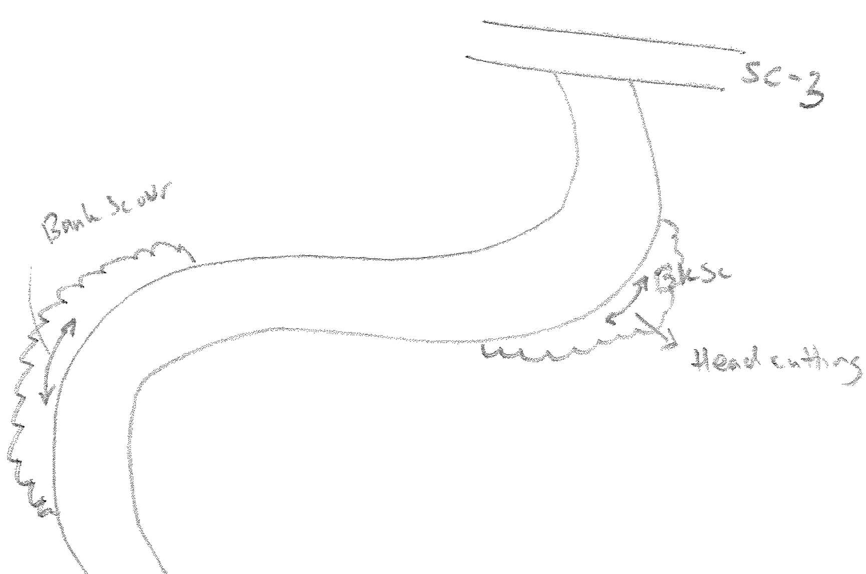
POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☒ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY (*circle #*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 (circled)	2 1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 (circled)	2 1

NOTES/CROSS SECTION SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Severe Bank Erosion

ER

WATERSHED/SUBSHED: Gages Brook	**DATE:** 6 / 4 / 08	**ASSESSED BY:** JHW
SURVEY REACH: GB-06	**TIME:** 3 : 30 AM/PM	**PHOTO ID** (CAMERA-PIC #): F40 /# 1784
SITE ID: (*Condition-#*) **ER-** 2	*START* **LAT** 41 ° 51 ' 49.4 " **LONG** 72 ° 24 ' 50.8 " **LMK** ____ *END* **LAT** 41 ° 51 ' 49.7 " **LONG** 72 ° 24 ' 50.5 **LMK** ____	**GPS:** (*Unit ID*)

PROCESS: ☐ Currently unknown

- ☐ Downcutting
- ☐ Widening
- ☐ Headcutting
- ☐ Aggrading
- ☐ Sed. deposition
- ☐ Bed scour
- ☒ Bank failure
- ☒ Bank scour
- ☐ Slope failure
- ☐ Channelized

BANK OF CONCERN: ☐ LT ☒ RT ☐ Both (*looking downstream*)

LOCATION: ☒ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT ____ ft	and/or RT ____ ft	Bottom width 6 ft
Bank Ht	LT 6 ft	and/or RT ____ ft	Top width 25 ft
Bank Angle	LT 45 °	and/or RT ____ °	Wetted Width 4 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☐ Unknown

LAND COVER: ☐ Forest ☐ Field/Ag ☒ Developed:

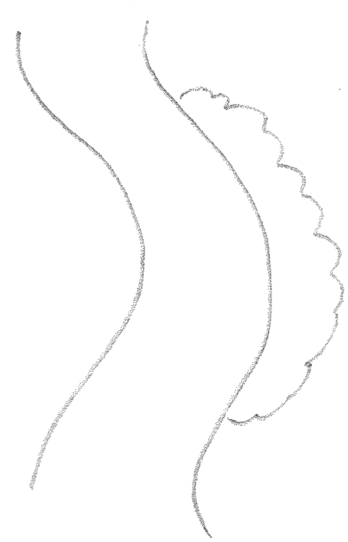
POTENTIAL RESTORATION CANDIDATE: ☐ No ☐ Grade control ☐ Other: ☒ Bank stabilization

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☒ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3	2 1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3	2 1

NOTES/CROSS SECTION SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Goyer Bk		**DATE:** 6/4/08	**ASSESSED BY:** DRB
SURVEY REACH: GB-06	**TIME:** 3:45 AM/PM	**PHOTO ID** (CAMERA-PIC #): DBCanon/# 1765, 1766	
SITE ID: (*Condition-#*) ER-03	*START* **LAT** 41° 51' 46.4" **LONG** 77° 24' 48.8" **LMK** ____		**GPS:** (*Unit ID*)
	END **LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ____		

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Bed scour
☒ Widening ☒ Bank failure
☐ Headcutting ☒ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both (*looking downstream*)
LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT 0 ft	and/or RT 30 ft	Bottom width 8 ft
Bank Ht	LT 5 ft	and/or RT 5 ft	Top width 9 ft
Bank Angle	LT 90 °	and/or RT 90 ° (vertical)	Wetted Width 5 ft

LAND OWNERSHIP: ☐ Private ☐ Public ☒ Unknown **LAND COVER:** ☒ Forest ☐ Field/Ag ☐ Developed:

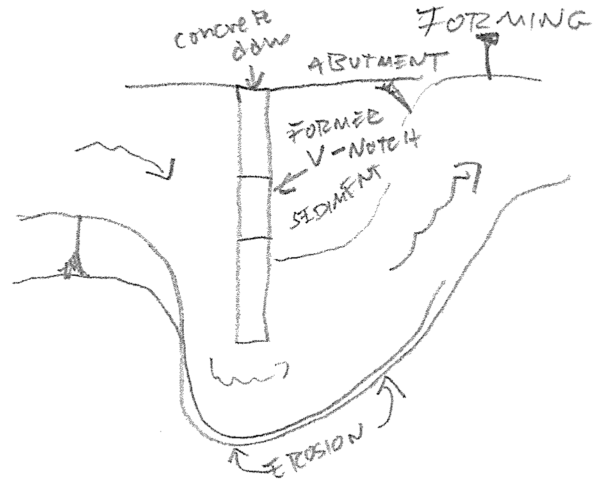
POTENTIAL RESTORATION CANDIDATE: ☒ Grade control ☒ Bank stabilization
☐ No ☒ Other: Dam Removal

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☒ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH: STREAM ERODED AROUND FORMER DAM FORMING NEW CHANNEL. FORMER DAM HEIGHT = 5'



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Gogu Bk		**DATE:** 6/4/08	**ASSESSED BY:** DRB
SURVEY REACH: GB-06	**TIME:** 4:00 AM/PM	**PHOTO ID** (CAMERA-PIC #): /# 1787	
SITE ID: (*Condition-#*) ER-04	*START* LAT 41° 51' 49.8" LONG 72° 24' 47.6" LMK ____		**GPS:** (*Unit ID*)
	END LAT 41° 51' 48.9" LONG 72° 24' 46.7" LMK ____		

PROCESS: ☐ Currently unknown
☒ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☒ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both (*looking downstream*)
LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:
DIMENSIONS:
Length (*if no GPS*) LT 200 ft and/or RT 200 ft | Bottom width 5 ft
Bank Ht LT 4-5 ft and/or RT 4-5 ft | Top width 10 ft
Bank Angle LT 80-90° and/or RT 80-90° | Wetted Width 6 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☐ Unknown
LAND COVER: ☒ Forest ☐ Field/Ag ☒ Developed:

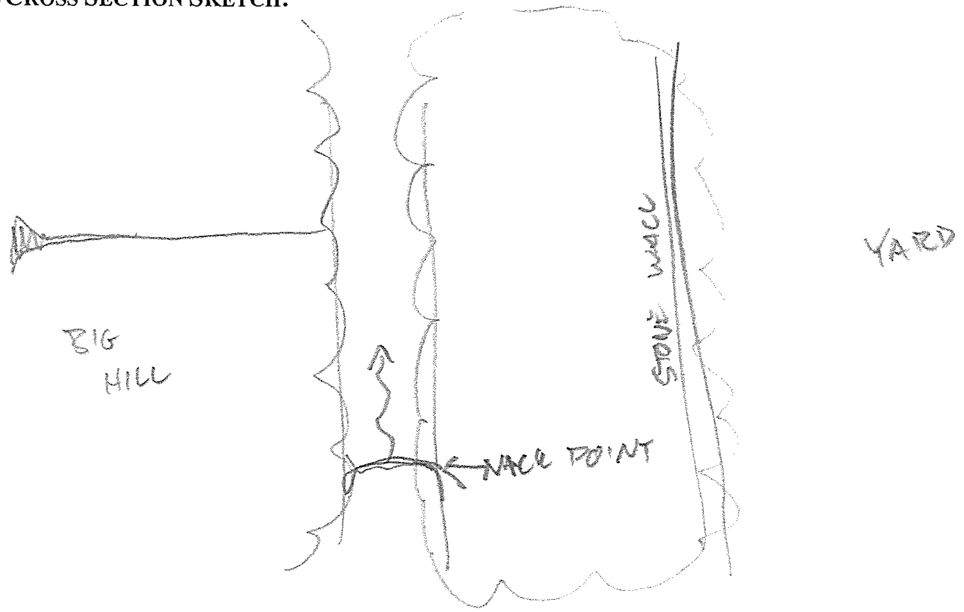
POTENTIAL RESTORATION CANDIDATE: ☒ Grade control ☒ Bank stabilization
☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☒ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☒ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED: Gages		**DATE:** 6 / 4 / 08	**ASSESSED BY:** CM
SURVEY REACH: GB-08	**TIME:** 4 : 25 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Camera/# 1790	
SITE ID: (*Condition-#*) IB- 1	*START* LAT 41 ° 51 ' 52.1 " LONG 72 ° 24 ' 33.7 " LMK ____		**GPS:** (*Unit ID*)
	END LAT 41 ° 51 ' 51.4 " LONG 72 ° 24 ' 31.0 " LMK ____		

IMPACTED BANK: ☑ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☑ Widespread invasive plants ☐ Recently planted ☐ Other: encroachment from landscape

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☑	☐	☐	☐	☐:
RT Bank	☑	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☑	☐	☐:
RT Bank	☐	☐	☑	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☑ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☑ Partial ☐ Full | **WETLANDS PRESENT?** ☑ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☑ Active reforestation ☐ Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other: bank stabilization

RESTORABLE AREA

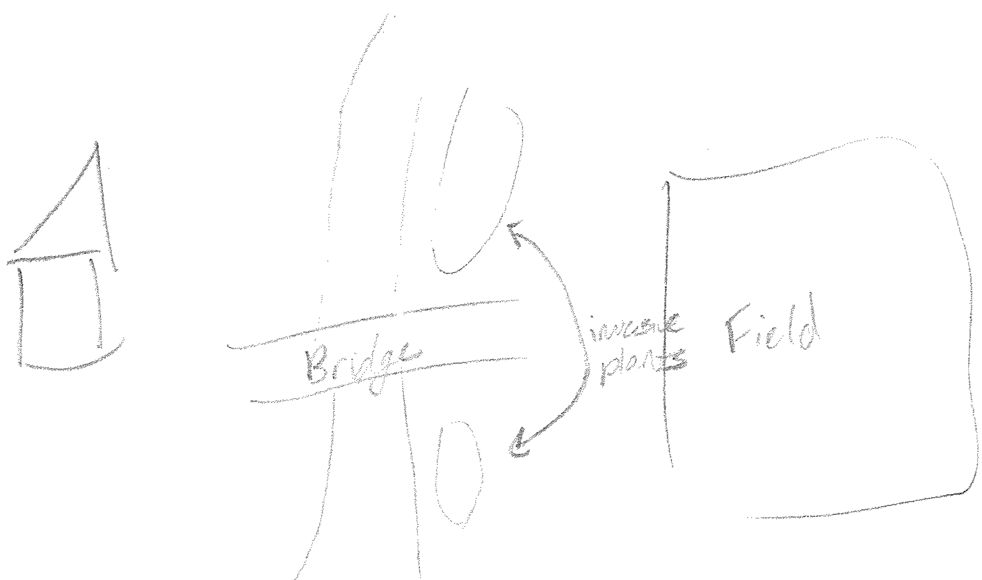
	LT BANK	RT
Length (ft):	150	300
Width (ft):	50	75

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☑ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☑ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other: property ownership

NOTES:



Stream Crossing **SC**

WATERSHED/SUBSHED: Goges Brook	**DATE:** 6 / 4 / 08	**ASSESSED BY:** DRB
SURVEY REACH ID: GB-06	**TIME:** 3:30 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon /# 1779
SITE ID: (*Condition-#*) SC-02	**LAT** 41 ° 51 ' 50.4 " **LONG** 72 ° 24 ' 58.3 " **LMK**____	**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: ________(ft)
Culvert length: ________(ft)
Width: ________(ft)
Roadway elevation: ________(ft)

CONDITION: (*Evidence of...*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☒ Other: Stream geomorphology restoration

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☒ Total ☐ Partial ☐ Temporary ☐ Unknown

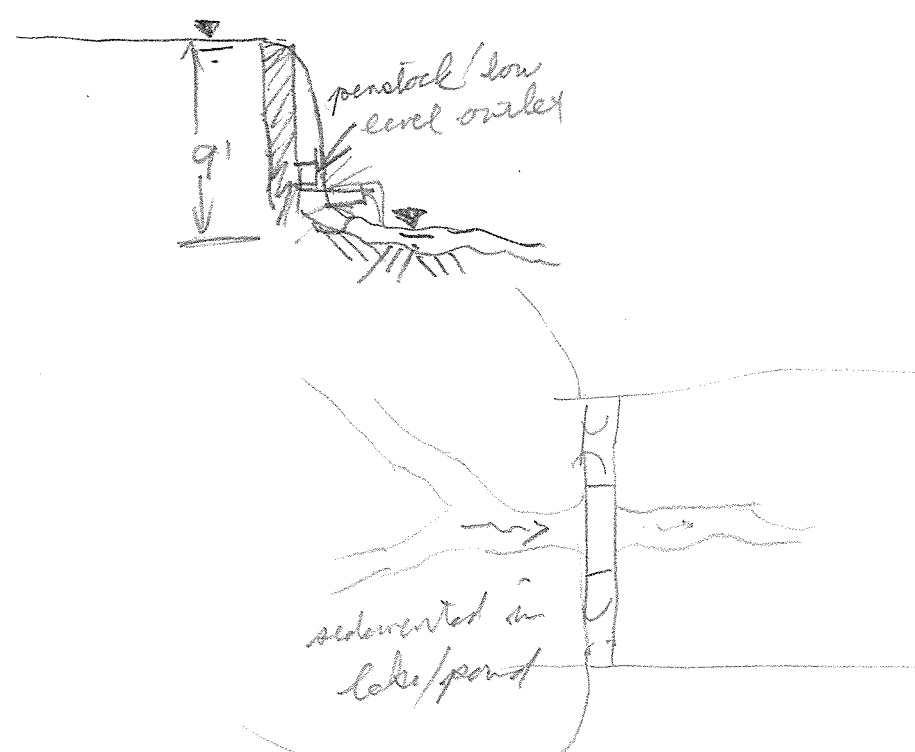
CAUSE: ☒ Drop too high Water Drop: 3 (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

5	4	3	2	1
A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.		A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.		A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

Circled: 4

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Gages	**DATE:** 6 / 4 / 08	**ASSESSED BY:** CM
SURVEY REACH ID: GB-6 — **TIME:** 3 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1779	
SITE ID: (*Condition-#*) SC-62 — **LAT** 41 ° 51 ' 50.4 " **LONG** 72 ° 24 ' 58.3 " **LMK**____	**GPS** (*Unit ID*)	

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [ ] Circular [ ] Other:

 # BARRELS: [x] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [ ] Concrete [x] Metal [ ] Other:

ALIGNMENT: [x] Flow-aligned [ ] Not flow-aligned [ ] Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 3 (ft)
Height: 3 (ft)
Culvert length: 25 (ft)
Width: 3 (ft)
Roadway elevation: 8 (ft)

CONDITION: (*Evidence of…*)
[ ] Cracking/chipping/corrosion [ ] Downstream scour hole
[x] Sediment deposition [ ] Failing embankment
[ ] Other (*describe*):

CULVERT SLOPE: [ ] Flat [x] Slight (2° – 5°) [ ] Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit
[x] no [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [ ] No [ ] Yes [ ] Unknown

If yes for fish barrier

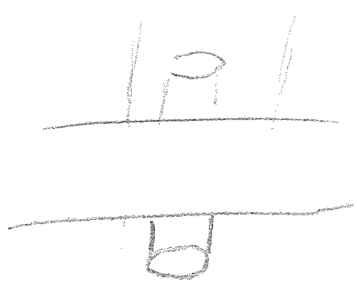
EXTENT OF PHYSICAL BLOCKAGE:
[ ] Total [x] Partial
[x] Temporary [ ] Unknown

CAUSE:
[x] Drop too high — Water Drop: 6 (in)
[ ] Flow too shallow — Water Depth:____ (in)
[ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

5 — 4	3 — 2	1
A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

NOTES/SKETCH:



REPORTED TO AUTHORITIES [ ] YES [ ] NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Gages	**DATE:** 6 / 4 / 08	**ASSESSED BY:** JW
SURVEY REACH ID: GB-06 · **TIME:** 3 : 05 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1777	
SITE ID: (*Condition-#*) SC-01 · **LAT** 41 ° 51 ' 51.4 " **LONG** 72 ° 25 ' 01.4 " **LMK**_____	**GPS** (*Unit ID*)	

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☑ Other: Old road/bed

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☑ Other: undefined

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other: none

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: ________(ft)
Culvert length: ________(ft)
Width: ________(ft)
Roadway elevation: ________(ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit ☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

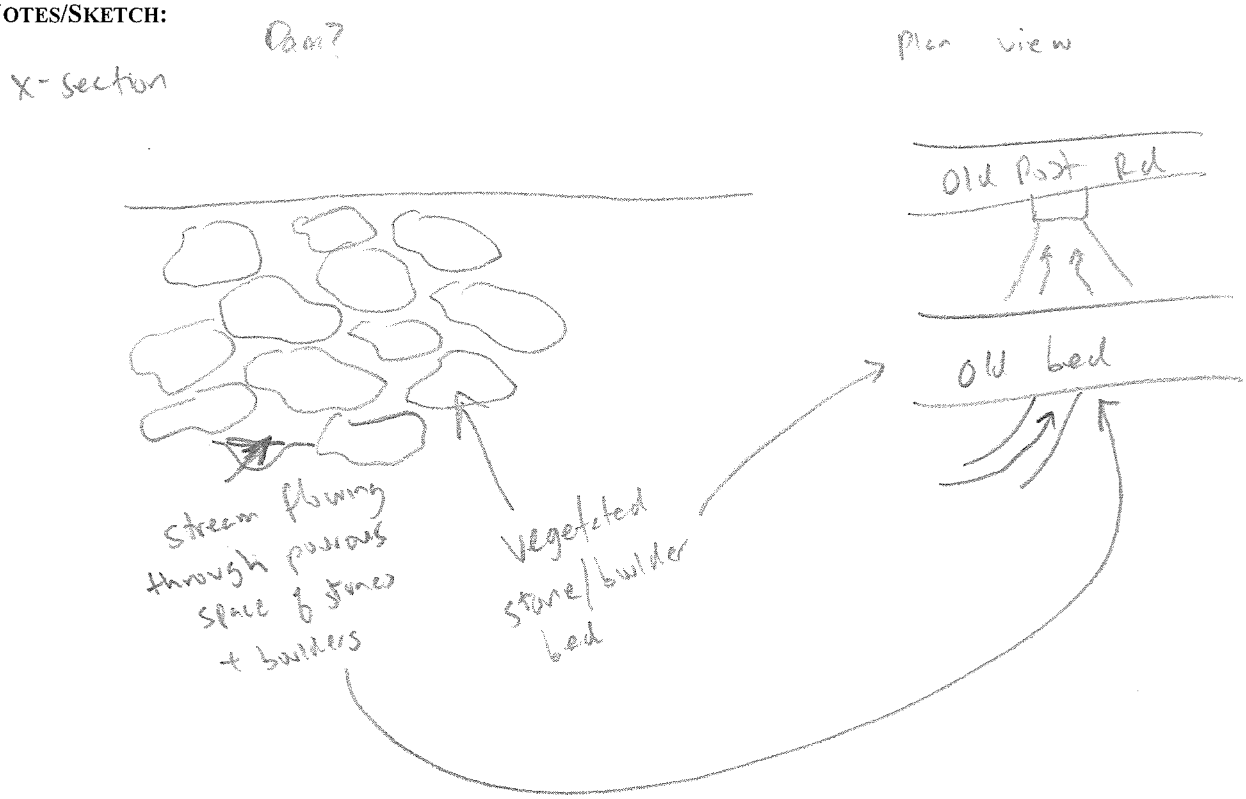
EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: _____ (in)
☐ Flow too shallow Water Depth: _____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-07	**WTRSHD/SUBSHD:**	**DATE:** 6 / 4 / 08	**ASSESSED BY:**

START **TIME:** 4 : 50 AM/PM **LMK:** ____	*END* **TIME:** 5 : 05 AM/PM **LMK:** ____	**GPS ID:**
LAT 41 ° 51 ' 51.9 " **LONG** 72 ° 24 ' 31.0 "	**LAT** 41 ° 51 ' 53.0 " **LONG** 72 ° 24 ' 21. "	
DESCRIPTION:	**DESCRIPTION:**	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☑ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☑ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☑ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Downcutting ☑ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

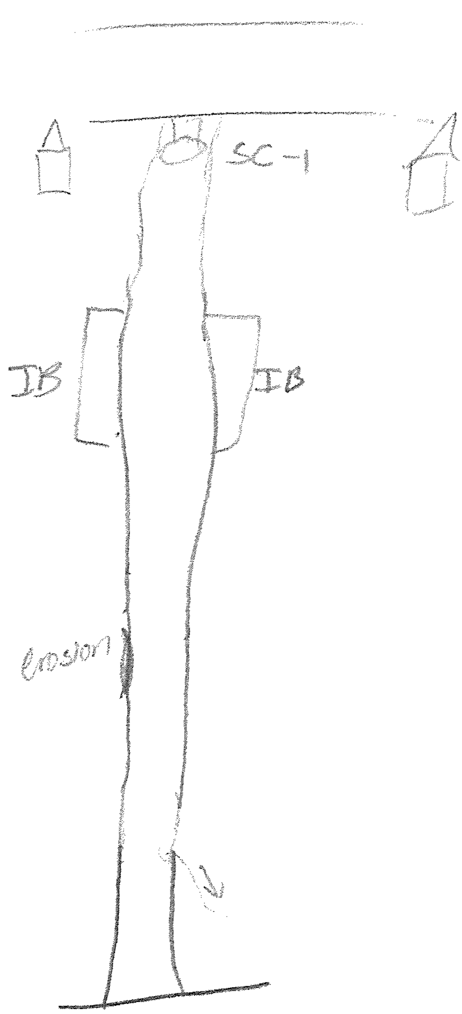
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2 (ft)
RT bank 2 (ft)
Width: Bottom 5 (ft)
Top 12-15 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Impacted Buffer **IB**

WATERSHED/SUBSHED: Gogea Bk | **DATE:** 6 / 9 / 08 | **ASSESSED BY:** JHW

SURVEY REACH: GB-07 | **TIME:** 5 : 00 AM/PM (PM circled) | **PHOTO ID:** (*Camera-Pic #*) Canon /# 595

SITE ID: (*Condition-#*) **IB-** 1

START **LAT** 41 ° 51 ' 52.5 " **LONG** 72 ° 24 ' 2.8 " **LMK** ____

END **LAT** ___ ° ___ ' ___ " **LONG** ___ ° ___ ' ___ " **LMK** ____

GPS: (*Unit ID*)

IMPACTED BANK: ☒ LT ☒ RT ☒ Both

REASON INADEQUATE: ☐ Lack of vegetation ☒ Too narrow ☒ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☒	☐	☐	☐	☐ :
RT Bank	☒	☐	☐	☐	☐ :

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☒	☐ :
RT Bank	☐	☐	☐	☐	☐	☐	☒ : Pachysandra

INVASIVE PLANTS: ☐ None ☐ Rare ☒ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full | **WETLANDS PRESENT?** ☒ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☐ Greenway design ☒ Natural regeneration ☒ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

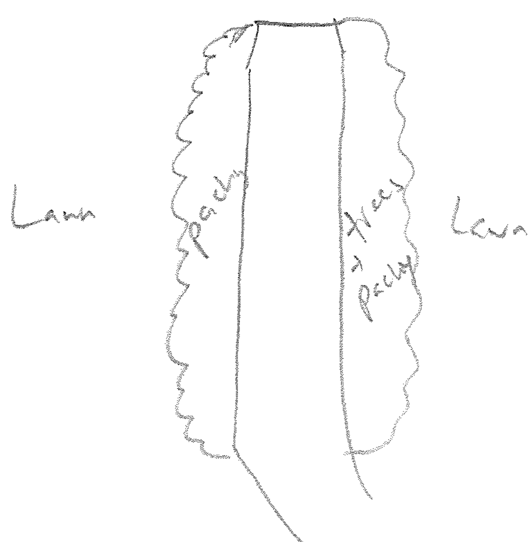
	LT BANK	RT
Length (ft):	100	100
Width (ft):	25	25

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3 (circled)	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:



Stream Crossing **SC**

WATERSHED/SUBSHED: Goges Bk	**DATE:** 6/4/08	**ASSESSED BY:** DPB
SURVEY REACH ID: GB-07 **TIME:** 5:00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon /#	
SITE ID: (*Condition-#*) SC- 01 **LAT** 41° 51' 53.0" **LONG** 72° 24' 21.1" **LMK**	**GPS** (*Unit ID*)	

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☒ Circular ☐ Other:

 # BARRELS: ☒ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 24 in (ft)
Height: ______ (ft)
Culvert length: ~200 (ft)
Width: ______ (ft)
Roadway elevation: 30± (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☒ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☒ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☒ Total ☐ Partial
☐ Temporary ☐ Unknown

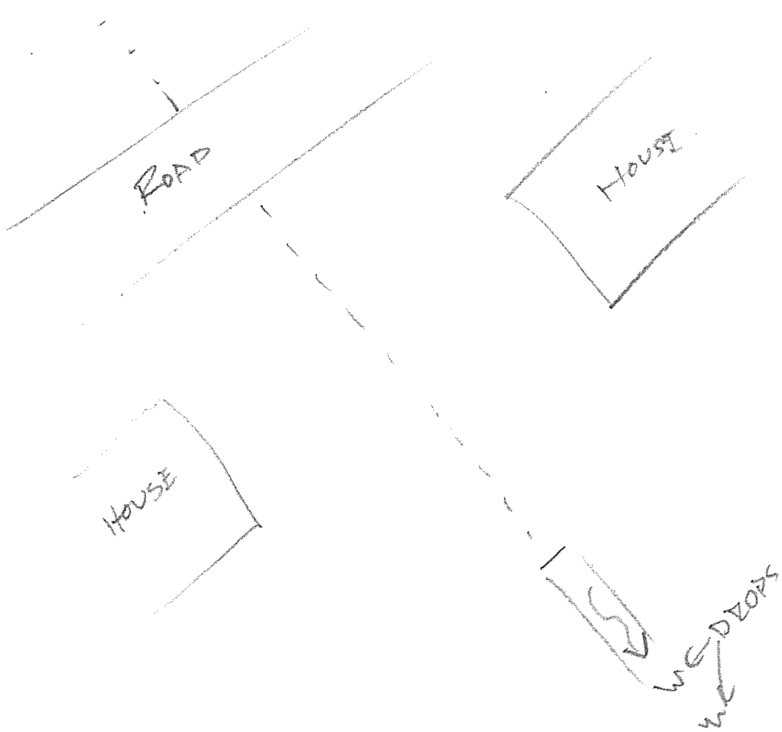
CAUSE:
☒ Drop too high Water Drop: 24 (in)
☒ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:



small drop @ culvert outlet, but large drop in 2 ft (x2) increments D.S.

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-8	**WTRSHD/SUBSHD:** Gages	**DATE:** 6 / 5 / 08	**ASSESSED BY:**

START TIME: 6 : 55 (AM)/PM LMK: 0	*END* TIME: 7 : 25 (AM)/PM LMK: _____	**GPS ID:**
LAT 41 ° 51 ' 52.6 " LONG 72 ° 24 ' 14.7 "	LAT 41 ° 51 ' 55.5 " LONG 72 ° 24 ' 10.7 "	
DESCRIPTION:	**DESCRIPTION:**	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☑ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☑ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☑ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☑ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☑ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition
☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

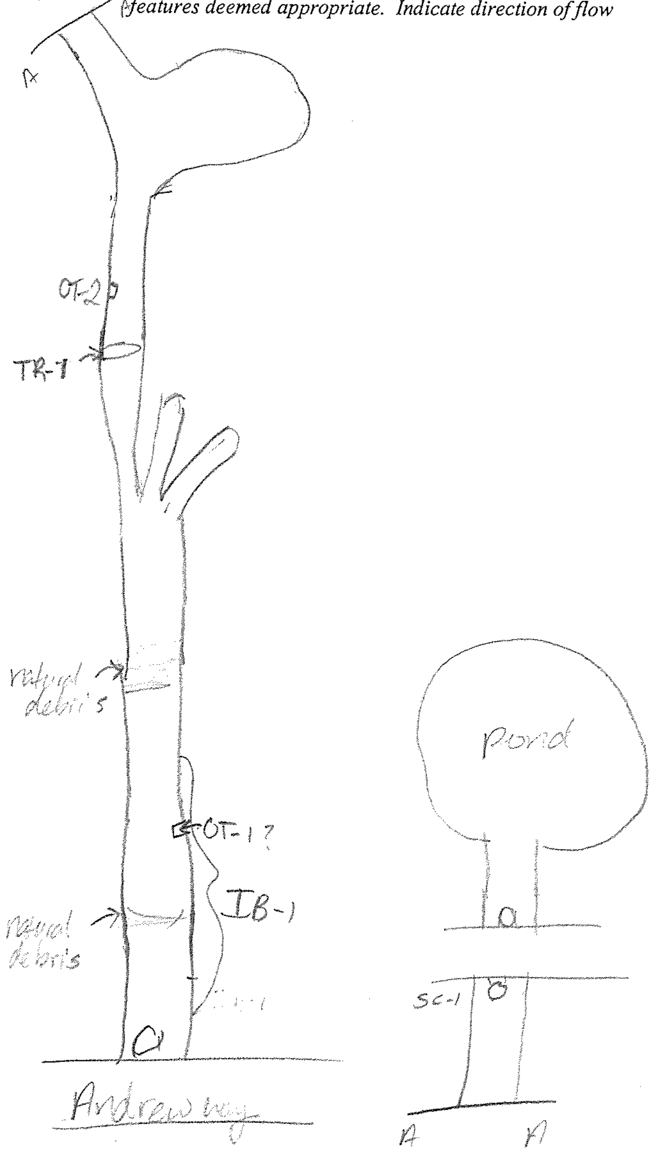
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 1 (ft)
RT bank 2 (ft)
Width: Bottom 3 (ft)
Top 10 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (2)	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

OVERALL STREAM CONDITION

	Optimal	Suboptimal	Marginal	Poor
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION

	Optimal	Suboptimal	Marginal	Poor
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACH-MENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gogoe Bk		**DATE:** 6 / 5 / 08	**ASSESSED BY:** DRB
SURVEY REACH ID: GB-08	**TIME:** 6 : 50 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 1798	
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 51 ' 52.6 " **LONG** 72 ° 24 ' 18.7 " **LMK**____		**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☒ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 2.5 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

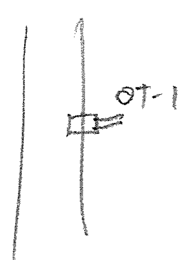
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☒ Not investigated
Land Use description:____________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:



Has screen; looks like an inlet, but is elevated above water surface by ~1 ft (at top of bank).

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED: Gayes Bk		**DATE:** 6/5/08	**ASSESSED BY:** DRB
SURVEY REACH: GB-08	**TIME:** 6:45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon /#	
SITE ID: (*Condition-#*) IB-01	*START* LAT 41°51'52.6" LONG 72°24'18.7" LMK ____		**GPS:** (*Unit ID*)
	END LAT ___°___'___" LONG ___°___'___" LMK ____		

IMPACTED BANK: ☒ LT ☒ RT ☒ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☒ Other: Landscaping & maintained lawn

LAND USE:

(*Facing downstream*)	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☒	☐	☐	☐	☐:
RT Bank	☒	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☒	☐	☐	☐	☐:
RT Bank	☐	☐	☒	☐	☐	☐	☐:

INVASIVE PLANTS: ☒ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☐ Greenway design ☐ Natural regeneration ☐ Invasives removal ☒ no ☐ Other:

RESTORABLE AREA

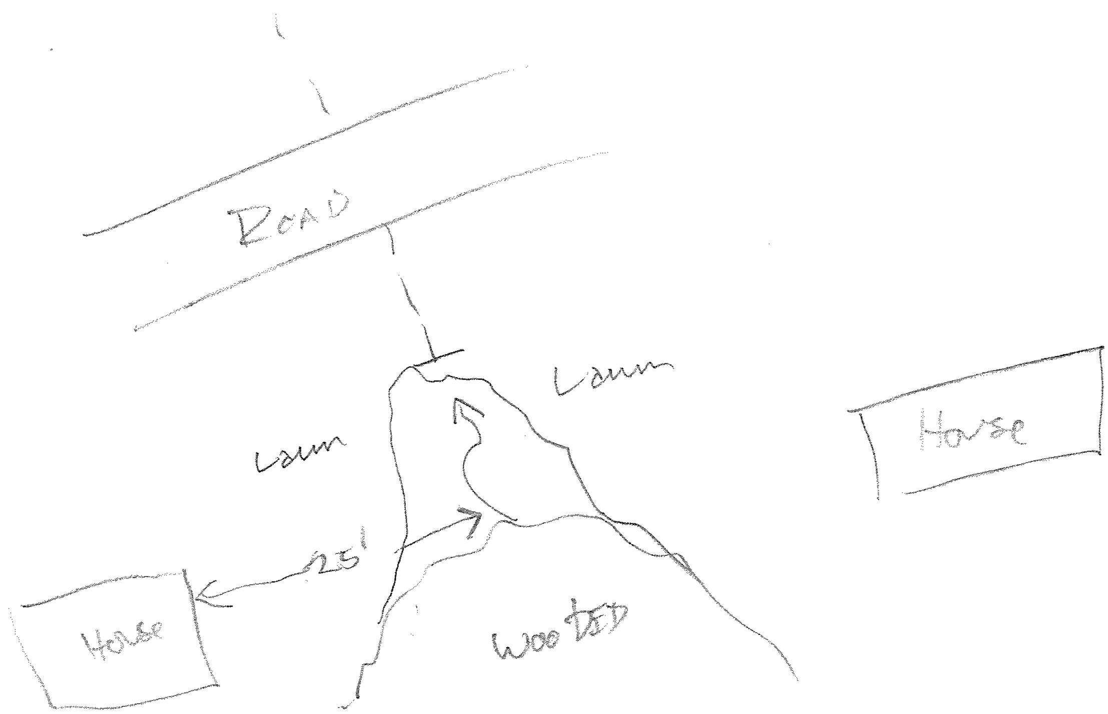
	LT	RT
Length (ft):	300	300
Width (ft):	50-75	50-75

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2 (circled)	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:



Stream Crossing **SC**

WATERSHED/SUBSHED: Goops	**DATE:** 6 / 5 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB48	**TIME:** 7 : 25 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /#1406
SITE ID: (*Condition-#*) SC- 1	**LAT** 41° 51 ' 55.5" **LONG** 72° 24 ' 10.7" **LMK**____	**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☑ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE:	**# BARRELS:**	**MATERIAL:**	**ALIGNMENT:**	**DIMENSIONS:** (*if variable, sketch*)
☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:	☑ Single ☐ Double ☐ Triple ☐ Other:	☑ Concrete ☐ Metal ☐ Other:	☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know	Barrel diameter: 18in (ft) Height: 18in (ft)
CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*): good			**CULVERT SLOPE:** ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)	Culvert length: 130 (ft) Width: 18in (ft) Roadway elevation: 12 (ft)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☑ Other: daylighting

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

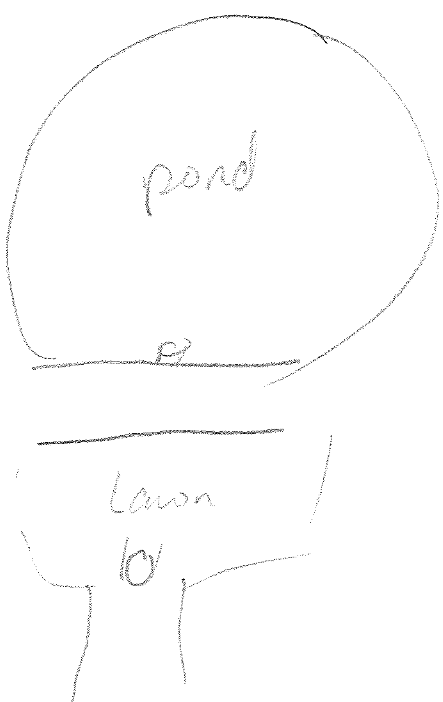
EXTENT OF PHYSICAL BLOCKAGE:
☑ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☑ Drop too high Water Drop: ______ (in)
☑ Flow too shallow Water Depth: ______ (in)
☑ Other: Dam

BLOCKAGE SEVERITY: *(circle #)*

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Goges Brook	**DATE:** 6 / 5 / 08	**ASSESSED BY:** DEB
SURVEY REACH ID: OG-08 **TIME:** 7 : 10 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Cam /# 1801 & 1802	
SITE ID: (*Condition-#*) TR-01 **LAT** 41° 51 ' 54.4 " **LONG** 72° 24 ' 12.6 " **LMK** ____		**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☒ Commercial ☒ Residential	☐ Plastic ☐ Paper ☒ Metal ☒ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☒ Other: DRUM	☐ Unknown ☐ Flooding ☒ Illegal dump ☐ Local outfall	☒ Stream ☐ Riparian Area ☐ Lt bank ☒ Rt bank	☐ Public ☒ Unknown ☒ Private **AMOUNT** (*# Pickup truck loads*):

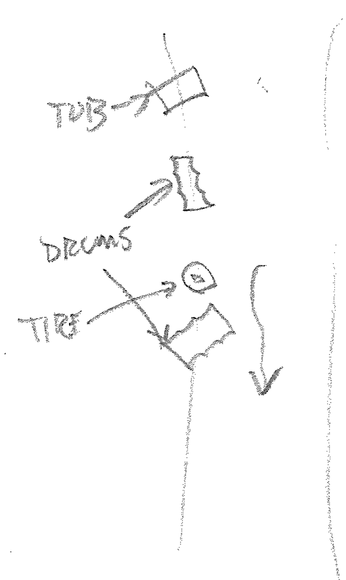
POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☒ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☒ No ☐ Unknown
	WHO CAN DO IT: ☐ Volunteers ☒ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access		A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5	4	3	2	1

NOTES: TIRE, BATHTUB, 2 - 55 gallon drums

REPORTED TO AUTHORITIES ☐ YES ☐ NO



Reach Level Assessment

RCH

SURVEY REACH ID: GB-04	WTRSHD/SUBSHD: GAGES BK	DATE: 6 / 4 / 08	ASSESSED BY:
START TIME: 9 : 30 AM/PM LMK: ____ LAT [illegible] ° 51 ' 44.5 " LONG 72 ° 35 ' [illegible] " DESCRIPTION:	*END* TIME: 10 : 10 AM/PM LMK: ____ LAT 41 ° 51 ' [illegible] " LONG 72 ° [illegible] ' [illegible] " DESCRIPTION:		GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☑ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☑ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☑ Industrial ☑ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☑ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☑ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☑ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☑ Fish ☐ Beaver ☑ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☑ Downcutting ☑ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

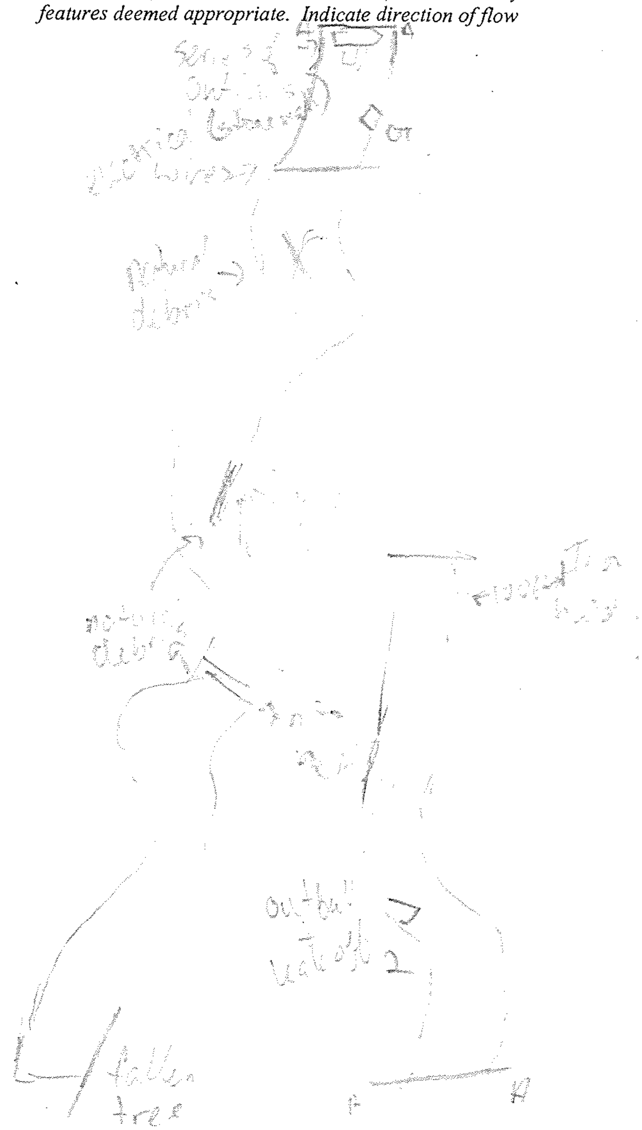
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 6 (ft)
Top 15 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (circled) 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Storm Water Outfalls

OT

WATERSHED/SUBSHED: GATES BK	**DATE:** 6/4/06	**ASSESSED BY:** DRB
SURVEY REACH ID: GB-09 **TIME:** 10:20 AM/PM	**PHOTO ID:** (*Camera-Pic #*) DB Canon/# 1751	
SITE ID (*Condition-#*): **OT-** 07 **LAT** 41° 51 ' 41.6 " **LONG** 72° 24 ' 59.7 "	**LMK**_____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☒ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☒ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 6 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☒ Other: ASPHALT

SHAPE: ☐ Trapezoid ☒ Parabolic ☐ Other:

Depth: 4 (in)
Width (Top): 36 (in)
" (Bottom): 14 (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☒ Bank Erosion ☐ Other: EROSION FROM OT to Stream

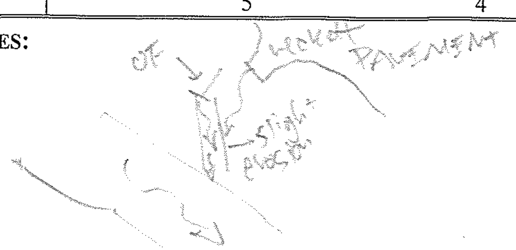
POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☒ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater: pipe
Is stormwater currently controlled? ~ lookoff
☐ Yes ☒ No ☒ Not investigated
Land Use description: Industrial (solid waste transfer?)
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Gates Brk.		**DATE:** 6/4/08	**ASSESSED BY:** DRB
SURVEY REACH ID: GB 9	**TIME:** 9:55 AM/PM (AM circled)	**PHOTO ID:** (*Camera-Pic #*) DR Canon /# 1749	
SITE ID (*Condition-#*): OT-01	**LAT** 41° 51' 42.5" **LONG** 72° 25' 01.3"	**LMK**____	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [x] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [x] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [x] Single [ ] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: [ ] No [x] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

Depth: ____(in) Width (Top): ____(in) " (Bottom): ____(in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [ ] None [ ] Oily [ ] Flow Line [ ] Paint [x] Other: RUST

VEGGIE DENSITY: [x] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [ ] No pool [ ] Good [ ] Odors [x] Colors [x] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [x] Orange [x] Red [ ] Other:
	TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [x] Opaque
	FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [x] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

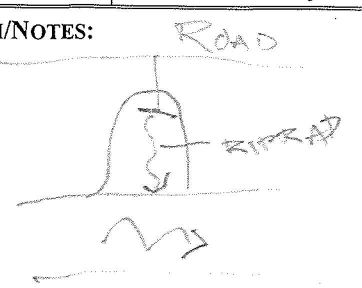
POTENTIAL RESTORATION CANDIDATE [x] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [ ] no [x] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ______ft Type of existing vegetation:__________ Slope: ______°

If yes for stormwater:
Is stormwater currently controlled? [ ] Yes [x] No [ ] Not investigated
Land Use description: Industrial
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4 (circled)	3 2	1

SKETCH/NOTES:



Severity due to color, not flow quantity. ~~Also~~ Turbidity/color may be iron particulate from GW intrusion. Should be investigated.

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Stream Crossing **SC**

WATERSHED/SUBSHED: GAGES | **DATE:** 6/ 4 /08 | **ASSESSED BY:** DRB

SURVEY REACH ID: GR-09 | **TIME:** 10 : 00 AM/PM | **PHOTO ID:** (*Camera-Pic #*) DRBowen /# 1750

SITE ID: (*Condition-#*) SC-01 | **LAT** 41° 51' 47.3" **LONG** 72° 25' 00.6" **LMK**_____ | **GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: _________(ft)
Height: _________(ft)
Culvert length: _________(ft)
Width: _________(ft)
Roadway elevation: _________(ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☒ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☒ Total ☐ Partial ☐ Temporary ☐ Unknown

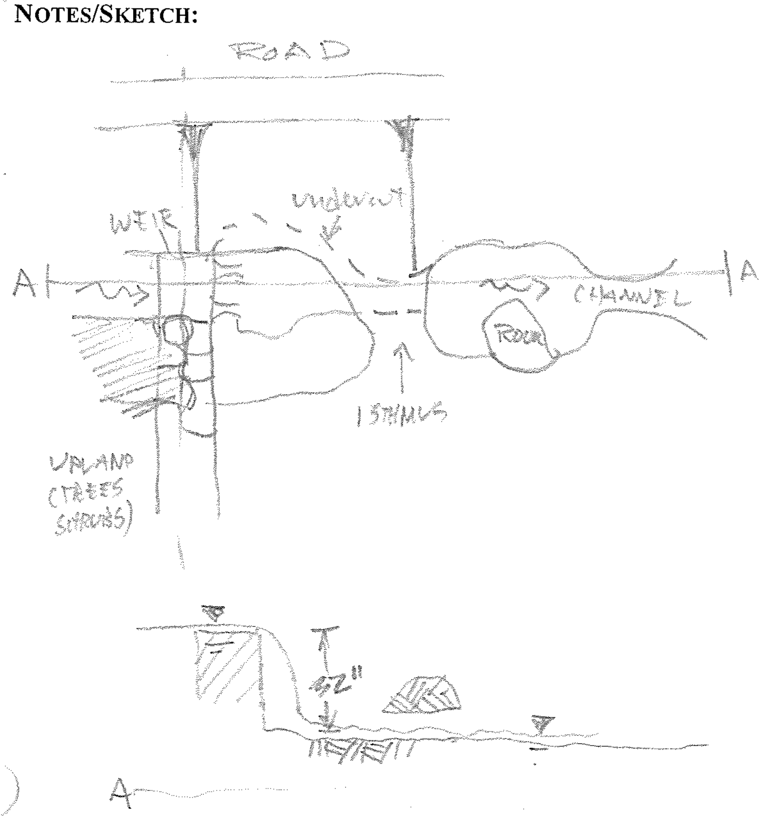
CAUSE:
☒ Drop too high Water Drop: 32 (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: GB-10	**WTRSHD/SUBSHD:**	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
START TIME: 10 : 30 AM/PM LMK: ____ LAT 41 ° 51 ' 47.3 " LONG 72 ° 24 ' 51.9 " DESCRIPTION:		*END* TIME: 11 : 45 AM/PM LMK: ____ LAT 41 ° 51 ' 28.6 " LONG __ ° 24 ' 38.0 " DESCRIPTION:	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☒ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☒ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☒ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☒ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☒ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☒ Fish ☐ Beaver ☐ Deer
☐ Snails ☒ Other: mink

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☒ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☒ Sed. deposition ☐ Channelized

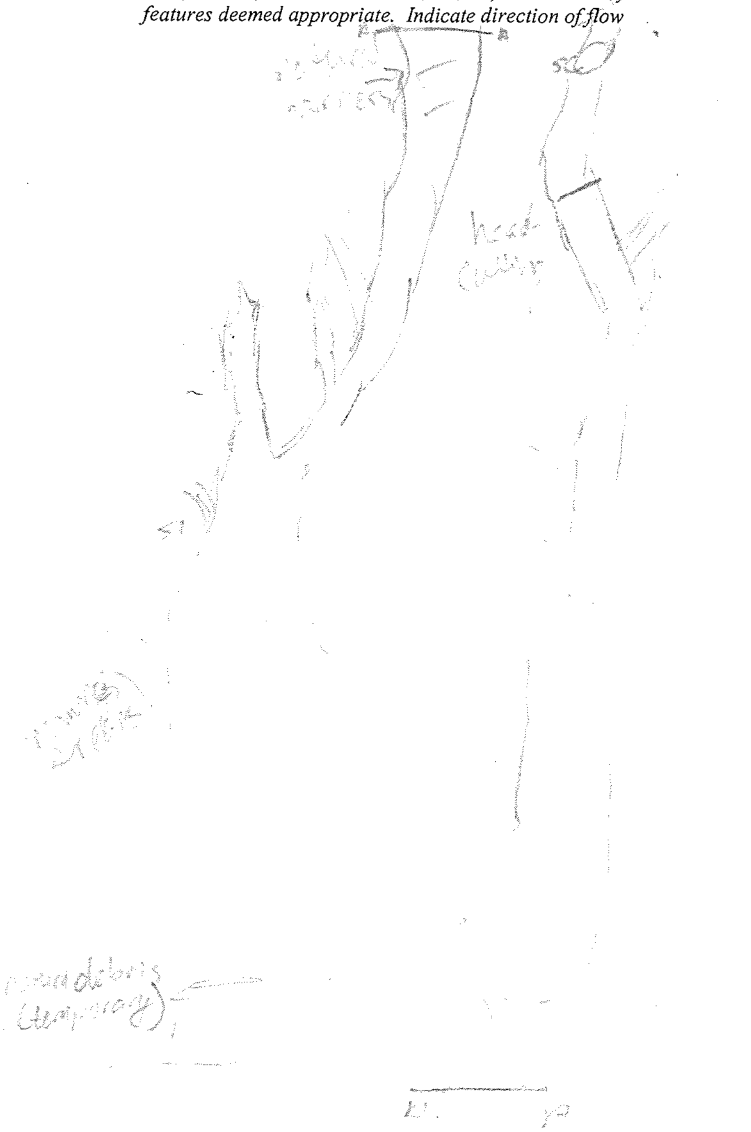
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 5 (ft)
Top 8 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: GATES BROOK		**DATE:** 6 / 4 / 08	**ASSESSED BY:** DEB
SURVEY REACH ID: GB10	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) DR CANON /# 1765	
SITE ID (*Condition-#*): OT-01	**LAT** 41° 51' 32.1" **LONG** 72° 24' 36.3"	**LMK** ____	**GPS:** (*Unit ID*)

← see cover log →

BANK: [ ] LT [x] RT [ ] Head

FLOW: [ ] None [ ] Trickle [x] Moderate [ ] Substantial [ ] Other:

TYPE: [ ] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [ ] Single [ ] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: ____ (in)

SUBMERGED: [ ] No [ ] Partially [ ] Fully

TYPE: [x] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [x] Other: RIPRAP VEGETATED

SHAPE: [ ] Trapezoid [ ] Parabolic [x] Other: AMORPHOUS

Depth: 6-12 (in) Width (Top): 6'-15' (in) ft " (Bottom): varies (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [ ] None [ ] Normal [ ] Inhibited [x] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [ ] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [x] Other: Leaves & sed.

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [x] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [x] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[x] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [x] Needs Regular Maintenance [ ] Bank Erosion [x] Other: Potential for future erosion

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [ ] no [ ] Storm water retrofit [x] Other: MONITOR

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? [x] Yes [ ] No [ ] Not investigated

Land Use description: Residential - new subdivision

Area available: 1/4 acre

OUTFALL SEVERITY: *(circle #)*	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

A   TRICKLE OUT   A

Impacted Buffer

IB

WATERSHED/SUBSHED:

DATE: 6 / 4 / 08

ASSESSED BY:

SURVEY REACH: GB-10

TIME: 11 : 15 AM/PM

PHOTO ID: (*Camera-Pic #*) Canon /# 1763

SITE ID: (*Condition-#*) **IB-** 01

START	**LAT** 41 ° 51 ' 32.4 "	**LONG** 72 ° 24 ' 42.7 "	**LMK** ____	**GPS:** (*Unit ID*)
END	**LAT** 41 ° 51 ' 31.7 "	**LONG** 72 ° 24 ' 42.2 "	**LMK** ____	

IMPACTED BANK: ☐ LT ☐ RT ☑ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☑ Other: Wooded buffer turns to shrub

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☑	☐	☐	☐	☐:
RT Bank	☑	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☑	☑	☐	☐:
RT Bank	☐	☐	☐	☑	☑	☐	☐:

INVASIVE PLANTS: ☑ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☑ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐ Active reforestation ☐ Greenway design ☑ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT (BANK)	RT
Length (ft):	250	200
Width (ft):	50+	50+

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4 3 2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES: Buffer from GB coordinate to SC

Stream Crossing **SC**

WATERSHED/SUBSHED: Goes		**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: GB4D	**TIME:** 11 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1764	
SITE ID: (*Condition-#*) SC- 1	**LAT** 41 ° 51 ' 31.7 " **LONG** 72 ° 24 ' 42.4 " **LMK**____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 24 in (ft)
Height: 24 in (ft)
Culvert length: 60 (ft)
Width: 24 in (ft)
Roadway elevation: 6 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☑ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☑ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☑ Partial
☐ Temporary ☐ Unknown

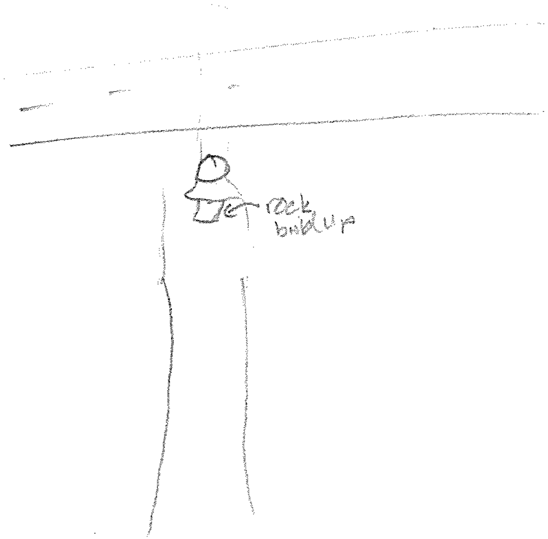
CAUSE:
☒ Drop too high Water Drop: 6 (in)
☑ Flow too shallow Water Depth: 1 (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

[illegible] fish habitat and passage



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Utility Impacts

UT

WATERSHED/SUBSHED: GAGES BK	**DATE:** 6 / 4 / 08	**ASSESSED BY:** DPB
SURVEY REACH ID: GB-10	**TIME:** 11 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) Canon /# 1763
SITE ID: (*Condition-#*) UT-01	**LAT** 41 ° 51 ' 32.4 " **LONG** 72 ° 24 ' 42.7 " **LMK:** ____	**GPS:** (*Unit ID*)

TYPE:
- [ ] Leaking sewer
- [ ] Exposed pipe
- [ ] Exposed manhole
- [x] Other: NEW CROSSING W/IMPACTED BUFFER

MATERIAL:
- [ ] Concrete
- [ ] Corrugated metal
- [ ] Smooth metal
- [ ] PVC
- [x] Other: UNKNOWN

LOCATION:
- [ ] Floodplain
- [ ] Stream bank
- [ ] Above stream
- [ ] Stream bottom
- [x] Other: BURIED BENEATH STREAM

POTENTIAL FISH BARRIER: [ ] Yes [ ] No

PIPE DIMENSIONS:
Diameter: ____ in
Length exposed: ____ ft

CONDITION: [ ] Joint failure [ ] Pipe corrosion/cracking [ ] Protective covering broken [ ] Manhole cover absent [x] Other: GOOD except grass/shrubs

EVIDENCE OF DISCHARGE:		
	COLOR	[x] None [ ] Clear [ ] Dark Brown [ ] Lt Brown [ ] Yellowish [ ] Greenish [ ] Other:
	ODOR	[x] None [ ] Sewage [ ] Oily [ ] Sulfide [ ] Chlorine [ ] Other:
	DEPOSITS	[x] None [ ] Tampons/Toilet Paper [ ] Lime [ ] Surface oils [ ] Stains [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Structural repairs [ ] Pipe testing [ ] Citizen hotlines [ ] Dry weather sampling
[x] no [ ] Fish barrier removal [ ] Other:

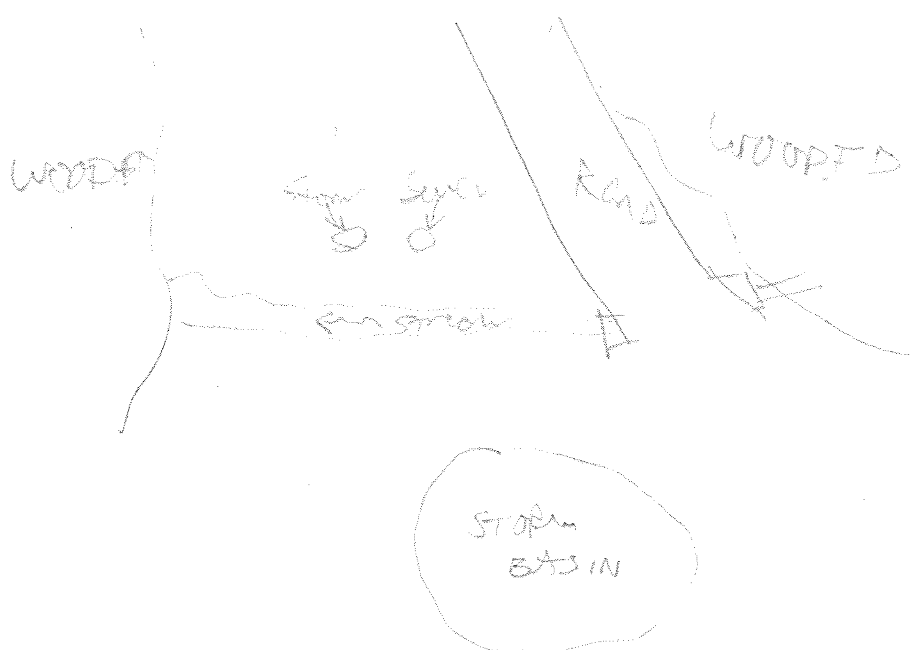
If yes to fish barrier, Water Drop: ________ (in)

UTILITY IMPACT SEVERITY: (*Circle #*) Leaking= [ ] 5	Section of pipe undermined by erosion and could collapse in the near future; a pipe running across the bed or suspended above the stream; a long section along the edge of the stream where nearly the entire side of the pipe is exposed; or a manhole stack that is located in the center of the stream channel and there is evidence of stack failure.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.	Small section of exposed pipe, stream bank near the pipe is stable; the pipe is across the bottom of the stream but only a small portion of the top of the pipe exposed; the pipe is exposed but is reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.
	5	4 3	2 1

NOTES:

No exposed pipe

REPORTED TO LOCAL AUTHORITIES [ ] Yes [ ] No



Stream Crossing **SC**

WATERSHED/SUBSHED: Lower Fenton/hoosen	DATE: 6 / 5 / 08	ASSESSED BY: GA JS, BZ
URVEY REACH ID: LTR-03 — TIME: 4 : 50 AM/PM	PHOTO ID: (Camera-Pic #) 29, 30 /# 31	
SITE ID: (Condition-#) SC- 01 — LAT 41 ° 49 ' 27.2 " LONG 72 ° 29 ' 15.8 "	LMK____	GPS (Unit ID)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: ________(ft)
Culvert length: ________(ft)
Width: ________(ft)
Roadway elevation:________(ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☒ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☒ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☒ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment

RCH

SURVEY REACH ID: LTR-03	**WTRSHD/SUBSHD:** Lower Tank. River	**DATE:** 6/5/08	**ASSESSED BY:** JS, GA, RD
START TIME: 4:04 AM/PM (PM) LMK: ____ LAT 41° 49' 20.3" LONG 72° 29' 41.3" DESCRIPTION: Talcottville Pond Inlet	END TIME: 5:07 AM/PM LMK: ____ LAT 41° 49' 27.2" LONG 72° 29' 15.9" DESCRIPTION: Dobsinville Dam		GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☑ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☑ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☑ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☑ Other: Highway

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☑ 75-100%

DOMINANT SUBSTRATE ☐ Silt/clay (fine or slick) ☐ Sand (gritty) ☐ Gravel (0.1-2.5") ☑ Cobble (2.5 –10") ☐ Boulder (>10") ☐ Bed rock

WATER CLARITY ☐ Clear ☐ Turbid *(suspended matter)* ☑ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)* somewhat cloudy

AQUATIC PLANTS IN STREAM Attached: ☑ none ☐ some ☐ lots Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☑ Fish ☑ Beaver ☑ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface) ☑ Mostly shaded (≥75% coverage) ☐ Halfway (≥50%) ☐ Partially shaded (≥25%) ☐ Unshaded (< 25%)

CHANNEL DYNAMICS ☐ Unknown ☐ Downcutting ☑ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*

Height: LT bank 2.5 (ft), RT bank 4.5 (ft)

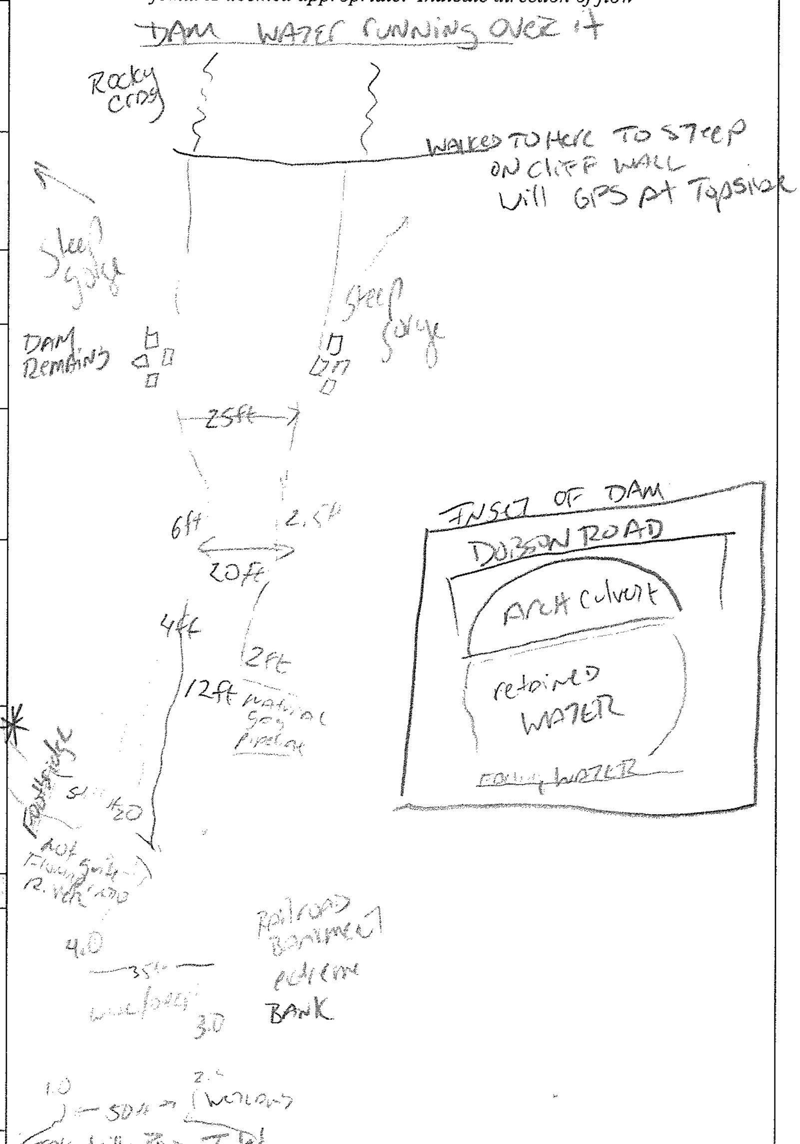
Width: Bottom 20 (ft), Top 25 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.		**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.		**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5	4	3 (circled)	2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

* STORM WATER Catch BASIN FOR I-84 Highway RUNOFF

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition

	Optimal	Suboptimal	Marginal	Poor
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition

	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 53 /80 + Buffer/Floodplain: 58 /80 = **Total** Survey Reach 111 /160

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Lower Tank, River	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JS, RT, GA
SURVEY REACH ID: LTR-03	**TIME:** 4 : 24 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) 27 /#
SITE ID (*Condition-#*): OT-01	**LAT** 41 ° 49 ' 23.6 " **LONG** 72 ° 29 ' 31.6 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☒ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter:____(in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel

MATERIAL: ☐ Concrete ☒ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth:____(in) Width (Top):____(in) " (Bottom):____(in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☒ Oily ☐ Flow Line ☐ Paint ☒ Other: RUSTY

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☒ Other: Pollution

POTENTIAL RESTORATION CANDIDATE ☒ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☒ Other: CONTAMINATES

If yes for daylighting:

Length of vegetative cover from outfall: ______ft Type of existing vegetation:________ Slope: ______°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

I-84 Runoff goes to Retention Pond → Pond to River. Silty / orange / Rusty → Thick sludge Bottom.

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: MTR-01	**WTRSHD/SUBSHD:** Middle Tank River	**DATE:** 6 / 4 / 08	**ASSESSED BY:** JK, GA, JS, PET
START **TIME:** 1 : 52 AM/PM **LMK:** ____ **LAT** 41 ° 49 ' 36.0 " **LONG** 72 ° 26 ' 24.6 " **DESCRIPTION:** inlet to Pond		*END* **TIME:** 3 : 40 AM/PM **LMK:** ____ **LAT** 41 ° 49 ' 37.4 " **LONG** 72 ° 27 ' 58.5 " **DESCRIPTION:** Stream Divides into Two	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☒ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☒ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: WETLAND

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☒ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☐ some ☐ lots Floating: ☐ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☒ Beaver ☒ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☒ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☒ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☒ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

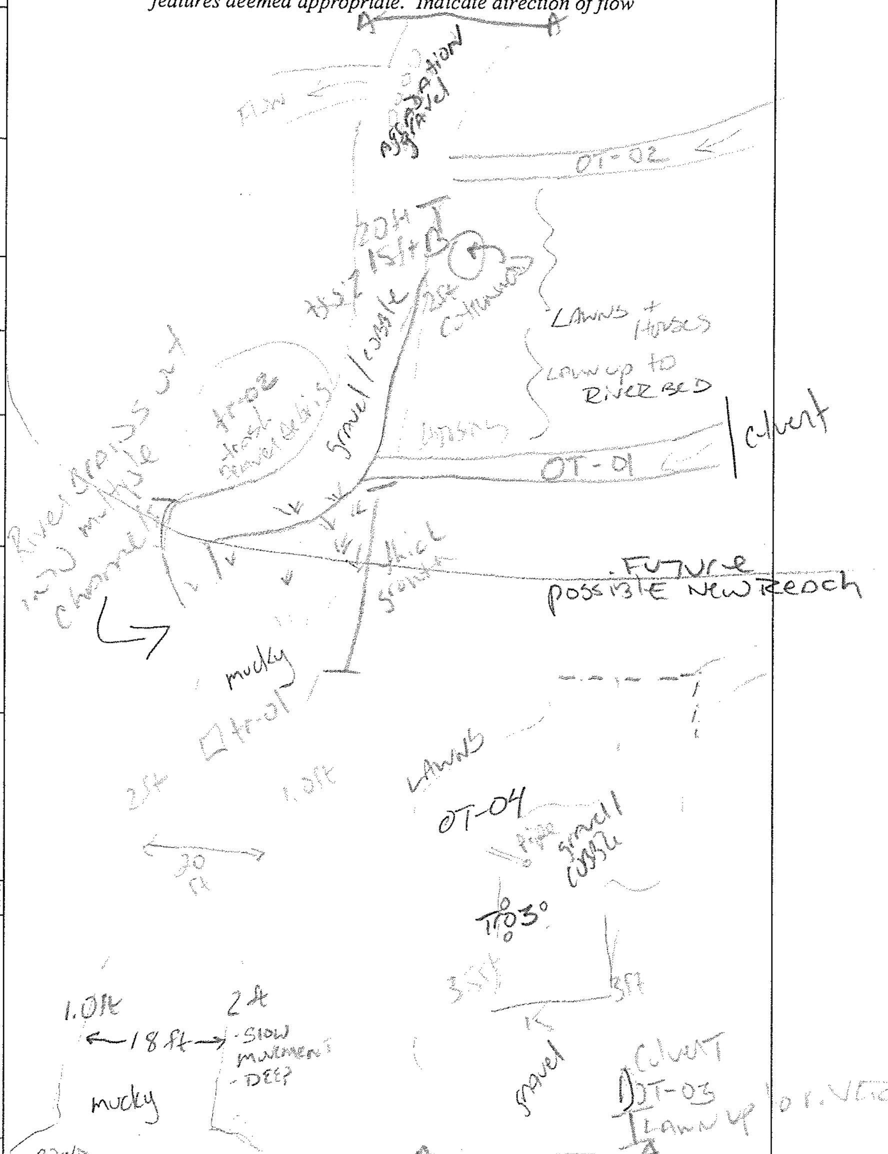
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.5 (ft)
RT bank 2.75 (ft)
Width: Bottom 19 (ft)
Top 22 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (circled) 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field / WETLAND / TURF	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 47 /80 + Buffer/Floodplain: 34 /80 = **Total** Survey Reach 81 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED:	**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: MR - 01 · **TIME:** 2 : 30 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 24	
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 49 ' 36.1 " **LONG** 72 ° 28 ' 15.7 " **LMK**_____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

- **MATERIAL:** ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:
- **SHAPE:** ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
- **DIMENSIONS:** Diameter: 3 ft (in)
- **SUBMERGED:** ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

- **MATERIAL:** ☐ Concrete ☐ Earthen ☐ Other:
- **SHAPE:** ☐ Trapezoid ☐ Parabolic ☐ Other:
- **DIMENSIONS:** Depth: _____(in) Width (Top):_____(in) " (Bottom):_____(in)
- **SUBMERGED:** *NOT APPLICABLE*

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: __________ft Type of existing vegetation:____________________ Slope: __________°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:______________________________

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5 · 4	3 · 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID: MTR-01 **TIME:** 2 : 45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 30 /#	
SITE ID (*Condition-#*): **OT-** 02 **LAT** 41 ° 49 ' 36.2 " **LONG** 72 ° 28 ' 12.1 "	**LMK** _____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☒ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE:

☐ Closed pipe
- **MATERIAL:** ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:
- **SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
- **DIMENSIONS:** Diameter:______ (in)
- **SUBMERGED:** ☐ No ☐ Partially ☐ Fully

☒ Open channel
- **MATERIAL:** ☐ Concrete ☒ Earthen ☐ Other:
- **SHAPE:** ☐ Trapezoid ☐ Parabolic ☐ Other:
- **DIMENSIONS:** Depth: 9.5 (in); Width (Top): 4 (in); " (Bottom): 5 (in)
- **SUBMERGED:** NOT APPLICABLE

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: __________ ft Type of existing vegetation:____________________ Slope: _________ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:______________________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED:	**DATE:** ___/____/___	**ASSESSED BY:**
SURVEY REACH ID: MYR-01	**TIME:** 3 : 00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 31 /#
SITE ID (*Condition-#*): **OT-** 03	**LAT** 41 ° 49 ' 36.9 " **LONG** 72 ° 28 ' 09.2 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Double ☐ Triple ☒ Circular ☐ Elliptical ☐ Other:

DIMENSIONS: Diameter: 14 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☒ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ Storm water retrofit ☐ Other:
☒ no

If yes for daylighting:
Length of vegetative cover from outfall: ______ft Type of existing vegetation:__________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:__________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tankerhoosen River	**DATE:** 6/4/08	**ASSESSED BY:** JS, GA
SURVEY REACH ID: MTR-01	**TIME:** ___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID (*Condition-#*): **OT-** 04	**LAT** 41° 49' 38.1" **LONG** 72° 27.' 57.7" **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 2 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____(in) Width (Top):____(in) " (Bottom):____(in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☑ Other: ABS pipe from yard - unknown purpose

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:____________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tankerhoosen River		**DATE:** 6 / 4 / 08	**ASSESSED BY:** JS, DT, JL, GA
SURVEY REACH ID: MTR-01	**TIME:** 2 : 00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 23 /#	
SITE ID: (*Condition-#*) TR- 01	LAT 41 ° 49 ' 36.0 " LONG 72 ° 28 ' 22.6 " LMK ____		**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☒ Commercial ☐ Residential	☒ Plastic Barrel ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☐ Other:	☐ Unknown ☐ Flooding ☐ Illegal dump ☒ Local outfall	☒ Stream ☐ Riparian Area ☐ Lt bank ☒ Rt bank	☐ Public ☒ Unknown ☐ Private **AMOUNT** (*# Pickup truck loads*): 1.0

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☒ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☒ Unknown	**DUMPSTER WITHIN 100 FT:** ☒ Yes ☐ No ☐ Unknown
	WHO CAN DO IT: ? ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5 4	3	2 1

NOTES:

BLUE PLASTIC 55 GALLON BARREL/DRUM
LABELED ZYKO COLD PRO
DO NOT KNOW IF BARREL IS SEALED OR OPEN

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tenkerhoosen Riv.	**DATE:** 6 / 4 / 08	**ASSESSED BY:** JS, GA, JK, PT
SURVEY REACH ID: MTR-01	**TIME:** 2 : 36 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 28, 29
SITE ID: (*Condition-#*) TR-02	**LAT** 41 ° 49 ' 363 " **LONG** 72 ° 26 ' 15.4 " **LMK** ____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☐ Commercial ☒ Residential	☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☒ Other: Fence posts Beaver Debris	☐ Unknown ☐ Flooding ☐ Illegal dump ☒ Local outfall Vernon DPW Left it	☐ Stream ☒ Riparian Area ☐ Lt bank ☒ Rt bank	☐ Public ☐ Unknown ☒ Private **AMOUNT** (*# Pickup truck loads*): 2 or 3

POTENTIAL RESTORATION CANDIDATE ☒ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☒ Heavy equipment ☐ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☐ No ☐ Unknown
	WHO CAN DO IT: ☒ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5	4	3	2	1

NOTES: We were told by neighbors of site that Vernon DPW came out to remove beaver dam. Debris was piled on either side of stream channel. Debris on residential side was removed by homeowners. Debris on far side was left.

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tankerhoosen River		**DATE:** 6/4/08	**ASSESSED BY:** JS, GA
SURVEY REACH ID: MTR-01	**TIME:** 3:10 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) TR-03	**LAT** 41° 49' 380" **LONG** 72° 28' 008" **LMK** ____		**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**			**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial	☒ Plastic	☐ Paper	☐ Metal	☒ Unknown	☒ Stream	☐ Public ☐ Unknown
☐ Commercial	☐ Tires	☐ Construction	☐ Medical	☐ Flooding	☐ Riparian Area	☒ Private
☒ Residential	☐ Appliances	☐ Yard Waste		☐ Illegal dump	☐ Lt bank	**AMOUNT** (*# Pickup truck loads*): 2 or 3
	☐ Automotive	☐ Other: Five gallon buckets, closed sunk in stream		☐ Local outfall	☒ Rt bank	

POTENTIAL RESTORATION CANDIDATE ☒ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED:** ☐ Heavy equipment ☐ Trash bags ☒ Unknown	**DUMPSTER WITHIN 100 FT:**
	WHO CAN DO IT: ? ☒ Volunteers ☐ Local Gov ☒ Hazmat Team ☐ Other	☒ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access		A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5		4	3	2	1

NOTES:

ARE NOT SURE WHAT THE BUCKETS CONTAIN They ARE COVERED AND SUNK INTO THE RIVER BOTTOM ~16 BUCKETS TOTAL MAYBE MORE

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: MTR-02	**WTRSHD/SUBSHD:** Mindy Tank, Reservoir	**DATE:** 6/4/08	**ASSESSED BY:** JS + GA

START TIME: 3:45 AM/PM (PM circled) LMK: ____	*END* TIME: 4:10 AM/PM (PM circled) LMK: ____	**GPS ID:**
LAT 41° 49' 37.4" LONG 72° 27' 56.5"	LAT 41° 49' 37.4" LONG 72° 27' 50.9"	
DESCRIPTION: STREAM DIVIDES IN TWO LEFT BRANCH	DESCRIPTION: TUNNEL ROAD CULVERT	

RAIN IN LAST 24 HOURS ☐ Heavy rain ☒ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☒ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: Highway/Roadways

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☒ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☒ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Unknown ☒ Sed. deposition ☐ Channelized

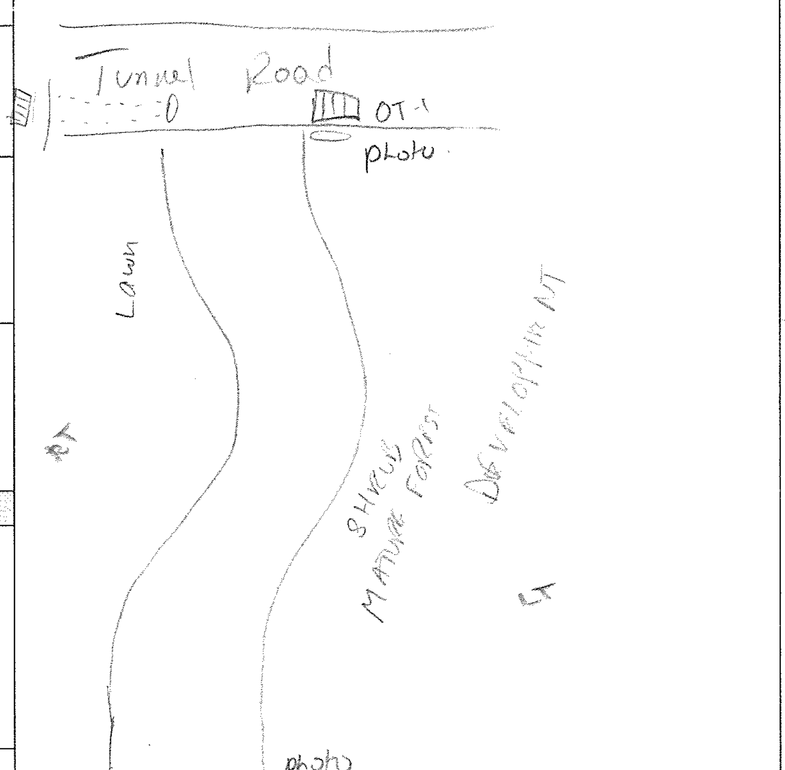
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 15 (ft)
Top 20 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (circled) 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition

	Optimal	Suboptimal	Marginal	Poor
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition

	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

turf mostly on right bank

Sub Total In-stream: 36 /80 + Buffer/Floodplain: 32 /80 = **Total** Survey Reach 88 /160

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 02	**TIME:** 4 : 19 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 49 ' 37.4 " **LONG** 72 ° 27 ' 50.9 " **LMK**_____	**GPS:** (*Unit ID*)

BANK: ☑ LT ☑ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 14 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description: ____________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR - 02 — **TIME:** 4 : 19 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC- 01 — **LAT** 41 ° 49 ' 37.4 " **LONG** 72 ° 27 ' 50.9 " **LMK**____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☑ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☑ Double ☐ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: L - 5.5' R - 4.0' (ft)
Culvert length: ________(ft)
Width: L - 13 R - 13 (ft)
Roadway elevation: 6 (ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☑ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☑ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☑ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☑ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: MTR-07	**WTRSHD/SUBSHD:** Middle Tank Riv.	**DATE:** 6/5/08	**ASSESSED BY:** JS, JK, MA, TDD
START **TIME:** 12:45 AM/PM **LMK:** ____ **LAT** 41° 49' 38.7" **LONG** 72° 27' 51.8" **DESCRIPTION:** Tunnel Road Culvert	*END* **TIME:** 1:45 AM/PM **LMK:** ____ **LAT** 41° 49' 48.4" **LONG** 72° 27' 28.8" **DESCRIPTION:** Confluence of Tank & Clark Brook		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☒ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☒ Industrial park ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE ☐ Silt/clay (fine or slick) ☐ Sand (gritty) ☒ Gravel (0.1-2.5") ☒ Cobble (2.5 –10") ☐ Boulder (>10") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☒ none ☐ some ☐ lots Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☒ Fish ☒ Beaver ☒ Deer ☐ Snails ☒ Other: Raccoon/Songbirds

STREAM SHADING (water surface) ☒ Mostly shaded (≥75% coverage) ☐ Halfway (≥50%) ☐ Partially shaded (≥25%) ☐ Unshaded (< 25%)

CHANNEL DYNAMICS ☐ Downcutting ☒ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized ☐ Unknown

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*

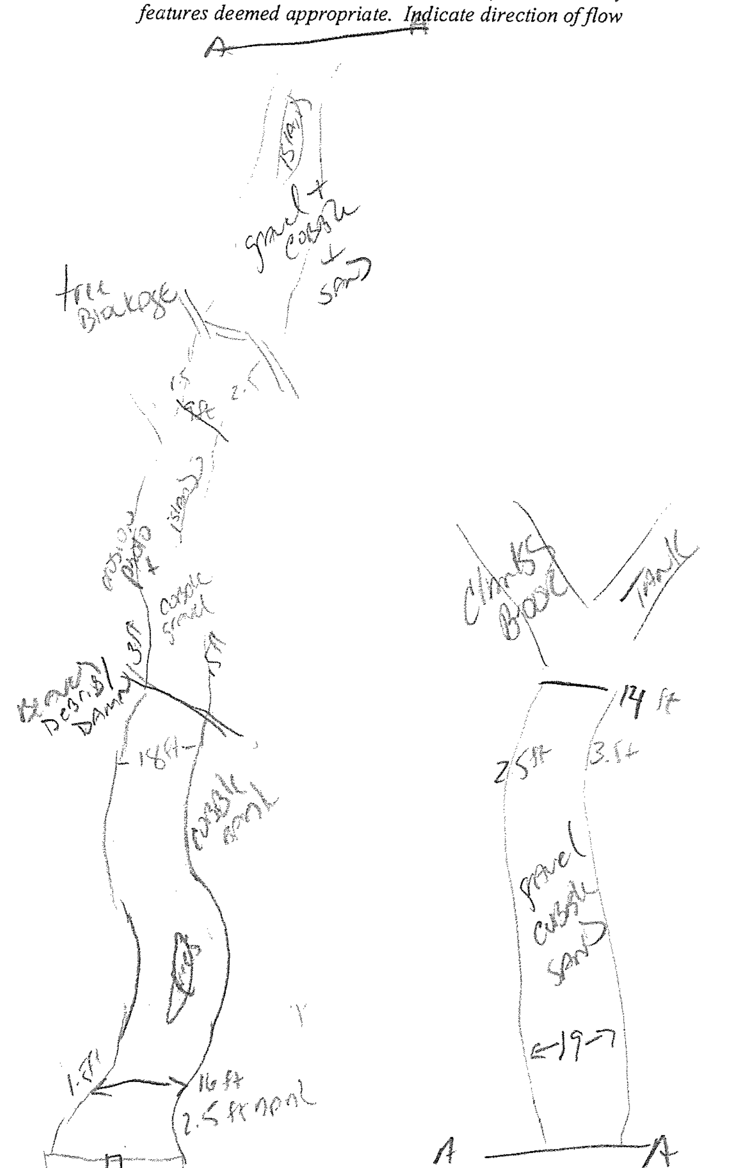
Height:	LT bank	2.5 (ft)
	RT bank	3.5 (ft)
Width:	Bottom	13.5 (ft)
	Top	15.5 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.		Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.		Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5	4	3	2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)* Tunnel Road Drive Culvert

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 69 /80 + Buffer/Floodplain: 70 /80 = **Total** Survey Reach 139 /160

Reach Level Assessment **RCH**

SURVEY REACH ID: MTR-06	**WTRSHD/SUBSHD:** Middle Tank. R.	**DATE:** 6/5/08	**ASSESSED BY:** SS, JC, GA, (Z)

START TIME: 1:49 AM/PM LMK: ____ LAT 41° 49' 44.4" LONG 72° 27' 28.6" **DESCRIPTION:** Convergence of Clarkbrook + Tank.	*END* TIME: 2:52 AM/(PM) LMK: ____ LAT 41° 49' 44.6" LONG 72° 26' 57.1" **DESCRIPTION:** Confluence of Tank/Railroad Brook	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☒ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: OLD FIELD

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE ☐ Silt/clay (fine or slick) ☐ Sand (gritty) ☒ Gravel (0.1-2.5") ☒ Cobble (2.5 –10") ☐ Boulder (>10") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☒ none ☐ some ☐ lots Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☒ Fish ☐ Beaver ☒ Deer ☐ Snails ☒ Other: Songbirds / RACCOON

STREAM SHADING (water surface) ☒ Mostly shaded (≥75% coverage) ☐ Halfway (≥50%) ☐ Partially shaded (≥25%) ☐ Unshaded (< 25%)

CHANNEL DYNAMICS ☐ Downcutting ☒ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized ☐ Unknown

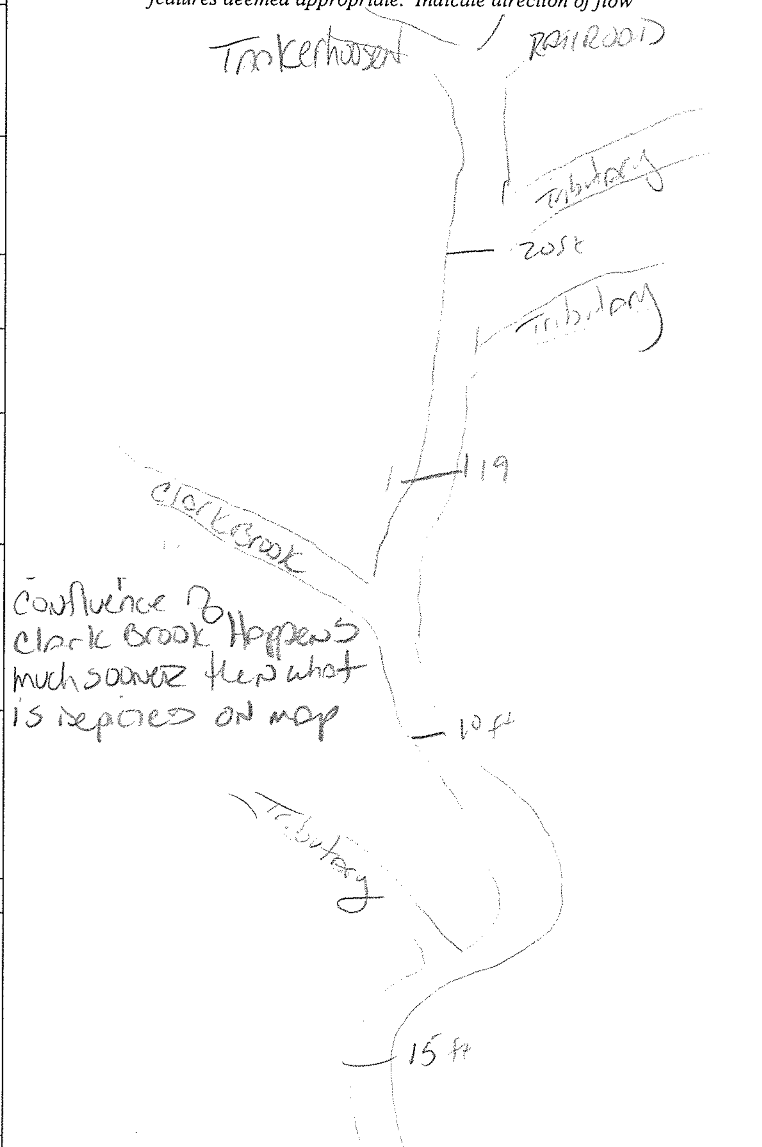
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3.0 (ft) RT bank 3.0 (ft)
Width: Bottom 16 ft (ft) Top 18 ft (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 77 /80 + Buffer/Floodplain: 76 /80 = **Total** Survey Reach 153 /160

Reach Level Assessment **RCH**

SURVEY REACH ID: MTR-9	**WTRSHD/SUBSHD:** Middle Tankerhoosen R.	**DATE:** 6/4/5/08	**ASSESSED BY:** JK, JS, GA, RT

START TIME: 5 : 05 AM/PM LMK: ____	*END* TIME: 11 : 12 AM/PM LMK: ____
LAT 41° 49 37.4" LONG 72° 27' 56.5"	LAT 41° 49 ' 22.6" LONG 72° 27 ' 43.6"
DESCRIPTION: Stream Drive Tank Branch	DESCRIPTION: Tunnel Rd Stream Crossing

GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☒ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☒ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☒ Park rails to trails ☐ Crop ☐ Pasture ☒ Other: Wetlands

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☑ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☒ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☑ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☑ none ☐ some ☐ lots
Floating: ☑ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☑ Deer
☐ Snails ☑ Other: Raccoon

STREAM SHADING (water surface)
☑ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☑ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 4 (ft)
RT bank 4 (ft)
Width: Bottom 6 (ft)
Top 14 (ft)

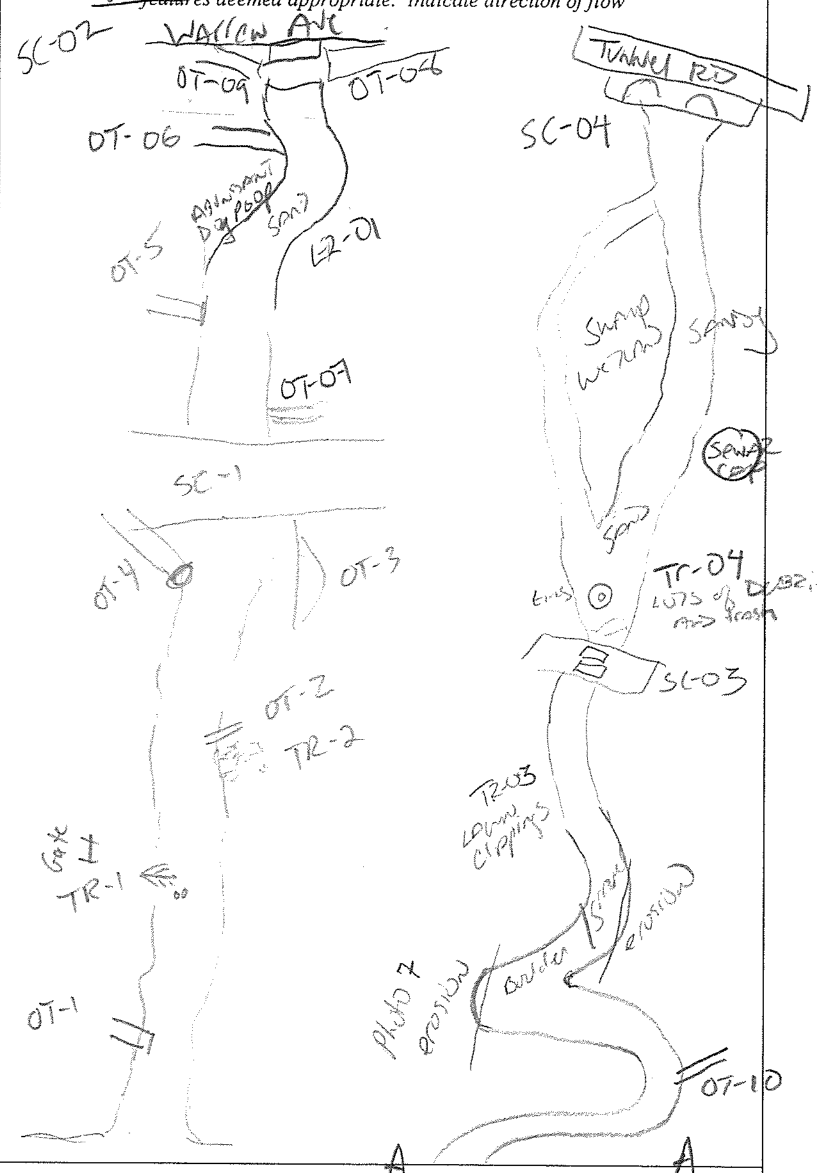
REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.

5 (4) 3 2 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 45 /80 + Buffer/Floodplain: 49 /80 = **Total** Survey Reach 94 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tank River		**DATE:** 6 / 5 / 08	**ASSESSED BY:** JS, JK, GO, PD
SURVEY REACH ID: MTR-09	**TIME:** 10 : 05 AM/PM (AM circled)	**PHOTO ID:** (*Camera-Pic #*) 4 /#	
SITE ID (*Condition-#*): OT-10	**LAT** 41° 49' 27.8" **LONG** 72° 27' 54.0" **LMK**____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☐ Head

FLOW: ☐ None ☒ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☒ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☐ Double ☐ Triple ☐ Circular ☐ Elliptical ☐ Other:

DIMENSIONS: Diameter: 1.5 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☒ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? Land Use description:________________
☐ Yes ☐ No ☐ Not investigated Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4 (circled)	3	2 1

SKETCH/NOTES:

BLACK pipe Coming From Residence / driveway on Warren Ave. Unclear of purpose.
JS this legal?
Silty Discharge / Brown

REPORTED TO AUTHORITIES: ☐ YES ☒ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 06	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09	**TIME:** 5 : 15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 48
SITE ID (*Condition-#*): **OT-** 01	**LAT** 41 ° 49 ' 35.7 " **LONG** 72 ° 27 ' 54.6 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☑ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 8 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top):____ (in)
" (Bottom):____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:______________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? Land Use description:________________
☐ Yes ☐ No ☐ Not investigated Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09	**TIME:** 5 : 32 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) /# 50
SITE ID (*Condition-#*): **OT-** 02	**LAT** 41 ° 49 ' 34.3 " **LONG** 72 ° 27 ' 56.1 " **LMK** ____	**GPS:** (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☑ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☑ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☑ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☑ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☑ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ________ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ____________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 (circled)	2 1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Middle Tank		**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09	**TIME:** 5 : 40 AM/PM (circled: PM)	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): **OT-** 03	**LAT** 41 ° 49 ' 33.1 " **LONG** 72 ° 27 ' 55.9 " **LMK**____		**GPS:** (*Unit ID*)

BANK: ☑ LT ☐ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe | ☐ Open channel

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other: | (Open channel) ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☑ Single ☐ Circular ☐ Double ☑ Elliptical ☐ Triple ☐ Other: | (Open channel) ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Diameter:____(in) 2' wide 10" high | Depth:____(in) Width (Top):____(in) " (Bottom):____(in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully | NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☑ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1 (circled)

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tank		**DATE:** 6 / 4 / 08	**ASSESSED BY:**
SURVEY REACH ID: MTR 09	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): OT- 04	**LAT** ___° ___' ___" **LONG** ___° ___' ___" **LMK** ___		**GPS:** (*Unit ID*)

S/A SC-01

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe
- **MATERIAL:** ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:
- **SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
- **DIMENSIONS:** Diameter: 4 (in)
- **SUBMERGED:** ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel
- **MATERIAL:** ☐ Concrete ☐ Earthen ☐ Other:
- **SHAPE:** ☐ Trapezoid ☐ Parabolic ☐ Other:
- **DIMENSIONS:** Depth: ___ (in) Width (Top): ___ (in) " (Bottom): ___ (in)
- NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ________ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ________

Area available:

OUTFALL SEVERITY: (*circle #*)

5	4	3	2	1
Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09	**TIME:** 5 : 53 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID (*Condition-#*): OT-05	LAT 41 ° 49 ' 31.3 " LONG 72 ° 27 ' 55.0 " LMK____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☑ Single ☑ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____(in) Width (Top): ____(in) " (Bottom): ____(in)

NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:________________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tank		**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09	**TIME:** 6 : 04 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 56	
SITE ID (*Condition-#*): **OT-**06	**LAT** 41 ° 49 ' 29.5 " **LONG** 72 ° 27 ' 54.9 " **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☑ Moderate ☐ Substantial ☐ Other:

TYPE: ☑ Closed pipe

- **MATERIAL:** ☐ Concrete ☐ Metal ☑ PVC/Plastic ☐ Brick ☐ Other:
- **SHAPE:** ☑ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
- **DIMENSIONS:** Diameter: 4 (in)
- **SUBMERGED:** ☑ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

- **MATERIAL:** ☐ Concrete ☐ Earthen ☐ Other:
- **SHAPE:** ☐ Trapezoid ☐ Parabolic ☐ Other:
- **DIMENSIONS:** Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)
- NOT APPLICABLE

CONDITION: ☑ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☑ Other: slight

DEPOSITS/STAINS: ☑ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☑ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☑ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ________ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ________

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Middle Tank	**DATE:** 06/5/08	**ASSESSED BY:** JS, TD, JK, GA
SURVEY REACH ID: MTR-09 — **TIME:** 9 : 49 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 1 /# /	
SITE ID (*Condition-#*): **OT-** 06 — **LAT** 41 ° 49 ' 26.7 " **LONG** 72 ° 27 ' 54.3 "	**LMK**____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☒ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 2 ft ~~(in)~~

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ______ ft Type of existing vegetation: __________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: __________

Area available:

OUTFALL SEVERITY: (*circle #*)

5	4	3	2	1
Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☒ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Middle Tank Rvr	**DATE:** 6 / 5 / 04	**ASSESSED BY:** JS JK GA TD7
SURVEY REACH ID: MR-09	**TIME:** 9 : 51 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 2 /#
SITE ID (*Condition-#*): **OT-** 09	**LAT** 41 ° 49 ' 287 " **LONG** 72 ° 27 ' 843 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☐ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☒ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 2 ft ~~(in)~~

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ______(in) Width (Top): ______(in) " (Bottom): ______(in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: __________ft Type of existing vegetation:____________________ Slope: ________°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:______________________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH: MTR 09	**TIME:** 6 : 00 AM/PM	**PHOTO ID** (CAMERA-PIC #): /#

SITE ID: (*Condition-#*) ER- 01	*START* **LAT** 41 ° 49 ' 29.6 " **LONG** 72 ° 27 ' 54.9 " **LMK** ____ *END* **LAT** ___ ° ___ ' ___ " **LONG** ___ ° ___ ' ___ " **LMK** ____	**GPS:** (*Unit ID*)

PROCESS: ☐ Currently unknown
- ☐ Downcutting
- ☐ Widening
- ☐ Headcutting
- ☐ Aggrading
- ☐ Sed. deposition
- ☐ Bed scour
- ☐ Bank failure
- ☑ Bank scour
- ☐ Slope failure
- ☐ Channelized

BANK OF CONCERN: ☑ LT ☐ RT ☐ Both (*looking downstream*)

LOCATION: ☑ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length (*if no GPS*)	LT 20 ft	and/or RT ____ ft	Bottom width	____ ft
Bank Ht	LT 6 ft	and/or RT 3 ft	Top width	____ ft
Bank Angle	LT ____ °	and/or RT ____ °	Wetted Width	____ ft

LAND OWNERSHIP: ☑ Private ☐ Public ☐ Unknown

LAND COVER: ☐ Forest ☐ Field/Ag ☑ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☑ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☑ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Middle Tank		**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC-01	**LAT** 41° 49' 28.7" **LONG** 72° 27' 54.3" **LMK** ___		**GPS** (*Unit ID*)

S/A of 3 + 4

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☑ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☑ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ______(ft)
Height: 4' (ft)
Culvert length: ______(ft)
Width: 6' (ft)
Roadway elevation: ______(ft)

CONDITION: (*Evidence of…*) ☑ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☑ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☒ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☑ Yes ☐ Unknown 14" drop

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Middle tank, River	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JS, JK, GA
SURVEY REACH ID: MTR-09	**TIME:** 9 : 52 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 3 /#
SITE ID: (*Condition-#*) SC- 02	**LAT** 41 ° 49 ' 267 " **LONG** 72 ° 27 ' 54.3 " **LMK**_____	**GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☒ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☒ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: 5 (ft)
Culvert length: ________(ft)
Width: 10 (ft)
Roadway elevation: 3 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☒ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: *(circle #)*

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Middle Tank River	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JS, JC, GA, RP
SURVEY REACH ID: MTR-09	**TIME:** 10 : 17 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 6 /#
SITE ID: (*Condition-#*) SC- 03	**LAT** 41 ° 49 ' 26.4 " **LONG** 72 ° 27 ' 51.3 " **LMK**____	**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☒ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other: Rails to Trails

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☒ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☒ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☒ Other: Stone Blocks

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: 5 ft (ft) 5 ft
Culvert length: ________(ft)
Width: 3 ft (ft) 3 ft
Roadway elevation: 60 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☒ Other (*describe*): Blocks twisted

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☒ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

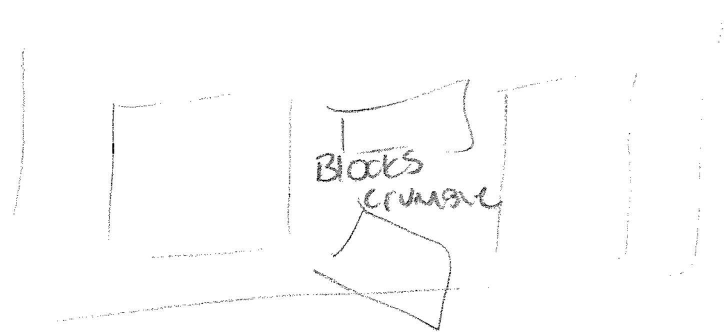
CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

- Rails to Trails culvert
- Looks dangerous in need of repair



REPORTED TO AUTHORITIES ☐ YES ☒ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 5 / 08	**ASSESSED BY:** JK, GA, JS, RD
SURVEY REACH ID: MTR-09	**TIME:** 11 : 12 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 10, 11 /# 4-12
SITE ID: (*Condition-#*) SC-64	**LAT** 41 ° 49 ' 22.6" **LONG** 72 ° 27 ' 43.6" **LMK**____	**GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☒ Circular ☐ Other:

 # BARRELS: ☐ Single ☒ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☒ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4ft 10 in (ft)
Height: ______ (ft)
Culvert length: 50 (ft)
Width: ______ (ft)
Roadway elevation: 3 (ft)

CONDITION: (*Evidence of…*)
☒ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☒ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☒ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☒ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ____ (in)
☐ Flow too shallow Water Depth: ____ (in)
☒ Other: Debris blockage on far end

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 (circled) 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: MTR 09 **TIME:** 5 : 30 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 49	
SITE ID: (*Condition-#*) TR- 01	**LAT** 41 ° 49 ' 34.5 " **LONG** 72 ° 27 ' 55.9 " **LMK** ____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☐ Commercial ☑ Residential	☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☑ Yard Waste ☐ Automotive ☑ Other: Tennis Balls	☐ Unknown ☐ Flooding ☑ Illegal dump ☐ Local outfall	☑ Stream ☑ Riparian Area ☐ Lt bank ☑ Rt bank	☐ Public ☐ Unknown ☑ Private **AMOUNT** (*# Pickup truck loads*): 1/10

POTENTIAL RESTORATION CANDIDATE ☑ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☑ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:**
	WHO CAN DO IT: ☑ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	☑ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5	4	3	2	1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tank	**DATE:** 6/4/08	**ASSESSED BY:** FRIENDS
SURVEY REACH ID: MTR 09 — **TIME:** 5:32 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 51	
SITE ID: (*Condition-#*) TR-02 — **LAT** 41° 49' 34.3" **LONG** 72° 27' 56.1" **LMK** ____		**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☐ Commercial ☑ Residential	☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☑ Yard Waste ☐ Automotive ☐ Other:	☐ Unknown ☐ Flooding ☑ Illegal dump ☐ Local outfall	☑ Stream ☑ Riparian Area ☑ Lt bank ☐ Rt bank	☐ Public ☐ Unknown ☑ Private **AMOUNT** (*# Pickup truck loads*): 1

POTENTIAL RESTORATION CANDIDATE ☑ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☑ Unknown **WHO CAN DO IT:** ☑ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	**DUMPSTER WITHIN 100 FT:** ☑ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5	4 3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tank River	**DATE:** 6 / 5 / 06	**ASSESSED BY:** FRIENDS
SURVEY REACH ID: MTR-09	**TIME:** 10 : 13 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 5 /#
SITE ID: (*Condition-#*) TR- 03	**LAT** 41 ° 49 ' 26.7 " **LONG** 72 ° 27 ' 32.4 " **LMK** ____	**GPS:** (*Unit ID*)

TYPE:
- ☐ Industrial
- ☐ Commercial
- ☒ Residential

MATERIAL:
- ☐ Plastic
- ☐ Paper
- ☐ Metal
- ☐ Tires
- ☐ Construction
- ☐ Medical
- ☐ Appliances
- ☒ Yard Waste
- ☐ Automotive
- ☐ Other:

SOURCE:
- ☐ Unknown
- ☐ Flooding
- ☒ Illegal dump
- ☐ Local outfall

LOCATION:
- ☒ Stream
- ☒ Riparian Area
  - ☐ Lt bank
  - ☐ Rt bank

LAND OWNERSHIP:
- ☐ Public
- ☐ Unknown
- ☒ Private

AMOUNT (*# Pickup truck loads*): 1 or 2

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping ☒ no ☐ Other:

If yes for trash or debris removal

EQUIPMENT NEEDED : ☐ Heavy equipment ☐ Trash bags ☐ Unknown

WHO CAN DO IT: ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other

DUMPSTER WITHIN 100 FT: ☒ Yes ☐ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)

A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
5	4	3	2	1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Middle Tank River	DATE: 6/5/08	ASSESSED BY: JS, PJ, GA, JK
SURVEY REACH ID: MTR-09 / TIME: 10:55 AM/PM	PHOTO ID: (Camera-Pic #) 8, 9 /#	
SITE ID: (Condition-#) TR-04	LAT 41° 49' 24.5" LONG 72° 27' 46.3" LMK ____	GPS: (Unit ID)

TYPE:	MATERIAL:	SOURCE:	LOCATION:	LAND OWNERSHIP:
☐ Industrial ☐ Commercial ☒ Residential	☐ Plastic ☐ Paper ☐ Metal ☒ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☐ Other:	☒ Unknown ☐ Flooding ☐ Illegal dump ☐ Local outfall	☒ Stream ☐ Riparian Area ☐ Lt bank ☐ Rt bank	☐ Public ☐ Unknown ☒ Private AMOUNT (# Pickup truck loads): 2 or 3

POTENTIAL RESTORATION CANDIDATE ☒ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	EQUIPMENT NEEDED : ☒ Heavy equipment ☐ Trash bags ☐ Unknown	DUMPSTER WITHIN 100 FT:
	WHO CAN DO IT: ☒ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	☐ Yes ☒ No ☐ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5	4	3	2	1

NOTES:

LOTS OF DEBRIS / LEAVES / LOGS
TIRES, STUMPS

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): **OT-**_____	**LAT** ___°_____'_____" **LONG** ___°_____'_____" **LMK**_____		**GPS:** (*Unit ID*)

BANK: ☐LT ☐RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE:
☐ Closed pipe

MATERIAL: ☐ Concrete ☐Metal ☐ PVC/Plastic ☐Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter:_____(in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully

☐ Open channel

☐ Concrete ☐ Earthen ☐ Other:

☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: _____(in)
Width (Top):_____(in)
" (Bottom):_____(in)

NOT APPLICABLE

CONDITION: ☐ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐Gas ☐ Sewage ☐Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐Oily ☐ Flow Line ☐ Paint ☐Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐Odors ☐Colors ☐Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	**COLOR:**	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:
OTHER CONCERNS:	☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:	

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization
☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: __________ft Type of existing vegetation:____________________ Slope: __________°

If yes for stormwater:
Is stormwater currently controlled? Land Use description:______________________________
☐ Yes ☐ No ☐ Not investigated Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Severe Bank Erosion **ER**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH: **TIME:**___:____AM/PM	**PHOTO ID** (CAMERA-PIC #): /#	

SITE ID: (*Condition-#*) **ER-**_____	*START* **LAT** ____°____'____" **LONG** ____°____'____" **LMK** _____ *END* **LAT** ____°____'____" **LONG** ____°____'____" **LMK** _____	**GPS:** (*Unit ID*)

PROCESS: ☐ Currently unknown

- ☐ Downcutting
- ☐ Widening
- ☐ Headcutting
- ☐ Aggrading
- ☐ Sed. deposition
- ☐ Bed scour
- ☐ Bank failure
- ☐ Bank scour
- ☐ Slope failure
- ☐ Channelized

BANK OF CONCERN: ☐ LT ☐ RT ☐ Both (*looking downstream)*

LOCATION: ☐ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:

DIMENSIONS:

Length *(if no GPS)*	LT_______ft	and/or RT_________ft	Bottom width _______ft
Bank Ht	LT_______ft	and/or RT__________ft	Top width __________ft
Bank Angle	LT________°	and/or RT________°	Wetted Width _______ft

LAND OWNERSHIP: ☐ Private ☐ Public ☐ Unknown **LAND COVER:** ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☐ Bank stabilization ☐ No ☐ Other:

THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY(*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	Good access: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair access: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult access. Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) IB-______	*START* **LAT** ____°____'____" **LONG** ____°____'____" **LMK** ______ *END* **LAT** ____°____'____" **LONG** ____°____'____" **LMK** ______	**GPS:** (*Unit ID*)	

IMPACTED BANK: ☐ LT ☐ RT ☐ Both

REASON INADEQUATE: ☐ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐:

DOMINANT LAND COVER:	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☐ Partial ☐ Full

WETLANDS PRESENT? ☐ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☐Active reforestation ☐Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT	BANK	RT
Length (ft):	_________		_________
Width (ft):	_________		_________

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

Stream Crossing **SC**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID: **TIME:**___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) **SC-**_____ **LAT** ___°_____'_____" **LONG** ___°_____'_____" **LMK**_____	**GPS** (*Unit ID*)	

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: _________(ft)
Height: _________(ft)
Culvert length: _________(ft)
Width: _________(ft)
Roadway elevation:_________(ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight ($2^o – 5^0$) ☐ Obvious ($>5^o$)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: _____ (in)
☐ Flow too shallow Water Depth:_____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Channel Modification **CM**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) CM-_____	*START* **LAT** ____°____'____" **LONG** ____°____'____" **LMK** _____ *END* **LAT** ____°____'____" **LONG** ____°____'____" **LMK** _____	**GPS:** (*Unit ID*)

TYPE: ☐ Channelization ☐ Bank armoring ☐ concrete channel ☐ Floodplain encroachment ☐ Other:

MATERIAL: ☐ Concrete ☐ Gabion ☐ Rip Rap ☐ Earthen ☐ Metal ☐ Other:	Does channel have perennial flow? ☐ Yes ☐ No Is there evidence of sediment deposition? ☐ Yes ☐ No Is vegetation growing in channel? ☐ Yes ☐ No Is channel connected to floodplain? ☐ Yes ☐ No	**DIMENSIONS:** Height ________________(ft) Bottom Width ________________(ft) Top Width: ________________(ft) Length: ________________(ft)

BASE FLOW CHANNEL Depth of flow _____________(in) Defined low flow channel? ☐ Yes ☐ No % of channel bottom __________%	**ADJACENT STREAM CORRIDOR** Available width LT_________(ft) RT________(ft) Utilities Present? ☐ Yes ☐ No Fill in floodplain? ☐Yes ☐ No

POTENTIAL RESTORATION CANDIDATE ☐ Structural repair ☐ Base flow channel creation ☐ Natural channel design ☐ Can't tell ☐ no ☐ De-channelization ☐ Fish barrier removal ☐ Bioengineering

CHANNEL-IZATION SEVERITY: (*Circle #*)	A long section of concrete stream (>500') channel where water is very shallow (<1" deep) with no natural sediments present in the channel.	A moderate length (> 200') ,but channel stabilized and beginning to function as a natural stream channel. Vegetated bars may have formed in channel.	An earthen channel less than 100 ft with good water depth, a natural sediment bottom, and size and shape similar to the unchannelized stream reaches above and below impacted area.
	5 4	3	2 1

NOTES:

Trash and Debris **TR**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID: **TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) **TR-**_____	**LAT** ___°_____'_____" **LONG** ___°_____'_____" **LMK** _____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☐ Commercial ☐ Residential	☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☐ Yard Waste ☐ Automotive ☐ Other:	☐ Unknown ☐ Flooding ☐ Illegal dump ☐ Local outfall	☐ Stream ☐ Riparian Area ☐ Lt bank ☐ Rt bank	☐ Public ☐ Unknown ☐ Private **AMOUNT** (*# Pickup truck loads*):

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☐ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☐ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☐ No ☐ Unknown
	WHO CAN DO IT: ☐ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5 4	3	2 1

NOTES:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Utility Impacts **UT**

WATERSHED/SUBSHED:	**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:	**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **UT-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**LOCATION:**	**POTENTIAL FISH BARRIER:**	**PIPE DIMENSIONS:**
☐ Leaking sewer ☐ Exposed pipe ☐ Exposed manhole ☐ Other:	☐ Concrete ☐ Corrugated metal ☐ Smooth metal ☐ PVC ☐ Other:	☐ Floodplain ☐ Stream bank ☐ Above stream ☐ Stream bottom ☐ Other:	☐ Yes ☐ No **CONDITION:** ☐ Joint failure ☐ Pipe corrosion/cracking ☐ Protective covering broken ☐ Manhole cover absent ☐ Other:	Diameter: _____in Length exposed: _____ft

EVIDENCE OF DISCHARGE:		
	COLOR	☐ None ☐ Clear ☐ Dark Brown ☐ Lt Brown ☐ Yellowish ☐ Greenish ☐ Other:
	ODOR	☐ None ☐ Sewage ☐ Oily ☐ Sulfide ☐ Chlorine ☐ Other:
	DEPOSITS	☐ None ☐ Tampons/Toilet Paper ☐ Lime ☐ Surface oils ☐ Stains ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Structural repairs ☐ Pipe testing ☐ Citizen hotlines ☐ Dry weather sampling
☐ no ☐ Fish barrier removal ☐ Other:

If yes to fish barrier, Water Drop: ________ (in)

UTILITY IMPACT SEVERITY: (*Circle #*)			
	Section of pipe undermined by erosion and could collapse in the near future; a pipe running across the bed or suspended above the stream; a long section along the edge of the stream where nearly the entire side of the pipe is exposed; or a manhole stack that is located in the center of the stream channel and there is evidence of stack failure.	A moderately long section of pipe is partially exposed but there is no immediate threat that the pipe will be undermined and break in the immediate future. The primary concern is that the pipe may be punctured by large debris during a large storm event.	Small section of exposed pipe, stream bank near the pipe is stable; the pipe is across the bottom of the stream but only a small portion of the top of the pipe exposed; the pipe is exposed but is reinforced with concrete and it is not causing a blockage to upstream fish movement; a manhole stack that is at the edge of the stream and does not extend very far out into the active stream channel.
Leaking= ☐ 5	5	4 3	2 1

NOTES:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:		**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____		**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:		**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____		**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

WATERSHED/SUBSHED:		**DATE:** ___/_____/___	**ASSESSED BY:**
SURVEY REACH ID:		**TIME:**___:____AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) **MI-**_____	**LAT**___°_____'_____" **LONG** ___°_____'_____" **LMK:** _____		**GPS:** (*Unit ID*)

POTENTIAL RESTORATION CANDIDATE ☐ Storm water retrofit ☐ Stream restoration ☐ Riparian Management
☐ no ☐ Discharge Prevention ☐ Other:

DESCRIBE:

REPORTED TO LOCAL AUTHORITIES ☐ Yes ☐ No

Reach Level Assessment **RCH**

SURVEY REACH ID: ______	**WTRSHD/SUBSHD:**	**DATE:** ___/_____/___	**ASSESSED BY:**

START **TIME:**____:____AM/PM **LMK:** ______ **LAT**____°______'______" **LONG** ____°______'______" **DESCRIPTION:**	*END* **TIME:**____:____AM/PM **LMK:** ______ **LAT**____°______'______" **LONG** ____°______'______" **DESCRIPTION:**	**GPS ID:**

RAIN IN LAST 24 HOURS £ Heavy rain £ Steady rain £ None £ Intermittent £ Trace

PRESENT CONDITIONS £ Heavy rain £ Steady rain £ Intermittent £ Clear £ Trace £ Overcast £ Partly cloudy

SURROUNDING LAND USE: £ Industrial £ Commercial £ Urban/Residential £ Suburban/Res £ Forested £ Institutional £ Golf course £ Park £ Crop £ Pasture £ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH	£ 0-25% £ 50%-75% £ 25-50 % £ 75-100%
DOMINANT SUBSTRATE	£ Silt/clay (fine or slick) £ Cobble (2.5 –10") £ Sand (gritty) £ Boulder (>10") £ Gravel (0.1-2.5") £ Bed rock
WATER CLARITY	£ Clear £ Turbid *(suspended matter)* £ Stained *(clear, naturally colored)* £ Opaque *(milky)* £ Other *(chemicals, dyes)*
AQUATIC PLANTS IN STREAM	Attached: £ none £ some £ lots Floating: £ none £ some £ lots
WILDLIFE IN OR AROUND STREAM	(Evidence of) £ Fish £ Beaver £ Deer £ Snails £ Other:
STREAM SHADING (water surface)	£ Mostly shaded (≥75% coverage) £ Halfway (≥50%) £ Partially shaded (≥25%) £ Unshaded (< 25%)
CHANNEL DYNAMICS ☐ Unknown	☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*	Height: LT bank ____________(ft) RT bank ____________(ft) Width: Bottom ____________(ft) Top ____________(ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.

5 4 3 2 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Photo Inventory

(By Camera)

Project: ______________

Group: _______________

Camera: _____________

This field sheet is to be completed AS photos are taken in the field. The intent is to force us to organize pictures taken on a camera basis. Fill out one sheet per camera (add sheets as needed). Only fill in Date/Reach/Location ID when you start in a new spatial or temporal location.

Date	Stream/ Reach	Location ID	Photo #	Description

Date	Stream/ Reach	Location ID	Photo #	Description

Comments:

(BACK)

Reach Level Assessment **RCH**

SURVEY REACH ID: TB-01	**WTRSHD/SUBSHD:** Tucker BK	**DATE:** 7/1/08	**ASSESSED BY:** KB/DB

START **TIME:** 3:00 AM/PM (PM circled) **LMK:** ____ **LAT** 41° 49' 27" **LONG** 72° 29' 16" **DESCRIPTION:** Conf. w/ LTR	*END* **TIME:** 4:00 AM/PM **LMK:** ____ **LAT** 41° 49' 17" **LONG** 72° 29' 13" **DESCRIPTION:** SC-04	**GPS ID:**

RAIN IN LAST 24 HOURS ☒ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☒ Overcast ☒ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☒ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☒ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)*
☒ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☐ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☒ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☒ Bank scour
☒ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

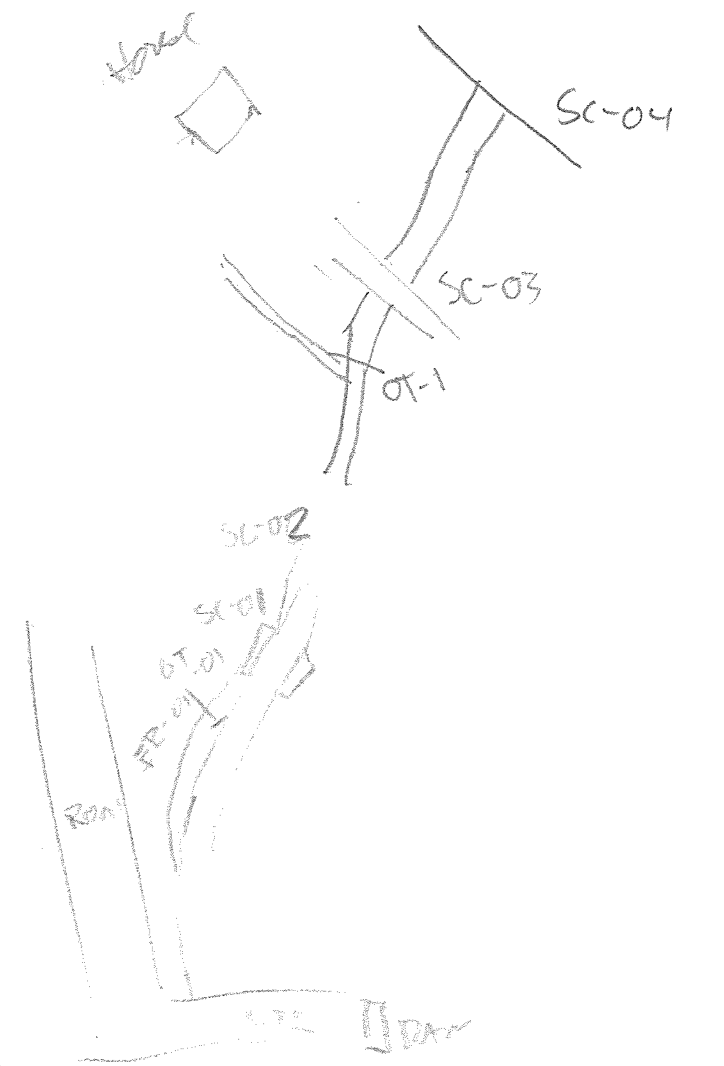
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 12 (ft)
Top 20 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3	2 (circled) 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

Failing industrial-era infrastructure

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: ______ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach ______ /160

Severe Bank Erosion **ER**

WATERSHED/SUBSHED: ~~Tanker~~ Tucker Brk		**DATE:** 7/1/08	**ASSESSED BY:** KB
SURVEY REACH: TB01	**TIME:** 3:15 AM/PM (PM circled)	**PHOTO ID** (CAMERA-PIC #): /#	
SITE ID: (*Condition-#*) ER-01	*START* LAT 41° 49' 26" LONG 72° 29' 15" LMK ____		**GPS:** (*Unit ID*)
	END LAT ___° ___' ___" LONG ___° ___' ___" LMK ____		

PROCESS: ☐ Currently unknown

- ☐ Downcutting
- ☐ Widening
- ☐ Headcutting
- ☐ Aggrading
- ☐ Sed. deposition
- ☐ Bed scour
- ☒ Bank failure
- ☒ Bank scour
- ☐ Slope failure
- ☐ Channelized

BANK OF CONCERN: ☐ LT ☒ RT ☐ Both (*looking downstream*)

LOCATION: ☒ Meander bend ☐ Straight section ☒ Steep slope/valley wall ☐ Other:

DIMENSIONS:

	LT	and/or RT		
Length (*if no GPS*)	___ ft	50 ft	Bottom width	15 ft
Bank Ht	___ ft	10 ft	Top width	20 ft
Bank Angle	___ °	90 °	Wetted Width	10 ft

LAND OWNERSHIP: ☐ Private ☐ Public ☒ Unknown **LAND COVER:** ☒ Forest ☐ Field/Ag ☐ Developed:

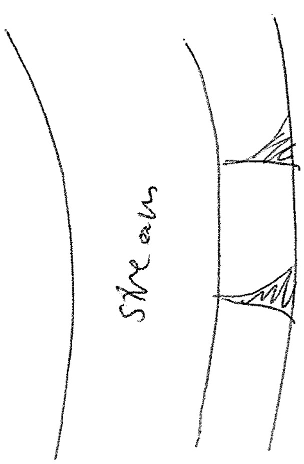
POTENTIAL RESTORATION CANDIDATE: ☐ No ☐ Grade control ☐ Other: ☒ Bank stabilization

THREAT TO PROPERTY/INFRASTRUCTURE: ☒ No ☐ Yes (Describe):

EXISTING RIPARIAN WIDTH: ☒ ≤25 ft ☐ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 (circled)	2 1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4 (circled)	3	2 1

NOTES/CROSS SECTION SKETCH:



Bank being stabilized by trees, roots are hanging out of bank

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: ~~Tanter~~ Tucker | **DATE:** 7 / 1 / 08 | **ASSESSED BY:** KB

SURVEY REACH ID: TB01 | **TIME:** 4 : 00 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /#

SITE ID: (*Condition-#*) SC- 04 | **LAT** 41° 49' 18" | **LONG** 72° 29' 12" | **LMK**_____ | **GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☒ Circular ☐ Other:

 # BARRELS: ☐ Single ☒ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 6 (ft)
Height: 6 (ft)
Culvert length: 100 (ft)
Width: ______ (ft)
Roadway elevation: 15 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☒ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight ($2^\circ - 5^0$) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

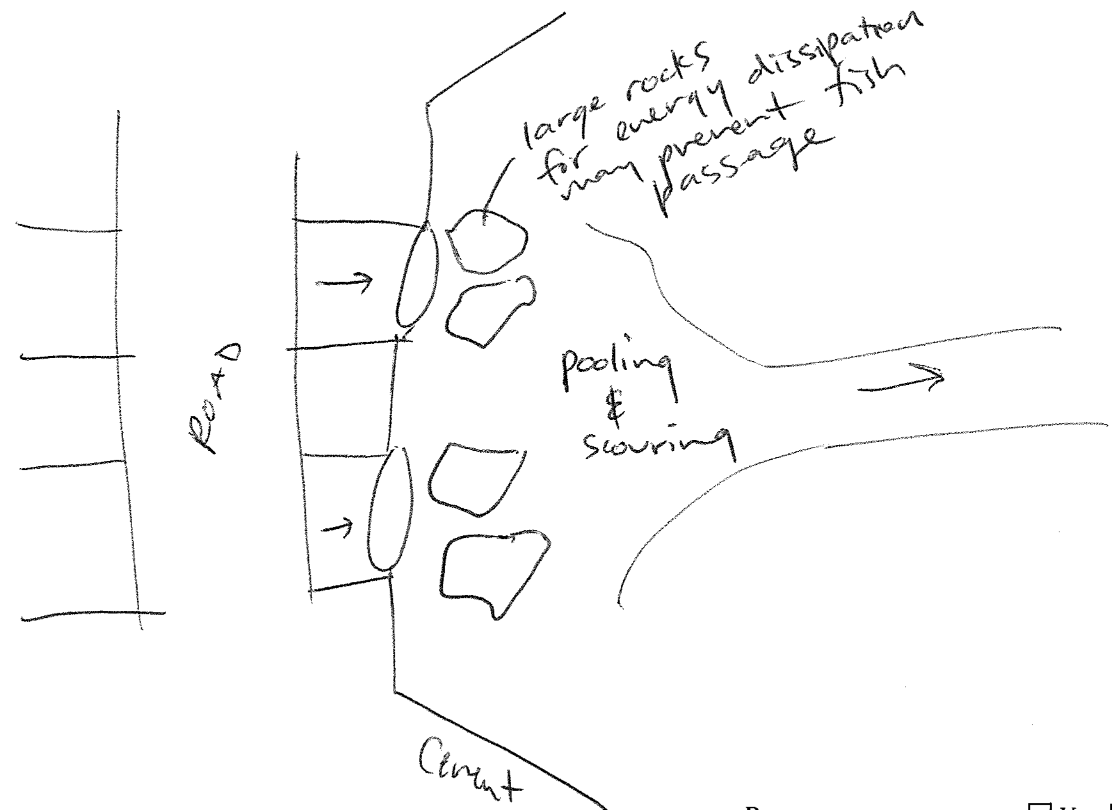
EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☒ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☒ Other: rocks @ ds end

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: ~~Tanker~~ Tucker | **DATE:** 7 / 1 / 08 | **ASSESSED BY:** KB

SURVEY REACH ID: TB01 | **TIME:** 3 : 50 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /#

SITE ID: (*Condition-#*) SC-03 | **LAT** 41° 49 ' 20 " **LONG** 72° 29 ' 14 " | **LMK**____ | **GPS** (*Unit ID*)

TYPE: [x] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [x] Bottomless [x] Box [ ] Elliptical [ ] Circular [ ] Other:

 # BARRELS: [x] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [x] Concrete [ ] Metal [ ] Other:

ALIGNMENT: [x] Flow-aligned [ ] Not flow-aligned [ ] Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 8 (ft)
Height: 8 (ft)
Culvert length: 20 (ft)
Width: ____ (ft)
Roadway elevation: 10 (ft)

CONDITION: (*Evidence of…*)
[ ] Cracking/chipping/corrosion [x] Downstream scour hole
[ ] Sediment deposition [ ] Failing embankment
[ ] Other (*describe*):

CULVERT SLOPE: [ ] Flat [x] Slight (2° – 5°) [ ] Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE [ ] Fish barrier removal [x] Culvert repair/replacement [ ] Upstream storage retrofit
[ ] no [x] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [x] No [ ] Yes [ ] Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
[ ] Total [ ] Partial
[ ] Temporary [ ] Unknown

CAUSE:
[ ] Drop too high Water Drop: ____ (in)
[ ] Flow too shallow Water Depth: ____ (in)
[ ] Other:

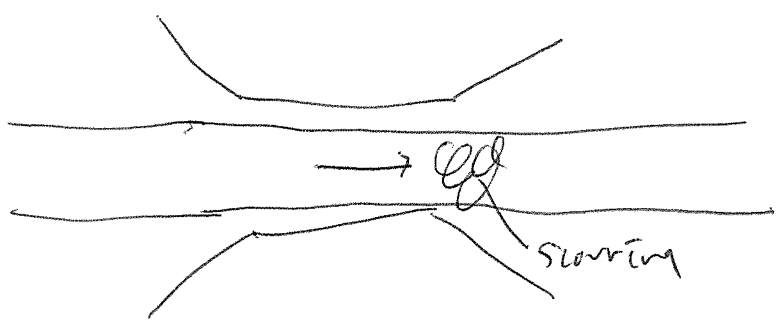
BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

Box covered or abutment w/ deck type crossing
Scoring of bed is occuring downstream
Significant Scoring near and under pilings on abutments



REPORTED TO AUTHORITIES [ ] YES [ ] NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker Bk | **DATE:** 7/1/08 | **ASSESSED BY:** DB

SURVEY REACH ID: TB-01 | **TIME:** 3:15 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /#

SITE ID (*Condition-#*): **OT-** 01 | **LAT** 41° 49' 25" **LONG** 72° 29' 14" | **LMK** ____ | **GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☒ Other: VCP

SHAPE: ☐ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 12 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☐ None ☒ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☒ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ no ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ Storm water retrofit ☒ Other: Removal? Doesn't seem to have use

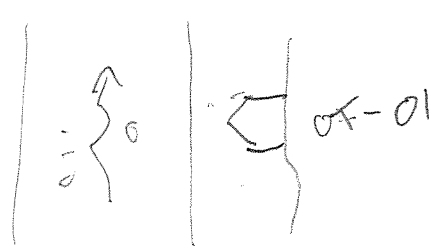
If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation: ____________ Slope: ______°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☒ Not investigated
Land Use description: ____________
Area available:

OUTFALL SEVERITY: (*circle #*)

5	4	3	2	1
Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.

SKETCH/NOTES:



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker		**DATE:** 7/1/08	**ASSESSED BY:** KB
SURVEY REACH ID: TB-01	**TIME:** 2:45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): OT-02	**LAT** 41° 49' 22" **LONG** 72° 29' 13"	**LMK**	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [ ] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [ ] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [ ] Single [ ] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: ____ (in)

SUBMERGED: [ ] No [ ] Partially [ ] Fully

TYPE: [x] Open channel

MATERIAL: [ ] Concrete [x] Earthen [ ] Other:

SHAPE: [x] Trapezoid [ ] Parabolic [ ] Other:

DIMENSIONS: Depth: 36 (in) Width (Top): 5 ft (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [ ] None [x] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY	
COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [x] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ____ °

If yes for stormwater:
Is stormwater currently controlled? [ ] Yes [ ] No [ ] Not investigated
Land Use description: ________
Area available:

OUTFALL SEVERITY: (*circle #*)

5	4	3	2	1
Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.

SKETCH/NOTES:

May be stormwater OT from highway – entrance would be >200ft upstream

REPORTED TO AUTHORITIES: [ ] YES [x] NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Tucker Bk	**DATE:** 7/1/06	**ASSESSED BY:** DB
SURVEY REACH ID: TB-01 **TIME:** 3:20 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 39
SITE ID: (*Condition-#*) SC-01 **LAT** 41° 49' 25" **LONG** 72° 29' 15" **LMK**____		**GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☒ Other: Abutment/deck

 # BARRELS: ☒ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 15 (ft)
Height: NA (ft)
Culvert length: 20 (ft)
Width: ______(ft)
Roadway elevation: NA (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☒ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

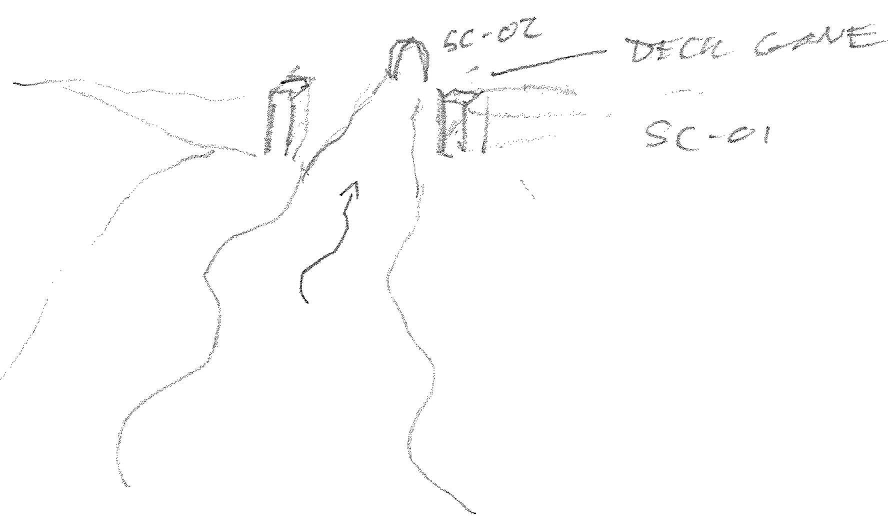
EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☒ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☒ Other: FLOODPLAIN ENCROACHMENT

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Tanter Tucker		**DATE:** 7 / 1 / 08	**ASSESSED BY:** KB
SURVEY REACH ID: TB01	**TIME:** 3:20 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC-02	**LAT** 41° 49' 24" **LONG** 72° 29' 14" **LMK**____		**GPS** (*Unit ID*)

TYPE: [X] ~~Road Crossing~~ [X] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [X] Arch [ ] Box [ ] Circular [ ] Other: [ ] Bottomless [ ] Elliptical

 # BARRELS: [X] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [ ] Concrete [ ] Metal [X] Other: Stone

ALIGNMENT: [X] Flow-aligned [ ] Not flow-aligned [ ] Do not know

CONDITION: (*Evidence of…*) [ ] Cracking/chipping/corrosion [ ] Sediment deposition [ ] Other (*describe*): [X] Downstream scour hole [ ] Failing embankment

CULVERT SLOPE: [ ] Flat [X] Slight (2° – 5°) [ ] Obvious (>5°)

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 6 (ft)
Height: 8 (ft)
Culvert length: 125 (ft)
Width: ________ (ft)
Roadway elevation: 40 (ft)

POTENTIAL RESTORATION CANDIDATE [ ] no [X] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [ ] No [ ] Yes [ ] Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: [X] Total [ ] Partial [ ] Temporary [ ] Unknown

CAUSE: [X] Drop too high Water Drop: 4 (in) [ ] Flow too shallow Water Depth: ______ (in) [ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 — 4 (circled) — 3 — 2 — 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES [ ] YES [X] NO

Impacted Buffer **IB**

WATERSHED/SUBSHED: ~~Tanker~~ Tucker BRK | **DATE:** 7 / 1 / 08 | **ASSESSED BY:** KB

SURVEY REACH: TB01 | **TIME:** 3 : 04 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /# 35,36

SITE ID: (*Condition-#*) IB-01

START LAT 41 ° 49 ' 27 " LONG 72 ° 29 ' 16 " LMK ____

END LAT ___ ° ___ ' ___ " LONG ___ ° ___ ' ___ " LMK ____

GPS: (*Unit ID*)

IMPACTED BANK: ☐ LT ☒ RT ☒ Both

REASON INADEQUATE: ☐ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☒ Other: Bridge abutment / wingwall

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐ :
RT Bank	☐	☐	☐	☐	☐ :

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☒	☐	☒	☐	☐ :
RT Bank	☒	☐	☐	☐	☐	☐	☒ : ROADWAY

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☒ unknown

STREAM SHADE PROVIDED? ☒ None ☐ Partial ☐ Full | **WETLANDS PRESENT?** ☒ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☐ Greenway design ☒ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT (BANK)	RT
Length (ft):	40	30
Width (ft):	20	3

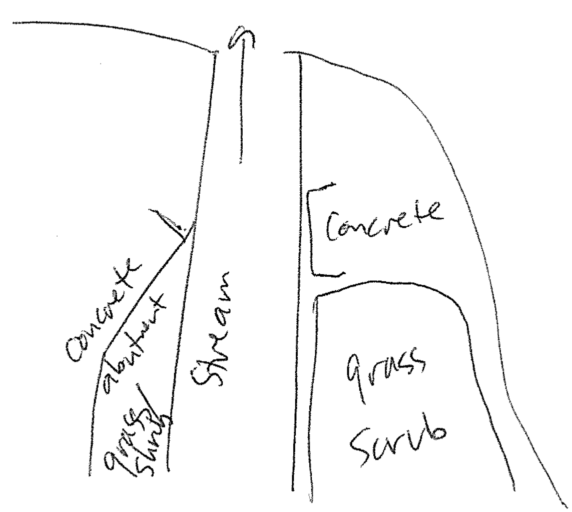
REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5 4	3 2	1 (circled)

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☒ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

left bank could be restored, currently grass/scrub
40 ft upstream has concrete abutment approx 15 ft long
right bank has bridge abutment, no possible restoration



Reach Level Assessment **RCH**

SURVEY REACH ID: TB-02	**WTRSHD/SUBSHD:** Tucker Bk	**DATE:** 7/1/08	**ASSESSED BY:** UB/DB
START **TIME:** ___:___ AM/PM **LMK:** ___ **LAT** 41° 49' 15" **LONG** 72° 29' 11" **DESCRIPTION:**	*END* **TIME:** ___:___ AM/PM **LMK:** ___ **LAT** ___° ___' ___" **LONG** ___° ___' ___" **DESCRIPTION:**		**GPS ID:**

RAIN IN LAST 24 HOURS ☒ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☒ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☒ 0-25% ☐ 25-50 % ☐ 50%-75% ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☒ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☒ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

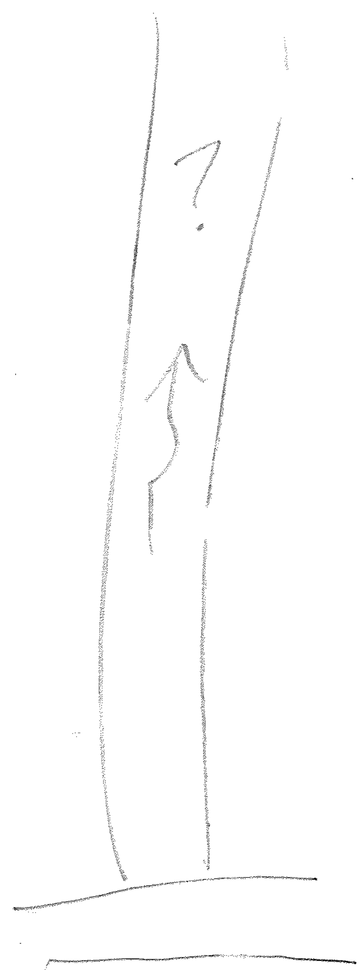
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2 (ft)
RT bank 2 (ft)
Width: Bottom 15 (ft)
Top 30 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 **2**	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

DID NOT WALK REACH – TB-01 INFO LIMITED IN USE

REPORTED TO AUTHORITIES ☐ YES ☐ NO

<table>
<tr><th colspan="5">OVERALL STREAM CONDITION</th></tr>
<tr><th></th><th>Optimal</th><th>Suboptimal</th><th>Marginal</th><th>Poor</th></tr>
<tr><td rowspan="2">IN-STREAM HABITAT
(May modify criteria based on appropriate habitat regime)</td><td>Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).</td><td>40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).</td><td>20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.</td><td>Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.</td></tr>
<tr><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td rowspan="3">VEGETATIVE PROTECTION
(score each bank, determine sides by facing downstream)</td><td>More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.</td><td>70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.</td><td>50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.</td><td>Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.</td></tr>
<tr><td>Left Bank 10 9</td><td>8 7 6</td><td>5 4 3</td><td>2 1 0</td></tr>
<tr><td>Right Bank 10 9</td><td>8 7 6</td><td>5 4 3</td><td>2 1 0</td></tr>
<tr><td rowspan="3">BANK EROSION
(facing downstream)</td><td>Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.</td><td>Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.</td><td>Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure</td><td>Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.</td></tr>
<tr><td>Left Bank 10 9</td><td>8 7 6</td><td>5 4 3</td><td>2 1 0</td></tr>
<tr><td>Right Bank 10 9</td><td>8 7 6</td><td>5 4 3</td><td>2 1 0</td></tr>
<tr><td rowspan="2">FLOODPLAIN CONNECTION</td><td>High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.</td><td>High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.</td><td>High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.</td><td>High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.</td></tr>
<tr><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><th colspan="5">OVERALL BUFFER AND FLOODPLAIN CONDITION</th></tr>
<tr><th></th><th>Optimal</th><th>Suboptimal</th><th>Marginal</th><th>Poor</th></tr>
<tr><td rowspan="3">VEGETATED BUFFER WIDTH</td><td>Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.</td><td>Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.</td><td>Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.</td><td>Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.</td></tr>
<tr><td>Left Bank 10 9</td><td>8 7 6</td><td>5 4 3</td><td>2 1 0</td></tr>
<tr><td>Right Bank 10 9</td><td>8 7 6</td><td>5 4 3</td><td>2 1 0</td></tr>
<tr><td rowspan="2">FLOODPLAIN VEGETATION</td><td>Predominant floodplain vegetation type is mature forest</td><td>Predominant floodplain vegetation type is young forest</td><td>Predominant floodplain vegetation type is shrub or old field</td><td>Predominant floodplain vegetation type is turf or crop land</td></tr>
<tr><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td rowspan="2">FLOODPLAIN HABITAT</td><td>Even mix of wetland and non-wetland habitats, evidence of standing/ponded water</td><td>Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water</td><td>Either all wetland or all non-wetland habitat, evidence of standing/ponded water</td><td>Either all wetland or all non-wetland habitat, no evidence of standing/ponded water</td></tr>
<tr><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
<tr><td rowspan="2">FLOODPLAIN ENCROACH-MENT</td><td>No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures</td><td>Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function</td><td>Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function</td><td>Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function</td></tr>
<tr><td>20 19 18 17 16</td><td>15 14 13 12 11</td><td>10 9 8 7 6</td><td>5 4 3 2 1 0</td></tr>
</table>

Sub Total In-stream: _____ **/80** + Buffer/Floodplain: _____ **/80** = **Total** Survey Reach _____ **/160**

Reach Level Assessment **RCH**

SURVEY REACH ID: TB-03	**WTRSHD/SUBSHD:** Tucker Bk	**DATE:** 7/1/08	**ASSESSED BY:** DE/KB
START **TIME:** 9:00 AM/PM **LMK:** ____ **LAT** 41° 48' 51" **LONG** 72° 29' 14" **DESCRIPTION:** END OF RES. LU	*END* **TIME:** 11:00 AM/PM **LMK:** ____ **LAT** 41° 46' 44" **LONG** 72° 29' __" **DESCRIPTION:** Phoenix RD		**GPS ID:** etrex

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☒ Clear ☐ Trace ☐ Overcast ☒ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE
☒ Silt/clay (fine or slick)
☒ Sand (gritty)
☒ Gravel (0.1-2.5")
☒ Cobble (2.5 –10")
☐ Boulder (>10")
☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☒ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☒ Fish ☐ Beaver ☐ Deer ☐ Snails ☒ Other: crayfish

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☒ Downcutting
☐ Widening
☐ Headcutting
☒ Aggrading
☐ Sed. deposition
☐ Bed scour
☒ Bank failure
☒ Bank scour
☐ Slope failure
☐ Channelized

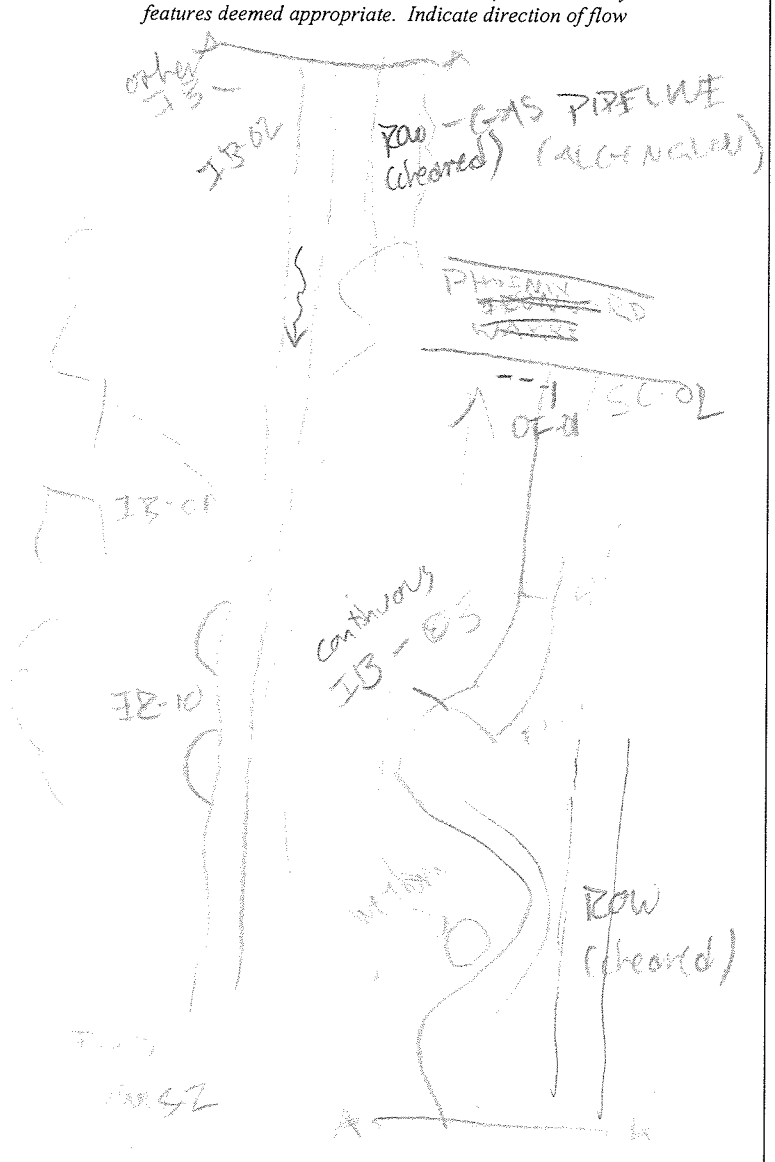
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 3 (ft)
RT bank 3 (ft)
Width: Bottom 6 (ft)
Top 12 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*
IMPACTED BUFFER

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	~~5~~ 4 3	2 1 0
	Right Bank 10 9	8 7 ~~6~~	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker		**DATE:** 7/1/08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB 03	**TIME:** 10:00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): OT-01	**LAT** 41° 48' 44" **LONG** 72° 29' 7" **LMK**____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☒ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 15 (in)

SUBMERGED: ☐ No ☒ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: ____(in) Width (Top):____(in) " (Bottom):____(in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:________________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED: Tucker		**DATE:** 7/1/08	**ASSESSED BY:** KMB
SURVEY REACH: TB-03	**TIME:** 9:45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) IB-03	*START* LAT 41°48'46" LONG 72°29'10" LMK ___		**GPS:** (*Unit ID*)
	END LAT 41°48'44" LONG 72°29'7" LMK ___		

IMPACTED BANK: ☐ LT ☒ RT ☐ Both

REASON INADEQUATE: ☒ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☐: Unknown
RT Bank	☒	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☐	☒	☒	☐	☐: ATV trail
RT Bank	☐	☐	☒	☐	☐	☐	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full

WETLANDS PRESENT? ☒ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☐ Greenway design ☒ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT	BANK	RT
Length (ft):	______		______
Width (ft):	______		______

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting	Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate	Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5 4	3 2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

Impacted Buffer **IB**

WATERSHED/SUBSHED: Tucker		**DATE:** 7/1/08	**ASSESSED BY:** KMB
SURVEY REACH: TB03	**TIME:** 9:29 AM/PM	**PHOTO ID:** (*Camera-Pic #*) #6,7	
SITE ID: (*Condition-#*) IB-02	*START* LAT 41° 48' 49" LONG 72° 29' 13" LMK ___ *END* LAT ___° ___' ___" LONG ___° ___' ___" LMK ___		**GPS:** (*Unit ID*)

IMPACTED BANK: ☒ LT ☐ RT ☐ Both

REASON INADEQUATE: ☒ Lack of vegetation ☒ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☐	☐	☐	☐	☒: ATV trail?
RT Bank	☒	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☒	☐	☐	☐	☒: leaf
RT Bank	☐	☐	☐	☐	☒	☒	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☐ Partial coverage ☐ Extensive coverage ☒ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full

WETLANDS PRESENT? ☒ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☒ Greenway design ☐ Natural regeneration ☐ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):	30	
Width (ft):	20	

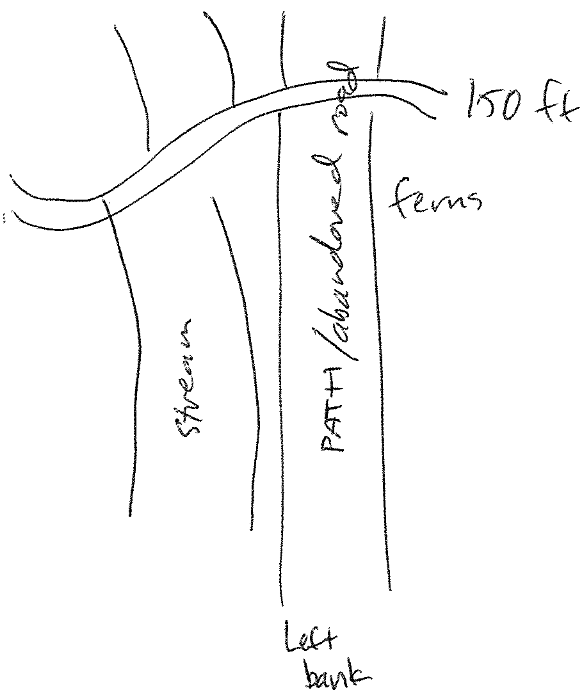
REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	(3)	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☒ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☐ Other:

NOTES:

2 sections



Impacted Buffer **IB**

WATERSHED/SUBSHED: Tucker		**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH: TB03	**TIME:** 9 : 22 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 5
SITE ID: (*Condition-#*) IB-01	*START* **LAT** 41 ° 48 ' 50 " **LONG** 72 ° 29 ' 12 " **LMK** ____ *END* **LAT** ___ ° ___ ' ___ " **LONG** ___ ° ___ ' ___ " **LMK** ____		**GPS:** (*Unit ID*)

IMPACTED BANK: [ ] LT [x] RT [ ] Both

REASON INADEQUATE: [ ] Lack of vegetation [x] Too narrow [x] Widespread invasive plants [ ] Recently planted [ ] Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	[ ]	[ ]	[ ]	[ ]	[x]: Forest
RT Bank	[x]	[ ]	[ ]	[ ]	[ ]:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	[ ]	[ ]	[ ]	[ ]	[ ]	[x]	[ ]:
RT Bank	[ ]	[ ]	[x]	[x]	[x]	[ ]	[ ]:

INVASIVE PLANTS: [x] None [ ] Rare [ ] Partial coverage [ ] Extensive coverage [x] unknown

STREAM SHADE PROVIDED? [ ] None [x] Partial [ ] Full **WETLANDS PRESENT?** [x] No [ ] Yes [ ] Unknown

POTENTIAL RESTORATION CANDIDATE [x] Active reforestation [ ] Greenway design [ ] Natural regeneration [ ] Invasives removal [ ] no [ ] Other:

RESTORABLE AREA

	LT BANK	RT
Length (ft):		50
Width (ft):		20

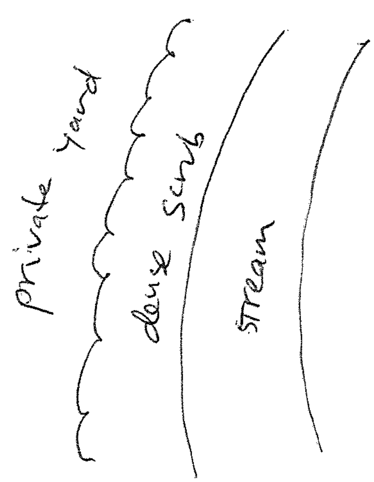
REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

(3 circled)

POTENTIAL CONFLICTS WITH REFORESTATION [ ] Widespread invasive plants [ ] Potential contamination [ ] Lack of sun [ ] Poor/unsafe access to site [ ] Existing impervious cover [ ] Severe animal impacts (deer, beaver) [x] Other: residential

NOTES:



Severe Bank Erosion

ER

WATERSHED/SUBSHED: Tucker	**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH: TB03	**TIME:** 9 : 05 AM/PM	**PHOTO ID** (CAMERA-PIC #): /#
SITE ID: (*Condition-#*) ER- 01	*START* LAT 41 ° 48 ' 51 " LONG 72 ° 29 ' 13 " LMK ____ *END* LAT 41 ° 48 ' 50 " LONG 72 ° 29 ' 12 " LMK ____	**GPS:** (*Unit ID*)

PROCESS: ☐ Currently unknown

☐ Downcutting ☐ Bed scour
☐ Widening ☒ Bank failure
☐ Headcutting ☒ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized

BANK OF CONCERN: ☐ LT ☒ RT ☐ Both (*looking downstream*)
LOCATION: ☒ Meander bend ☐ Straight section ☐ Steep slope/valley wall ☐ Other:
DIMENSIONS:

Length (*if no GPS*)	LT ____ ft	and/or RT 125 ft	Bottom width 5 ft
Bank Ht	LT ____ ft	and/or RT ____ ft	Top width 15 ft
Bank Angle	LT ____ °	and/or RT ____ °	Wetted Width 5 ft

LAND OWNERSHIP: ☒ Private ☐ Public ☒ Unknown **LAND COVER:** ☐ Forest ☐ Field/Ag ☐ Developed:

POTENTIAL RESTORATION CANDIDATE: ☐ Grade control ☒ Bank stabilization
☐ No ☐ Other:

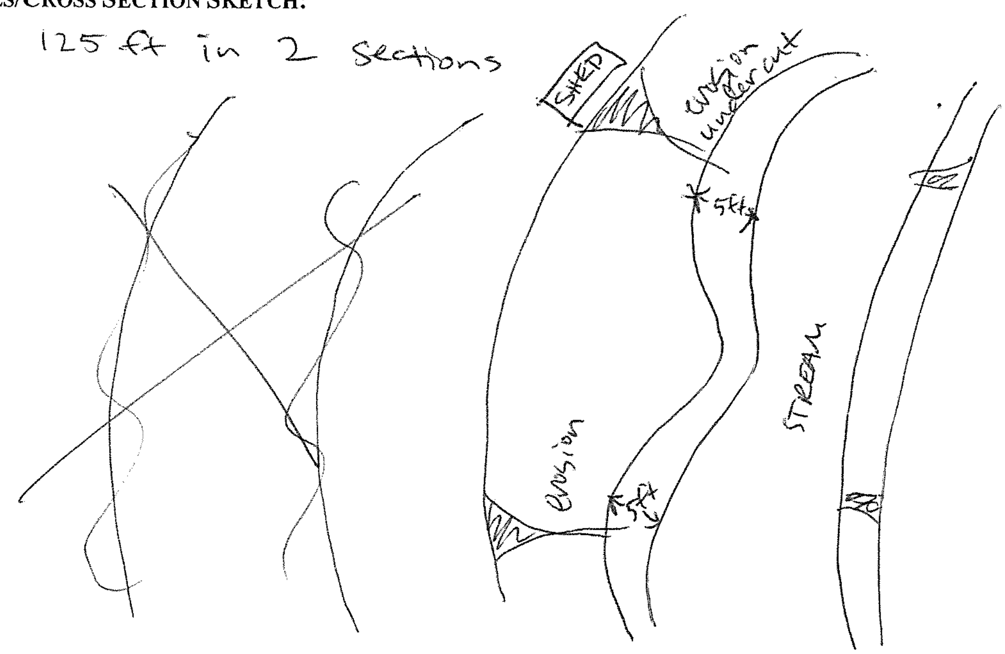
THREAT TO PROPERTY/INFRASTRUCTURE: ☐ No ☒ Yes (Describe): Shed

EXISTING RIPARIAN WIDTH: ☐ ≤25 ft ☒ 25 - 50 ft ☐ 50-75ft ☐ 75-100ft ☐ >100ft

EROSION SEVERITY (*circle#*) Channelized= ☐ 1	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.	Pat downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.
	5 4	3 2	1
ACCESS:	**Good access:** Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair access:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult access.** Must cross wetland, steep slope or other sensitive areas to access stream. Minimal stockpile areas available and/or located a great distance from stream section. Specialized heavy equipment required.
	5 4	3 2	1

NOTES/CROSS SECTION SKETCH:

125 ft in 2 sections



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Tucker Brk		**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB03	**TIME:** ___:___AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 10
SITE ID: (*Condition-#*) SC-01	**LAT** 41 ° 48 ' 45 " **LONG** 72 ° 29 ' 8 "	**LMK**____	**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: ________(ft)
Culvert length: ________(ft)
Width: ________(ft)
Roadway elevation: ________(ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

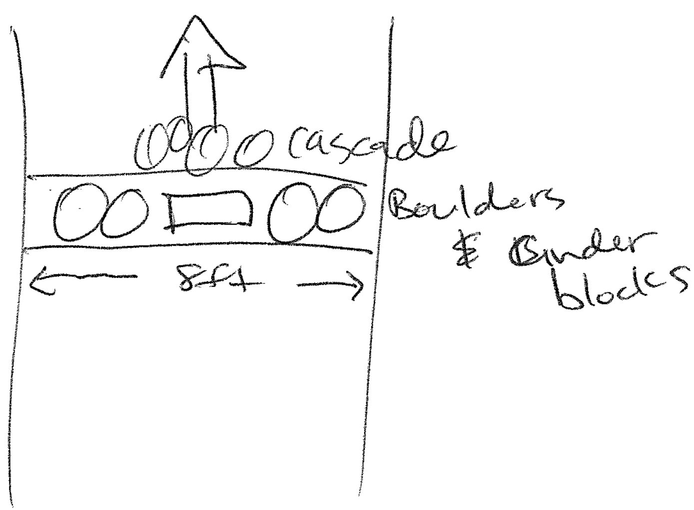
CAUSE:
☒ Drop too high Water Drop: 12 (in)
☒ Flow too shallow Water Depth: <1 (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

5	4	3	2	1
A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.		A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.		A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

Circled: 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: tucker Brk | **DATE:** 7/ 1 / 08 | **ASSESSED BY:** KMB

SURVEY REACH ID: TB03 | **TIME:** 9 : 54 AM/PM | **PHOTO ID:** (*Camera-Pic #*) /# 11

SITE ID: (*Condition-#*) SC- 02 | **LAT** 41° 48 ' 44 " **LONG** 72° 29 ' 7 " **LMK**_____ | **GPS** (*Unit ID*)

TYPE: [X] Road Crossing [ ] Railroad Crossing [ ] Manmade Dam [ ] Beaver Dam [ ] Geological Formation [ ] Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: [ ] Arch [ ] Bottomless [ ] Box [ ] Elliptical [X] Circular [ ] Other:

 # BARRELS: [X] Single [ ] Double [ ] Triple [ ] Other:

MATERIAL: [X] Concrete [ ] Metal [ ] Other:

ALIGNMENT: [X] Flow-aligned [ ] Not flow-aligned [ ] Do not know

CONDITION: (*Evidence of…*) [ ] Cracking/chipping/corrosion [ ] Downstream scour hole [ ] Sediment deposition [ ] Failing embankment [ ] Other (*describe*):

CULVERT SLOPE: [X] Flat [ ] Slight ($2° – 5°$) [ ] Obvious ($>5°$)

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 48 in (ft)
Height: _________(ft)
Culvert length: 30 ft (ft)
Width: _________(ft)
Roadway elevation: 8 (ft)

POTENTIAL RESTORATION CANDIDATE [X] no [ ] Fish barrier removal [ ] Culvert repair/replacement [ ] Upstream storage retrofit [ ] Local stream repair [ ] Other:

IS SC ACTING AS GRADE CONTROL [X] No [ ] Yes [ ] Unknown

If yes for fish barrier

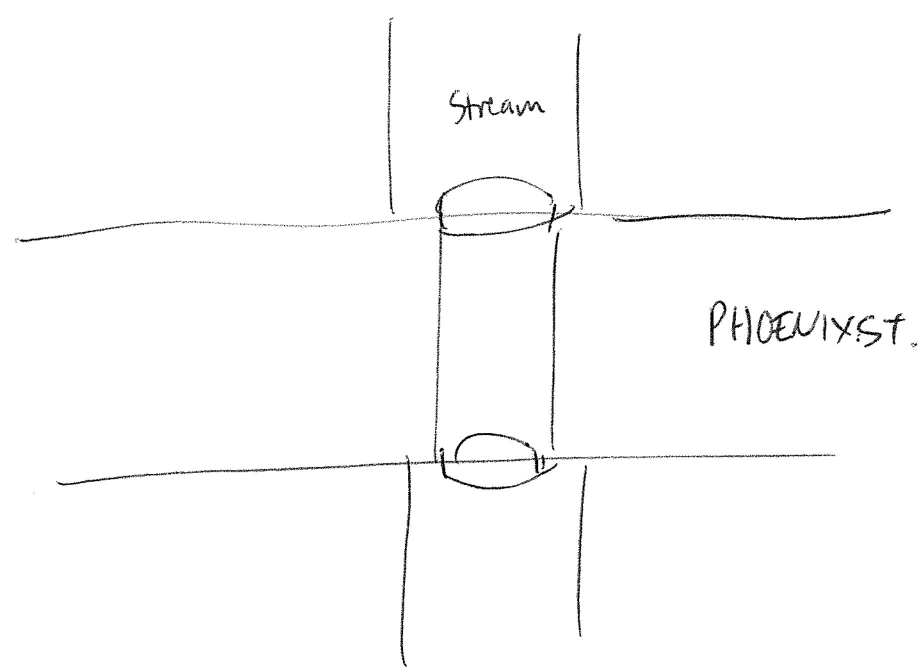
EXTENT OF PHYSICAL BLOCKAGE: [ ] Total [ ] Partial [ ] Temporary [ ] Unknown

CAUSE: [ ] Drop too high Water Drop: ______ (in) [ ] Flow too shallow Water Depth:______ (in) [ ] Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES [ ] YES [ ] NO

Reach Level Assessment **RCH**

SURVEY REACH ID: TB-04A	**WTRSHD/SUBSHD:** Tucker Brk	**DATE:** 7/1/05	**ASSESSED BY:** DB/KS
START **TIME:** 10:30 AM/PM **LMK:** ___ **LAT** 41° 46' 44" **LONG** 42° 29' 07" **DESCRIPTION:** Phoenix Rd		*END* **TIME:** 10:36 AM/PM **LMK:** ___ **LAT** 41° 46' 45" **LONG** 72° 29' 06" **DESCRIPTION:** Pond Outlet/Beaver dam	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☒ Clear ☐ Trace ☐ Overcast ☒ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE
☒ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☐ some ☒ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☒ Beaver ☐ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☒ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition
☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

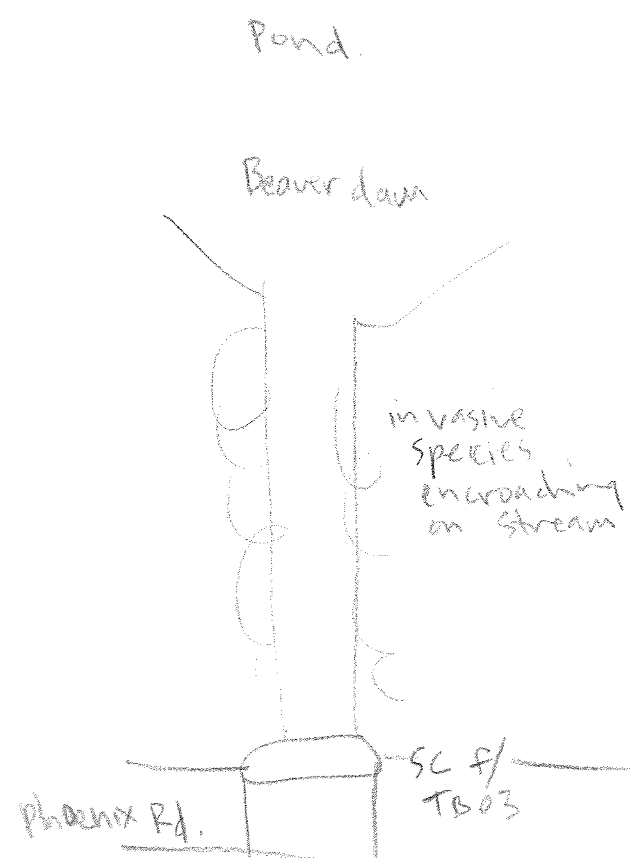
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2 (ft)
RT bank 2 (ft)
Width: Bottom 3 (ft)
Top 15 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 (circled) 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

Beaver dam @ upstream end.

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: ______ /80 + Buffer/Floodplain: ______ /80 = **Total** Survey Reach ______ /160

Reach Level Assessment **RCH**

SURVEY REACH ID: TB04B	**WTRSHD/SUBSHD:** Tucker Brk	**DATE:** 7/1/08	**ASSESSED BY:** DRB KMB
START TIME: 10:52 AM/PM LMK: ___ LAT 41°48'43" LONG 72°29'5" DESCRIPTION: entrance to Beaver Dam		*END* TIME: 11:28 AM/PM LMK: ___ LAT 41°48'73" LONG 72°29'00" DESCRIPTION: residential begins	**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☒ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☒ 25-50 % ☐ 50%-75% ☐ 75-100%

DOMINANT SUBSTRATE
☒ Silt/clay (fine or slick) ☐ Cobble (2.5 –10") ☐ Sand (gritty) ☐ Boulder (>10") ☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ~~☒ Clear~~ ☐ Turbid *(suspended matter)* ☒ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☐ some ☒ lots
Floating: ☐ none ☒ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☒ Beaver ☐ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☒ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☒ Sed. deposition
☐ Bed scour ☐ Bank failure ☒ Bank scour ☐ Slope failure ☐ Channelized

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2 (ft)
RT bank 2 (ft)
Width: Bottom 8 (ft)
Top 12 (ft)

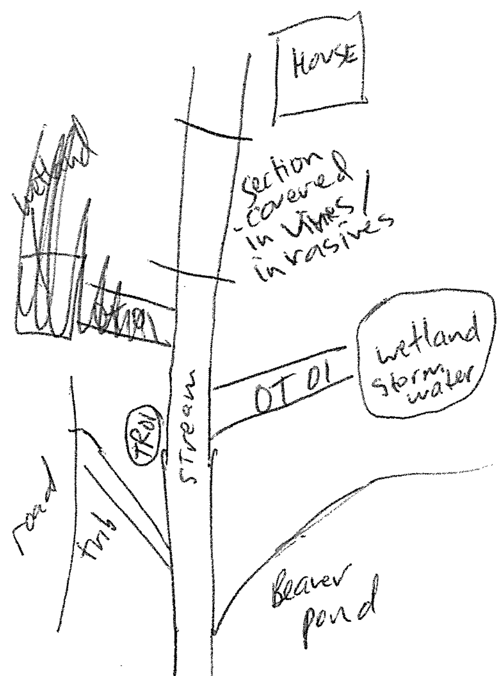
REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.

5 4 3 2 1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*
Invasive species covering stream

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition

	Optimal	Suboptimal	Marginal	Poor
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	~~8~~ 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition

	Optimal	Suboptimal	Marginal	Poor
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker		**DATE:** 7/1/08	**ASSESSED BY:** LMB, DRB
SURVEY REACH ID: TB04B	**TIME:** 11:06 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 22
SITE ID (*Condition-#*): OT-01	**LAT** 41° 48' 44" **LONG** 72° 29' 2"	**LMK**____	**GPS:** (*Unit ID*)

BANK: [X] LT [ ] RT [ ] Head

FLOW: [ ] None [ ] Trickle [X] Moderate [ ] Substantial [ ] Other:

TYPE: [X] Closed pipe

MATERIAL: [X] Concrete [ ] Metal [ ] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [X] Single [X] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 18 (in)

SUBMERGED: [ ] No [X] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [ ] None [X] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [X] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [X] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [X] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [X] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [X] ~~No pool~~ [ ] Good [ ] Odors [ ] Colors [ ] Oils [X] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY	
COLOR:	[X] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
TURBIDITY:	[X] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
FLOATABLES:	[X] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [X] Needs Regular Maintenance [X] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [X] Local stream repair/outfall stabilization [ ] no [X] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ____ °

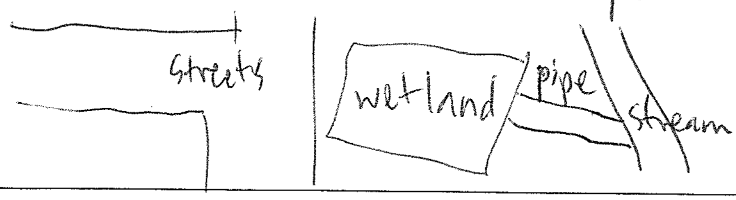
If yes for stormwater:
Is stormwater currently controlled? [X] Yes [ ] No [ ] Not investigated
Land Use description: ________
Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5 4	3 2	1

SKETCH/NOTES:

dry weather flow from small wetland for storm water drainage of residential area.



REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Trash and Debris

TR

WATERSHED/SUBSHED: Tucker	**DATE:** 7/1/08	**ASSESSED BY:** KMB DRB
SURVEY REACH ID: TB04B	**TIME:** 11:02 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 20
SITE ID: (*Condition-#*) TR-01	**LAT** 41° 48' 44" **LONG** 72° 29' 3" **LMK** ____	**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☐ Commercial ☒ Residential	☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☒ Yard Waste ☐ Automotive ☐ Other:	☐ Unknown ☐ Flooding ☒ Illegal dump ☐ Local outfall	☐ Stream ☒ Riparian Area ☐ Lt bank ☒ Rt bank	☐ Public ☐ Unknown ☒ Private **AMOUNT** (*# Pickup truck loads*): 0.5

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment ☒ Removal/prevention of dumping ☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☒ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:**
	WHO CAN DO IT: ☒ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	☐ Yes ☐ No ☒ Unknown

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials
	5 4	3	2 1

NOTES: grass and brush clippings

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: IB-04C	**WTRSHD/SUBSHD:** Nicker Bk	**DATE:** 7/1/08	**ASSESSED BY:** KB/DB

START TIME: 11:30 AM/PM LMK: ____ LAT 41° 48' 43" LONG 72° 29' 00" DESCRIPTION: Backyard	*END* TIME: __:__ AM/PM LMK: ____ LAT __° __' __" LONG __° __' __" DESCRIPTION:	GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☒ Clear ☐ Trace ☐ Overcast ☒ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☒ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☐ Other:

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☐ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☐ some ☐ lots
Floating: ☐ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
☐ Fish ☐ Beaver ☐ Deer
☐ Snails ☐ Other:

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Sed. deposition ☐ Channelized
☐ Unknown

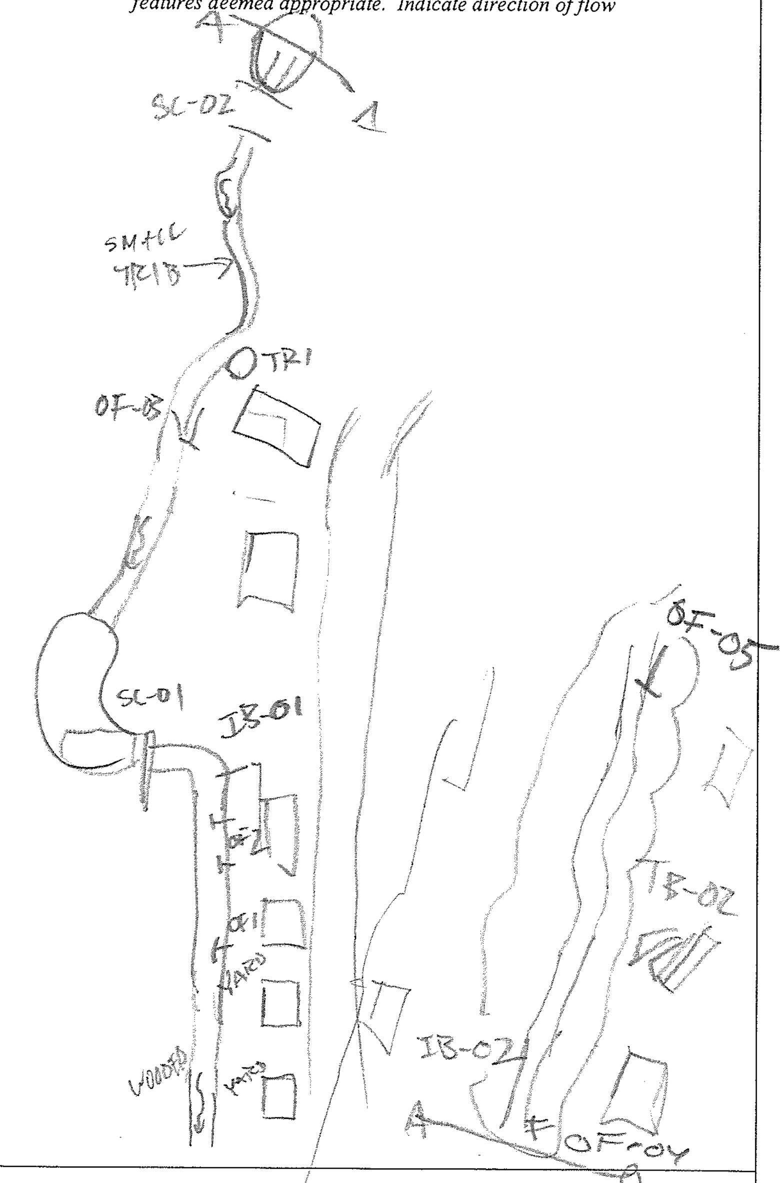
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank ________(ft)
RT bank ________(ft)
Width: Bottom ________(ft)
Top ________(ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroach-ment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: _____ /80 + Buffer/Floodplain: _____ /80 = **Total** Survey Reach _____ /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker	**DATE:** 7/1/08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB04C — **TIME:** 12:08 AM/(PM)	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): OT-04 — **LAT** 41° 48' 43" **LONG** 72° 28' 51"	**LMK** ____	**GPS:** (*Unit ID*)

BANK: [X] LT [ ] RT [ ] Head

FLOW: [ ] None [X] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [X] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [X] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [ ] Single [X] Circular [X] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: 2@ Diameter: 4 (in)

SUBMERGED: [X] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [X] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [X] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [X] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [X] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [ ] None [ ] Brown [X] Orange [ ] Green [ ] Other:

POOL QUALITY: [X] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY	
COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [X] Orange [ ] Red [ ] Other:
TURBIDITY:	[X] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
FLOATABLES:	[X] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [X] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [ ] no [X] Storm water retrofit [ ] Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? [ ] Yes [ ] No [ ] Not investigated

Land Use description: ____________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	3	2	1

SKETCH/NOTES:

Iron ppt

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker	**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB04C	**TIME:** 12:46 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID (*Condition-#*): OT- 05	**LAT** 41 ° 48 ' ~~[illegible]~~ 37 " **LONG** 72° 28 ' 46 " **LMK**____	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [x] None [ ] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [x] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [x] Single [x] Circular [ ] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 8 (in)

SUBMERGED: [x] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [x] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [ ] None [ ] Brown [x] Orange [ ] Green [ ] Other:

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [x] no [ ] Storm water retrofit [ ] Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? [ ] Yes [ ] No [ ] Not investigated
Land Use description: ____________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Tucker Brook	**DATE:** 7/1/08	**ASSESSED BY:** DB
SURVEY REACH ID: TB-04C / **TIME:** 11:45 (AM)/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID (*Condition-#*): OT-02 / **LAT** 41° 48' 44" **LONG** 72° 28' 55"	**LMK**____	**GPS:** (*Unit ID*)

BANK: [x] LT [ ] RT [ ] Head

FLOW: [ ] None [ ] Trickle [ ] Moderate [ ] Substantial [ ] Other:

TYPE: [x] Closed pipe

MATERIAL: [ ] Concrete [ ] Metal [x] PVC/Plastic [ ] Brick [ ] Other:

SHAPE: [ ] Single [x] Circular [x] Double [ ] Elliptical [ ] Triple [ ] Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: [x] No [ ] Partially [ ] Fully

TYPE: [ ] Open channel

MATERIAL: [ ] Concrete [ ] Earthen [ ] Other:

SHAPE: [ ] Trapezoid [ ] Parabolic [ ] Other:

DIMENSIONS: Depth: ____(in) Width (Top):____(in) " (Bottom):____(in)

NOT APPLICABLE

CONDITION: [x] None [ ] Chip/Cracked [ ] Peeling Paint [ ] Corrosion [ ] Other:

ODOR: [x] No [ ] Gas [ ] Sewage [ ] Rancid/Sour [ ] Sulfide [ ] Other:

DEPOSITS/STAINS: [x] None [ ] Oily [ ] Flow Line [ ] Paint [ ] Other:

VEGGIE DENSITY: [x] None [ ] Normal [ ] Inhibited [ ] Excessive [ ] Other:

PIPE BENTHIC GROWTH: [x] None [ ] Brown [ ] Orange [ ] Green [ ] Other:

POOL QUALITY: [x] No pool [ ] Good [ ] Odors [ ] Colors [ ] Oils [ ] Suds [ ] Algae [ ] Floatables [ ] Other:

FOR FLOWING ONLY		
	COLOR:	[ ] Clear [ ] Brown [ ] Grey [ ] Yellow [ ] Green [ ] Orange [ ] Red [ ] Other:
	TURBIDITY:	[ ] None [ ] Slight Cloudiness [ ] Cloudy [ ] Opaque
	FLOATABLES:	[ ] None [ ] Sewage (toilet paper, etc.) [ ] Petroleum (oil sheen) [ ] Other:

OTHER CONCERNS: [ ] Excess Trash (paper/plastic bags) [ ] Dumping (bulk) [ ] Excessive Sedimentation [ ] Needs Regular Maintenance [ ] Bank Erosion [ ] Other:

POTENTIAL RESTORATION CANDIDATE [ ] Discharge investigation [ ] Stream daylighting [ ] Local stream repair/outfall stabilization [ ] no [x] Storm water retrofit [ ] Other: Replace Roof leaders w/ raingarden

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:________ Slope: ______°

If yes for stormwater:

Is stormwater currently controlled? [ ] Yes [x] No [ ] Not investigated

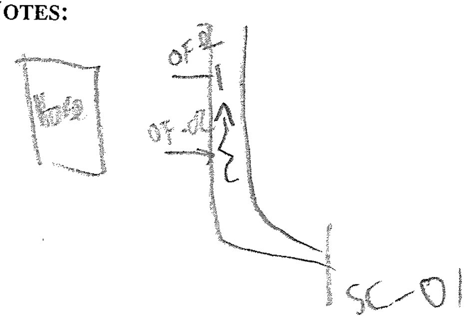
Land Use description:________

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5	4	3	2	(1)

SKETCH/NOTES:



REPORTED TO AUTHORITIES: [ ] YES [ ] NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Tucker		**DATE:** 7/1/08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB04C	**TIME:** 11:55 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 27	
SITE ID (*Condition-#*): OT-03	**LAT** 41° 48' 43" **LONG** 72° 28' 52" **LMK**		**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☒ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ ~~None~~ ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ____________ Slope: ______ °

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description: ____________

Area available:

OUTFALL SEVERITY: (*circle #*)

Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
5	4	3	2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Impacted Buffer **IB**

WATERSHED/SUBSHED: Tucker		DATE: 7/1/08	ASSESSED BY: KMB
SURVEY REACH: TB04 C	TIME: 12:40 AM/PM	PHOTO ID: (Camera-Pic #) /#	
SITE ID: (Condition-#) IB-01	START LAT 41° 48' 43" LONG 72° 29' 00" LMK ____		GPS: (Unit ID)
	END LAT 41° 48' 44" LONG 72° 28' 55" LMK ____		

IMPACTED BANK: ☒ LT ☐ RT ☐ Both

REASON INADEQUATE: ☒ Lack of vegetation ☐ Too narrow ☐ Widespread invasive plants ☐ Recently planted ☐ Other:

LAND USE: (Facing downstream)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	☒	☐	☐	☐	☐:
RT Bank	☒	☐	☐	☐	☐:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	☐	☐	☒	☐	☐	☐	☐:
RT Bank	☐	☐	☐	☐	☒	☒	☐:

INVASIVE PLANTS: ☐ None ☐ Rare ☒ Partial coverage ☐ Extensive coverage ☐ unknown

STREAM SHADE PROVIDED? ☐ None ☒ Partial ☐ Full

WETLANDS PRESENT? ☒ No ☐ Yes ☐ Unknown

POTENTIAL RESTORATION CANDIDATE ☒ Active reforestation ☐ Greenway design ☒ Natural regeneration ☒ Invasives removal ☐ no ☐ Other:

RESTORABLE AREA

	LT	RT
Length (ft):		
Width (ft):	15	

REFORESTATION POTENTIAL: (Circle #)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION ☐ Widespread invasive plants ☐ Potential contamination ☐ Lack of sun ☐ Poor/unsafe access to site ☐ Existing impervious cover ☐ Severe animal impacts (deer, beaver) ☒ Other: residential/private

NOTES:

Impacted Buffer **IB**

WATERSHED/SUBSHED: TB	**DATE:** 7/1/08	**ASSESSED BY:** DRB
SURVEY REACH: TB-04C	**TIME:** 12:15 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) IB-02	*START* LAT 41°48'41" LONG 72°28'50" LMK ____ *END* LAT 41°48'41" LONG 72°28'49" LMK ____	**GPS:** (*Unit ID*)

IMPACTED BANK: [ ] LT [x] RT [ ] Both

REASON INADEQUATE: [x] Lack of vegetation [ ] Too narrow [ ] Widespread invasive plants [ ] Recently planted [ ] Other:

LAND USE: (*Facing downstream*)

	Private	Institutional	Golf Course	Park	Other Public
LT Bank	[x]	[ ]	[ ]	[ ]	[ ]:
RT Bank	[x]	[ ]	[ ]	[ ]	[ ]:

DOMINANT LAND COVER:

	Paved	Bare ground	Turf/lawn	Tall grass	Shrub/scrub	Trees	Other
LT Bank	[ ]	[ ]	[ ]	[ ]	[x]	[ ]	[ ]:
RT Bank	[ ]	[ ]	[ ]	[ ]	[x]	[ ]	[ ]:

INVASIVE PLANTS: [ ] None [ ] Rare [x] Partial coverage [ ] Extensive coverage [ ] unknown

STREAM SHADE PROVIDED? [x] None [ ] Partial [ ] Full

WETLANDS PRESENT? [x] No [ ] Yes [ ] Unknown

POTENTIAL RESTORATION CANDIDATE [x] Active reforestation [ ] Greenway design [x] Natural regeneration [ ] Invasives removal [ ] no [ ] Other:

RESTORABLE AREA

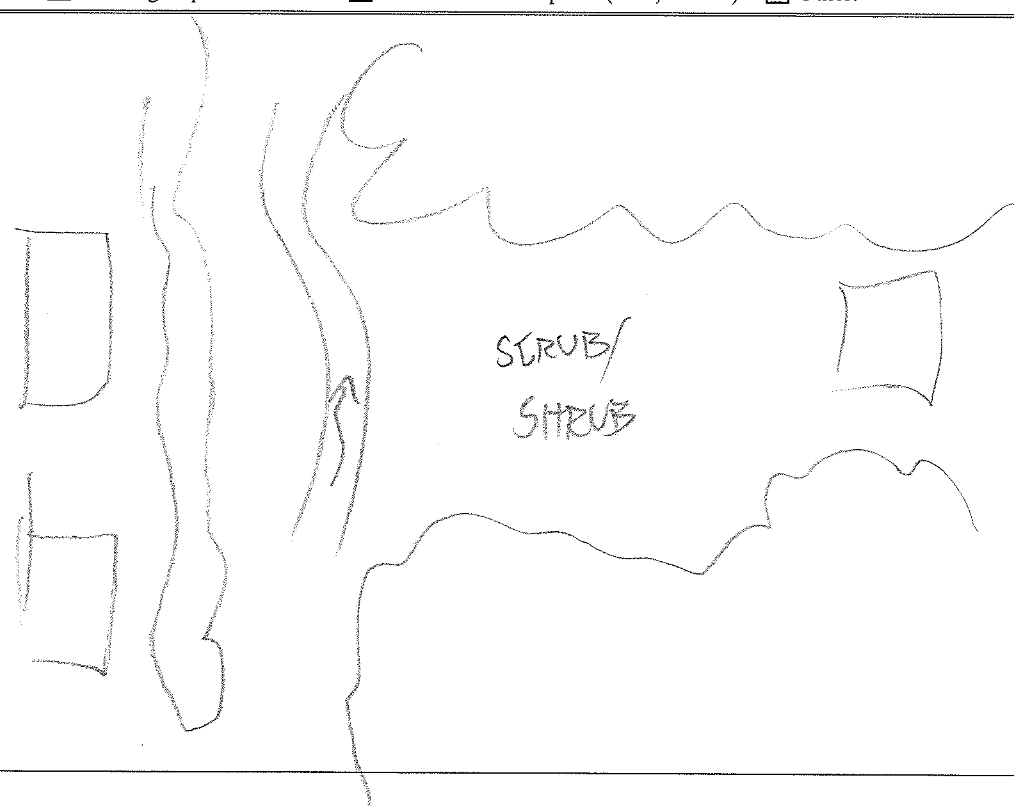
	LT BANK	RT
Length (ft):	90	60
Width (ft):	20	100

REFORESTATION POTENTIAL: (*Circle #*)

Impacted area on public land where the riparian area does not appear to be used for any specific purpose; plenty of area available for planting		Impacted area on either public or private land that is presently used for a specific purpose; available area for planting adequate		Impacted area on private land where road; building encroachment or other feature significantly limits available area for planting
5	4	3	2	1

POTENTIAL CONFLICTS WITH REFORESTATION [ ] Widespread invasive plants [ ] Potential contamination [ ] Lack of sun [ ] Poor/unsafe access to site [ ] Existing impervious cover [ ] Severe animal impacts (deer, beaver) [ ] Other:

NOTES:



Storm Water Outfalls

OT

WATERSHED/SUBSHED: Tucker Brk	**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB DRB
SURVEY REACH ID: TB04C	**TIME:** 11 : 38 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID (*Condition-#*): OT-01	**LAT** 41 ° 48 ' 43 " **LONG** 72 ° 28 ' 57 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☒ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☒ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4 (in)

SUBMERGED: ☒ No ☐ Partially ☐ Fully

☐ Open channel

☐ Concrete ☐ Earthen ☐ Other:

☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in)
Width (Top): ____ (in)
" (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☒ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☒ Green ☐ Other:

POOL QUALITY: ☒ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:____________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Tucker	**DATE:** 7/1/08	**ASSESSED BY:** KMB, DRB
SURVEY REACH ID: TB04C — **TIME:** 11:45 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/#
SITE ID: (*Condition-#*) SC-01 — **LAT** 41° 48' 44" **LONG** 72° 28' 55" **LMK**____		**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☒ Other: Bridge also

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☒ ~~Arch~~ ☐ Box ☐ Circular ☐ Other: ☐ Bottomless ☐ Elliptical

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ______(ft)
Height: ______(ft)
Culvert length: ______(ft)
Width: ______(ft)
Roadway elevation: ______(ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Sediment deposition ☐ Other (*describe*): ☐ Downstream scour hole ☐ Failing embankment

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

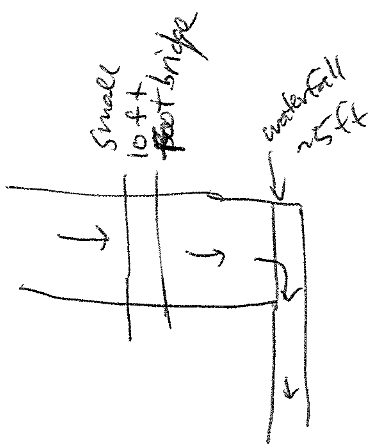
EXTENT OF PHYSICAL BLOCKAGE: ☒ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE: ☒ Drop too high Water Drop: 5ft (in) ☐ Flow too shallow Water Depth:____ (in) ☐ Other:

BLOCKAGE SEVERITY: *(circle #)*

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:



Cement & rock waterfall/dam

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Tucker		**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB04C	**TIME:** ___:___ AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC-07	**LAT** 41° 48' 42" **LONG** 72° 28' 50" **LMK**___		**GPS** (*Unit ID*)

TYPE: ☐ Road Crossing ☐ Railroad Crossing ☒ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: ________(ft)
Height: ________(ft)
Culvert length: ________(ft)
Width: ________(ft)
Roadway elevation: ________(ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☒ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☒ Total ☐ Partial
☐ Temporary ☐ Unknown

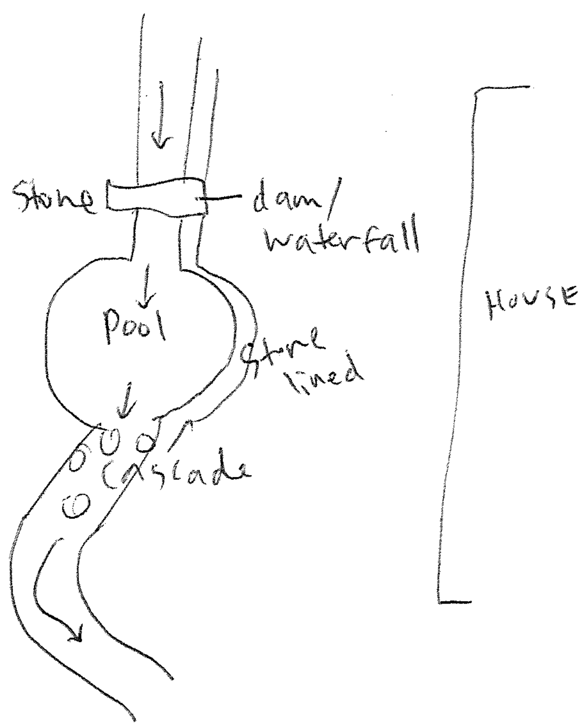
CAUSE:
☒ Drop too high Water Drop: 36 (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☒ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Tucker	**DATE:** 7/1/08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB04C **TIME:** 12:50 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC-03 **LAT** 41° 48' 37" **LONG** 72° 28' 45" **LMK** ____	**GPS** (*Unit ID*)	

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☒ Arch ☐ Box ☐ Circular ☐ Other: ☐ Bottomless ☐ Elliptical

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☒ Other: 6

MATERIAL: ☐ Concrete ☒ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 13 (ft)
Height: 5 (ft)
Culvert length: ~~8~~70 (ft)
Width: ____ (ft)
Roadway elevation: 15 (ft)

CONDITION: (*Evidence of…*) ☐ Cracking/chipping/corrosion ☐ Sediment deposition ☐ Other (*describe*): ☐ Downstream scour hole ☐ Failing embankment

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ no ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE: ☐ Drop too high Water Drop: ____ (in) ☐ Flow too shallow Water Depth: ____ (in) ☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Trash and Debris

TR

WATERSHED/SUBSHED: Tucker	**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB 04C / **TIME:** 12 : 27 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) TR- 02 / **LAT** 41 ° 48 ' 40 " **LONG** 72 ° 28 ' 49 " **LMK**	**GPS:** (*Unit ID*)	

TYPE: ☐ Industrial ☐ Commercial [x] Residential

MATERIAL: ☐ Plastic ☐ Tires ☐ Appliances ☐ Automotive ☐ Paper ☐ Construction [x] Yard Waste ☐ Other: ☐ Metal ☐ Medical

SOURCE: ☐ Unknown ☐ Flooding [x] Illegal dump ☐ Local outfall

LOCATION: ☐ Stream [x] Riparian Area [x] Lt bank ☐ Rt bank

LAND OWNERSHIP: ☐ Public ☐ Unknown [x] Private

AMOUNT (*# Pickup truck loads*): 2

POTENTIAL RESTORATION CANDIDATE ☐ Stream cleanup ☐ Stream adoption segment [x] Removal/prevention of dumping ☐ no ☐ Other:

If yes for trash or debris removal

EQUIPMENT NEEDED : [x] Heavy equipment ☐ Trash bags ☐ Unknown

WHO CAN DO IT: [x] Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other

DUMPSTER WITHIN 100 FT: ☐ Yes ☐ No [x] Unknown

CLEAN-UP POTENTIAL: (*Circle #*)

A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access		A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.	A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
5	4	3	2	1

NOTES: Tree in pieces b/w 2-10 ft long diameter ~ 1ft

REPORTED TO AUTHORITIES ☐ YES [x] NO

Trash and Debris

TR

WATERSHED/SUBSHED: Tucker		**DATE:** 7 / 1 / 08	**ASSESSED BY:** KMB
SURVEY REACH ID: TB04C	**TIME:** 12 : 00 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 28	
SITE ID: (*Condition-#*) TR- 01	**LAT** 41° 48 ' 44 " **LONG** 72° 28 ' 52 " **LMK** ____		**GPS:** (*Unit ID*)

TYPE:	**MATERIAL:**	**SOURCE:**	**LOCATION:**	**LAND OWNERSHIP:**
☐ Industrial ☐ Commercial ☒ Residential	☐ Plastic ☐ Paper ☐ Metal ☐ Tires ☐ Construction ☐ Medical ☐ Appliances ☒ Yard Waste ☐ Automotive ☐ Other:	☐ Unknown ☐ Flooding ☒ Illegal dump ☐ Local outfall	☐ Stream ☒ Riparian Area ☐ Lt bank ☒ Rt bank	☒ ~~Public~~ ☐ Unknown ☒ Private **AMOUNT** (*# Pickup truck loads*): 1

POTENTIAL RESTORATION CANDIDATE ☒ Stream cleanup ☐ Stream adoption segment ☒ Removal/prevention of dumping
☐ no ☐ Other:

If yes for trash or debris removal	**EQUIPMENT NEEDED :** ☐ Heavy equipment ☒ Trash bags ☐ Unknown	**DUMPSTER WITHIN 100 FT:** ☐ Yes ☐ No ☒ Unknown
	WHO CAN DO IT: ☒ Volunteers ☐ Local Gov ☐ Hazmat Team ☐ Other	

CLEAN-UP POTENTIAL: (*Circle #*)	A small amount of trash (i.e., less than two pickup truck loads) located inside a park with easy access	A large amount of trash, or bulk items, in a small area with easy access. Trash may have been dumped over a long period of time but it could be cleaned up in a few days, possibly with a small backhoe.		A large amount of trash or debris scattered over a large area, where access is very difficult. Or presence of drums or indications of hazardous materials	
	5	4	3	2	1

NOTES: pile of leaves and yard clippings

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: WR01	**WRTSHD/SUBSHD:** Walker Reservoir	**DATE:** 6/4/08	**ASSESSED BY:** GA, Jock, JS, RT
START **TIME:** 10:26 AM/PM **LMK:** ____ **LAT** 41° 50' 56.0" **LONG** 72° 26' 11.3" **DESCRIPTION:** Walker's Res. West	*END* **TIME:** 10:35 AM/PM **LMK:** ____ **LAT** 41° 50' 57.7" **LONG** 72° 26' 14.0" **DESCRIPTION:** culvert at I-84		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☒ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☒ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: Highway

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☒ 0-25% ☐ 25-50 % ☐ 50%-75% ☐ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick) ☐ Cobble (2.5–10") ☒ Sand (gritty) ☐ Boulder (>10") ☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)* NO WATER IN most of Reach

AQUATIC PLANTS IN STREAM
Attached: ☒ none ☐ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☒ Deer ☐ Snails ☐ Other:

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☒ Sed. deposition
☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

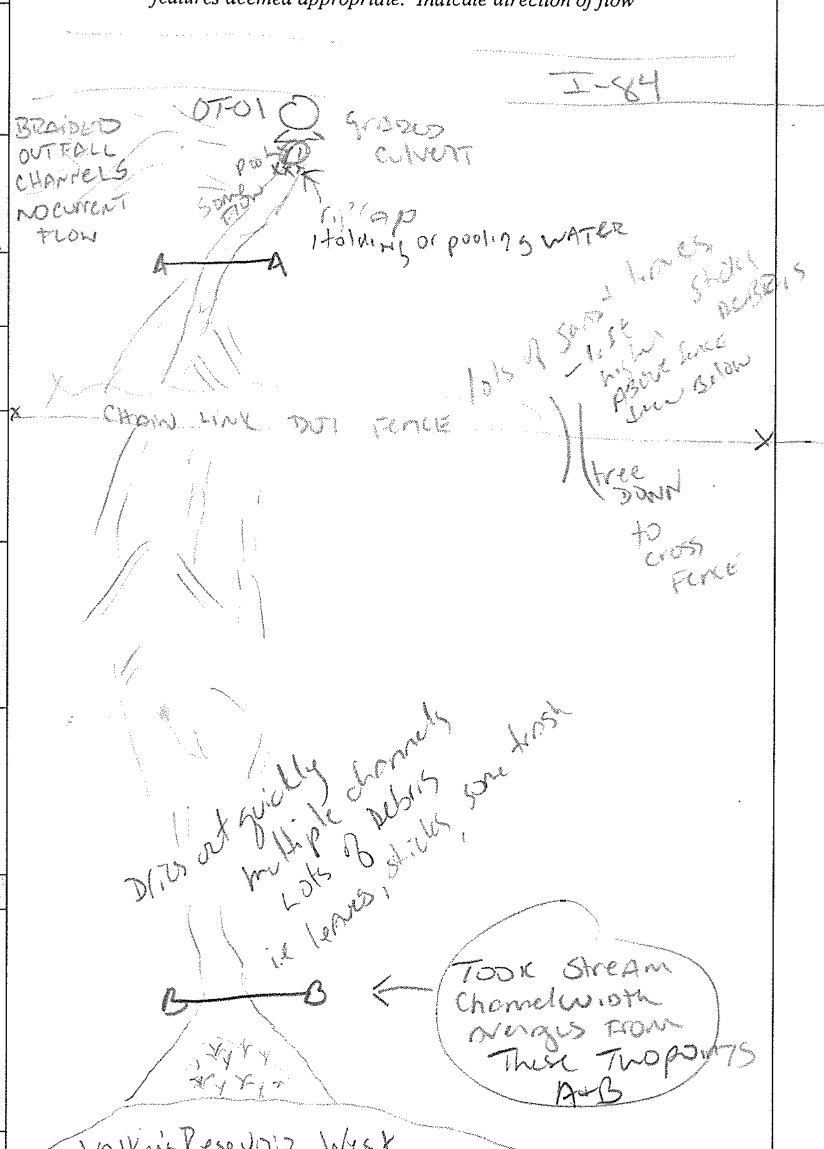
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)* Braided flow channel NO TRUE channel or Heights
Height: LT bank no Bank (ft)
RT bank no Bank (ft)
Width: Bottom 35 (ft)
Top 55 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4 (circled)	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

OVERALL STREAM CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream) no banks	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 0 /80 + Buffer/Floodplain: 35 /80 = **Total** Survey Reach 35 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Wallkins Reservoir		**DATE:** 6/4/08	**ASSESSED BY:** JK, GA, JS, TT
SURVEY REACH ID: WR01	**TIME:** 10:35 AM/PM	**PHOTO ID:** (*Camera-Pic #*) 16 /#	
SITE ID (*Condition-#*): OT-01	**LAT** 41° 50 ' 37.7 " **LONG** 72° 76 ' 14.0 " **LMK**____		**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe — **MATERIAL:** ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other: — **SHAPE:** ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other: See sketch — **DIMENSIONS:** Diameter:____ (in) — **SUBMERGED:** ☐ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel — **MATERIAL:** ☐ Concrete ☒ Earthen ☐ Other: — **SHAPE:** ☐ Trapezoid ☐ Parabolic ☐ Other: — **DIMENSIONS:** Depth:____ (in) Width (Top):____ (in) " (Bottom):____ (in) — *NOT APPLICABLE*

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☒ Other: Excessive debris

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☒ Other: Clean up leaves/sticks/trash

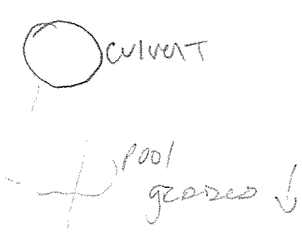
If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________ Slope: ______°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:____________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

BRAIDED DEBRIS CHANNEL
- NO CURRENT FLOW
- LOTS OF LEAVES, STICKS & SOME TRASH



REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Walker's Reservoir | **DATE:** 6 / 4 / 08 | **ASSESSED BY:** JK, GA, JS, TJ

SURVEY REACH ID: WR01 | **TIME:** ___:___ AM/PM | **PHOTO ID:** (*Camera-Pic #*) /# 13 + 14

SITE ID: (*Condition-#*) SC- 01 | **LAT** 41 ° 50 ' 37.7 " **LONG** 72 ° 26 ' 14.0 " **LMK**____ | **GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☒ Circular ☐ Other:

 # BARRELS: ☒ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☒ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 2.0 (ft)
Height: ______(ft)
Culvert length: ~ 650 (ft)
Width: ______(ft)
Roadway elevation: 20 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☒ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☒ Other: Remove Debris

IS SC ACTING AS GRADE CONTROL ☐ No ☒ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: WR02	**WTRSHD/SUBSHD:** Walkers Reservoir	**DATE:** 6/4/08	**ASSESSED BY:** JK GA, JS, RT
START TIME: 11:35 AM/PM LMK: ____ LAT 41° 50' 54.3" LONG 72° 26' 26.4" DESCRIPTION: I-84 culvert	*END* TIME: 11:40 AM/PM LMK: ____ LAT 41° 50' 52.0" LONG 72° 26' 23.9" DESCRIPTION: I-84 culvert Sedge Fen Pond		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☒ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☒ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: Highway + Pond

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☒ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE ☐ Silt/clay (fine or slick) ☒ Cobble (2.5 –10") riprap ☒ Sand (gritty) ☐ Boulder (>10") ☒ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☒ none ☐ some ☐ lots Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☒ Deer ☐ Snails ☐ Other:

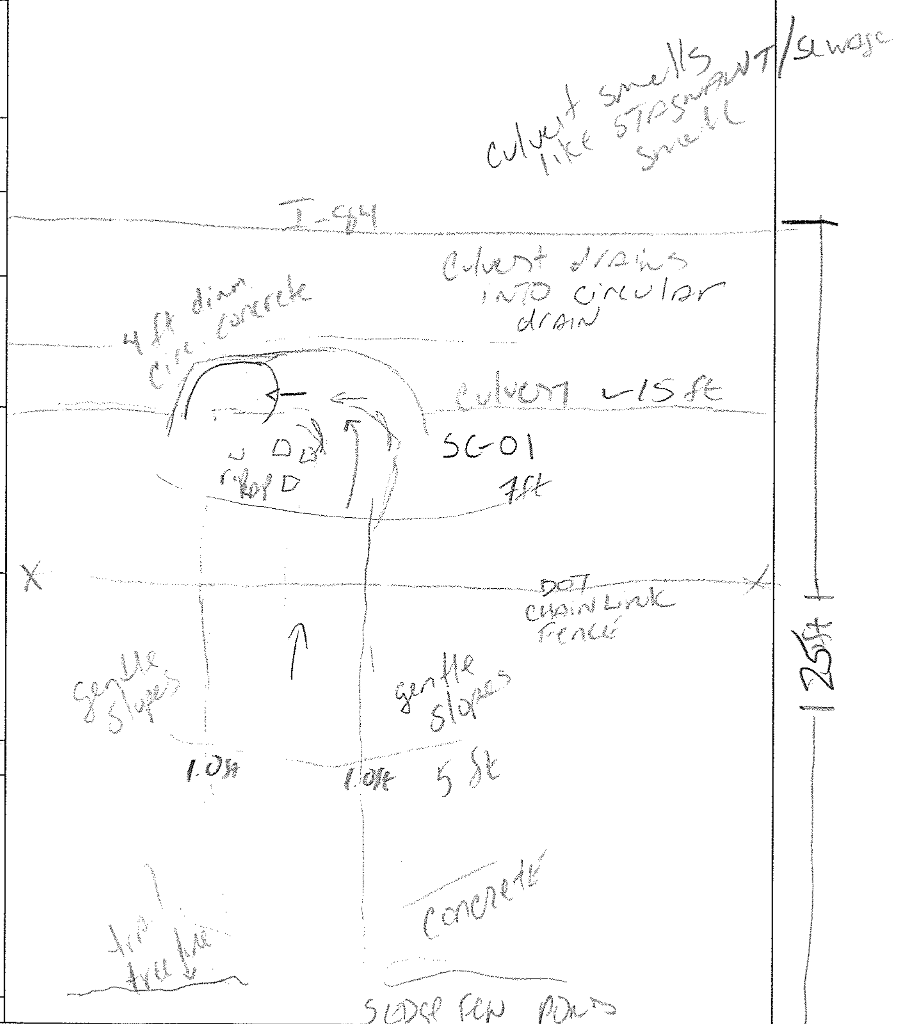
STREAM SHADING (water surface) ☒ Mostly shaded (≥75% coverage) ☐ Halfway (≥50%) ☐ Partially shaded (≥25%) ☐ Unshaded (< 25%)

CHANNEL DYNAMICS Channel only 25 ft long ☐ Unknown ☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☐ Sed. deposition ☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☐ Channelized

CHANNEL DIMENSIONS *(FACING DOWNSTREAM)* Height: LT bank 1.0 (ft) RT bank 1.0 (ft) Width: Bottom 12 ft (ft) Top 8 ft (ft)

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4	3 2	1

(3 circled)

NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 47 /80 + Buffer/Floodplain: 33 /80 = **Total** Survey Reach 80 /160

Stream Crossing **SC**

WATERSHED/SUBSHED: Walker's Reservoir	**DATE:** 6 / 4 / 06	**ASSESSED BY:** JK, GA, JS, TD
SURVEY REACH ID: WR02	**TIME:** 11 : 40 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#
SITE ID: (*Condition-#*) SC- 01	**LAT** 41° 50 ' 52.0" **LONG** 72° 26 ' 23.9 " **LMK**____	**GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☒ Circular ☐ Other:

 # BARRELS: ☒ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4 ft. (ft)
Height: ________(ft)
Culvert length: 325 (ft)
Width: ________(ft)
Roadway elevation: 25 (ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☒ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3	2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: WR03 | **WTRSHD/SUBSHD:** Walker's Reservoir | **DATE:** 6 / 3 / 08 | **ASSESSED BY:** Renee George, Jane

START **TIME:** 3 : 10 AM/PM (PM circled) **LMK:** ____
LAT 41 ° 51 ' 07.1 " **LONG** 72 ° 25 ' 44.4 "
DESCRIPTION: 1st reach upstream from Reservoir

END **TIME:** 3 : 35 AM/PM (PM circled) **LMK:** ____
LAT 41 ° 51 ' 07.8 " **LONG** 72 ° 25 ' 42.8 "
DESCRIPTION: End of reach at Culvert

GPS ID:

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☒ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: old FIELD

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 50%-75% ☐ 25-50 % ☒ 75-100%

DOMINANT SUBSTRATE
☒ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☒ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM
(Evidence of)
☒ Fish ☒ Beaver ☒ Deer
☒ Snails ☒ Other: Birds

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☒ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☐ Unknown ☒ Sed. deposition ☐ Channelized

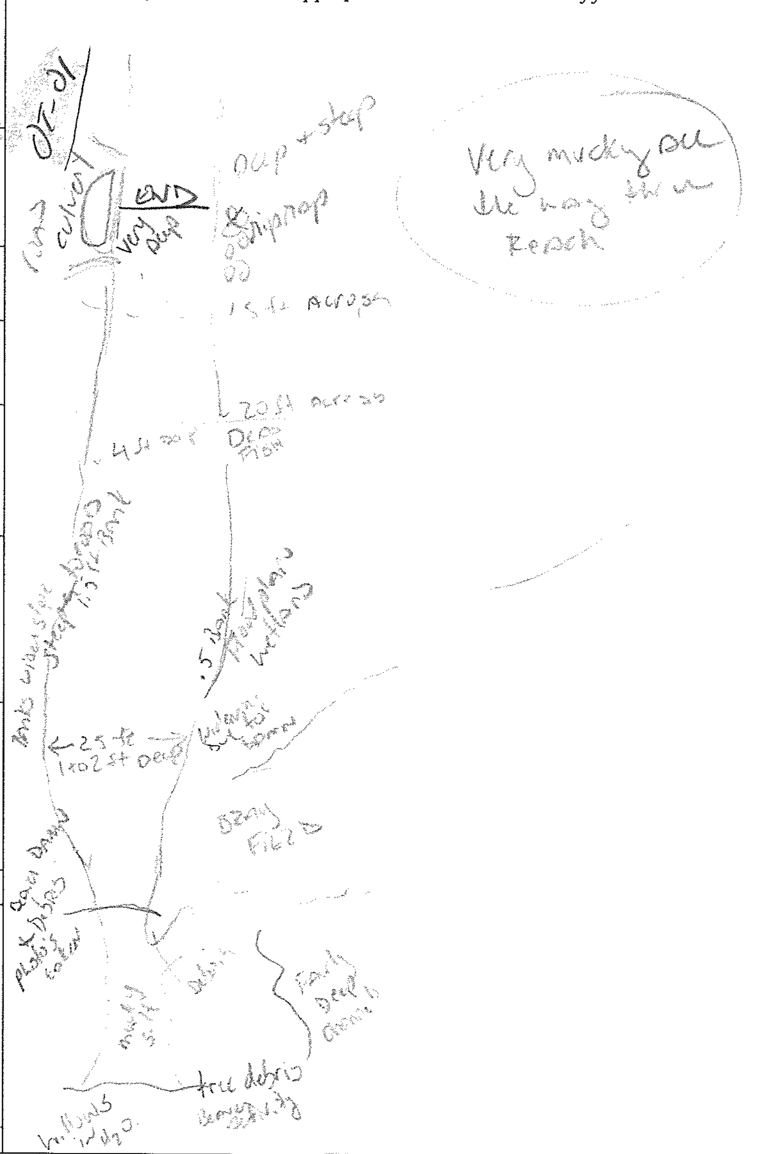
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.0 (ft)
RT bank 2.75 (ft)
Width: Bottom 14.0 (ft)
Top 19.0 (ft)

REACH ACCESSIBILITY

Good	Fair	Difficult
Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4 (circled)	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 48 **/80** + Buffer/Floodplain: 43 **/80** = **Total** Survey Reach 91 **/160**

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Walker Reservoir	**DATE:** 6 / 3 / 08	**ASSESSED BY:** JS, GA, TC7
SURVEY REACH ID: WR03 **TIME:** 3 : 35 AM/PM	**PHOTO ID:** (*Camera-Pic #*) # 4 /#	
SITE ID (*Condition-#*): **OT-** 01 **LAT** 41 ° 51 ' 7.8 " **LONG** 72 ° 25 ' 42.8 "	**LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☒ Substantial ☐ Other:

TYPE: ☒ Closed pipe

MATERIAL: ☐ Concrete ☒ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☒ Single ☒ Circular ☐ Double ☒ ~~Elliptical~~ ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 4.5 ft ~~(in)~~

SUBMERGED: ☐ No ☒ Partially ☐ Fully

☐ Open channel — ☐ Concrete ☐ Earthen ☐ Other: — ☐ Trapezoid ☐ Parabolic ☐ Other: — Depth: ____(in) Width (Top):____(in) " (Bottom):____(in) — NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☒ None ☒ ~~Normal~~ ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☒ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☒ Other: Canada Geese Present (Droppings)

FOR FLOWING ONLY		
	COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:____________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: WR04	**WRTSHD/SUBSHD:** Walker Reservoir	**DATE:** 6/4/08	**ASSESSED BY:** JS, GA, RT, JOE
START TIME: 8:52 AM/PM LMK: ___ LAT 41° 51' 7.8" LONG 72° 25' 42.8" DESCRIPTION: Start of Reach at Culvert	*END* TIME: 9:41 AM/PM LMK: ___ LAT 41° 51' 13.3" LONG 72° 25' 45.3" DESCRIPTION: culvert at exit 67 off I-84		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☒ Steady rain ☐ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☒ Steady rain ☐ Intermittent ☐ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☐ Suburban/Res ☐ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: DOT ROAD + COMM. LOT

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☒ 50%-75% ☐ 25-50 % ☐ 75-100%

DOMINANT SUBSTRATE
☒ Silt/clay (fine or slick) ☐ Cobble (2.5 –10")
☒ Sand (gritty) ☐ Boulder (>10")
☐ Gravel (0.1-2.5") ☐ Bed rock

WATER CLARITY ☐ Clear ☒ Turbid *(suspended matter)*
☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)*
☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM Attached: ☐ none ☒ some ☐ lots
Floating: ☐ none ☒ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) ☐ Fish ☐ Beaver ☐ Deer ☐ Snails ☒ Other: Canada Geese Droppings

STREAM SHADING (water surface)
☐ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☒ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Downcutting ☐ Bed scour
☐ Widening ☐ Bank failure
☐ Headcutting ☐ Bank scour
☐ Aggrading ☐ Slope failure
☒ Sed. deposition ☐ Channelized
☐ Unknown

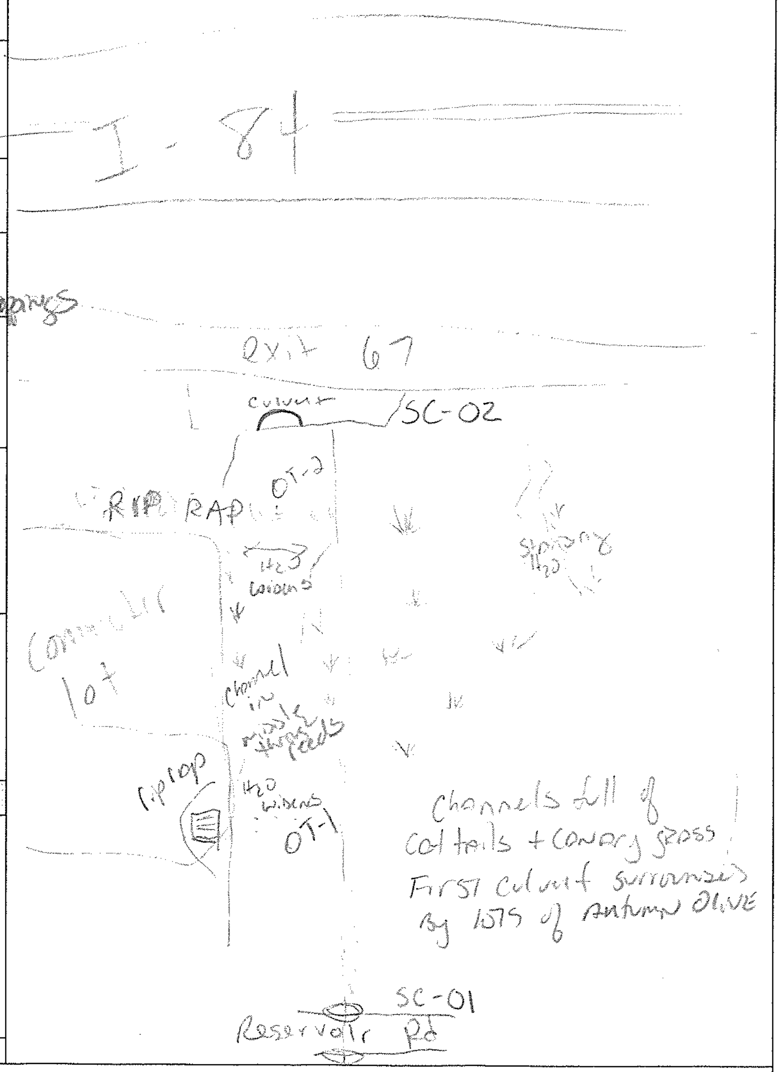
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank No Bank (ft)
RT bank No Bank (ft)
Width: Bottom 7 (ft)
Top 9 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.		Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.		Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 (circled)	4	3	2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)*

REPORTED TO AUTHORITIES ☐ YES ☒ NO

OVERALL STREAM CONDITION	Optimal	Suboptimal	Marginal	Poor
IN-STREAM HABITAT *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION (facing downstream) NO BANKS	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

OVERALL BUFFER AND FLOODPLAIN CONDITION	Optimal	Suboptimal	Marginal	Poor
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field Wetlands Plants	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 41 /80 + Buffer/Floodplain: 35 /80 = **Total** Survey Reach 76 /160

Storm Water Outfalls

OT

WATERSHED/SUBSHED: Walkers Reservoir	**DATE:** 10/4/08	**ASSESSED BY:** Friends
SURVEY REACH ID: WR 04	**TIME:** 9:18 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 7, 8
SITE ID (*Condition-#*): **OT-** 02	**LAT** 41 ° 51 ' 12.8 " **LONG** 72 ° 25 ' 45.4 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☑ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe / ☐ Open channel

MATERIAL: (Closed pipe) ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other: — (Open channel) ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: (Closed pipe) ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other: — (Open channel) ☐ Trapezoid ☐ Parabolic ☑ Other: Rip Rap

DIMENSIONS: Diameter:____(in) — Depth:____(in) Width (Top):____(in) " (Bottom):____(in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully — *NOT APPLICABLE*

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☐ Normal Bittersweet ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☑ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☑ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ft Type of existing vegetation:________________ Slope: ________°

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description:________________________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 — 4	3 — 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Walker's Reservoir | **DATE:** 6 / 4 / 08 | **ASSESSED BY:** Friends

SURVEY REACH ID: WR04 | **TIME:** 9 : 05 AM/PM (AM circled) | **PHOTO ID:** (*Camera-Pic #*) /# 5, [illegible]

SITE ID (*Condition-#*): OT- 01 | **LAT** 41 ° 5 ' [illegible] " **LONG** 72 ° 25 ' [illegible] " **LMK** ____ | **GPS:** (*Unit ID*)

BANK: ☐ LT ☑ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☑ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☑ Circular ☐ Double ☑ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter: 3 (in) 3'ht [illegible]

SUBMERGED: ☐ No ☑ Partially ☐ Fully

TYPE: ☐ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☐ Other:

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)

NOT APPLICABLE

CONDITION: ☐ None ☑ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☑ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☑ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☑ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☑ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☑ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description: ________
Area available:

OUTFALL SEVERITY (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Walkers Reservoir		**DATE:** 6 / 4 / 08	**ASSESSED BY:** Friends
SURVEY REACH ID: WR04	**TIME:** 8 : 52 AM/PM	**PHOTO ID:** (*Camera-Pic #*)	/# 1,2
SITE ID: (*Condition-#*) SC-01	**LAT** 41° 51 ' 7.8 " **LONG** 72° 25 ' 42.8" **LMK**____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ ~~Elliptical~~ ☑ Circular ☐ Other:

 # BARRELS: ☐ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☑ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4.5 (ft)
Height: ______(ft)
Culvert length: 60 (ft)
Width: ______(ft)
Roadway elevation: 30 (ft)

CONDITION: (*Evidence of…*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☑ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☒ Other: maintenance to Remove Autumn Olive starting to clog pipe

IS SC ACTING AS GRADE CONTROL ☑ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth:______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.
5 4	3 2	1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Walkers Reservoir		**DATE:** 6/4/08	**ASSESSED BY:** Friends
SURVEY REACH ID: WR04	**TIME:** 9:23 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /# 9,10	
SITE ID: (*Condition-#*) SC-02	**LAT** 41° 51' 13.3" **LONG** 72° 25' 45.3" **LMK**____		**GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☐ Box ☐ Elliptical ☑ Circular ☐ Other:

 # BARRELS: ☑ Single ☐ Double ☐ Triple ☐ Other:

MATERIAL: ☐ Concrete ☑ Metal ☐ Other:

ALIGNMENT: ☐ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: 4 (ft)
Height: ____ (ft)
Culvert length: ____ (ft)
Width: ____ (ft)
Roadway elevation: ____ (ft)

CONDITION: (*Evidence of...*)
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☑ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☐ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit
☐ no ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☐ No ☐ Yes ☐ Unknown

If yes for fish barrier

EXTENT OF PHYSICAL BLOCKAGE:
☐ Total ☐ Partial
☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ____ (in)
☐ Flow too shallow Water Depth: ____ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

5 4 3 2 1

NOTES/SKETCH:

REPORTED TO AUTHORITIES ☐ YES ☐ NO

Reach Level Assessment **RCH**

SURVEY REACH ID: WR05	**WTRSHD/SUBSHD:** Walkers Res.	**DATE:** 6/3/08	**ASSESSED BY:** Jone, Renee, George
START **TIME:** 4:20 AM/~~PM~~ **LMK:** ____ **LAT** 41° 51' 07.8" **LONG** 72° 25' 42.8" **DESCRIPTION:** Reach begins at culvert	*END* **TIME:** 5:43 AM/~~PM~~ **LMK:** ____ **LAT** 41° 51' 14.6" **LONG** 72° 25' 36.9" **DESCRIPTION:** I-84 onramp double culvert		**GPS ID:**

RAIN IN LAST 24 HOURS ☐ Heavy rain ☐ Steady rain ☒ None ☐ Intermittent ☐ Trace

PRESENT CONDITIONS ☐ Heavy rain ☐ Steady rain ☐ Intermittent ☒ Clear ☐ Trace ☐ Overcast ☐ Partly cloudy

SURROUNDING LAND USE: ☐ Industrial ☐ Commercial ☐ Urban/Residential ☒ Suburban/Res ☒ Forested ☐ Institutional ☐ Golf course ☐ Park ☐ Crop ☐ Pasture ☒ Other: Highway

AVERAGE CONDITIONS *(check applicable)*

BASE FLOW AS % CHANNEL WIDTH ☐ 0-25% ☐ 25-50 % ☐ 50%-75% ☒ 75-100%

DOMINANT SUBSTRATE
☐ Silt/clay (fine or slick)
☒ Sand (gritty)
☒ Gravel (0.1-2.5")
☐ Cobble (2.5 – 10") Limited
☐ Boulder (>10")
☐ Bed rock

WATER CLARITY ☒ Clear ☐ Turbid *(suspended matter)* ☐ Stained *(clear, naturally colored)* ☐ Opaque *(milky)* ☐ Other *(chemicals, dyes)*

AQUATIC PLANTS IN STREAM
Attached: ☐ none ☒ some ☐ lots
Floating: ☒ none ☐ some ☐ lots

WILDLIFE IN OR AROUND STREAM (Evidence of) Great blue heron, Canada geese
☒ Fish ☐ Beaver ☒ Deer ☐ Snails ☒ Other: raccoon

STREAM SHADING (water surface)
☒ Mostly shaded (≥75% coverage)
☐ Halfway (≥50%)
☐ Partially shaded (≥25%)
☐ Unshaded (< 25%)

CHANNEL DYNAMICS
☐ Unknown
☐ Downcutting ☐ Widening ☐ Headcutting ☐ Aggrading ☒ Sed. deposition
☐ Bed scour ☐ Bank failure ☐ Bank scour ☐ Slope failure ☒ Channelized

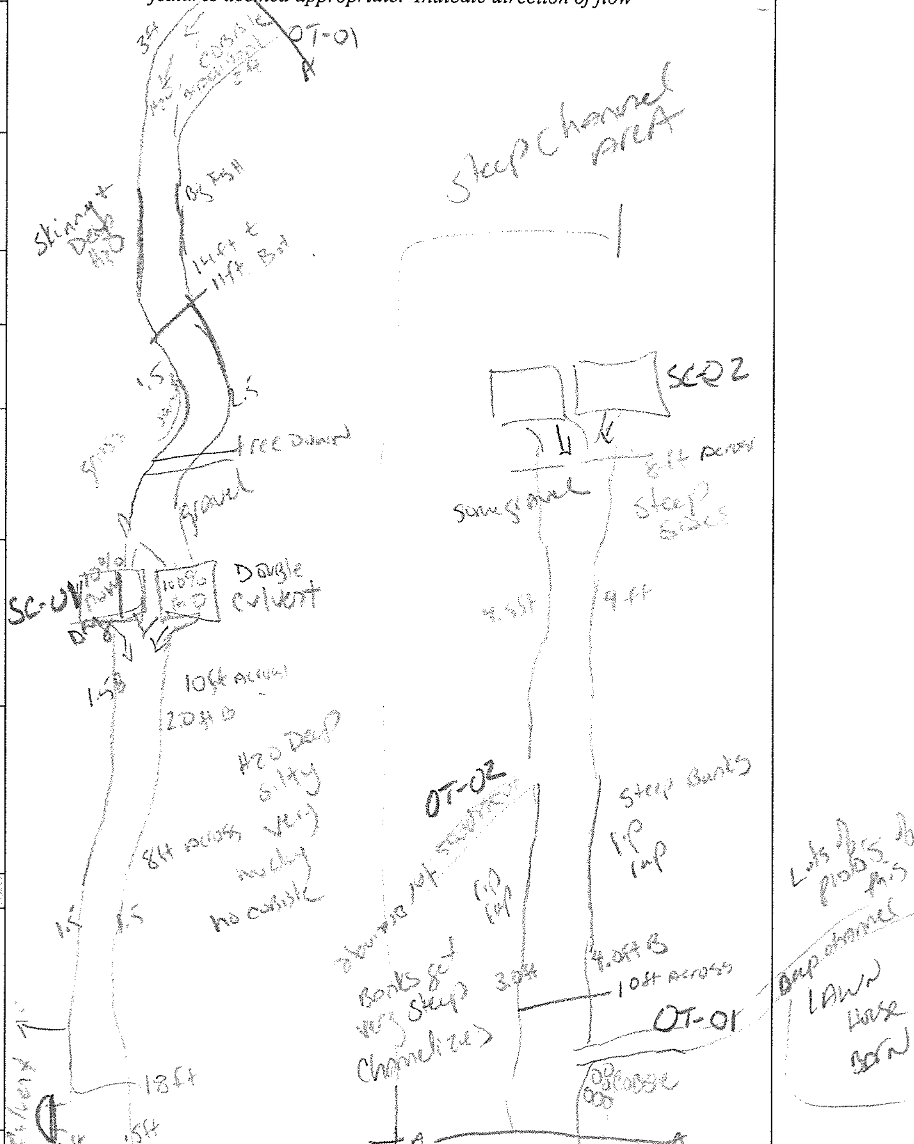
CHANNEL DIMENSIONS *(FACING DOWNSTREAM)*
Height: LT bank 2.4 (ft)
RT bank 2.1 (ft)
Width: Bottom 11.6 (ft)
Top 14.5 (ft)

REACH ACCESSIBILITY

Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.	**Fair:** Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.	**Difficult.** Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.
5 4 (circled)	3 2	1

REACH SKETCH AND SITE IMPACT TRACKING

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB,SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow



NOTES: *(biggest problem you see in survey reach)* Culvert at downstream end of WR04 and beginning of WR04

REPORTED TO AUTHORITIES ☐ YES ☒ NO

Overall Stream Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
In-Stream Habitat *(May modify criteria based on appropriate habitat regime)*	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Vegetative Protection *(score each bank, determine sides by facing downstream)*	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Bank Erosion (facing downstream)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Connection	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) **not** able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Overall Buffer and Floodplain Condition				
	Optimal	**Suboptimal**	**Marginal**	**Poor**
Vegetated Buffer Width	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
Floodplain Vegetation	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Habitat	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Floodplain Encroachment	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Sub Total In-stream: 44 /80 + Buffer/Floodplain: 38 /80 = **Total** Survey Reach 82 /160

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Walker Reservoir	**DATE:** 6 / 3 / 08	**ASSESSED BY:** JS, RT, GA
SURVEY REACH ID: WR05 **TIME:** 5 : 06 AM/PM (PM)	**PHOTO ID:** (*Camera-Pic #*) 8-13 /#	
SITE ID (*Condition-#*): OT- 01 **LAT** 41° 51 ' 11.4 " **LONG** 72° 25 ' 39.1 " **LMK** ____		**GPS:** (*Unit ID*)

BANK: ☒ LT ☐ RT ☐ Head

FLOW: ☐ None ☐ Trickle ☒ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe
MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:
SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:
DIMENSIONS: Diameter: ____ (in)
SUBMERGED: ☐ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel
MATERIAL: ☐ Concrete ☒ Earthen ☐ Other:
SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:
Depth: ____ (in) Width (Top): ____ (in) " (Bottom): ____ (in)
NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☒ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY	
COLOR:	☒ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
TURBIDITY:	☒ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
FLOATABLES:	☒ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☒ Other: increased runoff? Deep channel

POTENTIAL RESTORATION CANDIDATE ☒ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☐ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:
Length of vegetative cover from outfall: ________ ft Type of existing vegetation: ________ Slope: ______ °

If yes for stormwater:
Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated
Land Use description: ________
Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.		Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.		Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5	4	(3)	2	1

SKETCH/NOTES:

Very Deep cut channel through Residential property. Owner states flow comes from uphill runoff / spring. Fresh cuttings of [illegible] alive in channel

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Storm Water Outfalls **OT**

WATERSHED/SUBSHED: Walker Reservoir	**DATE:** 6 / 3 / 08	**ASSESSED BY:** JS, RJ, GA
SURVEY REACH ID: W205 — **TIME:** 5 : 25 AM/PM (PM circled)	**PHOTO ID:** (*Camera-Pic #*) 14 /#	
SITE ID (*Condition-#*): OT- 02	**LAT** 41° 51 ' 13.5 " **LONG** 72 ° 25 ' 40.1 " **LMK**____	**GPS:** (*Unit ID*)

BANK: ☐ LT ☒ RT ☐ Head

FLOW: ☒ None ☐ Trickle ☐ Moderate ☐ Substantial ☐ Other:

TYPE: ☐ Closed pipe

MATERIAL: ☐ Concrete ☐ Metal ☐ PVC/Plastic ☐ Brick ☐ Other:

SHAPE: ☐ Single ☐ Circular ☐ Double ☐ Elliptical ☐ Triple ☐ Other:

DIMENSIONS: Diameter:_____ (in)

SUBMERGED: ☐ No ☐ Partially ☐ Fully

TYPE: ☒ Open channel

MATERIAL: ☐ Concrete ☐ Earthen ☒ Other: bar

SHAPE: ☐ Trapezoid ☐ Parabolic ☐ Other:

DIMENSIONS: Depth: 8 (in) Width (Top): 42 (in) " (Bottom): 30 (in)

NOT APPLICABLE

CONDITION: ☒ None ☐ Chip/Cracked ☐ Peeling Paint ☐ Corrosion ☐ Other:

ODOR: ☐ No ☐ Gas ☐ Sewage ☐ Rancid/Sour ☐ Sulfide ☐ Other:

DEPOSITS/STAINS: ☐ None ☐ Oily ☐ Flow Line ☐ Paint ☐ Other:

VEGGIE DENSITY: ☐ None ☒ Normal ☐ Inhibited ☐ Excessive ☐ Other:

PIPE BENTHIC GROWTH: ☐ None ☐ Brown ☐ Orange ☐ Green ☐ Other:

POOL QUALITY: ☐ No pool ☐ Good ☐ Odors ☐ Colors ☐ Oils ☐ Suds ☐ Algae ☐ Floatables ☐ Other:

FOR FLOWING ONLY		
	COLOR:	☐ Clear ☐ Brown ☐ Grey ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:
	TURBIDITY:	☐ None ☐ Slight Cloudiness ☐ Cloudy ☐ Opaque
	FLOATABLES:	☐ None ☐ Sewage (toilet paper, etc.) ☐ Petroleum (oil sheen) ☐ Other:

OTHER CONCERNS: ☐ Excess Trash (paper/plastic bags) ☐ Dumping (bulk) ☐ Excessive Sedimentation ☐ Needs Regular Maintenance ☐ Bank Erosion ☐ Other:

POTENTIAL RESTORATION CANDIDATE ☐ Discharge investigation ☐ Stream daylighting ☐ Local stream repair/outfall stabilization ☒ no ☐ Storm water retrofit ☐ Other:

If yes for daylighting:

Length of vegetative cover from outfall: ________ft Type of existing vegetation:____________________ Slope: ________°

If yes for stormwater:

Is stormwater currently controlled? ☐ Yes ☐ No ☐ Not investigated

Land Use description:______________________________

Area available:

OUTFALL SEVERITY: (*circle #*)	Heavy discharge with a distinct color and/or a strong smell. The amount of discharge is significant compared to the amount of normal flow in receiving stream; discharge appears to be having a significant impact downstream.	Small discharge; flow mostly clear and odorless. If the discharge has a color and/or odor, the amount of discharge is very small compared to the stream's base flow and any impact appears to be minor / localized.	Outfall does not have dry weather discharge; staining; or appearance of causing any erosion problems.
	5 4	3 2	1

SKETCH/NOTES:

REPORTED TO AUTHORITIES: ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Walker's Reservoir	**DATE:** 6/3/08	**ASSESSED BY:** JS EZ GA
SURVEY REACH ID: WR05 **TIME:** 5:45 AM/PM	**PHOTO ID:** (*Camera-Pic #*) /#	
SITE ID: (*Condition-#*) SC- 02 **LAT** 41° 51 ' 14.6 " **LONG** 72° 25 ' 36.9 "	**LMK**____	**GPS** (*Unit ID*)

TYPE: ☒ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☒ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☒ Double ☐ Triple ☐ Other:

MATERIAL: ☒ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☒ Flow-aligned ☐ Not flow-aligned ☐ Do not know

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: Square (ft)
Height: 6.5ft Rt / 6.0ft Lt (ft)
Culvert length: ______ (ft)
Width: 9ft Rt / 9ft Lt (ft)
Roadway elevation: 22 (ft)

CONDITION: (*Evidence of...*) Looks Good
☐ Cracking/chipping/corrosion ☐ Downstream scour hole
☐ Sediment deposition ☐ Failing embankment
☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

POTENTIAL RESTORATION CANDIDATE ☒ No ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

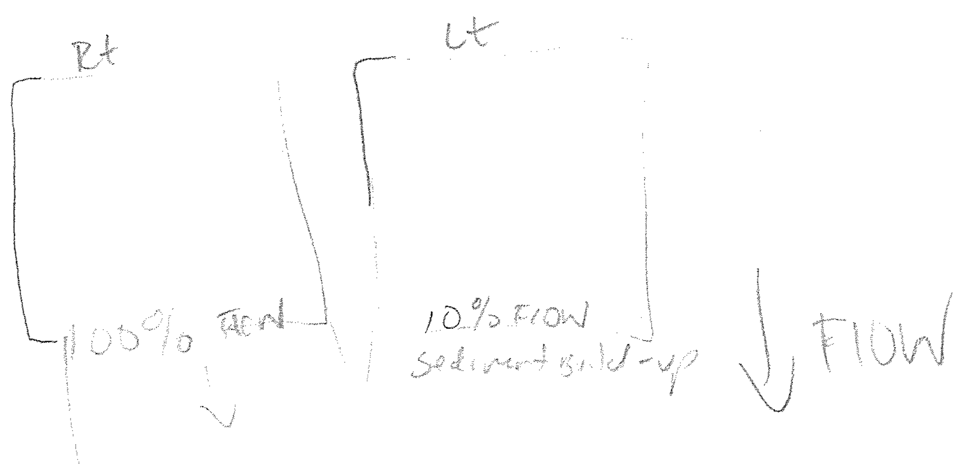
EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE:
☐ Drop too high Water Drop: ______ (in)
☐ Flow too shallow Water Depth: ______ (in)
☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

5	4	3	2	1
A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.		A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.		A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

NOTES/SKETCH:



REPORTED TO AUTHORITIES ☐ YES ☐ NO

Stream Crossing **SC**

WATERSHED/SUBSHED: Walkers Reservoir **DATE:** 6 / 3 / 08 **ASSESSED BY:** BWMA

SURVEY REACH ID: WR05 **TIME:** 4 : 36 AM/PM (PM circled) **PHOTO ID:** (*Camera-Pic #*) #7 /#

SITE ID: (*Condition-#*) SC-01 **LAT** 41 ° 51 ' 09.7 " **LONG** 72 ° 25 ' 41.4 " **LMK**____ **GPS** (*Unit ID*)

TYPE: ☑ Road Crossing ☐ Railroad Crossing ☐ Manmade Dam ☐ Beaver Dam ☐ Geological Formation ☐ Other:

FOR ROAD/ RAILROAD CROSSINGS ONLY

SHAPE: ☐ Arch ☐ Bottomless ☑ Box ☐ Elliptical ☐ Circular ☐ Other:

 # BARRELS: ☐ Single ☑ Double ☐ Triple ☐ Other:

MATERIAL: ☑ Concrete ☐ Metal ☐ Other:

ALIGNMENT: ☑ Flow-aligned ☐ Not flow-aligned ☐ Do not know

CONDITION: (*Evidence of…*) ☑ Cracking/chipping/corrosion ☐ Downstream scour hole ☐ Sediment deposition (very little at edges) ☐ Failing embankment ☐ Other (*describe*):

CULVERT SLOPE: ☒ Flat ☐ Slight (2° – 5°) ☐ Obvious (>5°)

DIMENSIONS: (*if variable, sketch*)
Barrel diameter: Square (ft)
Height: 7 ft Lt (ft) 6.2 ft RT
Culvert length: ______ (ft)
Width: 9 ft Lt (ft) 9 ft RT
Roadway elevation: 30 (ft)

POTENTIAL RESTORATION CANDIDATE ☒ no ☐ Fish barrier removal ☐ Culvert repair/replacement ☐ Upstream storage retrofit ☐ Local stream repair ☐ Other:

IS SC ACTING AS GRADE CONTROL ☒ No ☐ Yes ☐ Unknown

If yes for fish barrier

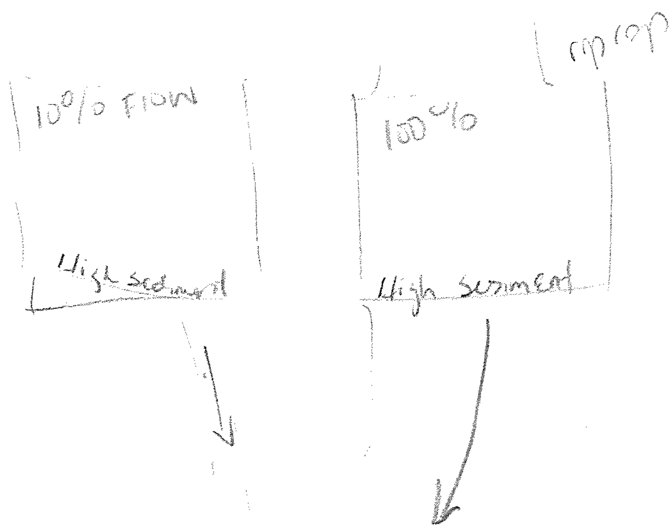
EXTENT OF PHYSICAL BLOCKAGE: ☐ Total ☐ Partial ☐ Temporary ☐ Unknown

CAUSE: ☐ Drop too high Water Drop: ______ (in) ☐ Flow too shallow Water Depth: ______ (in) ☐ Other:

BLOCKAGE SEVERITY: (*circle #*)

5 – 4	3 – 2	1
A structure such as a dam or road culvert on a 3rd order or greater stream blocking the upstream movement of anadromous fish; no fish passage device present.	A total fish blockage on a tributary that would isolate a significant reach of stream, or partial blockage that may interfere with the migration of anadromous fish.	A temporary barrier such as a beaver dam or a blockage at the very head of a stream with very little viable fish habitat above it; natural barriers such as waterfalls.

NOTES/SKETCH:



Lots of Canada geese droppings present

REPORTED TO AUTHORITIES ☐ YES ☐ NO

APPENDIX B

Upland Assessment Field Forms

WATERSHED: Tanker	**SUBWATERSHED:** CARKS	**UNIQUE SITE ID:** ~~[illegible]~~ CB-HSI-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB	**CAMERA ID:** / **PIC#:**
MAP GRID:	**LAT** ___° ___' ___" **LONG** ___° ___' ___"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: No name
Sand, gravel & construction block

Category: [ ] Commercial [x] Industrial [ ] Institutional [ ] Municipal [ ] Transport-Related
Miscellaneous: [ ] Golf Course [ ] Marina [ ] Animal Facility

SIC code (if available): ___________

Basic Description of Operation: storage/processing of fill & block

NPDES Status: [ ] Regulated [ ] Unregulated [x] Unknown

INDEX*

B. VEHICLE OPERATIONS [ ] N/A *(Skip to part C)* — Observed Pollution Source? [ ]

B1. Types of vehicles: [ ] Fleet vehicles [ ] School buses [ ] Other: ________

B2. Approximate number of vehicles: ________

B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored ○

B4. Are vehicles stored and/or repaired outside? [ ] Y [ ] N [x] Can't Tell ○
Are these vehicles lacking runoff diversion methods? [ ] Y [ ] N [x] Can't Tell

B5. Is there evidence of spills/leakage from vehicles? [ ] Y [ ] N [x] Can't Tell ○

B6. Are uncovered outdoor fueling areas present? [ ] Y [ ] N [x] Can't Tell ○

B7. Are fueling areas directly connected to storm drains? [ ] Y [x] N [ ] Can't Tell ○

B8. Are vehicles washed outdoors? [ ] Y [ ] N [x] Can't Tell ○
Does the area where vehicles are washed discharge to the storm drain? [ ] Y [ ] N [x] Can't Tell

C. OUTDOOR MATERIALS [ ] N/A *(Skip to part D)* — Observed Pollution Source? [ ]

C1. Are loading/unloading operations present? [x] Y [ ] N [ ] Can't Tell ○
If yes, are they uncovered *and* draining towards a storm drain inlet? [ ] Y [ ] N [ ] Can't Tell

C2. Are materials stored outside? [x] Y [ ] N [ ] Can't Tell If yes, are they [ ] Liquid [x] Solid Description: Dirt ○
Where are they stored? [ ] grass/dirt area [ ] concrete/asphalt [ ] bermed area

C3. Is the storage area directly or indirectly connected to storm drain (circle one)? [ ] Y [ ] N [x] Can't Tell ○

C4. Is staining or discoloration around the area visible? [ ] Y [ ] N [x] Can't Tell ○

C5. Does outdoor storage area lack a cover? [ ] Y [ ] N [x] Can't Tell ○

C6. Are liquid materials stored *without* secondary containment? [ ] Y [ ] N [x] Can't Tell ○

C7. Are storage containers missing labels or in poor condition (rusting)? [ ] Y [ ] N [x] Can't Tell ○

D. WASTE MANAGEMENT [ ] N/A *(Skip to part E)* — Observed Pollution Source? [ ]

D1. Type of waste *(check all that apply)*: [ ] Garbage [x] Construction materials [ ] Hazardous materials ○

D2. Dumpster condition (*check all that apply)*: [ ] No cover/Lid is open [ ] Damaged/poor condition [ ] Leaking or evidence of leakage (stains on ground) [ ] Overflowing ○

D3. Is the dumpster located near a storm drain inlet? [ ] Y [ ] N [ ] Can't Tell ○
If yes, are runoff diversion methods (berms, curbs) lacking? [ ] Y [ ] N [ ] Can't Tell

E. PHYSICAL PLANT [ ] N/A *(Skip to part F)* — Observed Pollution Source? [ ]

E1. Building: Approximate age: 20 yrs. Condition of surfaces: [ ] Clean [ ] Stained [x] Dirty [ ] Damaged ○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? [ ] Y [ ] N [x] Don't know ○

*Index: ○ denotes potential pollution source; [ ] denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☒ Dirty ☐ Breaking up
Surface material ☒ Paved/Concrete ☐ Gravel ☒ Permeable ☐ Don't know — ◯ ✓

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☒ Don't know ☐ None visible
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☒ Don't know — ◯

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☒ Y ☐ N ☐ Can't Tell — ◯

F. Turf/Landscaping Areas ☐ N/A *(skip to part G)* — Observed Pollution Source? ☐

F1. % of site with: Forest canopy ____% Turf grass 20% Landscaping ____% Bare Soil 80% — ◯ ✓

F2. Rate the turf management status: ☐ High ☒ Medium ☐ Low — ◯

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell — ◯

F4. Do landscaped areas drain to the storm drain system? ☒ Y ☐ N ☐ Can't Tell — ◯

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☒ Can't Tell — ◯

G. Storm Water Infrastructure ☐ N/A *(skip to part H)* — Observed Pollution Source? ☐

G1. Are storm water treatment practices present? ☐ Y ☐ N ☒ Unknown If yes, please describe: ________________ — ◯

G2. Are private storm drains located at the facility? ☐ Y ☐ N ☒ Unknown
Is trash present in gutters leading to storm drains? If so, complete the index below. — ◯

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. Initial Hotspot Status - Index Results

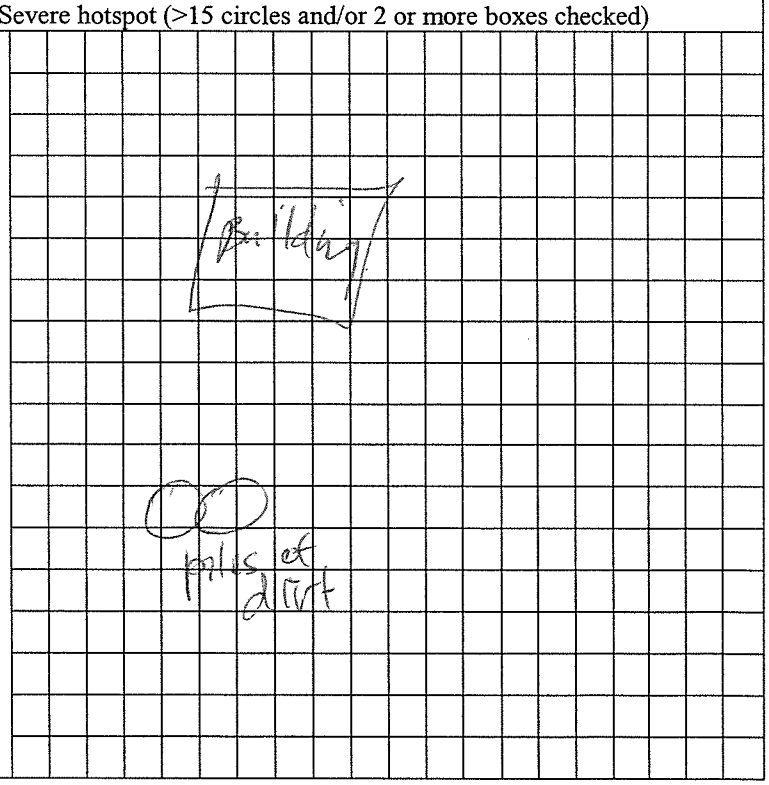
☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☒ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☒ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ______________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Follow needed - private industry
pipes & debris in yard
and large dirt piles
sw practices unknown



7/16/08 TUCKER BROOK

- Meadowbrook Subdivision
- Retrofit opportunity
- Basin Maintenance - cleanout, add forebay if none present.
- Basin likely town-owned since part of subdivision
- small PVC pipes discharging to U.S. storm line

Hotspot Site Investigation **HSI**

WATERSHED: Tanker	**SUBWATERSHED:** LTR		**UNIQUE SITE ID:** LTR-HSI-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** 41° 49' 37" **LONG** 72° 28' 53"		**LMK#**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: Highway Garage - CTDOT & DOT maintenance Service Center district 1

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☒ Municipal ☐ Transport-Related

Miscellaneous: ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ________

Basic Description of Operation: Large garage, salt, sand storage, office

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

INDEX*

B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)* — **Observed Pollution Source?** ☐

B1. Types of vehicles: ☒ Fleet vehicles ☐ School buses ☒ Other: (Commuter	
B2. Approximate number of vehicles: ________	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored	○
B4. Are vehicles stored and/or repaired outside? ☐ Y ☒ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☒ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☒ Can't Tell	○
B6. Are uncovered outdoor fueling areas present? ☒ Y ☐ N ☐ Can't Tell	⊗
B7. Are fueling areas directly connected to storm drains? ☒ Y ☐ N ☐ Can't Tell	⊗
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☒ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○

C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — **Observed Pollution Source?** ☐

C1. Are loading/unloading operations present? ☒ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☒ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☒ Solid Description: mulch, sand fill, gravel Where are they stored? ☐ grass/dirt area ☒ concrete/asphalt ☐ bermed area	⊗
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☒ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☒ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☒ Y ☐ N ☐ Can't Tell	⊗
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☒ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☒ Can't Tell	○

D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)* — **Observed Pollution Source?** ☐

D1. Type of waste *(check all that apply)*: ☒ Garbage ☒ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply*): ☒ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☒ Overflowing	⊗
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☒ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☒ Can't Tell	○

E. PHYSICAL PLANT ☐ N/A *(Skip to part F)* — **Observed Pollution Source?** ☐

E1. Building: Approximate age: 50 yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☒ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age 20 yrs. Condition: ☒ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☒ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☒ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☒ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☒ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ N/A *(skip to part G)*	**Observed Pollution Source?** ☐
F1. % of site with: Forest canopy 0 % Turf grass 10 % Landscaping 0 % Bare Soil 0 %	○
F2. Rate the turf management status: ☐ High ☐ Medium ☒ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☒ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☒ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☒ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)*	**Observed Pollution Source?** ☐
G1. Are storm water treatment practices present? ☐ Y ☒ N ☒ Unknown If yes, please describe: ________________	○
G2. Are private storm drains located at the facility? ☐ Y ☒ N ☒ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☒ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
- ☐ Refer for immediate enforcement
- ☒ Suggest follow-up on-site inspection
- ☐ Test for illicit discharge
- ☐ Include in future education effort
- ☐ Check to see if hotspot is an NPDES non-filer
- ☒ Onsite non-residential retrofit
- ☐ Pervious area restoration; complete PAA sheet and record Unique Site ID here: ____________________
- ☐ Schedule a review of storm water pollution prevention plan

Notes:

Conn DOT Facility

Hotspot Site Investigation **HSI**

WATERSHED: Tucker	SUBWATERSHED: Walker	UNIQUE SITE ID: WR-HSI-01
DATE: 7/10/08	ASSESSED BY: KB, DB	CAMERA ID:	PIC#: ~~3698~~ -3701
MAP GRID:	LAT 41° 51' 11" LONG 72° 25' 45"	LMK #

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: Rt 31 off of I84

Category: ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☒ Transport-Related

Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

SIC code (if available): ________

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Basic Description of Operation: DOT Commuter Lot

INDEX*

B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)* — Observed Pollution Source? ☐

Question	Index
B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☐ Other: vehicle parking	
B2. Approximate number of vehicles: 150	
B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored Parking	☒
B4. Are vehicles stored and/or repaired outside? ☐ Y ☒ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell	○
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☒ Can't Tell Possible oil leaks/sediment f/salting/sanding	☒
B6. Are uncovered outdoor fueling areas present? ☐ Y ☒ N ☐ Can't Tell	○
B7. Are fueling areas directly connected to storm drains? ☐ Y ☒ N ☐ Can't Tell	○
B8. Are vehicles washed outdoors? ☐ Y ☒ N ☐ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	○

C. OUTDOOR MATERIALS ☒ N/A *(Skip to part D)* — Observed Pollution Source? ☐

Question	Index
C1. Are loading/unloading operations present? ☐ Y ☒ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell	○
C2. Are materials stored outside? ☐ Y ☒ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ________ Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area	○
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☒ Y ☐ N ☐ Can't Tell	○
C4. Is staining or discoloration around the area visible? ☐ Y ☒ N ☐ Can't Tell	○
C5. Does outdoor storage area lack a cover? ☐ Y ☒ N ☐ Can't Tell	○
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☐ Can't Tell	○
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell	○

D. WASTE MANAGEMENT ☒ N/A *(Skip to part E)* — Observed Pollution Source? ☐

Question	Index
D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials	○
D2. Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing	○
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell	○

E. PHYSICAL PLANT ☒ N/A *(Skip to part F)* — Observed Pollution Source? ☐

Question	Index
E1. Building: Approximate age: ________ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged	○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know	○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age 10 yrs. Condition: [ ] Clean [ ] Stained [X] Dirty [ ] Breaking up
Surface material [X] Paved/Concrete [ ] Gravel [ ] Permeable [ ] Don't know

E3. Do downspouts discharge to impervious surface? [ ] Y [ ] N [ ] Don't know [ ] None visible
Are downspouts directly connected to storm drains? [ ] Y [ ] N [ ] Don't know

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? [ ] Y [ ] N [ ] Can't Tell

F. Turf/Landscaping Areas [X] N/A *(skip to part G)* — Observed Pollution Source? [ ]

F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____%

F2. Rate the turf management status: [ ] High [ ] Medium [ ] Low

F3. Evidence of permanent irrigation or "non-target" irrigation [ ] Y [ ] N [ ] Can't Tell

F4. Do landscaped areas drain to the storm drain system? [ ] Y [ ] N [ ] Can't Tell

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? [ ] Y [ ] N [ ] Can't Tell

G. Storm Water Infrastructure [ ] N/A *(skip to part H)* — Observed Pollution Source? [ ]

G1. Are storm water treatment practices present? [ ] Y [X] N [ ] Unknown If yes, please describe: ________________

G2. Are private storm drains located at the facility? [X] Y [ ] N [ ] Unknown
Is trash present in gutters leading to storm drains? If so, complete the index below.

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	[ ] 1	[ ] 2	[X] 3	[ ] 4	[ ] 5
Organic material	[ ] 1	[X] 2	[ ] 3	[ ] 4	[ ] 5
Litter	[ ] 1	[X] 2	[ ] 3	[ ] 4	[ ] 5

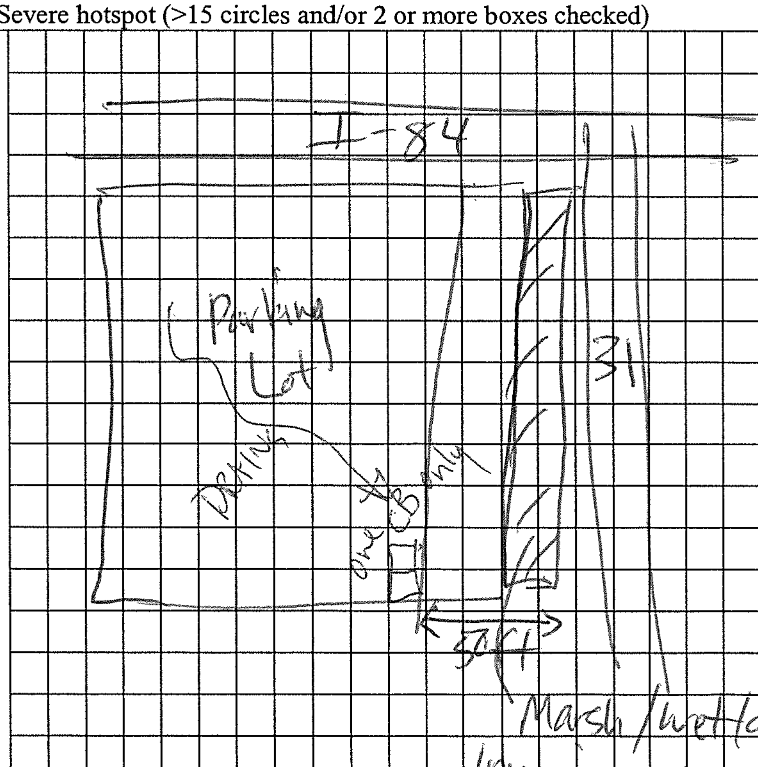
G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: [ ] Dirty [ ] Clean

H. Initial Hotspot Status - Index Results

[ ] Not a hotspot (fewer than 5 circles and no boxes checked) [X] Potential hotspot (5 to 10 circles but no boxes checked)
[ ] Confirmed hotspot (10 to 15 circles and/or 1 box checked) [ ] Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
- [ ] Refer for immediate enforcement
- [ ] Suggest follow-up on-site inspection
- [ ] Test for illicit discharge
- [ ] Include in future education effort
- [ ] Check to see if hotspot is an NPDES non-filer
- [X] Onsite non-residential retrofit
- [ ] Pervious area restoration; complete PAA sheet and record Unique Site ID here: ____________________
- [ ] Schedule a review of storm water pollution prevention plan

Notes:
SW runoff from parking lot directly enters wetland area & likely contains oil and sediments & salts. Retrofit possible with large buffer.



Marsh/wetland
Invasives along w/ cattails & some marsh plants

WR-HS7-DT

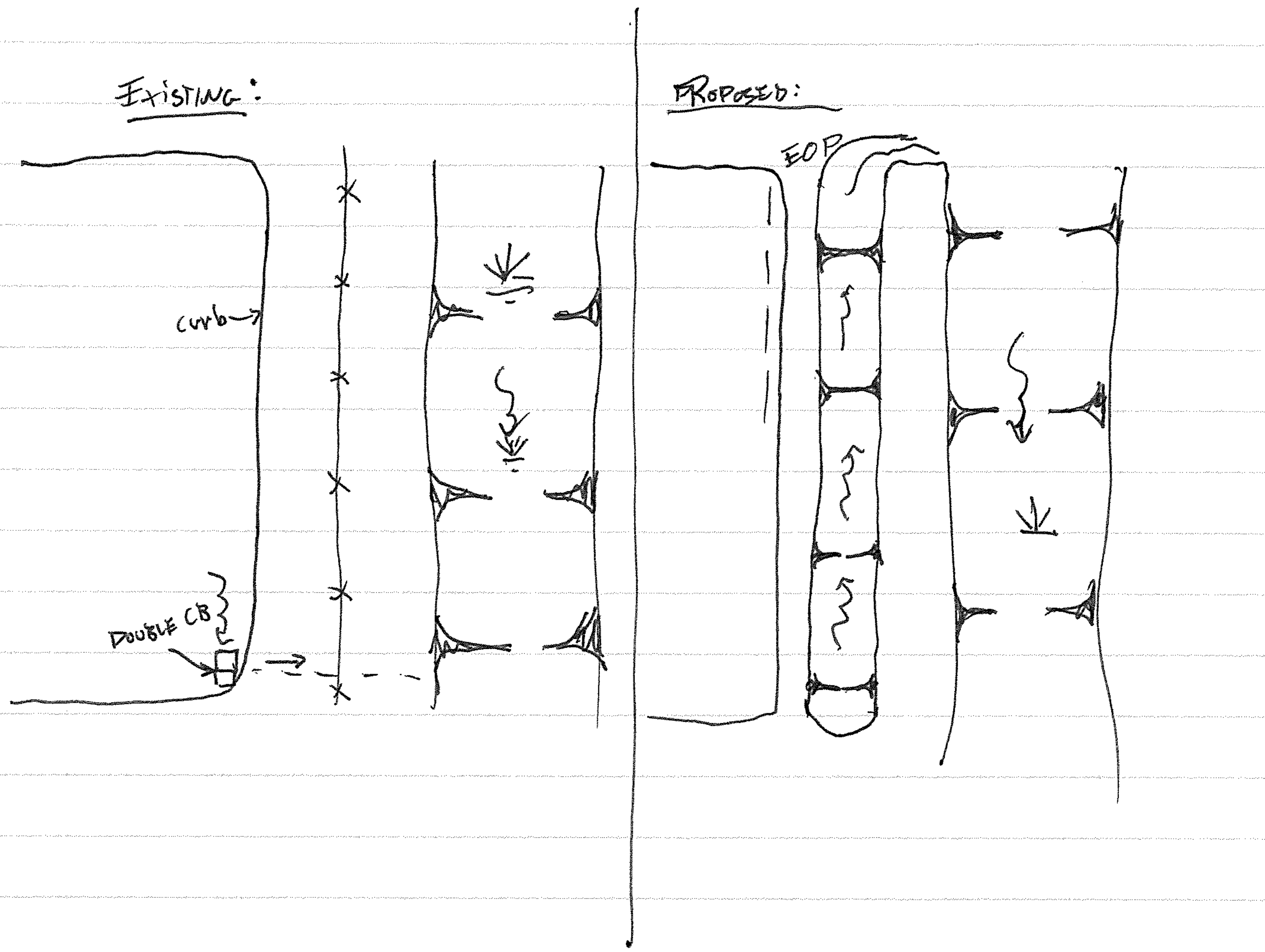
1/16/08 Hotspot Investigation - 41°51'11" 72°25'45"

DOT commuter lot - WR subwatershed

Drainage overland to SE corner

Discharge to wetland

Wide grass strip between curb & wetland could be used for swale



Hotspot Site Investigation **HSI**

WATERSHED: Tucker	**SUBWATERSHED:** Gages	**UNIQUE SITE ID:** GB-HSI-02
DATE: 7/16/08	**ASSESSED BY:** KWB	**CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** 41° 51 ' 30 " **LONG** 72° 25 ' 09 "	**LMK#**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: Dari Farms Ice Cream Distribution

SIC code (if available): ______

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Category: ☐ Commercial ☒ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

Miscellaneous: ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation: Distribution Center

INDEX*

B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)* — Observed Pollution Source? ☐

	Index
B1. Types of vehicles: ☒ Fleet vehicles ☐ School buses ☒ Other: cars/trucks lot	
B2. Approximate number of vehicles: 20 18 wheelers 40 commuter vehicles	
B3. Vehicle activities *(circle all that apply)*: Maintained, Repaired, Recycled, Fueled, Washed, Stored	◯ ✓
B4. Are vehicles stored and/or repaired outside? ☒ Y ☐ N ☐ Can't Tell Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☒ Can't Tell	◯ ✓
B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☐ N ☒ Can't Tell	◯
B6. Are uncovered outdoor fueling areas present? ☐ Y ☒ N ☐ Can't Tell	◯
B7. Are fueling areas directly connected to storm drains? ☒ Y ☐ N ☒ Can't Tell probably	◯ ✓
B8. Are vehicles washed outdoors? ☐ Y ☐ N ☒ Can't Tell Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell	◯

C. OUTDOOR MATERIALS ☐ N/A *(Skip to part D)* — Observed Pollution Source? ☐

	Index
C1. Are loading/unloading operations present? ☒ Y ☐ N ☐ Can't Tell If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☒ Can't Tell	◯
C2. Are materials stored outside? ☒ Y ☐ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______ Where are they stored? ☐ grass/dirt area ☒ concrete/asphalt ☐ bermed area	◯
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☒ Y ☐ N ☐ Can't Tell	◯ ✓
C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☒ Can't Tell	◯
C5. Does outdoor storage area lack a cover? ☒ Y ☐ N ☐ Can't Tell	◯ ✓
C6. Are liquid materials stored *without* secondary containment? ☐ Y ☐ N ☒ Can't Tell	◯
C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☒ N ☐ Can't Tell	◯

D. WASTE MANAGEMENT ☐ N/A *(Skip to part E)* — Observed Pollution Source? ☐

	Index
D1. Type of waste *(check all that apply)*: ☒ Garbage ☐ Construction materials ☐ Hazardous materials	◯
D2. Dumpster condition *(check all that apply)*: ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing NOT observed	◯
D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☒ Can't Tell If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☒ Can't Tell	◯

E. PHYSICAL PLANT ☐ N/A *(Skip to part F)* — Observed Pollution Source? ☐

	Index
E1. Building: Approximate age: 5 yrs. Condition of surfaces: ☒ Clean ☐ Stained ☐ Dirty ☐ Damaged	◯
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☒ Don't know	◯

*Index: ◯ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age 5 yrs. Condition: ☒ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☒ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☒ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○ ✓
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☒ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☐ N/A *(skip to part G)*	**Observed Pollution Source?** ☐
F1. % of site with: Forest canopy ____% Turf grass 90 % Landscaping 10 % Bare Soil ____%	○
F2. Rate the turf management status: ☒ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☒ Y ☐ N ☐ Can't Tell	○ ✓
F4. Do landscaped areas drain to the storm drain system? ☒ Y ☐ N ☐ Can't Tell	○ ✓
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☒ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)*	**Observed Pollution Source?** ☐
G1. Are storm water treatment practices present? ☐ Y ☐ N ☒ Unknown If yes, please describe: ____________	○
G2. Are private storm drains located at the facility? ☒ Y ☐ N ☐ Unknown No Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☒ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

Hotspot Site Investigation **HSI**

WATERSHED: ~~Gages~~ Tank	**SUBWATERSHED:** Gages		**UNIQUE SITE ID:** GB-HSI-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB	**CAMERA ID:**	**PIC#:** 3687
MAP GRID:	**LAT** 41° 51' 38" **LONG** 72° 25' 15"		**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address:
Industrial Park West

SIC code (if available): ______

NPDES Status: ☐ Regulated ☐ Unregulated ☐ Unknown

Category: ☐ Commercial ☒ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related
Miscellaneous ☐ Golf Course ☐ Marina ☐ Animal Facility

Basic Description of Operation: Office Building – Gerber Technologies ~~[illegible]~~

INDEX*

B. VEHICLE OPERATIONS ☐ N/A *(Skip to part C)* — Observed Pollution Source? ☐

B1. Types of vehicles: ☐ Fleet vehicles ☐ School buses ☒ Other: Commuter vehicles

B2. Approximate number of vehicles: ~~50~~ 100

B3. Vehicle activities *(circle all that apply)*: Maintained (circled) Repaired Recycled Fueled Washed Stored ○

B4. Are vehicles stored and/or repaired outside? ☐ Y ☒ N ☐ Can't Tell
Are these vehicles lacking runoff diversion methods? ☐ Y ☐ N ☐ Can't Tell ○

B5. Is there evidence of spills/leakage from vehicles? ☐ Y ☒ N ☐ Can't Tell ○

B6. Are uncovered outdoor fueling areas present? ☐ Y ☒ N ☐ Can't Tell ○

B7. Are fueling areas directly connected to storm drains? ☐ Y ☒ N ☐ Can't Tell ○

B8. Are vehicles washed outdoors? ☐ Y ☒ N ☐ Can't Tell
Does the area where vehicles are washed discharge to the storm drain? ☐ Y ☐ N ☐ Can't Tell ○

C. OUTDOOR MATERIALS ☒ N/A *(Skip to part D)* — Observed Pollution Source? ☐

C1. Are loading/unloading operations present? ☐ Y ☒ N ☐ Can't Tell
If yes, are they uncovered *and* draining towards a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell ○

C2. Are materials stored outside? ☐ Y ☒ N ☐ Can't Tell If yes, are they ☐ Liquid ☐ Solid Description: ______
Where are they stored? ☐ grass/dirt area ☐ concrete/asphalt ☐ bermed area ○

C3. Is the storage area directly or indirectly connected to storm drain (circle one)? ☐ Y ☐ N ☐ Can't Tell ○

C4. Is staining or discoloration around the area visible? ☐ Y ☐ N ☒ Can't Tell ○

C5. Does outdoor storage area lack a cover? ☐ Y ☐ N ☐ Can't Tell ○

C6. Are liquid materials stored *without* secondary containment? ☐ Y ☒ N ☐ Can't Tell ○

C7. Are storage containers missing labels or in poor condition (rusting)? ☐ Y ☐ N ☐ Can't Tell ○

D. WASTE MANAGEMENT ☒ N/A *(Skip to part E)* — Observed Pollution Source? ☐

D1. Type of waste *(check all that apply)*: ☐ Garbage ☐ Construction materials ☐ Hazardous materials ○

D2. Dumpster condition (*check all that apply*): ☐ No cover/Lid is open ☐ Damaged/poor condition ☐ Leaking or evidence of leakage (stains on ground) ☐ Overflowing ○

D3. Is the dumpster located near a storm drain inlet? ☐ Y ☐ N ☐ Can't Tell
If yes, are runoff diversion methods (berms, curbs) lacking? ☐ Y ☐ N ☐ Can't Tell ○

E. PHYSICAL PLANT ☒ N/A *(Skip to part F)* — Observed Pollution Source? ☐

E1. Building: Approximate age: ______ yrs. Condition of surfaces: ☐ Clean ☐ Stained ☐ Dirty ☐ Damaged ○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? ☐ Y ☐ N ☐ Don't know ○

*Index: ○ denotes potential pollution source; ☐ denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age ______ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up
Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know ○

E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible
Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know ○

E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell ○

F. Turf/Landscaping Areas ☐ N/A *(skip to part G)* — Observed Pollution Source? ☐

F1. % of site with: Forest canopy ____% Turf grass 90 % Landscaping 10 % Bare Soil ____% ○

F2. Rate the turf management status: ☒ High ☐ Medium ☐ Low ○

F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☒ Can't Tell ○

F4. Do landscaped areas drain to the storm drain system? ☒ Y ☐ N ☐ Can't Tell ○

F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☒ Can't Tell ○

G. Storm Water Infrastructure ☐ N/A *(skip to part H)* — Observed Pollution Source? ☐

G1. Are storm water treatment practices present? ☒ Y ☐ N ☐ Unknown If yes, please describe: ________________ ○

G2. Are private storm drains located at the facility? ☒ Y ☐ N ☐ Unknown
Is trash present in gutters leading to storm drains? If so, complete the index below. ○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. Initial Hotspot Status - Index Results

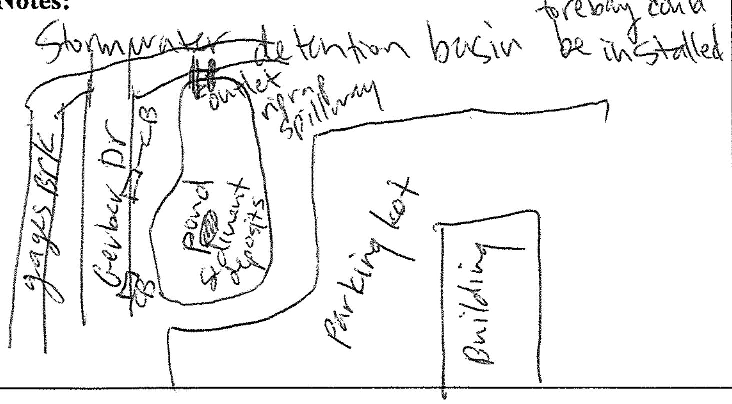
☒ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:
- ☐ Refer for immediate enforcement
- ☐ Suggest follow-up on-site inspection
- ☐ Test for illicit discharge
- ☐ Include in future education effort
- ☐ Check to see if hotspot is an NPDES non-filer
- ☐ Onsite non-residential retrofit
- ☐ Pervious area restoration; complete PAA sheet and record Unique Site ID here: ____________________
- ☐ Schedule a review of storm water pollution prevention plan

outlet has plants growing on top of riprap could be removed

Notes:

Sediment forebay could be installed



GB-HSI-01

1/16/08 Gerber Drive – Stormwater retrofit

- EXISTING BASIN, NO SED. FOREBAY
- SIGNIFICANT SED. ACCUMULATION
- INLET NOT IDENTIFIED
- OUTLET A RIPRAP CHANNEL FULL OF TREES & SHRUBS
- Recall that erosion was present downstream

∴ Good potential candidate for maintenance & retrofit

Hotspot Site Investigation **HSI**

WATERSHED: Tanker	**SUBWATERSHED:** Clark	**UNIQUE SITE ID:** CB-HSI-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB **CAMERA ID:**	**PIC#:**
MAP GRID:	**LAT** __°___'___" **LONG** __°___'___"	**LMK #**

A. SITE DATA AND BASIC CLASSIFICATION

Name and Address: Superior Energy Rt. 30

Category: [X] Commercial [ ] Industrial [ ] Institutional [ ] Municipal [ ] Transport-Related

Miscellaneous: [ ] Golf Course [ ] Marina [ ] Animal Facility

SIC code (if available): ______

NPDES Status: [ ] Regulated [ ] Unregulated [ ] Unknown

Basic Description of Operation: Propane

INDEX*

B. VEHICLE OPERATIONS [ ] N/A *(Skip to part C)* — **Observed Pollution Source?** [ ]

B1. Types of vehicles: [X] Fleet vehicles [ ] School buses [ ] Other: ______

B2. Approximate number of vehicles: 5 propane trucks

B3. Vehicle activities *(circle all that apply)*: Maintained Repaired Recycled Fueled Washed Stored ○

B4. Are vehicles stored and/or repaired outside? [ ] Y [ ] N [ ] Can't Tell
Are these vehicles lacking runoff diversion methods? [ ] Y [ ] N [X] Can't Tell ○

B5. Is there evidence of spills/leakage from vehicles? [ ] Y [ ] N [X] Can't Tell ○

B6. Are uncovered outdoor fueling areas present? [ ] Y [ ] N [X] Can't Tell ○

B7. Are fueling areas directly connected to storm drains? [ ] Y [ ] N [ ] Can't Tell ○

B8. Are vehicles washed outdoors? [ ] Y [ ] N [ ] Can't Tell
Does the area where vehicles are washed discharge to the storm drain? [ ] Y [ ] N [ ] Can't Tell ○

C. OUTDOOR MATERIALS [ ] N/A *(Skip to part D)* — **Observed Pollution Source?** [ ]

C1. Are loading/unloading operations present? [X] Y [ ] N [ ] Can't Tell
If yes, are they uncovered *and* draining towards a storm drain inlet? [ ] Y [ ] N [X] Can't Tell ○

C2. Are materials stored outside? [X] Y [ ] N [ ] Can't Tell If yes, are they [ ] Liquid [ ] Solid Description: ______
Where are they stored? [ ] grass/dirt area [X] concrete/asphalt [ ] bermed area ○

C3. Is the storage area directly or indirectly connected to storm drain (circle one)? [ ] Y [ ] N [X] Can't Tell ○

C4. Is staining or discoloration around the area visible? [ ] Y [ ] N [ ] Can't Tell ○

C5. Does outdoor storage area lack a cover? [X] Y [ ] N [ ] Can't Tell ○

C6. Are liquid materials stored *without* secondary containment? [X] Y [X] N [ ] Can't Tell ○

C7. Are storage containers missing labels or in poor condition (rusting)? [X] Y [ ] N [ ] Can't Tell Rust ○

D. WASTE MANAGEMENT [ ] N/A *(Skip to part E)* — **Observed Pollution Source?** [ ]

D1. Type of waste *(check all that apply)*: [ ] Garbage [ ] Construction materials [ ] Hazardous materials ○

D2. Dumpster condition (*check all that apply*): [ ] No cover/Lid is open [ ] Damaged/poor condition [ ] Leaking or evidence of leakage (stains on ground) [ ] Overflowing ○

D3. Is the dumpster located near a storm drain inlet? [ ] Y [ ] N [ ] Can't Tell
If yes, are runoff diversion methods (berms, curbs) lacking? [ ] Y [ ] N [ ] Can't Tell ○

E. PHYSICAL PLANT [ ] N/A *(Skip to part F)* — **Observed Pollution Source?** [ ]

E1. Building: Approximate age: 30-40 yrs. Condition of surfaces: [ ] Clean [ ] Stained [ ] Dirty [ ] Damaged ○
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? [ ] Y [ ] N [ ] Don't know ○

*Index: ○ denotes potential pollution source; [ ] denotes confirmed polluter (evidence was seen)

E2. Parking Lot: Approximate age _____ yrs. Condition: ☐ Clean ☐ Stained ☐ Dirty ☐ Breaking up Surface material ☐ Paved/Concrete ☐ Gravel ☐ Permeable ☐ Don't know	○
E3. Do downspouts discharge to impervious surface? ☐ Y ☐ N ☐ Don't know ☐ None visible Are downspouts directly connected to storm drains? ☐ Y ☐ N ☐ Don't know	○
E4. Evidence of poor cleaning practices for construction activities (stains leading to storm drain)? ☐ Y ☐ N ☐ Can't Tell	○
F. TURF/LANDSCAPING AREAS ☒ N/A *(skip to part G)*	**Observed Pollution Source?** ☐
F1. % of site with: Forest canopy ____% Turf grass _____ % Landscaping ____% Bare Soil ____%	○
F2. Rate the turf management status: ☐ High ☐ Medium ☐ Low	○
F3. Evidence of permanent irrigation or "non-target" irrigation ☐ Y ☐ N ☐ Can't Tell	○
F4. Do landscaped areas drain to the storm drain system? ☐ Y ☐ N ☐ Can't Tell	○
F5. Do landscape plants accumulate organic matter (leaves, grass clippings) on adjacent impervious surface? ☐ Y ☐ N ☐ Can't Tell	○
G. STORM WATER INFRASTRUCTURE ☐ N/A *(skip to part H)*	**Observed Pollution Source?** ☐
G1. Are storm water treatment practices present? ☐ Y ☒ N ☐ Unknown If yes, please describe: ______________	○
G2. Are private storm drains located at the facility? ☐ Y ☐ N ☐ Unknown Is trash present in gutters leading to storm drains? If so, complete the index below.	○

Index Rating for Accumulation in Gutters

	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

G3. Catch basin inspection – Record SSD Unique Site ID here: ________ Condition: ☐ Dirty ☐ Clean

H. INITIAL HOTSPOT STATUS - INDEX RESULTS

☐ Not a hotspot (fewer than 5 circles and no boxes checked) ☐ Potential hotspot (5 to 10 circles but no boxes checked)
☐ Confirmed hotspot (10 to 15 circles and/or 1 box checked) ☐ Severe hotspot (>15 circles and/or 2 or more boxes checked)

Follow-up Action:

☐ Refer for immediate enforcement
☐ Suggest follow-up on-site inspection
☐ Test for illicit discharge
☐ Include in future education effort
☐ Check to see if hotspot is an NPDES non-filer
☐ Onsite non-residential retrofit
☐ Pervious area restoration; complete PAA sheet and record
Unique Site ID here: ____________________
☐ Schedule a review of storm water pollution prevention plan

Notes:

WATERSHED: Parker	**SUBWATERSHED:** Clarks	**UNIQUE SITE ID:** CB-NSA-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB	**CAMERA ID:** / **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: High Manor — Neighborhood Area (acres) ~~50~~ 50 [39] GIS

If unknown, address (or streets) surveyed:

Homeowners Association? [ ] Y [ ] N [X] Unknown — If yes, name and contact information:

Residential *(circle average single family lot size):*

[ ] Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre — [ ] Multifamily (Apts, Townhomes, Condos)

[ ] Single Family Detached <¼ ¼ ½ 1 >1 acre — [X] Mobile Home Park

	INDEX*
Estimated Age of Neighborhood: 30 years — Percent of Homes with Garages: 0 % — With Basements 0 %	
Sewer Service? [X] Y [ ] N	○
Index of Infill, Redevelopment, and Remodeling [X] No Evidence [ ] <5% of units [ ] 5-10% [ ] >10%	○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	INDEX*
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover	40		
B2. % of lot with grass cover	40		○
B3. % of lot with landscaping (e.g., mulched bed areas)	20		◇
B4. % of lot with bare soil	0		○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy	10		◇
B6. Evidence of permanent irrigation or "non-target" irrigation	No (0%)		○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 50		○
	Med: 40		
	Low: 10		
B8. Outdoor swimming pools? [ ] Y [X] N [ ] Can't Tell Estimated # ___			○
B9. Junk or trash in yards? [ ] Y [X] N [ ] Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious [ ] N/A	100		
C2. Driveway Condition [X] Clean [ ] Stained [ ] Dirty [X] Breaking up			○
C3. Are sidewalks present? [ ] Y [X] N If yes, are they on one side of street [ ] or along both sides [ ]			
[ ] Spotless [ ] Covered with lawn clippings/leaves [ ] Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? ___ ft.			◇
Is pet waste present in this area? [ ] Y [ ] N [ ] N/A			○
C4. Is curb and gutter present? [X] Y [ ] N If yes, check all that apply:			
[X] Clean and Dry [ ] Flowing or standing water [X] Long-term car parking [ ] Sediment			○
[ ] Organic matter, leaves, lawn clippings [ ] Trash, litter, or debris [ ] Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

CB-NSA-01

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface	10		
D3. Downspouts discharge to pervious area	90		
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? [X] Y [ ] N			◇

E. COMMON AREAS	
E1. Storm drain inlets? [X] Y [ ] N If yes, are they stenciled? [ ] Y [X] N Condition: [X] Clean [ ] Dirty	◆
Catch basins inspected? [X] Y [ ] N If yes, include Unique Site ID from SSD sheet: ______	○
E2. Storm water pond? [ ] Y [X] N Is it a [ ] wet pond or [ ] dry pond? Is it overgrown? [ ] Y [ ] N What is the estimated pond area? [ ] <1 acre [ ] about 1 acre [ ] > 1 acre	◇
E3. Open Space? [ ] Y [X] N If yes, is pet waste present? [ ] Y [ ] N dumping? [ ] Y [ ] N	○
Buffers/floodplain present: [ ] Y [ ] N If yes, is encroachment evident? [ ] Y [ ] N	

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*) [ ] Nutrients [ ] Oil and Grease [ ] Trash/Litter [ ] Bacteria [X] Sediment [ ] Other ______	○

Recommended Actions

Specific Action

- [ ] Onsite retrofit potential?
- [X] Better lawn/landscaping practice?
- [ ] Better management of common space?
- [ ] Pond retrofit?
- [ ] Multi-family Parking Lot Retrofit?
- [ ] Other action(s) ______

Describe Recommended Actions:

Better landscaping w/ increased pervious areas.

Initial Assessment

NSA Pollution Severity Index

- [ ] Severe (More than 10 circles checked)
- [ ] High (5 to 10 circles checked)
- [X] Moderate (Fewer than 5 circles checked)
- [ ] None (No circles checked)

Neighborhood Restoration Opportunity Index

- [ ] High (More than 5 diamonds checked)
- [X] Moderate (3-5 diamonds checked)
- [X] ~~Low~~ (Fewer than 3 diamonds checked)

NOTES:

WATERSHED: Tankerhoosen	**SUBWATERSHED:** Tucker	**UNIQUE SITE ID:** TB-NSA-01
DATE: 7/16/08	**ASSESSED BY:**	**CAMERA ID:** / **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: ______ Neighborhood Area (acres) 106 (HS)

If unknown, address (or streets) surveyed: Meadow Brook Ave - , Duke, Amherst St

Homeowners Association? ☐ Y ☐ N ☒ Unknown If yes, name and contact information: ______

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☒ Single Family Detached <¼ ¼ ½ 1 >1 acre ☐ Mobile Home Park

	INDEX*
Estimated Age of Neighborhood: 10 years — Percent of Homes with Garages: 100% With Basements ? %	
Sewer Service? ☒ Y ☐ N	○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☒ 5-10% ☐ >10%	○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	INDEX*
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover	50		
B2. % of lot with grass cover	30		○
B3. % of lot with landscaping (e.g., mulched bed areas)	20		◇
B4. % of lot with bare soil	0		○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy	20		◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 100		○
	Med: ___		
	Low: ___		
B8. Outdoor swimming pools? ☒ Y ☐ N ☐ Can't Tell Estimated # 10			○
B9. Junk or trash in yards? ☐ Y ☒ N ☐ Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A	100		
C2. Driveway Condition ☒ Clean ☐ Stained ☐ Dirty ☐ Breaking up			○
C3. Are sidewalks present? ☒ Y ☐ N If yes, are they on one side of street ☒ or along both sides ☐			
☒ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? 5 ft.			◇
Is pet waste present in this area? ☐ Y ☒ N ☐ N/A			○
C4. Is curb and gutter present? ☒ Y ☐ N If yes, check all that apply:			
☒ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment			○
☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

TB-NSA-01

Neighborhood Source Assessment **NSA**

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface	10		
D3. Downspouts discharge to pervious area	90		
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☑ Y ☐ N			◇

E. COMMON AREAS	
E1. Storm drain inlets? ☒ Y ☐ N If yes, are they stenciled? ☑ Y ☐ N Condition: ☒ Clean ☐ Dirty	◇
Catch basins inspected? ☑ Y ☐ N If yes, include Unique Site ID from SSD sheet: ________	○
E2. Storm water pond? ☒ Y ☐ N Is it a ☒ wet pond or ☐ dry pond? Is it overgrown? ☒ Y ☐ N What is the estimated pond area? ~~☒ < 1 acre~~ ☒ about 1 acre ☐ > 1 acre	◇
E3. Open Space? ☐ Y ☐ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N	○
Buffers/floodplain present: ☐ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N	

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*) ☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other ________	○

Recommended Actions

Specific Action

- ☒ 1 Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☒ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ________

Describe Recommended Actions:

Found 1 pond along Yale & Chatham Drs ~~although too small for entire neighborhood other ponds unknown.~~ may be large enough for whole neighborhood

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☐ Moderate (Fewer than 5 circles checked)
- ☒ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☒ Low (Fewer than 3 diamonds checked)

1 pond could be retrofitted see stream assessment forms

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: WR / CB	**SUBWATERSHED:**	**UNIQUE SITE ID:** WR-NSA-01
DATE: 7/16/08	**ASSESSED BY:** KB/DB	**CAMERA ID:** WS Canon — **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Mt. Vernon Apts. Neighborhood Area (acres) 20-30ac [33 Acres GIS]

If unknown, address (or streets) surveyed:

Homeowners Association? [x] Y [ ] N [ ] Unknown If yes, name and contact information: Rental

Residential *(circle average single family lot size):*

[ ] Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre [x] Multifamily (Apts, Townhomes, Condos)

[ ] Single Family Detached <¼ ¼ ½ 1 >1 acre [ ] Mobile Home Park

	INDEX*
Estimated Age of Neighborhood: 10 years — Percent of Homes with Garages: 0 % With Basements ___ %	
Sewer Service? [x] Y [ ] N	○
Index of Infill, Redevelopment, and Remodeling [x] No Evidence [ ] <5% of units [ ] 5-10% [ ] >10%	○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	INDEX*
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover	50		
B2. % of lot with grass cover	30		○
B3. % of lot with landscaping (e.g., mulched bed areas)	20		◇
B4. % of lot with bare soil	0		○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy	20		◇
B6. Evidence of permanent irrigation or "non-target" irrigation	N		○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 100		○
	Med: ___		
	Low: ___		
B8. Outdoor swimming pools? [ ] Y [x] N [ ] Can't Tell Estimated # ___			○
B9. Junk or trash in yards? [ ] Y [x] N [ ] Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious [ ] N/A	100		
C2. Driveway Condition [ ] Clean [x] Stained [ ] Dirty [ ] Breaking up			○
C3. Are sidewalks present? [x] Y [ ] N If yes, are they on one side of street [ ] or along both sides [ ]			
[ ] Spotless [ ] Covered with lawn clippings/leaves [ ] Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? _____ ft.			◇
Is pet waste present in this area? [ ] Y [ ] N [ ] N/A			○
C4. Is curb and gutter present? [x] Y [ ] N If yes, check all that apply:			
[x] Clean and Dry [ ] Flowing or standing water [x] Long-term car parking [ ] Sediment			○
[ ] Organic matter, leaves, lawn clippings [ ] Trash, litter, or debris [ ] Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer	✓		◇ ○
D2. Downspouts are directed to impervious surface			
D3. Downspouts discharge to pervious area			
D4. Downspouts discharge to a cistern, rain barrel, etc.			
***Note: C1 through C4 should total 100%**			
D5. Lawn area present downgradient of leader for rain garden? ☑ Y ☐ N			◇

E. COMMON AREAS	
E1. Storm drain inlets? ☑ Y ☐ N If yes, are they stenciled? ☐ Y ☑ N Condition: ☑ Clean ☐ Dirty	◇
Catch basins inspected? ☑ Y ☐ N If yes, include Unique Site ID from SSD sheet: NSA-01	○
E2. Storm water pond? ☐ Y ☐ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre	◇
E3. Open Space? ☑ Y ☐ N If yes, is pet waste present? ☐ Y ☑ N dumping? ☐ Y ☑ N	○
Buffers/floodplain present: ☐ Y ☑ N If yes, is encroachment evident? ☐ Y ☐ N	

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: *(check all that apply)* ☐ Nutrients ☑ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☑ Other connected impervious	○

Recommended Actions

Specific Action

- ☑ Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ____________

Describe Recommended Actions:

Rain gardens for downspouts

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☒ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☑ Moderate (3-5 diamonds checked)
- ☐ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Tanker	**SUBWATERSHED:** LTR	**UNIQUE SITE ID:** LTR-NSA-01
DATE: 7/16/08	**ASSESSED BY:**	**CAMERA ID:** / **PIC#:**

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: ______ Neighborhood Area (acres) 13 (6-15)

If unknown, address (or streets) surveyed: Campbell Avenue

Homeowners Association? ☐ Y ☒ N ☐ Unknown If yes, name and contact information: ______

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <⅛ ⅛ ¼ ⅓ ⅓ acre ☐ Multifamily (Apts, Townhomes, Condos)

☒ Single Family Detached <¼ (¼) ½ 1 >1 acre ☐ Mobile Home Park

		INDEX*
Estimated Age of Neighborhood: 50 years	Percent of Homes with Garages: 0 % With Basements 0 %	
Sewer Service? ☒ Y ☐ N		○
Index of Infill, Redevelopment, and Remodeling ☒ No Evidence ☐ <5% of units ☐ 5-10% ☐ >10%		○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover	50		
B2. % of lot with grass cover	40		○
B3. % of lot with landscaping (e.g., mulched bed areas)	10		○
B4. % of lot with bare soil	0		○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy	10		◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 10		○
	Med: 80		
	Low: 10		
B8. Outdoor swimming pools? ☐Y ☐N ☒ Can't Tell Estimated # 1			○
B9. Junk or trash in yards? ☒ Y ☐ N ☐ Can't Tell Cars (1)			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A 1 was pervious	95		
C2. Driveway Condition ☒ Clean ☐ Stained ☐ Dirty ☒ Breaking up			○
C3. Are sidewalks present? ☐ Y ☒ N If yes, are they on one side of street ☐ or along both sides ☐			
☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? _____ ft.			◇
Is pet waste present in this area? ☐ Y ☒ N ☒ N/A			○
C4. Is curb and gutter present? ☒ Y ☐ N If yes, check all that apply:			
☒ Clean and Dry ☐ Flowing or standing water ☒ Long-term car parking ☐ Sediment			○
☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☐ Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface	5		
D3. Downspouts discharge to pervious area	95		
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☐ N			◇

E. COMMON AREAS	
E1. Storm drain inlets? ☒ Y ☐ N If yes, are they stenciled? ☐ Y ☐ N Condition: ☐ Clean ☐ Dirty	◇
Catch basins inspected? ☒ Y ☐ N If yes, include Unique Site ID from SSD sheet: LTR NSA-01	○
E2. Storm water pond? ☐ Y ☒ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre	◇
E3. Open Space? ☐ Y ☒ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N	○
Buffers/floodplain present: ☐ Y ☐ N If yes, is encroachment evident? ☐ Y ☐ N	

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*) ☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☒ Sediment ☐ Other ____________	○

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☒ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☒ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ____________

Describe Recommended Actions:

Detention pond for storm drains is possible

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☒ Moderate (Fewer than 5 circles checked)
- ☐ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☒ Low (Fewer than 3 diamonds checked)

NOTES:

Neighborhood Source Assessment **NSA**

WATERSHED: Tucker	**SUBWATERSHED:** Gages	**UNIQUE SITE ID:** GB- NSA-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB	**CAMERA ID:** / **PIC#:** 394-97

A. NEIGHBORHOOD CHARACTERIZATION

Neighborhood/Subdivision Name: Valley View Dr / Andrews Way & Neighborhood Area (acres) 55 (GIS)
If unknown, address (or streets) surveyed:

Homeowners Association? ☐ Y ☐ N ☐ Unknown If yes, name and contact information:

Residential *(circle average single family lot size):*

☐ Single Family Attached (Duplexes, Row Homes) <1/8 1/8 1/4 1/3 1/3 acre ☐ Multifamily (Apts, Townhomes, Condos)
☒ Single Family Detached <1/4 1/4 1/2 (1) >1 acre ☐ Mobile Home Park

	INDEX*
Estimated Age of Neighborhood: 25 years — Percent of Homes with Garages: 95 % With Basements 10 %	
Sewer Service? ☒ Y ☐ N ? look @ map	○
Index of Infill, Redevelopment, and Remodeling ☐ No Evidence ☐ <5% of units ☐ 5-10% ☒ >10%	○

Record percent observed for each of the following indicators, depending on applicability and/or site complexity	Percentage	Comments/Notes	INDEX*
B. YARD AND LAWN CONDITIONS			
B1. % of lot with impervious cover	20		
B2. % of lot with grass cover	60		○
B3. % of lot with landscaping (e.g., mulched bed areas)	20		◇
B4. % of lot with bare soil	0		○
**Note: B1 through B4 must total 100%*			
B5. % of lot with forest canopy	40		◇
B6. Evidence of permanent irrigation or "non-target" irrigation			○
B7. Proportion of *total neighborhood* turf lawns with following management status:	High: 90		○
	Med: 10		
	Low:		
B8. Outdoor swimming pools? ☒ Y ☐ N ☐ Can't Tell Estimated # 8			○
B9. Junk or trash in yards? ☐ Y ☒ N ☐ Can't Tell			○
C. DRIVEWAYS, SIDEWALKS, AND CURBS			
C1. % of driveways that are impervious ☐ N/A	100		
C2. Driveway Condition ☒ Clean ☐ Stained ☐ Dirty ☐ Breaking up			○
C3. Are sidewalks present? ☐ Y ☒ N If yes, are they on one side of street ☐ or along both sides ☐			
☐ Spotless ☐ Covered with lawn clippings/leaves ☐ Receiving 'non-target' irrigation			○
What is the distance between the sidewalk and street? ____ ft.			◇
Is pet waste present in this area? ☐ Y ☐ N ☒ N/A			○
C4. Is curb and gutter present? ☒ Y ☐ N If yes, check all that apply:			
☒ Clean and Dry ☐ Flowing or standing water ☐ Long-term car parking ☐ Sediment			○
☐ Organic matter, leaves, lawn clippings ☐ Trash, litter, or debris ☒ Overhead tree canopy			◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

GB-NSA-01

Neighborhood Source Assessment **NSA**

D. ROOFTOPS			
D1. Downspouts are directly connected to storm drains or sanitary sewer			◇ ○
D2. Downspouts are directed to impervious surface	25		
D3. Downspouts discharge to pervious area	75		
D4. Downspouts discharge to a cistern, rain barrel, etc.			
**Note: C1 through C4 should total 100%*			
D5. Lawn area present downgradient of leader for rain garden? ☐ Y ☒ N			◇

E. COMMON AREAS	
E1. Storm drain inlets? ☒ Y ☐ N If yes, are they stenciled? ☐ Y ☒ N Condition: ☒ Clean ☐ Dirty	◇
Catch basins inspected? ☒ Y ☐ N If yes, include Unique Site ID from SSD sheet: ______	○
E2. Storm water pond? ☐ Y ☒ N Is it a ☐ wet pond or ☐ dry pond? Is it overgrown? ☐ Y ☐ N What is the estimated pond area? ☐ <1 acre ☐ about 1 acre ☐ > 1 acre	◇
E3. Open Space? ☐ Y ☒ N If yes, is pet waste present? ☐ Y ☐ N dumping? ☐ Y ☐ N	○
Buffers/floodplain present: ☒ Y ☐ N If yes, is encroachment evident? ☒ Y ☐ N	

F. INITIAL NEIGHBORHOOD ASSESSMENT AND RECOMMENDATIONS	
Based on field observations, this neighborhood has significant indicators for the following: (*check all that apply*) ☐ Nutrients ☐ Oil and Grease ☐ Trash/Litter ☐ Bacteria ☐ Sediment ☐ Other ______	○

Recommended Actions

Specific Action

- ☐ Onsite retrofit potential?
- ☐ Better lawn/landscaping practice?
- ☐ Better management of common space?
- ☐ Pond retrofit?
- ☐ Multi-family Parking Lot Retrofit?
- ☐ Other action(s) ______

Describe Recommended Actions:

roadway improvements

Initial Assessment

NSA Pollution Severity Index

- ☐ Severe (More than 10 circles checked)
- ☐ High (5 to 10 circles checked)
- ☐ Moderate (Fewer than 5 circles checked)
- ☒ None (No circles checked)

Neighborhood Restoration Opportunity Index

- ☐ High (More than 5 diamonds checked)
- ☐ Moderate (3-5 diamonds checked)
- ☒ Low (Fewer than 3 diamonds checked)

NOTES:

WATERSHED: Tank	**SUBWATERSHED:** GB	**UNIQUE SITE ID:** GB-HSI-01
DATE: 7/16/08	**ASSESSED BY:** KB/DB	**CAMERA ID:** WS Sony
MAP GRID	**RAIN IN LAST 24 HOURS** ☐ Y ☒ N	**PIC #**

A. LOCATION

A1. Street names or neighborhood surveyed: Industrial Park West

A2. Adjacent land use: ☐ Residential ☐ Commercial ☒ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here ______

B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☒ Local ☐ Alley ☐ Other: ____

B2. Condition of Pavement: ☐ New ☒ Good ☐ Cracked ☐ Broken

B3. Is on-street parking permitted ☒ Y ☐ N If yes, approximate number of cars per block: 0

B4. Are large cul-de-sacs present? ☒ Y ☐ N

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.

	Index Rating for Accumulation in Gutters				
	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic Material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: ☐ open ☒ enclosed ☐ mixed

C2. Percentage of inlets with catch basin storage: ____ ☐ N/A

Sample 1-2 catch basins per NSA/HSI	**C3.** Catch basin #1	**C4.** Catch basin #2
Latitude	41° 51' 38"	41° 51' 35"
Longitude	72° 25' 15"	72° 25' 17"
LMK #		
Picture #	101-3687	101-3688
Current Condition	☒ Wet ☐ Dry	☒ Wet ☐ Dry
Condition of Inlet	☒ Clear ☐ Obstructed	☒ Clear ☐ Obstructed
Litter Accumulation	☐ Y ☒ N	☒ Y ☒ N
Organics Accumulation	☐ Y ☒ N	☒ Y ☐ N
Sediment Accumulation	☒ Y ☐ N	☒ Y ☐ N
Sediment Depth (in feet)	<0.5 ft.	<0.5 ft.
Water Depth	<0.2 ft.	<0.2 ft.
Evidence of oil and grease	☐ Y ☒ N	☐ Y ☒ N
Sulfur smell	☐ Y ☒ N	☐ Y ☒ N
Accessible to vacuum truck	☒ Y ☐ N	☒ Y ☐ N

D. NON-RESIDENTIAL PARKING LOT (>2 acres)

D1. Approximate size: 10 acres

D2. Lot Utilization: ☒ Full ☐ About half full ☐ Empty

D3. Overall condition of Pavement: ☐ Smooth (no cracks) ☒ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? ☒ Y ☐ N If yes, describe: Basin

D5. On-site retrofit potential: ☐ Excellent ☒ Good ☐ Poor

E. Municipal Pollutant Reduction Strategies

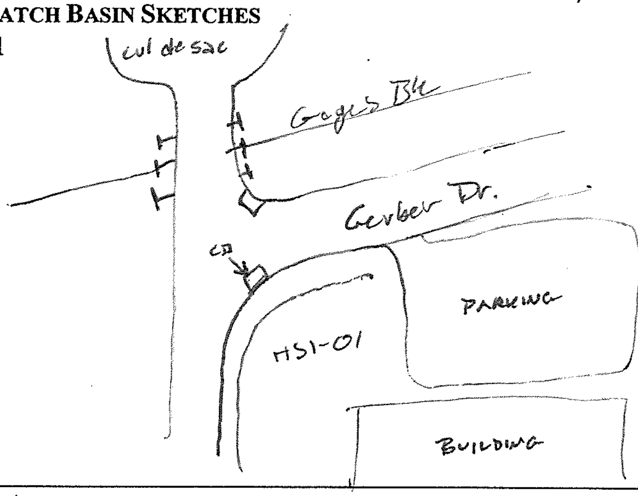
E1. Degree of pollutant accumulation in the system: ☐ High ☐ Medium ☒ Low ☐ None

E2. Rate the feasibility of the following pollution prevention strategies:

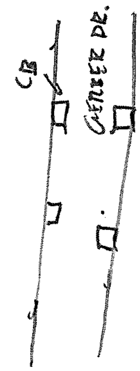
Street Sweeping:	☐ High	☒ Moderate	☐ Low
Storm Drain Stenciling:	☐ High	☒ Moderate	☐ Low
Catch Basin Clean-outs:	☐ High	☒ Moderate	☐ Low
Parking Lot Retrofit Potential:	☐ High	☒ Moderate	☐ Low

Catch Basin Sketches

#1



#2



Notes:

WATERSHED: TANK	**SUBWATERSHED:** CTB	**UNIQUE SITE ID:** SSD-01
DATE: 7/16/08	**ASSESSED BY:** KB/DB	**CAMERA ID:** WS Sony
MAP GRID	**RAIN IN LAST 24 HOURS** ☐ Y ☒ N	**PIC #**

A. LOCATION

A1. Street names or neighborhood surveyed: Clark Rd Industrial Parks

A2. Adjacent land use: ☐ Residential ☐ Commercial ☒ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here ________

B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☒ Local ☐ Alley ☐ Other: ________

B2. Condition of Pavement: ☐ New ☐ Good ☒ Cracked ☒ Broken

B3. Is on-street parking permitted ☒ Y ☐ N If yes, approximate number of cars per block: ________

B4. Are large cul-de-sacs present? ☒ Y ☐ N

11

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.	Index Rating for Accumulation in Gutters				
	Clean				Filthy
Sediment	☐ 1	☒ 2	☐ 3	☐ 4	☐ 5
Organic Material	☐ 1	☐ 2	☐ 3	☒ 4	☐ 5
Litter	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: ☐ open ☒ enclosed ☐ mixed

C2. Percentage of inlets with catch basin storage: ________ ☐ N/A

Sample 1-2 catch basins per NSA/HSI	**C3.** Catch basin #1	**C4.** Catch basin #2
Latitude	41° 50' 17"	41° 50' 07"
Longitude	72° 27' 17"	72° 27' 25"
LMK #		
Picture #	101-3716	101-3720
Current Condition	☒ Wet ☐ Dry	☐ Wet ☐ Dry
Condition of Inlet	☐ Clear ☐ Obstructed	☐ Clear ☒ Obstructed
Litter Accumulation	☐ Y ☒ N	☒ Y ☐ N
Organics Accumulation	☒ Y ☐ N	☒ Y ☐ N
Sediment Accumulation	☒ Y ☐ N	☒ Y ☐ N
Sediment Depth (in feet)	____ ft.	0.5 ft.
Water Depth	0.5 ft.	0.5 ft.
Evidence of oil and grease	☐ Y ☒ N	☐ Y ☒ N
Sulfur smell	☐ Y ☒ N	☐ Y ☒ N
Accessible to vacuum truck	☒ Y ☐ N	☒ Y ☐ N

D. NON-RESIDENTIAL PARKING LOT (>2 acres)

D1. Approximate size: ________ acres varies

D2. Lot Utilization: ☐ Full ☒ About half full ☐ Empty

D3. Overall condition of Pavement: ☐ Smooth (no cracks) ☐ Medium (few cracks) ☒ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? ☐ Y ☒ N If yes, describe: ________

D5. On-site retrofit potential: ☐ Excellent ☐ Good ☐ Poor

E. Municipal Pollutant Reduction Strategies

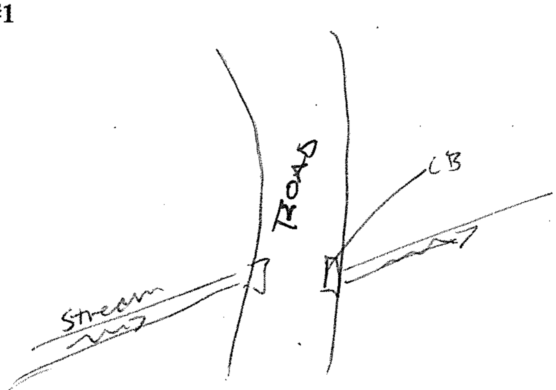
E1. Degree of pollutant accumulation in the system: ☐ High ☒ Medium ☐ Low ☐ None

E2. Rate the feasibility of the following pollution prevention strategies:

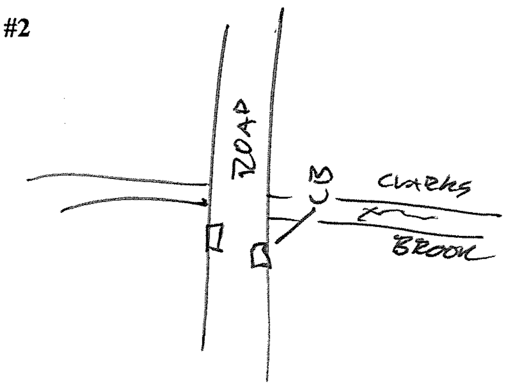
Street Sweeping:	☒ High	☐ Moderate	☐ Low
Storm Drain Stenciling:	☐ High	☐ Moderate	☒ Low
Catch Basin Clean-outs:	☐ High	☒ Moderate	☐ Low
Parking Lot Retrofit Potential:	☐ High	☒ Moderate	☐ Low

Catch Basin Sketches

#1



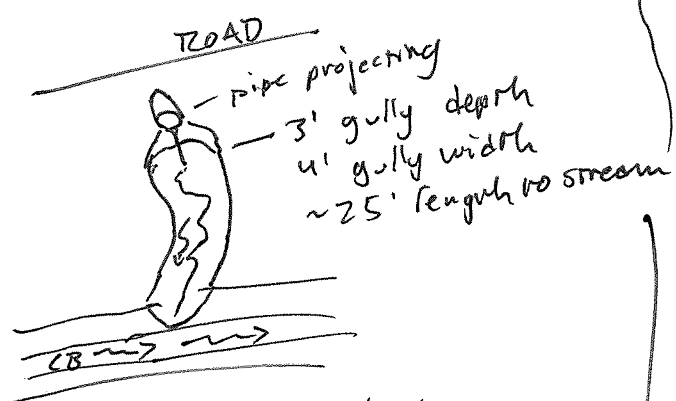
#2



Notes:

#1:

Dry weather flow
severe erosion at outfall



Source is a wetland
area adjacent to
ind. bldg; no pipe in.

Water in CB @
higher level than stream
surface & not moving

WATERSHED: TANK	**SUBWATERSHED:** LTR	**UNIQUE SITE ID:** LTR-NSA-01
DATE: 7/16/08	**ASSESSED BY:** KB/DB	**CAMERA ID:** WS Sony
MAP GRID	**RAIN IN LAST 24 HOURS** [ ] Y [x] N	**PIC #**

A. LOCATION

A1. Street names or neighborhood surveyed: Campbell Dr

A2. Adjacent land use: [x] Residential [ ] Commercial [ ] Industrial [ ] Institutional [ ] Municipal [ ] Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here NSA-01

B. STREET CONDITIONS

B1. Road Type: [ ] Arterial [x] Collector [x] Local [ ] Alley [ ] Other: ________

B2. Condition of Pavement: [ ] New [ ] Good [x] Cracked [ ] Broken

B3. Is on-street parking permitted [x] Y [ ] N If yes, approximate number of cars per block: 2

B4. Are large cul-de-sacs present? [ ] Y [x] N

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.

Index Rating for Accumulation in Gutters	1 (Clean)	2	3	4	5 (Filthy)
Sediment	[ ]	[x]	[ ]	[ ]	[ ]
Organic Material	[x]	[ ]	[ ]	[ ]	[ ]
Litter	[ ]	[x]	[ ]	[ ]	[ ]

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: [ ] open [x] enclosed [ ] mixed

C2. Percentage of inlets with catch basin storage: ________ [ ] N/A unknown

Sample 1-2 catch basins per NSA/HSI	**C3.** Catch basin #1	**C4.** Catch basin #2
Latitude	41° 49' 32"	41° 49' 32"
Longitude	72° 29' 07"	72° 29' 07"
LMK #		
Picture #		
Current Condition	[ ] Wet [x] Dry	[ ] Wet [x] Dry
Condition of Inlet	[x] Clear [ ] Obstructed	[ ] Clear [x] Obstructed
Litter Accumulation	[ ] Y [x] N	[ ] Y [x] N
Organics Accumulation	[ ] Y [x] N	[ ] Y [x] N
Sediment Accumulation	[x] Y [ ] N	[x] Y [ ] N
Sediment Depth (in feet)	1 ft.	1 ft.
Water Depth	0 ft.	0 ft.
Evidence of oil and grease	[ ] Y [x] N	[ ] Y [x] N
Sulfur smell	[ ] Y [x] N	[ ] Y [x] N
Accessible to vacuum truck	[x] Y [ ] N	[x] Y [ ] N

D. NON-RESIDENTIAL PARKING LOT (>2 acres)

D1. Approximate size: ________ acres

D2. Lot Utilization: [ ] Full [ ] About half full [ ] Empty

D3. Overall condition of Pavement: [ ] Smooth (no cracks) [ ] Medium (few cracks) [ ] Rough (many cracks) [ ] Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? [ ] Y [ ] N If yes, describe: ________

D5. On-site retrofit potential: [ ] Excellent [ ] Good [ ] Poor

E. Municipal Pollutant Reduction Strategies

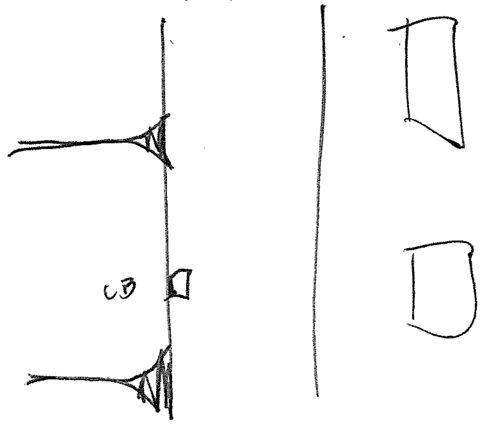
E1. Degree of pollutant accumulation in the system: ☐ High ☐ Medium ☐ Low ☐ None

E2. Rate the feasibility of the following pollution prevention strategies:

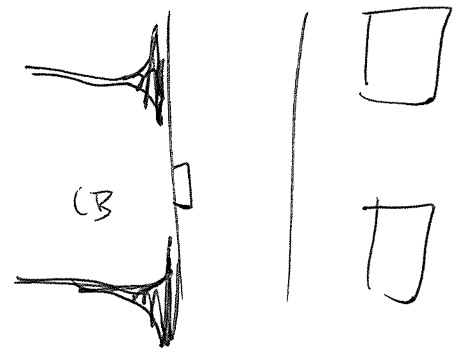
Street Sweeping:	☐ High	☒ Moderate	☐ Low
Storm Drain Stenciling:	☒ High	☐ Moderate	☐ Low
Catch Basin Clean-outs:	☒ High	☐ Moderate	☐ Low
Parking Lot Retrofit Potential:	☐ High	☐ Moderate	☒ Low

Catch Basin Sketches

#1



#2



Notes:

WATERSHED: ~~Clarke~~ Tanker	**SUBWATERSHED:** CB	**UNIQUE SITE ID:** CB-NSA-01
DATE: 7/16/08	**ASSESSED BY:** KB/DB	**CAMERA ID:** WS Sony
MAP GRID	**RAIN IN LAST 24 HOURS** ☐ Y ☒ N	**PIC #**

A. LOCATION

A1. Street names or neighborhood surveyed: High Manor Trailer Park

A2. Adjacent land use: ☒ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here NSA-01

B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☒ Local ☐ Alley ☐ Other: ________

B2. Condition of Pavement: ☐ New ☒ Good ☐ Cracked ☐ Broken

B3. Is on-street parking permitted ☒ Y ☐ N If yes, approximate number of cars per block: 3

B4. Are large cul-de-sacs present? ☐ Y ☒ N

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.	Index Rating for Accumulation in Gutters				
	Clean				Filthy
Sediment	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic Material	☐ 1	☐ 2	☒ 3	☐ 4	☐ 5
Litter	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: ☐ open ☒ enclosed ☐ mixed

C2. Percentage of inlets with catch basin storage: ________ ☐ N/A

Sample 1-2 catch basins per NSA/HSI	**C3.** Catch basin #1	**C4.** Catch basin #2
Latitude	41° 50' 51"	41° 50' 57"
Longitude	72° 26' 46"	72° 26' 54"
LMK #		
Picture #	101-3710	101-3711
Current Condition	☐ Wet ☒ Dry	☒ Wet ☐ Dry
Condition of Inlet	☒ Clear ☐ Obstructed	☒ Clear ☐ Obstructed
Litter Accumulation	☐ Y ☒ N	☐ Y ☒ N
Organics Accumulation	☐ Y ☒ N	☐ Y ☒ N
Sediment Accumulation	☒ Y ☐ N	☒ Y ☐ N
Sediment Depth (in feet)	1 ft.	0.5 ft.
Water Depth	0 ft.	0.5 ft.
Evidence of oil and grease	☐ Y ☒ N	☐ Y ☒ N
Sulfur smell	☐ Y ☒ N	☐ Y ☒ N
Accessible to vacuum truck	☒ Y ☐ N	☒ Y ☐ N

D. NON-RESIDENTIAL PARKING LOT (>2 acres)

D1. Approximate size: ________ acres

D2. Lot Utilization: ☐ Full ☐ About half full ☐ Empty

D3. Overall condition of Pavement: ☐ Smooth (no cracks) ☐ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? ☐ Y ☐ N If yes, describe: ________________

D5. On-site retrofit potential: ☐ Excellent ☐ Good ☐ Poor

E. Municipal Pollutant Reduction Strategies

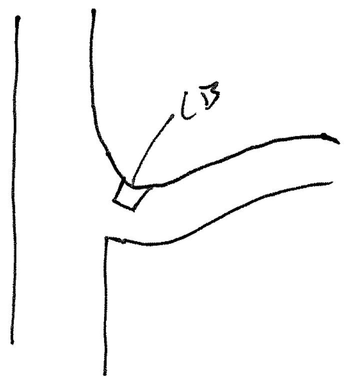
E1. Degree of pollutant accumulation in the system: ☐ High ☒ Medium ☐ Low ☐ None

E2. Rate the feasibility of the following pollution prevention strategies:

Street Sweeping:	☐ High	☒ Moderate	☐ Low
Storm Drain Stenciling:	☐ High	☒ Moderate	☐ Low
Catch Basin Clean-outs:	☒ High	☐ Moderate	☐ Low
Parking Lot Retrofit Potential:	☐ High	☒ Moderate	☐ Low

Catch Basin Sketches

#1



#2

Notes:

WATERSHED: ~~[illegible]~~ Tankerhoosen	**SUBWATERSHED:** Walker/Clarks	**UNIQUE SITE ID:** WR-~~[illegible]~~ NSA-01
DATE: 7/16/08	**ASSESSED BY:** KB, DB	**CAMERA ID:**
MAP GRID	**RAIN IN LAST 24 HOURS** ☐ Y ☒ N	**PIC #** 3705

A. LOCATION

A1. Street names or neighborhood surveyed: Mt. Vernon Apartments

A2. Adjacent land use: ☒ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here NSA-WR-01

B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☒ Local ☐ Alley ☐ Other: ______

B2. Condition of Pavement: ☐ New ☒ Good ☐ Cracked ☐ Broken

B3. Is on-street parking permitted ☒ Y ☐ N If yes, approximate number of cars per block: 25/building

B4. Are large cul-de-sacs present? ☒ Y ☐ N

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount. No	Index Rating for Accumulation in Gutters				
	Clean				Filthy
Sediment	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic Material	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: ☐ open ☒ enclosed ☐ mixed

C2. Percentage of inlets with catch basin storage: ______ ☐ N/A

Sample 1-2 catch basins per NSA/HSI	**C3.** Catch basin #1	**C4.** Catch basin #2
Latitude	41° 50' 59"	41° 51' 06"
Longitude	72° 26' 26"	72° 26' 22"
LMK #		
Picture #		
Current Condition	☐ Wet ☒ Dry	☐ Wet ☒ Dry
Condition of Inlet	☒ Clear ☐ Obstructed	☒ Clear ☐ Obstructed
Litter Accumulation	☐ Y ☒ N	☐ Y ☒ N
Organics Accumulation	☐ Y ☒ N	☐ Y ☒ N
Sediment Accumulation	☐ Y ☒ N	☐ Y ☒ N
Sediment Depth (in feet)	2in ft.	1 ft.
Water Depth	1 ft.	Ø ft.
Evidence of oil and grease	☐ Y ☒ N	☐ Y ☒ N
Sulfur smell	☐ Y ☒ N	☐ Y ☒ N
Accessible to vacuum truck	☒ Y ☐ N	☒ Y ☐ N

D. NON-RESIDENTIAL PARKING LOT (>2 acres) N/A

D1. Approximate size: ______ acres

D2. Lot Utilization: ☐ Full ☐ About half full ☐ Empty

D3. Overall condition of Pavement: ☐ Smooth (no cracks) ☐ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? ☐ Y ☐ N If yes, describe: ______

D5. On-site retrofit potential: ☐ Excellent ☐ Good ☐ Poor

E. Municipal Pollutant Reduction Strategies

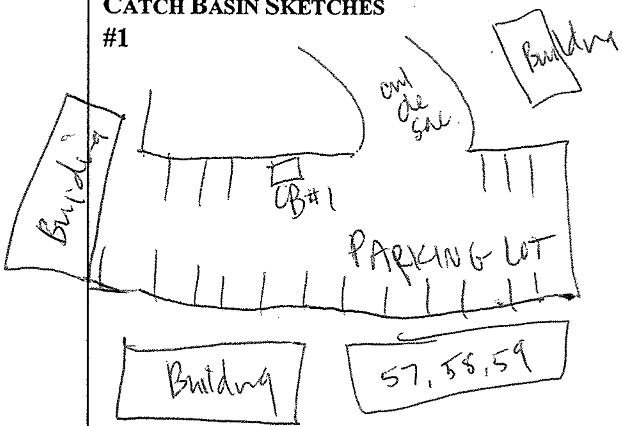
E1. Degree of pollutant accumulation in the system: ☐ High ☐ Medium ☒ Low ☐ None

E2. Rate the feasibility of the following pollution prevention strategies:

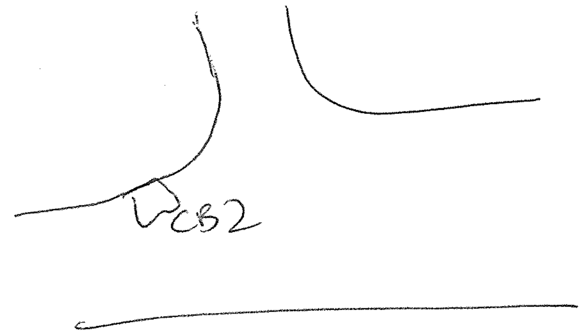
Street Sweeping:	☒ High	☐ Moderate	☐ Low
Storm Drain Stenciling:	☒ High	☐ Moderate	☐ Low
Catch Basin Clean-outs:	☒ High	☐ Moderate	☐ Low
Parking Lot Retrofit Potential:	☐ High	☐ Moderate	☒ Low

Catch Basin Sketches

#1



#2



PIC# 1013208

Notes:

Pic # 3706/7 is small catch area draining behind Building [41 50 57.3] [72 26 19.0], leaf litter & debris in woods.

WATERSHED: TAVK	**SUBWATERSHED:** GAGES	**UNIQUE SITE ID:** CB-NSA-01
DATE: 7/16/06	**ASSESSED BY:** KB/DB	**CAMERA ID:** WS-Canon
MAP GRID	**RAIN IN LAST 24 HOURS** ☐ Y ☒ N	**PIC #**

A. LOCATION

A1. Street names or neighborhood surveyed: Valley View Dr. / Andrew Way

A2. Adjacent land use: ☒ Residential ☐ Commercial ☐ Industrial ☐ Institutional ☐ Municipal ☐ Transport-Related

A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here NSA-01

B. STREET CONDITIONS

B1. Road Type: ☐ Arterial ☐ Collector ☒ Local ☐ Alley ☐ Other: ________

B2. Condition of Pavement: ☒ New ☐ Good ☐ Cracked ☐ Broken New Rough top coarse

B3. Is on-street parking permitted ☒ Y ☐ N If yes, approximate number of cars per block: 0

B4. Are large cul-de-sacs present? ☒ Y ☐ N

B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.

	Index Rating for Accumulation in Gutters				
	Clean				Filthy
Sediment	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Organic Material	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5
Litter	☒ 1	☐ 2	☐ 3	☐ 4	☐ 5

C. STORM DRAIN INLETS AND CATCH BASINS

C1. Type of storm drain conveyance: ☐ open ☒ enclosed ☐ mixed

C2. Percentage of inlets with catch basin storage: 50 ☐ N/A

Sample 1-2 catch basins per NSA/HSI	**C3.** Catch basin #1	**C4.** Catch basin #2
Latitude	41° 51' 54"	41° 51' 59"
Longitude	72° 24' 38"	72° 24' 26"
LMK #		
Picture #	101-3694	101-3697
Current Condition	☒ Wet ☐ Dry	☒ Wet ☐ Dry
Condition of Inlet	☒ Clear ☐ Obstructed	☒ Clear ☐ Obstructed
Litter Accumulation	☐ Y ☒ N	☐ Y ☒ N
Organics Accumulation	☐ Y ☒ N	☐ Y ☒ N
Sediment Accumulation	☐ Y ☒ N	☐ Y ☒ N
Sediment Depth (in feet)	0 ft.	0 ft.
Water Depth	~0.5 ft.	~0.5 ft.
Evidence of oil and grease	☐ Y ☒ N	☐ Y ☒ N
Sulfur smell	☐ Y ☒ N	☐ Y ☒ N
Accessible to vacuum truck	☐ Y ☒ N	☐ Y ☒ N

D. NON-RESIDENTIAL PARKING LOT (>2 acres) N/A

D1. Approximate size: ________ acres

D2. Lot Utilization: ☐ Full ☐ About half full ☐ Empty

D3. Overall condition of Pavement: ☐ Smooth (no cracks) ☐ Medium (few cracks) ☐ Rough (many cracks) ☐ Very Rough (numerous cracks and depressions)

D4. Is lot served by a storm water treatment practice? ☐ Y ☐ N If yes, describe: ________

D5. On-site retrofit potential: ☐ Excellent ☐ Good ☐ Poor

E. Municipal Pollutant Reduction Strategies

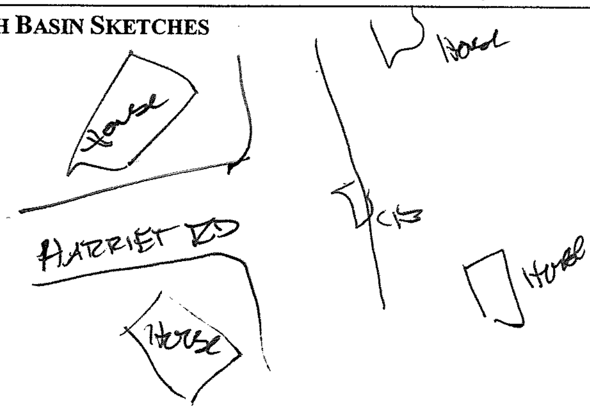
E1. Degree of pollutant accumulation in the system: ☐ High ☐ Medium ☐ Low ☐ None

E2. Rate the feasibility of the following pollution prevention strategies:

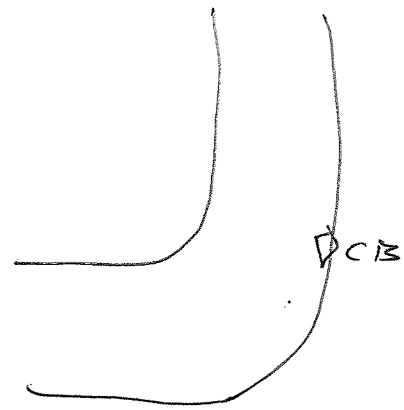
Street Sweeping:	☒ High	☐ Moderate	☐ Low
Storm Drain Stenciling:	☒ High	☐ Moderate	☐ Low
Catch Basin Clean-outs:	☐ High	☒ Moderate	☐ Low
Parking Lot Retrofit Potential:	☐ High	☐ Moderate	☒ Low

Catch Basin Sketches

#1



#2



Notes:

APPENDIX C

Photographs on CD

APPENDIX D

Vernon Regulatory Review Memorandum

MEMORANDUM

TO: Technical Advisory Committee, Tankerhoosen River Watershed Management Plan and Town of Vernon Land Use Commissioners

FROM: Erik Mas, P.E., Fuss & O Neill, Inc.

DATE: June 9, 2008

RE: Stormwater and Low Impact Development (LID) Regulations in the Tankerhoosen River Watershed –Vernon Regulatory Review

1.0 INTRODUCTION

Fuss & O Neill is working with the Friends of the Hockanum River Linear Park, Inc., in collaboration with its project partners (Town of Vernon Planning Department, Town of Vernon Conservation Commission, North Central Conservation District, Hockanum River Watershed Association, Rivers Alliance of Connecticut, Inc, and the Belding Wildlife Trust) to prepare a Watershed Management Plan for the Tankerhoosen River watershed. The watershed plan will identify action items that can be implemented by the watershed municipalities and private groups to protect and improve the health of the Tankerhoosen River watershed, which is a particularly valuable natural resource, demonstrated by the Class A water quality in the upper regions of the watershed that harbor the Belding Wild Trout Management Area, one of only two such Class I areas east of the Connecticut River.

A key element of the Watershed Management Plan is to identify potential land use regulatory mechanisms (i.e., new or modified land use regulations) that can be implemented by the watershed towns to better manage stormwater runoff associated with land development within the watershed. Many Connecticut communities are in the process of developing new or modified land use regulations that incorporate Low Impact Development (LID) and related stormwater management approaches to address stormwater quantity and quality objectives. Communities, including Vernon, are faced with a mandate to meet State and Federal Phase II stormwater permit requirements under the National Pollutant Discharge Elimination System (NPDES) program, as well as addressing local concerns about the damaging effects of increased impervious cover and uncontrolled stormwater runoff from land development and suburban sprawl. An opportunity exists for the Town of Vernon to develop and implement an ordinance or other regulatory mechanism to satisfy Phase II stormwater regulatory requirements, while also strengthening the existing land use controls to protect natural resources within the Tankerhoosen River watershed.

This memorandum summarizes our review of Vernon s existing land use regulations and related planning documents that pertain to stormwater management and natural resource protection issues, as well as potential approaches for developing regulatory mechanisms to incorporate improved stormwater management, including LID concepts and opportunities to reduce impervious cover, into the Town s land use regulations. The information presented in this technical memorandum is intended to facilitate a discussion of these issues during the upcoming workshop meeting with the Tankerhoosen River Management Plan Technical Advisory Committee and the Town of Vernon land use commissioners.

2.0 EXISTING REGULATORY MECHANISMS

Fuss & O Neill reviewed the following documents and information provided by the Town, which are the primary regulatory mechanisms and related planning documents that address stormwater management and related natural resource protection issues in the Town of Vernon:

- Subdivision Regulations,
- Zoning Regulations,
- Inland Wetland and Watercourses Regulations,
- Plan of Conservation and Development.

2.1 Subdivision Regulations

The Town s subdivision regulations (effective date: May 8, 2007) regulate the division of a tract or parcel of land with the purpose of sale or building development. The subdivision regulations address street and lot layout, water supplies, sanitary sewage facilities, stormwater drainage, utilities, open space, street widths, grades and construction, and other necessary improvements. The following is a summary of specific sections of the subdivision regulations that relate to stormwater management and natural resource protection issues.

- Section 5 - Standards for Maps and Plans: This section specifies requirements for maps and plans submitted with subdivision applications, including Site Development Plans, Construction Plans, and Grading Plans. Existing and proposed watercourses and stormwater management systems are required to be shown on the Site Development Plan. Grading Plans are required to include notations and details on erosion and sedimentation control methods.

- Section 6.1.3 - General Improvements, Open Space to be Dedicated: The Planning and Zoning Commission may require the set aside of Open Space as part of a subdivision where the Commission finds the existing land applicable to one or more of the following:

    - The policies and objectives of the Plan of Conservation and Development
    - Areas sensitive to development
    - Prime and important farmland soils
    - Natural Diversity Database Areas as updated by the Connecticut Department of Environmental Protection
    - Unconsolidated Aquifers and Aquifer Protection Areas
    - Areas indicated for future community facility needs
    - Existing open areas and significant cultural and natural resources
    - Potential open space system

- Land Use Plan and Strategy
- Significant natural and cultural resources inventory
- Viable vernal pools verified by the Town of Vernon Vernal Pool Study or by a qualified licensed professional

- Section 6.1.3.2 - General Improvements, Location of Open Space: The protection and preservation of the Hockanum River, Ogden Brook, Tankerhoosen River, Gage's Brook, Railroad Brook, Walker's Reservoir East, Walker's Reservoir West, Valley's Fall's Pond, or a Vernal Pool indentified by the Town, is considered a priority when the parcel being subdivided contains portions of the aforementioned watercourses.

  When the parcel being subdivided contains portions of land that would allow for the connection of the Shenipsit Trail, Hockanum River Trail, Risley Pond Trail, Land Trust Trail, Belding Path, Hockanum River Linear Park, Box Mountain Greenway, Talcottville & Tankerhoosen Trail/open space system, Ellington Trail System, Tolland Trail System, Bolton Greenways, Manchester Greenways, other potential greenway, linear park, or trail identified in the POCD or by the Department of Parks and Recreation, the provision and connection of these amenities shall be a priority in the design and or location of Open Space.

- Section 6.1.3.3 - General Improvements, Size of Open Space: When Open Space is required, the minimum recommended amount of Open Space to be provided is 12% of the total area of land to be subdivided, 15% of the total area of land if the location of the subdivision is identified in the Land Use Plan and Strategy of the POCD, and 20% of the total land area if the location of the subdivision is identified as a Priority Area for Open Space Protection of the POCD.

- Section 6.1.3.4.3 - General Improvements, Open Space Standards: Any land to be dedicated as Open Space shall be left in its natural state by the subdivider and shall not be graded, cleared, disturbed, or used as a temporary or permanent repository for stumps, brush, earth, building materials, debris, detention ponds, or basins.

- Section 6.4 - Lot Grading and Drainage: Grading plans shall be submitted where substantial grading is required in order to provide a buildable site and shall employ standards and methods equal to or exceeding those set forth in the Erosion and Sediment Control Handbook (USDA, SCS, Storrs, Conn., 1976). Lot drainage should be coordinated with the general storm drainage patterns for the area, and drainage should be designed to avoid concentrated stormwater to adjacent lots.

  Comment: Contains an outdated reference to a previous version of the State Erosion and Sedimentation Control Handbook. Revise the language to reference the current CT Erosion and Sedimentation Control Guidelines, as amended

- Section 6.5.1.1 - Street Grading and Improvement: Roads shall be related appropriately to the topography, and streets shall be arranged so as to obtain as many as possible of the building sites at, or above, the grades of the streets.

  Comments: consistent with fitting the development to the topography. Building sites above the grade of the streets provides opportunity for use of roadside swales. Consider adding a provision to allow elimination of curbing for roads for grades less than 5% to encourage the use of vegetated swales and similar LID stormwater management systems.

- Section 6.6.6 - Cul-de-sac or Dead-End: Cul-de-sac pavement shall be a uniform 45 foot radius except when an island is used, in which case the outside radius shall be 50 feet with an island radius of 20 feet.

  Comment: The radius of cul-de sacs should be the minimum required to accommodate emergency and maintenance vehicles. Consider smaller cul-de-sac radius of (30 to 40 feet), or alternative designs such as hammerheads, to reduce impervious cover, such that the design allows for continuous turning movement of the largest fire fighting vehicle used by the Town of Vernon. Also consider encouraging the use of LID bioretention/rain gardens in cul-de-sac islands for stormwater management.

- Section 6.7.1 - Design Standards, Road Width: Table 1 contains minimum pavement width for collector (32 ft), local (28 ft), and limited local roads (28 ft).

  Comment: Design residential streets for the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance, and service vehicle access. Consider pavement widths of between 24 and 28 feet, if such a reduction will not negatively impact public safety or emergency response. Refer to Table 4-3 in the Connecticut Stormwater Quality Manual for potential variation in residential roadway widths based on terrain and development density.

- Section 6.7.2 - Design Standards, Curbs: Curbs shall be required on all new streets and shall conform to construction and design standards in the Appendix of the regulations.

  Comment: The requirement for curbs on all new roads appears to preclude the use of curbless roads and open vegetated channels for stormwater management.

- Section 6.9.1 - Drainage and Storm Sewers, General Requirements: The developer shall be fully responsible for constructing adequate facilities for the control, collection, conveyance and acceptable disposal of storm water, other surface water and subsurface water, whether originating within the sub- division area or in a tributary drainage area.

- Section 6.9.2.2 - Drainage and Storm Sewers, Location of Stormwater Facilities: The applicant may be required to dedicate either in fee or by drainage or conservation easement, land on both sides of existing watercourses to a distance to be determined by the Commission.

- Section 6.9.3 - Drainage and Storm Sewers, Drainage Discharge: The discharge of all storm water from a subdivision shall be into suitable streams or other acceptable and suitable storm water drainage facilities having adequate capacity to carry the additional water. Sufficient and adequate facilities shall be constructed on private lots wherever necessary to prevent the flow of surface drainage from the property on which it originates onto adjacent property in sufficient quantity, concentration or velocity to cause damage or create a nuisance on adjoining property.

  Comment: The Subdivision Regulations do not include post-development peak flow, volume control, or stormwater quality requirements.

- Section 6.9.3 - Drainage and Storm Sewers, Drainage Design: Designs shall be based on the maximum ultimate development of the entire watershed as permitted by the Zoning Regulations. On watersheds one square mile or over, the design of culverts, bridges and through watercourses shall be based upon not less than a 100-year storm. On watersheds of less than one square mile, the design for the through drainage system shall be for no: less than a 50-year storm. The drainage system for roads, including catch basins, inlets, pipes, underdrains and gutters within or abutting the subdivision shall be designed for not less than a 10-year storm.

  Drainage ditches will, in general, not be permitted where it is feasible to install underground pipe.

  Comment: This requirements restricts the use curbless roads and roadside vegetated swales in lieu of traditional curb, gutter, and piped drainage.

- Section 6.12.1 - Sidewalks: Sidewalks shall be required in all subdivisions on at least one side of all new streets, unless waived by a three-quarters vote of all members of the Commission, and may be required on both sides at the discretion of the Commission.

  Comment: Sidewalks required on two side of the street increase impervious cover. Where practical, consider locating sidewalks on only one side of the street and reduce sidewalk width to 3 or 4 feet. Grade sidewalks to the front yard rather than to the street. Consider using alternative materials such as pavers, stone dust, or pervious concrete.

- Section 6.14 - Certified Erosion and Sediment Control Plan: A soil erosion and sediment control plan shall be submitted with any application for development when the disturbed area of such development is cumulatively more than one-half acre. A single family dwelling that is not a part of a subdivision of land shall be exempt from these soil erosion and sediment control regulations.

  Comment: Construction of single family dwellings that disturb an acre or more of land are subject to state and federal NPDES Phase II Stormwater Program requirements. Consider amending the single family exemption to indicate that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land.

- Section 6.14.3 - Erosion and Sediment Control Plan: a soil erosion and sediment control plan shall contain proper provisions to adequately control accelerated erosion and sedimentation and reduce the danger from storm water runoff on the proposed site based on the best available technology. Such principles, methods and practices necessary for certification are found in the Connecticut Guidelines for Soil Erosion and Sediment Control (1985) as amended.

  Plans for soil erosion and sediment control shall be developed in accordance with these regulations using the principles as out-lined in Chapters 3 and 4 of the Connecticut Guidelines for Soil Erosion and Sediment Control (1985), as amended. Soil erosion and sediment control plans shall result in a development that minimizes erosion and sedimentation during construction; is stabilized and protected from erosion when completed; and does not cause off-site erosion and/or sedimentation.

- Section 6.14.6 - Conditions Relating to Soil Erosion and Sediment Control: A performance bond may be required for the estimated costs of measures required to control soil erosion and sedimentation, as specified in the certified plan.

- Section 13 - Rear Lots: This section includes provisions for greater residential development flexibility, particularly where a site has an unusual lot line or natural resource configuration or where rear lot development would promote or enhance the protection of valuable natural resource features.

  Comment: This concept is consistent with LID principles to protect and preserve natural features of a site.

2.2 Zoning Regulations

Site development in the Town of Vernon must comply with the Vernon Zoning Regulations (effective date: May 8, 2007). The following is a summary of specific zoning regulations that relate to stormwater management and natural resource protection issues.

- Section 3.4 - General Provisions, Collection and Disposal of Storm Drainage: Proper provision shall be made for collection and disposal of storm water from roofs and parking areas through a pipe system connected to existing storm drains or carried to a natural watercourse or to an on-site area approved by the Town Engineer in compliance with the recommendations of the latest edition of the "Stormwater Quality Manual" of the Connecticut Department of Environmental Protection (DEP).

- Section 3.18 - General Provisions, Building Above or Below Center Line of Road: Any lot or parcel of land with the top of foundation more than five (5) feet above or below the center line grade of the road opposite the midpoint of the front foundation wall requires a detailed site plan showing the existing and proposed topography, driveways, storm drainage, and other information.

- Section 3.25 - General Provisions, Sidewalks: Sidewalks shall be installed for all new developments in all areas, unless waived by a three-quarters vote of all members of the Commission.

- Sections 4.1 through 4.25 - Use Districts, Setbacks and Lot Dimensions: These sections specify minimum setbacks and lot dimensions for various use districts in the Town of Vernon.

  Comment: Minimum setbacks and frontage distances can increase impervious cover. Front yard setbacks, which dictate how far houses must be from the street, can extend driveway length. Large side setbacks and frontage distances influence the road length needed to serve individual lots. Review current setbacks and lot dimensions for potential to relax side yard setbacks and allow narrower frontages to reduce road length and site imperviousness, and to relax front setback requirements to reduce driveway length and lot imperviousness.

- Section 7 - Cluster Development: Developers may vary the lot size requirements in Residential 40 and Residential 27 zoning districts, leaving a substantial area free of building lots (i.e., "cluster" development). The land area not allocated to building lots and streets shall be permanently reserved in open space and be readily usable for recreation or conservation.

- Section 12 - Off-street Parking and Loading: Section 12.1 specifies parking ratios, which are the number of parking spaces that must be provided for particular uses. The Planning & Zoning Commission may reduce the number of off-street parking spaces which must be installed provided that the required number of spaces is reduced by no more than 20%, the number of spaces will not result in an increase of on-street parking, and the developer pays a fee of $500 for each space eliminated (fee-in-lieu of parking). Section 12.3 specifies the minimum stall dimensions for off-street parking and truck loading spaces, which already appear to be at or near recommended minimum values.

  Comment: Parking ratios typically represent the minimum number of spaces needed to accommodate the highest hourly parking rate at the site. In many cases, parking ratios far exceed parking demand, which refers to the number of spaces actually used for a particular land use. Parking ratios often result in far more spaces than are actually required because ratios are typically set as minimums and not maximums. This results in excessive impervious cover for many land uses. Existing parking ratios should be reviewed to see if lower ratios are warranted and feasible. The required parking ratio for a particular land use should be enforced as both a maximum and minimum to limit excess parking space construction and impervious cover. Consider allowing the Commission to approve parking lots with more spaces than the allowed maximum provided all of the spaces above the maximum number are composed of a pervious surface, and where adequate stormwater management is provided. Also consider parking spaces held in reserve for phased developments, thereby avoiding the situation where unnecessary parking is not constructed if future phases of development do not occur.

Shared parking is another strategy that reduces the number of parking spaces needed by allowing adjacent land uses to share parking lots, particularly when parking demands occur at different times during the day or week. Section 12.3 appears to allow for shared parking for non-residential uses, although it is unclear if the Town actively promotes shared parking. Where shared parking is used, the Zoning Regulations should require a corresponding reduction in parking spaces.

Also consider adding language to Section 12 that references specific stormwater management and landscape design standards in the Connecticut Stormwater Quality Manual, local stormwater management design manual, other sections of the Zoning regulations, or new/modified local stormwater management and LID regulations.

Model zoning regulations for parking were developed in 2003 for communities in northwestern Connecticut through a study sponsored by the Northwestern Connecticut Council of Governments (NWCCOG), the Litchfield Hills Council of Elected Officials (LHCEO), and the Connecticut DEP. This document provides a good starting point for reviewing and modifying local zoning regulations for parking to address impervious cover and stormwater management issues.

- <u>Section 18 – Activities Requiring a Certified Erosion and Sediment Control Plan</u>: A soil erosion and sediment control plan shall be submitted with any application for development when the disturbed area of such development is cumulatively more than one-half acre, except for a single family dwelling that is not a part of subdivision of land, which is exempt from these soil erosion and sediment control regulations.

  Comment: The section of the Zoning Regulations is consistent with the Erosion and Sediment Control Plan requirements (Section 6.14) of the Subdivision Regulations. Construction of single family dwellings that disturb an acre or more of land are subject to state and federal NPDES Phase II Stormwater Program requirements. Consider amending the single family exemption to indicate that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land.

- <u>Section 19 – Rear Lots</u>: This section includes provisions for greater residential development flexibility, particularly where a site has an unusual lot line or natural resource configuration or where rear lot development would promote or enhance the protection of valuable natural resource features.

  Comment: This section of the Zoning Regulations is consistent with Section 13 of the Subdivision Regulations.

2.3 <u>Inland Wetlands & Watercourses Regulations</u>

The Town of Vernon Inland Wetlands and Watercourses Regulations (effective date: October 2, 2006) regulate the removal or deposition of materials and the construction, obstruction, alteration, or pollution of wetlands and watercourses in the Town. The regulations make provisions for the protection, preservation, maintenance and use of inland wetlands and watercourses by minimizing their disturbance and pollution, maintaining and improving water quality in accordance with federal, state, and local authority, and preventing damage from erosion, turbidity, or siltation as well as preventing the loss of beneficial aquatic organisms.

- Section 2 – Definitions, Regulated Activity: Regulated activities include any operation within or use of a wetland or watercourse involving removal or deposition of material, or any obstruction, construction, alteration or pollution, of such wetlands or watercourses. Any clearing, grubbing, filling, grading, paving, excavating, constructing, depositing, or removing of material and discharging of stormwater on the land within the following *upland review areas* is a regulated activity:

Resource	Upland Review Area
Wetland and Watercourse	100 ft.
Hockanum River, Ogden Brook, Tankerhoosen River, Gage's Brook, Railroad Brook, Walker Reservoir West, Walker Reservoir East, and Valley Falls Pond	200 ft.
Other	Agency Discretion*

*The Commission may rule that any activity that alters the existing rate or quality of any stormwater discharge conveyed to a Regulated Area or is likely to impact or affect wetlands or watercourses is a Regulated Activity. The Commission may rule that any other activity whether located within or outside the Regulated Area that is likely to have an affect on the wetlands or watercourses is a Regulated Activity.

Additionally, the Commission may rule that any activity that alters the existing rate or quality of any stormwater discharge conveyed to a Regulated Area or is likely to impact or affect wetlands or watercourses is a Regulated Activity.

- Section 2 – Definitions, Significant Activity: A "significant activity" includes any activity involving a deposition or removal of material which will or may have a substantial adverse effect on the Regulated Area or on another part of the inland wetland or watercourse system or an activity which substantially changes the natural channel or may inhibit the natural dynamics of a watercourse system or substantially diminishes the natural capacity of an inland wetland or watercourse to support desirable biological life, prevent flooding, supply water, assimilate waste, facilitate drainage, and/or provide recreation and open space, or any activity which would results in degrading a watercourse or the surface and/or groundwater of an inland wetland, such degradation to be measured by the standards of the Water Compliance Division of the Connecticut Department of Environmental Protection.

- Section 4.3.2 – Fee Schedule: A technical review may be required by a consultant for certain regulated activities, including those that are within 200 feet of a watercourse of concern (including the Tankerhoosen River and its major tributaries), regulated activities proposed in a use district where the proposed activity exceeds the impervious coverage thresholds established in such districts, as well as parking space, building square footage, disturbance, and other thresholds.

- Section 4.3.4 - Application Procedure: Any person wishing to undertake a Regulated Activity must submit an application to the Commission. The application must include a map showing the location of the site, the nature and extend of the proposed activity, the location of the Regulated Areas, existing and proposed structures, two-foot elevation contours, all drainage to be engineered, areas where material may be deposited or removed, all proposed construction within Regulated Area, areas of significant vegetation. The application must also include a detailed description of the activity, a map drawn by a licensed surveyor if the proposed activity exceeds ½ acre, the names and address of property owners within 500 feet of the proposed activity, and any reasonable measures which would mitigate the impacts of the Regulated Activity.

- Section 4.5 - Evaluation of Proposed Activities: This section specifies the information and criteria upon which the Commission makes its decision on an application. Section 4.5.2 includes factors related to erosion, siltation, and leaching; adverse effects on water quality and aquatic life; the likelihood of any changes in the velocity, volume, or course of water flow, or in the water table, and any consequences such changes may have for the capacity of the wetland or watercourse to help control flooding and to purify and supply water; and the existing and desired quality and use of the water in and near the affected area.

  Comment: The evaluation criteria do not contain specific stormwater management standards and do not reference available design guidance such as the Connecticut Stormwater Quality Manual or local design guidance. The regulations also do not require or recommend the use of LID practices to meet stormwater management objectives.

- Watercourse Buffers: Section 4.5.2.12 states that the Commission may require the provision of a buffer along a watercourse if proposed activities and/or development may create negative impacts on a watercourse that could be prevented or mitigated by provision of a buffer, as described in "Appendix B. Design Standards Recommended for a Watercourse Protection Buffer." The watercourse buffer design standards state that in areas where vegetated buffers do not exist, or are of limited width, consideration should be given to the creation of a buffer area. Newly created buffers should include canopy or shade trees, shrubs, and herbaceous plant species suited to the local habitat in three (3) zones of plantings. The recommended minimum width of a watercourse buffer is one hundred (100) feet measured horizontally from the banks of the watercourse and fifty (50) feet measured horizontally related to intermittent watercourses.

  The recommended watercourse protection area with landscape buffer may be reduced when (1) an engineered stormwater management and pollution control system employing technical best management practices (BMP) in compliance with the Connecticut Department of Environmental Protection (DEP) "Stormwater Quality Manual: is provided to treat run-off from a development site; (2) the site is served by a public sewer system; and (3) a reduction of the river protection buffer depth would not result in a significant potential adverse impact to the watercourse.

2.4 Plan of Conservation and Development

The Vernon Plan of Conservation and Development (June 2001) presents a detailed strategy for open space conservation and preservation, including increasing the amount of preserved open space as well as creating linkages between open space areas. The Plan identifies priority open space preservation areas along the Hockanum and Tankerhoosen River corridors.

A series of neighborhood meetings were held as an initial phase of the POCD. Several common themes emerged at public meetings. The themes associated with the protection of open space and watercourses included:

- Need to preserve open space for perpetuity in a positive, planned manner with adequate financial resources devoted to this program. A goal of 20% open space might be considered
- Retail development should be limited to prevent Vernon from becoming another Manchester in the Route 84 corridor or like the Berlin Turnpike along other major corridors in Town.
- The water quality of the Town's lakes and rivers as well as groundwater should be protected.

In addition to the currently-implemented Zoning Regulations, Subdivision Regulations, and Inland Wetlands and Watercourses Regulations, the Open Space section of the POCD also recommends adoption of a Hockanum River and Tankerhoosen River Protection Overlay District. Such a district would establish a contiguous and parallel buffer strip on either side of these rivers and would supplement the inland wetland and underlying zoning regulations, with the added provision that the land within the buffer areas and the river itself would remain in a natural, undisturbed state.

3.0 OBSERVATIONS & PRELIMINARY RECOMMENDATIONS

Based on our review of the Town's existing land use regulations and planning documents that pertain to stormwater management and natural resource protection, we offer the following observations and preliminary recommendations for discussion during the upcoming workshop meeting with the Tankerhoosen River Management Plan Technical Advisory Committee and the Town of Vernon land use commissioners.

3.1 Observations

The Town has a number of land use regulations that regulate construction and post-construction stormwater runoff from new development and redevelopment activities, and provide for protection of natural resources. The local regulations are particularly strong in terms of erosion and sediment control (as well as consistent between the various regulations), open space protection, and regulating activities that can potentially affect wetlands and watercourses, including requirements for watercourse buffers. However, there are several areas where the regulations and design standards and guidance could be strengthened through amendments or new regulations to clarify and strengthen stormwater management requirements and better promote the use of LID principles.

1. Stormwater Management Standards and Design Manual

The Town land use regulations do not contain specific stormwater management standards. The Zoning Regulations reference the recommendations and design guidance contained in the Connecticut Stormwater Quality Manual, while the Subdivision Regulations indicate that stormwater systems shall be designed by methods approved by the Town Engineer. The Inland Wetlands and Watercourses Regulations do not contain specific stormwater management standards and do not reference design guidance such as the DEP Stormwater Quality Manual or local design standards, except for instances when the applicant requests reduction in the watercourse buffer width requirements.

While the Connecticut Stormwater Quality Manual contains hydrologic sizing criteria (for water quality, quantity, groundwater recharge, etc.) and detailed design guidance for specific stormwater treatment practices, it does not prescribe a set of stormwater standards due to the lack of state-wide stormwater regulations. The Connecticut Stormwater Quality Manual does contain many LID principles in addition to more traditional end-of-pipe stormwater controls. However, it does not contain more recently developed guidance on LID design methods and clear incentives for developers to use LID over traditional stormwater management methods, such as LID credit systems which have been adopted by communities in recent years. Another drawback of relying solely on the DEP manual is that the information in the manual may eventually become outdated and lacking in areas of new or emerging stormwater management issues, as DEP does not plan to revise the manual in the foreseeable future.

Although the Vernon land use commissions are encouraged to use the Connecticut Stormwater Quality Manual to review applications, an alternative approach is to develop a local stormwater and LID manual to complement the DEP stormwater manual. A local manual could reference applicable sections of the DEP manual and take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town. The Town land use regulations could also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the Town land use regulations. Several other Connecticut communities have chosen this approach, including Tolland, which has developed a LID and Stormwater Management Design Manual, in addition to amendments to the Tolland Subdivision and Zoning Regulations. The Town of Greenwich is also in the process of revising its outdated drainage manual to incorporate stormwater quality elements and LID principles. Greenwich is also considering adopting a stand-alone ordinance or modifying its local land use regulations to implement the provisions of the new manual.

2. Local Regulatory Mechanism

As indicated in the introduction section, an opportunity exists for the Town of Vernon to develop and implement new or revised regulations to satisfy Phase II stormwater regulatory requirements, while at the same time incorporating LID principles and addressing natural resource protection issues. The Town's existing land use regulations address some of the elements of the post-construction stormwater management "regulatory mechanism" required by the DEP Phase II Stormwater program. However, none of the existing regulations, either individually or collectively, addresses post-construction stormwater management in a comprehensive manner as required by the Phase II program. Additionally, the Town may want to consider regulating stormwater runoff from projects that may not currently be subject to Town land use regulations but which are known to be a source of stormwater quality and drainage issues (such as single family residential redevelopment outside of the Upland Review Area).

Two general approaches exist for implementing a comprehensive stormwater regulatory mechanism to meet Phase II stormwater program requirements and to incorporate LID principles and other specific community objectives. One approach involves developing a new stand-alone stormwater ordinance that could be incorporated into the Vernon Town Code and implemented by a single department or commission such as the Engineering Department. This approach has been used by Stratford and other communities throughout southern New England. An alternate approach would be to implement more comprehensive stormwater management/LID requirements in a new section of the Zoning Regulations and maintain the responsibility for administering the stormwater/LID provisions with the Planning and Zoning Commission. Such an approach has been used by Tolland and Guilford, Connecticut. Elements of both approaches are summarized as follows:

a. *Stand-Alone Stormwater Ordinance*

- Adopt a new stormwater ordinance as part of the Vernon Town Code. The ordinance could be similar to the draft ordinance which is provided in <u>Attachment A</u> of this memorandum and is based upon a model ordinance endorsed by the DEP. Typically, a new stormwater ordinance is a more efficient and effective way to address the Phase II Stormwater program regulatory mechanism requirement than separate revisions to the individual municipal land use regulations that are currently in place. The stormwater ordinance would apply to post-construction stormwater runoff from new development and redevelopment projects that disturb greater than a threshold value that could be selected by the Town. The Phase II General Permit requires that the ordinance apply to projects that would disturb one or more acres. Vernon could consider an alternative applicability threshold to ensure that the requirements would apply to in-fill development projects and other smaller land disturbance activities with the potential for drainage or water quality impacts. The sample draft ordinance provided in <u>Attachment A</u> would apply to all projects that disturb 5,000 square feet or more. Other applicability thresholds could be considered as well. The ordinance should incorporate by reference the technical standards and design guidance contained in a local stormwater manual and/or the Connecticut Stormwater Quality Manual, as amended.

- The stand-alone stormwater ordinance could be administered by the Engineering Department, which would initially receive stormwater management permit applications for land disturbance activities subject to the ordinance. Stormwater Management Plans would then be reviewed by one or more of the applicable land use commissions (Planning and Zoning Commission or Inland Wetlands Regulatory Commission) with jurisdiction or expertise over the proposed project. Projects that do not fall under the jurisdiction of the Planning and Zoning Commission or the Inland Wetlands Regulatory Commission would be reviewed solely by the Engineering Department for compliance with the ordinance. This administrative structure places responsibility for stormwater management plan review on those agencies that already perform regulatory reviews (P&Z and IW), but consolidates authority for the stormwater ordinance under a single department (Engineering). A drawback to this approach is that the Engineering Department would bear the responsibility for administering the permit program and would likely require additional staff resources.

- The Town could consider creating a dedicated "stormwater inspector" position within the Engineering Department. The stormwater inspector would be responsible for conducting stormwater inspections during and after construction of stormwater facilities in support of the new ordinance, as well as augment the related inspection capabilities of Building Inspector and Zoning Enforcement Officer.

- Short-term funding for administration of the post-construction stormwater ordinance and other elements of the Town's Phase II program would most likely come from taxes and application fees. The Town could investigate implementation of a service charge-based system, such as user fees or a stormwater utility. However, these funding sources are often difficult to implement due to public resistance. Stormwater utilities have been established in Chicopee, Massachusetts, Burlington, Vermont, and elsewhere throughout the U.S. Stonington, Connecticut has investigated the feasibility of a stormwater utility. Several other Connecticut coastal communities are undertaking DEP-funded demonstration projects to explore the feasibility of developing and implementing a stormwater utility. Vernon may also explore the feasibility of a stormwater utility or similar stormwater service charge, although this would likely be a long-term potential funding source.

b. *Incorporation of Stormwater Management/LID Requirements in Zoning Regulations*

- Incorporate a new post-construction stormwater management and LID section into the existing Zoning Regulations. The new section could be similar to the stand-alone example ordinance in terms of applicability thresholds, exemptions, and general stormwater management standards and LID principles. Specific stormwater management standards and design guidance should not be included in the regulations, but rather in a local stormwater manual to avoid the need for significant future amendments to the regulations when the standards or design guidance are revised. A copy of the recent amendment to the Town of Tolland Zoning Regulations, which added a new LID section, is included as Attachment B of this memorandum.

- In addition, the Zoning Regulations could be modified to potentially require a Stormwater Management Plan for a proposed activity that only requires a Building Permit, such as a single-family dwelling, if it results in the disturbance of one or more acres (the Phase II permit minimum requirement) or a lower threshold selected by the Town. The following sample language is an excerpt from the Guilford Zoning Regulations:

  Stormwater Management Plans shall be prepared for any Site Plan, Coastal Site Plan (CAM) or Special Permit Application in accordance with 273-75.F(3) of this Code. Futhermore, for an Application for Certificate of Zoning Compliance (Building Permit) for any new single family dwelling, the Town Engineer, or the Environmental Planner may require that a Stormwater Management Plan be prepared, all or in part, as required by 273-75.F.(3) when he/she has determined that the development if the single family dwelling may have an adverse impact on stormwater quality.

  This approach consolidates stormwater management review within the Planning and Zoning Commission through the existing site plan and special permit application review process. The Subdivision and Inland Wetlands and Watercourses Regulations would also need to be modified to require a Stormwater Management Plan consistent with the Zoning Regulations.

3. LID Incentives and Obstacles

Although recent studies demonstrate that LID practices can reduce project costs and improve environmental performance, the perception still exists that site development using LID is more expensive than traditional approaches to stormwater management. Initial project costs may be higher in some cases than those for conventional design. However, significant savings are typically realized due to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping (USEPA, Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, EPA publication number 841-F-07-006, December 2007).

Many states and local communities have adopted LID credit systems as an added incentive for developers to use LID, and in particular non-structural measures, to ultimately reduce the size and cost of structural stormwater management systems.

LID Site Design Credits encourage environmentally sensitive site design and LID techniques for managing stormwater that minimize impervious surfaces and preserve natural hydrologic conditions. The credits allow project proponents to reduce or eliminate the structural stormwater BMPs otherwise required to meet certain stormwater standards by implementing LID site design techniques according to a prescribed set of standards. The Tolland LID Design

Manual includes such an LID credit system. Attachment C of this memorandum contains an example LID Site Design Credit System that is also being considered by the Town of Greenwich.

Local land use regulations often contain design standards that preclude or limit the use of certain LID practices, particularly the use of curbless roads and roadside vegetated swales. Traditional curb-and-gutter systems convey stormwater with virtually no treatment or attenuation. Open vegetated channels remove pollutants by allowing infiltration and filtering to occur, and encourage groundwater recharge, which can reduce the volume of stormwater generated from a site. Traditionally, the use of curbless roads and vegetated open channels has been discouraged and, in many instances, specifically prohibited in local land use regulations and drainage design manuals, due to concerns over maintenance problems, pavement stability, and potential nuisances such as mosquitoes. Many of these concerns can be addressed through careful design and integration of open channels along streets.

The Vernon Subdivision Regulations contain provisions that limit the use of curbless roads and roadside vegetated swales. The Subdivision Regulations require curbs on all new streets and do not permit drainage ditches where it is feasible to install underground pipe. The Town should evaluate the underlying reasons for these restrictions and determine if the Subdivision Regulations should be amended to encourage the use of curbless roads and roadside swales, consistent with LID principles.

4. Local Regulations and Impervious Cover

Impervious cover in a watershed is a strong indicator of the overall quality of streams and aquatic ecosystems. The correlation between watershed impervious cover and stream indicators is due to the relationship between impervious cover and stormwater runoff, since streams and receiving water bodies are directly influenced by stormwater quantity and quality. As impervious cover increases, overall stream health declines.

A goal of LID, which is a form of alternative site design, is to reduce impervious cover, disconnect impervious surfaces from the storm drainage system, and preserve natural site features. Local land use regulations and design requirements were typically not developed with impervious cover in mind. Rather, they evolved from perceived consumer demand, safety concerns, and land availability, often resulting in more impervious cover than is necessary due to expansive parking lots, wide streets, and large-lot subdivisions with little conserved natural areas and open space.

Communities interested in adopting LID and alternative sit design principles need to re-evaluate local land use regulations to overcome these challenges. Based on our review of the Vernon Subdivision and Zoning Regulations, some of the key design parameters that strongly influence impervious cover are already at or near optimal levels (e.g., off-street parking stall dimensions and configuration), while others should be reviewed to determine if further refinement is warranted and feasible (e.g., cul-de-sac design, road width, sidewalks, parking ratios).

3.2 Preliminary Recommendations

This section contains preliminary recommendations based on our review of the existing land use regulations and planning documents, as well as our observations discussed in the previous section. These recommendations are intended to facilitate a discussion with the Technical Advisory Committee and Vernon land use commissioners during the upcoming workshop meeting, and to serve as a starting point and basis for further refinement and implementation.

1. *Town Design Manual*

- Develop a Town stormwater and LID design manual. A local manual should reference applicable sections of the Connecticut Stormwater Quality Manual to take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town (see Recommendation 2). The Town land use regulations should also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the land use regulations.

- Include a section of the design manual that addresses stormwater retrofits for redevelopment and drainage system upgrade and maintenance projects. Stormwater retrofits for residential and commercial redevelopment projects are an important element for the Town's stormwater management strategy given the level of existing development in the Town. Stormwater retrofits also present an opportunity to implement lot-level LID strategies as opposed to larger end-of-pipe controls where land may not be available for stormwater management facilities.

- Incorporate/reference stormwater quantity and conveyance sections of the Connecticut DOT Drainage Manual for consistency with state drainage standards.

2. *Stormwater Management Standards*

- Develop and incorporate into the Town stormwater design manual a set of stormwater management standards, which would become regulatory standards referenced by the existing Town land use regulations and/or new stormwater ordinance (see Recommendation 3). Development of stormwater management standards would allow Vernon to establish clearer, specific standards that all projects must meet in order to obtain local land use permits. The stormwater standards could include LID requirements, complement the hydrologic sizing criteria in the *Connecticut Stormwater Quality Manual* and be tailored (using variable minimum performance standards) to protect specific water bodies or sensitive resources in the Town of Vernon. An example set of stormwater management standards is included in Attachment D.

3. *New or Modified Stormwater Regulations*

- Develop and implement new or revised stormwater regulations to 1) satisfy Phase II Stormwater Program regulatory requirements, 2) encourage or require LID principles to be implemented for development projects in Vernon, and 3) address other local drainage and natural resource protection issues identified by the Town. Two potential approaches have been identified – 1) a new stand-alone stormwater ordinance, or 2) addition/amendments to the existing Zoning Regulations.

- Form an advisory committee or workgroup consisting of representatives from the various land use commissions and selected Town departments to further evaluate and select the best approach for Vernon, including key decisions regarding:

    - If a new, stand-alone stormwater ordinance is selected, which department or commission will have responsibility for administering the program (i.e., the "Stormwater Authority")?
    - Which projects and activities will the new ordinance apply to (i.e., applicability)?
    - How will applications be received and reviewed?
    - Who will be responsible for inspections and enforcement?
    - Will additional staff be required to handle the increased workload to review and process applications?

4. *Other Amendments to Existing Regulations*

<u>Subdivision Regulations</u>

- Amend Section 6.4 to reference the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, as opposed to the outdated reference to the 1976 version of the Erosion and Sediment Control Handbook.

- Section 6.5.1.1 (Street Grading and Improvement): Consider eliminating the curbing requirement for roads with grades less than 5% to encourage the use of vegetated swales and similar LID practices.

- Section 6.6.6 (Cul-de-sacs): Consider smaller cul-de-sac radius of (30 to 40 feet), or alternative designs such as hammerheads, to reduce impervious cover, such that the design allows for continuous turning movement of the largest fire fighting vehicle used by the Town of Vernon. Also consider encouraging the use of LID bioretention/rain gardens in cul-de-sac islands for stormwater management.

- Section 6.7.1 (Design Standards, Road Width): Consider pavement widths of between 24 and 28 feet, if such a reduction will not negatively impact public safety or emergency response. Refer to Table 4-3 in the Connecticut Stormwater Quality Manual for potential variation in residential roadway widths based on terrain and development density.

- Section 6.7.2 (Design Standards, Curbs): Consider eliminating the curbing requirement for roads with grades less than 5% to encourage the use of vegetated swales and similar LID practices.

- Section 6.9 (Drainage and Storm Sewers): Modify these sections to reference stormwater management standards and LID principles contained in a stand-alone stormwater ordinance or new section of the Zoning Regulations, and/or the Town stormwater design manual.

- Section 6.9.3 (Drainage Design): Amend this section to allow the use of roadside vegetated swales designed in accordance with the Town stormwater design manual.

- Section 6.12.1 (Sidewalks): Consider requiring sidewalks on only one side of the street and reduce sidewalk width to 3 or 4 feet. Grade sidewalks to the front yard rather than to the street. Consider using alternative materials such as pavers, stone dust, or pervious concrete.

- Section 6.14 (Certified Erosion and Sediment Control Plan): Amend the single family exemption such that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land, which is consistent with the Phase II Stormwater Program regulatory requirement.

Zoning Regulations

- Section 3.4 (General Provisions): If the Town develops a local stormwater design manual, change the reference to the Connecticut Stormwater Quality Manual to the Town manual.

- Sections 4.1 through 4.25 (Use Districts, Setbacks and Lot Dimensions): Review current setbacks and lot dimensions for potential to relax side yard setbacks and allow narrower frontages to reduce road length and site imperviousness, and to relax front setback requirements to reduce driveway length and lot imperviousness.

- Section 12 (Off-street Parking and Loading): Review existing parking ratios to see if lower ratios are warranted and feasible. The required parking ratio for a particular land use should be enforced as both a maximum and minimum to limit excess parking space construction and impervious cover. Consider allowing the Commission to approve parking lots with more spaces than the allowed maximum provided all of the spaces above the maximum number are composed of a pervious surface, and where adequate stormwater management is provided. Also consider parking spaces held in reserve for phased developments, thereby avoiding the situation where unnecessary parking is not constructed if future phases of development do not occur.

Clarify Section 12 of the regulations to encourage the use of shared parking. Where shared parking is used, the Zoning Regulations should require a corresponding reduction in parking spaces.

Consider adding language to Section 12 that references specific stormwater management and landscape design standards in the Town stormwater manual and/or the Connecticut Stormwater Quality Manual.

- Section 18 (Activities Requiring a Certified Erosion and Sediment Control Plan): Amend the single family exemption such that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land, which is consistent with the Phase II Stormwater Program regulatory requirement.

Inland Wetlands and Watercourses Regulations

- Section 4.5 (Evaluation of Proposed Activities): Add language referencing the stormwater management standards and LID principles contained in the Town stormwater manual and/or the Connecticut Stormwater Quality Manual.

ATTACHMENT A

Draft Model Stormwater Ordinance

DRAFT

POST-CONSTRUCTION STORMWATER ORDINANCE
(CITY NAME)

Table of Contents

1.0 PURPOSE AND AUTHORITY

The purpose of this ordinance is to protect, maintain and enhance the public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse impacts associated with post-construction stormwater runoff. Proper management of stormwater runoff will minimize damage to public and private property, reduce the effects of development on land and wetlands, control stream channel erosion, reduce local flooding, improve water quality, and maintain after development, as nearly as possible, the pre-development runoff characteristics.

The provisions of this ordinance are pursuant to Connecticut State Statutes 7-148 (c) (8) (A)[1], 8-2 (a)[2], 8-25[3], and 22a-36 to 22a-45 inclusive[4], and 8-2(b)[5] and shall apply to all development occurring within the incorporated area of(City Name), Connecticut. The application of this ordinance and provisions expressed herein shall be the minimum stormwater management requirements and shall not be deemed a limitation or repeal of any other powers granted by State statute. The agencies defined in Section 2.0 as the

---

[1] Municipal Powers: The municipality has the power to "Provide for the protection and improvement of the environment including, but not limited to, coastal areas, wetlands and areas adjacent to waterways in a manner not inconsistent with the general statutes.

[2] Regulations: The zoning commission is authorized to adopt regulations "…to secure safety from …flood and other dangers; to promote health and the general welfare…"

[3] Subdivision of land: Authorizes the zoning commission to see "…that proper provision shall be made for… drainage…" and "that proper provision shall be made for protective flood control measures…"

[4] The Inland Wetlands and Watercourses Act.

[5] "In any municipality that is contiguous to Long Island Sound the regulations adopted under this section shall be made with reasonable consideration for restoration and protection of the ecosystem and habitat of Long Island Sound and shall be designed to reduce hypoxia, pathogens, toxic contaminants and floatable debris in Long Island Sound. Such regulations shall provide that the zoning commission consider the environmental impact on Long Island sound of any proposal for development."

"Responsible Authority" shall be responsible for the coordination and enforcement of the provisions of this ordinance.

1.1 Incorporation by Reference

For the purpose of this ordinance, the Connecticut Stormwater Quality Manual (as amended) is incorporated by reference by (City Name), Connecticut and shall serve as the official guide for stormwater principles, methods, and practices.

2.0 DEFINITIONS

A. For the purpose of this ordinance, the following definitions describe the meaning of the terms used in this ordinance:

(1) "Adverse impact" means any deleterious effect on waters or wetlands, including their quality, quantity, surface area, species composition, aesthetics or usefulness for human or natural uses which are or may potentially be harmful or injurious to human health, welfare, safety or property, to biological productivity, diversity, or stability or which unreasonably interfere with the enjoyment of life or property, including outdoor recreation.

(2) "Agricultural land management practices" means those methods and procedures used in the cultivation of land in order to further crop and livestock production and conservation of related soil and water resources.

(3) "Applicant" means any person, firm, or governmental agency who executes the necessary forms to procure official approval of a project or a permit to carry out construction of a project.

(4) "Aquifer" means porous water bearing geologic formation generally restricted to materials capable of yielding an appreciable supply of water.

(5) “BMP (Best Management Practice)” means a structural device or nonstructural practice designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution, and provide other amenities.

(6) "Clearing" means the removal of trees and brush from the land (i.e., removal of vegetative cover) but shall not include the ordinary mowing of grass

(7) “DEP” means the Connecticut Department of Environmental Protection.

(8) “Design Manual” means the most current edition of the Connecticut Stormwater Quality Manual that serves as the official guide for the stormwater management principles, methods, and practices.

(9) "Detention structure" means a permanent structure for the temporary storage of runoff, which is designed so as not to create a permanent pool of water.

(10) "Develop land" means to change the runoff characteristics of a parcel of land in conjunction with residential, commercial, industrial, municipal, or institutional construction or alteration.

(11) “Direct discharge” means the concentrated release of stormwater to tidal waters or vegetated tidal wetlands from new development or redevelopment projects in the Critical Area.

(12) “Disturb” or “Disturbance” means any activity consisting of the removal of vegetation, topsoil, or overburden, or the placement of topsoil, spoil, or other material, as defined in the Guidelines.

(13) "Drainage area" means an area that contributes runoff to a single point measured in a horizontal plane, which is enclosed by a ridgeline.

(14) “Easement" means a grant or reservation by the owner of land for the use of such land by others for a specific purpose or purposes, and which must be included in the conveyance of land affected by such easement.

(15) “Exemption" means those land development activities that are not subject to the stormwater management requirements contained in this ordinance.

(16) “Extended detention” means a stormwater design feature that provides gradual release of a volume of water in order to increase settling of pollutants and protect downstream channels from frequent storm events. Methods for designing extended detention BMPs are specified in the Design Manual.

(17) “Extreme flood volume” means the storage volume required to control those infrequent but large storm events in which overbank flows reach or exceed the boundaries of the 100-year floodplain.

(18) "Flow attenuation" means prolonging the flow time of runoff to reduce the peak discharge.

(19) "Grading” means any act by which soil is cleared, stripped, stockpiled, excavated, scarified, filled or any combination thereof.

(20) “Groundwater recharge volume (GRV)” means that portion of the water quality volume used to maintain groundwater recharge rates at development sites. Methods for calculating the groundwater recharge volume are specified in the Design Manual.

(21) “Guidelines” means the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, or as may be amended, established pursuant to Section 22a-328 of the Connecticut General Statutes.

(22) "Infiltration" means the passage or movement of water into the soil surface.

(23) "Off-site stormwater management" means the design and construction of a facility necessary to control stormwater from more than one development.

(24) "On-site stormwater management" means the design and construction of systems necessary to control stormwater within an immediate development.

(25) “Peak runoff attenuation” means controlling by structural practices the volume to prevent an increase in the frequency of out of bank flooding generated by development.

(26) “Primary treatment practice”, as defined in the Design Manual, means a stormwater treatment practice that is capable of providing high levels of water quality treatment as a stand-alone measure.

(27) “Redevelopment” means any construction, alteration, or improvement exceeding five thousand (5,000) square feet of land disturbance performed on sites where existing land use is commercial, industrial, municipal, institutional or multifamily residential.

(28) “Responsible Authority” means employees, members, or designees of (City Name) (Agency Name). Other responsible agencies under this ordinance include:

(a) The Inland Wetlands and Watercourses Commission for stormwater runoff impacting wetlands and watercourses. (For the purposes of only this paragraph, the definition of “wetlands” and “watercourse” is the definition used in the most current version of the Inland Wetland and Watercourses regulations of (City Name).

(b) The Engineering Division of the Department of Public Works for stormwater runoff from public roads and sidewalks.

(c) The Planning Commission and Zoning Commission for all other stormwater runoff.

(29) "Responsible Official" means (City Name) Director of Public Works ("Director").

(30) "Retention structure" means a permanent structure that provides for the storage of runoff by means of a permanent pool of water.

(31) "Retrofitting" means the construction of a structural BMP in a previously developed area, the modification of an existing structural BMP, or the implementation of a nonstructural practice to improve water quality over current conditions.

(32) "Secondary treatment practice", as defined in the Design Manual, means a stormwater treatment practice that may not be suitable as stand-alone treatment because is not capable of meeting the water quality treatment performance criteria in the Design Manual or has not yet received the thorough evaluation needed to demonstrate the capabilities for meeting the performance criteria in the Design Manual.

(33) "Sediment" means soils or other surficial materials transported or deposited by the action of wind, water, ice, or gravity as a product of erosion.

(34) "Site" means:

(a) For "new development" any tract, lot or parcel of land or combination of tracts, lots, or parcels of land, which are in one ownership, or are contiguous and in diverse ownership where development is to be performed as part of a unit, subdivision, or project.

(b) For "redevelopment" the area of new construction as shown on an approved site plan or the original parcel. Final determination of the applicable area shall be made by the Responsible Authority.

(35) "Stabilization" means the prevention of soil movement by any of various vegetative and/or structural means.

(36) "Stormwater management" means the selective use of various management measures to effectively address the adverse water quality and quantity impacts of urban stormwater runoff.

(37) "Stormwater Management Plan" means a set of drawings or other documents that describe the potential water quality and quantity impacts associated with a development project after construction. A stormwater management plan also identifies selected source controls and treatment practices to address those potential impacts, the engineering design of the treatment practices, and maintenance requirements for proper performance of the selected practices.

(38) "Stormwater Treatment Practice", as defined in the Design Manual, means a measure constructed for primary treatment or secondary treatment of stormwater runoff.

(39) "Stream Channel Protection" means restricting peak flows from storm events that result in flow conditions where the stream is flowing to the full extent of its banks so the damaging effects to the channel of increased runoff from urbanization can be reduced. Methods for calculating stream channel protection are specified in the most current edition of the Design Manual.

(40) "Variance" means the modification of the minimum stormwater management requirements for specific circumstances such that strict adherence to the requirements would result in necessary hardship and not fulfill the intent of this ordinance.

(41) "Waiver" means the relinquishment from stormwater management requirements by the Responsible Authority for a specific development on a case-by-case review basis.

(a) “Quality stormwater management waiver” includes water quality volume and groundwater recharge volume design parameters.

(b) “Quantity stormwater management waiver” includes stream channel protection, peak runoff attenuation, and extreme flood volume design parameters.

(38) "Watercourse" means any natural or artificial stream, river, brook, lake, pond, marsh, swamp, bog, ditch, channel, canal, conduit, culvert, drain, waterway, gully, ravine, wash, and all other bodies of water, natural or artificial, vernal or intermittent, public or private in and including any adjacent area that is subject to inundation from overflow or flood water.

(39) “Watershed” means the total drainage area contributing runoff to a single point.

(40) “Water quality volume” means the volume of runoff generated by one inch of rainfall on the site.

3.0 APPLICABILITY

3.1 Scope

No person shall develop land for residential, commercial, industrial, municipal, or institutional uses without having provided stormwater management measures that control or manage runoff from such development, except as provided within this section. The stormwater management measures must be designed consistent with the Design Manual and constructed according to an approved plan for new development or the policies stated in Section 3.4 for redevelopment.

3.2 Exemptions

The following development activities are exempt from the provisions of this ordinance and the requirements of providing stormwater management, except as noted:

A. Development of single family residential property that results in the disturbance of less than one (1) acre of land, not including projects less than one (1) acre that are part of a larger common plan of development or sale that will ultimately disturb greater or equal to one (1) acre must conform to the requirements presented in Section 4.4.

B. Agricultural land management practices;

C. Any activity that will disturb an area less than five thousand (5,000) square feet over the total project;

D. Maintenance of existing landscaping, gardens or lawn areas associated with a single family dwelling;

E. Repair or replacement of an existing roof of a single family dwelling;

F. Construction of utilities (gas, water, electric, telephone, sanitary sewer, etc.) other than drainage, which will not alter terrain, ground cover, or drainage patterns;

G. Emergency repairs to any stormwater management facility or practice that poses a threat to public health or safety, or as deemed necessary by the Responsible Authority.

3.3 Waivers / Watershed Management Plans

A. Stormwater management quantity control waivers may be granted by the Responsible Authority to projects when the Responsible Authority determines that circumstances exist that prevent the reasonable implementation of quantity control practices.

B. Stormwater management quality control waivers granted by the Responsible Authority apply to:

(1) In-fill development projects where implementation of stormwater management quality controls is not feasible;

(2) Redevelopment projects if the requirements of Section 3.4 of this ordinance are satisfied; or

(3) Sites where the Responsible Authority determines that circumstances exist that prevent or make unnecessary the reasonable implementation of quality control practices.

C. Waivers must be requested in writing one week in advance of the regular meeting of the (Responsible Authority Agency Name) in a manner prescribed by the Director of Public Works.

D. Waivers granted must:

(1) Be on a case-by-case basis;

(2) Consider the cumulative effects of the waiver policy; and

(3) Reasonably ensure the development will not adversely impact stream quality.

3.4 Redevelopment

A. All redevelopment projects shall reduce existing site impervious area by 20%. Where site conditions prevent the reduction of impervious area, then stormwater management practices shall be implemented to provide quality control for at least 20% of the site's impervious area. The elements and principles of stormwater quality control are noted in the Design Manual.

B. Where conditions prevent impervious area reduction or on-site stormwater management, the Responsible Authority may consider practical alternatives including:

(1) Watershed or stream restoration;

(2) Retrofitting; or

(3) Other practices approved by Responsible Authority.

3.5 Variance

The Responsible Authority may grant a written variance from any requirement of Section 4.0 (Stormwater Management Criteria), of this ordinance if there are exceptional circumstances applicable to the site such that strict adherence will result in unnecessary hardship and not fulfill the intent of this ordinance. A written request for variance shall be provided to the Responsible Authority and shall state the specific variances sought and reasons for their granting. The Responsible Authority shall not grant a variance unless and until the person developing land provides sufficient justification.

4.0 STORMWATER MANAGEMENT CRITERIA

4.1 Minimum Control Requirements

A. The minimum control criteria established in this section and the Design Manual are as follows:

(1) Shall require that the groundwater recharge volume, water quality volume, and peak runoff attenuation for the 2-year frequency storm event be used to design BMPs according to the Design Manual. Control of the 10-year frequency storm event is required according to the Design Manual. Control of larger storm events may be required at the discretion of the Responsible Authority if a flooding problem exists and downstream floodplain development and conveyance system design cannot be controlled.

(2) Shall require that the groundwater recharge volume, water quality volume, and stream channel protection sizing criteria be used to design BMPs according to the Design Manual.

(3) The Responsible Authority may require more than the minimum control requirements specified in this ordinance if hydrologic or topographic conditions warrant or if flooding, stream channel erosion, or water quality problems exist downstream from a proposed project.

B. Stormwater management and development plans where applicable, shall be consistent with adopted and approved watershed management plans or flood management plans as approved by the DEP.

4.2 Stormwater Management Measures

The structural and nonstructural stormwater management measures established in this ordinance shall be used, either alone or in a combination, in developing a stormwater management plan.

A. Nonstructural Stormwater Management Measures.

(1) The following nonstructural stormwater management practices shall be applied according to the Design Manual to minimize increases in new development runoff:

(a) Natural area conservation;

(b) Disconnection of rooftop runoff;

(c) Disconnection of non-rooftop runoff;

(d) Sheet flow to buffers;

(e) Grass channels; and

(f) Environmentally sensitive development and Low Impact Development (LID) practices;

(2) The use of nonstructural stormwater management practices shall be encouraged to minimize the reliance on structural BMPs.

(3) The minimum control requirements listed in Section 4.1 of this ordinance may be reduced when nonstructural stormwater management practices are incorporated into site designs according to the Design Manual.

(4) The use of nonstructural stormwater management practices may not conflict with existing State or local laws, ordinances, or policies.

(5) Nonstructural stormwater management practices used to reduce the minimum control requirements must be recorded and remain unaltered by subsequent property owners. Prior approval from the Responsible Authority shall be obtained before nonstructural stormwater practices are altered.

B. Structural Stormwater Management Measures.

(1) The following structural stormwater management practices or "Stormwater Treatment Practices" shall be designed according to the Design Manual to satisfy the applicable minimum control requirements established in Section 4.1 of this ordinance.

(a) Primary Treatment Practices, including stormwater ponds, stormwater wetlands, stormwater infiltration practices, stormwater filtering practices, and water quality swales.

(b) Combination of primary treatment practices and secondary treatment practices.

(c) Multiple secondary treatment practices, at the discretion of the Responsible Authority.

(2) The performance criteria specified in the Design Manual with regard to general feasibility, conveyance, pretreatment, treatment and geometry, environment and landscaping, and maintenance shall be considered when selecting structural stormwater management practices.

(3) Structural stormwater management practices shall be selected to accommodate the unique hydrologic or geologic regions of the state.

C. Alternative structural and nonstructural stormwater management practices may be used for new development water quality control if they meet the performance criteria established in the Design Manual. Practices used for redevelopment projects shall be approved by the Responsible Authority.

D. For the purposes of modifying the minimum control requirements or design criteria, the owner/developer shall submit at the request of the Responsible Authority an analysis of the impacts of stormwater flows downstream in the watershed. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications of the proposed development upon a dam, highway, structure, or natural point of restricted stream flow. The point of investigation is to be established with the concurrence of the Responsible Authority.

4.3 Specific Design Criteria

The basic design criteria, methodologies, and construction specifications, subject to the approval of the Responsible Authority, shall be those of the Design Manual.

4.4 Single Family Residence Lot Level Controls

Construction of single family residences that results in the disturbance of less than 1 acre of land must minimize or disconnect impervious area runoff from the public storm drainage system by implementing stormwater management measures designed in accordance with the Design Manual. The applicant shall submit evidence on a form prescribed by the Responsible Official that the requirements of Section 4.4 have been met prior to issuance of a building permit.

5.0 STORMWATER MANAGEMENT PLANS

5.1 Review and Approval of Stormwater Management Plans

A. For any proposed development, the developer shall submit a stormwater management plan or waiver application to the Responsible Authority for review and approval, unless otherwise exempted. The stormwater management plan shall contain supporting computations, drawings, and sufficient information describing the manner, location, and type of measures in which stormwater runoff will be managed from the entire development. The Responsible Authority shall review the plan to determine compliance with the requirements of this ordinance prior to approval. The plan shall serve as the basis for all subsequent construction.

B. Notification of approval or reasons for disapproval or modification shall be given to the applicant within [time frame] after submission of the completed stormwater plan. If a decision is not made within [time frame] the applicant shall be informed of the status of the review process and the anticipated completion date. The stormwater management plan shall not be considered approved without the inclusion of the signature and date of signature of the responsible official on the plan.

5.2 Contents of the Stormwater Management Plan

A. The developer is responsible for submitting a stormwater management plan that meets the design requirements of this ordinance. The plan shall be accompanied by a report that includes sufficient information to evaluate the environmental characteristics of affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing stormwater runoff. An engineer licensed in Connecticut shall certify on the drawings that all clearing, grading, drainage, construction, and development shall be conducted in strict accordance with the plan. If a stormwater management plan involves direction of some or all runoff off of the site, it is the responsibility of the developer to obtain from adjacent property owners any easements or necessary property interests concerning flowage of water. Approval of a stormwater management plan does not create or affect any right to direct runoff onto adjacent property without that property owner's permission.

The minimum information submitted for support of a stormwater management plan or application for a waiver shall be as follows:

B. Reports submitted for stormwater management plan approval shall include:

(1) A brief narrative description of the project;

(2) Geotechnicial investigations including soil maps, borings, site-specific recommendations, and any additional information necessary for the proposed stormwater management design;

(3) Descriptions of all watercourses, impoundments, and wetlands on or adjacent to the site or into which stormwater directly flows;

(4) Hydrologic computations, including drainage area maps depicting pre development and post development runoff flow path segmentation and land use that demonstrate compliance with Section 4.0 of this ordinance;

(5) Hydraulic computations;

(6) Structural computations;

(7) Hydrologic sizing criteria computations according to the Design Manual; and

(8) Any other information required by the Responsible Authority.

C. Construction drawings submitted for stormwater management plan approval shall include the following:

(1) A vicinity map;

(2) Topography survey showing existing and proposed contours, including the area necessary to determine downstream analysis for proposed stormwater management facilities;

(3) Any proposed improvements including location of buildings or other structures, impervious surfaces, storm drainage facilities, and all grading;

(4) The location of existing and proposed structures and utilities;

(5) Any easements and rights-of-way;

(6) The delineation, if applicable, of the 100-year floodplain and any on-site wetlands;

(7) Structural and construction details for all components of the proposed drainage system or systems, and stormwater management facilities.

(8) All necessary construction specifications;

(9) A sequence of construction;

(10) Data for total site area, disturbed area, new impervious area, and total impervious area;

(11) A table showing the hydrologic sizing criteria volumes described in the Design Manual;

(12) A table of materials to be used for stormwater management facility planting;

(13) All soil boring logs and locations;

(14) A maintenance schedule;

(15) Certification by a Connecticut certified engineer that all stormwater management construction will be done according to this plan;

(16) An as-built certification signature block to be executed after project completion; and

(17) Any other information required by the Responsible Authority.

5.3 Preparation of the Stormwater Management Plan

A. A professional engineer licensed in the State shall design and prepare a stormwater management plan as necessary to protect the public and the environment.

B. If a stormwater treatment practice requires either a dam safety permit from DEP or approval from the Inland Wetlands and Watercourses Agency, the Responsible Authority shall require that a professional engineer licensed in the State prepare the design.

6.0 PERMITS

6.1 Permit Requirement

A building permit may not be issued for any parcel or lot unless a stormwater management plan has been approved or waived by the Responsible Authority as meeting all the requirements of this ordinance. Where appropriate, a building permit may not be issued without:

A. Recorded easements for the stormwater management facility and easements to provide adequate access for inspection and maintenance from a public right-of-way;

B. A recorded stormwater management maintenance agreement;

C. A cash bond; and

D. Permission from adjacent property owners as necessary.

6.2 Permit Fee

A non-refundable permit fee will be collected at the time the stormwater management plan or application for waiver is submitted. The permit fee will provide for the cost of plan review, administration, and management of the permitting process, and inspections by the Responsible Authority of all projects subject to this ordinance. A permit fee schedule shall be established by the Responsible Authority based upon the relative complexity of the project and may be amended from time to time.

6.3 Permit Suspension and Revocation

Any building permit issued by the Responsible Authority may be suspended or revoked after written notice is given to the permittee for any of the following reasons:

A. Any violation(s) of the conditions of the stormwater management plan approval.

B. Changes in site runoff characteristics upon which an approval or waiver was granted.

C. Construction is not in accordance with the approved plan.

D. Noncompliance with correction notice(s) or stop work order(s) issued for the construction of the stormwater management facility.

E. An immediate danger exists in a downstream area in the opinion of the Responsible Authority.

6.4 Permit Conditions

In granting the plan approval, the Responsible Authority may impose such conditions that may be deemed necessary to ensure compliance with the provisions of this ordinance and the preservation of the public health and safety.

7.0 CASH BOND

The Responsible Authority shall require from the developer a cash bond prior to the issuance of any building permit for the construction of a development requiring a stormwater management facility. The amount of the security shall not be less than the total estimated construction cost of the stormwater management facility. The bond required in this section shall include provisions relative to forfeiture for failure to complete work specified in the approved stormwater management plan, compliance with all of the provisions of this ordinance, and other applicable laws and regulations, and any time limitations. The bond shall not be fully released without a final inspection of the completed work by the Responsible Authority, submission of "as-built" plans, and certification of completion by the Responsible Authority that the stormwater management facilities comply with the approved plan and the provisions of this ordinance. A procedure may be used to release parts of the bond held by the Responsible Authority after various stages of construction have been completed and accepted by the Responsible Authority. The procedures used for partially releasing performance bonds must be specified by the Responsible Authority in writing prior to stormwater management plan approval.

[1) a cash bond posted within the Town treasury or 2) a surety bond that the town could investigate/ approve. Language should be consistent with language currently under review/development by Town Counsel.]

The bond requirement under this ordinance may be waived by the Responsible Authority provided that a bond is required by another agency in the amount equal to or greater than the total estimated construction cost of the stormwater management facilities for the project.

8.0 INSPECTION

8.1 Inspection Schedule and Reports

A. The developer shall notify the Responsible Official at least 48 hours before commencing any work in conjunction with the stormwater management plan and upon completion of the project when a final inspection will be conducted.

B. The developer shall retain a professional engineer licensed in the State to conduct inspections. Written inspection reports shall be made of the periodic inspections necessary during construction of stormwater management systems to ensure compliance with the approved plans.

C. Written inspection reports shall be provided by the developer’s engineer to the Responsible Authority on a standard form provided by the Town.

D. The owner/developer and on-site personnel shall be notified in writing when violations are observed. Written notification shall describe the nature of the violation and the required corrective action.

E. No work shall proceed until the Responsible Authority approves the work previously completed. The inspector shall provide the developer and Responsible Authority with the results of the inspection reports as soon as possible after completion of each required inspection.

8.2 Inspection Requirements During Construction

A. At a minimum, inspections shall be made and documented at the following specified stages of construction:

(1) For stormwater ponds:

(a) Upon completion of excavation to sub-foundation and when required, installation of structural supports or reinforcement for structures, including but not limited to:

(i) Core trenches for structural embankments

(ii) Inlet and outlet structures, anti-seep collars or diaphragms, and watertight connectors on pipes; and

(iii) Trenches for enclosed storm drainage facilities;

(b) During placement of structural fill, concrete, and installation of piping and catch basins;

(c) During backfill of foundations and trenches;

(d) During embankment construction; and

(e) Upon completion of final grading and establishment of permanent stabilization.

(2) For stormwater wetlands – at the stages specified for pond construction in 8.2 A (1) of this section, during and after wetland reservoir area planting, and during the second growing season to verify a vegetation survival rate of at least 50 percent.

(3) For infiltration trenches:

(a) During excavation to subgrade;

(b) During placement and backfill of underdrain systems and observation wells;

(c) During placement of geotextiles and all filter media;

(d) During construction of appurtenant conveyance systems such as diversion structures, pre-filters and filters, inlets, outlets, and flow distribution structures; and

(e) Upon completion of final grading and establishment of permanent stabilization;

(4) For infiltration basins – at the stages specified for pond construction in 8.2 A (1) of this section and during placement and backfill of underdrain systems.

(5) For filtering systems:

(a) During excavation to subgrade;

(b) During placement and backfill of underdrain systems;

(c) During placement of geotextiles and all filter media;

(d) During construction of appurtenant conveyance systems such as flow diversion structures, pre-filters and filters, inlets, outlets, orifices, and flow distribution structures; and

(e) Upon completion of final grading and establishment of permanent stabilization.

(6) For open channel systems:

(a) During excavation to subgrade;

(b) During placement and backfill of underdrain systems for dry swales;

(c) During installation of diaphragms, check dams, or weirs; and

(d) Upon completion of final grading and establishment of permanent stabilization.

(7) For nonstructural practices – upon completion of final grading, the establishment of permanent stabilization, and before issuance of use and occupancy approval.

(8) For secondary treatment practices, including subsurface manufactured devices:

(a) During excavation to subgrade;

(b) During placement and backfill of treatment unit;

(c) During construction of appurtenant conveyance systems such as diversion structures, pre-filters and filters, inlets, outlets, and flow distribution structures; and

(e) Upon completion of final grading and establishment of permanent stabilization;

B. The Responsible Authority may, for enforcement purposes, use any one or a combination of the following actions:

(1) A notice of violation shall be issued specifying the need for a violation to be corrected if the stormwater management plan noncompliance is identified;

(2) A stop work order shall be issued for the site by the Responsible Authority if a violation persists;

(3) Bonds or securities may be withheld or the case may be referred for legal action if reasonable efforts to correct the violation have not been undertaken; or

(4) In addition to any other sanctions, a civil action or criminal prosecution may be brought against any person in violation of the Stormwater Management subtitle or this ordinance.

C. Any step in the enforcement process may be taken at any time, depending on the severity of the violation.

D. Once construction is complete, as-built plan certification shall be submitted by a professional engineer licensed in the State to ensure that constructed stormwater management practices and conveyance systems comply with the specifications contained in the approved plans. At a minimum, as-built certification shall include a set of drawings comparing the approved stormwater management plan with what was constructed the Responsible Authority may require additional information.

9.0 MAINTENANCE

9.1 Maintenance Inspection

A. The owner (or the developer during construction) shall ensure that all stormwater management systems are inspected for performance of preventative maintenance. Inspection shall occur during the first year of operation and at least once every 3 years thereafter. In addition, a maintenance agreement between the owner and the Responsible Authority shall be executed for privately owned stormwater management systems as described in 9.2 of this section.

B. The owner (or the developer during construction) shall maintain inspection reports for all stormwater management systems.

C. Inspection reports for stormwater management systems shall include the following:

(1) The date of inspection;

(2) Name of inspector;

(3) The condition of:

(a) Vegetation or filter media;

(b) Fences or other safety devices;

(c) Spillways, valves, or other control structures;

(d) Embankments, slopes, and safety benches;

(e) Reservoir or treatment areas;

(f) Inlet and outlet channels or structures;

(g) Underground drainage;

(h) Sediment and debris accumulation in storage and forebay areas;

(i) Any nonstructural practices to the extent practicable; and

(j) Any other item that could affect the proper function of the stormwater management system.

(4) Description of needed maintenance.

D. After notification is provided to the owner of any deficiencies discovered from an inspection of a stormwater management system, the owner shall have 30 days or other time frame mutually agreed to between the Responsible Authority and the owner to correct the deficiencies. The Responsible Authority shall then conduct a subsequent inspection to ensure completion of the repairs.

E. If repairs are not undertaken or are not done properly, then enforcement procedures following 9.2 C of this section shall be followed by the Responsible Authority

F. If, after an inspection by the Responsible Authority, the condition of a stormwater management facility presents an immediate danger to the public health or safety, because of an unsafe condition or improper maintenance, the Responsible Authority shall take such action as may be necessary to protect the public and make the facility safe. Any cost incurred by (City Name) shall be assessed against the owner(s), as provided in Section 9.2 C.

9.2 Maintenance Agreement

A. Prior to the issuance of any building permit for which stormwater management is required, the Responsible Authority shall require the applicant or owner to execute an inspection and maintenance agreement binding on all subsequent owners of land served by a private stormwater management facility. Such agreement shall provide for access to the facility at reasonable times for regular inspections by the Responsible Authority or its authorized representative to ensure that the facility is maintained in proper working condition to meet design standards.

B. The applicant and/or owner shall record the agreement in the land records of (City Name).

C. The agreement shall also provide that, if after notice by the Responsible Authority to correct a violation requiring maintenance work, satisfactory corrections are not made by the owner(s) within a reasonable period of time (30 days maximum), the Responsible Authority may perform all necessary work to place the facility in proper working condition. The owner(s) of the facility shall be assessed the cost of the work and any penalties. This may be accomplished by placing a lien on the property, which may be placed on the tax bill and collected as ordinary taxes by the County/Municipality.

9.3 Maintenance Responsibility

A. The owner of the property on which work has been done pursuant to this ordinance for private stormwater management facilities, or any other person or agent in control of such property, shall maintain in good condition and promptly repair and restore all grade surfaces, walls, drains, dams and structures, vegetation, erosion and sediment control measures, and other protective devices. Such repairs or restoration and maintenance shall be in accordance with approved plans.

B. A maintenance schedule shall be developed for the life of any stormwater management facility and shall state the maintenance to be completed, the time period for completion, and who shall perform the maintenance. This maintenance schedule shall be printed on the approved stormwater management plan.

10.0 APPEALS

Any person aggrieved by the action of any official charged with the enforcement of this ordinance, as the result of the disapproval of a properly filed application for a permit, issuance of a written notice of violation, or an alleged failure to properly enforce this ordinance in regard to a specific application, shall have the right to appeal in a manner prescribed in the regulations and procedures of the Responsible Authority and the State of Connecticut.

11.0 SEVERABILITY

If a court of competent jurisdiction holds any portion of this ordinance invalid or unconstitutional, such portion shall not affect the validity of the remaining portions of this ordinance. It is the intent of (City Name) that this ordinance shall stand, even if a section, subsection, sentence, clause, phrase, or portion may be found invalid.

12.0 PENALTIES

Any person convicted of violating the provisions of this ordinance shall be guilty of a misdemeanor, and upon conviction thereof, shall be subject to a fine of not more than Five Thousand Dollars ($5,000.00) or imprisonment not exceeding 1 year or both for each violation with costs imposed in the discretion of the court. Each day that a violation continues shall be a separate offense. In addition, the Responsible Authority may institute or cause to be instituted injunctive, mandamus or other appropriate action or proceedings of law to correct violations of this ordinance. Any court of competent jurisdiction shall have the right to issue temporary or permanent restraining orders, injunctions or mandamus, or other appropriate forms of relief.

13.0 EFFECTIVE DATE

And be it further enacted, that this ordinance shall take effect [number] days from the date it becomes adopted.

ATTACHMENT B

Tolland Zoning Regulation Amendments
Low Impact Development

ARTICLE XXIV
LOW IMPACT DEVELOPMENT

The Town of Tolland requires that Low Impact Development techniques be implemented on all development projects within the boundaries of the Town to protect high quality wetlands, watercourses, open water bodies and other sensitive areas from the impacts of point and non-point sources of storm water due to land development projects.

The concept of Low Impact Development (LID) utilizes many tools to reduce the impact of development on the environment. A primary benefit of LID is a better balance between Conservation of Natural Resources, growth, ecosystem protection and the public health.

A. Goals of Low Impact Development

- Preserve Open Space within developments by using Cluster and Open Space subdivision standards as found in Section 170-38 of these regulations.
- Incorporate natural site elements (ridge lines, significant trees, open meadows, suitable soils for infiltration, wetlands and streams) into the design as features.
- Minimize land clearing and disturbance and increase natural landscape buffers at the limit of development to improve storm water management.
- Incorporate decentralized storm water management systems in to the site design, treat storm water runoff at its source, disconnect impervious areas.
- Maintain pre-development Times of Concentrations for post-development runoff Maintain sheet flow to the maximum extent possible, avoid concentrating runoff, reduce runoff volumes by infiltration.
- Provide water quality treatment to remove pollutants from storm water, pollution, modify human activities to reduce the introduction of pollutants into the environment.
- Encourage public education and participation in environmental protection within the community

B. Benefits of Low Impact Development

There are many benefits associated with the use of Low Impact Development for all of the stakeholders in the development field. The three stakeholders in the development field are the environment, the municipality, and the developer. The benefits of LID for each stakeholder are stated below.

1. Environmental Benefits:
    - Preserve the biological and ecological integrity of natural systems through the preservation of trees and natural vegetation,
    - Protect the water quality by reducing sediment, nutrient and toxic loads to wetland/watercourse aquatic environments and also terrestrial plants and animals.

2. Municipality Benefits:
    - Increase collaborative public/private partnerships on environmental protection by the protection of regional flora and fauna.
    - Balance Growth needs with environmental protections.
    - Reduce municipal infrastructure and utility maintenance costs (roads, and storm water drainage systems)

3. Developer Benefits:
    - Reduce land clearing and earth disturbance costs, reduce infrastructure costs (roads, storm water conveyance and treatment systems)
    - Reduce storm water management costs by the reduction of structural components of a drainage system.
    - Increase quality of building lots and community marketability.

C. Low Impact Development Strategies

1. Vegetation and Soils:
    - Retain native forest cover on undeveloped sites, restore vegetated area on previously cleared sites when possible as vegetation captures rainfall, thus increasing evapotranspiration and infiltration.

2. Site Design:
    - Define and locate Critical Resource areas, such as wetlands/watercourses, unusual forest features, and soils with moderate to high infiltrative capacities, locate roads, driveways, parking areas, home sites and other buildings away from critical resource areas
    - Minimize impervious surfaces such as roads, driveways, parking areas, and roof tops. Eliminate direct discharges of runoff from impervious areas to wetlands and watercourses

3. Storm Water Management:
    - Reduce reliance on the use of traditional storm water collection and conveyance systems (catch basins, pipes, and detention basins) and use small scale storm water management systems, such as bioretention, and rain gardens. Integrate source storm water controls during the design process.

    - Create a site design that slows runoff from rainfall events and increases the amount of time that runoff stays on the site. Incorporate multiple Low Impact Development treatment systems in a treatment train to increase the redundancy of the system to reduce the possibility of system failure

4. Education and Maintenance
    - Develop reliable long-term maintenance protocols for LID systems with built in enforcement provisions.

- Educate homeowners, building owners and landscape contractors on the appropriate maintenance requirements for LID systems

D. Types of LID Storm Water Systems:

1. Vegetated Systems:
   - Vegetated Buffers, Rain Gardens, Bioretention Systems, Water Quality Swales (wet and dry), Grass Filter Strips, Vegetated Level Spreaders, and Vegetated Roofs

2. Infiltration Systems:
   - Soil Amendments, Surface Sand Filters, Underground Sand Filters, Gravel Infiltration Trenches, Underground Infiltration Systems, (large diameter perforated PVC pipes and galleries), and Tree Wells

3. Surface Treatment Systems:
   - Permeable Pavement, Permeable Concrete, Concrete or PVC Pavers with gravel or grass surface

4. Storm Water Ponds and Wetland Systems:
   - Wet Ponds, Multiple Ponds in series, Gravel Wetland Systems, Micropool extended detention pond, Shallow Wetlands, Pond/wetland system, and Extended detention ponds

Refer to Town of Tolland Design Manual for more information on individual systems.

References:

1. Low-Impact Development Design Strategies – An Integrated Design Approach
Prepared by: Prince George's County, Maryland; Department of Environmental Resources, Programs and Planning Division; June 1999
2. Low-Impact Development Hydrologic Analysis
Prepared by: Prince George's County, Maryland; Department of Environmental Resources, Programs and Planning Division; July 1999
3. LOW IMPACT DEVELOPMENT – Technical Guidance Manual for Puget Sound; January 2005
Prepared by Puget Sound Action Team * Washington State University Pierce County Extension
4. 2004 Connecticut Stormwater Quality Manual by the Connecticut Department of Environmental Protection
5. 2002 Connecticut Guidelines for Soil Erosion and Sediment Control by The Connecticut Council on Soil and Water Conservation in Cooperation with the Connecticut Department of Environmental Protection

ATTACHMENT C

Example LID Site Design Credit System

LOW IMPACT DEVELOPMENT (LID)
SITE DESIGN CREDIT SYSTEM

DRAFT

The Low Impact Development (LID) Site Design Credits encourage environmentally sensitive site design and Low Impact Development techniques for managing stormwater that minimize impervious surfaces and preserve natural hydrologic conditions. The credits allow project proponents to reduce or eliminate the structural stormwater BMPs otherwise required to meet Standards 3 and 4 by directing stormwater runoff to qualifying pervious surfaces that provide recharge and treatment.

Available LID Site Design Credits

There are five types of LID credits that can be obtained:

- Credit 1 – Natural Area Conservation,
- Credit 2 – Environmentally Sensitive Development,
- Credit 3 – Rooftop Runoff Directed to Qualifying Pervious Area,
- Credit 4 – Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area,
- Credit 5 – Sheet Flow to Buffer.

The credits may be used to reduce the required Groundwater Recharge Volume (GRV) and the required Water Quality Volume (WQV) provided that any pervious surfaces used to treat and infiltrate stormwater runoff meet the requirements set forth herein. A proponent of a project that is eligible for the site design credit is required to comply with all other applicable stormwater management standards. The application of these credits does not relieve the design engineer or reviewer from the standard of engineering practice associated with safe conveyance of stormwater runoff and good drainage design.

Not Eligible for Credits

The LID Site Design Credits may <u>not</u> be applied to reduce the required Groundwater Recharge Volume and the required Water Quality Volume:

- At sites where stormwater runoff is directed to non-permeable soils, such as bedrock and soils classified as Hydrologic Soil Group D; and
- At sites with urban fill, soils classified as contaminated pursuant to the Connecticut Remediation Standards Regulations, and soils with seasonal high groundwater – groundwater elevation within 2 feet of the land surface.

Sites with land uses with higher potential pollutant loads are not eligible for Credit No. 2.

Sites with land uses with higher potential pollutant loads are eligible for Credits 3 and 4, provided that no runoff from the areas or activities that may generate runoff with higher potential pollutant loads is directed to the pervious surfaces used to satisfy the credit, and provided further that the proposal satisfies all the other requirements set forth herein.

Runoff from metal roofs is only eligible for Credit 3 when the metal roof is located outside a recharge areas for public water supplies (groundwater and surface water supplies) and the building is not used for industrial purposes.

Runoff from green roofs is not eligible for Credit 3.

1. Natural Area Conservation Credit

A credit is given when natural areas are conserved at development sites, thereby preserving predevelopment hydrologic and water quality characteristics. A simple WQV credit is granted for all conservation areas permanently protected under conservation easements. Under this credit, the design engineer can substract the conservation areas from the total site area when computing the water quality volume. The volumetric runoff coefficient, R, is still based upon the percent impervious cover for the entire site. As an additional incentive, the post-development curve number (CN) for all natural areas permanently protected can be assumed to be woods in good condition when calculating the total site CN.

Minimum Criteria for Credit:

- The area shall not be disturbed during the construction process.
- The area shall be protected from having the limits of disturbance clearly shown on all construction and mitigation plans and shall be delineated in the field.
- The area shall be located within an acceptable conservation easement or other enforceable instrument that provides perpetual protection of the area.
- The area shall be located on the development project site.

2. Environmentally Sensitive Development Credit

This credit is given for environmentally sensitive site design techniques that "cluster development" or reduce development scale, to leave a significant amount of the site undisturbed in its natural state. If a site is designed, constructed, operated and maintained in accordance with the requirements of this credit, the credit eliminates the need for structural practices to treat the WQV (Standard 4) and GRV (Standard 5) for low density or cluster residential developments.

Minimum Criteria for Credit:

Single Lot Development

- Total site impervious cover is less than 15%.
- Lot size shall be at least 1 acre.
- Rooftop runoff is disconnected in accordance with the criteria listed in Credit 3 and qualifying pervious areas are used to convey runoff from roads and driveways instead of curb and gutter systems in accordance with the criteria listed in Credit 4.

Multiple Lot Development

- Total site impervious cover is less than 15%.
- Lot size shall be at least 1 acre if clustering techniques are not used.

- If clustering techniques are used, the average lot shall not be less than _____ square feet, which is the minimum residential lot size as identified in the Town of _______ Building Zone Regulations.
- Rooftop runoff is disconnected in accordance with the criteria listed in Credit 3 and qualifying pervious areas are used to convey runoff from roads and driveways instead of curb and gutter systems in accordance with the criteria listed in Credit 4.
- A minimum of 25% of the site is placed in a natural conservation area maintained by an acceptable conservation easement or other enforceable instrument that provides perpetual protection of the area.

3. Rooftop Runoff Directed to Qualifying Pervious Area Credit

This credit is available when rooftop runoff is directed to a qualifying pervious area where it can either infiltrate into the soil or flow over it with sufficient time and reduced velocity to allow for filtering. Qualifying pervious areas are relatively flat locations, where the discharge is directed via sheet flow and not as a point source discharge. The credit may be obtained by grading the site to induce sheet flow over specially designed flat vegetated areas or bioretention areas that can treat and infiltrate rooftop runoff. If rooftop runoff is adequately directed to a qualifying pervious area, the rooftop area can be deducted from total impervious area, therefore reducing the required WQV and the size of the structural treatment practices.

Minimum Criteria for Credit:

- To take credit for rooftop disconnection associated with a land use with higher potential pollutant loads, the rooftop runoff must not commingle with runoff from any paved surfaces or activities or areas on the site that may generate higher pollutant loads.
- Disconnection shall cause no basement seepage.
- The contributing area of the rooftop to each disconnected discharge point (gutter pipe) shall not exceed 1,000 square feet.
- The length of the qualifying pervious area shall be 75 feet or greater.
- The width of the qualifying pervious area (in feet) shall be equal to or greater than the roof length. For example, if a roof section is 20 feet wide by 50 feet long (1,000 ft2 roof), the width of the qualifying pervious area shall be at least 50 feet.
- Dry wells, rain gardens, or other filtration/infiltration treatment practices may be utilized to compensate if the disconnection length is less than 75 feet.
- Although they may abut, there shall be no overlap between qualifying pervious areas. For example, the runoff from two 1,000 square foot sections of roof must be directed to separate qualifying pervious areas. They may not be directed to the same area.
- The lot must be greater than ______ square feet.
- The slope of the qualifying pervious area shall be less than or equal to 5%.
- Where provided, downspouts must be at least 10 feet away from the nearest impervious surface to discourage reconnection to the stormwater management system.
- Where a gutter/downspout system is not used, the rooftop runoff must be designed to sheet flow at low velocity away from the structure housing the roof.
- Qualifying pervious areas should be located on relatively permeable soils (HSG "A" and "B"). A soil evaluation by a Registered Professional Engineer or soil scientist is required to confirm the soil type. The soil evaluation shall also confirm that the depth to groundwater is 2 feet or more and that the long-term saturated hydraulic conductivity of

the soil is at least 0.17 inches/hour. The soil evaluation must identify the soil texture, Hydrologic Soil Group and depth to groundwater. For saturated hydraulic conductivity, use Rawls Rates for the actual location where the qualifying pervious area is located.

- If a qualifying pervious area is located in less permeable soils (HSG "C"), the water table depth and permeability shall be evaluated by a Registered Professional Engineer to determine if a spreading device is needed to sheet flow stormwater over vegetated surfaces.
- To prevent compaction of the soil in the qualifying pervious area, construction vehicles must not be allowed to drive over the area. If it becomes compacted, the soil must be amended, tilled and revegetated to restore its infiltrative capacity once construction is complete.
- The qualifying pervious area may not include any wetland areas.
- The qualifying pervious area must be owned or controlled (e.g., drainage easement) by the property owner.
- For those rooftops draining directly to a buffer, only the rooftop disconnection credit or the buffer credit may be taken, not both.

4. Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area Credit

Credit is given for practices that direct runoff from impervious roads, driveways, and parking lots to pervious areas where plants provide filtration (through sheet flow) and infiltration into the soil can occur. This credit can be obtained by grading the site to promote overland vegetative filtering and infiltration. This credit is available for paved driveways, roads, and parking lots associated with all land uses, except for high-intensity parking lots that generate 1,000 or more vehicle trips per day or runoff not segregated from land uses with higher potential pollutant loads.

Disconnected impervious areas can be subtracted from the site impervious area when computing the WQV. In addition, disconnected impervious surfaces can be used to reduce the GRV.

Minimum Criteria for Credit:

- The maximum contributing impervious flow path length shall be 75 feet.
- The length of the qualifying pervious area must be equal to or greater than the length of the contributing impervious area.
- Dry wells, rain gardens, or other filtration/infiltration treatment practices may be utilized to compensate if the site cannot meet the required length of the qualifying pervious area.
- The width of the qualifying pervious area shall be no less than the width of the contributing impervious surface. For example, if a driveway is 15 feet wide, the qualifying pervious area width shall be no less than 15 feet.
- The entire qualifying pervious area shall be on a slope less than or equal to 5%.
- The impervious area draining to any one discharge location cannot exceed 1,000 square feet.
- Qualifying pervious areas should be located on relatively permeable soils (HSGs A and B). A soil evaluation is required to confirm the soil type. The soil evaluation shall also

confirm that the depth to groundwater is 2 feet or more, and that the long term saturated hydraulic conductivity of the soil is at least 0.17 inches/hour. For saturated hydraulic conductivity, use Rawls Rates for the actual location where the qualifying pervious area is located.

- If a qualifying pervious area is located in less permeable soils (HSG C), the water table depth and permeability shall be evaluated by a Registered Professional Engineer to determine if a spreading device is needed to sheet flow stormwater over vegetated surfaces.
- To prevent compaction, construction vehicles must not be allowed to drive over the qualifying pervious area. If compacted, the soil must be amended, tilled, and revegetated once construction is complete to restore its infiltrative capacity.
- Runoff from driveways, roadways and parking lots may be directed over soft shoulders, through curb cuts, or level spreaders to qualifying pervious areas. Measures must be employed at the discharge point to the qualifying pervious area to prevent erosion and promote sheet flow.
- The qualifying pervious area may not include any wetland areas.
- The qualifying pervious area must be owned or controlled (e.g., drainage easement) by the property owner.
- For those rooftops draining directly to a buffer, only the rooftop disconnection credit or the buffer credit may be taken, not both.

5. Sheet Flow to Buffer Credit

This credit is given when stormwater is effectively treated by a natural buffer to a stream or forested area. Effective treatment is achieved when pervious and impervious area runoff is discharged to a grass or forested buffer via overland flow. The use of a filter strip is recommended to treat overland flow in the green space of a development site. This credit includes subtracting the area draining by sheet flow to a buffer from the total area in the WQV calculation and the area draining to the buffer contributes to the GRV requirement.

Minimum Criteria for Credit:

- The minimum stream buffer width (i.e., perpendicular to the stream flow path) shall be 50 feet as measured from the bank elevation of a stream or the boundary of a wetland.
- The maximum contributing path shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces.
- The average contributing overland slope to and across the stream buffer shall be less than or equal to 5%.
- Runoff shall enter the stream buffer as sheet flow. A level spreading device shall be utilized where local site conditions prevent sheet flow from being maintained.
- The credit is not applicable if rooftop or non-rooftop disconnection is already provided (i.e., no double counting).
- Stream buffers shall remain unmanaged other than routine debris removal.
- Buffers shall be protected by an acceptable conservation easement or other enforceable instrument that provides perpetual protection of the area.

ATTACHMENT D

Example Stormwater Management Standards

STORMWATER MANAGEMENT STANDARDS

DRAFT

The following stormwater standards establish minimum stormwater management criteria for all development and redevelopment activities in the Town of _______ and reflect the unique natural resources and development characteristics of the Town of ________. These standards encourage groundwater recharge and reduce the potential for stormwater discharges to cause or contribute to pollution of surface water and groundwater. The standards also promote low impact development (LID) techniques, the removal of illicit discharges to stormwater management systems, and improved operation and maintenance of stormwater BMPs. The standards are also consistent with the recommended stormwater management approaches and design guidance contained in the Connecticut Department of Environmental Protection *Connecticut Stormwater Quality Manual.*

Standard 1: Stormwater Management Practices

Stormwater Management Practices shall be used to meet the conditions below for control of peak flow and total volume of runoff, water quality protection, and maintenance of on-site groundwater recharge.

A. Stormwater management practices shall be selected to accommodate the unique hydrologic and geologic conditions of the site.

B. Proponents shall demonstrate how the proposed control(s) will comply with these standards, including the control of peak flow and total volume of runoff, protection of water quality, and recharge of stormwater to groundwater. The proponent must provide design calculations and other back-up materials necessary.

C. At the discretion of the Stormwater Authority, stormwater management systems shall incorporate designs that allow for shutdown and containment in the event of an emergency spill or other unexpected contamination event.

D. Pumping of stormwater is prohibited as part of a proposed stormwater management system design because of the significant runoff volumes, maintenance requirements, standby power requirements, and overflows associated with large storms. All other feasible approaches must be investigated to avoid the use of pumps for stormwater management. If the event the Stormwater Authority determines that pumps are necessary, the proponent must submit required backup information as described in the ________ Stormwater Drainage Manual.

Standard 2: Low Impact Development

A. Project proponents must consider the use of environmentally-sensitive site design and Low Impact Development (LID) techniques to reduce runoff rates, volumes, and pollutant loads. The proponent shall demonstrate why the use of environmentally-sensitive site design and LID techniques is not possible before proposing to use traditional, structural stormwater management measures. Such environmentally-sensitive site design and LID techniques include, but are not limited to:

a. Identify, map, and preserve the site's natural features and environmentally sensitive areas such as wetlands, native vegetation, mature trees, slopes, drainageways, permeable soils, flood plains, woodlands and soils to the greatest extent possible;
b. Minimize grading and clearing;
c. Delineate potential building envelopes, avoiding environmental resource areas and appropriate buffers by clustering buildings and reducing building footprints;
d. Develop methods to minimize impervious surfaces, and protect and preserve open space. Reduce impervious surfaces wherever possible through alternative street design, such as omission of curbs and use of narrower streets, shared driveways and through the use of shared parking areas;
e. Lengthen flow paths and maximize sheet flow;
f. Use nonstructural, low-tech methods including open drainage systems, disconnection of roof runoff, and street sweeping where possible;
g. Use native plant vegetation in buffer strips and in rain gardens (small planted depressions that can trap and filter runoff);
h. Use drought-resistant vegetation;
i. Manage runoff using smaller, decentralized, low-tech stormwater management techniques to treat and recharge stormwater close to the source in place of a centralized system comprised of closed pipes that direct all the drainage from the entire site into one large detention basin.
j. Integrate management techniques into the site design to create a hydrologically functional lot or development site, including but not limited to grass swales along roads, rain gardens, buffer strips, green roofs, tree box filters, use of amended soils that will store, filter and infiltrate runoff, bioretention areas (rain gardens), rain barrels and cisterns, and permeable pavement.

[NOTE: An "LID Site Design Credit" is available to encourage proponents to incorporate LID techniques in their projects. In exchange for directing runoff from roads and driveways to vegetated open areas, preserving natural areas on development sites, or directing runoff to landscaped or undisturbed areas, the LID credit system allows developers to reduce in size or eliminate the traditional BMPs used to treat and infiltrate stormwater. By using this credit, proponents can reduce the volume of stormwater subject to the Water Quality and Groundwater Recharge Standards. The proposed LID Site Design Credits include:

- Credit 1 – Natural Area Conservation
- Credit 2 – Environmentally Sensitive Development
- Credit 3 – Rooftop Runoff Directed to Qualifying Pervious Area
- Credit 4 – Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area]

Standard 3: Protection of Natural Hydrology

[NOTE: These standards are further reinforced through the LID Credit System.]

A. Site disturbance shall be minimized. The area outside the project disturbance area shall be maintained at natural grade and retaining existing, mature vegetated cover. The project disturbance area shall be depicted on the design, construction, and mitigation plans and shall be delineated in the field prior to commencing land disturbance activities. The project disturbance area shall include only the area necessary to reasonably accommodate construction activities.

B. Soil compaction on site shall be minimized by using the smallest (lightest) equipment possible and minimizing travel over areas that will be revegetated (e.g., lawn areas) or used to infiltrate stormwater (e.g., bioretention areas). In no case shall excavation equipment be placed in the bottom of an infiltration area during construction.

C. Development shall follow the natural contours of the landscape. A grading plan shall be submitted as part of the site plan review process showing both existing and finished grades for the proposed development. The original, natural grade of a lot shall not be raised or lowered more than 10 feet at any point for the construction of any structure or improvements. Retaining walls must comply with the requirements of the Building Zone Regulations. Basements that reach grade should be constructed as walk-outs.

D. No ground disturbed as a result of site construction and development shall be left as exposed bare soil at project completion. All areas exposed by construction, with the exception of finished building, structure, and pavement footprints, shall be decompacted (aerated) and covered with a minimum thickness of six inches of non-compacted topsoil, and shall be subsequently planted with a combination of living vegetation such as grass, groundcovers, trees, and shrubs, and other landscaping materials (mulch, loose rock, gravel, stone).

E. Priority shall be given to maintaining existing surface waters and systems, including, but not limited to, perennial and intermittent streams, wetlands, vernal pools, and natural swales.

F. Where roadway or driveway crossings of surface waters cannot be eliminated, disturbance to the surface water shall be minimized, hydrologic flows shall be maintained, there shall be no direct discharge of runoff from the roadway to the surface water, and the area shall be revegetated post-construction.

G. Roadway and driveway crossings over streams shall comply with the Connecticut Department of Environmental Protection *Stream Crossing Guidelines* (as amended) to accommodate high flows, minimize erosion, and support aquatic habitat and wildlife passage.

Standard 4: Post-Development Peak Discharge

A. Stream Channel Protection – The two-year, 24-hour post-development peak flow rate shall be (a) less than or equal to 50 percent of two-year, 24-hour storm pre-development peak flow rate and (b) less than or equal to the one-year, 24-hour storm pre-development peak flow rate. This Standard may be waived under certain conditions, as described in the *Connecticut Stormwater Quality Manual*.

B. Conveyance Protection – The 10-year, 24-hour post-development peak flow rate shall not exceed the pre-development peak flow rate for all flows within internal and external conveyance systems associated with stormwater treatment practices.

C. Peak Runoff Attenuation – The 10-year and 25-year, 24-hour post-development peak flow rate shall not exceed the pre-development peak flow rate for all flows off-site. This Standard may be waived for sites that discharge to a large river, lake, estuary, tidal waters, or land subject to coastal storm flows, as described in the *Connecticut Stormwater Quality Manual*.

D. Emergency Outlet Sizing - size the emergency outlet to safely pass the post-development peak runoff from the 100-year storm in a controlled manner without eroding the outlet works and downstream drainages and property.

E. Measurement of peak discharge rates shall be calculated using point of discharge or the downgradient property boundary. The topography of the site may require evaluation at more than one location if flow leaves the property in more than one direction. Calculations shall include runoff from adjacent upgradient properties. A proponent may demonstrate that a feature beyond the property boundary is more appropriate as a design point.

F. A downstream hydrologic analysis must be performed to determine whether peak flows, velocities, and hydraulic effects are attenuated by controlling the 2-year, 10-year, 25-year and 100-year, 24-hour storms. This analysis must be performed at the outlet(s) of the site and at critical downstream locations (stream confluences, culverts, other channel constrictions, and flood-prone areas) to a confluence point where the site drainage area represents 10% of the total drainage area above that point.

G. The proponent shall provide pre- and post-development total runoff volumes. The post-development total runoff volume shall be equal to 90 to 110 percent of the pre-development total runoff volume (based on a 2-year, 10-year, 25-year, and 50-year, 24-hour storms). Calculations shall include runoff onto the project site from adjacent up-gradient properties.

Standard 5: Water Quality

A. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspend Solids (TSS). This standard is met when:
   a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
   b. Stormwater management practices are sized to treat the Water Quality Volume or Water Quality Flow;
   c. Appropriate pretreatment is provided in accordance with the _______ Stormwater Drainage Manual; and
   d. Stormwater treatment practices are maintained as designed.

B. Compliance with the groundwater recharge requirements under Standard 6 shall be considered adequate to meet the treatment standards specified in 5.A above for the Groundwater Recharge Volume.

Standard 6: Groundwater Recharge

Loss of annual recharge to groundwater shall be eliminated or minimized to the maximum extent practicable through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater management practices, and good operation and maintenance. At a minimum the annual recharge from the post-development site shall approximate the annual recharge from the pre-development or existing site conditions. Infiltration of stormwater runoff from land uses with higher potential pollutant loads near or to a critical area is prohibited. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to a critical area, taking into account site-specific factors.

A. For all areas covered by impervious surfaces, the total volume of recharge that must be maintained shall be calculated as follows:

[NOTE: The NRCS classifies soils into four hydrologic groups A thru D indicative of the minimum infiltration obtained for a soil after prolonged wetting. Group A soils have the lowest runoff potential and the highest infiltration rates, while Group D soils have the highest runoff potential and the lowest infiltration rates. The prescribed stormwater volume that is required to be infiltrated must be determined using existing site conditions and the infiltration rates set forth below.

Hydrologic Group Volume to Recharge (x Total Impervious Area)

Hydrologic Group		Volume to Recharge x Total Impervious Area
A	gravels, sand, loamy sand or sandy loam	0.6 inches of runoff
B	silty loam	0.35 inches of runoff
C	sandy clay loam	0.25 inches of runoff
D	clay, silty clay loam, sandy clay, silty clay	0.10 inches of runoff

For each NRCS Hydrologic Group on the site, the volume that must be recharged equals the recharge volume above multiplied by the total area within that NRCS Hydrologic Group that is impervious. Infiltration of these volumes must be accomplished using appropriate BMPs. These BMPs include bioretention areas, rain gardens, dry wells, infiltration basins, infiltration chambers and galleys, infiltration trenches, leaching catch basins, and vegetated filter strips. Roof runoff may be infiltrated without any treatment, and that infiltrated volume may be used to satisfy the total recharge volume and reduce the water quality volume.

To size infiltration BMPs, proponents may use either the static method or the dynamic infiltration method. The static method assumes that the entire volume is discharged to storage instantaneously, is easy to calculate and generally results in a larger recharge volume than the dynamic method. The dynamic method assumes that that the recharge BMP is infiltrating as it fills and requires certain technical calculations that take this recharge into account when sizing the infiltration BMP.]

B. When designing infiltration BMPs, adequate subsurface information needs to be obtained. Infiltration systems must be installed in soils capable of absorbing the recharge volume (i.e. not D soils). Surface infiltration structures must be able to drain fully within 72 hours. In addition, there must be at least a three-foot separation from the bottom of the infiltration structure and the seasonal high ground water table or bedrock/ledge. Soils under BMPs shall be scarified or tilled to improve infiltration.

C. Pre-Treatment Requirements – All runoff must be pretreated prior to its entrance into the groundwater recharge device to remove materials that would clog the soils receiving the recharge water. Pretreatment devices shall be provided for each BMP, shall be designed to accommodate a minimum of one-year's worth of sediment, shall be designed to capture anticipated pollutants, and be designed and located to be easily accessible to facilitate inspection and maintenance.

D. Infiltration of stormwater may be prohibited or subject to additional pre-treatment requirements, at the discretion of the Stormwater Authority, for 1) land uses with higher potential pollutant loads (see Standard 7), 2) areas with soil or groundwater contamination such as brownfield sites, and 3) public drinking water aquifer recharge areas, wellhead protection areas, or water supply intake protection areas.

Standard 7: Land Uses with Higher Potential Pollutant Loads

Stormwater discharges from land uses with higher potential pollutant loads require the use of specific source control and pollution prevention measures and specific stormwater management practices, approved by the Stormwater Authority for such use.

A. The following uses or activities are considered "high-load areas," with the potential to contribute higher pollutant loads to stormwater, and must comply with the requirements set forth in this section.
   a. Areas within an industrial site that are the location of activities subject to the DEP Industrial Stormwater General Permit (except where a No Exposure Certification for Exclusion from the General Permit has been executed)
   b. Vehicle salvage yards and recycling facilities
   c. Auto fueling facilities (gas stations and other facilities with on-site vehicle fueling)

d. Exterior fleet storage areas (cars, buses, trucks, public works equipment)
e. Exterior vehicle service, maintenance and equipment cleaning areas
f. Commercial parking lots with high intensity use (1,000 vehicle trips per day or more). Such areas typically include fast food restaurants, convenience stores, high turnover (chain) restaurants, shopping centers and supermarkets.
g. Road salt storage facilities (if exposed to rainfall)
h. Commercial nurseries
i. Non-residential facilities having uncoated metal roofs with a slope flatter than 20 percent.
j. Outdoor storage and loading/unloading of hazardous substances or materials
k. Facilities subject to chemical inventory reporting under Section 312 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), if materials or containers are exposed to rainfall)
l. Marinas (service, painting and hull maintenance areas).
m. Confined disposal facilities, disposal sites, landfills or wastewater residuals landfills if stormwater that may come into contact with the confined disposal area, disposal site, landfill or wastewater residuals landfill may cause or contribute to the discharge of pollutants to wetlands, surface waters or ground water or otherwise result in a release or threat of release
n. Other land uses and activities as designated by the Stormwater Authority

B. In addition to implementation of BMPs for designing site-specific stormwater management controls, high-load areas shall provide a stormwater pollution prevention plan (SWPPP) describing methods for source reduction and methods for pretreatment.

C. If a high-load area demonstrates, through a SWPPP, the use of BMPs that result in no exposure of regulated substances to precipitation or runoff or release of regulated substances, it shall no longer be considered a high-load area.

D. Infiltration of stormwater from high-load areas are prohibited within critical areas (see Standard 8). Infiltration of stormwater from high-load areas outside of critical areas (see Standard 8) is allowed. For such discharges, proponents should use one pretreatment BMP, one terminal treatment BMP, and one infiltration BMP.

E. For high-load areas, the following stormwater management practices may be used for treatment only if lined or sealed: Sand Filters/Organic Filters (may also be used for pretreatment), Wet Retention Basins, Detention Basins, Constructed Wetlands, Bioretention Areas, including rain gardens (underdrain required).

Standard 8: Critical Areas

A. Critical Areas are defined as:
a. Shellfish growing areas,
b. Bathing beaches,
c. Recharge areas for public water supplies (groundwater and surface water supplies),
d. Any listed water bodies and wetlands as designated by the Town of ________.

B. The stormwater BMPs approved for discharges to or near critical areas shall be designed to treat the Water Quality Volume (WQV) for the post-development site. These practices are included in the *Connecticut Stormwater Quality Manual* and the ______ Stormwater Drainage Manual. These stormwater discharges require the use of a treatment train that provides 80% TSS removal prior to discharge. This treatment train shall include at least one pretreatment BMP, one terminal treatment BMP, and one infiltration BMP.

C. Infiltration of stormwater from high-load areas are prohibited within critical areas.

Standard 9: Parking

A. Snow may not be plowed to, dumped in, or otherwise stored within 15 feet of a wetland or waterbody, except for snow that naturally falls into this area. Snow storage areas shall be shown on the site plan to comply with these requirements.

B. At the discretion of the Stormwater Authority, parking spaces may be required to be constructed of a pervious surface (i.e. grass, pervious asphalt, pervious pavers).

C. Infrequently used emergency access points or routes shall be constructed with pervious surfaces (i.e. grass, pervious asphalt, pervious pavers).

Standard 10: Redevelopment

A. Redevelopment projects are defined to include the following:
   a. Maintenance and improvement of existing roadways including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems and repaving;
   b. Development, rehabilitation, expansion and phased projects on previously developed sites; and
   c. Remedial projects specifically designed to provide improved stormwater management.

B. Redevelopment of previously developed sites must meet Standards 3, 4, 5, and 6 to the maximum extent practicable as determined by the Stormwater Authority. To make this determination the Stormwater Authority shall consider the benefits of redevelopment as compared to development of raw land with respect to stormwater. All projects involving redevelopment or reuse activities shall also improve existing conditions.

C. For all redevelopment projects, new stormwater controls (retrofitted or expanded) must be incorporated into the design and result in a reduction in annual stormwater pollutant loads from the site. Proponents of redevelopment projects shall make full use of all opportunities for controlling the sources of pollution and to incorporate environmentally sensitive site design and low impact development techniques. This is particularly important for constrained redevelopment sites where it is not possible to install BMPs that treat the entire water quality volume. All redevelopment projects shall also incorporate measures that will address water quantity issues by reducing the peak and total runoff from the site and by increasing groundwater recharge. Actions to improve existing conditions should address known water quality and water quantity problems such as documented failures to meet the Surface Water Quality Standards, low stream flow, or repeated flood events.

D. Redevelopment activities shall not infiltrate stormwater through materials or soils containing regulated or hazardous substances or areas with soil or groundwater contamination.

E. The portion of a property that is currently undeveloped is not a redevelopment and thus does not fall under Standard 10. Any development on previously undeveloped portions of a property must comply fully with all of the other Stormwater Management Standards.

Standard 11: Construction Erosion and Sediment Control

A. A plan to control construction related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) must be developed and implemented in accordance with the *Connecticut Guidelines for Soil Erosion and Sediment Control* (as amended).

B. All development, regardless of the area of disturbance, must implement erosion and sedimentation controls prior to and during construction.

Standard 12: Easements

A. Where a site is traversed by or requires construction of a watercourse or drainageway, an easement of adequate width may be required for such purpose.

B. There shall be at least a 10-foot wide permanent maintenance easement corridor on each side of any stormwater management system element, as well as at least a 10-foot wide temporary construction easement corridor contiguous with the boundaries of the permanent easement. For systems using underground pipes, the maintenance easement may need to be wider, depending on the depth of the pipe.

Standard 13: Operation and Maintenance

A. A long-term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed. This plan shall be reviewed and approved as part of the review of the proposed permanent (post-construction) stormwater management system and incorporated in the Stormwater Management Plan. Execution of the O&M Plan shall be considered a condition of approval of a stormwater management permit application. If the stormwater management system is not dedicated to the town pursuant to a perpetual offer of dedication, the Stormwater Authority may require a project proponent to establish a homeowners association or similar entity to maintain the stormwater management system. For high-load areas or activities under Standard 7, the O&M Plan shall include implementation of a SWPPP.

B. The O&M Plan shall at a minimum identify:
   a. Stormwater management system(s) owners;
   b. The party or parties responsible for operation and maintenance including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
   c. The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;
   d. Plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
   e. Description and delineation of public safety features; and
   f. Estimated operations and maintenance budget.

C. The stormwater management system owner is generally considered to be the landowner of the property, unless other legally binding agreements are established.

D. The proponent shall include with the stormwater management permit application a mechanism for implementing and enforcing the O&M Plan. The proponent shall identify the lots or units that will be serviced by the proposed stormwater BMPs. The proponent shall also provide a copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of stormwater BMPs. In the event that the stormwater BMPs will be operated and maintained by an entity, municipality, state agency or person other than the sole owner of the lot upon which the stormwater management facilities are placed, the proponent shall provide a plan and easement deed that provides a right of access for the legal entity to be able to perform said operation and maintenance functions, including inspections.

[NOTE: It is recommended that the stormwater management permit include a condition requiring that the responsible party provide a copy of the permit approval and the legal instrument to each unit or lot owner at or before the purchase of each unit or lot to be serviced by the stormwater BMPs.]

E. The owner shall keep the O&M Plan current, including making modifications to the O&M Plan as necessary to ensure that BMPs continue to operate as designed and approved. Proposed modifications of O&M Plans including, but not limited to, changes in inspection frequency, maintenance schedule, or maintenance activity along with appropriate documentation, shall be submitted to the Stormwater Authority for review and approval within thirty days of change.

F. Parties responsible for the operation and maintenance of a stormwater management system shall keep records of the installation, maintenance and repairs to the system, and shall retain records for at least five years.

G. Parties responsible for the operation and maintenance of a stormwater management system shall provide records of all maintenance and repairs during inspections and/or upon request.

H. When the responsible party fails to implement the O&M Plan, including, where applicable, the SWPPP, the municipality is authorized to assume responsibility for their implementation and to secure reimbursement for associated expenses from the responsible party, including, if necessary, placing a lien on the subject property.

Standard 14: Stormwater Management Plan

A. All stormwater management permit applications must include a Stormwater Management Plan. This plan shall document how the proposed project complies with the stormwater standards and must be submitted with the stamp and signature of a Professional Engineer (PE) licensed in the State of Connecticut.

Standard 15: Illicit Discharges

A. All illicit discharges to the stormwater management system are prohibited.

[NOTE: The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities:

- Landscape irrigation,
- Uncontaminated groundwater discharges such as pumped groundwater, foundation drains, water from crawl space pumps, and footing drains,
- Irrigation water,
- Lawn watering runoff,
- Residual street wash water,
- Discharges of uncontaminated air conditioner condensate,
- Discharges of flows from fire fighting activities,
- Discharges containing no chemical additives (including chlorine) from the flushing of fire protection systems, and
- Naturally occurring discharges such as rising groundwater, uncontaminated groundwater infiltration, springs, and flows from riparian habitats and wetlands.]

Appendix B

Vernon Regulatory Review Memorandum

MEMORANDUM

TO: Technical Advisory Committee, Tankerhoosen River Watershed Management Plan and Town of Vernon Land Use Commissioners

FROM: Erik Mas, P.E., Fuss & O Neill, Inc.

DATE: June 9, 2008

RE: Stormwater and Low Impact Development (LID) Regulations in the Tankerhoosen River Watershed –Vernon Regulatory Review

---

1.0 INTRODUCTION

Fuss & O Neill is working with the Friends of the Hockanum River Linear Park, Inc., in collaboration with its project partners (Town of Vernon Planning Department, Town of Vernon Conservation Commission, North Central Conservation District, Hockanum River Watershed Association, Rivers Alliance of Connecticut, Inc, and the Belding Wildlife Trust) to prepare a Watershed Management Plan for the Tankerhoosen River watershed. The watershed plan will identify action items that can be implemented by the watershed municipalities and private groups to protect and improve the health of the Tankerhoosen River watershed, which is a particularly valuable natural resource, demonstrated by the Class A water quality in the upper regions of the watershed that harbor the Belding Wild Trout Management Area, one of only two such Class I areas east of the Connecticut River.

A key element of the Watershed Management Plan is to identify potential land use regulatory mechanisms (i.e., new or modified land use regulations) that can be implemented by the watershed towns to better manage stormwater runoff associated with land development within the watershed. Many Connecticut communities are in the process of developing new or modified land use regulations that incorporate Low Impact Development (LID) and related stormwater management approaches to address stormwater quantity and quality objectives. Communities, including Vernon, are faced with a mandate to meet State and Federal Phase II stormwater permit requirements under the National Pollutant Discharge Elimination System (NPDES) program, as well as addressing local concerns about the damaging effects of increased impervious cover and uncontrolled stormwater runoff from land development and suburban sprawl. An opportunity exists for the Town of Vernon to develop and implement an ordinance or other regulatory mechanism to satisfy Phase II stormwater regulatory requirements, while also strengthening the existing land use controls to protect natural resources within the Tankerhoosen River watershed.

This memorandum summarizes our review of Vernon s existing land use regulations and related planning documents that pertain to stormwater management and natural resource protection issues, as well as potential approaches for developing regulatory mechanisms to incorporate improved stormwater management, including LID concepts and opportunities to reduce impervious cover, into the Town s land use regulations. The information presented in this technical memorandum is intended to facilitate a discussion of these issues during the upcoming workshop meeting with the Tankerhoosen River Management Plan Technical Advisory Committee and the Town of Vernon land use commissioners.

2.0 EXISTING REGULATORY MECHANISMS

Fuss & O Neill reviewed the following documents and information provided by the Town, which are the primary regulatory mechanisms and related planning documents that address stormwater management and related natural resource protection issues in the Town of Vernon:

- Subdivision Regulations,
- Zoning Regulations,
- Inland Wetland and Watercourses Regulations,
- Plan of Conservation and Development.

2.1 Subdivision Regulations

The Town's subdivision regulations (effective date: May 8, 2007) regulate the division of a tract or parcel of land with the purpose of sale or building development. The subdivision regulations address street and lot layout, water supplies, sanitary sewage facilities, stormwater drainage, utilities, open space, street widths, grades and construction, and other necessary improvements. The following is a summary of specific sections of the subdivision regulations that relate to stormwater management and natural resource protection issues.

- Section 5 - Standards for Maps and Plans: This section specifies requirements for maps and plans submitted with subdivision applications, including Site Development Plans, Construction Plans, and Grading Plans. Existing and proposed watercourses and stormwater management systems are required to be shown on the Site Development Plan. Grading Plans are required to include notations and details on erosion and sedimentation control methods.

- Section 6.1.3 - General Improvements, Open Space to be Dedicated: The Planning and Zoning Commission may require the set aside of Open Space as part of a subdivision where the Commission finds the existing land applicable to one or more of the following:

    - The policies and objectives of the Plan of Conservation and Development
    - Areas sensitive to development
    - Prime and important farmland soils
    - Natural Diversity Database Areas as updated by the Connecticut Department of Environmental Protection
    - Unconsolidated Aquifers and Aquifer Protection Areas
    - Areas indicated for future community facility needs
    - Existing open areas and significant cultural and natural resources
    - Potential open space system

- Land Use Plan and Strategy
- Significant natural and cultural resources inventory
- Viable vernal pools verified by the Town of Vernon Vernal Pool Study or by a qualified licensed professional

- Section 6.1.3.2 - General Improvements, Location of Open Space: The protection and preservation of the Hockanum River, Ogden Brook, Tankerhoosen River, Gage's Brook, Railroad Brook, Walker's Reservoir East, Walker's Reservoir West, Valley's Fall's Pond, or a Vernal Pool indentified by the Town, is considered a priority when the parcel being subdivided contains portions of the aforementioned watercourses.

  When the parcel being subdivided contains portions of land that would allow for the connection of the Shenipsit Trail, Hockanum River Trail, Risley Pond Trail, Land Trust Trail, Belding Path, Hockanum River Linear Park, Box Mountain Greenway, Talcottville & Tankerhoosen Trail/open space system, Ellington Trail System, Tolland Trail System, Bolton Greenways, Manchester Greenways, other potential greenway, linear park, or trail identified in the POCD or by the Department of Parks and Recreation, the provision and connection of these amenities shall be a priority in the design and or location of Open Space.

- Section 6.1.3.3 - General Improvements, Size of Open Space: When Open Space is required, the minimum recommended amount of Open Space to be provided is 12% of the total area of land to be subdivided, 15% of the total area of land if the location of the subdivision is identified in the Land Use Plan and Strategy of the POCD, and 20% of the total land area if the location of the subdivision is identified as a Priority Area for Open Space Protection of the POCD.

- Section 6.1.3.4.3 - General Improvements, Open Space Standards: Any land to be dedicated as Open Space shall be left in its natural state by the subdivider and shall not be graded, cleared, disturbed, or used as a temporary or permanent repository for stumps, brush, earth, building materials, debris, detention ponds, or basins.

- Section 6.4 - Lot Grading and Drainage: Grading plans shall be submitted where substantial grading is required in order to provide a buildable site and shall employ standards and methods equal to or exceeding those set forth in the Erosion and Sediment Control Handbook (USDA, SCS, Storrs, Conn., 1976). Lot drainage should be coordinated with the general storm drainage patterns for the area, and drainage should be designed to avoid concentrated stormwater to adjacent lots.

  Comment: Contains an outdated reference to a previous version of the State Erosion and Sedimentation Control Handbook. Revise the language to reference the current CT Erosion and Sedimentation Control Guidelines, as amended

- Section 6.5.1.1 - Street Grading and Improvement: Roads shall be related appropriately to the topography, and streets shall be arranged so as to obtain as many as possible of the building sites at, or above, the grades of the streets.

  Comments: consistent with fitting the development to the topography. Building sites above the grade of the streets provides opportunity for use of roadside swales. Consider adding a provision to allow elimination of curbing for roads for grades less than 5% to encourage the use of vegetated swales and similar LID stormwater management systems.

- Section 6.6.6 - Cul-de-sac or Dead-End: Cul-de-sac pavement shall be a uniform 45 foot radius except when an island is used, in which case the outside radius shall be 50 feet with an island radius of 20 feet.

  Comment: The radius of cul-de sacs should be the minimum required to accommodate emergency and maintenance vehicles. Consider smaller cul-de-sac radius of (30 to 40 feet), or alternative designs such as hammerheads, to reduce impervious cover, such that the design allows for continuous turning movement of the largest fire fighting vehicle used by the Town of Vernon. Also consider encouraging the use of LID bioretention/rain gardens in cul-de-sac islands for stormwater management.

- Section 6.7.1 - Design Standards, Road Width: Table 1 contains minimum pavement width for collector (32 ft), local (28 ft), and limited local roads (28 ft).

  Comment: Design residential streets for the minimum required pavement width needed to support travel lanes; on-street parking; and emergency, maintenance, and service vehicle access. Consider pavement widths of between 24 and 28 feet, if such a reduction will not negatively impact public safety or emergency response. Refer to Table 4-3 in the Connecticut Stormwater Quality Manual for potential variation in residential roadway widths based on terrain and development density.

- Section 6.7.2 - Design Standards, Curbs: Curbs shall be required on all new streets and shall conform to construction and design standards in the Appendix of the regulations.

  Comment: The requirement for curbs on all new roads appears to preclude the use of curbless roads and open vegetated channels for stormwater management.

- Section 6.9.1 - Drainage and Storm Sewers, General Requirements: The developer shall be fully responsible for constructing adequate facilities for the control, collection, conveyance and acceptable disposal of storm water, other surface water and subsurface water, whether originating within the sub- division area or in a tributary drainage area.

- Section 6.9.2.2 - Drainage and Storm Sewers, Location of Stormwater Facilities: The applicant may be required to dedicate either in fee or by drainage or conservation easement, land on both sides of existing watercourses to a distance to be determined by the Commission.

- Section 6.9.3 - Drainage and Storm Sewers, Drainage Discharge: The discharge of all storm water from a subdivision shall be into suitable streams or other acceptable and suitable storm water drainage facilities having adequate capacity to carry the additional water. Sufficient and adequate facilities shall be constructed on private lots wherever necessary to prevent the flow of surface drainage from the property on which it originates onto adjacent property in sufficient quantity, concentration or velocity to cause damage or create a nuisance on adjoining property.

  Comment: The Subdivision Regulations do not include post-development peak flow, volume control, or stormwater quality requirements.

- Section 6.9.3 - Drainage and Storm Sewers, Drainage Design: Designs shall be based on the maximum ultimate development of the entire watershed as permitted by the Zoning Regulations. On watersheds one square mile or over, the design of culverts, bridges and through watercourses shall be based upon not less than a 100-year storm. On watersheds of less than one square mile, the design for the through drainage system shall be for no: less than a 50-year storm. The drainage system for roads, including catch basins, inlets, pipes, underdrains and gutters within or abutting the subdivision shall be designed for not less than a 10-year storm.

  Drainage ditches will, in general, not be permitted where it is feasible to install underground pipe.

  Comment: This requirements restricts the use curbless roads and roadside vegetated swales in lieu of traditional curb, gutter, and piped drainage.

- Section 6.12.1 - Sidewalks: Sidewalks shall be required in all subdivisions on at least one side of all new streets, unless waived by a three-quarters vote of all members of the Commission, and may be required on both sides at the discretion of the Commission.

  Comment: Sidewalks required on two side of the street increase impervious cover. Where practical, consider locating sidewalks on only one side of the street and reduce sidewalk width to 3 or 4 feet. Grade sidewalks to the front yard rather than to the street. Consider using alternative materials such as pavers, stone dust, or pervious concrete.

- Section 6.14 - Certified Erosion and Sediment Control Plan: A soil erosion and sediment control plan shall be submitted with any application for development when the disturbed area of such development is cumulatively more than one-half acre. A single family dwelling that is not a part of a subdivision of land shall be exempt from these soil erosion and sediment control regulations.

  Comment: Construction of single family dwellings that disturb an acre or more of land are subject to state and federal NPDES Phase II Stormwater Program requirements. Consider amending the single family exemption to indicate that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land.

- Section 6.14.3 - Erosion and Sediment Control Plan: a soil erosion and sediment control plan shall contain proper provisions to adequately control accelerated erosion and sedimentation and reduce the danger from storm water runoff on the proposed site based on the best available technology. Such principles, methods and practices necessary for certification are found in the Connecticut Guidelines for Soil Erosion and Sediment Control (1985) as amended.

  Plans for soil erosion and sediment control shall be developed in accordance with these regulations using the principles as out-lined in Chapters 3 and 4 of the Connecticut Guidelines for Soil Erosion and Sediment Control (1985), as amended. Soil erosion and sediment control plans shall result in a development that minimizes erosion and sedimentation during construction; is stabilized and protected from erosion when completed; and does not cause off-site erosion and/or sedimentation.

- Section 6.14.6 - Conditions Relating to Soil Erosion and Sediment Control: A performance bond may be required for the estimated costs of measures required to control soil erosion and sedimentation, as specified in the certified plan.

- Section 13 - Rear Lots: This section includes provisions for greater residential development flexibility, particularly where a site has an unusual lot line or natural resource configuration or where rear lot development would promote or enhance the protection of valuable natural resource features.

  Comment: This concept is consistent with LID principles to protect and preserve natural features of a site.

2.2 Zoning Regulations

Site development in the Town of Vernon must comply with the Vernon Zoning Regulations (effective date: May 8, 2007). The following is a summary of specific zoning regulations that relate to stormwater management and natural resource protection issues.

- Section 3.4 - General Provisions, Collection and Disposal of Storm Drainage: Proper provision shall be made for collection and disposal of storm water from roofs and parking areas through a pipe system connected to existing storm drains or carried to a natural watercourse or to an on-site area approved by the Town Engineer in compliance with the recommendations of the latest edition of the "Stormwater Quality Manual" of the Connecticut Department of Environmental Protection (DEP).

- Section 3.18 - General Provisions, Building Above or Below Center Line of Road: Any lot or parcel of land with the top of foundation more than five (5) feet above or below the center line grade of the road opposite the midpoint of the front foundation wall requires a detailed site plan showing the existing and proposed topography, driveways, storm drainage, and other information.

- Section 3.25 - General Provisions, Sidewalks: Sidewalks shall be installed for all new developments in all areas, unless waived by a three-quarters vote of all members of the Commission.

- Sections 4.1 through 4.25 - Use Districts, Setbacks and Lot Dimensions: These sections specify minimum setbacks and lot dimensions for various use districts in the Town of Vernon.

  Comment: Minimum setbacks and frontage distances can increase impervious cover. Front yard setbacks, which dictate how far houses must be from the street, can extend driveway length. Large side setbacks and frontage distances influence the road length needed to serve individual lots. Review current setbacks and lot dimensions for potential to relax side yard setbacks and allow narrower frontages to reduce road length and site imperviousness, and to relax front setback requirements to reduce driveway length and lot imperviousness.

- Section 7 - Cluster Development: Developers may vary the lot size requirements in Residential 40 and Residential 27 zoning districts, leaving a substantial area free of building lots (i.e., "cluster" development). The land area not allocated to building lots and streets shall be permanently reserved in open space and be readily usable for recreation or conservation.

- Section 12 - Off-street Parking and Loading: Section 12.1 specifies parking ratios, which are the number of parking spaces that must be provided for particular uses. The Planning & Zoning Commission may reduce the number of off-street parking spaces which must be installed provided that the required number of spaces is reduced by no more than 20%, the number of spaces will not result in an increase of on-street parking, and the developer pays a fee of $500 for each space eliminated (fee-in-lieu of parking). Section 12.3 specifies the minimum stall dimensions for off-street parking and truck loading spaces, which already appear to be at or near recommended minimum values.

  Comment: Parking ratios typically represent the minimum number of spaces needed to accommodate the highest hourly parking rate at the site. In many cases, parking ratios far exceed parking demand, which refers to the number of spaces actually used for a particular land use. Parking ratios often result in far more spaces than are actually required because ratios are typically set as minimums and not maximums. This results in excessive impervious cover for many land uses. Existing parking ratios should be reviewed to see if lower ratios are warranted and feasible. The required parking ratio for a particular land use should be enforced as both a maximum and minimum to limit excess parking space construction and impervious cover. Consider allowing the Commission to approve parking lots with more spaces than the allowed maximum provided all of the spaces above the maximum number are composed of a pervious surface, and where adequate stormwater management is provided. Also consider parking spaces held in reserve for phased developments, thereby avoiding the situation where unnecessary parking is not constructed if future phases of development do not occur.

Shared parking is another strategy that reduces the number of parking spaces needed by allowing adjacent land uses to share parking lots, particularly when parking demands occur at different times during the day or week. Section 12.3 appears to allow for shared parking for non-residential uses, although it is unclear if the Town actively promotes shared parking. Where shared parking is used, the Zoning Regulations should require a corresponding reduction in parking spaces.

Also consider adding language to Section 12 that references specific stormwater management and landscape design standards in the Connecticut Stormwater Quality Manual, local stormwater management design manual, other sections of the Zoning regulations, or new/modified local stormwater management and LID regulations.

Model zoning regulations for parking were developed in 2003 for communities in northwestern Connecticut through a study sponsored by the Northwestern Connecticut Council of Governments (NWCCOG), the Litchfield Hills Council of Elected Officials (LHCEO), and the Connecticut DEP. This document provides a good starting point for reviewing and modifying local zoning regulations for parking to address impervious cover and stormwater management issues.

- <u>Section 18 – Activities Requiring a Certified Erosion and Sediment Control Plan</u>: A soil erosion and sediment control plan shall be submitted with any application for development when the disturbed area of such development is cumulatively more than one-half acre, except for a single family dwelling that is not a part of subdivision of land, which is exempt from these soil erosion and sediment control regulations.

  Comment: The section of the Zoning Regulations is consistent with the Erosion and Sediment Control Plan requirements (Section 6.14) of the Subdivision Regulations. Construction of single family dwellings that disturb an acre or more of land are subject to state and federal NPDES Phase II Stormwater Program requirements. Consider amending the single family exemption to indicate that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land.

- <u>Section 19 – Rear Lots</u>: This section includes provisions for greater residential development flexibility, particularly where a site has an unusual lot line or natural resource configuration or where rear lot development would promote or enhance the protection of valuable natural resource features.

  Comment: This section of the Zoning Regulations is consistent with Section 13 of the Subdivision Regulations.

2.3 <u>Inland Wetlands & Watercourses Regulations</u>

The Town of Vernon Inland Wetlands and Watercourses Regulations (effective date: October 2, 2006) regulate the removal or deposition of materials and the construction, obstruction, alteration, or pollution of wetlands and watercourses in the Town. The regulations make provisions for the protection, preservation, maintenance and use of inland wetlands and watercourses by minimizing their disturbance and pollution, maintaining and improving water quality in accordance with federal, state, and local authority, and preventing damage from erosion, turbidity, or siltation as well as preventing the loss of beneficial aquatic organisms.

- Section 2 – Definitions, Regulated Activity: Regulated activities include any operation within or use of a wetland or watercourse involving removal or deposition of material, or any obstruction, construction, alteration or pollution, of such wetlands or watercourses. Any clearing, grubbing, filling, grading, paving, excavating, constructing, depositing, or removing of material and discharging of stormwater on the land within the following *upland review areas* is a regulated activity:

Resource	Upland Review Area
Wetland and Watercourse	100 ft.
Hockanum River, Ogden Brook, Tankerhoosen River, Gage's Brook, Railroad Brook, Walker Reservoir West, Walker Reservoir East, and Valley Falls Pond	200 ft.
Other	Agency Discretion*

*The Commission may rule that any activity that alters the existing rate or quality of any stormwater discharge conveyed to a Regulated Area or is likely to impact or affect wetlands or watercourses is a Regulated Activity. The Commission may rule that any other activity whether located within or outside the Regulated Area that is likely to have an affect on the wetlands or watercourses is a Regulated Activity.

  Additionally, the Commission may rule that any activity that alters the existing rate or quality of any stormwater discharge conveyed to a Regulated Area or is likely to impact or affect wetlands or watercourses is a Regulated Activity.

- Section 2 – Definitions, Significant Activity: A "significant activity" includes any activity involving a deposition or removal of material which will or may have a substantial adverse effect on the Regulated Area or on another part of the inland wetland or watercourse system or an activity which substantially changes the natural channel or may inhibit the natural dynamics of a watercourse system or substantially diminishes the natural capacity of an inland wetland or watercourse to support desirable biological life, prevent flooding, supply water, assimilate waste, facilitate drainage, and/or provide recreation and open space, or any activity which would results in degrading a watercourse or the surface and/or groundwater of an inland wetland, such degradation to be measured by the standards of the Water Compliance Division of the Connecticut Department of Environmental Protection.

- Section 4.3.2 – Fee Schedule: A technical review may be required by a consultant for certain regulated activities, including those that are within 200 feet of a watercourse of concern (including the Tankerhoosen River and its major tributaries), regulated activities proposed in a use district where the proposed activity exceeds the impervious coverage thresholds established in such districts, as well as parking space, building square footage, disturbance, and other thresholds.

- <u>Section 4.3.4 - Application Procedure</u>: Any person wishing to undertake a Regulated Activity must submit an application to the Commission. The application must include a map showing the location of the site, the nature and extend of the proposed activity, the location of the Regulated Areas, existing and proposed structures, two-foot elevation contours, all drainage to be engineered, areas where material may be deposited or removed, all proposed construction within Regulated Area, areas of significant vegetation. The application must also include a detailed description of the activity, a map drawn by a licensed surveyor if the proposed activity exceeds ½ acre, the names and address of property owners within 500 feet of the proposed activity, and any reasonable measures which would mitigate the impacts of the Regulated Activity.

- <u>Section 4.5 - Evaluation of Proposed Activities</u>: This section specifies the information and criteria upon which the Commission makes its decision on an application. Section 4.5.2 includes factors related to erosion, siltation, and leaching; adverse effects on water quality and aquatic life; the likelihood of any changes in the velocity, volume, or course of water flow, or in the water table, and any consequences such changes may have for the capacity of the wetland or watercourse to help control flooding and to purify and supply water; and the existing and desired quality and use of the water in and near the affected area.

  Comment: The evaluation criteria do not contain specific stormwater management standards and do not reference available design guidance such as the Connecticut Stormwater Quality Manual or local design guidance. The regulations also do not require or recommend the use of LID practices to meet stormwater management objectives.

- <u>Watercourse Buffers</u>: Section 4.5.2.12 states that the Commission may require the provision of a buffer along a watercourse if proposed activities and/or development may create negative impacts on a watercourse that could be prevented or mitigated by provision of a buffer, as described in "Appendix B. Design Standards Recommended for a Watercourse Protection Buffer." The watercourse buffer design standards state that in areas where vegetated buffers do not exist, or are of limited width, consideration should be given to the creation of a buffer area. Newly created buffers should include canopy or shade trees, shrubs, and herbaceous plant species suited to the local habitat in three (3) zones of plantings. The recommended minimum width of a watercourse buffer is one hundred (100) feet measured horizontally from the banks of the watercourse and fifty (50) feet measured horizontally related to intermittent watercourses.

  The recommended watercourse protection area with landscape buffer may be reduced when (1) an engineered stormwater management and pollution control system employing technical best management practices (BMP) in compliance with the Connecticut Department of Environmental Protection (DEP) "Stormwater Quality Manual: is provided to treat run-off from a development site; (2) the site is served by a public sewer system; and (3) a reduction of the river protection buffer depth would not result in a significant potential adverse impact to the watercourse.

2.4 Plan of Conservation and Development

The Vernon Plan of Conservation and Development (June 2001) presents a detailed strategy for open space conservation and preservation, including increasing the amount of preserved open space as well as creating linkages between open space areas. The Plan identifies priority open space preservation areas along the Hockanum and Tankerhoosen River corridors.

A series of neighborhood meetings were held as an initial phase of the POCD. Several common themes emerged at public meetings. The themes associated with the protection of open space and watercourses included:

- Need to preserve open space for perpetuity in a positive, planned manner with adequate financial resources devoted to this program. A goal of 20% open space might be considered
- Retail development should be limited to prevent Vernon from becoming another Manchester in the Route 84 corridor or like the Berlin Turnpike along other major corridors in Town.
- The water quality of the Town's lakes and rivers as well as groundwater should be protected.

In addition to the currently-implemented Zoning Regulations, Subdivision Regulations, and Inland Wetlands and Watercourses Regulations, the Open Space section of the POCD also recommends adoption of a Hockanum River and Tankerhoosen River Protection Overlay District. Such a district would establish a contiguous and parallel buffer strip on either side of these rivers and would supplement the inland wetland and underlying zoning regulations, with the added provision that the land within the buffer areas and the river itself would remain in a natural, undisturbed state.

3.0 OBSERVATIONS & PRELIMINARY RECOMMENDATIONS

Based on our review of the Town's existing land use regulations and planning documents that pertain to stormwater management and natural resource protection, we offer the following observations and preliminary recommendations for discussion during the upcoming workshop meeting with the Tankerhoosen River Management Plan Technical Advisory Committee and the Town of Vernon land use commissioners.

3.1 Observations

The Town has a number of land use regulations that regulate construction and post-construction stormwater runoff from new development and redevelopment activities, and provide for protection of natural resources. The local regulations are particularly strong in terms of erosion and sediment control (as well as consistent between the various regulations), open space protection, and regulating activities that can potentially affect wetlands and watercourses, including requirements for watercourse buffers. However, there are several areas where the regulations and design standards and guidance could be strengthened through amendments or new regulations to clarify and strengthen stormwater management requirements and better promote the use of LID principles.

1. Stormwater Management Standards and Design Manual

The Town land use regulations do not contain specific stormwater management standards. The Zoning Regulations reference the recommendations and design guidance contained in the Connecticut Stormwater Quality Manual, while the Subdivision Regulations indicate that stormwater systems shall be designed by methods approved by the Town Engineer. The Inland Wetlands and Watercourses Regulations do not contain specific stormwater management standards and do not reference design guidance such as the DEP Stormwater Quality Manual or local design standards, except for instances when the applicant requests reduction in the watercourse buffer width requirements.

While the Connecticut Stormwater Quality Manual contains hydrologic sizing criteria (for water quality, quantity, groundwater recharge, etc.) and detailed design guidance for specific stormwater treatment practices, it does not prescribe a set of stormwater standards due to the lack of state-wide stormwater regulations. The Connecticut Stormwater Quality Manual does contain many LID principles in addition to more traditional end-of-pipe stormwater controls. However, it does not contain more recently developed guidance on LID design methods and clear incentives for developers to use LID over traditional stormwater management methods, such as LID credit systems which have been adopted by communities in recent years. Another drawback of relying solely on the DEP manual is that the information in the manual may eventually become outdated and lacking in areas of new or emerging stormwater management issues, as DEP does not plan to revise the manual in the foreseeable future.

Although the Vernon land use commissions are encouraged to use the Connecticut Stormwater Quality Manual to review applications, an alternative approach is to develop a local stormwater and LID manual to complement the DEP stormwater manual. A local manual could reference applicable sections of the DEP manual and take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town. The Town land use regulations could also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the Town land use regulations. Several other Connecticut communities have chosen this approach, including Tolland, which has developed a LID and Stormwater Management Design Manual, in addition to amendments to the Tolland Subdivision and Zoning Regulations. The Town of Greenwich is also in the process of revising its outdated drainage manual to incorporate stormwater quality elements and LID principles. Greenwich is also considering adopting a stand-alone ordinance or modifying its local land use regulations to implement the provisions of the new manual.

2. Local Regulatory Mechanism

As indicated in the introduction section, an opportunity exists for the Town of Vernon to develop and implement new or revised regulations to satisfy Phase II stormwater regulatory requirements, while at the same time incorporating LID principles and addressing natural resource protection issues. The Town's existing land use regulations address some of the elements of the post-construction stormwater management "regulatory mechanism" required by the DEP Phase II Stormwater program. However, none of the existing regulations, either individually or collectively, addresses post-construction stormwater management in a comprehensive manner as required by the Phase II program. Additionally, the Town may want to consider regulating stormwater runoff from projects that may not currently be subject to Town land use regulations but which are known to be a source of stormwater quality and drainage issues (such as single family residential redevelopment outside of the Upland Review Area).

Two general approaches exist for implementing a comprehensive stormwater regulatory mechanism to meet Phase II stormwater program requirements and to incorporate LID principles and other specific community objectives. One approach involves developing a new stand-alone stormwater ordinance that could be incorporated into the Vernon Town Code and implemented by a single department or commission such as the Engineering Department. This approach has been used by Stratford and other communities throughout southern New England. An alternate approach would be to implement more comprehensive stormwater management/LID requirements in a new section of the Zoning Regulations and maintain the responsibility for administering the stormwater/LID provisions with the Planning and Zoning Commission. Such an approach has been used by Tolland and Guilford, Connecticut. Elements of both approaches are summarized as follows:

a. *Stand-Alone Stormwater Ordinance*

- Adopt a new stormwater ordinance as part of the Vernon Town Code. The ordinance could be similar to the draft ordinance which is provided in Attachment A of this memorandum and is based upon a model ordinance endorsed by the DEP. Typically, a new stormwater ordinance is a more efficient and effective way to address the Phase II Stormwater program regulatory mechanism requirement than separate revisions to the individual municipal land use regulations that are currently in place. The stormwater ordinance would apply to post-construction stormwater runoff from new development and redevelopment projects that disturb greater than a threshold value that could be selected by the Town. The Phase II General Permit requires that the ordinance apply to projects that would disturb one or more acres. Vernon could consider an alternative applicability threshold to ensure that the requirements would apply to in-fill development projects and other smaller land disturbance activities with the potential for drainage or water quality impacts. The sample draft ordinance provided in Attachment A would apply to all projects that disturb 5,000 square feet or more. Other applicability thresholds could be considered as well. The ordinance should incorporate by reference the technical standards and design guidance contained in a local stormwater manual and/or the Connecticut Stormwater Quality Manual, as amended.

- The stand-alone stormwater ordinance could be administered by the Engineering Department, which would initially receive stormwater management permit applications for land disturbance activities subject to the ordinance. Stormwater Management Plans would then be reviewed by one or more of the applicable land use commissions (Planning and Zoning Commission or Inland Wetlands Regulatory Commission) with jurisdiction or expertise over the proposed project. Projects that do not fall under the jurisdiction of the Planning and Zoning Commission or the Inland Wetlands Regulatory Commission would be reviewed solely by the Engineering Department for compliance with the ordinance. This administrative structure places responsibility for stormwater management plan review on those agencies that already perform regulatory reviews (P&Z and IW), but consolidates authority for the stormwater ordinance under a single department (Engineering). A drawback to this approach is that the Engineering Department would bear the responsibility for administering the permit program and would likely require additional staff resources.

- The Town could consider creating a dedicated "stormwater inspector" position within the Engineering Department. The stormwater inspector would be responsible for conducting stormwater inspections during and after construction of stormwater facilities in support of the new ordinance, as well as augment the related inspection capabilities of Building Inspector and Zoning Enforcement Officer.

- Short-term funding for administration of the post-construction stormwater ordinance and other elements of the Town's Phase II program would most likely come from taxes and application fees. The Town could investigate implementation of a service charge-based system, such as user fees or a stormwater utility. However, these funding sources are often difficult to implement due to public resistance. Stormwater utilities have been established in Chicopee, Massachusetts, Burlington, Vermont, and elsewhere throughout the U.S. Stonington, Connecticut has investigated the feasibility of a stormwater utility. Several other Connecticut coastal communities are undertaking DEP-funded demonstration projects to explore the feasibility of developing and implementing a stormwater utility. Vernon may also explore the feasibility of a stormwater utility or similar stormwater service charge, although this would likely be a long-term potential funding source.

b. *Incorporation of Stormwater Management/LID Requirements in Zoning Regulations*

- Incorporate a new post-construction stormwater management and LID section into the existing Zoning Regulations. The new section could be similar to the stand-alone example ordinance in terms of applicability thresholds, exemptions, and general stormwater management standards and LID principles. Specific stormwater management standards and design guidance should not be included in the regulations, but rather in a local stormwater manual to avoid the need for significant future amendments to the regulations when the standards or design guidance are revised. A copy of the recent amendment to the Town of Tolland Zoning Regulations, which added a new LID section, is included as Attachment B of this memorandum.

- In addition, the Zoning Regulations could be modified to potentially require a Stormwater Management Plan for a proposed activity that only requires a Building Permit, such as a single-family dwelling, if it results in the disturbance of one or more acres (the Phase II permit minimum requirement) or a lower threshold selected by the Town. The following sample language is an excerpt from the Guilford Zoning Regulations:

  Stormwater Management Plans shall be prepared for any Site Plan, Coastal Site Plan (CAM) or Special Permit Application in accordance with 273-75.F(3) of this Code. Futhermore, for an Application for Certificate of Zoning Compliance (Building Permit) for any new single family dwelling, the Town Engineer, or the Environmental Planner may require that a Stormwater Management Plan be prepared, all or in part, as required by 273-75.F.(3) when he/she has determined that the development if the single family dwelling may have an adverse impact on stormwater quality.

  This approach consolidates stormwater management review within the Planning and Zoning Commission through the existing site plan and special permit application review process. The Subdivision and Inland Wetlands and Watercourses Regulations would also need to be modified to require a Stormwater Management Plan consistent with the Zoning Regulations.

3. *LID Incentives and Obstacles*

Although recent studies demonstrate that LID practices can reduce project costs and improve environmental performance, the perception still exists that site development using LID is more expensive than traditional approaches to stormwater management. Initial project costs may be higher in some cases than those for conventional design. However, significant savings are typically realized due to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping (USEPA, Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, EPA publication number 841-F-07-006, December 2007).

Many states and local communities have adopted LID credit systems as an added incentive for developers to use LID, and in particular non-structural measures, to ultimately reduce the size and cost of structural stormwater management systems.

LID Site Design Credits encourage environmentally sensitive site design and LID techniques for managing stormwater that minimize impervious surfaces and preserve natural hydrologic conditions. The credits allow project proponents to reduce or eliminate the structural stormwater BMPs otherwise required to meet certain stormwater standards by implementing LID site design techniques according to a prescribed set of standards. The Tolland LID Design

Manual includes such an LID credit system. Attachment C of this memorandum contains an example LID Site Design Credit System that is also being considered by the Town of Greenwich.

Local land use regulations often contain design standards that preclude or limit the use of certain LID practices, particularly the use of curbless roads and roadside vegetated swales. Traditional curb-and-gutter systems convey stormwater with virtually no treatment or attenuation. Open vegetated channels remove pollutants by allowing infiltration and filtering to occur, and encourage groundwater recharge, which can reduce the volume of stormwater generated from a site. Traditionally, the use of curbless roads and vegetated open channels has been discouraged and, in many instances, specifically prohibited in local land use regulations and drainage design manuals, due to concerns over maintenance problems, pavement stability, and potential nuisances such as mosquitoes. Many of these concerns can be addressed through careful design and integration of open channels along streets.

The Vernon Subdivision Regulations contain provisions that limit the use of curbless roads and roadside vegetated swales. The Subdivision Regulations require curbs on all new streets and do not permit drainage ditches where it is feasible to install underground pipe. The Town should evaluate the underlying reasons for these restrictions and determine if the Subdivision Regulations should be amended to encourage the use of curbless roads and roadside swales, consistent with LID principles.

4. Local Regulations and Impervious Cover

Impervious cover in a watershed is a strong indicator of the overall quality of streams and aquatic ecosystems. The correlation between watershed impervious cover and stream indicators is due to the relationship between impervious cover and stormwater runoff, since streams and receiving water bodies are directly influenced by stormwater quantity and quality. As impervious cover increases, overall stream health declines.

A goal of LID, which is a form of alternative site design, is to reduce impervious cover, disconnect impervious surfaces from the storm drainage system, and preserve natural site features. Local land use regulations and design requirements were typically not developed with impervious cover in mind. Rather, they evolved from perceived consumer demand, safety concerns, and land availability, often resulting in more impervious cover than is necessary due to expansive parking lots, wide streets, and large-lot subdivisions with little conserved natural areas and open space.

Communities interested in adopting LID and alternative sit design principles need to re-evaluate local land use regulations to overcome these challenges. Based on our review of the Vernon Subdivision and Zoning Regulations, some of the key design parameters that strongly influence impervious cover are already at or near optimal levels (e.g., off-street parking stall dimensions and configuration), while others should be reviewed to determine if further refinement is warranted and feasible (e.g., cul-de-sac design, road width, sidewalks, parking ratios).

3.2 Preliminary Recommendations

This section contains preliminary recommendations based on our review of the existing land use regulations and planning documents, as well as our observations discussed in the previous section. These recommendations are intended to facilitate a discussion with the Technical Advisory Committee and Vernon land use commissioners during the upcoming workshop meeting, and to serve as a starting point and basis for further refinement and implementation.

1. *Town Design Manual*

- Develop a Town stormwater and LID design manual. A local manual should reference applicable sections of the Connecticut Stormwater Quality Manual to take advantage of the existing design guidance, but also include more detailed guidance and stronger emphasis on LID practices and include specific stormwater standards tailored to the characteristics and needs of the Town (see Recommendation 2). The Town land use regulations should also reference the local stormwater design manual, thereby serving as a single, unifying guidance document that could be updated without the need for major revisions to the land use regulations.

- Include a section of the design manual that addresses stormwater retrofits for redevelopment and drainage system upgrade and maintenance projects. Stormwater retrofits for residential and commercial redevelopment projects are an important element for the Town's stormwater management strategy given the level of existing development in the Town. Stormwater retrofits also present an opportunity to implement lot-level LID strategies as opposed to larger end-of-pipe controls where land may not be available for stormwater management facilities.

- Incorporate/reference stormwater quantity and conveyance sections of the Connecticut DOT Drainage Manual for consistency with state drainage standards.

2. *Stormwater Management Standards*

- Develop and incorporate into the Town stormwater design manual a set of stormwater management standards, which would become regulatory standards referenced by the existing Town land use regulations and/or new stormwater ordinance (see Recommendation 3). Development of stormwater management standards would allow Vernon to establish clearer, specific standards that all projects must meet in order to obtain local land use permits. The stormwater standards could include LID requirements, complement the hydrologic sizing criteria in the *Connecticut Stormwater Quality Manual* and be tailored (using variable minimum performance standards) to protect specific water bodies or sensitive resources in the Town of Vernon. An example set of stormwater management standards is included in Attachment D.

3. *New or Modified Stormwater Regulations*

- Develop and implement new or revised stormwater regulations to 1) satisfy Phase II Stormwater Program regulatory requirements, 2) encourage or require LID principles to be implemented for development projects in Vernon, and 3) address other local drainage and natural resource protection issues identified by the Town. Two potential approaches have been identified – 1) a new stand-alone stormwater ordinance, or 2) addition/amendments to the existing Zoning Regulations.

- Form an advisory committee or workgroup consisting of representatives from the various land use commissions and selected Town departments to further evaluate and select the best approach for Vernon, including key decisions regarding:

    - If a new, stand-alone stormwater ordinance is selected, which department or commission will have responsibility for administering the program (i.e., the "Stormwater Authority")?
    - Which projects and activities will the new ordinance apply to (i.e., applicability)?
    - How will applications be received and reviewed?
    - Who will be responsible for inspections and enforcement?
    - Will additional staff be required to handle the increased workload to review and process applications?

4. *Other Amendments to Existing Regulations*

<u>Subdivision Regulations</u>

- Amend Section 6.4 to reference the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, as opposed to the outdated reference to the 1976 version of the Erosion and Sediment Control Handbook.

- Section 6.5.1.1 (Street Grading and Improvement): Consider eliminating the curbing requirement for roads with grades less than 5% to encourage the use of vegetated swales and similar LID practices.

- Section 6.6.6 (Cul-de-sacs): Consider smaller cul-de-sac radius of (30 to 40 feet), or alternative designs such as hammerheads, to reduce impervious cover, such that the design allows for continuous turning movement of the largest fire fighting vehicle used by the Town of Vernon. Also consider encouraging the use of LID bioretention/rain gardens in cul-de-sac islands for stormwater management.

- Section 6.7.1 (Design Standards, Road Width): Consider pavement widths of between 24 and 28 feet, if such a reduction will not negatively impact public safety or emergency response. Refer to Table 4-3 in the Connecticut Stormwater Quality Manual for potential variation in residential roadway widths based on terrain and development density.

- Section 6.7.2 (Design Standards, Curbs): Consider eliminating the curbing requirement for roads with grades less than 5% to encourage the use of vegetated swales and similar LID practices.

- Section 6.9 (Drainage and Storm Sewers): Modify these sections to reference stormwater management standards and LID principles contained in a stand-alone stormwater ordinance or new section of the Zoning Regulations, and/or the Town stormwater design manual.

- Section 6.9.3 (Drainage Design): Amend this section to allow the use of roadside vegetated swales designed in accordance with the Town stormwater design manual.

- Section 6.12.1 (Sidewalks): Consider requiring sidewalks on only one side of the street and reduce sidewalk width to 3 or 4 feet. Grade sidewalks to the front yard rather than to the street. Consider using alternative materials such as pavers, stone dust, or pervious concrete.

- Section 6.14 (Certified Erosion and Sediment Control Plan): Amend the single family exemption such that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land, which is consistent with the Phase II Stormwater Program regulatory requirement.

<u>Zoning Regulations</u>

- Section 3.4 (General Provisions): If the Town develops a local stormwater design manual, change the reference to the Connecticut Stormwater Quality Manual to the Town manual.

- Sections 4.1 through 4.25 (Use Districts, Setbacks and Lot Dimensions): Review current setbacks and lot dimensions for potential to relax side yard setbacks and allow narrower frontages to reduce road length and site imperviousness, and to relax front setback requirements to reduce driveway length and lot imperviousness.

- Section 12 (Off-street Parking and Loading): Review existing parking ratios to see if lower ratios are warranted and feasible. The required parking ratio for a particular land use should be enforced as both a maximum and minimum to limit excess parking space construction and impervious cover. Consider allowing the Commission to approve parking lots with more spaces than the allowed maximum provided all of the spaces above the maximum number are composed of a pervious surface, and where adequate stormwater management is provided. Also consider parking spaces held in reserve for phased developments, thereby avoiding the situation where unnecessary parking is not constructed if future phases of development do not occur.

Clarify Section 12 of the regulations to encourage the use of shared parking. Where shared parking is used, the Zoning Regulations should require a corresponding reduction in parking spaces.

Consider adding language to Section 12 that references specific stormwater management and landscape design standards in the Town stormwater manual and/or the Connecticut Stormwater Quality Manual.

- Section 18 (Activities Requiring a Certified Erosion and Sediment Control Plan): Amend the single family exemption such that the exemption only applies to single family dwellings that do not disturb 1 or more acres of land, which is consistent with the Phase II Stormwater Program regulatory requirement.

<u>Inland Wetlands and Watercourses Regulations</u>

- Section 4.5 (Evaluation of Proposed Activities): Add language referencing the stormwater management standards and LID principles contained in the Town stormwater manual and/or the Connecticut Stormwater Quality Manual.

ATTACHMENT A

Draft Model Stormwater Ordinance

DRAFT

POST-CONSTRUCTION STORMWATER ORDINANCE
(CITY NAME)

Table of Contents

1.0 PURPOSE AND AUTHORITY

The purpose of this ordinance is to protect, maintain and enhance the public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse impacts associated with post-construction stormwater runoff. Proper management of stormwater runoff will minimize damage to public and private property, reduce the effects of development on land and wetlands, control stream channel erosion, reduce local flooding, improve water quality, and maintain after development, as nearly as possible, the pre-development runoff characteristics.

The provisions of this ordinance are pursuant to Connecticut State Statutes 7-148 (c) (8) (A)[1], 8-2 (a)[2], 8-25[3], and 22a-36 to 22a-45 inclusive[4], and 8-2(b)[5] and shall apply to all development occurring within the incorporated area of(City Name), Connecticut. The application of this ordinance and provisions expressed herein shall be the minimum stormwater management requirements and shall not be deemed a limitation or repeal of any other powers granted by State statute. The agencies defined in Section 2.0 as the

---

[1] Municipal Powers: The municipality has the power to "Provide for the protection and improvement of the environment including, but not limited to, coastal areas, wetlands and areas adjacent to waterways in a manner not inconsistent with the general statutes.

[2] Regulations: The zoning commission is authorized to adopt regulations "…to secure safety from …flood and other dangers; to promote health and the general welfare…"

[3] Subdivision of land: Authorizes the zoning commission to see "…that proper provision shall be made for… drainage…" and "that proper provision shall be made for protective flood control measures…"

[4] The Inland Wetlands and Watercourses Act.

[5] "In any municipality that is contiguous to Long Island Sound the regulations adopted under this section shall be made with reasonable consideration for restoration and protection of the ecosystem and habitat of Long Island Sound and shall be designed to reduce hypoxia, pathogens, toxic contaminants and floatable debris in Long Island Sound. Such regulations shall provide that the zoning commission consider the environmental impact on Long Island sound of any proposal for development."

“Responsible Authority” shall be responsible for the coordination and enforcement of the provisions of this ordinance.

1.1 Incorporation by Reference

For the purpose of this ordinance, the Connecticut Stormwater Quality Manual (as amended) is incorporated by reference by (City Name), Connecticut and shall serve as the official guide for stormwater principles, methods, and practices.

2.0 DEFINITIONS

A. For the purpose of this ordinance, the following definitions describe the meaning of the terms used in this ordinance:

(1) "Adverse impact" means any deleterious effect on waters or wetlands, including their quality, quantity, surface area, species composition, aesthetics or usefulness for human or natural uses which are or may potentially be harmful or injurious to human health, welfare, safety or property, to biological productivity, diversity, or stability or which unreasonably interfere with the enjoyment of life or property, including outdoor recreation.

(2) "Agricultural land management practices" means those methods and procedures used in the cultivation of land in order to further crop and livestock production and conservation of related soil and water resources.

(3) "Applicant" means any person, firm, or governmental agency who executes the necessary forms to procure official approval of a project or a permit to carry out construction of a project.

(4) "Aquifer" means porous water bearing geologic formation generally restricted to materials capable of yielding an appreciable supply of water.

(5) “BMP (Best Management Practice)” means a structural device or nonstructural practice designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution, and provide other amenities.

(6) "Clearing" means the removal of trees and brush from the land (i.e., removal of vegetative cover) but shall not include the ordinary mowing of grass

(7) “DEP” means the Connecticut Department of Environmental Protection.

(8) “Design Manual” means the most current edition of the Connecticut Stormwater Quality Manual that serves as the official guide for the stormwater management principles, methods, and practices.

(9) "Detention structure" means a permanent structure for the temporary storage of runoff, which is designed so as not to create a permanent pool of water.

(10) "Develop land" means to change the runoff characteristics of a parcel of land in conjunction with residential, commercial, industrial, municipal, or institutional construction or alteration.

(11) “Direct discharge” means the concentrated release of stormwater to tidal waters or vegetated tidal wetlands from new development or redevelopment projects in the Critical Area.

(12) “Disturb” or “Disturbance” means any activity consisting of the removal of vegetation, topsoil, or overburden, or the placement of topsoil, spoil, or other material, as defined in the Guidelines.

(13) "Drainage area" means an area that contributes runoff to a single point measured in a horizontal plane, which is enclosed by a ridgeline.

(14) “Easement" means a grant or reservation by the owner of land for the use of such land by others for a specific purpose or purposes, and which must be included in the conveyance of land affected by such easement.

(15) “Exemption" means those land development activities that are not subject to the stormwater management requirements contained in this ordinance.

(16) “Extended detention” means a stormwater design feature that provides gradual release of a volume of water in order to increase settling of pollutants and protect downstream channels from frequent storm events. Methods for designing extended detention BMPs are specified in the Design Manual.

(17) “Extreme flood volume” means the storage volume required to control those infrequent but large storm events in which overbank flows reach or exceed the boundaries of the 100-year floodplain.

(18) "Flow attenuation" means prolonging the flow time of runoff to reduce the peak discharge.

(19) "Grading” means any act by which soil is cleared, stripped, stockpiled, excavated, scarified, filled or any combination thereof.

(20) “Groundwater recharge volume (GRV)” means that portion of the water quality volume used to maintain groundwater recharge rates at development sites. Methods for calculating the groundwater recharge volume are specified in the Design Manual.

(21) “Guidelines” means the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, or as may be amended, established pursuant to Section 22a-328 of the Connecticut General Statutes.

(22) "Infiltration" means the passage or movement of water into the soil surface.

(23) "Off-site stormwater management" means the design and construction of a facility necessary to control stormwater from more than one development.

(24) "On-site stormwater management" means the design and construction of systems necessary to control stormwater within an immediate development.

(25) “Peak runoff attenuation” means controlling by structural practices the volume to prevent an increase in the frequency of out of bank flooding generated by development.

(26) “Primary treatment practice”, as defined in the Design Manual, means a stormwater treatment practice that is capable of providing high levels of water quality treatment as a stand-alone measure.

(27) “Redevelopment” means any construction, alteration, or improvement exceeding five thousand (5,000) square feet of land disturbance performed on sites where existing land use is commercial, industrial, municipal, institutional or multifamily residential.

(28) “Responsible Authority” means employees, members, or designees of (City Name) (Agency Name). Other responsible agencies under this ordinance include:

(a) The Inland Wetlands and Watercourses Commission for stormwater runoff impacting wetlands and watercourses. (For the purposes of only this paragraph, the definition of “wetlands” and “watercourse” is the definition used in the most current version of the Inland Wetland and Watercourses regulations of (City Name).

(b) The Engineering Division of the Department of Public Works for stormwater runoff from public roads and sidewalks.

(c) The Planning Commission and Zoning Commission for all other stormwater runoff.

(29) “Responsible Official” means (City Name) Director of Public Works (“Director”).

(30) "Retention structure" means a permanent structure that provides for the storage of runoff by means of a permanent pool of water.

(31) “Retrofitting” means the construction of a structural BMP in a previously developed area, the modification of an existing structural BMP, or the implementation of a nonstructural practice to improve water quality over current conditions.

(32) “Secondary treatment practice”, as defined in the Design Manual, means a stormwater treatment practice that may not be suitable as stand-alone treatment because is not capable of meeting the water quality treatment performance criteria in the Design Manual or has not yet received the thorough evaluation needed to demonstrate the capabilities for meeting the performance criteria in the Design Manual.

(33) "Sediment" means soils or other surficial materials transported or deposited by the action of wind, water, ice, or gravity as a product of erosion.

(34) "Site" means:

(a) For “new development” any tract, lot or parcel of land or combination of tracts, lots, or parcels of land, which are in one ownership, or are contiguous and in diverse ownership where development is to be performed as part of a unit, subdivision, or project.

(b) For “redevelopment” the area of new construction as shown on an approved site plan or the original parcel. Final determination of the applicable area shall be made by the Responsible Authority.

(35) "Stabilization" means the prevention of soil movement by any of various vegetative and/or structural means.

(36) "Stormwater management" means the selective use of various management measures to effectively address the adverse water quality and quantity impacts of urban stormwater runoff.

(37) "Stormwater Management Plan" means a set of drawings or other documents that describe the potential water quality and quantity impacts associated with a development project after construction. A stormwater management plan also identifies selected source controls and treatment practices to address those potential impacts, the engineering design of the treatment practices, and maintenance requirements for proper performance of the selected practices.

(38) “Stormwater Treatment Practice”, as defined in the Design Manual, means a measure constructed for primary treatment or secondary treatment of stormwater runoff.

(39) “Stream Channel Protection” means restricting peak flows from storm events that result in flow conditions where the stream is flowing to the full extent of its banks so the damaging effects to the channel of increased runoff from urbanization can be reduced. Methods for calculating stream channel protection are specified in the most current edition of the Design Manual.

(40) "Variance" means the modification of the minimum stormwater management requirements for specific circumstances such that strict adherence to the requirements would result in necessary hardship and not fulfill the intent of this ordinance.

(41) "Waiver" means the relinquishment from stormwater management requirements by the Responsible Authority for a specific development on a case-by-case review basis.

(a) “Quality stormwater management waiver” includes water quality volume and groundwater recharge volume design parameters.

(b) “Quantity stormwater management waiver” includes stream channel protection, peak runoff attenuation, and extreme flood volume design parameters.

(38) "Watercourse" means any natural or artificial stream, river, brook, lake, pond, marsh, swamp, bog, ditch, channel, canal, conduit, culvert, drain, waterway, gully, ravine, wash, and all other bodies of water, natural or artificial, vernal or intermittent, public or private in and including any adjacent area that is subject to inundation from overflow or flood water.

(39) “Watershed” means the total drainage area contributing runoff to a single point.

(40) “Water quality volume” means the volume of runoff generated by one inch of rainfall on the site.

3.0 APPLICABILITY

3.1 Scope

No person shall develop land for residential, commercial, industrial, municipal, or institutional uses without having provided stormwater management measures that control or manage runoff from such development, except as provided within this section. The stormwater management measures must be designed consistent with the Design Manual and constructed according to an approved plan for new development or the policies stated in Section 3.4 for redevelopment.

3.2 Exemptions

The following development activities are exempt from the provisions of this ordinance and the requirements of providing stormwater management, except as noted:

A. Development of single family residential property that results in the disturbance of less than one (1) acre of land, not including projects less than one (1) acre that are part of a larger common plan of development or sale that will ultimately disturb greater or equal to one (1) acre must conform to the requirements presented in Section 4.4.

B. Agricultural land management practices;

C. Any activity that will disturb an area less than five thousand (5,000) square feet over the total project;

D. Maintenance of existing landscaping, gardens or lawn areas associated with a single family dwelling;

E. Repair or replacement of an existing roof of a single family dwelling;

F. Construction of utilities (gas, water, electric, telephone, sanitary sewer, etc.) other than drainage, which will not alter terrain, ground cover, or drainage patterns;

G. Emergency repairs to any stormwater management facility or practice that poses a threat to public health or safety, or as deemed necessary by the Responsible Authority.

3.3 Waivers / Watershed Management Plans

A. Stormwater management quantity control waivers may be granted by the Responsible Authority to projects when the Responsible Authority determines that circumstances exist that prevent the reasonable implementation of quantity control practices.

B. Stormwater management quality control waivers granted by the Responsible Authority apply to:

(1) In-fill development projects where implementation of stormwater management quality controls is not feasible;

(2) Redevelopment projects if the requirements of Section 3.4 of this ordinance are satisfied; or

(3) Sites where the Responsible Authority determines that circumstances exist that prevent or make unnecessary the reasonable implementation of quality control practices.

C. Waivers must be requested in writing one week in advance of the regular meeting of the (Responsible Authority Agency Name) in a manner prescribed by the Director of Public Works.

D. Waivers granted must:

(1) Be on a case-by-case basis;

(2) Consider the cumulative effects of the waiver policy; and

(3) Reasonably ensure the development will not adversely impact stream quality.

3.4 Redevelopment

A. All redevelopment projects shall reduce existing site impervious area by 20%. Where site conditions prevent the reduction of impervious area, then stormwater management practices shall be implemented to provide quality control for at least 20% of the site's impervious area. The elements and principles of stormwater quality control are noted in the Design Manual.

B. Where conditions prevent impervious area reduction or on-site stormwater management, the Responsible Authority may consider practical alternatives including:

(1) Watershed or stream restoration;

(2) Retrofitting; or

(3) Other practices approved by Responsible Authority.

3.5 Variance

The Responsible Authority may grant a written variance from any requirement of Section 4.0 (Stormwater Management Criteria), of this ordinance if there are exceptional circumstances applicable to the site such that strict adherence will result in unnecessary hardship and not fulfill the intent of this ordinance. A written request for variance shall be provided to the Responsible Authority and shall state the specific variances sought and reasons for their granting. The Responsible Authority shall not grant a variance unless and until the person developing land provides sufficient justification.

4.0 STORMWATER MANAGEMENT CRITERIA

4.1 Minimum Control Requirements

A. The minimum control criteria established in this section and the Design Manual are as follows:

(1) Shall require that the groundwater recharge volume, water quality volume, and peak runoff attenuation for the 2-year frequency storm event be used to design BMPs according to the Design Manual. Control of the 10-year frequency storm event is required according to the Design Manual. Control of larger storm events may be required at the discretion of the Responsible Authority if a flooding problem exists and downstream floodplain development and conveyance system design cannot be controlled.

(2) Shall require that the groundwater recharge volume, water quality volume, and stream channel protection sizing criteria be used to design BMPs according to the Design Manual.

(3) The Responsible Authority may require more than the minimum control requirements specified in this ordinance if hydrologic or topographic conditions warrant or if flooding, stream channel erosion, or water quality problems exist downstream from a proposed project.

B. Stormwater management and development plans where applicable, shall be consistent with adopted and approved watershed management plans or flood management plans as approved by the DEP.

4.2 Stormwater Management Measures

The structural and nonstructural stormwater management measures established in this ordinance shall be used, either alone or in a combination, in developing a stormwater management plan.

A. Nonstructural Stormwater Management Measures.

(1) The following nonstructural stormwater management practices shall be applied according to the Design Manual to minimize increases in new development runoff:

(a) Natural area conservation;

(b) Disconnection of rooftop runoff;

(c) Disconnection of non-rooftop runoff;

(d) Sheet flow to buffers;

(e) Grass channels; and

(f) Environmentally sensitive development and Low Impact Development (LID) practices;

(2) The use of nonstructural stormwater management practices shall be encouraged to minimize the reliance on structural BMPs.

(3) The minimum control requirements listed in Section 4.1 of this ordinance may be reduced when nonstructural stormwater management practices are incorporated into site designs according to the Design Manual.

(4) The use of nonstructural stormwater management practices may not conflict with existing State or local laws, ordinances, or policies.

(5) Nonstructural stormwater management practices used to reduce the minimum control requirements must be recorded and remain unaltered by subsequent property owners. Prior approval from the Responsible Authority shall be obtained before nonstructural stormwater practices are altered.

B. Structural Stormwater Management Measures.

(1) The following structural stormwater management practices or "Stormwater Treatment Practices" shall be designed according to the Design Manual to satisfy the applicable minimum control requirements established in Section 4.1 of this ordinance.

(a) Primary Treatment Practices, including stormwater ponds, stormwater wetlands, stormwater infiltration practices, stormwater filtering practices, and water quality swales.

(b) Combination of primary treatment practices and secondary treatment practices.

(c) Multiple secondary treatment practices, at the discretion of the Responsible Authority.

(2) The performance criteria specified in the Design Manual with regard to general feasibility, conveyance, pretreatment, treatment and geometry, environment and landscaping, and maintenance shall be considered when selecting structural stormwater management practices.

(3) Structural stormwater management practices shall be selected to accommodate the unique hydrologic or geologic regions of the state.

C. Alternative structural and nonstructural stormwater management practices may be used for new development water quality control if they meet the performance criteria established in the Design Manual. Practices used for redevelopment projects shall be approved by the Responsible Authority.

D. For the purposes of modifying the minimum control requirements or design criteria, the owner/developer shall submit at the request of the Responsible Authority an analysis of the impacts of stormwater flows downstream in the watershed. The analysis shall include hydrologic and hydraulic calculations necessary to determine the impact of hydrograph timing modifications of the proposed development upon a dam, highway, structure, or natural point of restricted stream flow. The point of investigation is to be established with the concurrence of the Responsible Authority.

4.3 Specific Design Criteria

The basic design criteria, methodologies, and construction specifications, subject to the approval of the Responsible Authority, shall be those of the Design Manual.

4.4 Single Family Residence Lot Level Controls

Construction of single family residences that results in the disturbance of less than 1 acre of land must minimize or disconnect impervious area runoff from the public storm drainage system by implementing stormwater management measures designed in accordance with the Design Manual. The applicant shall submit evidence on a form prescribed by the Responsible Official that the requirements of Section 4.4 have been met prior to issuance of a building permit.

5.0 STORMWATER MANAGEMENT PLANS

5.1 Review and Approval of Stormwater Management Plans

A. For any proposed development, the developer shall submit a stormwater management plan or waiver application to the Responsible Authority for review and approval, unless otherwise exempted. The stormwater management plan shall contain supporting computations, drawings, and sufficient information describing the manner, location, and type of measures in which stormwater runoff will be managed from the entire development. The Responsible Authority shall review the plan to determine compliance with the requirements of this ordinance prior to approval. The plan shall serve as the basis for all subsequent construction.

B. Notification of approval or reasons for disapproval or modification shall be given to the applicant within [time frame] after submission of the completed stormwater plan. If a decision is not made within [time frame] the applicant shall be informed of the status of the review process and the anticipated completion date. The stormwater management plan shall not be considered approved without the inclusion of the signature and date of signature of the responsible official on the plan.

5.2 Contents of the Stormwater Management Plan

A. The developer is responsible for submitting a stormwater management plan that meets the design requirements of this ordinance. The plan shall be accompanied by a report that includes sufficient information to evaluate the environmental characteristics of affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing stormwater runoff. An engineer licensed in Connecticut shall certify on the drawings that all clearing, grading, drainage, construction, and development shall be conducted in strict accordance with the plan. If a stormwater management plan involves direction of some or all runoff off of the site, it is the responsibility of the developer to obtain from adjacent property owners any easements or necessary property interests concerning flowage of water. Approval of a stormwater management plan does not create or affect any right to direct runoff onto adjacent property without that property owner's permission.

The minimum information submitted for support of a stormwater management plan or application for a waiver shall be as follows:

B. Reports submitted for stormwater management plan approval shall include:

(1) A brief narrative description of the project;

(2) Geotechnicial investigations including soil maps, borings, site-specific recommendations, and any additional information necessary for the proposed stormwater management design;

(3) Descriptions of all watercourses, impoundments, and wetlands on or adjacent to the site or into which stormwater directly flows;

(4) Hydrologic computations, including drainage area maps depicting pre development and post development runoff flow path segmentation and land use that demonstrate compliance with Section 4.0 of this ordinance;

(5) Hydraulic computations;

(6) Structural computations;

(7) Hydrologic sizing criteria computations according to the Design Manual; and

(8) Any other information required by the Responsible Authority.

C. Construction drawings submitted for stormwater management plan approval shall include the following:

(1) A vicinity map;

(2) Topography survey showing existing and proposed contours, including the area necessary to determine downstream analysis for proposed stormwater management facilities;

(3) Any proposed improvements including location of buildings or other structures, impervious surfaces, storm drainage facilities, and all grading;

(4) The location of existing and proposed structures and utilities;

(5) Any easements and rights-of-way;

(6) The delineation, if applicable, of the 100-year floodplain and any on-site wetlands;

(7) Structural and construction details for all components of the proposed drainage system or systems, and stormwater management facilities.

(8) All necessary construction specifications;

(9) A sequence of construction;

(10) Data for total site area, disturbed area, new impervious area, and total impervious area;

(11) A table showing the hydrologic sizing criteria volumes described in the Design Manual;

(12) A table of materials to be used for stormwater management facility planting;

(13) All soil boring logs and locations;

(14) A maintenance schedule;

(15) Certification by a Connecticut certified engineer that all stormwater management construction will be done according to this plan;

(16) An as-built certification signature block to be executed after project completion; and

(17) Any other information required by the Responsible Authority.

5.3 Preparation of the Stormwater Management Plan

A. A professional engineer licensed in the State shall design and prepare a stormwater management plan as necessary to protect the public and the environment.

B. If a stormwater treatment practice requires either a dam safety permit from DEP or approval from the Inland Wetlands and Watercourses Agency, the Responsible Authority shall require that a professional engineer licensed in the State prepare the design.

6.0 PERMITS

6.1 Permit Requirement

A building permit may not be issued for any parcel or lot unless a stormwater management plan has been approved or waived by the Responsible Authority as meeting all the requirements of this ordinance. Where appropriate, a building permit may not be issued without:

A. Recorded easements for the stormwater management facility and easements to provide adequate access for inspection and maintenance from a public right-of-way;

B. A recorded stormwater management maintenance agreement;

C. A cash bond; and

D. Permission from adjacent property owners as necessary.

6.2 Permit Fee

A non-refundable permit fee will be collected at the time the stormwater management plan or application for waiver is submitted. The permit fee will provide for the cost of plan review, administration, and management of the permitting process, and inspections by the Responsible Authority of all projects subject to this ordinance. A permit fee schedule shall be established by the Responsible Authority based upon the relative complexity of the project and may be amended from time to time.

6.3 Permit Suspension and Revocation

Any building permit issued by the Responsible Authority may be suspended or revoked after written notice is given to the permittee for any of the following reasons:

A. Any violation(s) of the conditions of the stormwater management plan approval.

B. Changes in site runoff characteristics upon which an approval or waiver was granted.

C. Construction is not in accordance with the approved plan.

D. Noncompliance with correction notice(s) or stop work order(s) issued for the construction of the stormwater management facility.

E. An immediate danger exists in a downstream area in the opinion of the Responsible Authority.

6.4 Permit Conditions

In granting the plan approval, the Responsible Authority may impose such conditions that may be deemed necessary to ensure compliance with the provisions of this ordinance and the preservation of the public health and safety.

7.0 CASH BOND

The Responsible Authority shall require from the developer a cash bond prior to the issuance of any building permit for the construction of a development requiring a stormwater management facility. The amount of the security shall not be less than the total estimated construction cost of the stormwater management facility. The bond required in this section shall include provisions relative to forfeiture for failure to complete work specified in the approved stormwater management plan, compliance with all of the provisions of this ordinance, and other applicable laws and regulations, and any time limitations. The bond shall not be fully released without a final inspection of the completed work by the Responsible Authority, submission of "as-built" plans, and certification of completion by the Responsible Authority that the stormwater management facilities comply with the approved plan and the provisions of this ordinance. A procedure may be used to release parts of the bond held by the Responsible Authority after various stages of construction have been completed and accepted by the Responsible Authority. The procedures used for partially releasing performance bonds must be specified by the Responsible Authority in writing prior to stormwater management plan approval.

[1) a cash bond posted within the Town treasury or 2) a surety bond that the town could investigate/ approve. Language should be consistent with language currently under review/development by Town Counsel.]

The bond requirement under this ordinance may be waived by the Responsible Authority provided that a bond is required by another agency in the amount equal to or greater than the total estimated construction cost of the stormwater management facilities for the project.

8.0 INSPECTION

8.1 Inspection Schedule and Reports

A. The developer shall notify the Responsible Official at least 48 hours before commencing any work in conjunction with the stormwater management plan and upon completion of the project when a final inspection will be conducted.

B. The developer shall retain a professional engineer licensed in the State to conduct inspections. Written inspection reports shall be made of the periodic inspections necessary during construction of stormwater management systems to ensure compliance with the approved plans.

C. Written inspection reports shall be provided by the developer's engineer to the Responsible Authority on a standard form provided by the Town.

D. The owner/developer and on-site personnel shall be notified in writing when violations are observed. Written notification shall describe the nature of the violation and the required corrective action.

E. No work shall proceed until the Responsible Authority approves the work previously completed. The inspector shall provide the developer and Responsible Authority with the results of the inspection reports as soon as possible after completion of each required inspection.

8.2 Inspection Requirements During Construction

A. At a minimum, inspections shall be made and documented at the following specified stages of construction:

(1) For stormwater ponds:

(a) Upon completion of excavation to sub-foundation and when required, installation of structural supports or reinforcement for structures, including but not limited to:

(i) Core trenches for structural embankments

(ii) Inlet and outlet structures, anti-seep collars or diaphragms, and watertight connectors on pipes; and

(iii) Trenches for enclosed storm drainage facilities;

(b) During placement of structural fill, concrete, and installation of piping and catch basins;

(c) During backfill of foundations and trenches;

(d) During embankment construction; and

(e) Upon completion of final grading and establishment of permanent stabilization.

(2) For stormwater wetlands – at the stages specified for pond construction in 8.2 A (1) of this section, during and after wetland reservoir area planting, and during the second growing season to verify a vegetation survival rate of at least 50 percent.

(3) For infiltration trenches:

(a) During excavation to subgrade;

(b) During placement and backfill of underdrain systems and observation wells;

(c) During placement of geotextiles and all filter media;

(d) During construction of appurtenant conveyance systems such as diversion structures, pre-filters and filters, inlets, outlets, and flow distribution structures; and

(e) Upon completion of final grading and establishment of permanent stabilization;

(4) For infiltration basins – at the stages specified for pond construction in 8.2 A (1) of this section and during placement and backfill of underdrain systems.

(5) For filtering systems:

(a) During excavation to subgrade;

(b) During placement and backfill of underdrain systems;

(c) During placement of geotextiles and all filter media;

(d) During construction of appurtenant conveyance systems such as flow diversion structures, pre-filters and filters, inlets, outlets, orifices, and flow distribution structures; and

(e) Upon completion of final grading and establishment of permanent stabilization.

(6) For open channel systems:

(a) During excavation to subgrade;

(b) During placement and backfill of underdrain systems for dry swales;

(c) During installation of diaphragms, check dams, or weirs; and

(d) Upon completion of final grading and establishment of permanent stabilization.

(7) For nonstructural practices – upon completion of final grading, the establishment of permanent stabilization, and before issuance of use and occupancy approval.

(8) For secondary treatment practices, including subsurface manufactured devices:

(a) During excavation to subgrade;

(b) During placement and backfill of treatment unit;

(c) During construction of appurtenant conveyance systems such as diversion structures, pre-filters and filters, inlets, outlets, and flow distribution structures; and

(e) Upon completion of final grading and establishment of permanent stabilization;

B. The Responsible Authority may, for enforcement purposes, use any one or a combination of the following actions:

(1) A notice of violation shall be issued specifying the need for a violation to be corrected if the stormwater management plan noncompliance is identified;

(2) A stop work order shall be issued for the site by the Responsible Authority if a violation persists;

(3) Bonds or securities may be withheld or the case may be referred for legal action if reasonable efforts to correct the violation have not been undertaken; or

(4) In addition to any other sanctions, a civil action or criminal prosecution may be brought against any person in violation of the Stormwater Management subtitle or this ordinance.

C. Any step in the enforcement process may be taken at any time, depending on the severity of the violation.

D. Once construction is complete, as-built plan certification shall be submitted by a professional engineer licensed in the State to ensure that constructed stormwater management practices and conveyance systems comply with the specifications contained in the approved plans. At a minimum, as-built certification shall include a set of drawings comparing the approved stormwater management plan with what was constructed the Responsible Authority may require additional information.

9.0 MAINTENANCE

9.1 Maintenance Inspection

A. The owner (or the developer during construction) shall ensure that all stormwater management systems are inspected for performance of preventative maintenance. Inspection shall occur during the first year of operation and at least once every 3 years thereafter. In addition, a maintenance agreement between the owner and the Responsible Authority shall be executed for privately owned stormwater management systems as described in 9.2 of this section.

B. The owner (or the developer during construction) shall maintain inspection reports for all stormwater management systems.

C. Inspection reports for stormwater management systems shall include the following:

(1) The date of inspection;

(2) Name of inspector;

(3) The condition of:

(a) Vegetation or filter media;

(b) Fences or other safety devices;

(c) Spillways, valves, or other control structures;

(d) Embankments, slopes, and safety benches;

(e) Reservoir or treatment areas;

(f) Inlet and outlet channels or structures;

(g) Underground drainage;

(h) Sediment and debris accumulation in storage and forebay areas;

(i) Any nonstructural practices to the extent practicable; and

(j) Any other item that could affect the proper function of the stormwater management system.

(4) Description of needed maintenance.

D. After notification is provided to the owner of any deficiencies discovered from an inspection of a stormwater management system, the owner shall have 30 days or other time frame mutually agreed to between the Responsible Authority and the owner to correct the deficiencies. The Responsible Authority shall then conduct a subsequent inspection to ensure completion of the repairs.

E. If repairs are not undertaken or are not done properly, then enforcement procedures following 9.2 C of this section shall be followed by the Responsible Authority

F. If, after an inspection by the Responsible Authority, the condition of a stormwater management facility presents an immediate danger to the public health or safety, because of an unsafe condition or improper maintenance, the Responsible Authority shall take such action as may be necessary to protect the public and make the facility safe. Any cost incurred by (City Name) shall be assessed against the owner(s), as provided in Section 9.2 C.

9.2 Maintenance Agreement

A. Prior to the issuance of any building permit for which stormwater management is required, the Responsible Authority shall require the applicant or owner to execute an inspection and maintenance agreement binding on all subsequent owners of land served by a private stormwater management facility. Such agreement shall provide for access to the facility at reasonable times for regular inspections by the Responsible Authority or its authorized representative to ensure that the facility is maintained in proper working condition to meet design standards.

B. The applicant and/or owner shall record the agreement in the land records of (City Name).

C. The agreement shall also provide that, if after notice by the Responsible Authority to correct a violation requiring maintenance work, satisfactory corrections are not made by the owner(s) within a reasonable period of time (30 days maximum), the Responsible Authority may perform all necessary work to place the facility in proper working condition. The owner(s) of the facility shall be assessed the cost of the work and any penalties. This may be accomplished by placing a lien on the property, which may be placed on the tax bill and collected as ordinary taxes by the County/Municipality.

9.3 Maintenance Responsibility

A. The owner of the property on which work has been done pursuant to this ordinance for private stormwater management facilities, or any other person or agent in control of such property, shall maintain in good condition and promptly repair and restore all grade surfaces, walls, drains, dams and structures, vegetation, erosion and sediment control measures, and other protective devices. Such repairs or restoration and maintenance shall be in accordance with approved plans.

B. A maintenance schedule shall be developed for the life of any stormwater management facility and shall state the maintenance to be completed, the time period for completion, and who shall perform the maintenance. This maintenance schedule shall be printed on the approved stormwater management plan.

10.0 APPEALS

Any person aggrieved by the action of any official charged with the enforcement of this ordinance, as the result of the disapproval of a properly filed application for a permit, issuance of a written notice of violation, or an alleged failure to properly enforce this ordinance in regard to a specific application, shall have the right to appeal in a manner prescribed in the regulations and procedures of the Responsible Authority and the State of Connecticut.

11.0 SEVERABILITY

If a court of competent jurisdiction holds any portion of this ordinance invalid or unconstitutional, such portion shall not affect the validity of the remaining portions of this ordinance. It is the intent of (City Name) that this ordinance shall stand, even if a section, subsection, sentence, clause, phrase, or portion may be found invalid.

12.0 PENALTIES

Any person convicted of violating the provisions of this ordinance shall be guilty of a misdemeanor, and upon conviction thereof, shall be subject to a fine of not more than Five Thousand Dollars ($5,000.00) or imprisonment not exceeding 1 year or both for each violation with costs imposed in the discretion of the court. Each day that a violation continues shall be a separate offense. In addition, the Responsible Authority may institute or cause to be instituted injunctive, mandamus or other appropriate action or proceedings of law to correct violations of this ordinance. Any court of competent jurisdiction shall have the right to issue temporary or permanent restraining orders, injunctions or mandamus, or other appropriate forms of relief.

13.0 EFFECTIVE DATE

And be it further enacted, that this ordinance shall take effect [number] days from the date it becomes adopted.

ATTACHMENT B

Tolland Zoning Regulation Amendments
Low Impact Development

ARTICLE XXIV
LOW IMPACT DEVELOPMENT

The Town of Tolland requires that Low Impact Development techniques be implemented on all development projects within the boundaries of the Town to protect high quality wetlands, watercourses, open water bodies and other sensitive areas from the impacts of point and non-point sources of storm water due to land development projects.

The concept of Low Impact Development (LID) utilizes many tools to reduce the impact of development on the environment. A primary benefit of LID is a better balance between Conservation of Natural Resources, growth, ecosystem protection and the public health.

A. Goals of Low Impact Development

- Preserve Open Space within developments by using Cluster and Open Space subdivision standards as found in Section 170-38 of these regulations.
- Incorporate natural site elements (ridge lines, significant trees, open meadows, suitable soils for infiltration, wetlands and streams) into the design as features.
- Minimize land clearing and disturbance and increase natural landscape buffers at the limit of development to improve storm water management.
- Incorporate decentralized storm water management systems in to the site design, treat storm water runoff at its source, disconnect impervious areas.
- Maintain pre-development Times of Concentrations for post-development runoff Maintain sheet flow to the maximum extent possible, avoid concentrating runoff, reduce runoff volumes by infiltration.
- Provide water quality treatment to remove pollutants from storm water, pollution, modify human activities to reduce the introduction of pollutants into the environment.
- Encourage public education and participation in environmental protection within the community

B. Benefits of Low Impact Development

There are many benefits associated with the use of Low Impact Development for all of the stakeholders in the development field. The three stakeholders in the development field are the environment, the municipality, and the developer. The benefits of LID for each stakeholder are stated below.

1. Environmental Benefits:
    - Preserve the biological and ecological integrity of natural systems through the preservation of trees and natural vegetation,
    - Protect the water quality by reducing sediment, nutrient and toxic loads to wetland/watercourse aquatic environments and also terrestrial plants and animals.

2. Municipality Benefits:
    - Increase collaborative public/private partnerships on environmental protection by the protection of regional flora and fauna.
    - Balance Growth needs with environmental protections.
    - Reduce municipal infrastructure and utility maintenance costs (roads, and storm water drainage systems)

3. Developer Benefits:
    - Reduce land clearing and earth disturbance costs, reduce infrastructure costs (roads, storm water conveyance and treatment systems)
    - Reduce storm water management costs by the reduction of structural components of a drainage system.
    - Increase quality of building lots and community marketability.

C. Low Impact Development Strategies

1. Vegetation and Soils:
    - Retain native forest cover on undeveloped sites, restore vegetated area on previously cleared sites when possible as vegetation captures rainfall, thus increasing evapotranspiration and infiltration.

2. Site Design:
    - Define and locate Critical Resource areas, such as wetlands/watercourses, unusual forest features, and soils with moderate to high infiltrative capacities, locate roads, driveways, parking areas, home sites and other buildings away from critical resource areas
    - Minimize impervious surfaces such as roads, driveways, parking areas, and roof tops. Eliminate direct discharges of runoff from impervious areas to wetlands and watercourses

3. Storm Water Management:
    - Reduce reliance on the use of traditional storm water collection and conveyance systems (catch basins, pipes, and detention basins) and use small scale storm water management systems, such as bioretention, and rain gardens. Integrate source storm water controls during the design process.

    - Create a site design that slows runoff from rainfall events and increases the amount of time that runoff stays on the site. Incorporate multiple Low Impact Development treatment systems in a treatment train to increase the redundancy of the system to reduce the possibility of system failure

4. Education and Maintenance
    - Develop reliable long-term maintenance protocols for LID systems with built in enforcement provisions.

- Educate homeowners, building owners and landscape contractors on the appropriate maintenance requirements for LID systems

D. Types of LID Storm Water Systems:
1. Vegetated Systems:
   - Vegetated Buffers, Rain Gardens, Bioretention Systems, Water Quality Swales (wet and dry), Grass Filter Strips, Vegetated Level Spreaders, and Vegetated Roofs

2. Infiltration Systems:
   - Soil Amendments, Surface Sand Filters, Underground Sand Filters, Gravel Infiltration Trenches, Underground Infiltration Systems, (large diameter perforated PVC pipes and galleries), and Tree Wells

3. Surface Treatment Systems:
   - Permeable Pavement, Permeable Concrete, Concrete or PVC Pavers with gravel or grass surface

4. Storm Water Ponds and Wetland Systems:
   - Wet Ponds, Multiple Ponds in series, Gravel Wetland Systems, Micropool extended detention pond, Shallow Wetlands, Pond/wetland system, and Extended detention ponds

Refer to Town of Tolland Design Manual for more information on individual systems.

References:
1. Low-Impact Development Design Strategies – An Integrated Design Approach
Prepared by: Prince George's County, Maryland; Department of Environmental Resources, Programs and Planning Division; June 1999
2. Low-Impact Development Hydrologic Analysis
Prepared by: Prince George's County, Maryland; Department of Environmental Resources, Programs and Planning Division; July 1999
3. LOW IMPACT DEVELOPMENT – Technical Guidance Manual for Puget Sound; January 2005
Prepared by Puget Sound Action Team * Washington State University Pierce County Extension
4. 2004 Connecticut Stormwater Quality Manual by the Connecticut Department of Environmental Protection
5. 2002 Connecticut Guidelines for Soil Erosion and Sediment Control by The Connecticut Council on Soil and Water Conservation in Cooperation with the Connecticut Department of Environmental Protection

ATTACHMENT C

Example LID Site Design Credit System

LOW IMPACT DEVELOPMENT (LID) SITE DESIGN CREDIT SYSTEM

DRAFT

The Low Impact Development (LID) Site Design Credits encourage environmentally sensitive site design and Low Impact Development techniques for managing stormwater that minimize impervious surfaces and preserve natural hydrologic conditions. The credits allow project proponents to reduce or eliminate the structural stormwater BMPs otherwise required to meet Standards 3 and 4 by directing stormwater runoff to qualifying pervious surfaces that provide recharge and treatment.

Available LID Site Design Credits

There are five types of LID credits that can be obtained:

- Credit 1 – Natural Area Conservation,
- Credit 2 – Environmentally Sensitive Development,
- Credit 3 – Rooftop Runoff Directed to Qualifying Pervious Area,
- Credit 4 – Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area,
- Credit 5 – Sheet Flow to Buffer.

The credits may be used to reduce the required Groundwater Recharge Volume (GRV) and the required Water Quality Volume (WQV) provided that any pervious surfaces used to treat and infiltrate stormwater runoff meet the requirements set forth herein. A proponent of a project that is eligible for the site design credit is required to comply with all other applicable stormwater management standards. The application of these credits does not relieve the design engineer or reviewer from the standard of engineering practice associated with safe conveyance of stormwater runoff and good drainage design.

Not Eligible for Credits

The LID Site Design Credits may <u>not</u> be applied to reduce the required Groundwater Recharge Volume and the required Water Quality Volume:

- At sites where stormwater runoff is directed to non-permeable soils, such as bedrock and soils classified as Hydrologic Soil Group D; and
- At sites with urban fill, soils classified as contaminated pursuant to the Connecticut Remediation Standards Regulations, and soils with seasonal high groundwater – groundwater elevation within 2 feet of the land surface.

Sites with land uses with higher potential pollutant loads are not eligible for Credit No. 2.

Sites with land uses with higher potential pollutant loads are eligible for Credits 3 and 4, provided that no runoff from the areas or activities that may generate runoff with higher potential pollutant loads is directed to the pervious surfaces used to satisfy the credit, and provided further that the proposal satisfies all the other requirements set forth herein.

Runoff from metal roofs is only eligible for Credit 3 when the metal roof is located outside a recharge areas for public water supplies (groundwater and surface water supplies) and the building is not used for industrial purposes.

Runoff from green roofs is not eligible for Credit 3.

1. Natural Area Conservation Credit

A credit is given when natural areas are conserved at development sites, thereby preserving predevelopment hydrologic and water quality characteristics. A simple WQV credit is granted for all conservation areas permanently protected under conservation easements. Under this credit, the design engineer can substract the conservation areas from the total site area when computing the water quality volume. The volumetric runoff coefficient, R, is still based upon the percent impervious cover for the entire site. As an additional incentive, the post-development curve number (CN) for all natural areas permanently protected can be assumed to be woods in good condition when calculating the total site CN.

Minimum Criteria for Credit:

- The area shall not be disturbed during the construction process.
- The area shall be protected from having the limits of disturbance clearly shown on all construction and mitigation plans and shall be delineated in the field.
- The area shall be located within an acceptable conservation easement or other enforceable instrument that provides perpetual protection of the area.
- The area shall be located on the development project site.

2. Environmentally Sensitive Development Credit

This credit is given for environmentally sensitive site design techniques that "cluster development" or reduce development scale, to leave a significant amount of the site undisturbed in its natural state. If a site is designed, constructed, operated and maintained in accordance with the requirements of this credit, the credit eliminates the need for structural practices to treat the WQV (Standard 4) and GRV (Standard 5) for low density or cluster residential developments.

Minimum Criteria for Credit:

Single Lot Development

- Total site impervious cover is less than 15%.
- Lot size shall be at least 1 acre.
- Rooftop runoff is disconnected in accordance with the criteria listed in Credit 3 and qualifying pervious areas are used to convey runoff from roads and driveways instead of curb and gutter systems in accordance with the criteria listed in Credit 4.

Multiple Lot Development

- Total site impervious cover is less than 15%.
- Lot size shall be at least 1 acre if clustering techniques are not used.

- If clustering techniques are used, the average lot shall not be less than _____ square feet, which is the minimum residential lot size as identified in the Town of _______ Building Zone Regulations.
- Rooftop runoff is disconnected in accordance with the criteria listed in Credit 3 and qualifying pervious areas are used to convey runoff from roads and driveways instead of curb and gutter systems in accordance with the criteria listed in Credit 4.
- A minimum of 25% of the site is placed in a natural conservation area maintained by an acceptable conservation easement or other enforceable instrument that provides perpetual protection of the area.

3. Rooftop Runoff Directed to Qualifying Pervious Area Credit

This credit is available when rooftop runoff is directed to a qualifying pervious area where it can either infiltrate into the soil or flow over it with sufficient time and reduced velocity to allow for filtering. Qualifying pervious areas are relatively flat locations, where the discharge is directed via sheet flow and not as a point source discharge. The credit may be obtained by grading the site to induce sheet flow over specially designed flat vegetated areas or bioretention areas that can treat and infiltrate rooftop runoff. If rooftop runoff is adequately directed to a qualifying pervious area, the rooftop area can be deducted from total impervious area, therefore reducing the required WQV and the size of the structural treatment practices.

Minimum Criteria for Credit:

- To take credit for rooftop disconnection associated with a land use with higher potential pollutant loads, the rooftop runoff must not commingle with runoff from any paved surfaces or activities or areas on the site that may generate higher pollutant loads.
- Disconnection shall cause no basement seepage.
- The contributing area of the rooftop to each disconnected discharge point (gutter pipe) shall not exceed 1,000 square feet.
- The length of the qualifying pervious area shall be 75 feet or greater.
- The width of the qualifying pervious area (in feet) shall be equal to or greater than the roof length. For example, if a roof section is 20 feet wide by 50 feet long (1,000 ft2 roof), the width of the qualifying pervious area shall be at least 50 feet.
- Dry wells, rain gardens, or other filtration/infiltration treatment practices may be utilized to compensate if the disconnection length is less than 75 feet.
- Although they may abut, there shall be no overlap between qualifying pervious areas. For example, the runoff from two 1,000 square foot sections of roof must be directed to separate qualifying pervious areas. They may not be directed to the same area.
- The lot must be greater than ______ square feet.
- The slope of the qualifying pervious area shall be less than or equal to 5%.
- Where provided, downspouts must be at least 10 feet away from the nearest impervious surface to discourage reconnection to the stormwater management system.
- Where a gutter/downspout system is not used, the rooftop runoff must be designed to sheet flow at low velocity away from the structure housing the roof.
- Qualifying pervious areas should be located on relatively permeable soils (HSG "A" and "B"). A soil evaluation by a Registered Professional Engineer or soil scientist is required to confirm the soil type. The soil evaluation shall also confirm that the depth to groundwater is 2 feet or more and that the long-term saturated hydraulic conductivity of

the soil is at least 0.17 inches/hour. The soil evaluation must identify the soil texture, Hydrologic Soil Group and depth to groundwater. For saturated hydraulic conductivity, use Rawls Rates for the actual location where the qualifying pervious area is located.

- If a qualifying pervious area is located in less permeable soils (HSG "C"), the water table depth and permeability shall be evaluated by a Registered Professional Engineer to determine if a spreading device is needed to sheet flow stormwater over vegetated surfaces.
- To prevent compaction of the soil in the qualifying pervious area, construction vehicles must not be allowed to drive over the area. If it becomes compacted, the soil must be amended, tilled and revegetated to restore its infiltrative capacity once construction is complete.
- The qualifying pervious area may not include any wetland areas.
- The qualifying pervious area must be owned or controlled (e.g., drainage easement) by the property owner.
- For those rooftops draining directly to a buffer, only the rooftop disconnection credit or the buffer credit may be taken, not both.

4. Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area Credit

Credit is given for practices that direct runoff from impervious roads, driveways, and parking lots to pervious areas where plants provide filtration (through sheet flow) and infiltration into the soil can occur. This credit can be obtained by grading the site to promote overland vegetative filtering and infiltration. This credit is available for paved driveways, roads, and parking lots associated with all land uses, except for high-intensity parking lots that generate 1,000 or more vehicle trips per day or runoff not segregated from land uses with higher potential pollutant loads.

Disconnected impervious areas can be subtracted from the site impervious area when computing the WQV. In addition, disconnected impervious surfaces can be used to reduce the GRV.

Minimum Criteria for Credit:

- The maximum contributing impervious flow path length shall be 75 feet.
- The length of the qualifying pervious area must be equal to or greater than the length of the contributing impervious area.
- Dry wells, rain gardens, or other filtration/infiltration treatment practices may be utilized to compensate if the site cannot meet the required length of the qualifying pervious area.
- The width of the qualifying pervious area shall be no less than the width of the contributing impervious surface. For example, if a driveway is 15 feet wide, the qualifying pervious area width shall be no less than 15 feet.
- The entire qualifying pervious area shall be on a slope less than or equal to 5%.
- The impervious area draining to any one discharge location cannot exceed 1,000 square feet.
- Qualifying pervious areas should be located on relatively permeable soils (HSGs A and B). A soil evaluation is required to confirm the soil type. The soil evaluation shall also

confirm that the depth to groundwater is 2 feet or more, and that the long term saturated hydraulic conductivity of the soil is at least 0.17 inches/hour. For saturated hydraulic conductivity, use Rawls Rates for the actual location where the qualifying pervious area is located.
- If a qualifying pervious area is located in less permeable soils (HSG C), the water table depth and permeability shall be evaluated by a Registered Professional Engineer to determine if a spreading device is needed to sheet flow stormwater over vegetated surfaces.
- To prevent compaction, construction vehicles must not be allowed to drive over the qualifying pervious area. If compacted, the soil must be amended, tilled, and revegetated once construction is complete to restore its infiltrative capacity.
- Runoff from driveways, roadways and parking lots may be directed over soft shoulders, through curb cuts, or level spreaders to qualifying pervious areas. Measures must be employed at the discharge point to the qualifying pervious area to prevent erosion and promote sheet flow.
- The qualifying pervious area may not include any wetland areas.
- The qualifying pervious area must be owned or controlled (e.g., drainage easement) by the property owner.
- For those rooftops draining directly to a buffer, only the rooftop disconnection credit or the buffer credit may be taken, not both.

5. Sheet Flow to Buffer Credit

This credit is given when stormwater is effectively treated by a natural buffer to a stream or forested area. Effective treatment is achieved when pervious and impervious area runoff is discharged to a grass or forested buffer via overland flow. The use of a filter strip is recommended to treat overland flow in the green space of a development site. This credit includes subtracting the area draining by sheet flow to a buffer from the total area in the WQV calculation and the area draining to the buffer contributes to the GRV requirement.

Minimum Criteria for Credit:
- The minimum stream buffer width (i.e., perpendicular to the stream flow path) shall be 50 feet as measured from the bank elevation of a stream or the boundary of a wetland.
- The maximum contributing path shall be 150 feet for pervious surfaces and 75 feet for impervious surfaces.
- The average contributing overland slope to and across the stream buffer shall be less than or equal to 5%.
- Runoff shall enter the stream buffer as sheet flow. A level spreading device shall be utilized where local site conditions prevent sheet flow from being maintained.
- The credit is not applicable if rooftop or non-rooftop disconnection is already provided (i.e., no double counting).
- Stream buffers shall remain unmanaged other than routine debris removal.
- Buffers shall be protected by an acceptable conservation easement or other enforceable instrument that provides perpetual protection of the area.

ATTACHMENT D

Example Stormwater Management Standards

STORMWATER MANAGEMENT STANDARDS

DRAFT

The following stormwater standards establish minimum stormwater management criteria for all development and redevelopment activities in the Town of _______ and reflect the unique natural resources and development characteristics of the Town of ________. These standards encourage groundwater recharge and reduce the potential for stormwater discharges to cause or contribute to pollution of surface water and groundwater. The standards also promote low impact development (LID) techniques, the removal of illicit discharges to stormwater management systems, and improved operation and maintenance of stormwater BMPs. The standards are also consistent with the recommended stormwater management approaches and design guidance contained in the Connecticut Department of Environmental Protection *Connecticut Stormwater Quality Manual.*

Standard 1: Stormwater Management Practices

Stormwater Management Practices shall be used to meet the conditions below for control of peak flow and total volume of runoff, water quality protection, and maintenance of on-site groundwater recharge.

A. Stormwater management practices shall be selected to accommodate the unique hydrologic and geologic conditions of the site.

B. Proponents shall demonstrate how the proposed control(s) will comply with these standards, including the control of peak flow and total volume of runoff, protection of water quality, and recharge of stormwater to groundwater. The proponent must provide design calculations and other back-up materials necessary.

C. At the discretion of the Stormwater Authority, stormwater management systems shall incorporate designs that allow for shutdown and containment in the event of an emergency spill or other unexpected contamination event.

D. Pumping of stormwater is prohibited as part of a proposed stormwater management system design because of the significant runoff volumes, maintenance requirements, standby power requirements, and overflows associated with large storms. All other feasible approaches must be investigated to avoid the use of pumps for stormwater management. If the event the Stormwater Authority determines that pumps are necessary, the proponent must submit required backup information as described in the ________ Stormwater Drainage Manual.

Standard 2: Low Impact Development

A. Project proponents must consider the use of environmentally-sensitive site design and Low Impact Development (LID) techniques to reduce runoff rates, volumes, and pollutant loads. The proponent shall demonstrate why the use of environmentally-sensitive site design and LID techniques is not possible before proposing to use traditional, structural stormwater management measures. Such environmentally-sensitive site design and LID techniques include, but are not limited to:

a. Identify, map, and preserve the site's natural features and environmentally sensitive areas such as wetlands, native vegetation, mature trees, slopes, drainageways, permeable soils, flood plains, woodlands and soils to the greatest extent possible;
b. Minimize grading and clearing;
c. Delineate potential building envelopes, avoiding environmental resource areas and appropriate buffers by clustering buildings and reducing building footprints;
d. Develop methods to minimize impervious surfaces, and protect and preserve open space. Reduce impervious surfaces wherever possible through alternative street design, such as omission of curbs and use of narrower streets, shared driveways and through the use of shared parking areas;
e. Lengthen flow paths and maximize sheet flow;
f. Use nonstructural, low-tech methods including open drainage systems, disconnection of roof runoff, and street sweeping where possible;
g. Use native plant vegetation in buffer strips and in rain gardens (small planted depressions that can trap and filter runoff);
h. Use drought-resistant vegetation;
i. Manage runoff using smaller, decentralized, low-tech stormwater management techniques to treat and recharge stormwater close to the source in place of a centralized system comprised of closed pipes that direct all the drainage from the entire site into one large detention basin.
j. Integrate management techniques into the site design to create a hydrologically functional lot or development site, including but not limited to grass swales along roads, rain gardens, buffer strips, green roofs, tree box filters, use of amended soils that will store, filter and infiltrate runoff, bioretention areas (rain gardens), rain barrels and cisterns, and permeable pavement.

[NOTE: An "LID Site Design Credit" is available to encourage proponents to incorporate LID techniques in their projects. In exchange for directing runoff from roads and driveways to vegetated open areas, preserving natural areas on development sites, or directing runoff to landscaped or undisturbed areas, the LID credit system allows developers to reduce in size or eliminate the traditional BMPs used to treat and infiltrate stormwater. By using this credit, proponents can reduce the volume of stormwater subject to the Water Quality and Groundwater Recharge Standards. The proposed LID Site Design Credits include:

- Credit 1 – Natural Area Conservation
- Credit 2 – Environmentally Sensitive Development
- Credit 3 – Rooftop Runoff Directed to Qualifying Pervious Area
- Credit 4 – Roadway, Driveway or Parking Lot Runoff Directed to Qualifying Pervious Area]

Standard 3: Protection of Natural Hydrology

[NOTE: These standards are further reinforced through the LID Credit System.]

A. Site disturbance shall be minimized. The area outside the project disturbance area shall be maintained at natural grade and retaining existing, mature vegetated cover. The project disturbance area shall be depicted on the design, construction, and mitigation plans and shall be delineated in the field prior to commencing land disturbance activities. The project disturbance area shall include only the area necessary to reasonably accommodate construction activities.

B. Soil compaction on site shall be minimized by using the smallest (lightest) equipment possible and minimizing travel over areas that will be revegetated (e.g., lawn areas) or used to infiltrate stormwater (e.g., bioretention areas). In no case shall excavation equipment be placed in the bottom of an infiltration area during construction.

C. Development shall follow the natural contours of the landscape. A grading plan shall be submitted as part of the site plan review process showing both existing and finished grades for the proposed development. The original, natural grade of a lot shall not be raised or lowered more than 10 feet at any point for the construction of any structure or improvements. Retaining walls must comply with the requirements of the Building Zone Regulations. Basements that reach grade should be constructed as walk-outs.

D. No ground disturbed as a result of site construction and development shall be left as exposed bare soil at project completion. All areas exposed by construction, with the exception of finished building, structure, and pavement footprints, shall be decompacted (aerated) and covered with a minimum thickness of six inches of non-compacted topsoil, and shall be subsequently planted with a combination of living vegetation such as grass, groundcovers, trees, and shrubs, and other landscaping materials (mulch, loose rock, gravel, stone).

E. Priority shall be given to maintaining existing surface waters and systems, including, but not limited to, perennial and intermittent streams, wetlands, vernal pools, and natural swales.

F. Where roadway or driveway crossings of surface waters cannot be eliminated, disturbance to the surface water shall be minimized, hydrologic flows shall be maintained, there shall be no direct discharge of runoff from the roadway to the surface water, and the area shall be revegetated post-construction.

G. Roadway and driveway crossings over streams shall comply with the Connecticut Department of Environmental Protection *Stream Crossing Guidelines* (as amended) to accommodate high flows, minimize erosion, and support aquatic habitat and wildlife passage.

Standard 4: Post-Development Peak Discharge

A. Stream Channel Protection – The two-year, 24-hour post-development peak flow rate shall be (a) less than or equal to 50 percent of two-year, 24-hour storm pre-development peak flow rate and (b) less than or equal to the one-year, 24-hour storm pre-development peak flow rate. This Standard may be waived under certain conditions, as described in the *Connecticut Stormwater Quality Manual*.

B. Conveyance Protection – The 10-year, 24-hour post-development peak flow rate shall not exceed the pre-development peak flow rate for all flows within internal and external conveyance systems associated with stormwater treatment practices.

C. Peak Runoff Attenuation – The 10-year and 25-year, 24-hour post-development peak flow rate shall not exceed the pre-development peak flow rate for all flows off-site. This Standard may be waived for sites that discharge to a large river, lake, estuary, tidal waters, or land subject to coastal storm flows, as described in the *Connecticut Stormwater Quality Manual*.

D. Emergency Outlet Sizing - size the emergency outlet to safely pass the post-development peak runoff from the 100-year storm in a controlled manner without eroding the outlet works and downstream drainages and property.

E. Measurement of peak discharge rates shall be calculated using point of discharge or the downgradient property boundary. The topography of the site may require evaluation at more than one location if flow leaves the property in more than one direction. Calculations shall include runoff from adjacent upgradient properties. A proponent may demonstrate that a feature beyond the property boundary is more appropriate as a design point.

F. A downstream hydrologic analysis must be performed to determine whether peak flows, velocities, and hydraulic effects are attenuated by controlling the 2-year, 10-year, 25-year and 100-year, 24-hour storms. This analysis must be performed at the outlet(s) of the site and at critical downstream locations (stream confluences, culverts, other channel constrictions, and flood-prone areas) to a confluence point where the site drainage area represents 10% of the total drainage area above that point.

G. The proponent shall provide pre- and post-development total runoff volumes. The post-development total runoff volume shall be equal to 90 to 110 percent of the pre-development total runoff volume (based on a 2-year, 10-year, 25-year, and 50-year, 24-hour storms). Calculations shall include runoff onto the project site from adjacent up-gradient properties.

Standard 5: Water Quality

A. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspend Solids (TSS). This standard is met when:
   a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
   b. Stormwater management practices are sized to treat the Water Quality Volume or Water Quality Flow;
   c. Appropriate pretreatment is provided in accordance with the _______ Stormwater Drainage Manual; and
   d. Stormwater treatment practices are maintained as designed.

B. Compliance with the groundwater recharge requirements under Standard 6 shall be considered adequate to meet the treatment standards specified in 5.A above for the Groundwater Recharge Volume.

Standard 6: Groundwater Recharge

Loss of annual recharge to groundwater shall be eliminated or minimized to the maximum extent practicable through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater management practices, and good operation and maintenance. At a minimum the annual recharge from the post-development site shall approximate the annual recharge from the pre-development or existing site conditions. Infiltration of stormwater runoff from land uses with higher potential pollutant loads near or to a critical area is prohibited. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to a critical area, taking into account site-specific factors.

A. For all areas covered by impervious surfaces, the total volume of recharge that must be maintained shall be calculated as follows:

[NOTE: The NRCS classifies soils into four hydrologic groups A thru D indicative of the minimum infiltration obtained for a soil after prolonged wetting. Group A soils have the lowest runoff potential and the highest infiltration rates, while Group D soils have the highest runoff potential and the lowest infiltration rates. The prescribed stormwater volume that is required to be infiltrated must be determined using existing site conditions and the infiltration rates set forth below.

Hydrologic Group Volume to Recharge (x Total Impervious Area)

Hydrologic Group		Volume to Recharge x Total Impervious Area
A	gravels, sand, loamy sand or sandy loam	0.6 inches of runoff
B	silty loam	0.35 inches of runoff
C	sandy clay loam	0.25 inches of runoff
D	clay, silty clay loam, sandy clay, silty clay	0.10 inches of runoff

For each NRCS Hydrologic Group on the site, the volume that must be recharged equals the recharge volume above multiplied by the total area within that NRCS Hydrologic Group that is impervious. Infiltration of these volumes must be accomplished using appropriate BMPs. These BMPs include bioretention areas, rain gardens, dry wells, infiltration basins, infiltration chambers and galleys, infiltration trenches, leaching catch basins, and vegetated filter strips. Roof runoff may be infiltrated without any treatment, and that infiltrated volume may be used to satisfy the total recharge volume and reduce the water quality volume.

To size infiltration BMPs, proponents may use either the static method or the dynamic infiltration method. The static method assumes that the entire volume is discharged to storage instantaneously, is easy to calculate and generally results in a larger recharge volume than the dynamic method. The dynamic method assumes that that the recharge BMP is infiltrating as it fills and requires certain technical calculations that take this recharge into account when sizing the infiltration BMP.]

B. When designing infiltration BMPs, adequate subsurface information needs to be obtained. Infiltration systems must be installed in soils capable of absorbing the recharge volume (i.e. not D soils). Surface infiltration structures must be able to drain fully within 72 hours. In addition, there must be at least a three-foot separation from the bottom of the infiltration structure and the seasonal high ground water table or bedrock/ledge. Soils under BMPs shall be scarified or tilled to improve infiltration.

C. Pre-Treatment Requirements – All runoff must be pretreated prior to its entrance into the groundwater recharge device to remove materials that would clog the soils receiving the recharge water. Pretreatment devices shall be provided for each BMP, shall be designed to accommodate a minimum of one-year's worth of sediment, shall be designed to capture anticipated pollutants, and be designed and located to be easily accessible to facilitate inspection and maintenance.

D. Infiltration of stormwater may be prohibited or subject to additional pre-treatment requirements, at the discretion of the Stormwater Authority, for 1) land uses with higher potential pollutant loads (see Standard 7), 2) areas with soil or groundwater contamination such as brownfield sites, and 3) public drinking water aquifer recharge areas, wellhead protection areas, or water supply intake protection areas.

Standard 7: Land Uses with Higher Potential Pollutant Loads

Stormwater discharges from land uses with higher potential pollutant loads require the use of specific source control and pollution prevention measures and specific stormwater management practices, approved by the Stormwater Authority for such use.

A. The following uses or activities are considered "high-load areas," with the potential to contribute higher pollutant loads to stormwater, and must comply with the requirements set forth in this section.
   a. Areas within an industrial site that are the location of activities subject to the DEP Industrial Stormwater General Permit (except where a No Exposure Certification for Exclusion from the General Permit has been executed)
   b. Vehicle salvage yards and recycling facilities
   c. Auto fueling facilities (gas stations and other facilities with on-site vehicle fueling)

d. Exterior fleet storage areas (cars, buses, trucks, public works equipment)
e. Exterior vehicle service, maintenance and equipment cleaning areas
f. Commercial parking lots with high intensity use (1,000 vehicle trips per day or more). Such areas typically include fast food restaurants, convenience stores, high turnover (chain) restaurants, shopping centers and supermarkets.
g. Road salt storage facilities (if exposed to rainfall)
h. Commercial nurseries
i. Non-residential facilities having uncoated metal roofs with a slope flatter than 20 percent.
j. Outdoor storage and loading/unloading of hazardous substances or materials
k. Facilities subject to chemical inventory reporting under Section 312 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), if materials or containers are exposed to rainfall)
l. Marinas (service, painting and hull maintenance areas).
m. Confined disposal facilities, disposal sites, landfills or wastewater residuals landfills if stormwater that may come into contact with the confined disposal area, disposal site, landfill or wastewater residuals landfill may cause or contribute to the discharge of pollutants to wetlands, surface waters or ground water or otherwise result in a release or threat of release
n. Other land uses and activities as designated by the Stormwater Authority

B. In addition to implementation of BMPs for designing site-specific stormwater management controls, high-load areas shall provide a stormwater pollution prevention plan (SWPPP) describing methods for source reduction and methods for pretreatment.

C. If a high-load area demonstrates, through a SWPPP, the use of BMPs that result in no exposure of regulated substances to precipitation or runoff or release of regulated substances, it shall no longer be considered a high-load area.

D. Infiltration of stormwater from high-load areas are prohibited within critical areas (see Standard 8). Infiltration of stormwater from high-load areas outside of critical areas (see Standard 8) is allowed. For such discharges, proponents should use one pretreatment BMP, one terminal treatment BMP, and one infiltration BMP.

E. For high-load areas, the following stormwater management practices may be used for treatment only if lined or sealed: Sand Filters/Organic Filters (may also be used for pretreatment), Wet Retention Basins, Detention Basins, Constructed Wetlands, Bioretention Areas, including rain gardens (underdrain required).

Standard 8: Critical Areas

A. Critical Areas are defined as:
a. Shellfish growing areas,
b. Bathing beaches,
c. Recharge areas for public water supplies (groundwater and surface water supplies),
d. Any listed water bodies and wetlands as designated by the Town of ________.

B. The stormwater BMPs approved for discharges to or near critical areas shall be designed to treat the Water Quality Volume (WQV) for the post-development site. These practices are included in the *Connecticut Stormwater Quality Manual* and the ______ Stormwater Drainage Manual. These stormwater discharges require the use of a treatment train that provides 80% TSS removal prior to discharge. This treatment train shall include at least one pretreatment BMP, one terminal treatment BMP, and one infiltration BMP.

C. Infiltration of stormwater from high-load areas are prohibited within critical areas.

Standard 9: Parking

A. Snow may not be plowed to, dumped in, or otherwise stored within 15 feet of a wetland or waterbody, except for snow that naturally falls into this area. Snow storage areas shall be shown on the site plan to comply with these requirements.

B. At the discretion of the Stormwater Authority, parking spaces may be required to be constructed of a pervious surface (i.e. grass, pervious asphalt, pervious pavers).

C. Infrequently used emergency access points or routes shall be constructed with pervious surfaces (i.e. grass, pervious asphalt, pervious pavers).

Standard 10: Redevelopment

A. Redevelopment projects are defined to include the following:
   a. Maintenance and improvement of existing roadways including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems and repaving;
   b. Development, rehabilitation, expansion and phased projects on previously developed sites; and
   c. Remedial projects specifically designed to provide improved stormwater management.

B. Redevelopment of previously developed sites must meet Standards 3, 4, 5, and 6 to the maximum extent practicable as determined by the Stormwater Authority. To make this determination the Stormwater Authority shall consider the benefits of redevelopment as compared to development of raw land with respect to stormwater. All projects involving redevelopment or reuse activities shall also improve existing conditions.

C. For all redevelopment projects, new stormwater controls (retrofitted or expanded) must be incorporated into the design and result in a reduction in annual stormwater pollutant loads from the site. Proponents of redevelopment projects shall make full use of all opportunities for controlling the sources of pollution and to incorporate environmentally sensitive site design and low impact development techniques. This is particularly important for constrained redevelopment sites where it is not possible to install BMPs that treat the entire water quality volume. All redevelopment projects shall also incorporate measures that will address water quantity issues by reducing the peak and total runoff from the site and by increasing groundwater recharge. Actions to improve existing conditions should address known water quality and water quantity problems such as documented failures to meet the Surface Water Quality Standards, low stream flow, or repeated flood events.

D. Redevelopment activities shall not infiltrate stormwater through materials or soils containing regulated or hazardous substances or areas with soil or groundwater contamination.

E. The portion of a property that is currently undeveloped is not a redevelopment and thus does not fall under Standard 10. Any development on previously undeveloped portions of a property must comply fully with all of the other Stormwater Management Standards.

Standard 11: Construction Erosion and Sediment Control

A. A plan to control construction related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) must be developed and implemented in accordance with the *Connecticut Guidelines for Soil Erosion and Sediment Control* (as amended).

B. All development, regardless of the area of disturbance, must implement erosion and sedimentation controls prior to and during construction.

Standard 12: Easements

A. Where a site is traversed by or requires construction of a watercourse or drainageway, an easement of adequate width may be required for such purpose.

B. There shall be at least a 10-foot wide permanent maintenance easement corridor on each side of any stormwater management system element, as well as at least a 10-foot wide temporary construction easement corridor contiguous with the boundaries of the permanent easement. For systems using underground pipes, the maintenance easement may need to be wider, depending on the depth of the pipe.

Standard 13: Operation and Maintenance

A. A long-term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed. This plan shall be reviewed and approved as part of the review of the proposed permanent (post-construction) stormwater management system and incorporated in the Stormwater Management Plan. Execution of the O&M Plan shall be considered a condition of approval of a stormwater management permit application. If the stormwater management system is not dedicated to the town pursuant to a perpetual offer of dedication, the Stormwater Authority may require a project proponent to establish a homeowners association or similar entity to maintain the stormwater management system. For high-load areas or activities under Standard 7, the O&M Plan shall include implementation of a SWPPP.

B. The O&M Plan shall at a minimum identify:
   a. Stormwater management system(s) owners;
   b. The party or parties responsible for operation and maintenance including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
   c. The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;
   d. Plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
   e. Description and delineation of public safety features; and
   f. Estimated operations and maintenance budget.

C. The stormwater management system owner is generally considered to be the landowner of the property, unless other legally binding agreements are established.

D. The proponent shall include with the stormwater management permit application a mechanism for implementing and enforcing the O&M Plan. The proponent shall identify the lots or units that will be serviced by the proposed stormwater BMPs. The proponent shall also provide a copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of stormwater BMPs. In the event that the stormwater BMPs will be operated and maintained by an entity, municipality, state agency or person other than the sole owner of the lot upon which the stormwater management facilities are placed, the proponent shall provide a plan and easement deed that provides a right of access for the legal entity to be able to perform said operation and maintenance functions, including inspections.

[NOTE: It is recommended that the stormwater management permit include a condition requiring that the responsible party provide a copy of the permit approval and the legal instrument to each unit or lot owner at or before the purchase of each unit or lot to be serviced by the stormwater BMPs.]

E. The owner shall keep the O&M Plan current, including making modifications to the O&M Plan as necessary to ensure that BMPs continue to operate as designed and approved. Proposed modifications of O&M Plans including, but not limited to, changes in inspection frequency, maintenance schedule, or maintenance activity along with appropriate documentation, shall be submitted to the Stormwater Authority for review and approval within thirty days of change.

F. Parties responsible for the operation and maintenance of a stormwater management system shall keep records of the installation, maintenance and repairs to the system, and shall retain records for at least five years.

G. Parties responsible for the operation and maintenance of a stormwater management system shall provide records of all maintenance and repairs during inspections and/or upon request.

H. When the responsible party fails to implement the O&M Plan, including, where applicable, the SWPPP, the municipality is authorized to assume responsibility for their implementation and to secure reimbursement for associated expenses from the responsible party, including, if necessary, placing a lien on the subject property.

Standard 14: Stormwater Management Plan

A. All stormwater management permit applications must include a Stormwater Management Plan. This plan shall document how the proposed project complies with the stormwater standards and must be submitted with the stamp and signature of a Professional Engineer (PE) licensed in the State of Connecticut.

Standard 15: Illicit Discharges

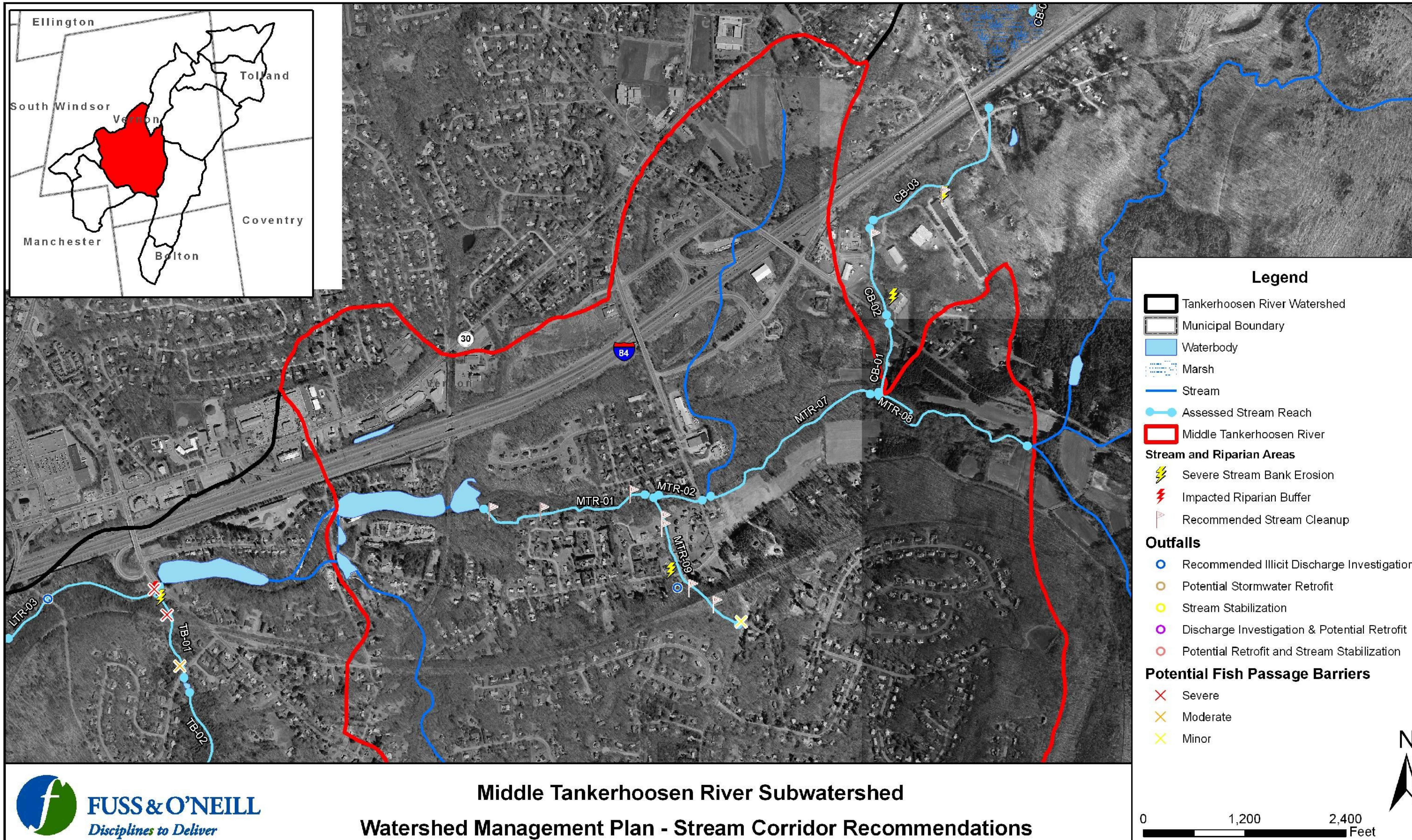
A. All illicit discharges to the stormwater management system are prohibited.

[NOTE: The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities:

- Landscape irrigation,
- Uncontaminated groundwater discharges such as pumped groundwater, foundation drains, water from crawl space pumps, and footing drains,
- Irrigation water,
- Lawn watering runoff,
- Residual street wash water,
- Discharges of uncontaminated air conditioner condensate,
- Discharges of flows from fire fighting activities,
- Discharges containing no chemical additives (including chlorine) from the flushing of fire protection systems, and
- Naturally occurring discharges such as rising groundwater, uncontaminated groundwater infiltration, springs, and flows from riparian habitats and wetlands.]

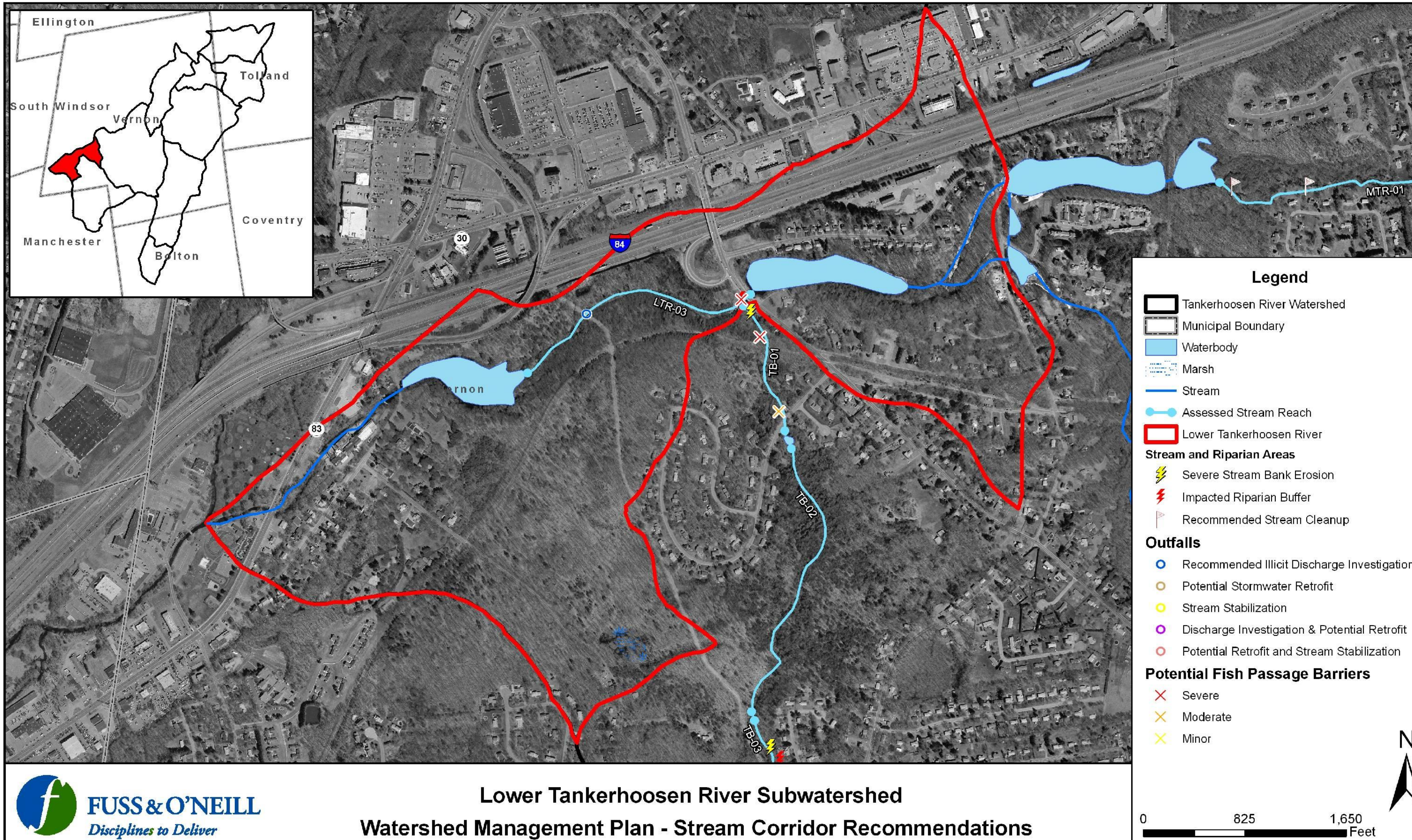
Appendix C

Targeted Stream Corridor Recommendations



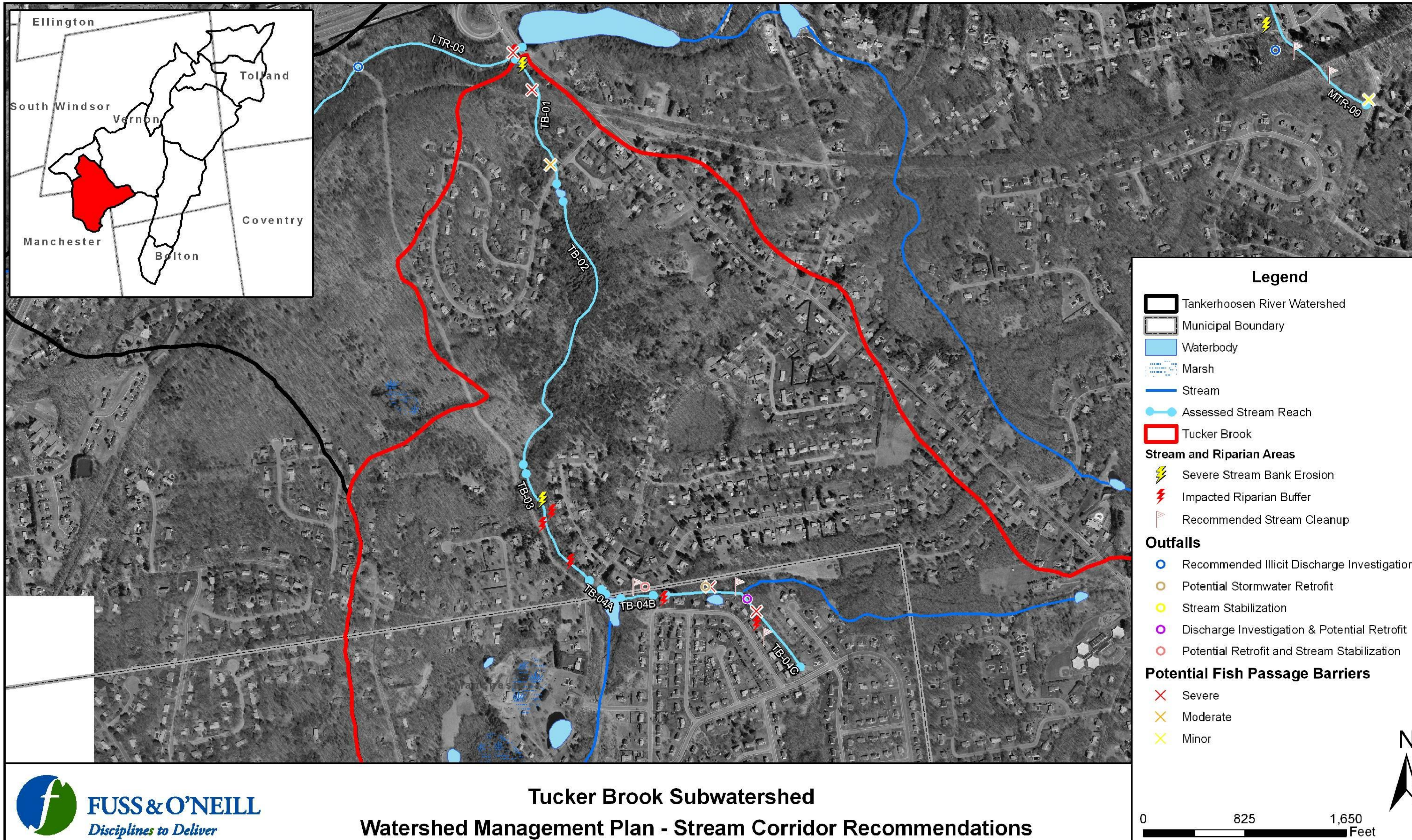
Middle Tankerhoosen River Subwatershed

Watershed Management Plan - Stream Corridor Recommendations



Lower Tankerhoosen River Subwatershed

Watershed Management Plan - Stream Corridor Recommendations



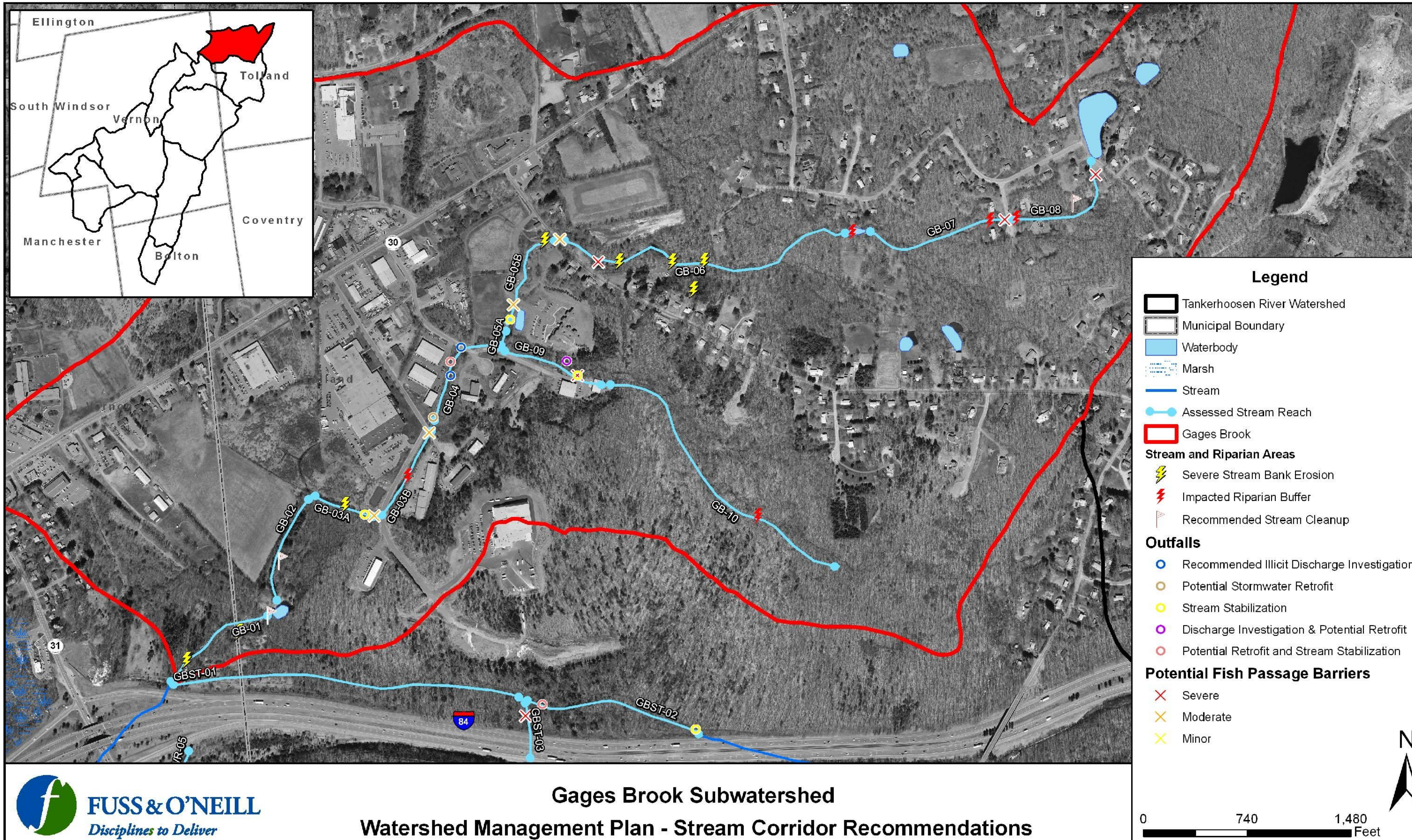
Tucker Brook Subwatershed

Watershed Management Plan - Stream Corridor Recommendations

FUSS & O'NEILL
Disciplines to Deliver

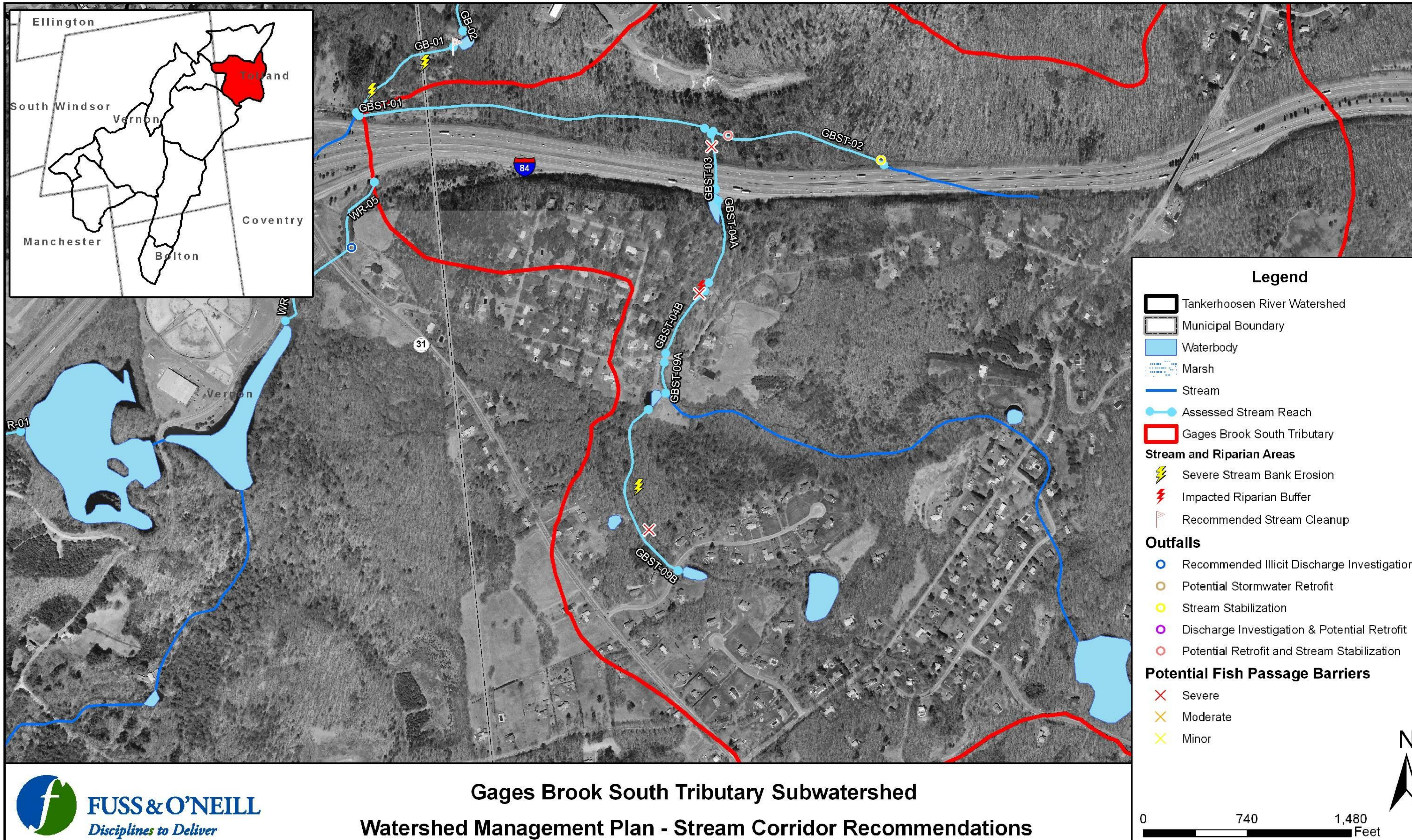
Walker Reservoir Subwatershed

Watershed Management Plan - Stream Corridor Recommendations



Gages Brook Subwatershed

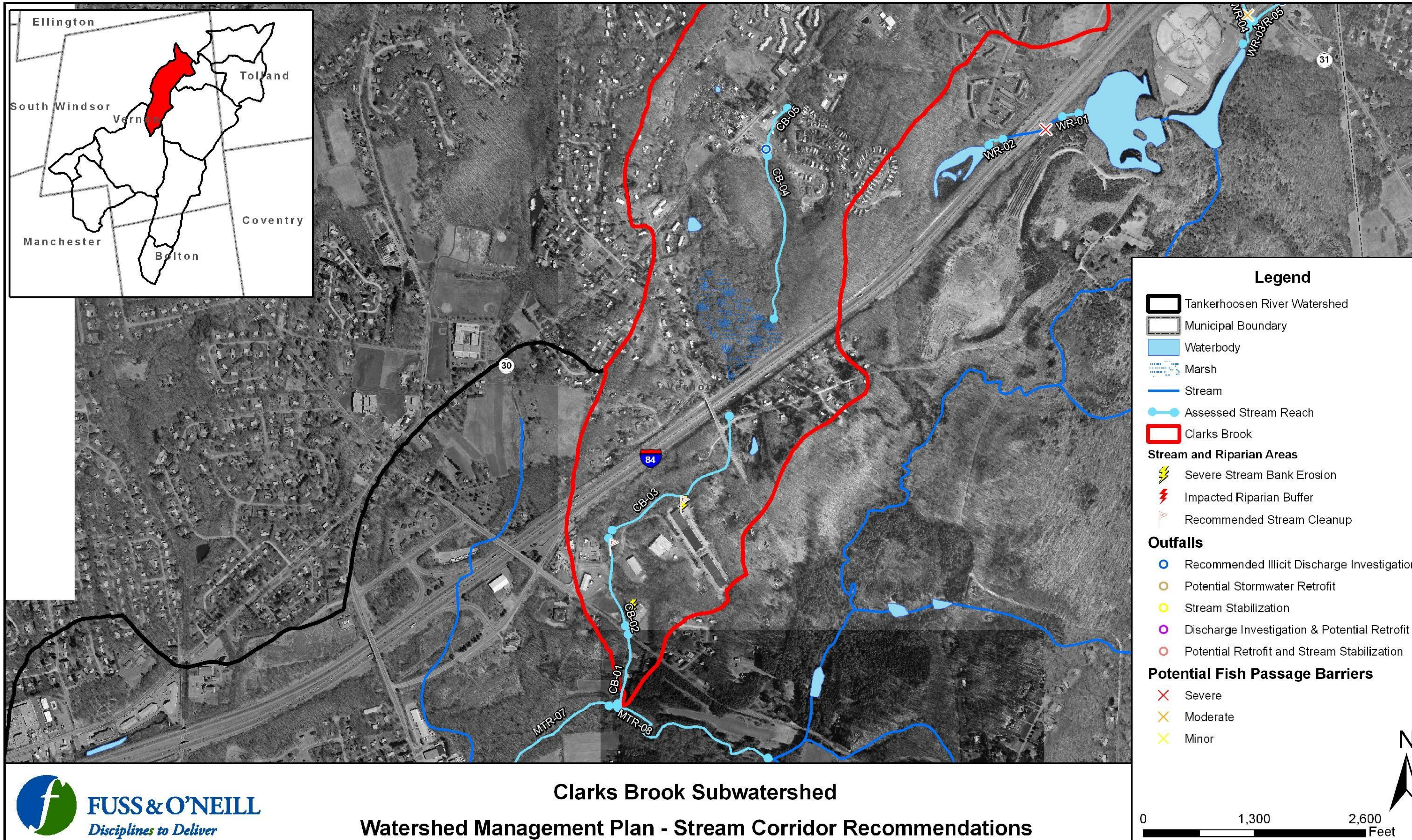
Watershed Management Plan - Stream Corridor Recommendations



FUSS & O'NEILL
Disciplines to Deliver

Gages Brook South Tributary Subwatershed

Watershed Management Plan - Stream Corridor Recommendations

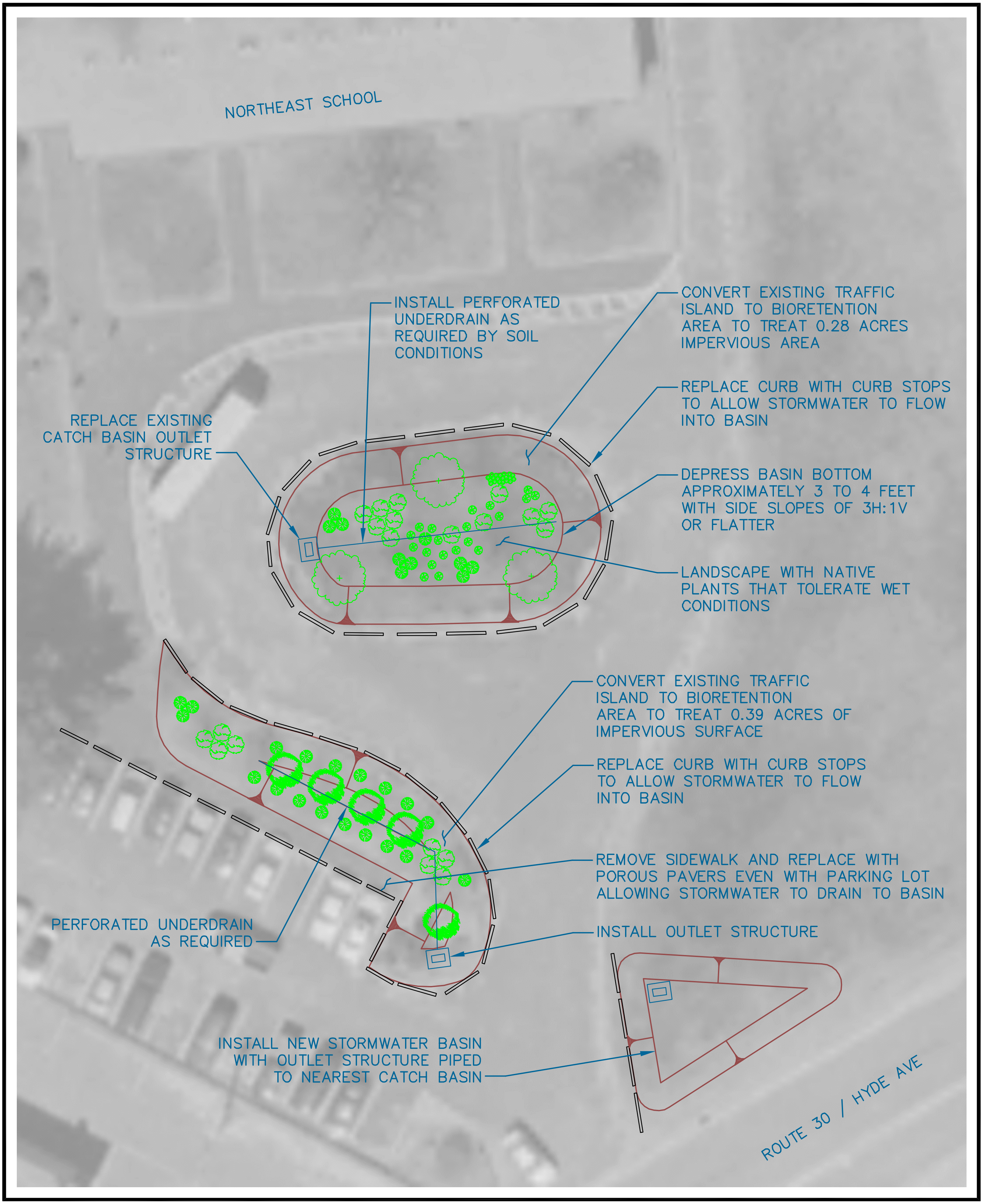


Clarks Brook Subwatershed

Watershed Management Plan - Stream Corridor Recommendations

Appendix D

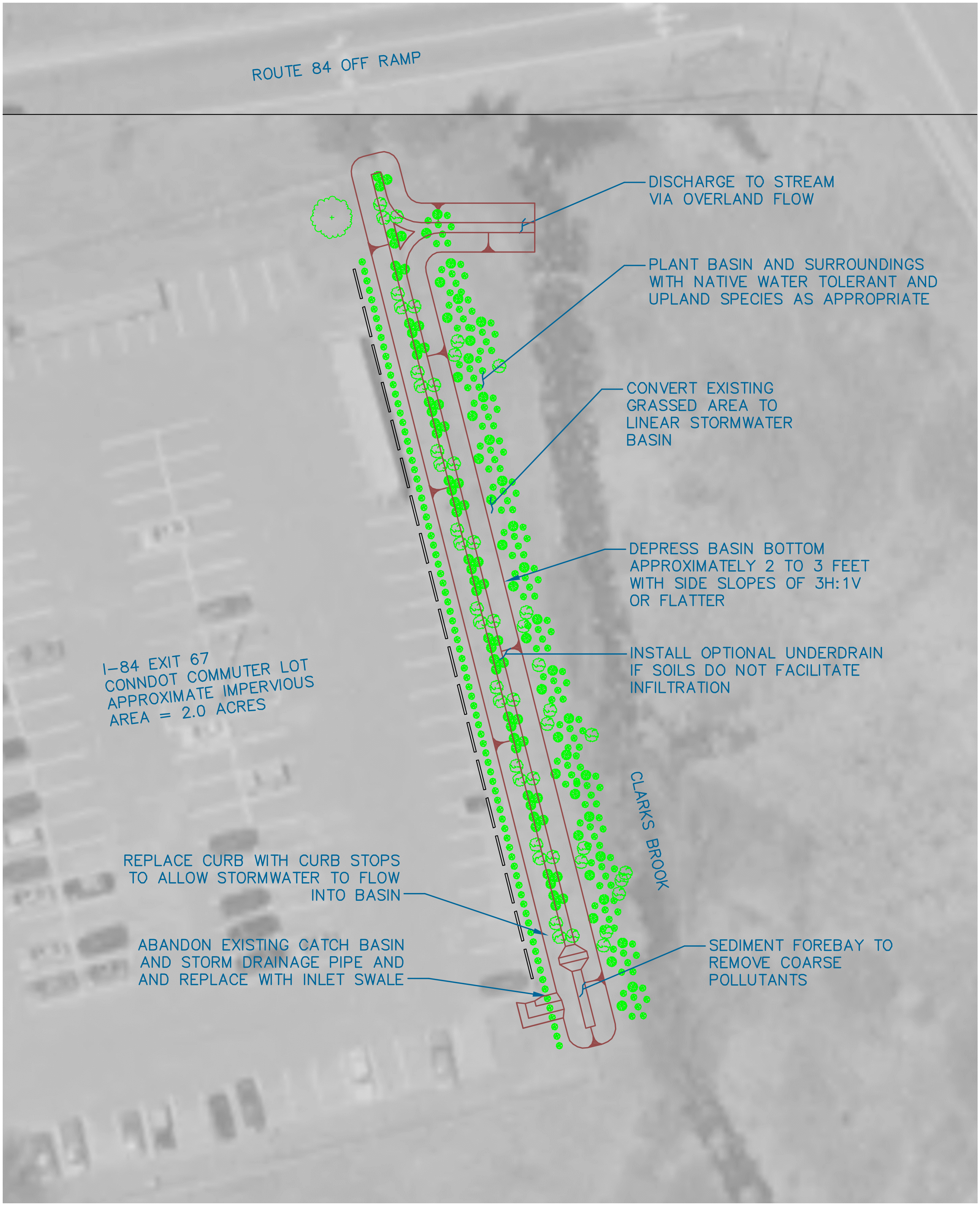
Stormwater Retrofit Concept Designs



File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20CON001.dwg, Layout: NORTHEAST SCHOOL Tue, Feb 24, 2009 - 11:14 AM User: DButtrick

MS VIEW: | LMAN: | CTB: | UCS:

SCALE: HORZ.: 1 INCH = 30 FEET VERT.: DATUM: HORZ.: VERT.: 0 15 30 GRAPHIC SCALE	WWW.FandO.COM FUSS & O'NEILL *Disciplines to Deliver* 78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445	FRIENDS OF THE HOCKANUM RIVER LINEAR PARK STORMWATER RETROFIT CONCEPT NORTHEAST SCHOOL TANKERHOOSEN RIVER WATERSHED CONNECTICUT	PROJ. No.: 20050257.A20 DATE: FEBRUARY 2009 1



SCALE:	
HORZ.:	1 INCH = 40 FEET
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 20 40

GRAPHIC SCALE

WWW.FandO.COM

FUSS & O'NEILL

Disciplines to Deliver

78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

STORMWATER RETROFIT CONCEPT

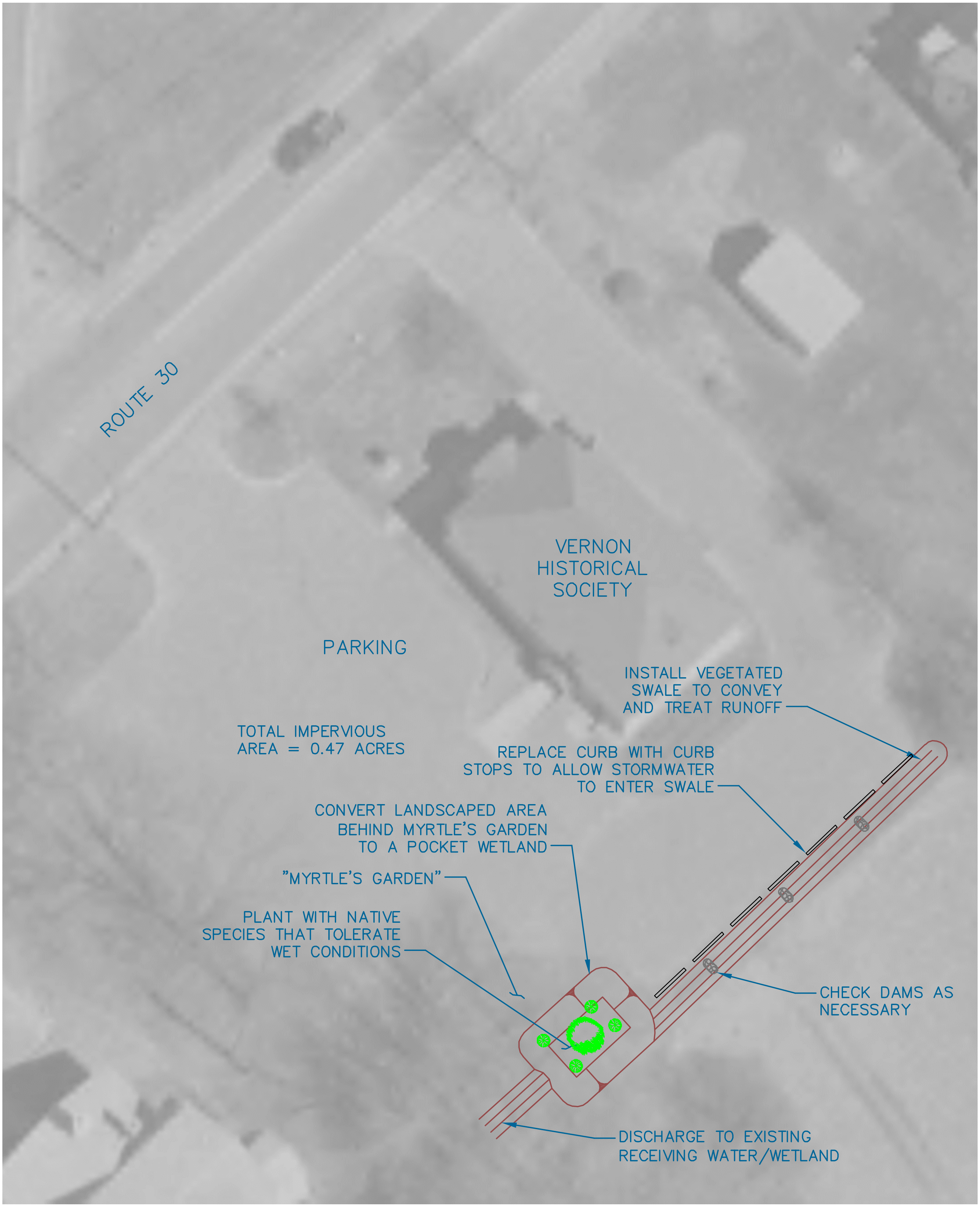
I-84 EXIT 67 COMMUTER LOT

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20

DATE: FEBRUARY 2009

2



SCALE:	
HORZ.: 1 INCH = 30 FEET	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 15 30

GRAPHIC SCALE

WWW.FandO.COM

FUSS & O'NEILL

Disciplines to Deliver

78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

STORMWATER RETROFIT CONCEPT

VERNON HISTORICAL SOCIETY

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

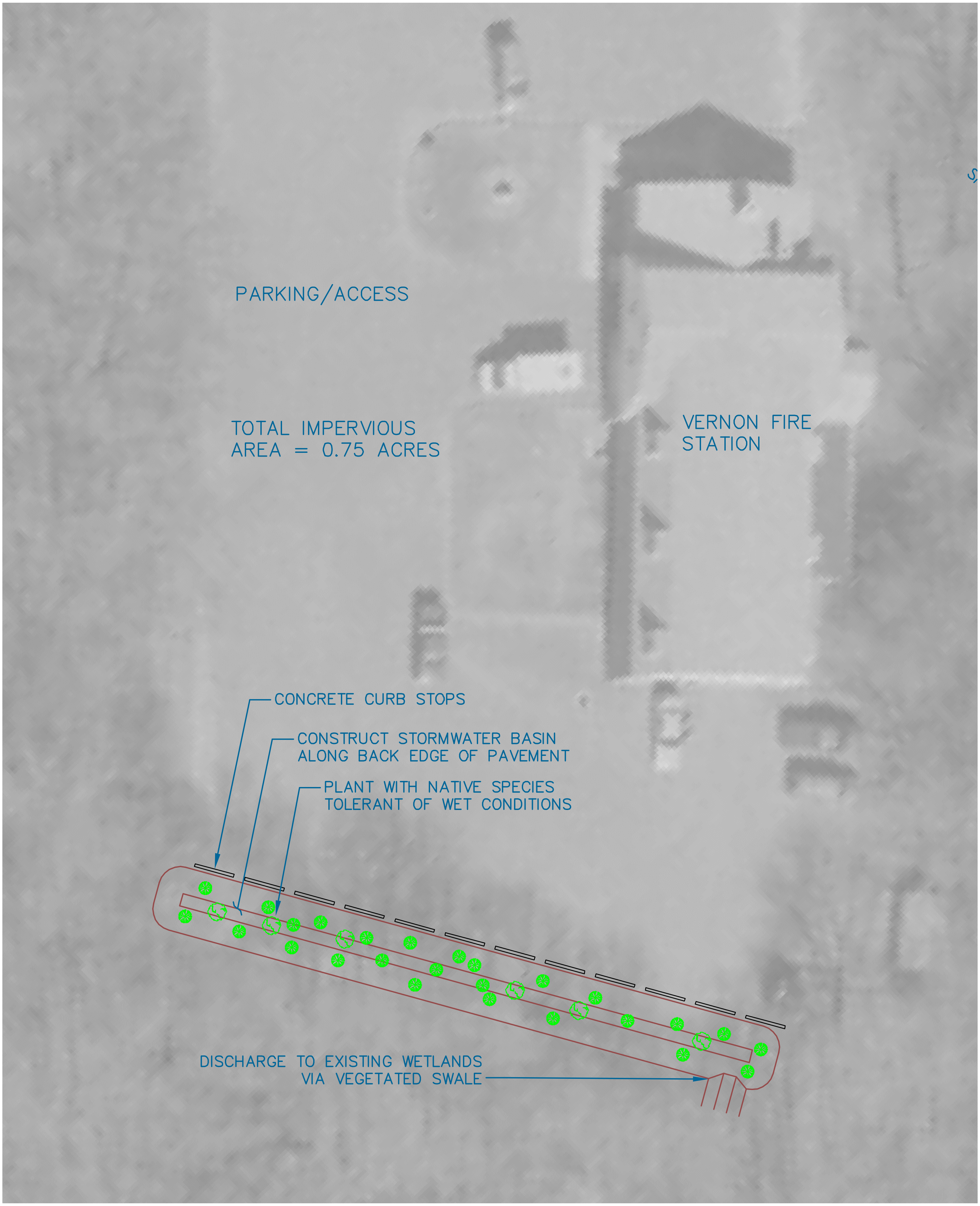
PROJ. No.: 20050257.A20

DATE: FEBRUARY 2009

3

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20CON001.dwg, Layout: HISTORICAL SOCIETY Tue, Feb 24, 2009 - 11:14 AM User: DButtrick

UCS: MS VIEW: LMAN: CTB:



File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20CON001.dwg, Layout: FIRE STATION Tue, Feb 24, 2009 - 11:14 AM User: DButtrick

UCS: MS VIEW: LMAN: CTB:

SCALE:
HORZ.: 1 INCH = 30 FEET
VERT.:
DATUM:
HORZ.:
VERT.:
0 15 30
GRAPHIC SCALE

WWW.FandO.COM

FUSS & O'NEILL
Disciplines to Deliver

78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

STORMWATER RETROFIT CONCEPT

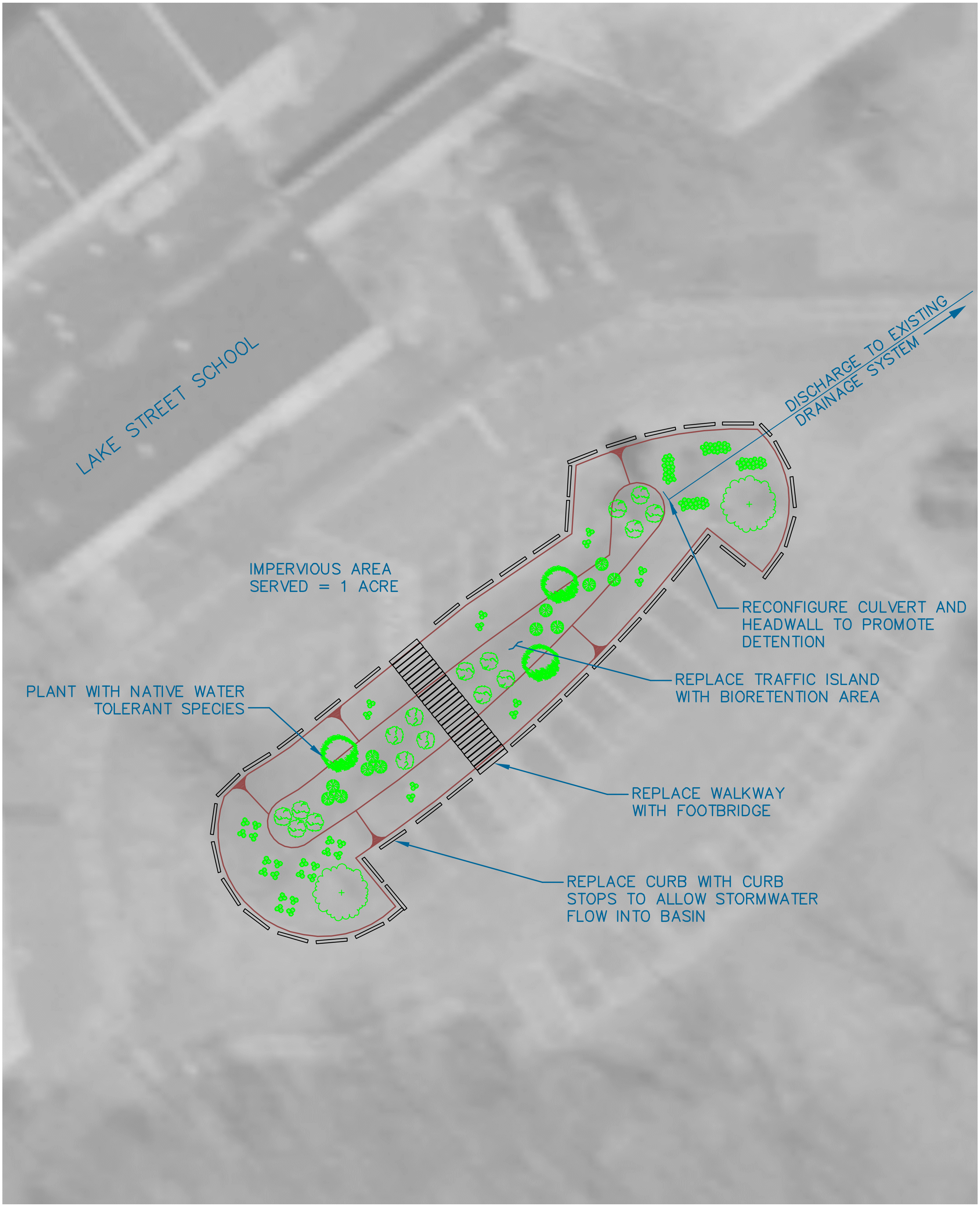
VERNON FIRE STATION

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

4

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20CON001.dwg, Layout: LAKE ST SCHOOL Tue, Feb 24, 2009 - 11:15 AM User: DButtrick



SCALE:	
HORZ.: 1 INCH = 30 FEET	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 15 30

GRAPHIC SCALE

WWW.FandO.COM

FUSS & O'NEILL

Disciplines to Deliver

78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

STORMWATER RETROFIT CONCEPT

LAKE STREET SCHOOL

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20

DATE: FEBRUARY 2009

5

UCS: MS VIEW: LMAN: CTB:

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20CON001.dwg, Layout: BN POND Tue, Feb 24, 2009 - 11:15 AM User: DButtrick

UCS: | MS VIEW: | LMAN: | CTB:

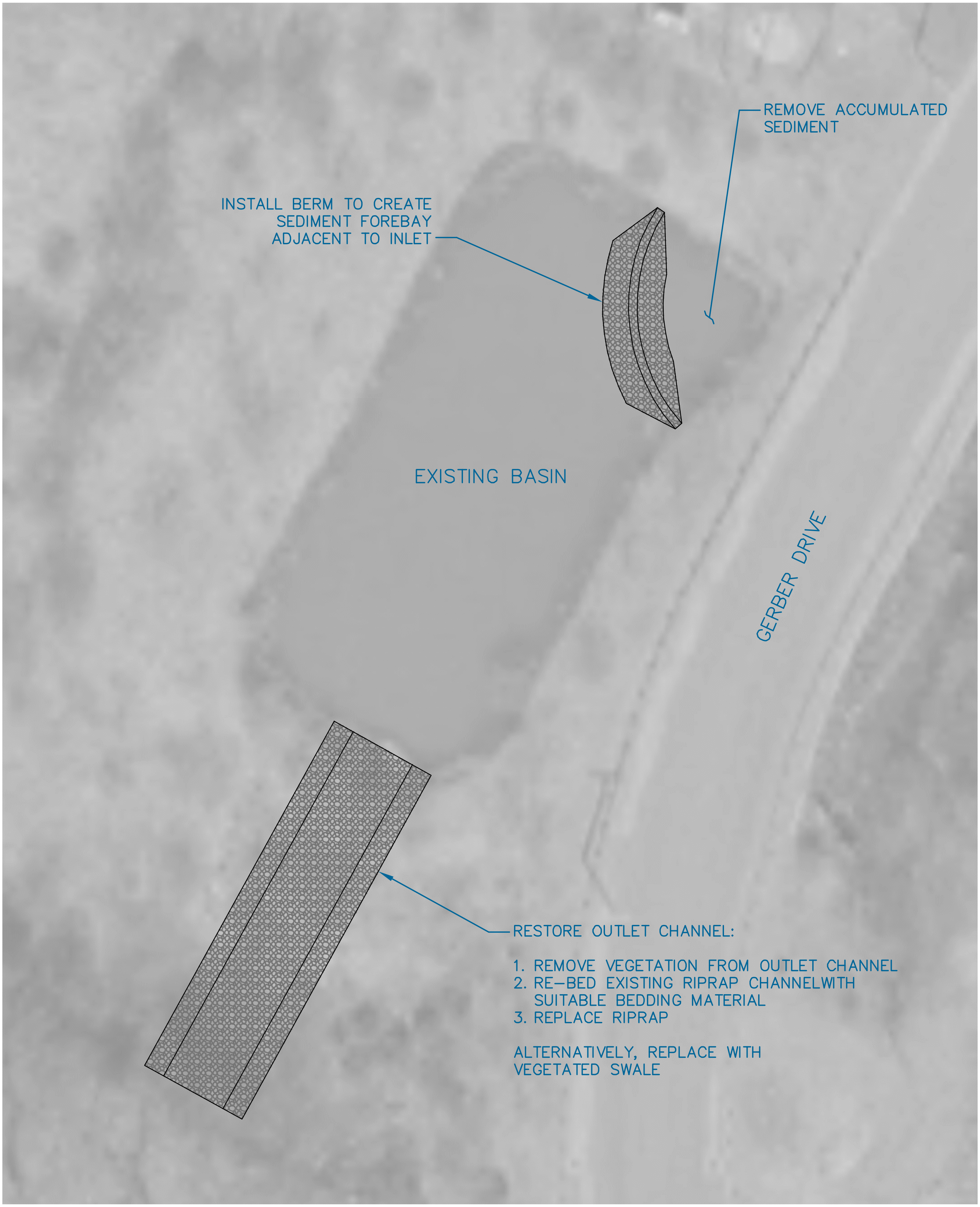
SCALE:
HORZ.: 1 INCH = 30 FEET
VERT.:
DATUM:
HORZ.:
VERT.:
0 15 30
GRAPHIC SCALE

WWW.FandO.COM
FUSS & O'NEILL
Disciplines to Deliver
78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK
STORMWATER RETROFIT CONCEPT
BOLTON NOTCH POND
TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

6



SCALE:	
HORZ.: 1 INCH = 30 FEET	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 15 30
GRAPHIC SCALE

WWW.FandO.COM
FUSS & O'NEILL
Disciplines to Deliver
78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

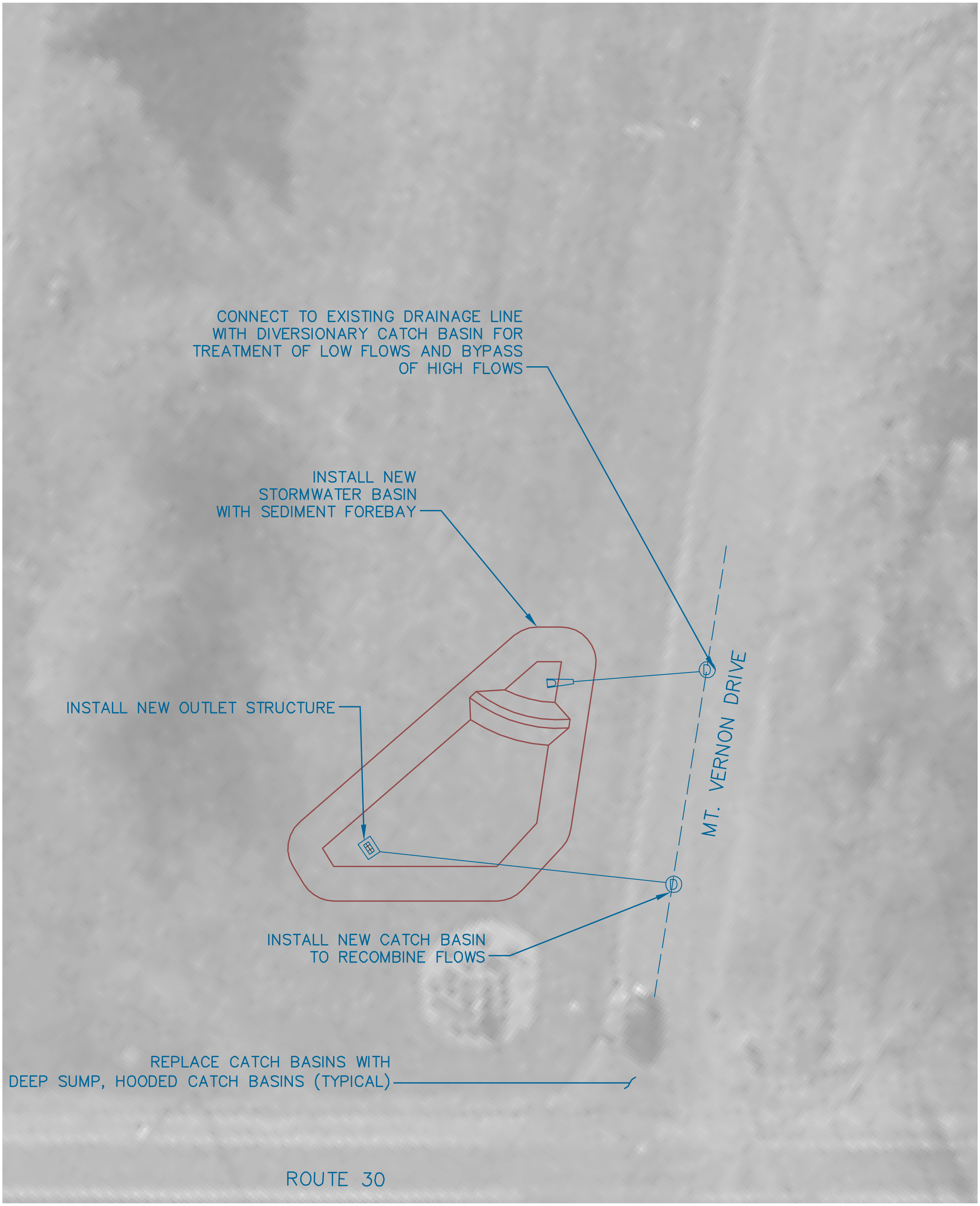
STORMWATER RETROFIT CONCEPT

GERBER TECHNOLOGIES BASIN

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

7



File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20CON001.dwg, Layout: MT VERNON APTS Tue, Feb 24, 2009 - 11:15 AM User: DButtrick

CTB:

LMAN:

MS VIEW:

UCS:

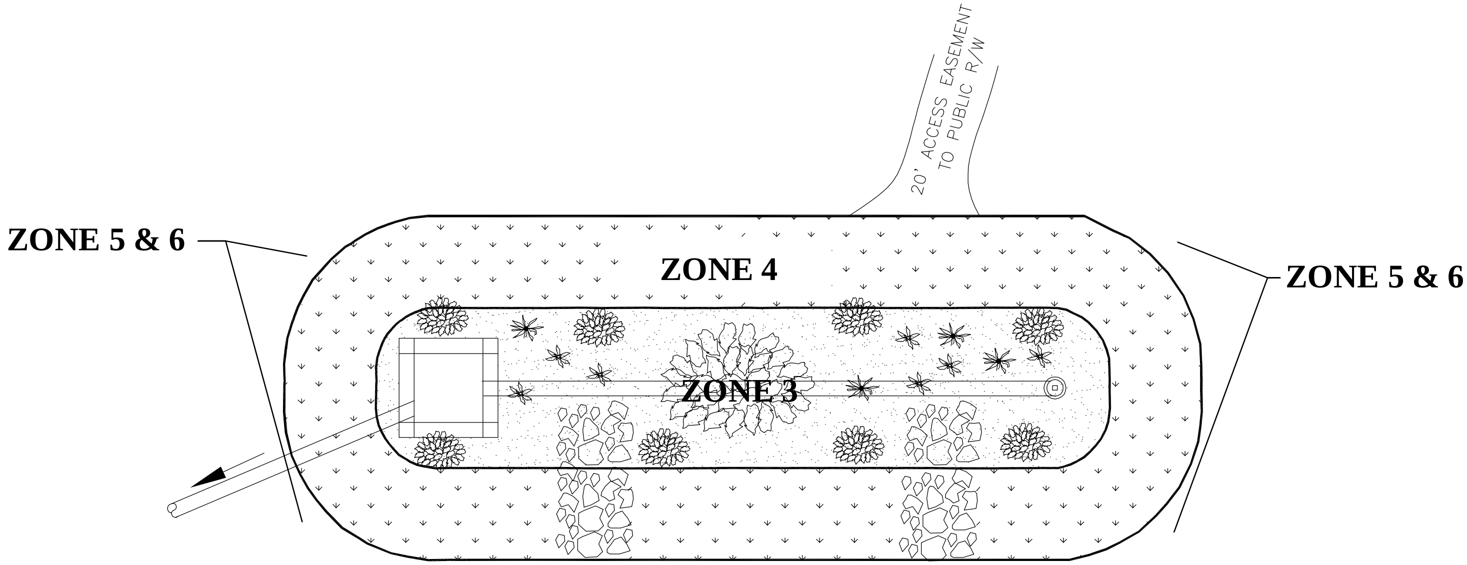
SCALE:
HORZ.: 1 INCH = 30 FEET
VERT.:
DATUM:
HORZ.:
VERT.:
0 15 30
GRAPHIC SCALE

WWW.FandO.COM
FUSS & O'NEILL
Disciplines to Deliver
78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK
STORMWATER RETROFIT CONCEPT
MOUNT VERNON APARTMENTS
TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

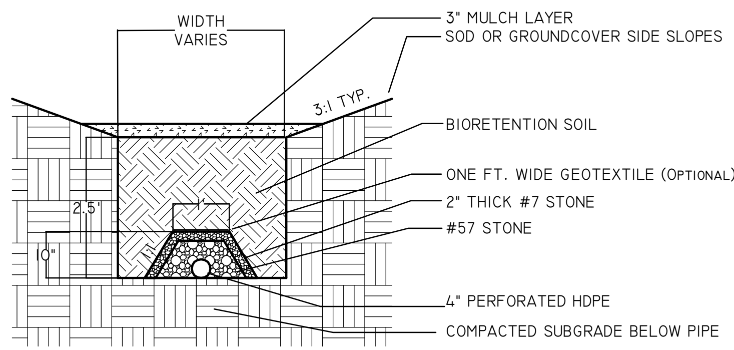
8



PLAN

NOTES:

1. PLANTING ZONES AND PLANT SELECTION PER DETAIL SHEET 7
2. ALL PLANTINGS SHALL BE LOCAL NATIVE SPECIES.
3. IRRIGATION MAY BE PROVIDED FOR INITIAL ESTABLISHMENT AND DRY SEASONS.



ADAPTED FROM CONNECTICUT STORMWATER QUALITY MANUAL (2004) AND CHARLOTTE – MECKLENBURG, NC POST–CONSTRUCTION BMP DESIGN MANUAL (APRIL 2008)

SCALE:	
HORZ.: N.T.S.	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	
0 NTS GRAPHIC SCALE	

WWW.FandO.COM
FUSS & O'NEILL
Disciplines to Deliver
78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

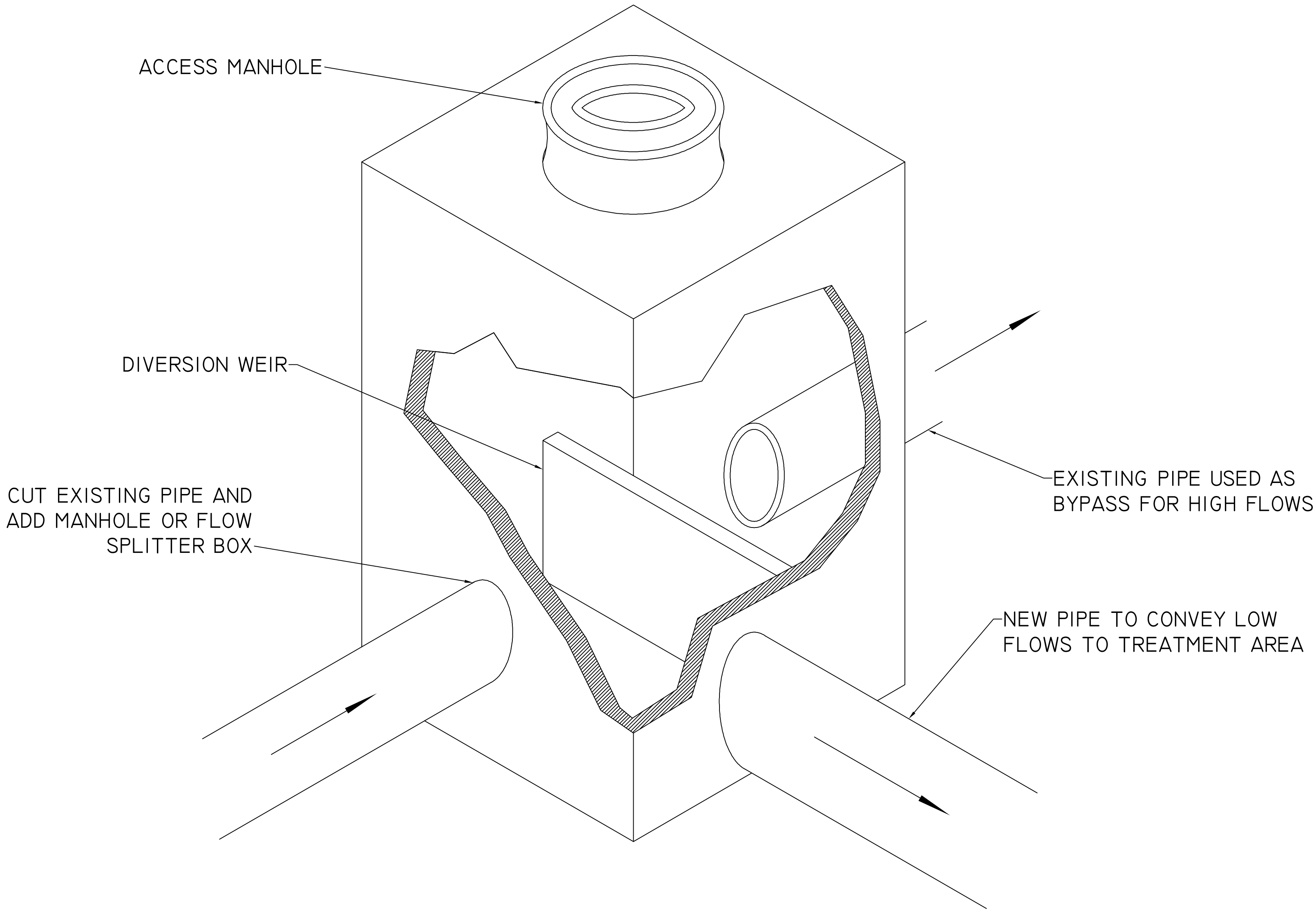
STORMWATER RETROFIT DETAILS

BIORETENTION AREA

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

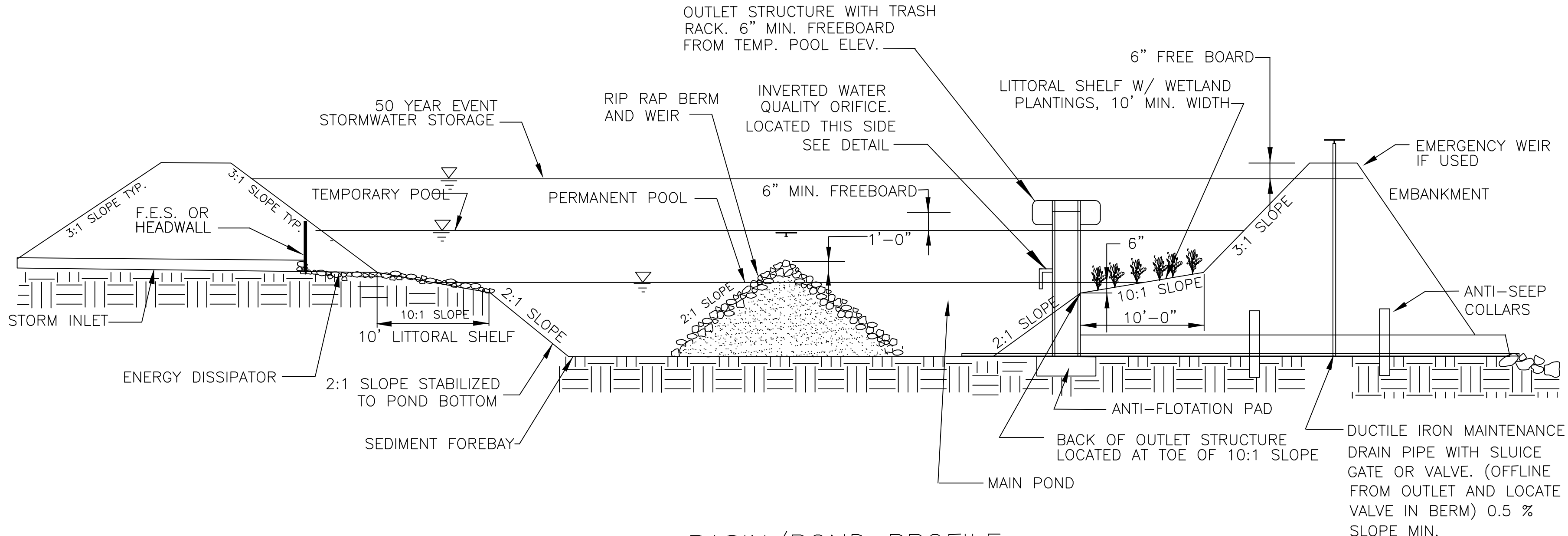
PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

DET 1



ADAPTED FROM THE CONNECTICUT STORMWATER QUALITY MANUAL (2004)

SCALE: HORZ.: N.T.S. VERT.: DATUM: HORZ.: VERT.: 0 NTS GRAPHIC SCALE	WWW.FandO.COM FUSS & O'NEILL *Disciplines to Deliver* 78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445	FRIENDS OF THE HOCKANUM RIVER LINEAR PARK STORMWATER RETROFIT DETAILS FLOW SPLITTER TANKERHOOSEN RIVER WATERSHED CONNECTICUT	PROJ. No.: 20050257.A20 DATE: FEBRUARY 2009 DET 2



BASIN/POND PROFILE

NOTES:

1. 4–6 INCH LAYER OF AMENDED SOIL IS RECOMMENDED IN ANY AREA WHERE PLANTINGS ARE REQUIRED

ADAPTED FROM THE CONNECTICUT STORMWATER QUALITY MANUAL (2004) AND THE CHARLOTTE – MECKLENBURG, NC POST–CONSTRUCTION BMP DESIGN MANUAL (APRIL 2008)

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20DET001.dwg, Layout: PONDPRO
Date: Tue, Feb 24, 2009 - 12:16 PM User: DButtrick

UCS: | MS VIEW: | LMAN: | CTB:

SCALE:	
HORZ.: N.T.S.	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 NTS
GRAPHIC SCALE

WWW.FandO.COM

FUSS & O'NEILL
Disciplines to Deliver

78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK

STORMWATER RETROFIT DETAILS

STORMWATER BASIN / POND PROFILE

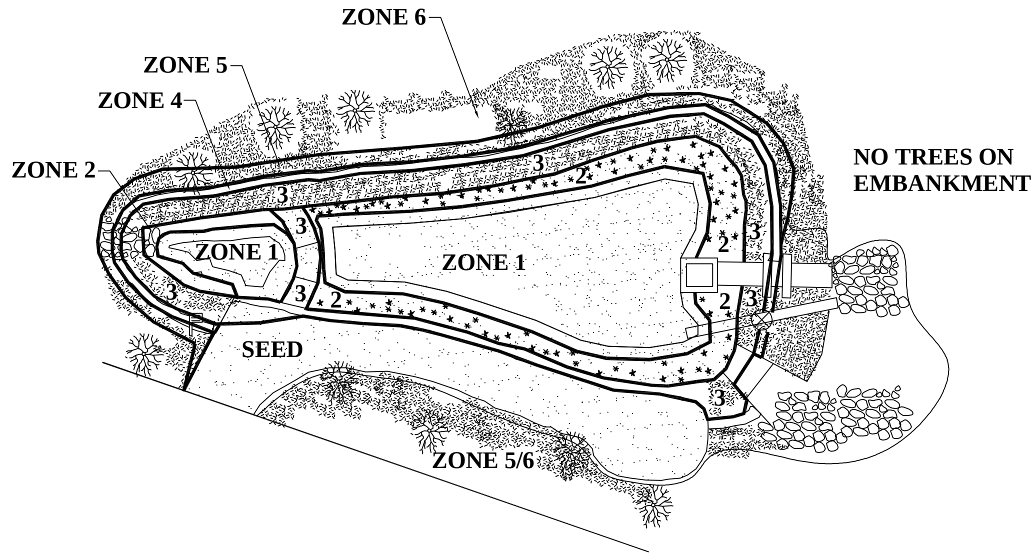
TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

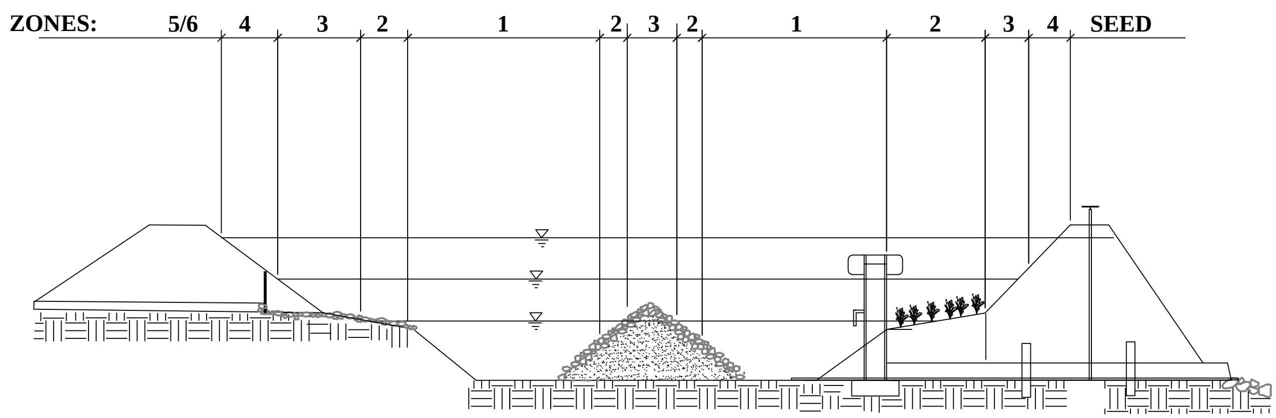
DET 3

NOTES:

1. PLANTINGS ZONES AND PLANT SELECTION PER NOTES ON DETAIL SHEET 7
2. ALL PLANTINGS SHALL BE LOCAL NATIVE SPECIES.
3. IRRIGATION MAY BE PROVIDED FOR INITIAL ESTABLISHMENT AND DRY SEASONS.



PLAN VIEW
NOT TO SCALE



POND CROSS SECTION

ADAPTED FROM THE CONNECTICUT STORMWATER QUALITY MANUAL (2004) AND THE CHARLOTTE – MECKLENBURG, NC POST-CONSTRUCTION BMP DESIGN MANUAL (APRIL 2008)

SCALE:	
HORZ.: N.T.S.	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	
0 NTS GRAPHIC SCALE	

WWW.FandO.COM

FUSS & O'NEILL
Disciplines to Deliver

78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK
STORMWATER RETROFIT DETAILS
POND PLANTING PLAN

TANKERHOOSEN RIVER WATERSHED CONNECTICUT

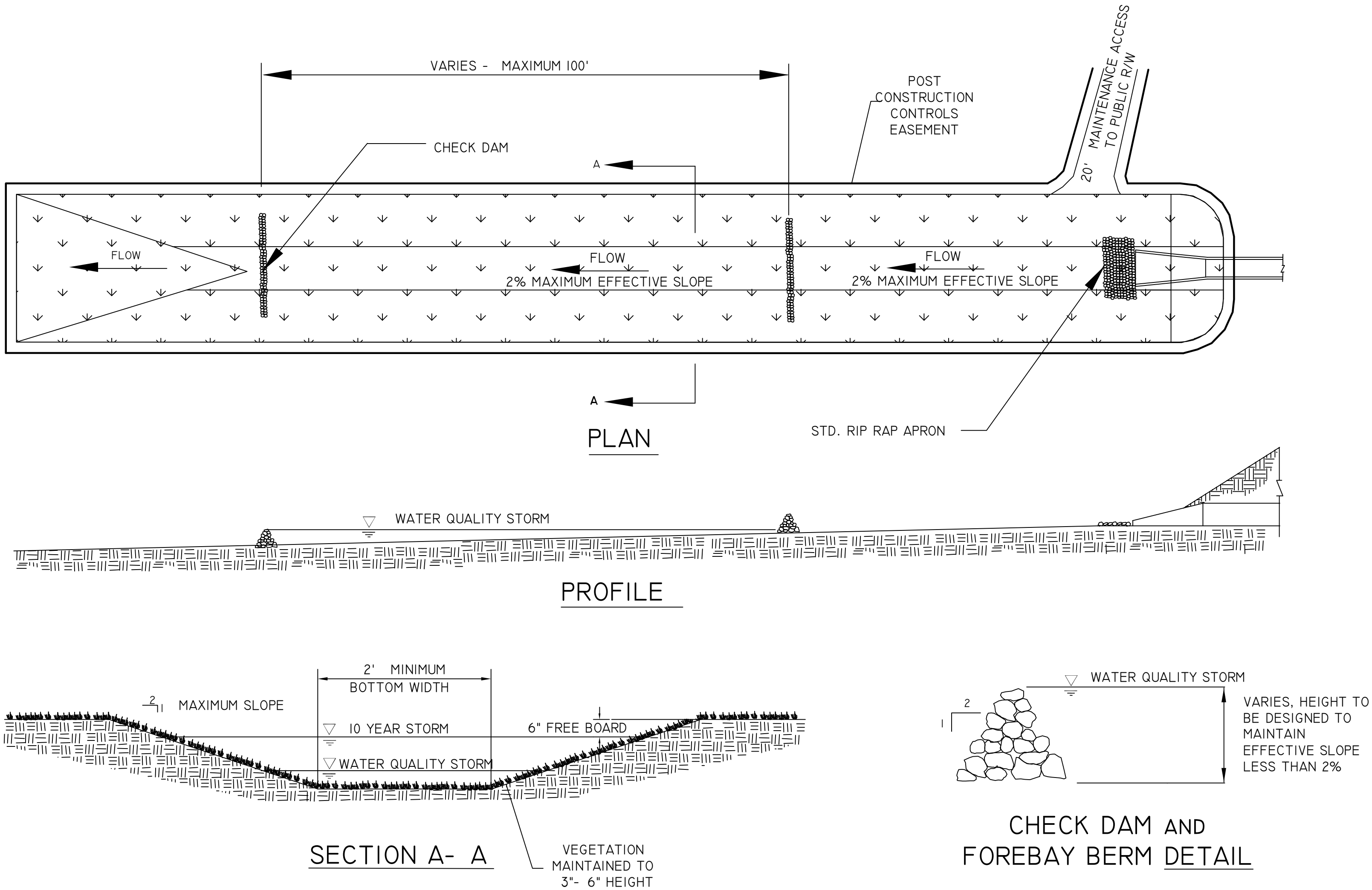
PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

DET 4

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20DET001.dwg, Layout: PONDPLAN
Date: Tue, Feb 24, 2009 - 12:16 PM User: DButtrick

CTB:
LMAN:
MS VIEW:
UCS:

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20DET001.dwg, Layout: SWALE
Date: Tue, Feb 24, 2009 - 12:17 PM User: DButtrick



NOTES:

1. CONNECT GRASS SWALE EASEMENT TO A DEDICATED PUBLIC RIGHT OF WAY WITH A 20-FOOT ACCESS EASEMENT.

ADAPTED FROM THE CONNECTICUT STORMWATER QUALITY MANUAL (2004) AND THE CHARLOTTE - MECKLENBURG, NC POST-CONSTRUCTION BMP DESIGN MANUAL (APRIL 2008)

SCALE:	
HORZ.: N.T.S.	
VERT.:	
DATUM:	
HORZ.:	
VERT.:	
0 NTS GRAPHIC SCALE	

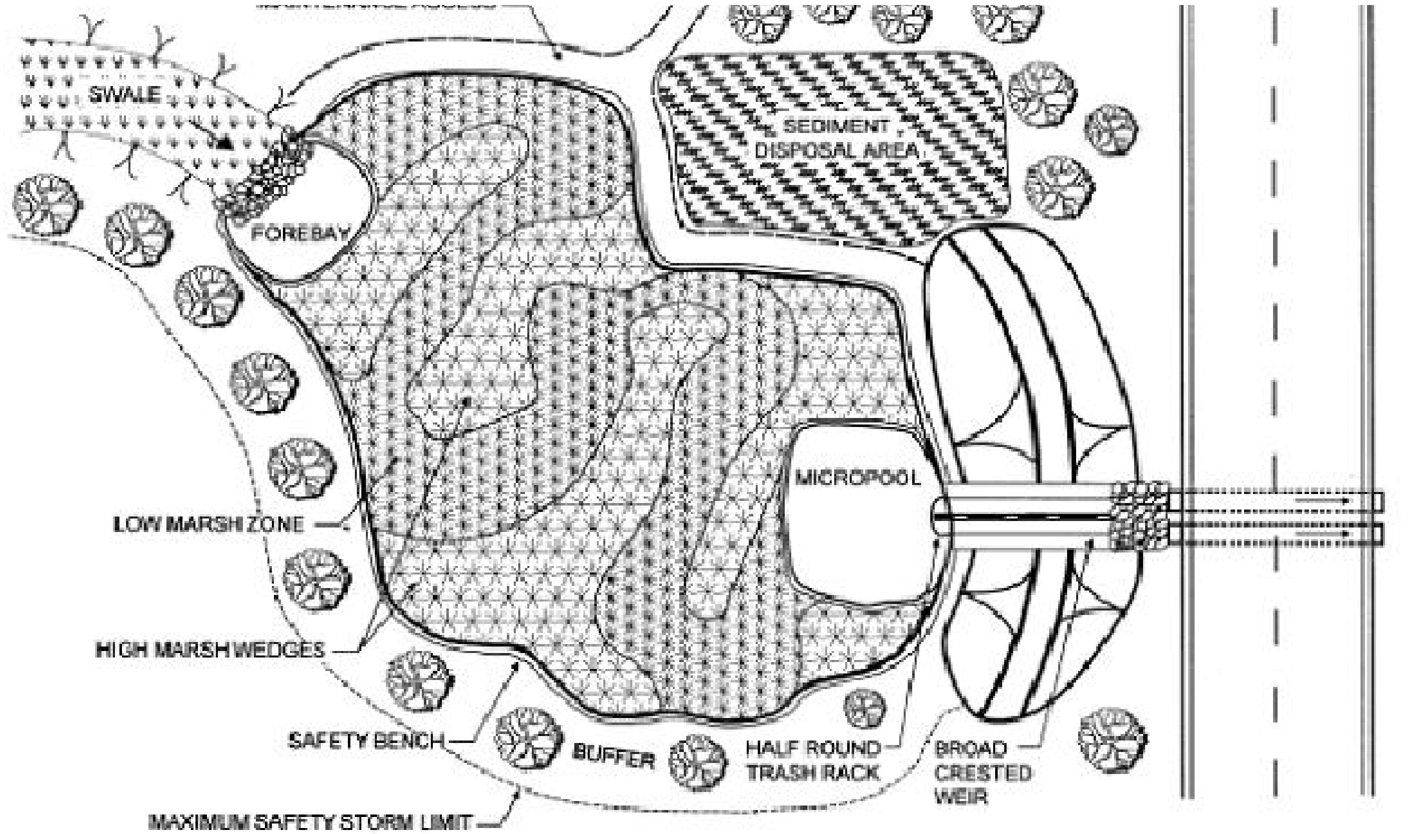
WWW.FandO.COM
FUSS & O'NEILL
Disciplines to Deliver
78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK
STORMWATER RETROFIT DETAILS
VEGETATED SWALE
TANKERHOOSEN RIVER WATERSHED CONNECTICUT

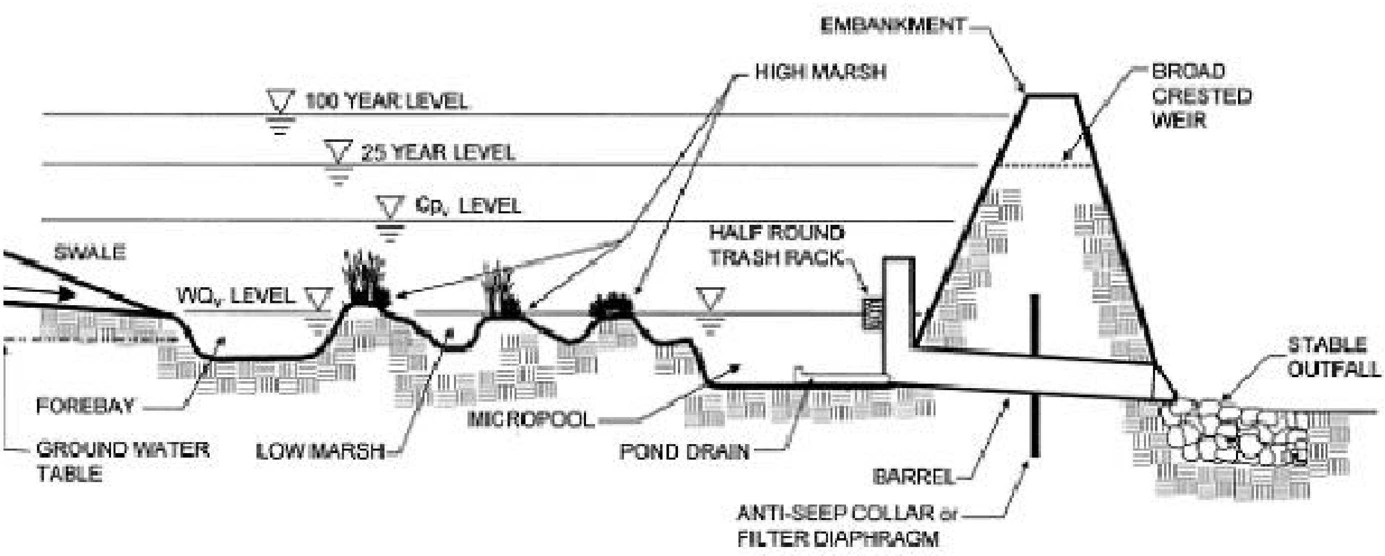
PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

DET 5

UCS: MS VIEW: LMAN: CTB:



PLAN VIEW



PROFILE

SOURCE: CENTER FOR WATERSHED PROTECTION

SCALE: HORZ.: N.T.S. VERT.: DATUM: HORZ.: VERT.: 0 NTS GRAPHIC SCALE	WWW.FandO.COM FUSS & O'NEILL *Disciplines to Deliver* 78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445	FRIENDS OF THE HOCKANUM RIVER LINEAR PARK STORMWATER RETROFIT CONCEPT POCKET WETLAND TANKERHOOSEN RIVER WATERSHED CONNECTICUT	PROJ. No.: 20050257.A20 DATE: FEBRUARY 2009 DET 6

File Path: H:\DWG\P2005\0257\A20\Plan\20050257A20DET001.dwg, Layout: POCKWET Tue, Feb 24, 2009 - 12:17 PM User: DButtrick
UCS: MS VIEW: LMAN: CTB:

Stormwater Structure Planting Zones		
ZONE	DESCRIPTION	
1	Deep Water Area	Inundated with 1 to 3 feet of water throughout the Growing Season
2	Shallow Water Bench	inundated with 0.5 to 1 foot of water throughout the growing season
3	Shoreline Fringe	Regulary inundated, ranging from 0.5 ft above to 0.5 ft.below the permanent pool elevation
4	Riparian Fringe	Periodically or seasonally inundated, from 0.5 ft. above the permanent pool elevation to the approximate 2- year storm water surface elevation
5	Floodplain Terrace	Infrequently or irregularly inundated, from the approximate 2- year water surface elevation to the 10- year water surface elevation
6	Upland	Above the 10- year water surface elevation

GENERAL PLANTING NOTES:

Grasses, Forbs, and Sedges in Zones 1, 2 and 3. Plant selections should be appropriate for the field environmental conditions of the planting site.
- Zone 1 – Deep Water Emergents: The designer should employ a method of "triangular spacing", and an approximate density of about 0.5 plants per square foot. A minimum of 2 herbaceous species shall be selected, for placement in each of the Zone 1 planting areas.
- Zone 2 – Shallow Water Bench Emergents: The designer should employ a method of "triangularspacing", and an approximate density of about 0.5 plants per square foot. A minimum of 3 herbaceous species shall be selected, for placement in each of the Zone 2 planting areas.
- Zone 3 – Shoreline Fringe: The designer should employ a method of "triangular spacing", and an approximate density of about 0.5 plants per square foot. A minimum of 4 herbaceous species shall be selected, for placement in each of the Zone 3 planting areas.

Grasses, Forbs, and Sedges (Seed Mixes) in Zones 4, 5 and 6.
- Zone 4 –Riparian Fringe, Zone 5 –Floodplain Terrace and Zone 6 – Planting zones shall receive preparation and seeding, with an appropriate seed mix, for establishing Native Wet Meadow, or Native Dry Meadow.

Trees, Shrubs, and Vines in Zones 4, 5 and 6 (ALL BMP's EXCEPT BIORETENTION): In designing and executing the plantings for Zone 4 –Riparian Fringe, Zone 5 –Floodplain Terrace and Zone 6 – Upland Plantings, the designer should consider the following:
- Employ a method of "random spacing", and a density of 1000 stems per acre. A full 70% of the species shall be Large Maturing Deciduous Tree species, and 30% shall be Small Maturing Deciduous Tree, Evergreen Tree, Deciduous Shrub, or Evergreen Shrub species.
- A minimum of 5 Large Maturing Deciduous Tree species shall be selected for each planting area and a minimum of 3 Small Maturing Deciduous Tree, Evergreen Tree, Deciduous Shrub or Evergreen Shrub species shall be selected for each planting area.
- The use of 3 plants of the same genus does not constitute the minimum selection and should be avoided.
- In addition to the 5 large stock tree and the 3 small stock tree requirements, each planted area shall contain, interspersed randomly among the stock, large maturing decidious trees at a planting density of 20 trees per acre, and a minimum size of two–inch caliper (2"cal.).

Trees, Shrubs, and Vines in BIORETENTION AREAS ONLY: In designing and executing the plantings for Bioretention Areas, the designer should consider the following:
- Employ a method of "random spacing", and a density of 2000 stems per acre. A maximum of 10% of the species shall be Large Maturing Deciduous Tree species, and 90% shall be Small Maturing Deciduous Tree, Evergreen Tree, Deciduous Shrub, or Evergreen Shrub species. Up to 25% of the Small Maturing Tree requirement (90%) may be substituted with certain grasses that grow to 3–ft to 5–ft in height if planted in five or seven–gallon pots.
- A minimum of 3 Large Maturing Deciduous Tree species shall be selected for each planting area, and
a minimum of 3 Small Maturing Deciduous Tree, Evergreen Tree, Deciduous Shrub or Evergreen Shrub species shall be selected for each planting area.
- The use of 3 plants of the same genus does not constitute the minimum selection and should be avoided.

ADAPTED FROM THE CONNECTICUT STORMWATER QUALITY MANUAL (2004) AND THE CHARLOTTE – MECKLENBURG, NC POST–CONSTRUCTION BMP DESIGN MANUAL (APRIL 2008)

SCALE:
HORZ.: N.T.S.
VERT.:
DATUM:
HORZ.:
VERT.:
0 NTS
GRAPHIC SCALE

WWW.FandO.COM
FUSS & O'NEILL
Disciplines to Deliver
78 INTERSTATE DR WEST SPRINGFIELD, MA 01089 413.452.0445

FRIENDS OF THE HOCKANUM RIVER LINEAR PARK
STORMWATER RETROFIT CONCEPT
PLANTING NOTES
TANKERHOOSEN RIVER WATERSHED CONNECTICUT

PROJ. No.: 20050257.A20
DATE: FEBRUARY 2009

DET 7

Appendix E

Site-Specific Stormwater Retrofit Cost Estimates

Site-Specific Stormwater Retrofit Cost Estimates – Tankerhoosen River Watershed Management Plan

					Design, Permitting, Contingency							
	Unit Cost	Unit	Units	Construction Cost (2009)	% Construction	Cost	Total Cost	Lifespan (yrs)	Annual Cost Over Lifespan	O&M (% Cost)	O&M ($/yr)	Total Capitalized Cost/yr over lifespan
Tankerhoosen Lake												
Sediment Forebay	77,000	total, 2004 dollars (BEC estimate)	1	$93,700	32%	$30,000	$123,700	30	$6,310	6%	$380	$6,690
4 Deep Sump CBs, piping, and swale	20,000	total, 2004 dollars (BEC estimate)	1	$24,300	32%	$7,800	$32,100	50	$1,250	15%	$190	$1,440
Northeast School												
Bioretention Area 1	$14.56	/ft^2 (commercial/ industrial area	2892	$42,100	32%	$13,500	$55,600	15	$4,660	8%	$370	$5,030
Bioretention Area 2	$14.56	/ft^2 (commercial/ industrial area	2137	$31,100	32%	$10,000	$41,100	15	$3,440	8%	$280	$3,720
SW Basin	$7.27	/ft^3 (developed area)	2495	$18,100	32%	$5,800	$23,900	30	$1,220	6%	$70	$1,290
Mount Vernon Apartments												
SW Basin	$7.27	/ft^3 (developed area)	5862	$42,600	32%	$13,600	$56,200	30	$2,870	6%	$170	$3,040
Deep sump CBs	$3,125.00	ea.	6	$18,800	32%	$6,000	$24,800	50	$960	20%	$190	$1,150
Fire Station (Route 30)												
SW Basin	$7.27	/ft^3 (developed area)	2976	$21,600	32%	$6,900	$28,500	30	$1,450	6%	$90	$1,540
Vegetated Swale	$14.56	/ft^2	59	$900	32%	$300	$1,200	10	$140	7%	$10	$150
Vernon Historical Society (Route 30)												
Pocket Wetland	30.6V^0.71 (03$)	/ft^3	1081	$5,500	32%	$1,800	$7,300	10	$860	6%	$50	$910
Vegetated swale	$14.56	/ft^2	657	$9,600	32%	$3,100	$12,700	10	$1,490	6%	$90	$1,580
ConnDOT Commuter Lot (Route 6/44 and I-384 Interchange)												
Vegetated swale	$14.56	/ft^2	532	$7,700	32%	$2,500	$10,200	29	$530	7%	$40	$570
SW Basin	$7.27	/ft^3 (developed area)	7105	$51,700	32%	$16,500	$68,200	30	$3,480	6%	$210	$3,690
ConnDOT Commuter Lot (I-84, Exit 67)												
SW Basin	$7.27	/ft^3 (developed area)	5299	$38,500	32%	$12,300	$50,800	30	$2,590	6%	$160	$2,750
Vegetated Swale	$14.56	/ft^2	103	$1,500	32%	$500	$2,000	10	$230	7%	$20	$250
Gerber Technologies Office Building												
Sediment Forebay	$50	/yd^3 of riprap	40	$2,000	32%	$600	$2,600	30	$130	30%	$40	$170
Discharge Channel	$3.86	/ft2	2324	$9,000	32%	$2,900	$11,900	30	$610	10%	$60	$670
Lake Street School												
Bioretention	$14.56	/ft^2 in commercial/ industrial area	4900	$71,300	32%	$22,800	$94,100	15	$7,880	8%	$630	$8,510
Note:												
Rate of Inflation used =	4%											
Interest (discount) rate used =	7%											