COORDINATED PUBLIC WATER SYSTEM PLAN

PART III: FINAL INTEGRATED REPORT

Southeast Connecticut
Public Water Supply Management Area

March 2001

Prepared for:

Department of Public Health
Hartford, Connecticut
and the
Southeast Connecticut
Water Utility Coordinating Committee

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CGS	Connecticut General Statutes
COG	Council of Governments
DEP	Department of Environmental Protection
DPH	Department of Public Health
DPUC	Department of Utility Control
ESA	Exclusive Service Area
GIS	Geographic Information System
gpcd	gallons per capita per day
gpd	gallons per day
mgd	million gallons per day
MMI	Milone & MacBroom, Inc.
OPM	Office of Policy and Management
SCWA	Southeastern Connecticut Water Authority
WPCA	Water Pollution Control Authority
WUCC	Water Utility Coordinating Committee

DEFINITIONS

Areawide Supplement – A part of a coordinated water system plan which addresses areawide water system concerns pertaining to the public water supply management area which are not otherwise included in each water company's individual water system plan. The supplement identifies the present and future water system concerns, analyzes alternatives and sets forth a means for meeting those concerns. An areawide supplement consists of a water supply assessment, exclusive service area boundaries, integrated report, and executive summary.

Community Water System – A public water system that serves at least 25 residents.

Coordinated Water System Plan – The individual water system plans of each public water system within a public water supply management area, filed pursuant to section 25-32d of the Connecticut General Statutes, and an areawide supplement to such plans developed pursuant to Connecticut General Statute 25-33h, which addresses water system concerns pertaining to the public water supply management area as a whole.

Exclusive Service Area (ESA) – An area where public water is supplied by one system.

Integrated Report – An overview of individual public water systems within the management area which addresses areawide water supply issues, concerns, and needs; and promotes cooperation among public water systems.

Non-Transient Non-Community Water System – A public water system that is not a community system and that regularly serves at least 25 of the same persons over six months per year.

Public Water Supply Management Area – An area for coordinated water supply planning determined by the Commissioner of Public Health to have similar water supply problems and characteristics.

Public Water System – Any private, municipal or regional water company supplying water to fifteen or more service connections or 25 or more persons.

Satellite Management – Management of a public water supply system by another public water system.

Transient Non-Community Water System – A non-community water system that does not meet the definition of a non-transient, non-community water system.

Water Utility Coordinating Committee (WUCC) – A committee consisting of one representative from each public water system with a source of supply or service area within the public water supply management area and one representative from each regional planning agency within the public water supply management area, elected by majority vote of the chief elected officials of the municipalities that are members of such regional planning agency.

DEFINITIONS

Areawide Supplement – A part of a coordinated water system plan which addresses areawide water system concerns pertaining to the public water supply management area which are not otherwise included in each water company's individual water system plan. The supplement identifies the present and future water system concerns, analyzes alternatives and sets forth a means for meeting those concerns. An areawide supplement consists of a water supply assessment, exclusive service area boundaries, integrated report, and executive summary.

Community Water System – A public water system which serves at least two residences or 25 residents throughout the year.

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Exclusive Service Areas – An area where public water is supplied by one system.

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Public Water System – Any private, municipal or regional utility supplying water to 15 or more service connections or 25 or more persons.

Water Utility Coordinating Committee (WUCC) – A committee consisting of one representative from each public water system with a source of supply or service area within the public water supply management area and one representative from each regional planning agency within the public water supply management area, elected by majority vote of the chief elected officials of the municipalities that are members of such regional planning agency.

ABBREVIATIONS

CGS	Connecticut General Statutes
CT-AM	Connecticut-American Water Company
CWC	Connecticut Water Company
DEP	Department of Environmental Protection
DPH	Department of Public Health
DPUC	Department of Public Utility Control
ECRWC	Eastern Connecticut Regional Water Company
GPM	Gallons Per Minute
MGD	Million Gallons Per Day
MMI	Milone & MacBroom, Inc.
NOV	Notice of Violation
OPM	Office of Policy and Management
SCWA	Southeastern Connecticut Water Authority
SID	System Identification Number
SWAP	Source Water Assessment Program
VOC	Volatile Organic Compound
WPCA	Water Pollution Control Authority
WSMA	Water Supply Management Area
WSP	Water Supply Plan
WUCC	Water Utility Coordinating Committee

1.0 INTRODUCTION

This Integrated Report has been prepared in conformance with Section 25-33(h) of the Regulations of State Agencies and is one of four components of the Coordinated Public Water System Plan for the Southeast Connecticut Public Water Supply Management Area.

This document is intended to serve as a long-term planning tool for the region. Various issues are evaluated herein, including existing and future projected population, existing and alternative water supplies, source protection, water conservation, existing and potential interconnections, system ownership and management, satellite management/ownership issues, minimum design standards, financial considerations, potential impacts on other uses of water resources, and land acquisition for proposed stratified drift wells. The document is organized as follows:

- Section 2.0 presents the areawide overview of the region, including existing and projected population, consumption demands, and safe yield;
- Section 3.0 describes existing and potential future interconnections, joint use of facilities and services, and satellite management operation;
- Section 4.0 presents the minimum design standards adopted by the WUCC;
- Section 5.0 presents the regional water conservation plan;
- Section 6.0 presents a region-wide analysis of alternative future water supply sources and an evaluation of the compatibility of existing land uses and zoning with existing and potential future water supply source development. A plan for potential land acquisition for the protection of stratified drift wells is also included in this section;
- Section 7.0 is an analysis of the potential impact of the coordinated public water system plan on other uses of water resources; and
- Section 8.0 evaluates planning cost estimates for plan implementation.

2.0 POPULATION, CONSUMPTION AND SAFE YIELD PROJECTIONS

2.1 Introduction

This areawide overview integrates individual public water system plans and provides information regarding safe yield, service populations and consumption projections for the recommended exclusive service areas (ESA's). The planning horizons correspond to the five-, 20-, and 50-year planning periods. The 20- and 50-year planning horizons are projected from the 1990 census data (2000 census data is not available at this time). Existing conditions are based on year 2000 data, and the planning horizons correspond to the years 2005, 2010, and 2040.

All projections are based on the recommended ESA's developed during the WUCC process, not the existing service areas of the providers. Existing demands of each system were compared to the yield of existing supplies to identify deficits. Future system demands (both residential and non-residential) were also projected through the 50-year planning period to identify future deficits. Each ESA public water supplier provided information regarding existing and projected service area populations. This information was supplemented with individual system water supply plans and the appropriate regional planning documents.

The population projections contained herein are, in some cases, dramatically different from those figures presented in the public water system's individual water supply plan. This is largely due to the difference in the previously projected future service area and the recommended exclusive service areas which, in some cases, are significantly different.

Table 2-1 provides a summary of the projected demands, surpluses, and deficits for the region through the planning period. The information presented in this table is developed in Section 2.3 of this document.

TABLE 2-1
Summary of Demand Projections and Surplus/Deficits
(all volumes reported in mgd)

Planning Horizon	Existing/Projected Demand	Existing/Projected Surplus/(Deficit)	Existing/Projected Margin of Safety
Existing Conditions	23.559 mgd	9.985 mgd	1.42
5-Year Planning Period (2005)	28.933 mgd	4.714 mgd	1.16
20-Year Planning Period (2010)	33.969 mgd	(0.321) mgd	0.99
50-Year Planning Period (2040)	49.346 mgd	(15.698) mgd	0.68

The areawide overview has focused on public water systems in the management area that serve more than 1,000 people, as well as those that have claimed expanded future exclusive service area. The majority of small community and non-community systems have not claimed expanded exclusive service areas and therefore have limited growth potential. Many of these systems serve less than 100 people and are likely to experience only small to modest increases in water supply demands. As a group, these systems serve a minor percentage of the population within the management area and are expected to represent an even smaller fraction of future population served.

Two notable exceptions are the Westerly Water Department and the Mashantucket Pequot Tribal Nation. While these are not "small systems" in the sense that they serve more than 1,000 customers, future demands have not been specifically evaluated, since these systems are not slated to expand their exclusive service area.

The Mashantucket system currently serves an estimated population of 1,615 people. Average day system demand in 1999 was 0.943 mgd [redacted] While this system serves more than 1,000 people, it has not been awarded an exclusive service area beyond the boundaries of the tribal lands.

The Westerly Water Department provides public water to the eastern portion of Stonington. Westerly did not claim an expanded exclusive service area and, as such was not further evaluated with respect to future demands.

2.2 Municipal Population and Demand Projections

Projections of regional residential water supply demand presented in the following discussion are based on population projections for each municipality. This evaluation uses future population projections developed by the Office of Policy and Management. This is in contrast to the projections presented in Section 2.3, which presents only projections for the portion of the population to be served by public water systems.

Municipal Population Projections

The overall regional population projection indicates steady, but not dramatic growth in southeastern Connecticut. Urban areas are projected to lose population through the year 2000, and increase thereafter. Population growth in the suburban areas is projected to vary across the region throughout the planning period. Growth in the majority of the rural municipalities is projected to be slow. Table 2-2 presents these projections by municipality for the region. This is a combination of data obtained from Series 95.1 and 95.2, published by the Office of Policy and Management.

Urban Area Population Projections

The urban municipalities of Groton, New London and Norwich are projected to continue losing population through the year 2000 and increase thereafter. Projections through the year 2040 show the population of Groton increasing by about 10,890 or 25%; New London by about 6,950 people or 21%; and Norwich by about 6,140 people or 15% above population estimates for the year 2000.

Suburban Area Population Projections

Preston and Colchester are projected to increase in population significantly compared to the rest of the municipalities in the suburban areas. Projected growth for Preston is 102% from 2000 through the year 2040, or an average of almost 150 persons per year. Colchester is also projected to experience a significant increase in population, with 49% growth projected between 2000 and 2040, or an average of almost 175 persons per year. East Haddam and Ledyard are also projected to experience population increases over the planning period, increasing their total population by 4,000 to 5,000 people each.

Population in the remaining municipalities is projected to increase, but at a slower rate, averaging between 25 to 85 persons per year over the planning period.

<u>*Rural Area Population Projections*</u>

Projections indicate that Lebanon may have the largest percentage increase in population in the rural area class, with a 50% increase between 2000 and 2040, an average of about 82 persons per year. The remaining municipalities are projected to grow slowly. Franklin is projected to lose population until the year 2005, with a gradual increase of only 250 persons between 2005 and 2040.

Municipal Demand Projections

The population estimates presented in Table 2-2 were used to estimate the total residential water demands for the region. These demands are based on an estimated consumption of 75 gallons per capita per day and reflect the population served by individual wells as well as those served by public water systems. Table 2-3 presents the residential demand projections for the region by municipality. In many instances, most of the demand will be met by private water supply wells serving individual residences. The total demand is not expected to be met solely by the public water supply systems of the region.

Overall, the population of the region is projected to increase by slightly more than 26% through the 50-year planning period from 287,670 in 2000 to 362,800 in 2040. Correspondingly, total residential water demand is estimated to increase from 21.6 million gallons per day (mgd) to 27.2 mgd over the same period.

2.3 Exclusive Service Area Population and Demand Projections

Population and demand projections for each recommended exclusive service area are based on information supplied by representatives of the public water systems. Future demands were analyzed for systems presently serving more than 1,000 people with an expanded exclusive service area, as well as those systems expected to experience considerable growth through the 50-year planning period. Demands have been analyzed for existing conditions as well as the five-, 20- and 50-year planning periods.

TABLE 2-2
Population by Municipality for the Southeast Region

Municipality	1990[1] (Census)	1995[1] (Projected)	2000[1] (Projected)	2005[1] (Projected)	2010[1] (Projected)	2015[1] (Projected)	2020[1] (Projected)	2030[2] (Projected)	2040[2] (Projected)
Bozrah	2,297	2,310	2,320	2,340	2,360	2,390	2,420	2,500	2,500
Colchester	10,980	12,600	13,600	14,400	15,200	16,000	16,800	18,500	20,300
East Haddam	6,676	7,000	7,350	7,880	8,570	9,320	10,100	11,100	12,200
East Hampton	10,428	10,830	11,190	11,560	11,990	12,430	12,840	13,800	14,800
East Lyme	15,340	15,420	15,440	15,490	15,570	15,630	15,660	15,800	15,900
Franklin	1,810	1,710	1,660	1,650	1,710	1,780	1,860	1,900	1,900
Griswold	10,384	10,220	10,120	10,350	10,850	11,390	11,910	12,500	13,100
Groton	45,144	44,360	43,810	44,880	46,910	48,780	50,560	52,600	54,700
Hebron	7,079	7,420	7,720	8,060	8,480	8,970	9,470	10,400	11,500
Lebanon	6,041	6,340	6,620	6,940	7,320	7,750	8,200	9,000	9,900
Ledyard	14,913	15,880	16,780	17,180	17,480	17,780	18,080	19,300	20,600
Lisbon	3,790	3,830	3,850	3,910	4,000	4,100	4,200	4,300	4,500
Lyme	1,949	1,930	1,910	1,890	1,880	1,870	1,860	1,900	1,900
Marlborough	5,535	5,680	5,780	5,930	6,120	6,320	6,530	6,900	7,300
Montville	16,673	16,900	17,400	17,900	18,200	18,500	18,800	19,600	20,400
New London	28,540	26,920	26,050	26,160	27,900	29,480	31,020	32,000	33,000
No. Stonington	4,884	4,960	5,000	5,050	5,150	5,280	5,430	5,600	5,800
Norwich	37,391	36,030	35,060	35,440	36,850	38,240	39,550	40,400	41,200
Old Lyme	6,535	6,680	6,800	6,960	7,140	7,330	7,500	7,900	8,200
Preston	5,006	5,340	5,780	6,540	7,530	8,560	9,640	10,600	11,700
Salem	3,310	3,620	3,750	3,890	4,070	4,290	4,540	5,000	5,500
Sprague	3,008	3,100	3,220	3,390	3,590	3,780	3,940	4,300	4,700
Stonington	16,919	16,670	16,340	16,210	16,260	16,460	16,750	16,800	16,800
Voluntown	2,113	2,190	2,260	2,360	2,490	2,630	2,760	3,000	3,300
Waterford	17,930	17,880	17,860	18,120	18,630	19,170	19,750	20,400	21,100
Total	**284,675**	**285,820**	**287,670**	**294,480**	**306,250**	**318,230**	**330,170**	**346,100**	**362,800**

[1]Series 95.1 Data
[2]Series 95.2 Data

TABLE 2-3

Projected Town-Wide Future Water Demands[1]

Municipality	2000		2005		2010		2040	
	Population	Projected Consumption (mgd)	Projected Population	Projected Consumption (mgd)	Projected Population	Projected Consumption (mgd)	Projected Population	Projected Consumption (mgd)
Bozrah	2,320	0.174	2,340	0.176	2,360	0.177	2,500	0.188
Colchester	13,600	1.020	14,400	1.080	15,200	1.140	20,300	1.523
East Haddam	7,350	0.551	7,880	0.591	8,570	0.643	12,200	0.915
East Hampton	11,190	0.839	11,560	0.867	11,990	0.899	14,800	1.110
East Lyme	15,440	1.158	15,490	1.162	15,570	1.168	15,900	1.193
Franklin	1,660	0.125	1,650	0.124	1,710	0.128	1,900	0.143
Griswold	10,120	0.759	10,350	0.776	10,850	0.814	13,100	0.983
Groton	43,810	3.286	44,880	3.366	46,910	3.518	54,700	4.103
Hebron	7,720	0.579	8,060	0.605	8,480	0.636	11,500	0.863
Lebanon	6,620	0.497	6,940	0.521	7,320	0.549	9,900	0.743
Ledyard	16,780	1.259	17,180	1.289	17,480	1.311	20,600	1.545
Lisbon	3,850	0.289	3,910	0.293	4,000	0.300	4,500	0.338
Lyme	1,910	0.143	1,890	0.142	1,880	0.141	1,900	0.143
Marlborough	5,780	0.434	5,930	0.445	6,120	0.459	7,300	0.548
Montville	17,400	1.305	17,900	1.343	18,200	1.365	20,400	1.530
New London	26,050	1.954	26,160	1.962	27,900	2.093	33,000	2.475
No. Stonington	5,000	0.375	5,050	0.379	5,150	0.386	5,800	0.435
Norwich	35,060	2.630	35,440	2.658	36,850	2.764	41,200	3.090
Old Lyme	6,800	0.510	6,960	0.522	7,140	0.536	8,200	0.615
Preston	5,780	0.434	6,540	0.491	7,530	0.565	11,700	0.878
Salem	3,750	0.281	3,890	0.292	4,070	0.305	5,500	0.413
Sprague	3,220	0.242	3,390	0.254	3,590	0.269	4,700	0.353
Stonington	16,340	1.226	16,210	1.216	16,260	1.220	16,800	1.260
Voluntown	2,260	0.170	2,360	0.177	2,490	0.187	3,300	0.248
Waterford	17,860	1.340	18,120	1.359	18,630	1.397	21,100	1.583
Total	**287,670**	**21.575**	**294,480**	**22.086**	**306,250**	**22.969**	**362,800**	**27.210**

Note: 1. Demands represent total water demand for town **NOT** demands on public water systems only.
Consumption projections are based on 75 gallons per capita per day.
All consumptions are reported in million gallons per day (mgd).

The volume of unaccounted-for water was estimated based on information from each service provider. In instances where data was not available, unaccounted-for water was assumed to be 15% of the total system demand. Projections presented in this section are compared to the existing safe yields and do not reflect the development of future water supply sources. (See Section 2.4 for a discussion of future projected safe yields and Section 6.0 for a discussion on potential future water supplies.)

In instances where an exclusive service area provider with multiple small, unconnected systems has been recommended to serve a municipality (e.g. Connecticut Water Company in Old Lyme), demands and available yields of the ESA provider within that town have been combined. This was done on the assumption that deficits in one service area would be alleviated by interconnection to another system within the provider's ESA. It also enables review of public water supply and demand on a town-wide basis.

Existing Conditions

Existing service area population and demand estimates for each public water system serving more than 1,000 people and those recommended for future exclusive service areas are presented in Table 2-4. These projections include only the population and associated demands for those who are currently served by public water systems. While several systems within the region currently project deficit under peak or drought conditions, the region as a whole shows an excess supply of almost 10 mgd. This translates to a region-wide margin of safety of 1.42. However, caution is advised in applying such a number, since the supply is not optimally distributed within the region, resulting in some systems with a very high margin of safety, while other systems have little to no margin.

A number of systems, most notably Montville WWPCA and Connecticut-American Water Company in Stonington and Groton, currently show slight deficits. The Connecticut-American Water Company system in Stonington and Groton projects the largest deficit, at 534,000 gallons per day. The Montville WWPCA currently purchases its water from the City of New London and does not maintain its own supplies. The existing agreement is for 70,000 gallons per day, while the average day demand of the Montville WWPCA system is 161,000 gpd. This represents a theoretical deficit of

91,000 gpd. However, New London has continued to provide the water volumes necessary to meet system demands.

Five-Year Planning Period

Projections for the five-year planning period are presented in Table 2-5. These projections include only the population and associated demands for those who are expected to be served by public water systems. The residential population in the region is projected to increase by slightly more than 2% during the five-year planning period, from 287,670 people in 2000 to 294,480 people in 2005. Yet the population served by public water systems is projected to increase almost 17% from 141,348 in 2000 to 165,306 in 2005. This may be due to somewhat optimistic projections by the ESA providers.

Total demand for public water in the region (including residential and non-residential demand) is projected to increase by almost 23% (including unaccounted for water). Residential demand is projected to increase 21% from its current rate of 10.0 mgd, to 12.1 mgd in 2005. Non-residential demand is expected to increase more rapidly, almost 29%, from the existing demand of 10.3 mgd, to 13.4 mgd in 2005.

Assuming no new sources are developed in the five-year planning period, a regional surplus of 4.7 mgd is predicted within the southeast Connecticut public water supply management area. This translates to a region-wide margin of safety of 1.16. Again, caution is advised in applying such a number, since the supply is not optimally distributed within the region. In fact, numerous individual systems project deficits in the five-year planning period. Table 2-6 provides a summary of systems (and providers) currently projecting deficits in excess of 100,000 gallons per day within the five-year planning period.

TABLE 2-4

Planning Horizon Based on Average Day Demand: Existing Conditions (2000)

For systems serving greater than 1,000 people and those recommended for expanded exclusive service area

(All volumes reported are million gallons per day (mgd) unless otherwise noted)

Municipality	ESA Designation	ESA Provider	Service Area Population	Residential Demand	Non-Residential Demand	Demand Sub-Total	Unaccounted for Water [22]	Total System Demand	Existing Safe Yield [1,2]	Water Transferred In	Water Transferred Out	Water Purchased	Water Sold [3,4]	Surplus / Deficit
[redacted]														

Notes:

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]
7. [redacted]
8. [redacted]
9. [redacted]
10. [redacted]
11. [redacted]
12. [redacted]
13. [redacted]
14. [redacted]
15. [redacted]
16. [redacted]
17. [redacted]
18. [redacted]
19. [redacted]
20. [redacted]
21. [redacted]
22. [redacted]
23. [redacted]

TABLE 2-5

Planning Horizon Based on Average Day Demand: 5-Year Planning Period (2005)

For systems serving greater than 1,000 people and those recommended for expanded exclusive service area

(All volumes reported are million gallons per day (mgd) unless otherwise noted)

Municipality	ESA Designation	ESA Provider	Service Area Population	Residential Demand	Non-Residential Demand	Demand Sub-Total	Unaccounted For Water [13]	Total System Demand	Existing Safe Yield [1,2]	Water Transferred In	Water Transferred Out	Water Purchased	Water Sold [4]	Surplus / Deficit
[redacted]														

Notes:

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]
7. [redacted]
8. [redacted]
9. [redacted]
10. [redacted]
11. [redacted]
12. [redacted]
13. [redacted]
14. [redacted]
15. [redacted]
16. [redacted]
17. [redacted]
18. [redacted]
19. [redacted]
20. [redacted]
21. [redacted]
22. [redacted]
23. East Hamp[redacted]

TABLE 2-6
Projected Deficits in Excess of 0.1 mgd Within the Five-Year Planning Period

ESA	ESA Provider	Projected Deficit
Town of East Hampton	East Hampton WPCA	1.075 mgd
City of Norwich	Norwich DPU	0.664 mgd
Southeast Groton / Western Stonington	CT-American Water Co.	0.622 mgd
Eastern Stonington	Town of Stonington	0.395 mgd
Town of East Lyme	Town of East Lyme	0.358 mgd
Town of Preston	Town of Preston	0.171 mgd
Eastern Montville	Montville WWPCA	0.124 mgd

20-Year Planning Period

Projections for the 20-year planning period are presented in Table 2-7. These projections include only the population and associated demands for the portion of the population projected to be served by public water. The regional population is predicted to increase during the 20-year planning period by slightly more than 6% from the current population of 287,670 people to 306,250 people in 2010. The population served by public water systems is predicted to increase approximately 28% over existing conditions from 141,348 in 2000 to 180,459 in 2010.

Total public water demand is projected to increase 44% from the current demands of 23.6 mgd to 34.0 mgd. The largest increase in demand is projected to be in the non-residential sector, with a predicted increase of almost 57% from the current demand of 10.3 mgd to 16.3 mgd in 2010. Residential demand is predicted to increase almost 29% during the same period, from 10.0 mgd in 2000 to 12.9 mgd in 2010.

Assuming no new sources are developed in the 20-year planning period, the region is expected to experience a public water supply deficit of slightly more than 0.3 mgd. This does not account for any margin of safety for the individual systems. Further, as previously noted, considerable excess supply may be available at some systems, while others project significant deficits. Systems predicting deficits greater than 100,000 gallons per day based on current supply availability are listed in Table 2-8

TABLE 2-7

Planning Horizon Based on Average Day Demand: 20-Year Planning Period (2010)

For systems serving greater than 1,000 people and those recommended for expanded exclusive service area

(All volumes reported are million gallons per day (mgd) unless otherwise noted)

Municipality	ESA Designation	ESA Provider	Service Area Population	Residential Demand	Non-Residential Demand	Demand Sub-Total	Unaccounted For Water [22]	Total System Demand	Existing Safe Yield [1,3]	Water Transferred In	Water Transferred Out	Water Purchased	Water Sold[4]	Surplus / Deficit
[redacted]														

Notes:

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]
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17. [redacted]
18. [redacted]
19. [redacted]
20. [redacted]
21. [redacted]
22. [redacted] umed to be 10%.
23. [redacted]

TABLE 2-8

Projected Deficits in Excess of 0.1 mgd Within the 20-Year Planning Period

ESA	ESA Provider	Projected Deficit (mgd)
City of Norwich	Norwich DPU	2.325
Town of East Hampton	East Hampton WPCA	1.700
Town of Preston	Town of Preston	0.814
Southeast Groton / Western Stonington	CT-American Water Co.	0.692
Eastern Stonington	Town of Stonington	0.668
Town of East Lyme	Town of East Lyme	0.631
Eastern Montville	Montville WWPCA	0.208

50-Year Planning Period

Projections for the 50-year planning period are presented in Table 2-9. These projections include demands only for the portion of the population to be served by public water systems. The 50-year planning period is based on demand projections through 2040. The overall population of the region is predicted to increase by 26% during the 50-year planning period from 287,670 in 2000 to 362,800 in 2040. However, the population served by public water is predicted to increase 67% over the current level of 141,348 to 235,416 in 2040.

Total public water system demand in the region is predicted to increase 109% over existing conditions from current demands of 23.6 mgd to 49.4 mgd in 2040. Residential water demand is projected to increase by 91% from 10.0 mgd in the year 2000 to 19.1 mgd in 2040. Non-residential demands are projected to increase from 10.3 mgd to 23.0 mgd in 2040, an increase of 123%.

Assuming no new sources are developed in the 50-year planning period, the public water supply deficit in the region is predicted to be 15.7 mgd. This projection is based on existing available supplies and does not account for the development of future water supply sources. This does not account for any margin of safety for the individual systems. As previously noted, considerable excess supply may be available at some systems, while others project significant deficits. The systems in Table 2-10 project deficits in excess of 100,000 gallons per day within the planning period.

TABLE 2-9

Planning Horizon Based on Average Day Demand: 50-Year Planning Period (2040)

For systems serving greater than 1,000 people and those recommended for expanded exclusive service area

(All volumes reported are million gallons per day (mgd) unless otherwise noted)

Municipality	ESA Designation	ESA Provider	Service Area Population	Residential Demand	Non-Residential Demand	Demand Sub-Total	Unaccounted For Water[22]	Total Demand	Existing Safe Yield[1,3]	Water Transferred In	Water Transferred Out	Water Purchased	Water Sold[4]	Surplus / Deficit
[redacted]														

Notes:

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]
5. [redacted]
6. [redacted]
7. [redacted]
8. [redacted]
9. [redacted]
10. [redacted]
11. [redacted]
12. [redacted]
13. [redacted]
14. [redacted]
15. [redacted]
16. [redacted]
17. [redacted]
18. [redacted]
19. [redacted]
20. [redacted]
21. [redacted]
22. [redacted]
23. [redacted]

TABLE 2-10

Projected Deficits in Excess of 0.1 mgd Within the 50-Year Planning Period

ESA	ESA Provider	Projected Deficit (mgd)
City of Norwich	Norwich DPU	4.316
Town of Preston	Town of Preston	3.991
Town of East Hampton	East Hampton WPCA	2.600
Eastern Montville	Montville WWPCA	1.786
Town of East Lyme	Town of East Lyme	1.495
Southeast Groton / Western Stonington	CT-American Water Co.	1.222
City of New London	New London Water Department	1.120
Town of Colchester	Colchester DPW	0.992
Eastern Stonington	Town of Stonington	0.965
Town of North Stonington	Town of North Stonington	0.504
Town of East Haddam	Town of East Haddam	0.271

Summary

Table 2-11 is a summary of demand projections and surplus/deficits for existing conditions as well as the five-, 20-, and 50-year planning periods. The margin of safety is calculated based on the total existing regional safe yield of 33.5 mgd. The demand projections represent demands on large systems and those with expanded exclusive service area.

TABLE 2-11

Summary of Demand Projections and Surplus/Deficits

(all volumes reported are mgd)

Planning Horizon	Existing/Projected Demand	Existing/Projected Surplus/(Deficit)	Existing/Projected Margin of Safety
Existing Conditions	23.559 mgd	9.985 mgd	1.42
5-Year Planning Period (2005)	28.933 mgd	4.714 mgd	1.16
20-Year Planning Period (2010)	33.969 mgd	(0.321) mgd	0.99
50-Year Planning Period (2040)	49.346 mgd	(15.698) mgd	0.68

Existing Conditions – Small Systems

Water supply demands and safe yield for systems serving less than 1,000 people are presented in Table 2-12. The small community public water systems within the southeast Connecticut region have sufficient supplies to meet current demands in almost all cases. Two systems, Mallard Cove Condominiums (East Hampton) and Fort Shantock Manor Apartments, System 1 (Montville), appear to be operating in a deficit condition at the present time. Other systems appear to have surplus water available based on existing system demands and yields.

Table 2-13 presents municipal populations in comparison to the projected public water service populations for each municipality. The public water service populations include both the large and small system populations.

At present, approximately 55% of the region is served by public water. This estimate is based on service area population data supplied by public water system representatives and OPM projections of the regional population. Within the five-year planning period, 62% of the population is projected to be served by public water. This is forecast to increase to 65% and 70% within the 20- and 50-year planning periods, respectively.

2.4 Existing and Future Safe Yields

Table 2-14 provides a summary of the existing and projected safe yields for each service provider serving more than 1,000 people and those with expanded exclusive service area. Future safe yield was taken from information provided by public water system representatives. When taking into account the development of future water supply sources, the region does not project a deficit within the 50-year planning period. However, it should be clearly understood that these future projected yields are estimates provided by the individual public water suppliers and do not necessarily correlate to specific sources or aquifers and may not reflect the safe yield of the developed source.

An additional 19.8 mgd of supply source yield is projected to be gained by the year 2040, for a total regional supply of 53.5 mgd. However, 17.9 of the projected 19.8 mgd comes from just five entities. These are the municipal systems in East Hampton, East Lyme, New London, North Stonington, and Preston.

It is not certain whether diversion permits can be obtained for all future sources and the future yield estimates may be optimistic. Section 6.0 of this document presents an analysis of future potential supply sources in the region as well as likely yields.

TABLE 2-12
Planning Horizon: Existing Conditions (2000)
For all systems serving less than 1,000 people and/or not recommended for expanded future service area

Municipality	ESA Designation	Existing Service Population	System Demand (gpd)	System Demand (mgd)	Existing Safe Yield (mgd)	Surplus/Deficit
Colchester	Colchester Commons Mgmt. Corp	160	9,774	0.0098	[redacted]	0.0097
	Colchester Courtyards	276	20,700	0.0207	[redacted]	0.0011
	AquaSource, Ponemah Village	87	7,000	0.0070	[redacted]	0.0360
	Knob Hill Condominiums	84	6,300	0.0063	[redacted]	0.0176
	Westchester Hill Condominiums	168	12,600	0.0126	[redacted]	0.0058
	AquaSource, Westchester Village	280	21,000	0.0210	[redacted]	0.0160
East Haddam	Chestelm Health Care	101	7,575	0.0076	[redacted]	0.0183
	Haddam Hills Academy	155	11,625	0.0116	[redacted]	0.0251
	Oak Grove Senior Housing Corp.	72	5,400	0.0054	[redacted]	0.0076
East Hampton	Barbara's Rest Home	30	2,250	0.0023	[redacted]	0.0140
	Bellwood Court	32	2,400	0.0024	[redacted]	0.0084
	Chatham Acres Elderly Housing	45	3,375	0.0034	[redacted]	0.0063
	Chatham Apartments	30	2,250	0.0023	[redacted]	0.0302
	Cobalt Lodge Health Care & Rehab	60	4,500	0.0045	[redacted]	0.0085
	CT-American, East Hampton District	168	12,600	0.0126	[redacted]	0.0064
	Edgemere Condominium Association, Inc.	520	39,000	0.0390	[redacted]	0.0668
	Mallard Cove Condominium Assoc.	177	13,275	0.0133	[redacted]	-0.0033
Griswold	Connolly's Trailer Park	75	5,550	0.0056	[redacted]	0.0161
	Gallup Water Country Mobile Div.	193	14,475	0.0145	[redacted]	0.0536
	Center for Optimum Care Summit	125	9,375	0.0094	[redacted]	0.0295
	Lakeview Mobile Home Park	96	7,238	0.0072	[redacted]	0.0133
Groton	Colonial Apartments	60	4,500	0.0045	[redacted]	0.0128
	Roger's Mobile Home Park	55	4,125	0.0041	[redacted]	0.0283
	Whipple's Mobile Home Park	164	12,300	0.0123	[redacted]	0.0039
Hebron	Abby Estates	100	7,500	0.0075	[redacted]	0.0119
	(Bolton Associates) Country Manor Apts.	72	5,400	0.0054	[redacted]	NDA
	Hebron Arms Apts.	39	2,925	0.0029	[redacted]	0.0187
	Hillside Condominiums	96	5,975	0.0060	[redacted]	NDA
	Wellswood Estates Foundation, Inc.	56	4,200	0.0042	[redacted]	0.0085
Lebanon	CT-American, Lebanon District	288	21,600	0.0216	[redacted]	0.0064
	Aquasource, Lebanon Elderly	30	2,250	0.0023	[redacted]	0.0128
	Carefree Homeowners Assn.	168	12,600	0.0126	[redacted]	0.0457
	Lebanon Pines	124	7,564	0.0076	[redacted]	0.0140
	Village Hill Apartments	36	2,700	0.0027	[redacted]	NDA
Ledyard	Avery Hill Water Assn.	117	8,775	0.0088	[redacted]	0.0398
	Christy Hill Condominiums	86	6,450	0.0065	[redacted]	0.0044
	Grandview Trailer Park System 1	60	4,500	0.0045	[redacted]	0.0160
	Grandview Trailer Park System 2	30	2,250	0.0023	[redacted]	0.0183
	Heritage Apartments	108	8,100	0.0081	[redacted]	0.0275
	Ledyard Village Homeowners Assn, Inc.	184	13,800	0.0138	[redacted]	0.0402
	Pheasant Run Condominiums	144	10,800	0.0108	[redacted]	0.0216
	SCWA, Barrett Division	300	22,500	0.0225	[redacted]	0.0332
	SCWA, Chriswood Division	160	12,000	0.0120	[redacted]	0.0045
	SCWA, Gray Farms Division	311	23,325	0.0233	[redacted]	0.0404
	Sleepy Hollow Mobile Home Park	51	3,825	0.0038	[redacted]	0.0016
	Williamsburg Apartments	63	4,725	0.0047	[redacted]	0.0428

Notes: NDA = No Data Available

TABLE 2-12
Planning Horizon: Existing Conditions (2000)
For all systems serving less than 1,000 people and/or not recommended for expanded future service area

Municipality	ESA Designation	Existing Service Population	System Demand (gpd)	System Demand (mgd)	Existing Safe Yield (mgd)	Surplus/Deficit
Lisbon	Jewett City Water Co., Hill-N-Dale	76	5,000	0.0050	[redacted]	0.0263
	Lisbon Mobile Home Park	90	7,000	0.0070	[redacted]	0.0000
	Round Hill Apartments	36	2,700	0.0027	[redacted]	0.0081
	Tunnel Hill Mobile Home Park	55	4,125	0.0041	[redacted]	0.0823
Marlborough	Birchwood Estates Water Assn.	260	19,500	0.0195	[redacted]	0.0485
	Forest Homes Water Assn.	160	12,000	0.0120	[redacted]	0.0026
	Hillside Corporation	124	5,975	0.0060	[redacted]	0.0070
	Laurel Hill Water Assoc.	100	3,375	0.0034	[redacted]	0.0166
Montville	Beechwood Acres	77	5,775	0.0058	[redacted]	0.0050
	D&W Trailer Park	39	2,925	0.0029	[redacted]	0.0011
	Deer Run Supply	53	3,975	0.0040	[redacted]	0.0079
	Fort Shantock Manor Apts - System 1	144	10,800	0.0108	[redacted]	-0.0003
	Fort Shantock Manor Apts - System 2	36	2,700	0.0027	[redacted]	0.0052
	Fox Laurel Mobile Home Park	40	3,000	0.0030	[redacted]	0.0510
	Freedom Village Elderly Housing	48	3,600	0.0036	[redacted]	0.0072
	Independence Village Elderly Housing	50	3,750	0.0038	[redacted]	0.0071
	Jensens Inc. Marina Cove Residential	71	5,325	0.0053	[redacted]	0.0093
	Kitemaug Orchard Assn.	472	35,400	0.0354	[redacted]	0.0316
	Lakeside Manor Apartments	72	4,000	0.0040	[redacted]	0.0460
	Martin Realty Inc. Mobile Home Park	29	2,175	0.0022	[redacted]	0.0075
	Meadows Apartments	301	33,575	0.0336	[redacted]	0.0528
	Montville Countryside LLC	30	2,250	0.0023	[redacted]	NDA
	Mountview Apartments	102	7,650	0.0077	[redacted]	NDA
	Oak Ridge Mobile Home Park	70	5,250	0.0053	[redacted]	0.0272
	Oakdale Heights Water Assoc.	876	65,700	0.0657	[redacted]	0.1924
	Platoz Apts. (Total Technology)	54	4,050	0.0041	[redacted]	NDA
	St. Thomas More School System #2	344	7,870	0.0079	[redacted]	0.0156
	St. Thomas More School System #3	326	10,400	0.0104	[redacted]	0.0131
	St. Thomas More School System #5	160	2,400	0.0024	[redacted]	0.0098
	Utz Mobile Home Park	90	6,750	0.0068	[redacted]	0.0273
	Village Apartments	132	9,900	0.0099	[redacted]	0.0009
No. Stonington	Cedar Ridge Water Assn.	496	37,200	0.0372	[redacted]	0.0244
	M.H. Garden Park	90	6,750	0.0068	[redacted]	0.0181
	SCWA, North Stonington Division	606	45,450	0.0455	[redacted]	0.0896
Norwich	Countryside Drive Assn.	60	4500	0.0045	[redacted]	NDA
	Oakland Heights Mobile Home Park	225	16,875	0.0169	[redacted]	0.0620
	Pleasure Valley MHP - System 1	150	11,250	0.0113	[redacted]	0.0104
	Pleasure Valley MHP - System 2	115	8,625	0.0086	[redacted]	0.0141
	Pleasure Valley MHP - System 3	65	4,875	0.0049	[redacted]	0.0038
	Sunny Waters Mobile Home Park	360	27,000	0.0270	[redacted]	0.0464

Notes: NDA = No Data Available

TABLE 2-12
Planning Horizon: Existing Conditions (2000)
For all systems serving less than 1,000 people and/or not recommended for expanded future service area

Municipality	ESA Designation	Existing Service Population	System Demand (gpd)	System Demand (mgd)	Existing Safe Yield (mgd)	Surplus/Deficit
Old Lyme	Boxwood Condominium Assn.	56	4,200	0.0042	[redacted]	0.0088
	Chadwick Homeowners Assn.	292	21,900	0.0219	[redacted]	0.0278
	Countryside Drive Assn.	60	4,500	0.0045	[redacted]	NDA
	Hawks Nest Beach III	420	31,500	0.0315	[redacted]	0.0603
	Hawks Nest II	93	6,975	0.0070	[redacted]	0.0362
	Laurel Heights Assn, Inc.	45	3,375	0.0034	[redacted]	0.0034
	Lyme Regis, Inc.	32	2,400	0.0024	[redacted]	0.0084
	Lymewood Elderly Housing	50	3,750	0.0038	[redacted]	0.0071
	Miami Beach Water Company	440	33,000	0.0330	[redacted]	0.0253
	Mile Creek Apartments	60	4,500	0.0045	[redacted]	0.0603
	Rye Field Manor Elderly Housing	78	5,850	0.0059	[redacted]	0.0009
	White Sands Beach Water Company	600	45,000	0.0450	[redacted]	0.0792
	Wildwood Water Company	132	9,900	0.0099	[redacted]	0.0095
Preston	Lincoln Park Senior Citizen Center	52	3,900	0.0039	[redacted]	0.0123
	Preston Plains Water Company	400	30,000	0.0300	[redacted]	0.0348
	Strawberry Park	50	11,920	0.0119	[redacted]	0.0010
Salem	Crystal Lake Associates - Bldg 103/105	40	3,000	0.0030	[redacted]	0.0197
	Crystal Lake Associates - Bldg 111/113	40	3,000	0.0030	[redacted]	0.0110
	Crystal Lake Associates - Bldg 63/65	40	3,000	0.0030	[redacted]	0.0132
	Crystal Lake Associates - Bldg 73	24	1,800	0.0018	[redacted]	0.0101
	Crystal Lake Associates - Bldg 83/85	40	3,000	0.0030	[redacted]	0.0067
	Salem Manor Condominiums	32	2,400	0.0024	[redacted]	0.0106
Sprague	Hanover Park	48	3,600	0.0036	[redacted]	NDA
Stonington	Arlington Acres Mobile Home Park	392	29,400	0.0294	[redacted]	0.0192
	Fair Acres Mobile Home Park	202	15,150	0.0152	[redacted]	0.0054
	Latimer Point Fire District	282	21,150	0.0212	[redacted]	NDA
	Lords Point System	524	39,300	0.0393	[redacted]	NDA
	SCWA, Lantern Hill	53	3,975	0.0040	[redacted]	0.0122
Voluntown	Connecticut Water Company, SDC System	162	12,150	0.0122	[redacted]	0.0581
Waterford	Waterford Country School	100	7,500	0.0075	[redacted]	0.0314
	Woodland Mobile Home Park	160	12,000	0.0120	[redacted]	0.0161
	Totals	**17,519**	**1,277,466**	**1.2775**	[redacted]	**2.3904**

Notes: NDA = No Data Available

TABLE 2-13
Projected Municipal Population versus Water Service Population

Municipality	2000			2005			2010			2040		
	Total Population	Service Population	% Served	Total Population	Service Population	% Served	Total Population	Service Population	% Served	Total Population	Service Population	% Served
Bozrah	2,320	133	5.73	2,340	150	6.4	2,360	300	12.7	2,500	500	20.0
Colchester	13,600	5,102	37.51	14,400	5,430	37.7	15,200	6,365	41.9	20,300	14,992	73.9
East Haddam	7,350	866	11.78	7,880	1,048	13.3	8,570	1,180	13.8	12,200	3,056	25.0
East Hampton	11,190	1,663	14.86	11,560	11,560	100.0	11,990	11,990	100.0	14,800	14,800	100.0
East Lyme	15,440	11,730	75.97	15,490	15,470	99.9	15,570	15,570	100.0	15,900	15,900	100.0
Franklin	1,660	176	10.60	1,650	230	13.9	1,710	355	20.8	1,900	400	21.1
Griswold	10,120	4,538	44.84	10,350	4,678	45.2	10,850	4,952	45.6	13,100	6,352	48.5
Groton	43,810	39,942	91.17	44,880	41,917	93.4	46,910	44,204	94.2	54,700	53,121	97.1
Hebron	7,720	1,678	21.74	8,060	1,843	22.9	8,480	1,978	23.3	11,500	2,455	21.3
Lebanon	6,620	1,379	20.83	6,940	1,488	21.4	7,320	1,534	21.0	9,900	1,866	18.8
Ledyard [1]	16,780	5,604	33.40	17,180	5,872	34.2	17,480	6,053	34.6	20,600	6,538	31.7
Lisbon	3,850	987	25.64	3,910	1,010	25.8	4,000	1,028	25.7	4,500	1,124	25.0
Lyme	1,910	0	0.00	1,890	0	0.0	1,880	0	0.0	1,900	0	0.0
Marlborough	5,780	897	15.52	5,930	924	15.6	6,120	950	15.5	7,300	993	13.6
Montville	17,400	8,399	48.27	17,900	9,458	52.8	18,200	11,041	60.7	20,400	20,400	100.0
New London	26,050	26,050	100.00	26,160	26,160	100.0	27,900	27,900	100.0	33,000	33,000	100.0
No. Stonington	5,000	1,192	23.84	5,050	1,192	23.6	5,150	1,192	23.1	5,800	2,692	46.4
Norwich	35,060	22,975	65.53	35,440	23,975	67.6	36,850	25,975	70.5	41,200	30,975	75.2
Old Lyme	6,800	4,426	65.09	6,960	4,955	71.2	7,140	5,862	82.1	8,200	7,083	86.4
Preston	5,780	1,065	18.43	6,540	1,115	17.0	7,530	1,247	16.6	11,700	3,489	29.8
Salem	3,750	216	5.76	3,890	341	8.8	4,070	466	11.4	5,500	716	13.0
Sprague	3,220	1,264	39.25	3,390	1,268	37.4	3,590	1,268	35.3	4,700	1,268	27.0
Stonington	16,340	6,620	40.51	16,210	7,376	45.5	16,260	7,633	46.9	16,800	9,518	56.7
Voluntown	2,260	305	13.50	2,360	305	12.9	2,490	305	12.2	3,300	337	10.2
Waterford	17,860	11,660	65.29	18,120	15,060	83.1	18,630	18,630	100.0	21,100	21,360	101.2
Totals	**287,670**	**158,867**	**55.23**	**294,480**	**182,825**	**62.1**	**306,250**	**197,978**	**64.6**	**362,800**	**252,935**	**69.7**

Notes: All data unclude populations served by less than 1,000 with current service population data.

1. Ledyard demands do not include Mashantucket Tribal Nation (500 persons, 0.923 mgd demand, 2.66 mgd safe yield).

TABLE 2-14
Existing and Future System Safe Yield
For systems serving greater than 1,000 people recommended for expanded exclusive service area

(All volumes reported are million gallons per day (mgd) unless otherwise noted)

Municipality	ESA Designation	ESA Provider	Existing Safe Yield[1]	Projected Safe Yield 2005[2,3]	Projected Safe Yield 2010[2,3]	Projected Safe Yield 2040[2,3]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Notes:

1. [redacted]
2. [redacted]
3. [redacted]
4. [redacted]

3.0 INTERCONNECTIONS, JOINT USE FACILITIES AND SATELLITE MANAGEMENT

3.1 Interconnections

Existing Interconnections in the Region

An interconnection is a physical, hydraulic connection between two or more public water systems. Interconnections may be temporary or permanent, uni-directional or bi-directional. Interconnections are used for different purposes. Emergency interconnections are put in place for anticipated use in the event of an emergency or drought condition such that one public water system is able to provide water to another system for the duration of the emergency.

Some interconnections are utilized on a periodic basis to supplement flows during unusually high demand peak periods of service. Other interconnections are utilized daily to supply water from one system to another. Interconnections can minimize environmental impacts associated with the development of new water supply sources. In the southeast Connecticut public water supply management area, numerous systems are in place for the daily transfer of water from one system to another. These are summarized in Table 3-1.

TABLE 3-1
Existing Interconnections Providing Daily Transfer of Water

System Supplying Water	System Receiving Water	Maximum Agreed-Upon Transfer
[redacted]		

[1]Actual use is on the order of 50,000 gpd
[2]This is a seasonal customer from April through November. Total annual use is approximately 1.3 MG.

Many of the smaller community public water systems in the region operate with a single source of supply, with no backup supply. This leaves these systems vulnerable to interrupted service due to equipment failures, contamination, and the like. Table 3-2 lists the known emergency interconnections in the southeast Connecticut region. There are only two.

TABLE 3-2
Known Emergency Interconnections

System Supplying Water	System Receiving Water
Connecticut-American Water Co.	Fair Acres Mobile Home Park
Norwich DPU	Oakdale Heights MHP

Interconnections are sometimes associated with consolidation. However they are different concepts. An interconnection allows flow of water in either one or both directions, sometimes during emergencies or during seasonal water shortages. In other cases to provide a sustained source of supply from one system to another. Interconnections are generally intended to augment or improve the operation of a system, and generally one source is not replaced by another.

Consolidation, on the other hand, serves to merge two separate systems to operate as one, either physically or administratively. This can be accomplished in any number of manners. System consolidation is not coincident with source elimination, and does not necessarily equate to elimination of a water supply entity. For instance, certain water purveyors maintain numerous separate public water systems in a single municipality. Interconnection of these systems would allow for the periodic exchange of water from one system to another, should that need arise, whether due to water quality problems in a supply source, increased demands in a system beyond available yield, or even routine maintenance, such as well reconditioning. Alternately, consolidation of one or more of these systems could occur if geographically feasible, wherein multiple sources are treated at one central location, or where certain sources are designated as primary supplies, with secondary supplies providing system peaking flows. In both cases, the water purveyor would not change hands and all existing supply sources would be maintained.

In other cases, consolidation of a small administratively faltering system may be appropriate. Again, consolidation could occur with no change in the source of supply. Systems currently exist in the southeast region that would benefit from the technical and maintenance support of an administratively more sound organization. Still other systems operate with a single source of supply with historic water quality problems. These systems may require elimination of an inferior supply source.

Sale of Excess Water

Section 22a-358 of the Connecticut General Statutes requires that whenever any public water system has water reserves in excess of those required to maintain an adequate supply of water to inhabitants of its service area, such system may sell such excess water to any other public water system upon approval from the Commissioner of Public Health. Such approval can be given only after the applicant has clearly established to the satisfaction of the Commissioner that such adequate supplies are in existence and will continue to be in existence for five years or for such longer period as the applicant seeks permission to sell excess water. Permits are valid for a maximum of ten years.

Prior to 1985, the sale of excess water was regulated through the Department of Environmental Protection. Public Act 85-142 transferred approval requirement from the Commissioner of DEP to the Commissioner of Public Health. Only three active sale of excess water permits for the southeast WUCC area are on file with DPH. These are listed in Table 3-3.

TABLE 3-3
Active Sale of Excess Water Permits on File with DPH

System Supplying Water	System Receiving Water	Maximum Agreed-Upon Transfer
[redacted]		

Diversion Permitting Requirements

Certain interconnections require a diversion permit from the Department of Environmental Protection. There are currently three types of diversion permits administered by DEP. These are categorizes as individual, minor and temporary. An individual permit is required for proposed diversions in excess of 50,000 gallons per day and inter-basin transfers. General permits can be issued for activities DEP deems minor, including emergency interconnections of water distribution systems. Temporary authorizations are issued by DEP for periods of up to 30 days.

A permanent, active interconnection of any water distribution system with the capacity to transfer over 50,000 gallons per day requires an individual diversion permit. However, CGS Section 22a-378a allows DEP to issue a general permit for minor activities including:

> "Transferring water from one distribution system or service area to another distribution system or service area or the installation of the capacity to transfer such water in anticipation of a water supply emergency for public water supply."

In the event of a water supply emergency, DEP has the authority to temporarily issue a permit for diversion of water for a period of up to thirty days, which can be extended for one additional thirty day period (C.G.S. Sec. 22a-378). Extensions may be granted beyond the second thirty day period however DEP must hold a hearing in order to grant the extension.

Interconnection Agreements

Interconnection agreements range from informal (in some cases based on a verbal agreement) to extensive legal documents. There are no set criteria with respect to the terms and conditions of interconnections, however most sound agreements include the following elements:

- term of agreement;
- location and type of water (raw or finished);
- apportionment of cost of design and construction of the interconnection;
- apportionment of maintenance costs, testing, flushing, etc.;
- quantity of water to be taken under a variety of conditions;
- time of day or time of year restrictions;
- metering devices required;
- price of water and mechanism for future price adjustments;
- frequency of payment;
- minimum purchases or standby charges;
- pressure range of water at point of transfer;
- factors mitigating the contract; and
- notice required to terminate.

Interconnections for purchased water may be included as part of the system's available water provided that reliable delivery is assured by contract. Interconnections for sale of water must be considered part of the system's demand for as long as the agreement exists.

Regional Interconnections

Inter- and intra-regional interconnections must be considered as a potential means of supplying water. They may be less expensive than developing additional sources or providing standby power for emergency use. Interconnections can also provide supply to areas where source development is not feasible.

It is recognized that a regional approach may be necessary in the future to satisfy demands. Accordingly, evaluation of future supply sources has considered the ability of each potential supply to serve regionally significant needs.

In July of 1999, a diversion permit application was submitted to DEP to interconnect public water systems in the municipalities of Groton, Ledyard, Preston, Norwich and Montville. This interconnection would allow surplus water from Groton to be routed through Ledyard, Preston, and Norwich for wholesale purchase to Montville. A more direct routing is possible from Groton to Montville through Ledyard, but would require a new crossing at the Thames River. Similarly, another alternate routing would be possible from Groton, across the Thames River to New London and then to Montville through Waterford.

The diversion permitting process for this interconnection came to a halt following a notice of insufficiency from DEP and a lack of agreement on the structure and direction of the application, including who would own the infrastructure to support it.

While it is recognized that the Groton-Montville loop is currently on hold, this interconnection is recommended as a short term goal for the region. This loop could be further extended through Waterford and New London to connect the three urban centers of southeastern Connecticut (Groton, New London, and Norwich).

Additional long term regional interconnections off a Groton-Norwich-New London loop are recommended along the I-95 corridor, incorporating East Lyme and Old Lyme to the west and Stonington to the east.

The regulatory and participatory process involved in creating regional interconnections can be costly and time-consuming. It also requires the cooperation of many municipal and private entities for its success. There are currently no mandates for systems to interconnect or for systems to act as a vehicle for pass-through transmission of water. A lack of cooperation of one or more entities could necessitate the installation of parallel transmission piping.

Water quality concerns also exist when interconnections result in the blending of water from two or more systems. When the character of drinking water changes, even slightly, consumers may become dissatisfied. Additional concerns arise for certain specialized uses, such as industrial process water.

System Specific Interconnections

Numerous large systems are within short distances from one another and have either not completed or have not pursued formal interconnections. Such interconnections would provide greater security in case of drought or system problems.

Table 3-4 lists the municipalities that are served by more than 10 community public water systems in total and more than two systems serving greater than 1,000 people. These areas represent the highest priority for interconnected small systems. This data was compiled from the master list of WUCC members as presented in the Final Water Supply Assessment (April 1999).

TABLE 3-4
Municipalities Served by Multiple Community Public Water Systems

Municipality	Total Number of Community Public Water Systems	Number of Municipally Owned Public Water Systems	Number of Public Water Systems Serving <500	Number of Public Water Systems Serving >500 but <1,000	Number of Public Water Systems Serving >1,000
East Hampton	12	1	11	1	0
Groton[1]	6	1	3	0	3
Ledyard	18	3	15	0	3
Montville	31	1	25	3	3
Old Lyme	14	0	11	1	2

[1]The Connecticut-American Water Company's Mystic Valley District System serves a portion of Stonington and a portion of Groton along the Mystic River. For accounting purposes, this system is included under Stonington.

Interconnections of systems that have water quality or other operational problems and those which rely on a single source of supply should be given a high priority with respect to interconnections. Additionally, those very small systems with administrative shortcomings should also be considered for interconnection or consolidation with adjacent systems. As reported in the 1999 Final Water Supply Assessment for this region, the most common water quality enforcement actions were against small community systems for failure to conduct the required testing and failure to employ staff with the appropriate certifications.

Small municipal systems should consider expanding their existing public water systems to meet new demands in lieu of developing additional non-community systems.

Recommended Interconnection Guidelines

The following guidelines have been developed for the use and maintenance of interconnections:

1. Conduct hydraulic analysis of the two systems to determine pipe size that is adequate to transmit the water required at a predetermined differential pressure.

2. Equip the interconnection with a meter that is sized to properly measure the anticipated flow and that has isolating valves.

3. Provide a flexible coupling to permit removal of the pipes or meter if required.

4. Provide a bypass for emergency use to allow the interconnection to be used at times when the meter is out of service.

5. Provide taps on each side of the meter isolating valves to check pressures prior to use and to empty pipes for dismantling for meter service and calibration.

6. Provide nearby hydrants for use in water sampling, flushing, and flow measurement.

7. Provide a meter pit, if possible, with manhole covers capable of being easily opened for purposes of meter reading, valve adjustment, and flushing.

3.2 Joint Use or Ownership of Facilities

Joint use or ownership of facilities and/or services can provide savings in capital and operational costs, result in maintenance reduction, and improve both reliability and efficiency of system operation for those systems engaged in such arrangements. Smaller systems may benefit from paying a proportionate share of such facilities or services in lieu of carrying the sole financial burden. Larger systems may more fully utilize existing equipment and/or expertise by broadening the scope of their operations.

Little information currently exists regarding the joint use or ownership of facilities for public water systems in the southeast Connecticut region. In an attempt to quantify the existing and planned shared or joint use facilities, as well as services and equipment which could be made available to other systems, a questionnaire was mailed to all public water system representatives within the southeast Connecticut public water supply management area. Of the ±110 members queried, approximately 50 responses were received. The results are reflected in the following discussion.

Joint Use/Ownership of Major Infrastructure

Joint use or ownership of major infrastructure, such as supply sources, storage, treatment, or water mains is not currently practiced in the region. More common is the arrangement where one public water system sells water to a neighboring system through an interconnection. For instance, Groton Utilities provides 100 percent of supply to the Noank Fire District and Groton Long Point systems. However, these systems do not share in the development, ownership, operation, or maintenance of the sources of supply that feed the system. Similar situations exist between New London and Montville; Groton and Ledyard; Connecticut-American Water Company and Connecticut Water Company's Masons Island System; and Connecticut American Water Company and Classee Water Company in Stonington.

One agreement does exist between the Town of Preston and The Connecticut Water Company (CWC) that applies to a potential future regional pipeline within Preston. This agreement would allow CWC to supply and/or transfer water through a regional pipeline owned, operated and maintained by the Town of Preston. The agreement further allows CWC to extend, enlarge, expand and interconnect to this pipeline at its own expense.

Given the forecast deficit in water supply sources in the southeast region, there is a potential for future shared ownership and use of supplies beyond routine interconnections. This type of shared use would require formal agreements among the stakeholders. Large scale regional interconnections of future water supplies could be fed by a jointly owned supply source. This may become more common if water supply development trends towards regional supplies to meet the needs of multiple systems.

Joint Use/Ownership of Equipment

Equipment is shared among public water systems in the region largely through informal arrangements and on an as-needed basis. The most common scenario is shared emergency generators among neighboring systems. Other equipment, including compressors, piping, fittings, meters, and the like are informally shared or borrowed on a cooperative basis and among systems with ongoing working relationships. Specialized equipment and operations are most commonly contracted out to non-water system suppliers. This includes water tankers, excavation equipment, portable generators, pumps, pipes, and fittings, and the like.

Joint Use/Ownership of Services

With the exception of informal, verbal agreements, no cooperative arrangements for shared services with neighboring public water systems have been identified by public water system representatives. Based on the responses received, the most common services that are contracted out include water quality sample collection, analysis, and reporting; leak detection; engineering; and major repairs. Documentation which would outline limitations on an arrangements and schedules for development, use, operation, and maintenance of such equipment and/or facilities does not exist.

Some systems contract out operations of their entire system under a satellite management agreement. These are described in Section 3.3 of this document. Several of the larger water providers, namely Connecticut Water Company, AquaSource (ECRWC), and SCWA, provide services to smaller systems, including leak detection, meter reading, and emergency repair services.

3.3 Satellite Management

Satellite management is defined in the regulations as management of a public water supply system by another public water supply system. Satellite management is common for small systems that are physically or geographically isolated from surrounding public water systems. Satellite management can be a cost-effective means of operating a small system because it takes advantage of the "economy of scale" factor that larger water suppliers can offer.

The term satellite system, while not defined in the regulations, is generally understood to mean a self-contained public water system that serves a discrete, usually small area that is not interconnected with a larger system or distribution piping network. Satellite systems typically serve a contained population, such as a condominium or apartment complex, a residential subdivision, a mobile home park, or a singular facility, such as a town hall, library, or school. Satellite systems may be managed by their owner (in the case of a private development) or a municipality (in the case of a public facility), or they may be managed by a separate entity. It is the latter scenario that is considered satellite management.

Table 3-5 lists service providers that currently manage multiple community public water systems that they do not own. (Many of these same providers, and others, also provide services for non-community public water systems). This information is based on a regulatory database of systems. It is clear from this listing that AquaSource (ECRWC) is the largest provider of contract operation for community public water systems services in the southeast region. Other larger systems have indicated a willingness or desire to provide similar services. These include Connecticut-American Water Company, Groton Utilities, Jewett City Water Company, Norwich DPU, and SCWA.

TABLE 3-5
Contract Operators Providing Service to Multiple Community Public Water Systems

Contract Operator	Number of Non-Owned Systems Served
AquaSource	21
Colchester Utilities Commission	2
Connecticut Water Company	2
Culligan	2
Hydro Dynamic Engineering	3
Mile Creek Apartments	2

In an effort to evaluate the future need for satellite contract operations, as well as the ability and willingness of water suppliers to provide such services, the exclusive service area providers in the region were queried. Results are presented in Table 3-6.

Numerous municipal ESA providers, including East Haddam, Lebanon, Lyme, Marlborough, North Stonington, Preston, and Stonington, have indicated a possible need for future satellite management of systems that are located within their exclusive service area. All of these noted municipalities currently provide service to limited facilities, such as schools and town halls, or in the case of Lyme and Stonington, do not currently provide service at all. Several of these municipalities have entered into agreements (some formal, some informal) with other providers for future satellite management.

Several of the larger municipal ESA providers (i.e. currently providing service to greater than 1,000 people), including those in Montville, Noank, and Sprague, have also indicated a possible future need for satellite management. This could include their entire system or could be limited to those isolated areas that are not physically connected to the main system.

The information presented in Table 3-6 can be used as a resource for those small system providers that are currently providing limited service in remote areas and that wish to contract out their operations..

TABLE 3-6
Satellite Management Needs and Opportunities of ESA Providers

ESA Provider	Intend to Operate Their Own Satellite Public Water Systems	Potential Need for Contract Operation by Other Providers	Available to Operate Satellite Water Systems for Other Providers
Colchester DPW	X		
Connecticut-American Water Co.	X		X
Connecticut Water Company	X		X
Town of East Haddam		X	
Town of East Hampton	X	X	
Town of East Lyme	X		
ECRWC/AquaSource	X		X
Groton Long Point Water Dept.	X		
Groton Utilities	X		X
Jewett City Water Company	X		X
Town of Lebanon		X	
Town of Lyme		X	
Town of Marlborough		X	
Montville WWPCA		X	
City of New London	X		
Town of North Stonington		X	
Noank Water Company		X	
Norwich DPU	X		X
Town of Preston		X	
SCWA	X		X
Town of Stonington		X	
Sprague Water & Sewer		X	
Waterford WPCA	X		

Table 3-7 lists those small community systems which are currently being managed or operated by others. There are more than 40 small community public water systems in the SEWUCC that currently do not require certified operators. All of these systems, along with 117 non-community systems, will require certified operation in 2001 due to new regulations. It is expected that the number of small community and non-community systems operated through satellite management will increase substantially due to these changes.

TABLE 3-7
Small Systems Currently Being Managed or Operated by Others

System	Location	Satellite Operator
Saint Thomas More School	Montville	Atlantic States RWA
Forest Homes Water Association	Marlborough	Colchester Utilities Commission
Westchester Hills Condominium Assoc.	Colchester	Colchester Utilities Commission
Colchester Courtyards	Colchester	Hungerfords
Classee Water Company	Stonington	Connecticut Water Company
Waterford Country School, Inc.	Waterford	Connecticut Water Company
Chatham Apartments	E. Hampton	Culligan
Williamsburg Apartments	Ledyard	Culligan
Avery Hill Water Association	Ledyard	Depot Pump & Supply Company
Barbara's Rest Home	E. Hampton	ECRWC (AquaSource)
Bellwood Court	E. Hampton	ECRWC (AquaSource)
Birchwood Estates Water Assoc., Inc.	Marlborough	ECRWC (AquaSource)
Cedar Ridge Water Association	N. Stonington	ECRWC (AquaSource)
Chatham Acres Elderly Housing	E. Hampton	ECRWC (AquaSource)
Colchester Commons	Colchester	ECRWC (AquaSource)
Colonial Apartments	Groton	ECRWC (AquaSource)
Crystal Lake Associates	Salem	ECRWC (AquaSource)
Edgemere Condominium Association, Inc.	E. Hampton	ECRWC (AquaSource)
Haddam Hills Academy	E. Haddam	ECRWC (AquaSource)
Hillside Corporation	Marlborough	ECRWC (AquaSource)
Jensens, Inc. Marina Cove Residential	Montville	ECRWC (AquaSource)
Knob Hill Condo/Westchester Hills Condo	Colchester	ECRWC (AquaSource)
Marlborough Health Care Center, Inc.	Marlborough	ECRWC (AquaSource)
Meadow Apartments	Montville	ECRWC (AquaSource)
Rye Field Manor Elderly Housing	Old Lyme	ECRWC (AquaSource)
Chadwick Homeowners Association, Inc.	Old Lyme	Hydro Dynamic Engineering
Mallard Cove Condominium Assoc	E. Hampton	Hydro Dynamic Engineering
Miami Beach Water Company	Old Lyme	Hydro Dynamic Engineering
Sleepy Hollow Mobile Home Park	Ledyard	Ledyard WPCA
Lyme Regis, Inc.	Old Lyme	Mile Creek Apartments
Lymewood Elderly Housing	Old Lyme	Mile Creek Apartments
Lebanon Pines	Lebanon	The Water Planet Company
Boxwood Condominium Association	Old Lyme	Water-Flo Inc.

No set schedule is contemplated by the WUCC for satellite management operation for those identified systems. Rather, this progression is expected to occur as the need arises.

Section 4

4.0 RECOMMENDED MINIMUM DESIGN STANDARDS

4.1 Overview

The State of Connecticut has included minimum design criteria as a portion of its regulations for issuing certificates of public convenience and necessity for water companies. The WUCC has recommended the State's design criteria, with amendments and additional minimum standards where appropriate. Where minimum design criteria recommended by the Southeast Connecticut WUCC differ from other standards, criteria, and requirements set forth by state statutes or regulations, the more stringent should apply. In no way, however, should the WUCC's recommended minimum design criteria negate requirements as set forth in state statute or regulation.

Section 16-262m-8 of the regulations begins by providing a summary of key definitions, and then goes on to identify criteria associated with facility location, design population and demand, water supply requirements, source protection, well construction and water quality, atmospheric storage tanks, on-site standby power, transmission and distribution systems, materials of construction, fire protection, service pipes (service connections), and pump house requirements. Throughout the subject section of the document, the term "State design criteria" is intended to reflect Section 16-252m-8.

With references to other State regulations, AWWA standards, and the National Electric Code, the State design criteria become fairly comprehensive in scope, and can serve as a basic minimum design framework for all water companies, regardless of size. However, case-by-case exceptions to these criteria should be made if justifiable, particularly for larger systems which often have their own minimum design criteria or are subject to more stringent requirements.

The minimum design criteria recommended by the Southeast Connecticut WUCC are presented in the ensuing text. It is recognized that it would not be economically feasible for many systems to retrofit existing systems to comply with these standards. Therefore, it is the intent that these criteria be applied to all new or expanded facilities.

4.2 Definition of Terms

Average daily demand can be estimated at 24-hour water usage computed at 75 gallons per person per day. Average day demands different than those defined in the State design criteria are acceptable if adequate historical information is available to justify a deviation.

Peak hour demand can be estimated as one third of the average daily demand. Peak hour demand different than those defined in the State design criteria are acceptable if adequate historical information is available to justify a deviation.

Safe daily yield of a water supply system is all water delivered to the system from all sources operating simultaneously at their individual safe yields for an 18-hour period.

Safe yield of a well in an unconsolidated aquifer shall be based on an analysis of the impact of dry period minimum water table elevations on the yield of the well(s) as determined by a minimum 72-hour yield test performed by a qualified well yield tester. The impacts of pumping, such as decreased streamflow or pollutant induction, shall be considered in determining safe yield. For confined or bedrock aquifers, safe yield shall be equal to 90 percent of the hourly yield for 18 hours per day. Hourly yield is to be based on a cone of depression which holds stable for 24 hours. Lower yields should be used if the calculated figures would cause unacceptable associated impacts or when records indicate the yield to be less than calculated.

4.3 Facility Location

1. Water systems (including treatment plants, pumping stations, storage tanks, etc.; excluding water intakes and connecting pipelines) should be located above the 100-year floodplain and outside of the floodway boundary. All facilities, including wells, should be located outside of the floodplain whenever possible. However, facility location (especially wells) can be permitted within floodplains with proper protection and DPH approval on a case-by-case basis. Local, state, and federal ordinances, statutes, and regulations must also be adhered to for any construction in the

floodplain. A two to three foot safety factor should be included for facilities elevation above the 100-year flood level.

2. All chlorine storage and use areas should be located at least 300 feet from any residence.

3. Water systems should not be placed in an area subject to fires or other natural hazards.

4.4 Water Supply Requirements

1. Water systems should be maintained such that a system safe yield of 115% of average daily demand is available. However, margin of safety should be examined on a case-by-case basis to determine the true adequacy of the source and system.

2. Water systems should be capable of meeting average daily demand with the largest well or pump out of service. For small systems, this would represent a margin of safety of 2.0.

3. All water supply wells should be pump tested for 72 hours during which time drawdown reaches a stable level for at least 24 hours. Testing should be performed during summer dry periods if possible.

4. Water supply yields should be periodically reviewed by water suppliers to assess whether any changes have occurred that would alter the safe yield of a supply source (i.e. siltation of a reservoir, encrustation of well screens, and the like).

5. Surface water intakes should be designed to allow selective withdrawal from multiple levels, with protection by coarse screens or racks on each intake; intake velocities should be less than 0.5 fps.

4.5 Source Protection

1. Minimum distances from sources to septic systems, buried oil tanks, sanitary sewers, surface waters, drains, and miscellaneous pollutant sources should be evaluated by water suppliers. Separation distances should be increased as well capacities increase, with greater distances required for high-rate gravel-packed wells with high bedrock levels and soil percolation rates. Buried propane tanks are considered to be a source of pollution and require a 75 foot separation distance.

2. Any fuel oil stored on a wellfield aquifer or water supply watershed should be required to be installed aboveground. Storage of regulated substances should be conducted in accordance with DEP and EPA regulations based on site specific criteria (in particular, underground storage may be preferable in areas where vandalism is a concern).

4.6 Well Construction and Water Quality

1. Well construction should be based on the promulgated Regulations of the well drilling industry.

2. Well construction must comply with Public Health Code 19-13-B51(e) through (k).

3. Water quality must conform to State requirements (Public Health Code 19-13-B102), with suitable treatment required if necessary.

4. Each well should be equipped with a level probe, lower water level pump shut-off, and lightning protection devices.

4.7 Atmospheric Storage Tanks

1. Atmospheric storage tanks should be equipped with bolted entry hatches, capped and locked filler pipes, sight glass gauge, screened vent pipe, high and low water signal system, drain valve with discharge to the ground (not to a sanitary sewer). Pressure gauges may be an acceptable alternate for sight glass gauges on storage tanks; both should be adequately protected from vandals.

2. Minimum usable tank capacity should be equal to the greater of 200 gallons per residential customer or the system's average daily demand, with allowances made for commercial and industrial use. Water suppliers should consider providing additional tank capacity for fire protection.

3. Hydropneumatic tanks and transfer pumps should be sized to accommodate peak hourly demand. At least two transfer pumps operating alternately should be installed between the atmospheric and hydropneumatic tanks, each capable of pumping the peak hourly rate and each protected by low water shutoff controls.

4. The usable volume of the hydropneumatic tank should allow for storage of five minutes discharge from the largest transfer pump.

5. Minimum and maximum clearance to the ground of six and 36 inches, respectively, should be specified for overflow and drain pipes from storage facilities. Provisions should be included to drain the storage facility without service interruptions. Properly protected vents should be utilized. A maximum level variation may be necessary based on a case-by-case analysis.

4.8 On-Site Standby Power

1. Water systems should have a permanent or portable generator to power the largest well pump, one transfer pump, all booster stations, and all treatment systems. Emergency power may not be necessary for all portions of certain systems. High

level systems may still deliver water at adequate pressure during power outages. Additionally, stand-by power may not be warranted for certain non-residential systems, such as schools and other non-critical facilities.

2. Fuel storage should be above ground with full containment.

4.9 Transmission and Distribution System

1. The minimum distribution pipe should be at least six inches in diameter, with smaller diameter piping allowable in cul-de-sacs or areas where the system cannot be extended.

2. The minimum distribution pipe should be at least eight inches in diameter where fire protection is provided.

3. To the extent possible, all water mains should be installed within the rights-of-way of paved roadways to facilitate access. Where required, due to unavailability of roadway rights-of-way or other engineering considerations, main placement may be located in easements which are out of the rights-of-way of a paved road.

4. Normal operating pressures should be between 35 and 125 psi at service connections, with pressure reducers provided where needed. In order to avoid re-pumping, it may occasionally be cost-effective to exceed the maximum pressure of 125 psi, with pressure regulators provided at individual service connections.

5. Dead-ends should be avoided, with blow-offs installed if a dead-end is necessary.

6. Isolation valves should be provided to facilitate repairs and flushing, and at all intersections of water mains.

7. Fire protection connections should be treated as system dead ends, with appropriate provisions made for regular flushing.

8. Customer booster pumps should be avoided except in extreme circumstances. Customer booster pumps for those systems regulated by the Department of Public Utility Control would only be allowed upon DPUC authorization. In special cases, it may be advisable to allow temporary or permanent individual booster pumps to serve homes which are either an excessive distance from, or elevation above, the distribution system, subject to the following conditions:

   - In no case should system pressures be less than 25 psi.
   - A booster pump may be utilized as a temporary measure as a system is upgraded.
   - Properly installed and approved backflow preventers should be provided, along with low water pressure cut-off switches.
   - If possible, the need for a booster pump should be noted on the legal description of the property.

9. A means of air relief should be provided at system high points. The air relief should be protected from flooding or contamination.

10. All appurtenant structures such as chambers, pits, etc. should drain to the ground surface or to underground absorption pits in accordance with state and federal regulations. Pumping of chambers or pits is only acceptable for areas where permanent drains are not feasible.

11. Pipes should be laid with a minimum cover of 4.5 feet (deeper if greater frost penetration is expected), provided with freezing protection at aerial crossings, and kept clean during installation. Trenches should provide suitable bedding for at least six inches below the pipe invert, be kept as free of water as possible, continuously and uniformly backfilled in tamped layers to a height great enough to protect the pipe, and covered overnight or when work is halted (with the pipe plugged). Case-by-case

flexibility should be exercised for variations in minimum depth of cover, with depths of less than 4.5 feet allowable with proper protection and insulation.

12. The minimum separating distance should not be waived or reduced in instances where a forced sanitary sewer is installed. However alternate protection means such as sleeving, encasement, etc. can be provided where clearances cannot be maintained between crossing water mains and gravity sanitary sewers and drains.

13. AWWA or Ten State Standards should be consulted for items such as flushing methodology at system dead ends. Minimum isolation valve spacing, pipe restraints at bends, tees, dead ends, etc., and minimum acceptable classes of various materials.

4.10 Materials

1. In general, AWWA standards should be met for all materials, coatings, equipment, and testing.

2. Tracer wires should be used with nonmetallic pipe.

3. All facilities should be disinfected and meet appropriate pressure and leakage tests as specified in AWWA standards before being put into service.

4.11 Fire Protection

1. Requirements for fire protection should be evaluated on a case-by-case basis.

2. Whenever fire protection is required, it should be in accordance with the recommendations of the Fire Underwriter's Insurance Services office, DPUC, and the entity that will own the water system.

3. No fire hydrants should be constructed unless at least 150,000 gallons of water are in atmosphere storage.

4. Cross-connection provisions should be made for fire protection connections in accordance with Section 19-13-B38a of the Regulations of Connecticut State Agencies.

Providing fire protection is generally an obligation of larger municipal and investor-owned water systems. However, many small systems which principally serve apartment or condominium complexes or smaller housing projects have not been designed with fire protection in mind. As with homes on private wells, fire protection is often provided to such systems through the use of on-site ponds or tanker-supplied pumpers, rather than being incorporated into system design. The cost of providing fire protection for small systems can be prohibitively expensive for ratepayers.

If fire protection is to be provided, standards should be those used by the local community or, at the community's option, those recommended by the State Fire Marshal. These requirements will normally conform to either ISO (Insurance Standards Organization) or NFPA (National Fire Protection Association) standards, leaving open the possibility that a public water system that provides service to more than one community may have to meet differing requirements.

From a minimum design standards perspective, fire protection becomes a difficult subject to address in terms of general requirements for the various WUCC members. The State regulations address this issue to some degree, stating that a minimum eight-inch diameter pipe (and at least 150,000 gallons of storage) be used for systems providing fire protection. Suggestions have been made that the WUCC's minimum design standards call for eight-inch pipe whenever a system might eventually be called upon to supply fire protection. This is a sensitive issue for the smaller systems, however, and is probably best left to case-by-case analysis, bearing in mind that initial installation of smaller pipe may preclude the eventual cost effective provision of conventional fire protection. It should be noted that fire protection is not typically required for public water systems.

4.12 Service Pipes

1. The minimum size service pipe should be ¾- inch in diameter. Depth beneath grade should be similar to distribution requirements.

2. Fire service connections should be separate.

3. Direct service should be provided from the water main without crossing intervening properties. A separate metered connection should be made for each unit adaptive to individual ownership (with some exceptions, such as high-rise apartment complexes, multi-storied homes, commercial buildings, and high-rise condominiums). Master meters may be acceptable on "vertical" developments (e.g. high rise office buildings, apartments, condominiums, etc.) regardless of their potential for individual unit ownership. Individually metered connections should still be provided for "horizontal" developments.

4. Shutoff valves should be provided at property lines and interior of premises, with detector check meter on fire service.

5. No interconnections should be allowed between public and non-public systems without special permission from DPUC and/or DPH.

4.13 Pumphouse Requirements

1. Rodents and small animals should be prevented from entering facilities. Locked gates and fences should be provided, along with suitable lighting, HVAC, and access facilities.

2. All manual and automatic controls, wiring and appurtenances should be installed in accordance with the National Electrical Code and provided with over and under voltage protection.

3. Raw water sample taps should be provided on each well discharge line.

4. Easily read instantaneous and totalizing meters should be installed to measure each source of supply independently.

5. Water treatment should be in accordance with procedures established by DPH.

6. Status of remote pumping stations should be telemetered to a central location; pressure gauges should be required on the discharge line from each pump (again, some flexibility may be needed for smaller systems).

4.14 Individual Utility Standards

Many larger systems have their own minimum design standards which parallel or in some instances are more stringent than those set forth by the State or the WUCC. Those systems which possess more stringent standards (or site-specific variations of the State standards) have the right to require developers to comply with these standards when constructing an extension to their existing system or service area. The State regulations (Section 16-262m-7) appear to support this contention by stipulating that the "specifications for materials, equipment, and testing shall be in accordance with ... the specified water utility which will eventually own the system..." It is important for a water purveyor to maintain consistency of design parameters throughout its service area as system expansion occurs, and to provide the appropriate pipe sizing to be consistent with continued expansion of the system.

4.15 Impact on Existing Systems

The criteria set forth in Sections 16-262m-1 to 16-262m-9 could have a significant impact on existing smaller systems if they desire to expand. This concern is specifically related to whether an entire system would have to be brought up to the minimum design criteria if expansion occurs, even if the public water system provider has historically delivered an adequate supply of water at sufficient pressure to their customers. Both DPH and DPUC have stated that review will be made of an entire existing system for conformance to the regulations if expansions of five percent or more are contemplated by a regulated water company, with particular emphasis during this review on whether or not the proposed expansion will compromise existing service under any potential average or peak demand conditions. The regulations do allow for a hearing process for aggrieved parties in which situations such as this could be addressed. However, it is uncertain if this process would look favorably upon the smaller systems.

4.16 Conclusions and Recommendations

The State regulations for issuing certificates of public convenience and necessity set forth minimum design criteria under Section 16-262m-8. These criteria provide an excellent framework from which to build the minimum design standards for the southeast Connecticut water supply management area for both small and large systems. These criteria have the advantage that they are set in law and are thus legislatively supported. Additional items and/or modifications to enhance these have been incorporated into the WUCC's minimum design criteria as presented above. It is recommended that the State design criteria under 16-262m-8 be used as the basis for the WUCC minimum design standards, with appropriate modifications as noted. Individual systems have the right to impose their own site-specific standards within their existing or exclusive service areas.

The WUCC has a continuing concern regarding the impact of any accepted set of minimum design standards. It was generally agreed that such rules or standards are essential and, at a minimum, must be applied to new systems or greatly expanded systems. However, it is also important that some realistic measure be incorporated for upgrading the existing portion of systems desiring to expand. For example, a system which is adding two or three houses, although it may represent a five percent or greater expansion, is different than expansion encompassing 100 or more customers. There is indeed merit to having streamlined procedures for existing smaller systems desiring minimal degree of expansion. State representatives have indicated that it is their intent to evaluate design criteria on a case-by-case basis.

5.0 WATER CONSERVATION

5.1 Introduction

Water conservation consists of measures designed to promote efficient use of water and to eliminate waste of water. Conserving water can be beneficial in many ways, but the most prominent reason for conservation is that it can help systems avoid, downsize, or postpone water and wastewater projects.

The facilities used to treat and deliver drinking water (and to collect and treat wastewater) are sized to meet demand. If the level of demand is inflated by losses or wasteful use, customers may pay more than necessary for both capital and operating costs to provide safe and adequate water supply and wastewater services. Moreover, when the cost of supplying drinking water and processing wastewater is reduced, financial resources can be used to meet other needs.

The benefits of water conservation extend beyond the water supply and wastewater system. It may also reduce consumers' energy usage and associated costs. By reducing the amount of water drawn from surface and subsurface supplies, conservation also helps to improve water quality, maintain ecosystems, and protect water resources.

All of the large public water systems (those with service populations greater than 1,000 persons) in the southeast Connecticut region engage in some level of water conservation. The ensuing narrative attempts to characterize conservation efforts in the region and make recommendations regarding future efforts that will benefit individual systems was well as the entire region. Table 5-1 presents this information in matrix form.

Table 5-1
Water Conservation Matrix

SUPPLY-SIDE WATER CONSERVATION MEASURES

WATER SUPPLY SYSTEM	CONTACT NAME AND TELEPHONE	Non-Revenue Water Low <10% Moderate: 10-20% High: >20%	Production Metering	Leak detection program	Pipe Replacement Program	Metering of non-revenue uses: municipal, fire, flushing, in-plant use etc.	Meter Calibration	Periodic Water System Evaluations	Pressure Reduction	Other Supply-Side Measures
Colchester Sewer and Water Commission [Water Conservation and Emergency Contingency Plan, 1994]		Moderate	Yes, production is metered at Cabin Road and Judd Brook wellfields; meters calibrated biannually. Source metering is conducted at individual wells but meters are not routinely calibrated.	Production and consumption data is reviewed by water utility staff. Occasional leak detection surveys through independent contractors. Last survey completed June 1989.	A more vigorous main replacement program is a potential future option.	No. May consider metering public uses and establishment of water logs for fire, street, and sewer uses. May consider metering all public uses.	Source meters calibrated twice per year by an outside contractor. More rigorous efforts with distribution meters are a potential future option.	Annual	No.	
Connecticut American Water Co. [Water Conservation Plan, 1994]		Mystic: Low-Moderate; Lebanon: Low; E. Hampton: Low	Yes; finished water is metered at the Deen's Mill (Mystic) facility and Leonard Hill (Lebanon) facility	Yes-Special leak-detection staff member. Acoustic surveys using microphones at valves, hydrants, and curb stops. Goal is annual surveys of all water systems. "Desktop" analyses are also conducted to identify flow or consumption anomalies.	Past program replaced small mains with large-diameter mains; mains w/a history of deterioration are replaced on a schedule. Customers are required to repair service lines within one month.	Fire flows are estimated using information supplied by fire depts. Hydrant flushing water is measured using a Pitot tube. Plant usage is estimated. Temporary water usage is metered.	Treatment plant and well station system delivery meters are tested annually.	Monthly operating report and twelve-month rolling total of delivery and sales. Continual system-wide accounting procedures to identify and quantify non-revenue and unaccounted for water.	Mystic system has five pressure zones separated by pressure-reducing valves or booster stations. New construction designed to keep pressures below 100psi. At smaller systems, pressure is regulated by pressure switches at hydro-pneumatic tanks.	Treatment water recycling at Mystic plant. At Lebanon, adsorption filter reduces the volume of spent backwash, recycling under evaluation. In E. Hampton, there are no filters, so no backwash is produced.
Connecticut Water Company [Water Conservation Plan, 1996]		Unknown	Meters at sources of supply. Records production data for all wells, reservoirs, and interconnections.	Quarterly audit compares production and consumption. Acoustic leak detection surveys on a three to five year cycle. (Bay Mtn., SOC, and Soundview systems will be surveyed as required.) Goal is <1500 gpd/ mile of water main.	Leaks repaired as soon as detected. Gradual replacement of mains that do not come up to present standards.	Fire service connections not metered; compiles monthly estimates of unmetered uses.		Quarterly water use audit compares metered production with metered consumption and accounted-for non-metered water.	Current operating pressures are 25-125psi. No system-wide pressure-reduction measures necessary; significant savings would only be realized if there were many leaks in the system.	
East Lyme Water Commission [Water Supply Plan, 1994]		Moderate	All sources metered; all readings recorded and totaled.	No. Upon request to users but not of the main system; sonic leak detection program is planned.	No; system is only 20 years old. Older system piping in Niantic is replaced as roads are constructed.	Hydrant flushing is single biggest cause of unaccounted-for water; will be estimated using pitot; new iron and manganese removal facilities should reduce need for flushing.	Meters calibrated and tested every 2 years.	Unaccounted for water is tabulated annually. Water audit program planned for 1995.	Has not been considered due to concerns regarding adequate pressure for fire flows. Current pressures are 35-85 psi.	
Eastern Connecticut Regional Water Company (ECRWC) –Amston Lake Div. [Conservation Plan 1998]		High	Yes		8,000 feet of pipe replaced by PVC in 1993; many pipes in Lebanon not buried deep enough to provide winter service. Ongoing program to replace pipe in Lebanon.	Estimated figures only				
Eastern Connecticut Regional Water Company (ECRWC) –Lake Hayward Div. [Conservation Plan 1998]		High			1999 WSP identified replacement of distribution system as major priority					
Groton Water Department [Water Conservation Plan, 1997]		Low	Yes	Yes. Most recent survey conducted 1983. No surveys scheduled for future unless excessive water loss is noted.	No	Yes	Ongoing	Evaluation conducted annually in October to quantify non-revenue water, etc.	Pressures range from 25 - 100 psi. Pressure-reducing valves installed where pressures exceed 85 psi.	Treatment plant filter backwash is recycled to reservoir when not overflowing.
Jewett City Water Co. [Water Conservation Plan, 2000]		Moderate	Yes	Mini-system, every 10-15 years, [illegible] systems as manpower exists. 1999 survey showed minor losses. Pipe is tested where conditions suggest possible leakage (puddles, etc.)		Water used by the utility is metered; system flushing, municipal, fire uses are estimated.	All production meters tested annually and calibrated as required.	More recent evaluation conducted in 1999. Annual comparisons of supply vs. billing.	Recommends pressure reducing valves on services where pressure exceeds 80psi. Considering a rule to require installation of pressure reducing valves whenever property is sold.	

DEMAND-SIDE WATER CONSERVATION MEASURES

WATER SUPPLY SYSTEM	100% customer metering	Meter testing and /or change-out programs	Increasing block rate structure	Seasonal rate structure	Distribution of educational materials; customer education program.	Coordination with schools	Plumbing retrofit/ distribution of conservation devices	Water audits & assistance for high-volume customers	Car wash/ sprinkler bans	Promotion of xeriscape gardens and lawns
Colchester Sewer and Water Commission [Water Conservation and Emergency Contingency Plan, 1994]	Yes, except for unauthorized use (recreation, tank filling), fire-fighting, street cleaning, water line flushing. Goal is to meter all individual, residential, commercial, industrial and public users. Meters read quarterly.	Active repair/ replacement program currently in place for service connection meters; approx 100 meters replaced annually; annual budget for meter testing, calibration, repair, and replacement.	Yes	No; potential future action	Under development (1994)	Films and slide shows	Yes; kits made available 1991-1994	Do not constitute high % of water users. Wateraudit program for high-volume customers planned as of 1994, will provide additional assistance to large water users.	No	Provides information on efficient lawn maintenance and drought-resistant plants.
Connecticut American Water Co. [Water Conservation Plan, 1994]	Yes, except for private fire services. Many condominiums and shopping centers meter individual buildings rather than from curbside master meter. Most residential meters read quarterly; commercial and industrial meters read monthly.	Meter testing, replacement, and repair program in place. Testing interval is annual to every 12 years, depending on size of meter.	No. Declining block rate (3 rate blocks); will seek to eliminate rate blocks and achieve a single tariff rate for all users.	No	Yes; mailings (bill stuffers), water conservation bulletins, presentations, media releases, exhibits, plant tours, exhibits, workshops, speakers, consumer roundtable. Literature: water conservation packet placed in the libraries.	Distributed Water Conservation Bulletin to schools and colleges. Theater presentations, videos, plant tours for school children.	Yes; distributed ~4,700 kits, 1993	Yes; conducting two audits per year for five years. Audits include analysis of water use, summary of recommendations, implementation plan, and cost-return analysis.	No	Developed exhibit/display for company business offices, libraries, municipal buildings, garden centers, etc.
Connecticut Water Company [Water Conservation Plan, 1996]	Bay Mtn. And SOC Systems: Yes all customers except for public and private fire. Developers encouraged to meter individual units. Soundview and Point O' Woods Systems: No meters. Meters read quarterly (monthly for large customers)	Meter testing, replacement, and repair program in place. Testing interval is annual to every 14 years, depending on size of meter.	No. Bay Mtn/SOC: Basic service charge and commodity charges (per 1,000gal). Soundview and Point O' Woods: two flat rate charges: year-round and seasonal. Reduced rates are offered to some businesses that meet certain state job creation criteria.	No	Yes. Year round education programs (bill stuffers, displays, slide shows, [illegible] records, [illegible], mailings, etc. During hot/dry periods customers asked to conserve.	Promote programs to at least 8 target towns per year; provide programs upon request to other schools; 10 programs per year; develop school handouts or displays.	Yes; home delivery of kits to all residential customers. Survey indicated 48% penetration rate. Companywide residential demand reduction of 8% for single family customers that installed kits and overall demand reduction of 4% for all residential customers.	Yes; water use audits on request. Initial target is 5-15% reduction in demand. Will pay for consultants to conduct audits in larger, more complex facilities. Will develop set of materials for smaller volume users to conduct "self-audit."	Voluntary conservation measures during dry periods. Customers appeared to cooperate and respond positively if they perceived that a problem did exist.	Developed special inserts on efficient lawn-watering practices; provides landscaping info annually through inserts, press releases, newsletters or other measures.
East Lyme Water Commission [Water Supply Plan, 1994]	100% of customers are metered. Metering alerts customers of "unusual" usage.	Customer meters are tested every 5 years and replaced every 10 years.	No. Minimum usage charge and per-gallon charges for additional use. Test suggests declining block rate structure exists.	No	Active Public advertising. Bill stuffers, plumbers' workshops, displays, media, pamphlets, speakers, etc. Speakers at Chamber of Commerce meetings.		Retrofit kits given out with informational [illegible]	Will be provided "when State money is available." Educational materials sent out in the meantime. Requests made of State Correctional Institutions to reduce usage during dry periods. Plans exist to approach motels regarding low-flow toilets and showerheads.	Under consideration	Media advisories regarding evapotranspiration and information on efficient watering and ornamental shrubs. Garden show and nursery displays.
Eastern Connecticut Regional Water Company (ECRWC) –Amston Lake Div. [Conservation Plan 1998]	Customers not metered; mostly seasonal service and cost of meter installation was determined to be prohibitive by ECRWC and DPUC.	Customers not metered	No monthly rates for seasonal and year-round usage.	No	Letters mailed to customers regarding retrofit kits.	No schools in service area.	Distributed 160 kits in 1992-1993	No commercial customers.		
Eastern Connecticut Regional Water Company (ECRWC) –Lake Hayward Div. [Conservation Plan 1998]	No customer water meters	Customers not metered	Monthly flat rates, regardless of usage.	No-seasonal system (April - October)		No schools in service area.		No commercial customers.		
Groton Water Department [Water Conservation Plan, 1997]	Yes. Monthly meter reading and billing	Yes, in accordance with DPUC regulations except for extension granted by DPUC "for 5/8", 3/4", & 1" meter testing for 8-10 years." Almost every meter is remote-read.	No. Three declining rate blocks; monthly service charge (based on meter size) but no minimum consumption charge. Inclining block rate structure has been considered. Meters are read monthly.	Yes. May have reduced residential demand during dry summer of 1995.	Annual educational mailings regarding efficient appliances and fixtures. Mailings, displays, media advisories, presentations.	Films and slide shows	>7,000 kits have been distributed (approximately 1.5 per residential meter). Residential consumption has declined 10% from 1993-1995 due to retrofit kits and seasonal rates.	Audits and technical assistance are available upon request. Have contacted three largest customers (Navy, Pfizer, Elec. Boat) to discuss conservation.	Odd-Even watering restrictions during peak periods.	Created a xeriscape garden exhibit at municipal building. Second planting is planned for water treatment facility.
Jewett City Water Co. [Water Conservation Plan, 2000]	Yes, including water used by the utility. Multifamily units are encouraged to retrofit for individual metering.	Customer meters tested in accordance with DPUC regulations.	No. Quarterly or monthly charge and three-step declining block rates.		Distributed pamphlets regarding conservation and outdoor water use.		Provided retrofit kits upon request; 1,800 kits delivered.	Voluntary audit of use [illegible] was distributed to four high-volume industrial customers.	[illegible]	

Water Conservation Matrix

WATER SUPPLY SYSTEM	CONTACT NAME AND TELEPHONE	SUPPLY-SIDE WATER CONSERVATION MEASURES									DEMAND-SIDE WATER CONSERVATION MEASURES									
		Non-Revenue Water Low: <10% Moderate: 10-20% High: >20%	Production Metering	Leak detection program	Pipe Replacement Program	Metering of non-revenue uses: municipal, fire, flushing, in-plant use etc.	Meter Calibration	Periodic Water System Evaluations	Pressure Reduction	Other Supply-Side Measures	100% customer metering	Meter testing and/or change-out programs	Increasing block rate structure	Seasonal rate structure	Distribution of educational materials; customer education program.	Coordination with schools	Plumbing retrofit/ distribution of conservation devices	Water audits & assistance for high-volume customers	Car wash/ sprinkler bans	Promotion of xeriscape gardens and lawns
Ledyard WPCA (Water Conservation Plan, 1995)		Moderate	Meters at individual wells utilizing flow meters measure production from all wells. Production readings recorded daily.	Biennial acoustic leak detection surveys, visual inspection of surface facilities.		Greensand filter has significantly reduced losses from hydrant flushing. Fire and street cleaning water is estimated. WPCA is considering purchase of a portable flow meter to measure water lost during hydrant flushings and water main blowoffs.	Annual production meter calibration.		Pressure >100psi have been measured in lower sections of distribution system. Currently investigating installation of pressure reduction valves in lower sections of system.		All service connections are metered.	Meters "inspected" quarterly during meter readings. Meter calibration conducted every five years or if a meter is found to be faulty.	Single family minimum quarterly charge equal to per capita use of 35gpd; inclining block rate structure above minimum usage. Single commercial rates. Flat rate for apartments and condos.		Notifies customers of continued availability of conservation devices. Annual notices to customers. Customers encouraged to call in for info. Flyers and videotapes.		Town supplied shower heads and faucet aerators to all residences (including apartments and condominium complexes) in 1993. Penetration rate is estimated at 95%. WPCA estimates a 10% reduction in demand through this program.			
Montville Water Pollution Control Authority (WPCA) (WSP, 1995)		Low									Yes. Decrease in demand since meter installation.				Yes. Covered under Norwich Plan.		Yes. Covered under Norwich Plan.			
Montville Correctional Institute (WSP, 1993)			Systems not currently metered	Proposed.	N/A	No.	No	No	N/A		N/A-Prison	N/A	N/A-Prison	N/A-Prison	No.	N/A	Yes, for new facilities	Proposed.	N/A	
New London Water Department (Water Conservation Plan, 1998)		Moderate-high	Production is metered at the Lake Konomoc filtration plant.	Leak detection survey in 1993 revealed a 250,000 gpd leak in a major transmission main. Another survey scheduled for 1999-2000 when most new meters installed and at five year intervals thereafter	Old pipes are gradually replaced.	Develops annual estimates of unmetered uses for flows, street sweepers, flushing, etc.	Source meter at Lake Konomoc was replaced in 1980 and calibrated at that time.		No action necessary	Backwash water at Lake Konomoc is recycled	All customers metered.	95% (6,000) of large meters have been recently replaced. Large meters to be tested on 2 year cycle, smaller meters to be replaced on 8-year cycle. Residential meters tested on request.	No. Service charge based on size of meter and a single rate.		Booklets and mailings. Press, radio and TV. Annual conservation / source protection mailing	Guided tours of Lake Konomoc treatment plant.	Available to all customers upon request. Distributed to all residential customers in 1982-1984.	Audits as requested	Adequate capacity to meet peak demands so no conservation efforts focused on peak periods. Promotion of better lawn sprinkling practices.	Booklets on xeriscaping and efficient lawn watering are available at the office.
Noank Fire District (WSP, 1994)				Yes flows are recorded during all season / low demand [illegible]													Yes.	N/A		
Norwich Water Department (WSP, 1987)		High		No ongoing, systematic effort. 1987 report anticipates development of leak detection program.	No ongoing or scheduled program, (under consideration as time of report.)			Underway at time of report.		Freeze prevention blowoffs are largest cause of non-revenue water; other freeze-prevention measures under consideration.	Yes. Monthly billing	None in place; many 20- and 30-year-old meters. Many may be under-registering. 1987 report anticipates meter replacement program.	No. Two-step declining block schedule.	No.	Occasional small promotional notices included with billings.		Yes: customers were notified by mail and kits were made available at Water Department offices. WSP does not indicate number of kits distributed.	Program under consideration		
Southeastern Connecticut Water Authority (SCWA) (Water Conservation Plan, June 1995)		Moderate	All active sources of supply are metered. Daily logs of production.	Yes. "Desktop" audits, supply meter checks. Sonic leak detection surveys when required, but not regularly.	Deteriorating lines replaced whenever main extensions or new connections make the replacement economically feasible.	Estimated.		Non-revenue / unaccounted for water calculated annually. Comprehensive water use audit planned for every three years, beginning in 1996.	Pressure reduction valves installed on customer service lines where pressure exceeds 100psi		All new residential, commercial and public authority accounts are metered.	Meters are replaced as needed, including entire divisions when warranted.	Yes. Minimum quarterly charge (including first 3,000 gal), commodity charge, and conservation surcharge over a certain amount.	No.	Yes: Annual water conservation notice. Notification if quarterly consumption is 20% > 3 year avg. Water conservation messages via local media during drought conditions.	Presentation available upon request of municipalities	Distributed ~2300 kits to TWR, FVH, and MTV Divisions	No major industrial users. Distribution of water audit booklets and provision of technical assistance.	Yes in selected divisions during peak periods.	
Sprague Water and Sewer (Water Conservation Plan, 1995)		Unknown-customers not metered	Source metering at treatment plant and at three wells.	Will begin quarterly audits to identify non-revenue water. Analysis of daily production logs and specialists sweeps distribution system regularly. Leak detection surveys every other year.	System rehabilitation program planned. Deteriorating lines are replaced when water main extensions and/or new connections make replacement economically feasible.	Backwash water and water used for hydrant flushing and firefighting.	Reservoir meters tested annually and recalibrated, as required.	Annual water system evaluation for DPUC. Plans to conduct quarterly audits to identify non-revenue water and triennial comprehensive Water Use Audits.	Not necessary, maximum pressure 75-80 psi.	Backwashing at filter plant will be eliminated when wells are built.	Only 11 of 440 services are metered. Plans to meter all customers.	Will be established once all customers are metered. Domestic meters will be tested and replaced at eight-year intervals.	No. Flat rate charge. Rates to be developed once metering is complete. Declining block rate will not be considered.	No.	Yes. Media advisories, bill stuffers, etc. Leak detection assistance to consumers.	Public education program for schools to be developed.	Residential retrofit program distributed 183 kits 1991-1993.	Audits booklets available upon request. Technical assistance available upon request.	Yes, during the summer if needed.	
Waterford Water Pollution Control Authority (WPCA) (WSP, 1993)		High																		
Westerly Water Department (Water Supply Plan, 1995)					Considered on a yearly basis. Some replacement recommendations of a 1971 report have not yet been implemented						Unclear		No. Flat rate/ Service Charge for minimum usage. Consumption Charge is added for additional usage.		Information available on request.		Yes. Approximately 2,000 kits distributed. No evaluation as of 1995.			

Greater consistency is needed in the information provided by public water systems regarding water conservation measures. Information regarding water conservation efforts has been gathered from individual water supply plans and (where available) water conservation plans. Water Conservation Plans were not available for every public water system, and those that were available varied widely in the type of information and the level of detail that was included.

There are significant gaps in available data for public water systems throughout the region. The water conservation plans included various amounts of qualitative information. Some plans provide estimates of authorized but non-metered uses; some simply presented the total percentage of non-revenue water; and others do not even state the percentage of non-revenue water. Greater consistency of water conservation information would greatly improve a regional analysis of water conservation efforts. With the adoption of revised individual water supply plan regulations in August 2000, consistency is anticipated to improve, since the newly adopted regulations are more specific with respect to water conservation requirements.

5.2 Supply Side Conservation Measures

Production Metering

Production metering is a basic supply-side measure that allows public water systems to track total water consumption and to quantify unaccounted-for water. Production metering involves measuring the amount of finished, potable water that enters the distribution system from the treatment facility.

Source metering is metering the amount of water withdrawn from surface water supplies or pumped from groundwater wells. While production metering is not strictly a water conservation effort *per se*, comparisons of production and customers' metered consumption allow public water systems to quantify unaccounted-for water that may be due to leaks and other losses. Furthermore, comparison of source metering and production metering figures allows a public water system to determine how much water is lost in the treatment process, and whether more efficient treatment methods are merited.

The following public water systems are known to meter production of finished water:

- Colchester Sewer and Water Commission
- Connecticut American Water Co.
- Connecticut Water Company
- East Lyme Water Company
- Groton Utilities
- Jewett City Water Company
- Ledyard WPCA
- New London Water Department
- SCWA
- Sprague Water and Sewer

Leak Detection

Leak detection and repair is a critical water conservation method as well as an important public water system management effort. Water lost through leaks is wasted and does not provide any corresponding income to the public water system. Most large public water systems in the region have some sort of leak detection program in place, although leak detection methods vary widely. Many public water systems conduct 'desktop' surveys (comparisons of production and metered consumption) that can identify flow or consumption anomalies that may indicate a leak somewhere in the system. Some systems that do not individually meter customer usage measure overall system demand during off-season / low demand periods, since significant demand during these periods may indicate the presence of a leak.

Approximately half of the large public water systems in the region have conducted acoustic leak detection surveys that can pinpoint the location of leaks, and some of those systems have indicated that such surveys will be conducted on regular schedules ranging from annually to every five years. Available information indicates that public water systems with newer systems (less than 20 years old) generally do not conduct surveys as often as those systems with older infrastructure, due in part to a perception that older systems are more prone to leakage. However, leaks still occur in relatively new systems due to bad joints, manufacturing defects, damage, and other causes. Therefore leak detection surveys are important for public water systems of any age.

Some systems perform leak detection surveys on an as-needed basis. For example, when non-revenue water exceeds 15% of production, one water company dispatches crews to check off-road transmission mains and known problem locations; continuing problems may prompt a sonic leak detection survey.

Sonic leak detection surveys have been successful in identifying both major and minor leaks. A 1993 survey in the New London system identified 26 leaks that amounted to a total loss estimated at 82,000 gpd. The survey also identified one major leak estimated at 250,000 gpd. In the course of repairing a leak in 1996, the Norwich Water Department discovered a major leak estimated at 0.5 mgd, roughly 10% of average day demand. An ongoing, systematic leak detection effort will prevent loss of water to such leaks over long periods of time.

Pipe Replacement

A pipe replacement program can help to reduce the amount of water lost through numerous smaller leaks. Few large public water systems in the region have a proactive pipe replacement program. Most public water systems replace older water mains gradually, as streets are repaired or other infrastructure improvements are made. Some systems prioritize those water mains or areas that have a history of leaks.

Connecticut-American Water Company has completed a water main replacement program. It also replaces mains with a history of deterioration (due to aggressive water or groundwater conditions) on a regular basis. The Groton Long Point system also recently instituted a main replacement program, which contributed to a 20% drop in demand. Younger systems, such as East Lyme, do not list the replacement of mains as a major priority. Review of the water conservation plans suggests that a proactive main replacement program may be appropriate if significant losses remain after conducting a leak detection survey and making the required repairs. However, main replacement programs are very expensive and must be balanced with other conservation efforts.

Metering of Non-Revenue Uses

Metering of non-revenue uses is an important component of water conservation and public water system management. While it is not intended to reduce the amount of water used for important, legitimate uses such as fire fighting and hydrant flushing, accurate accounting of non-revenue uses allows a public water system to more effectively determine how much non-revenue water is being used for those legitimate uses and how much is being lost to leaks or to unauthorized uses. Metering of water use at public facilities is a basic first step in this effort. This involves installing and reading meters at public facilities such as schools, municipal facilities, and others. Nearly all of the large public water systems in the region meter the volume of water delivered to public facilities.

Many of the reporting public water systems in the region also state that they develop estimates of unmetered water use, such as hydrant flushing, blowoffs, fire fighting, street sweeping, and water treatment. For hydrant flushings and blowoffs, staff must record the amount of time the hydrant is open and multiply it by an estimated rate of flow. At least three public water systems have stated that they use a pitot tube or other flow meter to more accurately estimate this rate. The amount of water used for fire fighting, street sweeping, and other such uses must be estimated by asking municipal staff to keep water logs. Water logs are also required to estimate the water used for temporary purposes, such as during construction or pool filling. Many public water systems provide contractors and others with portable meters for temporary use. Five public water systems stated that they plan to use portable meters to measure the amount of water used for tank filling and other temporary uses.

Finally, many public water systems develop estimates of the amount of water used for the treatment process itself. Some systems estimate the amount of backwash or other treatment water, while others simply subtract the amount of finished water from the amount metered at the source. Still others have separate meters for process water.

Meter Calibration

Meter calibration is an important component of a water management program. It ensures the accuracy of the measurement of production water. Seven public water systems in the region reported that they have calibrated their source meters. Five stated that calibration was done regularly, on a schedule ranging from biannually (one system), to annually (three systems), to biennially (one system). Two other systems indicated that their meters had been calibrated but that calibration was not done on a regular schedule.

Periodic Water System Evaluations

A water system evaluation is an opportunity for a public water system to conduct careful water accounting and determine the volume of water that is unaccounted-for and which may be lost through leaks, unauthorized use, or inaccurate accounting procedures. Eight public water systems stated that they conduct regular water system audits to determine unaccounted-for water (six on an annual basis, one quarterly; and one monthly). Three of these entities also stated they were planning to conduct more comprehensive water use audits on a triennial basis. Available materials did not specify the level of effort or methodology involved in these audits.

Pressure Reduction

Pressure reduction is a supply-side water conservation technique that can save water by reducing the amount of water lost through leaks. Moderate service pressure will also reduce the amount of water used by consumers' water fixtures. Pressure reduction measures are required when system pressures exceed 125 psi. Five public water systems reported that system pressures are less than 125 psi and that pressure reduction was not necessary. Two systems stated that they regulate water pressure, one through the division of the public water system into five zones separated by pressure-reducing valves and booster stations, and one through pressure-reducing valves on customer service lines where system pressure exceeds 100 psi. One other system is investigating the installation of pressure-reducing valves in the lower portions of its system where pressures exceed 100 psi.

Pressure reduction can have an immediate impact on water conservation by reducing the amount of water lost through leaks or used by household fixtures. Pressure to customer facilities or residences should not exceed 100 psi. Systems that have more leaks will realize a greater savings from pressure reduction than relatively tight systems.

Treatment Water Recycling

Recycling or reduction of treatment water is a supply-side conservation measure that generates immediate water savings. Depending on raw water quality and other factors, treatment water may constitute a significant portion of a system's non-revenue water. DPH regulations permit recycled water to constitute up to 10% of production. Recycling this water to the beginning of the treatment process can provide a measurable increment of supply for a public water system. Three public water systems stated that they recycle treatment water when it is feasible.

5.3 Demand Side Conservation Measures

Demand-side water conservation measures are designed to reduce the amount of water used by consumers. These measures include public education, charging customers based on their usage, instituting water rates that promote conservation, distribution of water conservation devices, water bans, and water audits.

Customer Metering

Universal customer metering is a fundamental demand-side water conservation measure. Charging customers according to usage encourages consumers to use less water. Ten public water systems in the region state that they meter all (or nearly all) service connections. Two public water systems stated that they do not meter all service connections. Systems that do not meter customers generally charge a flat fee for water service. This discourages conservation because customers are charged the same amount regardless of usage.

Decreased demand in response to metering can provide significant water savings. The Montville WWPCA recently installed meters at all of its service connections and realized a significant decrease in demand following meter installation. The Ledyard WPCA Highlands System also drastically reduced demand after the installation of customer meters.

Public water systems in the region generally read meters on a quarterly basis, although some systems read meters monthly. More frequent meter readings and billing statements send a stronger conservation signal to consumers, because they can observe variations in use on a more frequent basis. However, more frequent reading and billing may increase operating costs.

Meter Testing and/or Change-Out Programs

Customer metering is only worthwhile if meters are accurately recording the amount of water used. As moving parts wear, water meters tend to under-register with time. Most public water systems that have universal metering also have a meter testing or change-out program to ensure the accuracy of meter readings. DPUC regulates the frequency with which meters must be tested or replaced. Some larger systems test or replace meters on a regular schedule according to the size of the meter. The largest meters may be tested or replaced annually, while smaller meters for household customers are tested or replaced less frequently (every eight to fourteen years).

Some public water systems do not have a regular program and instead test or replace meters on an as-needed basis. The Norwich Water Department is one such system that does not have a meter testing program. Many of its meters are 20 to 30 years old, and an independent contractor has suggested that under-registering meters may be a significant cause of that system's abnormally high unaccounted-for water. It is critical to test and/or replace the largest meters on a regular basis, since metering errors for large volume users may translate into a significant amount of unaccounted-for water.

Increasing Block Rate Structure

An increasing block rate structure can be an effective method of promoting conservation. Under such a rate structure, customers are charged more per unit of water as consumption increases. Only three public water systems reported having an inclining block rate structure. Three systems have a flat rate (same rate per unit regardless of usage), and three systems have a declining block rate structure, in which the per-unit cost decreases as consumption increases, thus discouraging conservation. Two systems (those which do not meter their customers) charge a flat fee for water service, and one system has a single rate structure for one division and a flat fee in another.

Increasing block rates are an effective means of promoting conservation, especially for large water users, because they enhance the cost-effectiveness of water conservation investments. Public education and collaboration with industry is critical to ensuring that consumption does not rise to previous levels after customers become accustomed to the new rates.

Seasonal Rate Structure

A seasonal rate structure is an important conservation technique because it discourages use during dry periods when water supplies may already be stressed. Only one public water system (Groton Utilities) is known to have a seasonal rate structure. The Groton Utilities Water Conservation Plan suggests that this seasonal rate did have a measurable effect on consumption during the dry summer of 1995.

Distribution of Educational Materials; Customer Education

Customer education is important to all demand-side water conservation efforts. Consumers who understand water supply issues and the need for water conservation are more likely to use less water and to respond to conservation alerts during peak periods. Connecticut General Statute 25-32k requires every large public water system to provide educational materials to customers on a regular basis. These educational materials should provide information on water conservation and water supply source preservation methods, including methods to reduce contamination.

Eleven public water systems have an active public education program. Public education methods include water conservation bulletins, press releases, plant tours, traveling exhibits, school programs, workshops, speakers, brochures, mailings, and bill stuffers. Most material is designed to educate consumers regarding the sources, treatment, and distribution of water and methods of conservation. Many systems also provide direction on how to identify the presence of a leak in the household. The participation of municipal officials is critical to the success of customer education programs.

Four systems stated that they use bill stuffers to alert customers of unusually high usage (such as 20% greater than average usage) that may indicate a leak or wasteful water practices. These bill stuffers may be an effective way to raise awareness of conservation and link it to the water bill. This method is more effective with more frequent billing (such as monthly).

Coordination with Schools

Five public water systems report that they make presentations at area schools to educate students regarding water supplies and water conservation. These presentations are effective methods of instilling youngsters with an appreciation for water supplies and an understanding of water conservation.

Plumbing Retrofit / Distribution of Conservation Devices

Public Act 89-266 required all large public water systems (greater 1,000 customers) to distribute water conservation retrofit kits to residential customers free of charge. Standard retrofit kits consist of a low-flow showerhead, two faucet aerators, leak detection dye, and two toilet dams. All public water systems in the region have complied with this requirement and have made such kits available through mailings, via door-to-door distribution, or at public water system offices. Four public water systems in the region reported that they distributed at total of over 16,000 kits from 1991-1994.

Distribution of retrofit kits has been highly successful in reducing overall demand. Proper installation of the kits can reduce household demand by 8-10%. Based on observed penetration rates of 49-95%, this yields an overall reduction in residential demand of 4–10%. Similar results were observed by the Connecticut Water Company, Groton Utilities, and Ledyard WPCA. Other public water systems have not published their estimates of the magnitude of savings attributable to retrofit kits.

Because customers may later remove conservation devices, an ongoing customer education program is critical to ensuring the continuing success of a retrofit program. Water systems must also continue to make retrofit kits available for new residents or those who have removed their devices.

Additional savings from the retrofit program will be realized if public water systems continue to make kits available in order to increase the overall penetration rate. Once the penetration rate has leveled off, however, little additional savings will be recognized, since new construction is already required to utilize high-efficiency fixtures. One approach that may locally yield a reduction in residential demand is to encourage or mandate the installation of efficient fixtures when seasonal residences are converted to year-round use. This approach has been applied by the Groton Long Point System.

Water Audits and Assistance for High-Volume Customers

Five public water systems have indicated that they have some type of water audit / technical assistance program for high-volume customers. These programs vary widely. Some involve development of educational and technical materials so that customers can conduct their own water audit and identify conservation opportunities. Others include providing a technical expert (public water system staff member or consultant) to conduct a water audit and make recommendations. Some systems provide these service on request, and plan to conduct a certain number per year for the largest users.

Car Wash / Sprinkler Bans

Four public water systems stated that they have restrictions on outdoor use of water for lawn watering or car washing. Such restrictions range from odd-even watering rules to outright bans on car washing and lawn watering. Three systems have temporary restrictions during peak periods, while one has a permanent ban on car washing and lawn watering. Two other systems are considering implementation of such restrictions. Numerous systems promote efficient lawn watering practices, including voluntary restrictions during peak periods.

The success of restrictions on outdoor use varies widely with the type of restriction, the cooperation of municipal officials, and the resulting level of compliance. Compliance is a function of public perception regarding the need for water conservation. Enforcement is also a very important factor. As a result, public education is a critical component of any voluntary or mandatory water ban. While few public water systems have permanent restrictions on outdoor water uses, those that have implemented seasonal or as-needed restrictions have found that they can significantly reduce peak period demand.

Promotion of Xeriscape Gardens and Lawns

While few public water systems have permanently restricted lawn watering practices, many are encouraging both residents and businesses to develop landscapes that require less water for irrigation. Six public water systems have indicated that they provide customer information and public education regarding xeriscaping. Methods for disseminating information include bill stuffers, press releases, media advisories, exhibits, garden show displays, and booklets. Groton Utilities developed a xeriscape garden at the municipal building in order to demonstrate best practices. No estimates have been made regarding how many consumers have implemented xeriscaping practices on their property and the corresponding water savings.

5.4 Unaccounted-For Water

Unaccounted-for water is that percentage of total production not accounted for under metered use or attributable to known unmetered (non-revenue) uses such as hydrant flushing or fire fighting. Unaccounted-for water commonly includes leaks in the distribution system or unauthorized uses.

The following public water systems have a high percentage of non-revenue water (greater that 20% of production) and may be losing a significant portion of this water to leaks or unauthorized uses:

- ECRWC Lake Hayward Division: Unaccounted-for water may be largely attributable to leaks in the aging distribution system. The 1992 Individual Water Supply Plan identified replacement of the distribution system as a major priority that would help to control unaccounted-for water.

- New London Water Department: The 1998 Water Conservation Plan speculated that under-registering meters, rather than leaks, were responsible for a substantial fraction of the unaccounted-for water. A major meter replacement program was initiated in 1997 and will be completed in 2003, after which time meters will be replaced on regular intervals.

- Norwich Water Department: The Norwich system has an abnormally high percentage of unaccounted-for water which is believed to be attributable to blowoffs, leaks, and under-registering meters, in that order. The system maintains 12 freeze-prevention blowoffs at bridge crossings and they are currently evaluating freeze-prevention methods that do not involve dumping water, including insulation. Leakage may also be a major cause of unaccounted-for water; however, Norwich does not have an ongoing, systematic leak-detection effort. The importance of such an effort was highlighted by the 1996 discovery of a 0.5 mgd leak that had been active for an unknown period of time. Many of the system's meters are over 20 years old and may be significantly under-registering. Norwich also recently discovered the existence of a meter at Backus Hospital which had been ignored for years, and which accounted for nearly 1% of total system consumption. Active efforts on all three fronts (blowoffs, leakage, and meter management) should help Norwich to bring unaccounted-for water down to its goal of 15%.

5.5 Water Conservation Recommendations

In connection with infrastructure funding, the value of conservation is appropriately assessed in terms of supply, treatment, and distribution costs that can be avoided because of anticipated reductions in water demand. Conservation becomes more valuable over time because the cost of developing water supplies and treating and delivering them are expected to rise faster than inflation. Therefore, permanent conservation savings realized today will have increasing value into the future.

All public water systems, regardless of their size, unaccounted-for water percentages, or existing efforts, should engage in conservation planning. Conservation planning can help public water system managers take inventory of their existing efforts and identify new opportunities. Planning can help public water system managers balance competing goals and rising costs. Investments made in conservation planning and implementation should yield savings that can be measured in terms of water and dollars. Comprehensive conservation planning can help water managers to identify those measures that will provide the most efficient return on their investment and those that may provide substantial savings as an increment of supply for future demand.

Water conservation planning and implementation can be very expensive, or relatively straightforward and inexpensive. Water managers should be familiar with existing Connecticut water conservation requirements and should begin their planning efforts by examining the measures required by those standards. The U.S. Environmental Protection

Agency (USEPA) also published a document entitled *Water Conservation Plan Guidelines* (EPA-832-D-98-001, August 6, 1998). It provides a framework water managers can use to assess the cost-effectiveness of conservation as well as to the value of conservation in avoiding, lowering, or postponing supply-side capital and operating costs. It is important that any water conservation plan be designed to meet the specific needs of the public water system for which it is designed. Each public water system has different needs, and the conservation plan should focus on those recommendations that have the greatest potential to increase the efficiency of the system, reduce wastes, and encourage consumer water conservation efforts.

The following are some recommended actions that public water systems should implement as they address water conservation issues:

- Specify water conservation planning goals;
- Assess current conditions; develop a water system profile;
- Prepare a demand forecast;
- Describe planned facilities;
- Identify appropriate water conservation measures;
- Analyze benefits and cost;
- Select conservation measures;
- Integrate resources and modify forecasts; and
- Develop implementation and evaluation strategy.

The level of effort involved in each of these steps will depend on the size of the public water system and the particular challenges facing each system. Many public water systems may already have completed several of these steps as part of a water conservation program or to fulfill state requirements.

A water conservation plan should include both demand management and supply management measures to address both short- and long-term water conservation.

Specific Water Conservation Planning Goals

Public water systems should develop water conservation goals in the most specific terms possible. Some water conservation planning goals include the following:

- Eliminate, downsize, or postpone need for capital projects;
- Improve utilization and extend the life of existing facilities;
- Lower variable operating costs;
- Avoid new source development costs;
- Improve drought or emergency preparedness;
- Educate customers about the value of water;
- Improve reliability and margins of safe and dependable yields; and
- Protect and preserve environmental resources.

Many public water systems identify a specific water use reduction objective (as a percentage of current water usage) and may disaggregate this objective by sector (certain reduction in residential usage, certain reduction in industrial usage, etc.).

Goal development should be an open and participatory process that involves community members, businesses, advocacy groups, and government agencies. Public participation will enhance the success of any water conservation program by promoting the development of realistic goals, fostering broad-based support, facilitating public education, and monitoring implementation.

Develop a Water System Profile

Development of a water system profile consists of taking inventory of existing resources and conditions. Each system should already have available most of the information necessary to build an adequate profile, and many suppliers in the region have already assembled this data. Basic information that should be included in any water system profile includes the following:

- Estimated service population;
- Estimated service area;
- Total annual water supply;

- Percent metered water supply;
- Number of service connections by sector;
- Water demand by sector (both volume and percentage of total demand);
- Nonrevenue water (both volume and percentage of total demand);
- Average day demand (both by volume and as a percentage of total capacity);
- Maximum day demand (both by volume and as a percentage of total capacity); and
- Water rates by sector.

A water system profile should also include an analysis of conditions that might affect the conservation planning effort, including frequent shortages, substantial non-revenue water, demand forecasts, or proposed capital improvements.

Prepare Demand Forecasts

A demand forecast will help a public water system to evaluate the potential benefits of alternative water conservation measures. Demand forecasts range from simple projections based on population growth to complex regional models. Most public water systems have already prepared demand forecasts as part of their water supply plan. The most useful forecasts will also include projections for separate classifications of water use (residential, commercial, etc.).

Identify and Evaluate Conservation Measures

There are a wide variety of conservation measures that public water systems might employ. Conservation measures fall into two broad categories: supply-side and demand-side measures. They range from simple educational tools to advanced system management approaches. Public water systems should evaluate alternative conservation measures based on their cost-effectiveness as well as on how large an increment of supply they can provide to help meet future demand.

The most basic water conservation measures are fundamental operating practices that should be employed by all public water systems, regardless of their size.

Periodic Water System Evaluation

All public water systems, including smaller systems, should implement a basic system of water accounting. Periodic, consistent water accounting efforts or water system evaluations will provide a basis for developing a strategy to control losses over time. Addressing leakage and loss is a fundamental part of any water conservation strategy. The cost of water leakage or loss can be measured in terms of the operating costs associated with water supply, treatment, and delivery. Lost water costs money to produce but yields no corresponding revenues.

Non-revenue water is the difference between total metered source water and metered water sales. It may include water lost during treatment as well as water used for unmetered public or municipal uses, such as fire fighting, street cleaning, water line flushing, etc. Some public water systems meter water use at municipal facilities and/or estimate the amount of water used for fire-fighting, line flushing, and street cleaning. Unaccounted-for water is the amount of non-revenue water that cannot be attributed to any authorized or unauthorized use or any known leakage. It may include leaks, unauthorized water uses, erroneous metering or billing, and abandoned services. Unaccounted-for water is calculated by subtracting metered water sales, known or estimated treatment losses, and unbilled consumption (metered or estimated) from system consumption metered at the source.

Due to the diverse nature of water losses, a public water system's unaccounted-for water may be a relatively dynamic figure, especially over a time frame of weeks or months. The most useful non-revenue and unaccounted-for water figures are those that comprise data collected over the course of a year. Connecticut DPH has identified 15% non-revenue water as a goal for public water systems in the region.

Non-revenue water should be analyzed to identify potential revenue-producing opportunities as well as recoverable losses and leaks. Efforts to reduce illegal connections and water theft, which can be identified through a water system evaluation, have immediate benefit and the water purveyor can begin charging for water previously given away.

Leak Detection and Repair Program

Repair of larger leaks can be costly, but it can also produce substantial savings in water and expenditures over the long run. Public water systems can identify leaks through a comprehensive leak detection and repair strategy. This strategy may include regular on-site testing using computer-assisted leak detection equipment, a sonic leak-detection survey, or other acceptable method for detecting leaks along water distribution mains, valves, services, and meters. Many smaller water systems in the region determine the potential sum total of system leaks by measuring demand during off-peak/low demand periods. In a system that primarily serves residential customers, inordinate demand at off-peak/low demand times may indicate the presence of leaks that should be found with a sonic detection survey or other method.

A leakage rate of more than 2,500 gallons per mile of water main or 15% of non-revenue water may be recoverable waste which may be cost-effective to address through leak detection and repair, break analysis, and replacement programs. Public water systems that do not have significant losses in the transmission or distribution system should institute a maintenance program to retain and achieve the lowest feasible leakage rate.

Universal Metering

Metering is a fundamental tool of water system management and conservation. Public water systems that meter service connections should also enact a program of fixed-interval meter reading. Reading source and consumption meters at regular intervals and in the same order will facilitate accurate comparisons and analysis. Readings should be done at regular intervals, such as monthly, bimonthly, or quarterly. Estimated bills should be kept to a minimum, because lack of data can prevent accurate estimates of non-revenue water.

Production Metering

Source metering and production metering are essential for accurate water accounting efforts. Source metering is metering the amount of water withdrawn from surface water supplies or pumped from groundwater. Production metering involves measuring the amount of finished, potable water that enters the distribution system from the treatment facility. Comparison of these two figures will help public water systems to determine how much water is lost during the treatment process.

Customer Metering

Service connection metering, or customer metering, is needed to inform customers about how much water they are using and to bill those customers according to their usage. Without service connection metering and billing practices based on consumption, customers will have very little financial incentive to conserve water.

Metering of Non-Revenue Uses

Public water use metering allows public water systems to track the amount of water provided free of charge for public use. Metering of these uses is essential for an accurate accounting of lost and unaccounted-for water.

Meter Testing and/or Change-Out Programs

Water meters can be damaged and deteriorate with age, thus producing inaccurate readings. Inaccurate readings will give misleading information regarding water usage, make leak detection difficult, and may result in lost revenue for the system. All meters, especially older meters, should be tested for accuracy on a regular basis. The determination should also be made to determine that meters are appropriately sized. Meters that are too large for a customer's level of use will tend to under-register water use. Many systems implement a meter replacement program that will replace meters on a regular basis according to their size (e.g., ½-inch meters are replaced every 12 years, 1-inch meters every 6 years, etc.).

Meter Calibration

Many systems set a schedule of activities necessary to find and correct meter deficiencies. Meters should be recalibrated on a regular basis to ensure accurate water accounting.

Pressure Reduction

Reducing excessive pressure in a distribution system can save a significant quantity of water. Reducing water pressure can decrease leakage, the rate of flow through open faucets, and stresses on pipes and joints that may result in leaks. Lower water pressure may also decrease system deterioration, reducing the need for repairs and extending the life of existing facilities. Lower pressures can also reduce wear on end-use fixtures and appliances.

In residential areas, pressures above 80 psi should be assessed for pressure reduction. Pressure management or reduction strategies must be consistent with state and local regulations and standards, and should take into account system conditions and needs. Pressure reduction should not compromise the integrity of the system or service quality for customers.

A more aggressive pressure reduction plan may involve the purchase and installation of pressure-reducing valves in street mains or at individual service connections. System managers might consider insertion of flow restrictors on services where pressure exceeds 100 psi at the meter. Restrictors can be sized to allow for service length, system pressure, and elevation. Care is necessary, particularly where fire sprinkler systems are installed. Public water system managers should also consider providing technical assistance to customers to address pressure problems.

Use Water Rates to Encourage Conservation

Costing and pricing are important conservation strategies because they involve understanding the true value of water and conveying information about that value, through prices, to water consumers. Implementation of user charges is often considered a necessary (but not always sufficient) part of a water conservation strategy. Public water systems should use cost-of-services accounting, consistent with generally accepted practices. Once a public water system has developed an understanding of the costs of providing water, it can develop a system of user charges that will recover those costs without overcharging consumers.

Public water systems should meter all service connections and bill customers according to their water usage. 100% customer metering and usage-based charges will provide consumers with a financial incentive to use less water.

Further conservation incentives come in the form of non-promotional rates, that do not promote water usage over conservation. Such rates may take the form of an inclining block rate structure in which consumers pay more per unit of water as their consumption increases. Systems seeking to encourage conservation through an inclining block rate structure, for example, should consider various issues including the allocation between fixed and variable costs, usage blocks and breakpoints, minimum bills and whether water is provided in the minimum bill, seasonal pricing options, and pricing by customer class.

Systems should also consider the impact of a new rate structure on revenues. Changes in the rate structure should allow the system to achieve demand reduction goals while recovering water system costs. Planners must make certain assumptions regarding the elasticity of water demand or the responsiveness of water usage to a change in price. Public water system planners should consider the impact of the rate structure on user demand and revenue for specific customer classes.

Public water systems may also want to consider advanced pricing methods, such as different rates for different customer classes or type of water use. Seasonal rates that charge more for water during the summer months when demand is higher, can help to moderate usage peaks that can put a significant strain on a public water system. Economic criteria must be considered for customers such as large industrial users. The cost of water can be a critical element to business viability.

Water Audits and Assistance for High-Volume Customers

Public water systems should consider and evaluate a program to provide technical assistance to major water users in the performance of water audits and in the formulation and implementation of retrofit programs. Major water users should be inventoried along with daily usage and type of use. If possible, the water conservation plan should identify those users that have the greatest potential to conserve water. Conservation measures for various categories of water use (sanitary, process, domestic, heating, cooling, outdoor) should be listed and described. The conservation plan should also include a report on past program accomplishments, including cost, water savings, and payback period.

Customer Education

Information and education are critical to the success of any conservation program. Information and education measures can directly produce water savings by prompting consumers to change their water use habits. Water savings that may result from customer education programs are difficult to estimate. Informational programs may be even more successful when coupled with other, more direct approaches such as leak repair or retrofit programs. Information may also play an important role in how water consumers respond to a change in price. Those consumers who are aware of simple, available water conservation tactics will be more likely to implement those tactics in response to rate increases than other consumers who are not aware of ways to reduce their consumption and, consequently, their water bills. More generally, customers who are informed and involved are more likely to support their public water system's conservation planning efforts. However, it must be considered that a reduction in water use (as a result of customer education) may reduce revenues, creating a need for additional income.

An understandable water bill is a fundamental way to inform consumers. It should identify volume of usage, rates and charges, and other relevant information. Some public water systems distribute bills with additional information, such as comparisons to previous bills, and tips on water conservation.

Public water systems should also provide information to consumers upon request and might consider including informational materials with their bills. An information and education program should explain to water users all of the costs involved in supplying drinking water and should demonstrate how water conservation practices will provide water users with long-term savings. Many public water systems disseminate information regarding water conservation through a variety of school programs. These programs can help socialize young people about the value of water and provide an additional avenue for public water systems to convey conservation information to parents.

Car Wash / Sprinkler Bans

Many systems implement water use standards and regulations to manage water use during droughts, peak demand periods, and other times when the water supply is stressed. In some cases, public water system managers may find it desirable to extend water use regulations to promote conservation during non-emergency situations. Some of the most common water regulations are restrictions on nonessential uses, such as lawn watering, car washing, filling swimming pools, sidewalk washing, and golf course irrigation. Severe drought conditions merit the consideration of additional restrictions such as restrictions on commercial car washes, nurseries, hotels, and restaurants. All car wash facilities should have water recycling capabilities.

5.6 Conservation and Future Supplies

There are a number of systems in the region that will require additional water within the next ten years. Some of these systems have a high or moderate percentage of non-revenue water. Public water systems in this situation must begin implementation of a water conservation plan prior to applying for a diversion permit. While the Department of Environmental Protection reviews and comments upon water conservation plans during the individual water supply plan approval process, it is not uncommon for them to require a more rigorous conservation program as part of a diversion permit. Of particular importance is the justification that all reasonable measures have been taken to avoid development of new supply sources.

6.0 ANALYSIS OF ALTERNATIVE FUTURE WATER SUPPLIES AND LAND ACQUISITION FOR PROPOSED STRATIFIED DRIFT WELLS

6.1 Introduction

This section of the Integrated Report identifies the surface and groundwaters of the southeast Connecticut region and evaluates the ability of these resources to provide regionally significant volumes of potable water. For the purposes of this analysis, only those resources that may be able to produce one million gallons per day or more are considered to be regionally significant.

Resources were evaluated based on watershed size, percentage of stratified drift in the watershed, estimates of mean annual and drought flows, and estimates of groundwater well yields. This information was supplemented with the results of previous water supply studies completed for the region and individual water supply plans. Based on the inventory and analysis conducted herein, Table 6-1 presents a list of future water supply sources that were recognized as having the greatest potential to provide regionally significant water supplies in the southeast Connecticut Region. This listing has been prioritized based upon input and comment from the Department of Environmental Protection as well as proximity to existing and projected water demands.

The remainder of this section develops a strategy for developing and implementing the use of these potential sources to meet the region's long-term needs. Figure 6-1 is a reference map of potential groundwater and surface water supply sources. Figures 6-2 through 6-4 compare the location of the potential sources identified in this section to the areas in the southeast region that are expected to experience a water supply deficit within the five-, 20-, and 50-year planning periods.

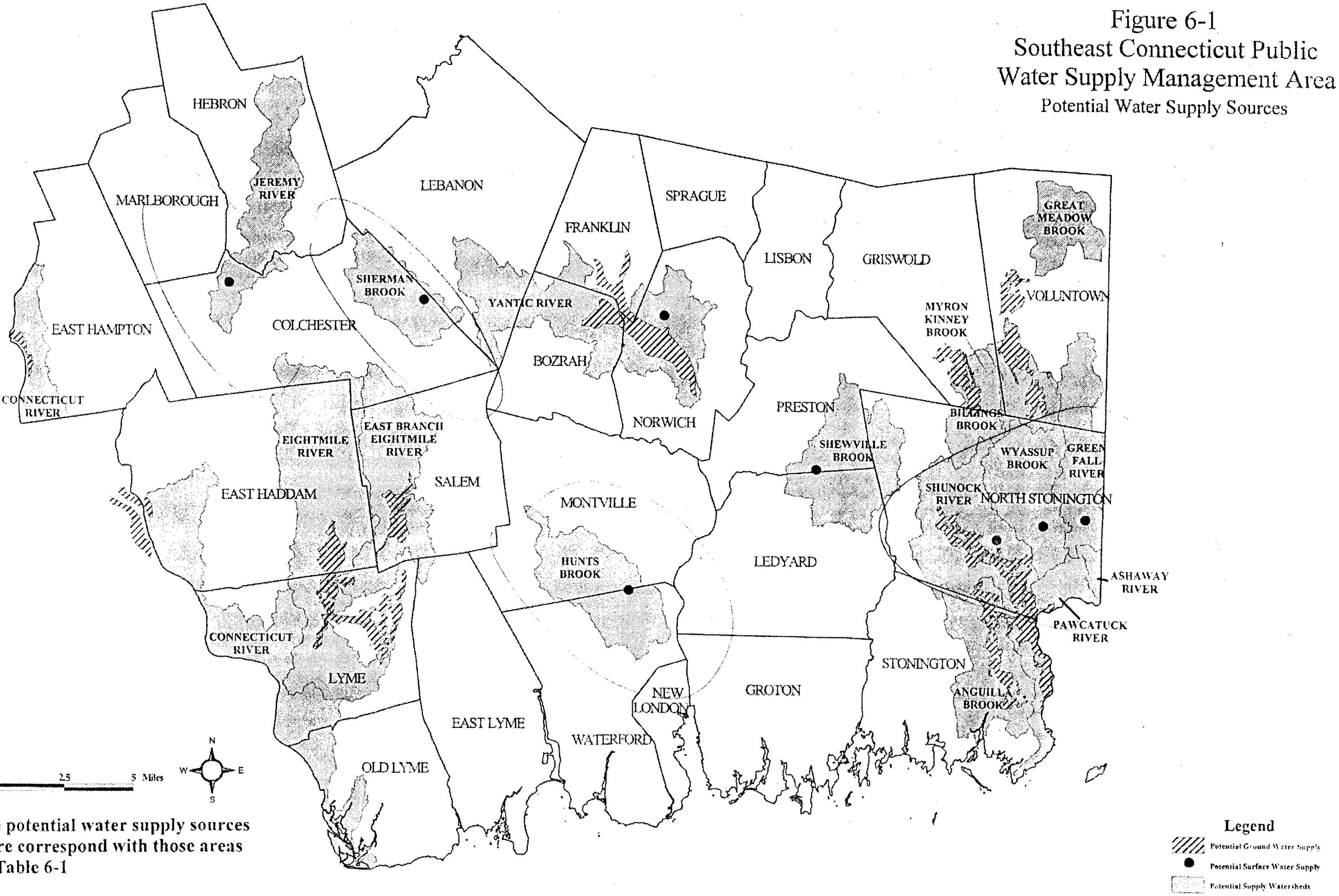
As presented in the areawide overview, supply deficits would occur during a 100-year frequency drought in some individual systems under existing demands. A regional deficit is forecast to occur soon after the five-year planning period (2005), even assuming that all surplus supply volumes could be delivered to the demand centers. In reality, the demand centers often do not coincide with the location of existing distribution systems.

TABLE 6-1
Recommended Future Water Supply Development Areas

Basin ID	Subregional Basin	Regional Basin	Type of Supply	Estimated Reservoir Yield (mgd)	Estimated Run-of-River Yield (mgd)	Estimated Ground Water Yield (mgd)	Environ-mental Sensitivity
1000	Pawcatuck River	Pawcatuck	G	N/A	N/A	7.2	Lowest
4000	Connecticut River	Connecticut	G	N/A	N/A	4.3	Lowest
1003	Ashaway River	Pawcatuck	S	11.1	1.3	N/A	Low
3903	Sherman Brook	Yantic	S	9.2	1.2	N/A	Low
1002	Green Fall River	Pawcatuck	S	9.0	1.1	N/A	Low
1001	Wyassup Brook	Pawcatuck	S	4.6	0.6	N/A	Low
3900	Yantic River	Yantic	G	N/A	N/A	4.9	Moderate
1004	Shunock River	Pawcatuck	S/G	6.6	0.8	1.3	Moderate
4705	Jeremy River	Salmon	S	17.0	2.2	N/A	Moderate
3002	Shewville Brook	Thames	S	5.8	0.7	N/A	Moderate
3006	Hunts Brook	Thames	S	5.2	0.7	N/A	Moderate
4800	Eightmile River	Eightmile	G	N/A	N/A	0.5-1.2	High
4802	E. Branch Eightmile	Eightmile	G	N/A	N/A	0.4-1.2	High
3605	Billings Brook	Pachaug	G	N/A	N/A	3.5	Highest
3601	Great Meadow Brook	Pachaug	G	N/A	N/A	2.8	Highest
2101	Anguilla Brook	SE Eastern	G	N/A	N/A	2.9	Highest
3604	Myron Kinney Brook	Pachaug	G	N/A	N/A	1.0	Highest
			TOTAL	**68.5**	**8.6**	**28.8 – 30.3**	

N/A = Not applicable
G = Groundwater Supply
S = Surface Water Supply

Figure 6-1
Southeast Connecticut Public Water Supply Management Area
Potential Water Supply Sources



Note: The potential water supply sources shown here correspond with those areas listed on Table 6-1

Figure 6-2
Southeast Connecticut Public Water Supply Management Area
5-Year Deficit Projections
(systems projecting deficits in excess of 100,000 gpd)

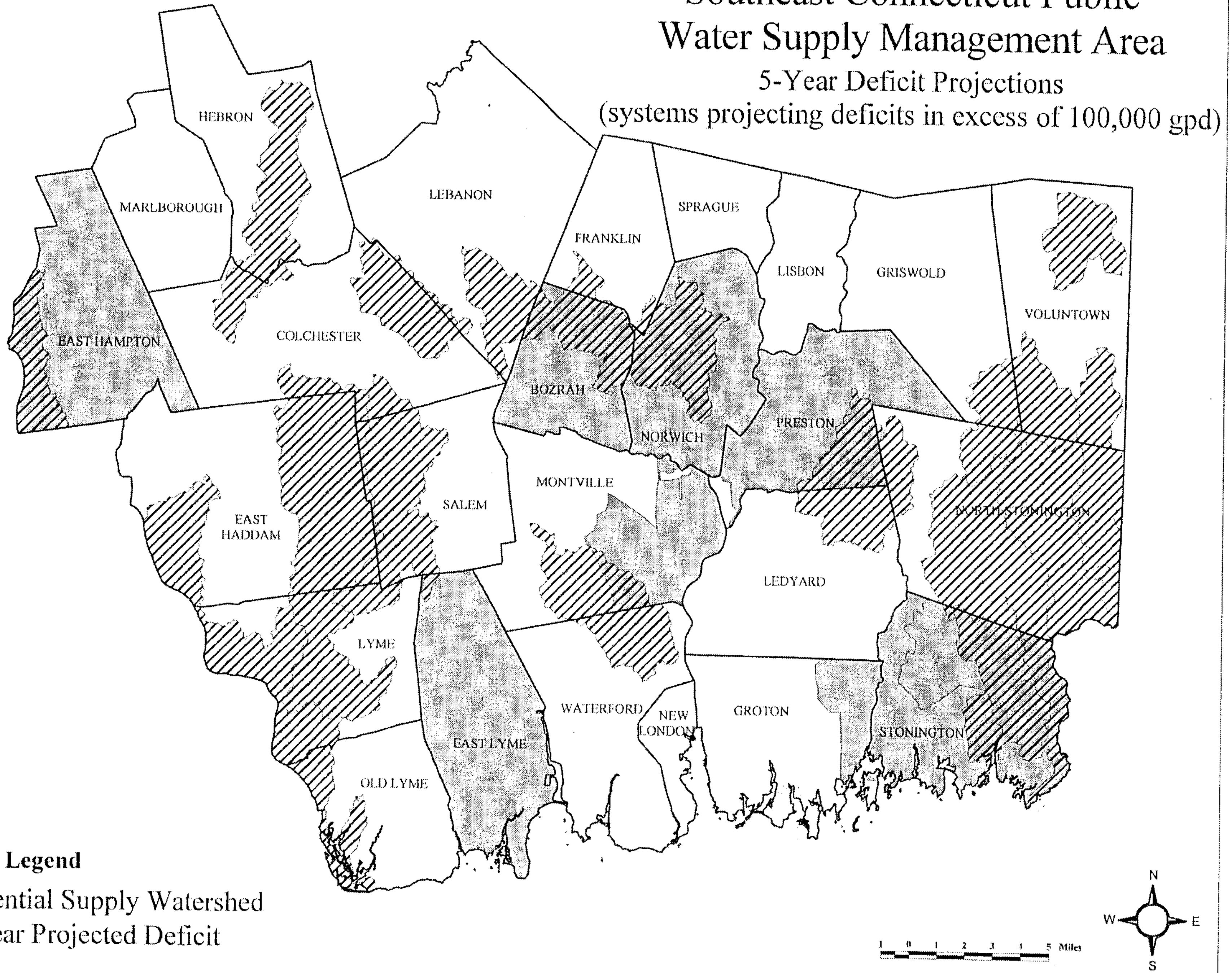


Figure 6-3
Southeast Connecticut Public Water Supply Management Area
20-Year Deficit Projections
(systems projecting deficits in excess of 100,000 gpd)

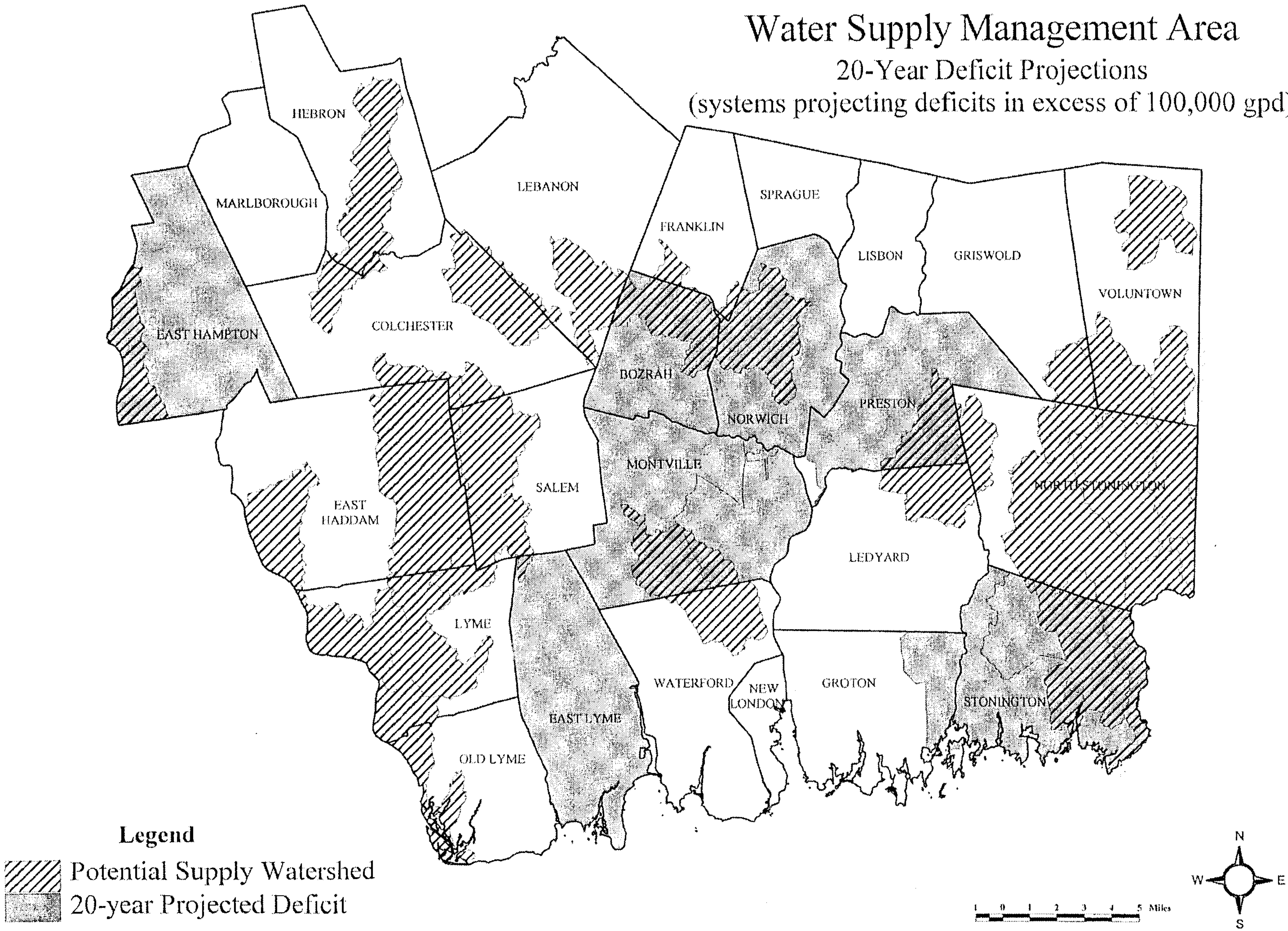
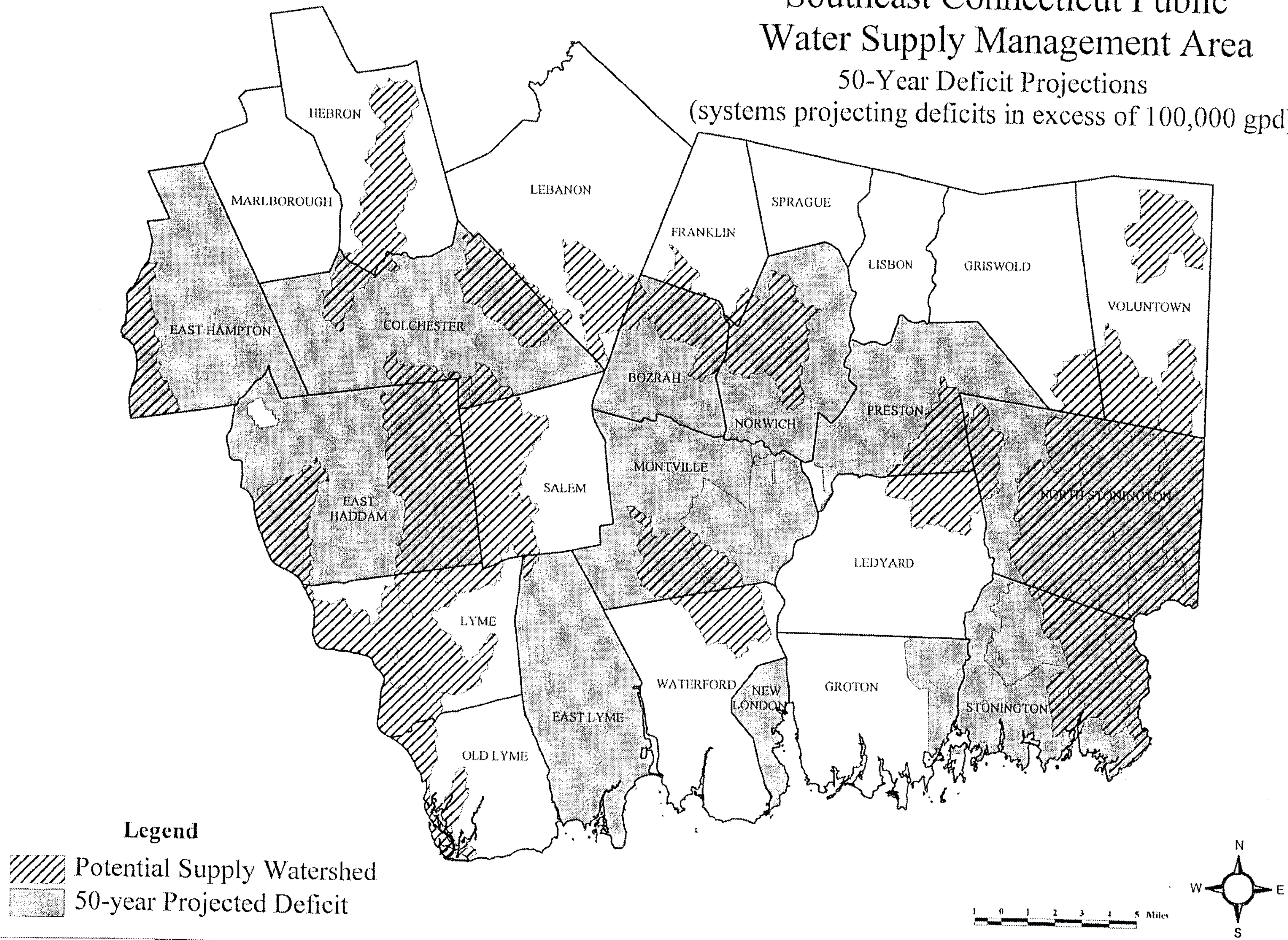


Figure 6-4
Southeast Connecticut Public Water Supply Management Area
50-Year Deficit Projections
(systems projecting deficits in excess of 100,000 gpd)



The region has many existing public water supply groundwater wells (generally located in the areas of highest water demand) and numerous reservoirs. The goal of this analysis is to identify the under-used or unused aquifers and surface waters that have the potential to provide regionally significant supplies in excess of 1.0 mgd.

The following sources of data were used in evaluating potential water supplies:

- Individual Water Supply Plans (dates vary);
- "Part I: Final Water Supply Assessment" Southeast Connecticut WUCC (April 1999);
- "Water Supply Plan for the Southeastern Connecticut Region" Southeastern Connecticut Water Authority and Southeastern Connecticut Regional Planning Agency (Volumes 1 and 2, 1969 and 1970);
- "Water Supply Plan for the Southeastern Connecticut Planning Region" (1977);
- Hydrogeology of Southeastern Connecticut (6 sheets, undated);
- Groundwater Yields for Selected Stratified Drift Areas in Connecticut (mapping, 1986);
- Geographic Information System Data (available via DEP and the *MAGIC* internet site); and
- Book I Data Sheets of Potential New Potable Water Sources (State Health Department, September 1971).

Regionally significant supply sources are likely to supply the large public water systems and/or those that have been recommended for expanded exclusive service areas. Table 6-2 summarizes the major water suppliers in the southeast Connecticut region. Additionally, the Mashantucket system currently serves an estimated population of 1,615 people. Average day system demand in 1999 was 0.943 mgd, while the system safe yield is [redacted]. While this system serves more than 1,000 people, it has not been awarded an exclusive service area beyond the boundaries of the tribal lands.

TABLE 6-2
Large Public Water Suppliers and/or Expanded ESA Providers

Public Water Supplier	Primary Area(s) Served
Colchester Sewer & Water Commission	Colchester
Connecticut-American Water Company	Groton/Stonington
Connecticut Water Company	Griswold, Old Lyme, Voluntown
Town of East Haddam	East Haddam
East Hampton Water & Sewer Authority	East Hampton
East Lyme Water Department	East Lyme
ECRWC (AquaSource)	East Hampton, Hebron, Marlborough
Groton Long Point Association	Groton Long Point
Groton Utilities	Groton
Jewett City Water Company	Jewett City/Griswold, Lisbon
Town of Lebanon	Lebanon
Ledyard WPCA	Ledyard
Town of Lyme	Lyme
Montville Correctional Complex	Montville
Montville WWPCA	Montville
New London Water Division	New London
Noank Fire District	Noank
Town of North Stonington	North Stonington
Norwich Water Department	Norwich, Bozrah, Lisbon
Town of Preston	Preston
SCWA	Montville, Ledyard, Franklin, Salem
Sprague Water and Sewer Authority	Sprague
Town of Stonington	Stonington
Waterford WPCA	Waterford
Westerly Water Department	Stonington

6.2 Previous Studies

Water Supply Plan for the Southeastern Connecticut Region, 1970

In 1970, the Southeastern Connecticut Water Authority (SCWA) and the Southeastern Connecticut Regional Planning Agency published a report entitled "Water Supply Plan for the Southeastern Connecticut Region." Water supply policies, quality requirements and the regulatory climate have changed substantially since then and many of the previous alternatives are no longer feasible. However, the basic resources have remained and this study was reviewed with respect to current standards. Potential water supplies in the following six regional basins were identified in the 1970 study:

- Salmon River Basin
- Yantic River Basin
- Shetucket River Basin
- Pachaug River Basin
- Quinebaug River Basin
- Thames River Basin

Water Supply Plan for the Southeastern Connecticut Planning Region, 1977

The 1977 regional "Water Supply Plan" prepared by the Southeastern Connecticut Regional Planning Agency evaluated alternate sites for water supply development. Each of these sites are summarized below with a brief assessment of their feasibility based on current regulations:

Haley Brook Dam and Diversion to Groton Reservoirs – This proposal would divert water to Groton's reservoirs by a small diversion dam and an existing pond. It remains an option under consideration by Groton Utilities.

Shewville Brook (Preston) Diversion to Groton Reservoirs – This small watershed lies along the busy Route 2 corridor, which could potentially impair its water quality. This watershed may, however, have potential to be a regional supply source and a detailed discussion of this source is included in Section 6.6.

Whitford/Williams Brook Groundwater Aquifer (Ledyard) – These streams are the headwaters to the Mystic River and have a large aquifer of stratified drift. The yield of this aquifer was estimated to be 1.4 mgd. The Williams Brook aquifer has been discounted in this analysis, due to low stream flow. The Whitford Brook aquifer is believed to be fully allocated.

Hunts Brook Reservoir and Diversion (Montville) – This alternative would have impounded Hunts Brook to create a new reservoir. However, it was never implemented.

New supplies in Hunts Brook have been evaluated as part of the subject study and are presented in Section 6.6.12.

Jordan Brook/Nevins Brook Aquifer (Waterford) – Three wellfield locations were identified within this aquifer. This area was not considered for regional supply purposes in this WUCC study due to the low estimated yield.

Lakes Pond Brook Aquifer (Waterford) – This area was identified as a potential wellfield location in 1977. A public water supply well has since been developed in this area.

Oxoboxo Lake Aquifer (Montville, Salem, Bozrah) – This aquifer was identified as a potential location for groundwater wells. The low projected yield of the aquifer prevented this from being considered a regional supply source in the subject study.

Convert Oxoboxo Lake to a Reservoir (Montville) – Oxoboxo Lake was identified as a potential water source for Montville and New London in 1977. This potential source is assessed herein as discussed in Section 6.6.

Trading Cove Brook Aquifer (Norwich and Bozrah) – The Trading Cove Brook aquifer is located within the Thames River regional basin. This source has not been developed and was considered in this analysis as presented in Section 6.6.

Stony Brook Reservoir Proposed Diversion to New London – The 1977 study proposed an interconnection of the Norwich DPU's Stony Brook reservoir to Lake Konomoc for sale to New London. Stony Brook remains an active supply source of the Norwich DPU. At the present time, the Norwich DPU does not project surplus supplies and the sale of water to New London from Stony Brook is no longer under consideration.

New Reservoir on Joe Clark Brook (Preston) – The 1977 water supply plan proposed the development of a reservoir to supply 9.5 mgd to New London, Groton, Ledyard and Montville. This basin was determined in the current analysis to be a potential supply source. However, a reservoir at this location is no longer believed to be feasible due to development that has taken place over the last 30 years.

Southeast Connecticut WUCC Water Supply Assessment (1999)

In a number of instances, preliminary investigations of future sources were reported in individual water supply plans for the larger systems in the southeast region. A summary of this information was presented in "Part I: Final Water Supply Assessment" of the Southeast Connecticut WUCC in April 1999.

6.3 Regional Water Supply Source Investigation

A comprehensive review of existing water resources in southeastern Connecticut was performed to identify potential potable and non-potable water sources. A database of existing information was generated to analyze area resources. Key criteria included in the database are:

- Basin Identification Number
- Basin Name
- Watershed Area
- Water Quality Classification
- Existing Water Supply Sources
- Significant Wastewater Discharges
- Presence of Stratified Drift
- Land Use
- Mean Stream Flow Rates
- Potential Mean Annual Yields
- Natural Diversity Database Areas of Special Concern
- Tidal Waters
- Significant Recreational Uses
- CTDEP Stocked Streams
- 303(d) List of Impaired Streams

The database was supplemented by a review of individual water supply plans, regional water supply studies, and discussions with DPH, DEP and public water system representatives. The core of the database was developed from the State Geographic Information System (GIS). The GIS data was supplemented with information from the statewide Rivers Assessment, U.S. Geological Survey, surficial geology mapping, Connecticut Department of Environmental Protection publications, and other sources.

The values of mean annual flows and potential yields are planning estimates based on regional data. They do not replace the need for detailed studies of sites that are ultimately selected for supply source development.

Streams that could not be considered for water supply due to their water quality classification, watershed size, existing uses, or other limiting factors were identified and eliminated. Potential groundwater aquifers were analyzed in a similar manner. Key indicators for potential groundwater sources were the presence of coarse-grained stratified drift, available recharge areas, land use, and the presence of existing water supply wellfields.

Potential supply sources were also identified based on existing data and reports. Data inquiries were made via a questionnaire to representatives of public water systems serving greater than 1,000 customers and those recommended for exclusive service area award. A listing of potential alternative supply sources and a plan for development of such sources was developed based on the collective body of information and data. Regional goals were adopted for future supply source development based on the developed information.

6.4 Inventory of Surface Water Supplies

Surface Water Hydrology

Based on data published by the USGS between the years 1931 to 1960, the southeast public water supply management area had an average annual precipitation of 48 inches and a corresponding average annual runoff of 26 inches. This is equivalent to a mean discharge of 1.17 million gallons per day per square mile of watershed (1.8 cfsm). Precipitation is fairly uniform through the year. However, evaporation and plant transpiration during the summer months exceed precipitation, reducing runoff. Drought conditions periodically occur for six months or less but, occasionally for several years at a time such as in the mid-1960's.

The frequency and magnitude of low stream flows is a severe challenge in water supply planning and natural resource protection. Water supply sources must be of sufficient capacity to provide water even under drought conditions, while preventing significant impact to aquatic habitat. The statistical data in Table 6-3 was developed by the USGS (1968) for southeast Connecticut based on stream gauging data from 1930 to 1960. It provides important information on the magnitude of stream flow per square mile during various drought frequencies and durations.

TABLE 6-3
Annual Lowest Mean Flows for Indicated Recurrence Intervals (Yantic River at Yantic)

Period of low flow (Consecutive days)	Annual Lowest Mean Flow (mgd per sq. mi.) for Indicated Recurrence Intervals (Years)						
	1.2	2	3	5	10	20	30
3	.088	.063	.051	.041	.031	.023	.019
7	.117	.080	.063	.050	.037	.028	.023
30	.189	.131	.109	.087	.063	.048	.040
60	.262	.182	.146	.117	.087	.066	.055
120	.408	.284	.233	.182	.138	.102	.087
183	.612	.423	.343	.270	.204	.153	.131
274	1.09	.730	.598	.481	.357	.270	.226
365	1.31	1.02	.873	.730	.598	.489	.430

Note: Flows are adjusted to the reference period of April 1930 to March 1960.
Source: USGS *Water Resources Inventory: Part 3 Lower Thames and Southeast Coastal River Basin*, 1968.

For example, the 120-day duration 20-year frequency mean flow on the Yantic River is only 0.1 million gallons per day (mgd) per square mile. Conversely, it would take a 10 square mile watershed to produce just 1.0 mgd, even without allowing for low stream flow releases. Table 6-4 presents low flow data for select stream flow gauges in southeast Connecticut. It demonstrates that the 7- and 30-day duration, two-year frequency low flows vary significantly per unit square mile. Typical values are about 0.1 mgd.

Surface Water Supplies
An inventory of the regional water resources was completed to evaluate potential future sources. Table 6-5 presents this inventory. Table 6-6 provides a summary of those sources that may provide regionally significant supplies.

TABLE 6-4
Average Monthly and Annual Precipitation

	Thames River Basin at Norwich (1931-60)		Thames River Basin at Mouth (1931-60)		SCRPA (1931-60)	
Month	**Precipitation**	**Runoff**	**Precipitation**	**Runoff**	**Precipitation**	**Runoff**
October	3.25	1.00	3.31	1.01	3.65	1.08
November	4.17	1.68	4.24	1.69	4.71	1.75
December	3.59	2.18	3.67	2.22	4.19	2.51
January	3.60	2.47	3.68	2.53	4.31	3.01
February	2.99	2.31	3.03	2.39	3.50	3.05
March	4.59	4.15	4.55	4.22	4.53	4.80
April	4.04	3.88	4.05	3.87	4.17	3.85
May	3.57	2.36	3.60	2.34	3.74	2.23
June	3.76	1.45	3.70	1.42	3.28	1.19
July	3.78	0.89	3.79	0.87	3.75	0.77
August	4.42	0.84	4.40	0.82	4.32	0.68
September	4.08	1.02	4.10	1.02	4.06	0.99
Annual	**45.84**	**24.23**	**46.12**	**24.40**	**48.21**	**25.91**

Note: All units are inches.

TABLE 6-5
Inventory of Potential Regionally Significant Surface Water Supplies
Southeast Connecticut WSMA

Major Basin	Regional Basin	Drainage Basin ID	Subregional Basin	Drainage Basin Area (mi^2)	Approx. 7Q10 (cfs)	Approx. 7Q10 (mgd)	Surface Water Class A or AA?	Consider Surface Supply Further?	Reason for No Longer Considering	Mean Flow Rate (cfs)	Mean Annual Daily Yield (MGD)	Approx. Base Flow (cfs)	Approx. Percent Stratified Drift	NDDB Areas in Basin?
Thames	Willimantic	3100	Willimantic River	225.50	32.02	20.69	N	N	WQ	405.9	263.8	56.4	20%	N
		3107	**Burnap Brook**	**7.31**	**3.93**	**2.54**	Y	Y	*	**13.2**	**8.6**	**1.8**	**80%**	N
		3108	Hop River	79.77	9.22	5.96	N	N	WQ	143.6	93.3	19.9	16%	N
		3109	Giffords Brook	5.91	0.06	0.04	Y	N	Flow	10.6	6.9	1.5	0%	N
		3110	Tenmile River	16.98	1.07	0.69	N	N	Flow/WQ	30.6	19.9	4.2	8%	N
	Moosup	3503	Ekonk Brook	5.33	0.05	0.03	Y	N	Flow	9.6	6.2	1.3	0%	N
	Pachaug	3600	Pachaug River	63.00	6.87	4.44	N	N	WQ	113.4	73.7	15.8	15%	Y
		3601	Great Meadow Brook	6.31	1.02	0.66	Y	N	Flow	11.4	7.4	1.6	23%	Y
		3602	Mount Misery Brook	8.53	1.61	1.04	Y	N	Flow	15.4	10.0	2.1	27%	Y
		3603	Denison Brook	4.02	1.63	1.05	Y	N	Flow	7.2	4.7	1.0	60%	N
		3604	Myron Kinney Brook	6.09	1.51	0.97	Y	N	Flow	11.0	7.1	1.5	36%	Y
		3605	Billings Brook	5.92	1.70	1.10	Y	N	Flow	10.7	6.9	1.5	42%	Y
	Quinebaug	3700	Quinebaug River	739.11	153.73	99.34	N	N	WQ	1330.4	864.8	184.8	30%	Y
		3713	**Mill Brook**	**17.80**	**3.94**	**2.54**	Y	Y	*	**32.0**	**20.8**	**4.5**	**32%**	N
		3715	Cory Brook	7.78	1.05	0.68	N	N	Flow/WQ	14.0	9.1	1.9	19%	N
		3716	Broad Brook	16.37	2.54	1.64	Y	N	*	29.5	19.2	4.1	22%	N
		3717	Choate Brook	5.16	0.46	0.30	Y	N	Flow	9.3	6.0	1.3	12%	Y
	Shetucket	3800	Shetucket River	1,265.38	137.93	89.13	N	N	WQ	2277.7	1480.5	316.3	15%	Y
		3804	Beaver Brook	11.33	1.91	1.23	Y	N	*	20.4	13.3	2.8	24%	Y
		3805	Little River	43.28	5.86	3.79	N	N	WQ	77.9	50.6	10.8	19%	N
	Yantic	3900	Yantic River	97.81	14.53	9.39	N	N	WQ	176.1	114.4	24.5	21%	N
		3901	Exeter Brook	5.55	0.94	0.60	Y	N	Flow	10.0	6.5	1.4	24%	N
		3902	Bartlett Brook	14.86	1.13	0.73	N	N	Flow	26.7	17.4	3.7	10%	N
		3903	**Sherman Brook**	**23.04**	**12.40**	**8.01**	Y	Y	*	**41.5**	**27.0**	**5.8**	**80%**	N
		3904	Deep River	31.90	6.00	3.88	Y	N	Utilized	57.4	37.3	8.0	27%	N
		3905	Pease Brook	12.31	1.10	0.71	Y	N	Flow	22.2	14.4	3.1	12%	N
		3906	Gardner Brook	13.84	2.97	1.92	Y	N	*	24.9	16.2	3.5	31%	N
		3907	Susquetonscut Brook	15.35	2.08	1.34	N	N	WQ	27.6	18.0	3.8	19%	Y

TABLE 6-5
Inventory of Potential Regionally Significant Surface Water Supplies
Southeast Connecticut WSMA

Major Basin	Regional Basin	Drainage Basin ID	Subregional Basin	Drainage Basin Area (mi^2)	Approx. 7Q10 (cfs)	Approx. 7Q10 (mgd)	Surface Water Class A or AA?	Consider Surface Supply Further?	Reason for No Longer Considering	Mean Flow Rate (cfs)	Mean Annual Daily Yield (MGD)	Approx. Base Flow (cfs)	Approx. Percent Stratified Drift	NDDB Areas in Basin?
Connecticut	CT Main Stem	4000	Connecticut River	11,267.26	856.31	553.35	N	N	WQ	20281.1	13182.7	2816.8	10%	Y
		4008	Cold Brook	7.48	1.11	0.72	Y	N	Flow	13.5	8.8	1.9	21%	N
		4011	Reservoir Brook	6.98	0.76	0.49	Y	N	Flow	12.6	8.2	1.7	15%	N
		4012	Carr Brook	6.77	0.83	0.53	Y	N	Flow	12.2	7.9	1.7	17%	N
		4016	Whalebone Creek	14.63	1.30	0.84	Y	N	Flow	26.3	17.1	3.7	12%	Y
		4020	Lieutenant River	12.14	2.45	1.58	N	N	WQ	21.9	14.2	3.0	29%	Y
		4021	Black Hall River	5.52	1.51	0.98	N	N	Flow/WQ	9.9	6.5	1.4	40%	Y
	Salmon	4700	Salmon River	148.98	11.32	7.32	N	N	WQ	268.2	174.3	37.2	10%	Y
		4701	Raymond Brook	9.05	0.69	0.44	Y	N	Flow	16.3	10.6	2.3	10%	N
		4702	Judd Brook	5.11	1.43	0.93	Y	N	Flow	9.2	6.0	1.3	41%	N
		4703	Meadow Brook	11.12	2.46	1.59	Y	N	Flow	20.0	13.0	2.8	32%	Y
		4705	**Jeremy River**	**43.17**	**6.13**	**3.96**	**N**	**Y**	**WQ**	**77.7**	**50.5**	**10.8**	**20%**	**Y**
		4706	Fawn Brook	12.80	0.97	0.63	Y	N	Flow	23.0	15.0	3.2	10%	Y
		4707	Blackledge River	38.87	2.95	1.91	N	N	WQ	70.0	45.5	9.7	10%	Y
		4708	Dickinson Creek	15.02	0.84	0.55	N	N	Flow/WQ	27.0	17.6	3.8	7%	Y
		4709	Pine Brook	15.27	1.06	0.68	N	N	Flow/WQ	27.5	17.9	3.8	9%	Y
		4710	Moodus River	17.61	1.80	1.17	N	N	WQ	31.7	20.6	4.4	14%	Y
	Eightmile	4800	Eightmile River	62.40	8.04	5.19	N	N	WQ	112.3	73.0	15.6	18%	Y
		4801	Harris Brook	6.16	0.59	0.38	Y	N	Flow	11.1	7.2	1.5	13%	N
		4802	E.Branch Eightmile River	22.53	2.60	1.68	N	N	WQ	40.6	26.4	5.6	16%	Y

Notes: * = Source is considered further based on watershed area and projected low flows.

TABLE 6-6
Summary of Regionally Significant Potential Surface Water Supplies
Southeast Connecticut WSMA

Drainage Basin ID	Major Basin	Regional Basin	Subregional Basin	Drainage Basin Area (mi²)	Approx. 7Q10 (cfs)	Approx. 7Q10 (mgd)	Mean Flow Rate (cfs)	Mean Annual Daily Yield (mgd)	Approx. Base Flow (cfs)	Approx. Percent Stratified Drift	Poteintial Reservoir Yield (mgd)	Potential Run of River Yield (mgd)	NDDB Areas in Basin?
4705	Connecticut	Salmon	Jeremy River	43.17	6.13	3.96	77.7	50.5	10.8	20%	17.27	2.16	Y
1003	Pawcatuck	Pawcatuck Main Stem	Ashaway River	27.72	4.67	3.02	49.9	32.4	6.9	24%	11.09	1.39	Y
3903	Thames	Yantic	Shennan Brook	23.04	12.40	8.01	41.5	27.0	5.8	80%	9.22	1.15	N
1002	Pawcatuck	Pawcatuck Main Stem	Green Fall River	22.58	4.40	2.84	40.6	26.4	5.6	28%	9.03	1.13	Y
3713	Thames	Quinebaug	Mill Brook	17.80	3.94	2.54	32.0	20.8	4.5	32%	7.12	0.89	N
2202	SE Coast	SE Eastern Complex	Latimer Brook	17.74	2.28	1.48	31.9	20.8	4.4	18%	7.10	0.89	Y
1004	Pawcatuck	Pawcatuck Main Stem	Shunock River	16.55	3.11	2.01	29.8	19.4	4.1	27%	6.62	0.83	Y
3716	Thames	Quinebaug	Broad Brook	16.37	2.54	1.64	29.5	19.2	4.1	22%	6.55	0.82	N
2107	Southeast Coast	SE Eastern Complex	Poquonock Brook	15.66	4.81	3.11	28.2	18.3	3.9	45%	6.26	0.78	Y
3002	Thames	Thames Main Stem	Shewville Brook	14.46	2.15	1.39	26.0	16.9	3.6	21%	5.78	0.72	Y
3906	Thames	Yantic	Gardner Brook	13.84	2.97	1.92	24.9	16.2	3.5	31%	5.54	0.69	N
3006	Thames	Thames Main Stem	Hunts Brook	13.08	1.43	0.92	23.5	15.3	3.3	15%	5.23	0.65	Y
1001	Pawcatuck	Pawcatuck Main Stem	Wyassup Brook	11.47	3.90	2.52	20.6	13.4	2.9	50%	4.59	0.57	Y
3804	Thames	Shetucket	Beaver Brook	11.33	1.91	1.23	20.4	13.3	2.8	24%	4.53	0.57	Y
2205	Southeast Coast	SE Eastern Complex	Pataguanset River	8.85	3.13	2.02	15.9	10.4	2.2	52%	3.54	0.44	Y
3107	Thames	Willimantic	Burnap Brook	7.31	3.93	2.54	13.2	8.6	1.8	80%	2.92	0.37	N

Note: All referenced watercourses are Class A.

The following is a summary of criteria and assumptions used to screen potential surface water resources:

1. The following is a summary of criteria and assumptions used to screen potential surface water resources. Regional surface water sources should provide a dependable safe yield of at least 1.0 million gallons per day.

2. The U.S. Fish and Wildlife Service requires maintenance of an aquatic base flow of 0.5 cubic feet per second per square mile of watershed. The Department of Environmental Protection Fisheries Division often uses this criteria when considering the potential impacts associated with proposed diversions.

3. A net reservoir yield of 0.4 mgd per square mile of watershed is typically obtainable, indicating a minimum watershed size of five square miles is necessary to obtain a yield of 2.0 mgd.

4. An approximate rule-of-thumb for safe yield of run-of-the-river withdrawals is 0.05 mgd per square mile of contributing drainage basin. The use of a direct intake, without reservoir storage, would therefore require a watershed area of 20 square miles to produce 1.0 mgd of dependable yield.

5. Heavily urbanized areas and areas with water quality classifications other than A or AA cannot be developed as new sources under current state statute 22a-417.

6. Water supply withdrawals from watercourses are difficult to permit if significant downstream environmental or social impacts would result. Feasibility of new source development depends on potential impacts to fisheries, swimming, boating, rare or endangered species, industrial water users, irrigation users, other water supply users, scenic and other environmental resources.

7. Larger rivers are not available for potable water supply due to their water quality classification, existing competing water uses, and regulatory requirements. However, many of them could be used for non-potable water supplies.

8. The Connecticut River and the Thames River are the two major watercourses in the southeast region, but neither is available for potable water supply. Both have variable levels of salinity and receive treated wastewater effluent.

9. All or a portion of the Pawcatuck, Pachaug, Quinebaug, Willimantic, Shetucket, and Yantic Rivers receive treated wastewater effluent and are designated by DEP as Class B waters. Existing state statute prohibits their development as potable surface water supply sources.

The Connecticut Department of Environmental Protection has prepared a list of impaired water bodies as required by the Clean Water Act, Section 303 (1998). It identifies water bodies that do not meet water quality standards and would not be suitable for surface water supply. Table 6-7 provides a listing of impacted water bodies within the project area. It does not include coastal waters.

TABLE 6-7
Water Quality Impaired Waters of Southeast Connecticut

Water Body	Town
Seth Williams Brook	Ledyard
Copps Brook	Stonington
Bride Brook	East Lyme
Dodge Pond	East Lyme
Amos Lake	Preston
Oxoboxo Brook	Montville
Pachaug River	Jewett City
Great Meadow Brook	Voluntown
Quinebaug River	Jewett City, Norwich
Aspenook Pond	Jewett City
Hopeville Pond	Griswold
Yantic River	Norwich
Kahn Brook	Bozrah
Red Cedar Lake	Lebanon

Permit Considerations

The modern environmental movement began around 1970 with passage of a number of State and federal regulatory programs. The Connecticut Water Pollution Control Act (1968), National Environmental Policy Act (1970), federal Safe Drinking Water Act

(1974), federal Clean Water Act (1972), and subsequent amendments, and parallel State programs provide the basis of water resource regulation and management.

The 1982 Diversion Act authorizes Connecticut DEP to regulate the withdrawal of water in excess of 50,000 gallons per day from surface and ground sources. There are approximately 1,800 "grandfathered" registered diversions that existed prior to 1982, and more than 350 diversion permits have been issued for new diversions. The Diversion Act requires DEP to consider the impact of a project based on potential impacts to streamflow rates, aquatic systems, recreation, fish habitat and boating. They also consider alternative actions such as water conservation and inter-system water purchases.

Section 404 of the Federal Water Pollution Control Act authorizes the USEPA and US Army Corps of Engineers to regulate discharges to the waters of the United States, including most watercourses and wetlands. The construction of dams and reservoirs are regulated because they usually result in the filling or submergence of wetlands. The Corps has denied permits for several major water supply reservoir projects due to potential environmental impacts.

The prospects of receiving regulatory permits for new or enlarged reservoirs depend greatly upon their environmental impact and the availability of alternatives. Projects that would require filling wetlands for dams, that inundate large wetland areas, or that harm downstream areas by diminishing stream flow, will have difficulty in being approved.

Low flow stream releases are often required for new diversions for the purpose of maintaining sufficient downstream habitat and supporting downstream uses. These requirements reduce the percentage of the watershed runoff that is available for water supply. Consequently, substantial water supply yields can only be expected from relatively large watersheds.

It is possible that raising dam elevations, dredging, diverting Class A non-tributary streams laterally to reservoirs, and pumping well water into reservoirs to enhance refill could augment existing reservoirs. These types of augmentation would require regulatory approvals, but may result in less impact as compared to development of new supplies, thereby making them preferable.

6.5 Inventory of Groundwater Supplies

Groundwater supplies are generally more economical to develop as compared to surface water supply reservoirs. Groundwater does not typically require complete conventional treatment and the management of large land areas is not generally required. Aquifers that are highly connected to surface waters are said to be "under the influence" of surface water and require similar treatment. This may arise when high volume wells are placed in high permeability soils close to stream channels.

Groundwater Hydrogeology

The potential yield of groundwater supplies varies depending on geologic conditions and recharge opportunities. Short-term withdrawals are often available from water stored within the geologic formations, while long term withdrawals are dependent on recharge rates. Groundwater aquifers in Connecticut include bedrock, glacial till soils, and stratified drift sediment deposits. Bedrock and glacial till aquifers are widespread through the region and provide water for many rural areas. However, they have limited yields that are often less than 10 gallons per minute per well. Higher yielding wells are almost always dependent on saturated stratified drift soil deposits.

Stratified drift consists of strata or layers and lenses of water-washed and water-laid gravel, sand, silt, and clay carried by meltwater from glacial ice. Saturated stratified drift deposits of sand and gravel temporarily store water in the voids between particles. They have an irregular distribution and variable yields.

Despite the wide size range of its component particles, stratified drift can be divided on a hydrologic basis into two water-bearing units: (1) a coarse-grained unit capable of yielding large quantities of water (e.g., up to several hundred gpm) to individual wells; and (2) a fine-grained unit capable of yielding only small quantities of water (generally less than 20 gpm) to single wells. Subdivision of the stratified drift units is based on surficial mapping, on published surficial maps, and on subsurface information from drillers' logs of wells and test holes (USGS, 1968).

Stratified drift is the most productive type of aquifer in the southeast region and is the only type ordinarily capable of yielding more than 100 gpm on a sustained pumping basis. In most places, it is underlain by till, but in some instances the till is absent and stratified drift is underlain by bedrock. Well yield in stratified drift aquifers is dependent on the recharge area and the ability to induce infiltration from surface waters. The stratified drift aquifers of southeastern Connecticut are generally narrow deposits placed in river valleys by glacial melt water, with limited modern sediment deposits. Most of these aquifers can provide short-term water quantities based on stored water and local recharge, but depend upon streambed infiltration for larger and long-term yields.

The Connecticut DEP has prepared a statewide groundwater availability map entitled "Groundwater Yields for Selected Stratified Drift Areas in Connecticut" that identifies potential and confirmed aquifers. The larger coarse grain aquifers are located along the lower Yantic River, Trading Cove Brook, Pachaug Pond and River, Middle Quinebaug River, Eightmile River, and Whitford Brook. The USGS Regional Water Resource Inventory indicates many coastal aquifers, including those along the Thames and Mystic Rivers, are prone to salt water intrusion if heavily pumped for withdrawals.

The western part of the region has limited aquifer resources. Stratified drift deposits are less extensive and are generally associated with smaller streams. Hebron, Marlborough, Colchester, and East Haddam do not possess aquifers with regional supply potential. Cobalt Landing in East Hampton is one aquifer in this area with the potential to yield a regionally significant groundwater source.

Potential Groundwater Aquifer Sites

Table 6-8 presents the inventory of groundwater aquifers in the southeast region. These areas were evaluated based upon estimated aquifer yields, nearby stream flow rates (particularly 7Q10 – the lowest streamflow that statistically occurs once every ten years over a period of seven days), and water quality. The 19 aquifers that were determined to be potential regional supply sources are summarized in Table 6-9.

TABLE 6-8

Inventory of Regionally Significant Potential Ground Water Supplies
Southeast Connecticut WSMA

Major Basin	Regional Basin	Drainage Basin ID	Subregional Basin	Drainage Basin Area (mi^2)	Approx. Percent Stratified Drift	Approx. 7Q10 (cfs)	Significant Saturated Stratified Drift Deposits	USGS Estimated Yield (MGD)	Consider GW Supply Further?	Reason for No Longer Considering	NDDB Areas in Basin?
Pawcatuck	Pawcatuck Main Stem	**1000**	**Pawcatuck River**	305.22	25%	53.41	Y	7.2	Y	*	Y
		1001	**Wyassup Brook**	11.47	50%	3.90	Y	Not Estimated	Y	*	Y
		1002	Green Fall River	22.58	28%	4.40	Y	0.7	N	Low 7Q10	Y
		1003	Ashaway River	27.72	24%	4.67	Y	Not Estimated	N	Low 7Q10	Y
		1004	**Shunock River**	16.55	27%	3.11	Y	1.3-3.1	Y	*	Y
	Wood	1100	Wood River	9.09	5%	0.39	N	N/A	N	Low SD&7Q10	Y
		1101	Brushy Brook	13.12	0%	0.13	N	N/A	N	Low SD&7Q10	Y
SE Coast	Southeast Shoreline	2000	Southeast Shoreline	42.68	15%	4.65	N	N/A	N	Low 7Q10	Y
	SE Eastern Complex	**2101**	**Anguilla Brook**	12.33	35%	2.97	Y	2.5-2.9	Y	*	Y
		2102	Copps Brook	7.54	14%	0.77	N	N/A	N	Low SD&7Q10	Y
		2103	**Williams Brook**	6.19	20%	0.88	Y	1.4	Y	*	Y
		2104	**Whitford Brook**	15.12	34%	3.54	Y	1.4	Y	*	Y
		2105	Haleys Brook	7.56	22%	1.17	Y	Not Estimated	N	Low 7Q10	Y
		2106	Mystic River	26.85	32%	5.94	Y	Not Estimated	N	Water Quality	Y
		2107	Poquonock River	15.66	45%	4.81	Y	Not Estimated	N	Utilized	Y
		2201	Jordan Brook	7.57	28%	1.47	Y	0.7	N	Low Yield/7Q10	Y
		2202	Latimer Brook	17.74	18%	2.28	N	0.3	N	Low Yield/7Q10	Y
		2203	Oil Mill Brook	5.21	32%	1.15	Y	Not Estimated	N	Low 7Q10	N
		2204	**Niantic River**	30.24	30%	6.29	Y	0.3	Y	*	N
		2205	**Pattagansett River**	8.85	52%	3.13	Y	2.6	Y	*	Y
		2206	Bride Brook	4.99	58%	1.96	Y	0.9	N	Low Yield/7Q10	Y
		2207	Fourmile River	6.56	34%	1.54	Y	0.9	N	Low Yield/7Q10	Y
Thames	Thames Main Stem	3000	Thames River	1,463.63	15%	159.54	N	N/A	N	Water Quality	Y
		3001	**Trading Cove Brook**	13.79	32%	3.05	Y	1.9	Y	*	Y
		3002	Shewville Brook	14.46	21%	2.15	Y	Not Estimated	N	Low 7Q10	Y
		3003	Poquetanuck Brook	28.41	25%	4.97	Y	Not Estimated	N	Low 7Q10	Y
		3004	**Oxoboxo Brook**	12.10	38%	3.16	Y	0.3-2.9	N	*	Y
		3005	Stony Brook	22.04	10%	1.68	N	N/A	N	Utilized	Y
		3006	Hunts Brook	13.08	15%	1.43	N	N/A	N	Low 7Q10	Y
	Willimantic	3100	Willimantic River	225.50	20%	32.02	Y	0.9-3.5	N	*	N
		3107	**Burnap Brook**	7.31	80%	3.93	Y	Not Estimated	Y	*	N
		3108	Hop River	79.77	16%	9.22	N	N/A	N	Low Yield	N
		3109	Giffords Brook	5.91	0%	0.06	N	N/A	N	Low SD&7Q10	N
		3110	Tenmile River	16.98	8%	1.07	N	N/A	N	Low SD&7Q10	N
	Moosup	3503	Ekonk Brook	5.33	0%	0.05	N	N/A	N	Low SD&7Q10	N

TABLE 6-8
Inventory of Regionally Significant Potential Ground Water Supplies
Southeast Connecticut WSMA

Major Basin	Regional Basin	Drainage Basin ID	Subregional Basin	Drainage Basin Area (mi²)	Approx. Percent Stratified Drift	Approx. 7Q10 (cfs)	Significant Saturated Stratified Drift Deposits	USGS Estimated Yield (MGD)	Consider GW Supply Further?	Reason for No Longer Considering	NDDB Areas in Basin?
Thames	Pachaug	3600	Pachaug River	63.00	15%	6.87	N	1.4	Y	*	Y
		3601	Great Meadow Brook	6.31	23%	1.02	Y	2.8	Y	*	Y
		3602	Mount Misery Brook	8.53	27%	1.61	Y	Not Estimated	N	Low 7Q10	Y
		3603	Denison Brook	4.02	60%	1.63	Y	Not Estimated	N	Low 7Q10	N
		3604	Myron Kinney Brook	6.09	36%	1.51	Y	1.0	Y	*	Y
		3605	Billings Brook	5.92	42%	1.70	Y	3.5	Y	*	Y
	Quinebaug	3700	Quinebaug River	739.11	30%	153.73	Y	1.3-2.5	Y	*	Y
		3713	Mill Brook	17.80	32%	3.94	Y	2.3	Y	*	N
		3715	Cory Brook	7.78	19%	1.05	N	N/A	N	Low 7Q10	N
		3716	Broad Brook	16.37	22%	2.54	Y	Not Estimated	N	Low 7Q10	N
		3717	Choate Brook	5.16	12%	0.46	N	N/A	N	Low 7Q10	Y
	Shetucket	3800	Shetucket River	1,265.38	15%	137.93	N	0.3	N	Low Yield	Y
		3804	Beaver Brook	11.33	24%	1.91	Y	Not Estimated	N	Low 7Q10	Y
		3805	Little River	43.28	19%	5.86	N	0.3	N	Low Yield	N
	Yantic	3900	Yantic River	97.81	21%	14.53	Y	4.9	Y	*	N
		3901	Exeter Brook	5.55	24%	0.94	Y	Not Estimated	N	Low 7Q10	N
		3902	Bartlett Brook	14.86	10%	1.13	N	0.9	N	Low Yield/7Q10	N
		3903	Sherman Brook	23.04	80%	12.40	Y	Not Estimated	Y	*	N
		3904	Deep River	31.90	27%	6.00	Y	Not Estimated	N	Utilized	N
		3905	Pease Brook	12.31	12%	1.10	N	N/A	N	Low 7Q10	N
		3906	Gardner Brook	13.84	31%	2.97	Y	2.9	N	*	N
		3907	Susquetonscut Brook	15.35	19%	2.08	N	4.9	N	*	Y
Connecticut	CT Main Stem	4000	Connecticut River	11,267.26	10%	856.31	N	4.3	Y	*	Y
		4008	Cold Brook	7.48	21%	1.11	Y	Not Estimated	N	Low 7Q10	N
		4011	Reservoir Brook	6.98	15%	0.76	N	N/A	N	Low 7Q10	N
		4012	Carr Brook	6.77	17%	0.83	N	N/A	N	Low 7Q10	N
		4016	Whalebone Creek	14.63	12%	1.30	N	N/A	N	Low 7Q10	Y
		4020	Lieutenant River	12.14	29%	2.45	Y	0.8	N	Low Yield/WQ	Y
		4021	Black Hall River	5.52	40%	1.51	Y	Not Estimated	N	Low 7Q10	Y

TABLE 6-8
Inventory of Regionally Significant Potential Ground Water Supplies
Southeast Connecticut WSMA

Major Basin	Regional Basin	Drainage Basin ID	Subregional Basin	Drainage Basin Area (mi^2)	Approx. Percent Stratified Drift	Approx. 7Q10 (cfs)	Significant Saturated Stratified Drift Deposits	USGS Estimated Yield (MGD)	Consider GW Supply Further?	Reason for No Longer Considering	NDDB Areas in Basin?
Connecticut	Salmon	**4700**	**Salmon River**	**148.98**	**10%**	**11.32**	**N**	**Not Estimated**	**Y**	*	**Y**
		4701	Raymond Brook	9.05	10%	0.69	N	N/A	N	Low 7Q10	N
		4702	Judd Brook	5.11	41%	1.43	Y	Not Estimated	N	Low 7Q10	N
		4703	Meadow Brook	11.12	32%	2.46	Y	Not Estimated	N	Low 7Q10	Y
		4705	Jeremy River	43.17	20%	6.13	Y	Not Estimated	N	*	Y
		4706	Fawn Brook	12.80	10%	0.97	N	N/A	N	Low 7Q10	Y
		4707	Blackledge River	38.87	10%	2.95	N	N/A	N	Low 7Q10	Y
		4708	Dickinson Creek	15.02	7%	0.84	N	N/A	N	Low SD&7Q10	Y
		4709	Pine Brook	15.27	9%	1.06	N	N/A	N	Low SD&7Q10	Y
		4710	Moodus River	17.61	14%	1.80	N	N/A	N	Low 7Q10	Y
	Eightmile	**4800**	**Eightmile River**	**62.40**	**18%**	**8.04**	**N**	**0.5 - 1.2**	**Y**	*	**Y**
		4801	Harris Brook	6.16	13%	0.59	N	N/A	N	Low 7Q10	N
		4802	**East Branch Eightmile River**	**22.53**	**16%**	**2.60**	**N**	**0.4 - 1.2**	**Y**	*	**Y**

Notes: * = Source is considered further based on watershed area and projected low flows.
All referenced aquifers are Class A.
Stratified drift deposits are considered significant if they underlie 20% of the watersehd area or more.

TABLE 6-9

Summary of Potential Regionally Significant Ground Water Supplies

Southeast Connecticut WSMA

Drainage Basin ID	Major Basin	Regional Basin	Subregional Basin	Drainage Basin Area (mi^2)	Approx. Percent Stratified Drift	Approx. 7Q10 (cfs)	Significant Saturated Stratified Drift Deposits	USGS Estimated Yield (MGD)	NDDB Areas in Basin?
1000	Pawcatuck	Pawcatuck Main Stem	Pawcatuck River	305.22	25%	53.41	Y	7.2	Y
3900	Thames	Yantic	Yantic River	97.81	21%	14.53	Y	4.9	N
4000	Connecticut	Connecticut Main Stem	Connecticut River	11,267.26	10%	856.31	N	4.3	Y
3605	Thames	Pachaug	Billings Brook	5.92	42%	1.70	Y	3.5	Y
3004	Thames	Thames Main Stem	Oxoboxo River	12.10	38%	3.16	Y	2.9	Y
3601	Thames	Pachaug	Great Meadow Brook	6.31	23%	1.02	Y	2.8	Y
2205	Southeast Coast	SE Eastern Complex	Pataguansett River	8.85	52%	3.13	Y	2.6	Y
2101	Southeast Coast	SE Eastern Complex	Anguilla Brook	12.33	35%	2.97	Y	2.5-2.9	Y
3713	Thames	Quinebaug	Mill Brook	17.80	32%	3.94	Y	2.3	N
3100	Thames	Willimantic	Willimantic River	225.50	20%	32.02	Y	2.2	N
3001	Thames	Thames Main Stem	Trading Cove Brook	13.79	32%	3.05	Y	1.9	Y
3600	Thames	Pachaug	Pachaug River	63.00	15%	6.87	Y	1.4	Y
2104	Southeast Coast	SE Eastern Complex	Whitford Brook	15.12	34%	3.54	Y	1.4	Y
2103	Southeast Coast	SE Eastern Complex	Williams Brook	6.19	20%	0.88	Y	1.4	Y
1004	Pawcatuck	Pawcatuck Main Stem	Shunock River	16.55	27%	3.11	Y	1.3-3.1	Y
3700	Thames	Quinebaug	Quinebaug River	739.11	30%	153.73	Y	1.3-2.5	Y
3604	Thames	Pachaug	Myron Kinney Brook	6.09	36%	1.51	Y	1.0	Y
4800	Connecticut	Eightmile	Eightmile River	62.40	18%	8.04	Y	0.5 - 1.2	Y
4802	Connecticut	Eightmile	East Branch Eightmile River	22.53	16%	2.60	Y	0.4 - 1.2	Y

Note: All referenced aquifers are Class A.

Table 6-10 lists watersheds that may have the potential to provide regionally significant groundwater sources, but do not currently have enough information available to fully assess. Among these supplies are the coastal groundwater aquifer of the Niantic River. The Department of Environmental Protection has indicated that instream flow concerns in aquifers adjacent to tidal rivers, such as the Niantic River, would be less of an issue as compared to many of the inland streams.

TABLE 6-10

Potential Groundwater Supply Sources that Warrant Further Investigation

Drainage Basin ID	Major Basin	Regional Basin	Subregional Basin	Drainage Basin Area (mi^2)	% Stratified Drift	Estimated 7Q10 (cfs)
1001	Pawcatuck	Pawcatuck Main Stem	Wyassup Brook	11.47	50	3.93
2204	Southeast Coast	SE Eastern Complex	Niantic River	30.24	30	6.29
3107	Thames	Willimantic	Burnap Brook	7.31	80	3.93
3903	Thames	Yantic	Sherman Brook	23.04	80	12.40
4700	Connecticut	Salmon	Salmon River	148.98	10	11.32

Note: The well yields of these aquifers have not been estimated. However, these sources warrant investigation based on watershed size and the area of stratified drift.

In addition to these sources, the [redacted] and [redacted] were considered for their ability to support a regionally significant water supply. [redacted]s located within the Reservoir Brook subregional basin (Basin 4011) and has a [redacted]. [redacted]r is located within the Cold Brook subregional basin (Basin 4008) and has a reported yield of 1.0 mgd. This surface water body has been impacted by development in the watershed and has suffered from sediment accumulation in recent years. The [redacted]n owns this reservoir.

6.6 Investigation of Potential Regionally Significant Surface and Groundwater Supplies

Each of the potential future sources listed in Tables 6-6 and 6-9 was investigated in more detail to further assess the feasibility of source development. The results of this investigation are presented in the ensuing text, beginning with surface waters, followed by groundwaters. The sources are presented in order based on its estimated yield. Each source was evaluated based on water quality, land use, conflicting water uses and areas of environmental concern. The DEP Natural Diversity Database (NDDB) mapping dated July 2000 was reviewed to assess areas of known environmental concern. Figure 6-1 is a location key of these potential sources.

6.6.1 Jeremy River (Basin 4705)

Jeremy River is located within the Salmon River Regional basin and includes areas within Hebron and Colchester. Following is a summary of characteristics of this basin:

- Watershed area: 43.17 square mile
- Stratified drift: 20%
- 7Q10 flow rate: 6.13 cfs (3.96 mgd)
- Mean annual flow rate: 77.7 cfs
- Mean annual yield: 50.5 mgd.
- Estimated reservoir yield: 17.27 mgd
- Estimated run-of-river yield: 2.16 mgd

Existing Diversions

The only registered or permitted diversion within the Jeremy River watershed is a 0.07 mgd withdrawal by the Connecticut Department of Environmental Protection for fisheries purposes. The Colchester Department of Public Works is currently pursuing diversion permits for its Cabin Brook wellfield located in this watershed.

DEP Fisheries has identified the confluence of the Jeremy River and Blackledge River as one of the "most significant fishery resources in Eastern Connecticut" (Brian Murphy, memo 11/22/00). The Salmon River regional basin has been the major focus of the Connecticut River Atlantic Salmon Restoration Project. Jeremy River supports habitat for wild trout and Atlantic Salmon.

Existing Land Uses / Land Use Compatibility

The majority of the Jeremy River watershed is rural in nature. Land use consists largely of single family residential development with some limited commercial areas in the center of Hebron. The Salmon River State Forest makes up a portion of the watershed at its downstream end. Any future surface water supply should be located as far downstream as possible within the watershed to maximize the contributing watershed and thus yield.

Aquifer protection regulations are in place in Colchester to protect this potential water supply. The confluence of the Jeremy River and the Blackledge River forms the Salmon River and is an important fisheries resource. As such, this area has been afforded protection from DEP to prevent incompatible land development within the watershed. The area is within the Salmon River State Forest.

Conclusion

The Jeremy River watershed may be a feasible location for the development of a future supply source. As part of the Salmon River regional basin, Jeremy River is the subject of fisheries restoration projects and impacts to fisheries would need to be assessed before a regional water supply source could be developed. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.1 of this document.

6.6.2 Ashaway River (Basin 1003)

The Ashaway River is located within the Pawcatuck Main Stem Regional basin. The majority of the watershed is located within the state of Rhode Island. However, a small portion of the watershed is located in North Stonington, Connecticut. The following is a summary of information regarding this watershed:

- Watershed area: 27.72 square miles
- Stratified drift: 24%
- 7Q10 flow rate: 4.67 cfs (3.02 mgd)
- Mean annual flow rate: 49.9 cfs (32.4 mgd)

- Estimated reservoir yield: 11.09 mgd
- Estimated run-of-river yield: 1.39 mgd

Existing Diversions

There are no existing registered or permitted diversions on file at DEP for this watershed.

Existing Land Uses / Land Use Compatibility

Outlying portions of this watershed are rural and consist mainly of residential development. Interstate 95 divides the watershed along an east/west axis, with the area north of the Interstate being largely undeveloped and areas to the south consisting of the commercial development associated with the Town of Ashaway, Rhode Island. The relatively high density development in the lower reaches of the watershed would likely prevent the use of this area for development of a surface water reservoir. While land use in the upper watershed may be amenable to the development of a surface water source, the size of the contributing watershed is significantly smaller, resulting in a lower potential yield.

This watershed is highly developed through its downstream areas. The majority of the watershed is located within Rhode Island and it is not clear if resource protection regulations exist.

Conclusion

The upper Ashaway River watershed in North Stonington may have some potential as a surface water supply. Basin size and potential location need to be considered further. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.2 of this document.

6.6.3 Sherman Brook (Basin 3903)

Sherman Brook is located within the Yantic River Regional Basin. The watershed is located within the towns of Colchester and Lebanon. The following is a summary of information regarding this watershed:

- Watershed area: 23.04 square miles
- Stratified drift: 80%
- 7Q10 flow rate: 12.40 cfs (8.01 mgd)
- Mean annual flow rate: 41.5 cfs
- Estimated reservoir yield: 9.22 mgd
- Estimated run-of-river yield: 1.15 mgd

Existing Diversions

One diversion permit has been issued for activities within the Sherman Brook watershed. The Harbor Pond Road diversion is located in the Town of Colchester and was issued for a site development project. This is not a consumptive use diversion. The Colchester Department of Public Works is currently pursuing a diversion permit for a new low yield bedrock well located in this aquifer. Based on data provided by DEP, existing water allocations would not preclude the development of a surface water supply in the Sherman Brook watershed.

Existing Land Uses / Land Use Compatibility

The watershed is rural in nature, with residential development being the most common land use. Route 2 passes through the watershed on an east/west axis, potentially impacting water quality in the lower basin. The location of Route 2 and its interchanges has also promoted the development in the areas along the highway corridor.

A 200-acre industrially zoned area exists in Colchester ½-mile west (upgradient) of a potential wellfield. An aquifer protection zone has not yet been designated. The development of inappropriate industrial activities (e.g., those involving hazardous materials, underground storage tanks, etc.) may threaten the aquifer quality. An existing mixed waste landfill near Exeter could also affect aquifer quality. The potential exists for additional development in this area that may affect water quality.

Conclusion

The Sherman Brook watershed may be a feasible location for the development of a regional supply source. However, water quality concerns associated with the location of

Route 2 could limit water supply source development to the upper watershed. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.3 of this document.

6.6.4 Green Fall River (Basin 1002)

The Green Fall River watershed is located within the Pawcatuck River Main Stem Regional Basin and the Pawcatuck Major Basin. The Green Fall River watershed extends from the Pachaug State Forest in Voluntown south to the Clarks Falls area of North Stonington. The following is a summary of information regarding this watershed:

- Watershed area: 22.58 square miles
- Stratified drift: 28%
- 7Q10 flow rate: 4.40 cfs (2.84mgd)
- Mean annual flow rate: 40.6 cfs
- Estimated reservoir yield: 9.03 mgd
- Estimated run-of-river yield: 1.13 mgd

Existing Diversions

There are no existing registered or permitted diversions on file at DEP for this watershed.

Existing Land Uses / Land Use Compatibility

Land use in the watershed is rural, with much of the northern watershed dedicated to state forestland. Overall land use in this watershed is low density, with limited commercial and industrial development.

An aquifer protection zone is in place in this watershed. These regulations are aimed at minimizing potential threats from agricultural uses (pesticides, manure disposal) in the upper (northern) portion and industrial and extractive activity in the lower (southern) portion.

Conclusion

The Green Fall River watershed may be a feasible source for the development of a surface water supply. Areas of environmental concern appear to be limited to the upper reaches of the watershed and there are no competing water diversions on file with DEP. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.4 of this document.

6.6.5 Mill Brook (Basin 3713)

Mill Brook is a 17.80 square mile subregional watershed within the Quinebaug River regional basin. The Mill Brook drainage basin lies within Griswold and Plainfield. The following is a summary of characteristics of this basin:

- Watershed area: 17.80 square miles
- Stratified drift: 32%
- 7Q10 flow rate: 3.94 cfs (2.54 mgd)
- Mean annual flow rate: 32.0 cfs
- Estimated reservoir yield: 7.12 mgd
- Estimated run-of-river yield: 0.89 mgd
- Estimated groundwater yield: 2.3 mgd

Existing Diversions

There is one registered diversion within the Mill Brook drainage basin for the Jewett City Water Company to divert a maximum of 1.15 mgd for public water supply at the Stone Hill Reservoir in Griswold.

Existing Land Uses / Land Use Compatibility

The upper reaches of the Mill Brook watershed consist of residential development. The Jewett City Water Company's Stone Hill Reservoir is located in this area. The lower reaches are highly developed and include portions of Plainfield and Interstate 395. Prior to discharging into the Quinebaug River, Mill Brook feeds a significant wetland area, located southwest of Plainfield Center. A sewage treatment plant discharges to this wetland area and appears, based on its location, to rely on Mill Brook for waste assimilation. The urban nature of the watershed in its lower reaches, in conjunction with the presence of the sewage treatment plant indicates this watershed would not be suitable for development of a surface water supply source.

Conclusion

The Mill Brook watershed is not considered to be a viable alternative for the development of a regionally significant water supply source. The upper basin is currently being utilized for water supply via the Stone Hill Reservoir. Land use in the lower basin is incompatible with future supply source development.

6.6.6 [redacted]

[redacted] located within the Southeastern Coast Major Basin and the Southeast Eastern Complex Regional Basin. The watershed area is located mostly within the town of East Lyme, Waterford and Montville. The following is a summary of characteristics associated with this watershed.

- Watershed area: 17.74 square miles
- Stratified drift: 18%
- 7Q10 flowrate: 2.28 cfs (1.48 mgd)
- Mean annual flow rate: 31.9 cfs
- [redacted]
- Estimated run-of-river yield: 0.89 mgd

Existing Diversions

There are a number of registered diversions from the [redacted], all of which are registered to the [redacted]. These are summarized in Table 6-11. The total volume of water permitted to be withdrawn from this watershed is [redacted]xcluding pump station diversions). Based on this information it appears that this watershed is fully allocated to th[redacted]

TABLE 6-11
Summary of Registered and Permitted Diversions in Latimer Brook Watershed

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
[redacted]			

Existing Land Uses / Land Use Compatibility
Existing land use in the Latimer Brook watershed consists of suburban residential areas in the upper portions of the watershed. In its southern reaches, the watershed includes the Flanders portion of the Town of East Lyme.

Conclusion
The Latimer Brook watershed appears to be fully allocated to the City of New London and would not be available for development of additional water supplies that would be regionally significant.

6.6.7 Shunock River (Basin 1004)

The Shunock River basin is located within the Pawcatuck Main Stem Regional Basin and the Pawcatuck Major Basin. The Shunock watershed is located mostly within the Town of North Stonington. The following is a summary of characteristics of this basin.

- Watershed area: 16.55 square miles
- Stratified drift: 27%
- 7Q10 flow rate: 3.11 cfs (2.01 mgd)
- Mean annual flow rate: 29.8 cfs
- Estimated reservoir yield: 6.62 mgd

- Estimated run-of-river yield: 0.83 mgd
- Estimated groundwater well yield: 1.3 mgd

Existing Diversions

The only registered or permitted diversion from Shunock River watershed is for a public water supply well in Town of North Stonington. The well is owned by the Southeastern Connecticut Water Authority and has a registered capacity of 0.18 mgd.

Existing Land Uses / Land Use Compatibility

Development in the watershed is rural in nature and consists largely of residential development with some limited commercial development along the Route 2 corridor. Route 2 bisects the watershed from northwest to southeast. Interstate 95 also passes through the southernmost portion of the watershed. There may be some potential in the lower reaches of the watershed, upstream of I-95, to develop a surface water supply.

An aquifer protection zone covers the primary recharge area of this aquifer and prohibits storage of road salt, underground fuel tanks, and waste disposal. Large agricultural areas may affect water quality in the upper portion of the aquifer due to fertilizer/herbicide/ pesticide use and storage/disposal of manure. On-site sewage disposal and road salt storage may impact the lower portion of the aquifer. The Town has proposed sewering economic development zones but not residences in the lower portion.

Conclusion

The Shunock River basin may have the potential to support a new surface water or groundwater supply source. The low 7Q10 flowrate would limit the capacity of any source that is developed and could prevent the development of a regionally significant supply source. Pump testing for a proposed groundwater well in this watershed resulted in an almost 1:1 reduction in surface water flow due to groundwater withdrawals (Brian Murphy memo 11/22/00). Land use in the watershed is compatible with water supply development and competing water uses are limited to one water supply well with a registered capacity of 0.18 mgd. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.5 of this document.

6.6.8 Broad Brook (Basin 3716)

Broad brook is located within the Thames River Major Basin and the Quinebaug River regional basin. The following are characteristics of this basin.

- Watershed area: 16.37 square miles
- Stratified drift: 22%
- 7Q10 flowrate: 2.54 cfs (1.64 mgd)
- Mean annual flow rate: 29.5 mgd
- Estimated reservoir yield: 6.55 mgd
- Estimated run-of-river yield: 0.82 mgd

Existing Diversions
There are no registered or permitted diversions from this Basin on file with DEP.

Existing Land Uses / Land Use Compatibility
The upper portion of the Broad Brook reservoir is mostly rural with some limited commercial and residential development. The lower portion of the watershed includes a large portion of downtown Plainfield, including the sewage treatment plant, which likely discharges into this watershed.

Conclusion
Broad Brook may be capable of supporting public water supplies, however they are not likely to be regionally significant.

6.6.9 Poquonock River (Great Brook) (Basin 2107)

Great Brook is located in the Southeast Coast major basin and the Southeastern Regional Complex western basin. The following is a summary of characteristics of this basin.

- Watershed area: 15.66 square miles
- Stratified drift: 45%

- 7Q10 flow rate: 4.81 cfs (3.11 mgd)
- Mean annual flow rate: 28.2 cfs
- [redacted]
- Estimated run-of-river yield: 0.78 mgd

Existing Diversions

Table 6-12 provides a summary of registered and permitted diversions in the [redacted] River watershed.

TABLE 6-12
Summary of Registered and Permitted Diversions in Poquonock River Watershed

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
[redacted]			

While it is not likely that the above summary accurately reflects the true diversion volume being withdrawn from the watershed (as the sum of diversions far exceeds the capacity of the watershed), it is clear that this watershed is allocated to water supply for Groton Utilities.

Existing Land Uses / Land Use Compatibility

Existing land uses in this watershed consist of residential development, with some limited commercial and industrial development in the lower reaches of the watershed, below the existing water supply reservoirs. Development within the watershed has likely been limited because the reservoirs within this watershed have been in service for many years.

Conclusion

[redacted]

Development of new regionally significant supplies is not likely to be feasible.

6.6.10 Shewville Brook (Basin 3002)

The Shewville Brook sub-regional basin is located in the Thames River major basin and the Thames Main Stem regional basin. The Shewville Brook watershed is located within the towns of Preston, North Stonington and Ledyard. The watershed extends northerly to Amos Lake in Preston and easterly to the Lake of Isles in North Stonington. Characteristics of this basin are as follows:

- Watershed area: 14.46 square miles
- Stratified drift: 21%
- 7Q10 flow rate: 2.15 cfs (1.39 mgd)
- Mean annual flow rate: 26.0 cfs
- Estimated reservoir yield: 5.78 mgd
- Estimated run-of-river yield: 0.72 mgd

Existing Diversions

There are no registered or permitted diversions within the Shewville Brook watershed.

Existing Land Uses / Land Use Compatibility

Route 2 splits this watershed on an east/west axis. Land use in the watershed ranges from high density residential development in the vicinity of Amos Lake, to commercial development along Route 164 in Preston. The watershed below Route 2 consists largely of Cedar Swamp, which acts as the headwaters of Shewville Brook. Land use in the watershed may be amenable to the development of a water supply source, as it is largely undeveloped. However, it also consists of large areas of wetland and swamp. The overall impacts to the habitat associated with the development of a surface water supply source would need to be carefully assessed before development is considered.

Land development in this watershed is limited due to the presence of large areas of swamp and wetland. Five years of water quality sampling and analysis in Shewville Brook have indicated no significant water quality issues.

Conclusion

Shewville Brook may be a possible location for a future regionally significant surface water supply source. Land use in the watershed appears compatible with potable water supply development and there are no apparent competing water diversions on record with DEP. Shewville Brook was long ago identified by SCWA/COG as a viable water supply. The concept raised nearly 30 years ago was to divert spring freshet flow to Groton's reservoir system for later treatment. A safe yield of on the order of 4 mgd was estimated. Additional investigation may be warranted. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.6 of this document.

[redacted]

Gardner Brook is located in the Yantic River Regional Basin. The following is a summary of watershed characteristics.

- Watershed area: 13.84 square miles
- Stratified drift: 31%
- 7Q10 flowrate: 2.97 cfs (1.92 mgd)
- Mean annual flowrate: 24.9 cfs
- Estimated reservoir yield: 5.54 mgd
- Estimated run-of-river yield: 0.69 mgd

Existing Diversions

Table 6-13 provides the registered and permitted diversions on file at DEP for this watershed.

TABLE 6-13
Summary of Registered and Permitted Diversion[redacted]Watershed

Registrant /Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
[redacted]			

[redacted]

6.6[redacted](Basin 3006)

Th[redacted]subregional basin is located within the Thames Main Stem major basin and the Thames River regional basin. [redacted]watershed is located in the towns of Montville and Waterford. The following is a summary of information regarding this watershed:

- Watershed area: 13.08 square miles
- Stratified drift: 15%
- 7Q10 flow rate: 1.43 cfs (0.92 mgd)
- Mean annual flow rate: 23.5 cfs
- [redacted]
- Estimated run-of-river yield: 0.65 mgd

Existing Diversions

[redacted]

Existing Land Uses / Land Use Compatibility

The upper portion of the [redacted] watershed is largely undeveloped at the present time. Land use in the lower portion consists of high density residential and commercial development along the west bank of the Thames River. This watershed has a steep gradient as the land drops off quickly to the Thames River. The development of a new surface water supply in this watershed would be difficult due to the limited land area available, although Millers Pond may be a viable supply alternative.

[redacted]

Some medium-density residential uses are existing or anticipated in the upper reaches of the [redacted]atershed along Old Colchester Road in Montville and immediately south of Miller Pond. These areas may contribute runoff with elevated levels of metals, solids, and nutrients. Watershed protection regulations are not currently in place in Waterford.

Conclusion

The City of New London has been considering developing additional sources within the [redacted]. Other entities are also pursuing development of a source of potable water in the [redacted] ome of these efforts are aimed at supplying a regional supply source, while others are for a specific water company's needs. Several of these proposals may be in conflict with one another. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.7 of this document.

6.6.13 Wyassup Brook (Basin 1001)

Wyassup Brook is located within the Pawcatuck Main Stem regional basin and the Thames River major basin. The basin is primarily located within North Stonington. Characteristics of this basin are summarized below:

- Watershed area: 11.47 square miles
- Stratified drift: 50%
- 7Q10 flow rate: 3.90 cfs (2.52 mgd)
- Mean annual flow: 20.4 cfs
- Estimated reservoir yield: 4.59 mgd
- Estimated run-of-river yield: 0.57 mgd

The potential groundwater yield has not been estimated for the Wyassup Brook aquifer, but the fact that the watershed consists of 50% stratified drift materials indicates that groundwater sources may warrant investigation.

Existing Diversions

There are no existing registered or permitted diversions in this watershed on file with DEP.

Existing Land Uses / Land Use Compatibility

Land use in the Wyassup Brook watershed consists largely of undeveloped state forest land in North Stonington. The Pachaug State Forest encompasses a large area of the watershed. Lower reaches of the watershed are dominated by Bell Cedar Swamp.

Overall land use in the watershed appears to be compatible with the development of a surface water supply source.

North Stonington has designated portions of this watershed as within the aquifer protection zone. This designation should allow the town to monitor and control development in the watershed to prevent uses that would be incompatible with water supply planning.

Conclusion

The Wyassup Brook watershed may be a feasible source of future water supplies. At the present time there are no competing water uses in the watershed and land use in the watershed appears compatible with public water supply development. Due to the high quality resources in the basin, environmental impacts would be of concern. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.8 of this document.

6.6.14 [redacted] (Basin 3804)

[redacted] is located in the Thames River Major Basin and the Shetucket River regional basin. The following is a summary of information regarding this watershed.

- Watershed area: 11.33 square miles
- Stratified drift: 24%
- 7Q10 flow: 1.91 cfs (1.23 mgd)
- Mean annual flow: 20.4 cfs
- Estimated reservoir yield: 4.53 mgd
- Estimated run-of-river yield: 0.57 mgd

Existing Diversions

Table 6-14 provides a summary of registered and permitted diversions within the [redacted]

TABLE 6-14
Summary of Registered and Permitted Diversions i[redacted] Watershed

Registrant /Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
[redacted]			

The volume of the existing diversions indicates that this basin may have some limited water available for public water supplies.

Existing Land Uses / Land Use Compatibility

The watershed area is mostly rural with some limited development along the Shetucket River in Sprague.

Conclusion

The [redacted] watershed would not be able to support the development of a regionally significant water supply source based on the projected run-of-river. It may be capable, however, of supporting a local supply.

6.6.15 [redacted] (Basin 2205)

The [redacted] drainage basin is located within the Southern Eastern Complex regional basin and the Southeast Coast Major Basin. The following is a summary of information regarding this drainage basin:

- Watershed area: 8.85 square miles
- Stratified drift: 52%
- 7Q10 flow rate: 3.13 cfs (2.02 mgd)
- Mean annual flow rate: 15.9 cfs
- [redacted]
- Estimated run-of-river yield: 0.44 mgd
- Estimated groundwater yield: 2.6 mgd

Existing Diversions

[redacted]

TABLE 6-15
Summary of Registered and Permitted Diversions in [redacted]er Watershed

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
[redacted]			

Available geologic information indicates the potential for a reservoir yield of up to 3.5 mgd from th[redacted]watershed. The USGS estimated an available yield of 2.6 mgd from groundwater wells within this basin. Based on the available diversion information, [redacted]as already been allocated to the East Lyme Water Commission.

Existing Land Uses / Land Use Compatibility

Land use in the upper reaches of the watershed is residential, while the lower reaches include the more developed area of Niantic. While land uses in the upper watershed may be amenable to development of a surface water supply, the contributing watershed would be limited. Land use in the lower reaches may be incompatible with the development of a water supply source.

Conclusion

[redacted]

6.6.16 Burnap Brook (Basin 3107)

The Burnap Brook watershed is located within the Willimantic River regional basin and the Thames River major basin. The Burnap Brook watershed consists of residential areas of the Towns of Hebron, Andover and Bolton. The following is a summary of watershed characteristics for Burnap Brook.

- Watershed area: 7.31 square miles
- Stratified drift: 80%
- 7Q10 flow rate: 3.93 cfs (2.54 mgd)
- Mean annual flow rate: 13.2 cfs
- Estimated reservoir yield: 2.92 mgd
- Estimated run-of-river yield: 0.37 mgd

Potential groundwater yields within the watershed have not been estimated. However, the fact that 80% of the watershed is underlain by stratified drift materials indicates that groundwater sources may warrant investigation.

Existing Diversions

There are no existing registered or permitted diversions in this watershed on file with DEP.

Existing Land Uses / Land Use Compatibility

Existing land use in the watershed is mostly residential development, with some limited commercial activities. The most appropriate location for a surface water source would be the area of Warner Swamp or Daly Swamp. Both of these areas are located in the upper portion of the watershed, limiting the potential surface water yield.

Conclusion

There are no competing permitted water uses in the watershed at the present time. Burnap Brook is not however, likely to be an appropriate basin for the development of a regionally significant surface water supply based on the estimated run-of-river yield. The most compatible land areas for a supply source development are located in the upper portion of the watershed, which has a limited contributing watershed area. The development of groundwater sources may, however, warrant further investigation.

6.6.17 Pawcatuck River (Basin 1000)

The Pawcatuck River subregional basin is located within the Pawcatuck Main Stem regional basin and the Pawcatuck major basin. The Pawcatuck River drainage basin is located in the towns of Westerly, Rhode Island and Stonington, Connecticut. While impaired water quality prevents the Pawcatuck River from being considered as a surface water source, the development of groundwater wells may be feasible. Significant stratified drift deposits located along the west bank of the river in Stonington may be a source of groundwater supply. The following is a summary of watershed characteristics for the Pawcatuck River.

- Watershed area: 305.2 square miles
- Stratified drift 25%
- 7Q10 flow rate: 53.41 cfs (34.52 mgd)
- Mean annual flow rate: 549.4 cfs
- Estimated groundwater well yield: 7.2 mgd

Existing Diversions
The Town of Westerly Rhode Island maintains a diversion for the Noyes Avenue well in Stonington. This diversion is permitted for 1.00 mgd maximum withdrawal.

Existing Land Uses / Land Use Compatibility
The majority of this basin is located in Rhode Island. Development in the upper reaches of the watershed consists of residential, suburban and commercial properties. The lower reaches are more densely developed with coastal communities and shorefront development.

An aquifer protection zone is in place over the portion of the primary recharge area that is located in North Stonington. The Town of Stonington has adopted special regulations pertaining to the establishment of aquifer protection zones, including the Pawcatuck River recharge area. The recharge area is heavily developed with high-density residential, extractive, and industrial uses. Existing groundwater discharges have been identified. Land uses in Rhode Island are undetermined and may influence aquifer quality. Additional mixed urban uses are anticipated.

Conclusion

The Pawcatuck River basin may be a feasible source for the development of future regionally significant groundwater supplies. A significant area of stratified drift deposit exists along the west bank of the river in Stonington. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.9 of this document.

6.6.18 [redacted]Basin 3900)

Th[redacted]bregional basin is located within th[redacted]regional basin and the Thames River major basin. The watershed area of th[redacted]extends through Lebanon, Franklin and Bozrah. Following is a summary of characteristics of this basin:

- Watershed area: 97.81 square miles
- Stratified drift: 21%
- 7Q10 flow rate: 14.53 cfs (9.39 mgd)
- Mean annual flow rate: 176.1 cfs
- Estimated groundwater yield: 4.9 mgd.

Existing Diversions

Table 6-16 presents a summary of the existing diversions from th[redacted]basin on file with the Connecticut DEP. These include both registered and permitted diversions.

TABLE 6-16

Summary of Registered and Permitted Diversions in the [redacted]atershed

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
[redacted]			

*See discussion below.

The total volume of water permitted to be withdrawn from the [redacted] basin at the present time is in excess of 80 mgd. This volume indicates that [redacted] likely exceeded its maximum diversion capacity and could not support the withdrawal of more water without environmental impacts. It should be noted, however, that diversion volumes often far exceed actual or even potential withdrawals.

[redacted]

Existing Land Uses / Land Use Compatibility

Existing land uses include residential development, with some limited commercial and industrial development in Fitchville and Norwichtown. Norwichtown is located at the downstream end of the watershed at the interchange of Route 2 and Interstate 395.

[redacted]

The saturated stratified drift aquifer lies within Norwich, Bozrah, and Franklin. Many existing uses in the area could affect groundwater quality. Groundwater contaminant discharges have been identified in all three towns. Oil/chemical spills, salt storage, and septage lagoons have been identified near the aquifer in Bozrah, potentially within a recharge zone. The area east of Fitchville and Norwich is more densely developed and designated for mixed urban uses. Source protection requires identification of most useable portions of the aquifer and inter-municipal coordination of land use policies. The best potential for development may be in the western part of aquifer (upgradient of Fitchville). Land uses around the aquifer in Franklin are mostly mixed suburban uses, with some extractive industrial activity along Susquetonscot Brook and agricultural waste storage near Smith Corner may affect aquifer quality. An aquifer protection zone is not in place currently.

Conclusion

The [redacted] as the potential to supply regionally significant volumes of water [redacted]. If these diversions can be reconciled to more accurately reflect the available capacity of the reservoir, development of additional water supplies may be feasible.

[redacted]

6.6.19 Connecticut River (Basin 4000)

The watershed area of the Connecticut River extends from Vermont to Long Island Sound. Characteristics of this basin are summarized below:

- Watershed area: 11,267 square miles
- Stratified drift: 10%
- 7Q10 at Long Island Sound: 856 cfs (34.52 mgd)
- Estimated groundwater well yield: 4.3 mgd

The area of stratified drift deposits as a percentage of the total watershed is small, but the size of the total watershed indicates that the river may provide significant groundwater water supplies. [redacted] While many towns in Massachusetts draw surface water from the river for potable uses, the Class B water quality designation in Connecticut prevents use of the river as a potable water supply for the southeast region.

Existing Diversions

There are dozens of existing diversions from the Connecticut River for both industrial and public water supply uses, both consumptive and non-consumptive. However, these diversions are not likely to pose limitations on future development due to the abundant flows in the Connecticut River, coupled with its tidal nature from Long Island Sound to Hartford, Connecticut.

Existing Land Uses / Land Use Compatibility

Land use in the Connecticut River valley varies widely. Stratified drift deposits in Lyme and East Haddam have the largest potential for development of groundwater supplies. These areas have remained largely undeveloped and serve as wildlife refuges and parks at the present time.

The area around the Cobalt Landing aquifer is characterized by low/medium density residential uses and a marina at the landing. The potential exists for surface water intrusion into the aquifer. Aquifer protection regulations are in place in East Hampton. East Haddam, however, has not developed zoning that would afford protection of the Connecticut River aquifer.

Conclusion

The Connecticut River aquifer may be a feasible source of regionally significant groundwater supplies. In particular, stratified drift deposits adjacent to the river in East Hampton, Lyme and East Haddam may suitable areas for future source development.

Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.11 of this document.

6.6.20 Billings Brook (Basin 3605)

The Billings Brook watershed is located within the Pachaug regional basin and the Thames River major basin. The small contributing watershed area prevents Billings Brook from being considered as a potential surface water supply source. However, it may be able to support regionally significant groundwater supplies. The following is a summary of watershed characteristics for Billings Brook.

- Watershed area: 5.92 square miles
- Stratified drift: 42%
- 7Q10 flow rate: 1.70 cfs
- Estimated groundwater well yield: 3.5 mgd

Existing Diversions

There are no permitted or registered diversions on file with the DEP for withdrawals from this drainage basin.

Existing Land Uses / Land Use Compatibility

Land use in the watershed is rural, consisting mostly of residential development. Mixed land uses exist throughout direct recharge area of potential well locations. The best potential (i.e., large undeveloped tracts) may be around the Pachaug State Park land located southeast of Hopeville, and in the southern Billings Brook corridor. No specific potential well sites have been identified. Aquifer protection regulations are not in place in Griswold. The southernmost (upgradient) portion of the aquifer is located in North Stonington. This area is currently open space, state forest, and low-density residential uses. An aquifer protection zone is in place.

Conclusion

The development of groundwater supplies within the Billings Brook watershed may provide a regionally significant source of water supply. The low 7Q10 flowrate does, however, indicate that yields may be limited. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.12 of this document.

6.6.21 [redacted]

Th[redacted]s located within the Thames Main Stem subregional basin and the Thames River regional basin. The following is a summary of information regarding this watershed.

- Watershed area: 12.10 square miles
- Stratified drift: 38%
- 7Q10 flow rate: 3.16 cfs (2.04 mgd)
- Estimated groundwater yield: 2.9 mgd

Existing Diversions

Table 6-17 provides a summary of registered and permitted diversions within the [redacted] If these diversions are consumptive, then this watershed would appear to be over allocated. Slightly more than 0.6 mgd has been allocated to public drinking water. The largest use is industrial, for both CL&P and Stone Container Corporation. Operation of these diversions should be verified to assess if they are active prior to further assessing water supplies in this basin.

Existing Land Uses / Land Use Compatibility

Land use in the watershed consists of residential and commercial development. Upper portions of the watershed have some high density residential development, particularly in the area of Oxoboxo Lake. Uncasville is located within the lower reaches of the watershed.

TABLE 6-17
Summary of Registered and Permitted Diversions in [redacted] Watershed

Registrant /Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
CL&P	Montville Well No.5	[redacted]	Industrial
CL&P	Montville Well No.6	[redacted]	Industrial
CL&P	Montville Well No.7	[redacted]	Industrial
Gadbois	Gadbois Farm Pond #2	[redacted]	Agricultural
Southeastern CT Water Authority	Montville Division Well No. 06	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 07	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 10	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 12	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 13	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 14	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 15	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 16	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 17	[redacted]	Public Water
Southeastern CT Water Authority	Montville Division Well No. 19[1]	[redacted]	Public Water
Rand Whitney Realty LLC	Oxoboxo Brook Diversion	[redacted]	Industrial
Southeastern CT Water Authority	Oxoboxo Brook Diversion	[redacted]	Public Water
Stone Container Corp.	Oxoboxo Brook Diversion	[redacted]	Industrial
Stone Container Corp.	Oxoboxo Brook Diversion	[redacted]	Industrial
Whipple	Oxoboxo Brook Diversion	[redacted]	Hydropower

Notes: 1. SCWA Well No. 19 was registered for a diversion of 0.178 mgd. The well was later permitted at the rate listed.

Conclusion

Surface water quality in the Oxoboxo River is degraded, eliminating it as a potential surface water source. Based on this analysis groundwater wells are not considered feasible, as the watershed appears to be fully allocated to existing diversions.

6.6.22 Great Meadow Brook (Basin 3601)

Great Meadow Brook is considered a potential source for a regionally significant groundwater supply. The following is a summary of watershed characteristics:

- Watershed area: 6.31 square miles
- Stratified drift: 23%
- 7Q10 flowrate: 1.02 cfs
- Estimated groundwater yield: 2.8 mgd

Existing Diversions
There are no existing registered or permitted diversions within the Great Meadow watershed on file with DEP.

Existing Land Uses / Land Use Compatibility
Land use in the watershed is rural with a large portion consisting of the undeveloped land of Pachaug State Forest, providing protection to the water resources of the area.

Conclusion
Great Meadow Brook may be a viable source for a regionally significant groundwater supply source. USGS has estimated that groundwater wells in this basin may yield up to 2.8 mgd. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.13 of this document.

6.6.23 Anguilla Brook (Basin 2101)

Anguilla Brook is located within the Southeast Eastern Complex Regional Basin and the Southeast Coast Major Basin. Stratified drift deposits are located throughout the Anguilla Brook valley in Stonington. The following is a summary of watershed characteristics:

- Watershed area: 12.33 square miles
- Stratified drift: 35%
- 7Q10 flow rate: 2.97 cfs
- Estimated groundwater well yield: 2.9 mgd

Existing Diversions
There are no permitted or registered diversions within this basin on file with the DEP. There is, however, one application currently pending for golf course irrigation.

Existing Land Uses / Land Use Compatibility
Land development in the area immediately adjacent to Anguilla Brook has been limited due to the presence of significant swamp and wetlands areas. The lower reaches of the watershed include the Wequetequock area of Stonington. Development in this area is residential with a limited number of commercial facilities.

The recharge area of this aquifer is sparsely developed, with one unsewered medium-density development in the northernmost (upgradient) portion of the recharge area in North Stonington. An aquifer protection zone is in place in North Stonington. The Town of Stonington has adopted special regulations pertaining to the establishment of aquifer protection zones, including the Anguilla Brook recharge area.

Conclusion
Anguilla Brook may be a feasible source for regionally significant groundwater supply provided any potential impacts to areas of environmental concern can be avoided. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.14 of this document.

6.6.2 [redacted]

The [redacted] cated within the Willimantic Regional Basin and the Thames River Major Basin. The river cannot be considered as a surface water source due to degraded water quality. However, the river valley immediately adjacent to the river consists of stratified drift deposits that may be amenable to the development of groundwater wells. The following is a summary of watershed characteristics:

- Watershed area: 225.5 square miles
- Stratified drift: 20%
- 7Q10 flow rate: 32 cfs
- Estimated groundwater well yield: 2.2 mgd

Groundwater in a large area adjacent to the river near its confluence with the Natchaug River is classified as GB. Other smaller areas throughout the river valley are also classified as impaired.

Existing Diversions

Table 6-18 provides a summary of the registered and permitted consumptive diversions within t[redacted]

TABLE 6-18

Summary of Registered and Permitted Diversions in t[redacted]

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
CT Water Company	Stafford Well #3	[redacted]	Public Water Supply
Manchester S&G Company	Mansfield Pond		Industrial
UConn	Willimantic River Well No. 1		Public Water Supply
UConn	Willimantic River Well No. 2		Public Water Supply
UConn	Willimantic River Well No. 3		Public Water Supply
UConn	Willimantic River Well No. 4		Public Water Supply
Tolland	Willimantic River Wellfield		Public Water Supply
Willimantic Power Corp.	Willimantic River Diversion		Hydropower

Disregarding the diversions for Willimantic Power Corporation and Manchester Sand and Gravel, [redacted] This exceeds the predicted well yield for this watershed of 2.2 mgd.

Existing Land Uses / Land Use Compatibility

Land use in th[redacted]es widely. A number of former mills and manufacturing facilities are located within this watershed.

Conclusion

The Willimantic River would not be a suitable source of future public water supplies. Groundwater quality in the basin has been impacted by historic land uses and the volume of existing water supply diversions exceeds the predicted yield of the aquifer.

6.6.25 Trading Cove Brook (Basin 3001)

Trading Cove Brook is located within the Thames River Main Stem Regional basin and the Thames River Major Basin near Norwich. The following characteristics describe the Trading Cove Brook watershed:

- Watershed area: 13.79 square miles
- Stratified drift: 32%
- 7Q10 flow rate: 3.05 cfs
- Estimated groundwater well yield: 1.90 mgd

Groundwater quality in the lower portions of the Trading Cove Brook, near its confluence with the Thames River has been degraded and is currently classified as GB/GA. The majority of the stratified drift within the watershed is located in this area.

Existing Diversions

There are no existing permitted or registered diversions in this watershed on file with the DEP.

Existing Land Uses / Land Use Compatibility

Land use in the Trading Cove Brook watershed consists of some residential development with commercial and industrial developments at Norwich Center.

Conclusion

Trading Cove Brook is not considered to be a suitable source for the development of regionally significant groundwater supplies. Groundwater at the mouth of the brook near the Thames River has been impacted by historic activities and would not be suitable for public water supplies.

6.6.26 Pachaug River (Basin 3600)

The Pachaug River is located in the Pachaug regional basin and the Thames River major basin, near Griswold and Voluntown. The following is a summary of watershed characteristics:

- Watershed area: 63.00 square miles
- Stratified drift 15%
- 7Q10 flow rate: 6.87 cfs
- Estimated groundwater well yield: 1.40 mgd

The Pachaug River is not suitable for use as a surface water supply due to impacted water quality. Groundwater in the watershed has been impacted in the vicinity of the confluence of the Quinebaug River and is classified as GB. Areas of significant stratified drift deposits are located around Pachaug Pond and immediately downstream.

Existing Diversions

The Connecticut Department of Environmental Protection has a registered diversion from the Pachaug River for 0.92 mgd. The registration is listed for agricultural uses in Voluntown. This diversion volume should be reconciled before the Pachaug River aquifer is considered as a supply source.

Existing Land Uses / Land Use Compatibility

Land use in the watershed varies from rural to suburban. The eastern limits of Jewett City are located in this watershed. Pachaug Pond and its associated wetlands are located in the central portion of this basin.

Conclusion

The Pachaug River aquifer does not appear to have the capacity to support a regionally significant groundwater supply. However, it may be possible to develop locally significant groundwater supplies in this watershed.

6.6.2[redacted]

[redacted] located in the Southeast Eastern Complex regional basin and the Southeast Coast major basin. The following characteristics describe the [redacted] watershed:

- Watershed area: 15.12 square miles
- Stratified drift: 34%
- 7Q10 flow rate: 3.54 cfs
- Estimated groundwater well yield: 1.40 mgd

Water quality in the brook has been impacted and therefore, is not a suitable source for surface water supplies.

Existing Diversions

Table 6-19 provides a summary of the consumptive registered and permitted diversions on file with the DEP.

TABLE 6-19
Summary of Registered and Permitted Diversions in th[redacted]

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
CT-American Water Company	Lantern Hill Well	[redacted]	Public Water Supply
Ledyard	Wells PW-1 and PW-2	[redacted]	Public Water Supply

Th[redacted] watershed appears to be fully allocated to existing water supply sources.

Existing Land Uses / Land Use Compatibility

Land use in the watershed is mostly residential in nature. The Mashantucket Pequot Reservation is located within this watershed.

Conclusion

[redacted]atershed is believed to be fully allocated for water supply purposes at the present time and is not available for the development of future regionally significant supply sources.

6.6.28 Williams Brook (Basin 2103)

Williams Brook is located within the Southeast Coast major basin and the Southeast Eastern Complex regional basin. The following is a summary of watershed characteristics.

- Watershed area: 6.19 square miles
- Stratified drift: 20%
- 7Q10 flowrate: 0.88 cfs
- Estimated groundwater well yield: 1.4 mgd

Existing Diversions

The Holdridge Farm Nursery in Ledyard maintains the only diversion from this watershed. The Nursery maintains a registration for the withdrawal of 0.43 mgd for agricultural purposes.

Existing Land Uses / Land Use Compatibility

Land use in this watershed consists of moderately dense residential development. There has also been some commercial development within Ledyard.

Conclusion

Williams Brook may be capable of supporting a locally significant source of water supply, but would not be able to support a diversion in a excess of 1 mgd. The low 7Q10 flow, combined with the existing diversion indicates that this watershed would not support additional supply source development in excess of 1.0 mgd.

6.6.29 [redacted]

The [redacted] watershed is located within the Thames River major basin and the Quinebaug regional basin. The following is a summary of watershed characteristics.

- Watershed area: 739.11 square miles
- Stratified drift: 30%
- 7Q10 flowrate: 153.73 cfs
- Estimated groundwater well yield: 1.3 to 2.5 mgd

Existing Diversions

There are a number of existing diversions from within this watershed as indicated in Table 6-20.

TABLE 6-20
Summary of Registered and Permitted Diversions in [redacted]

Registrant/Permitee	Name of Diversion	Diversion Volume (mgd)	Purpose
CTDEP	Quinebaug Well No. 1	[redacted]	Fisheries
CTDEP	Quinebaug Well No. 5	[redacted]	Fisheries
CTDEP	Quinebaug Well No. 6	[redacted]	Fisheries
CTDEP	Quinebaug Well No. 7	[redacted]	Fisheries
Crystal Water Company	Brooklyn Well No. 1	[redacted]	Public Water
Crystal Water Company	Brooklyn Well No. 2	[redacted]	Public Water
Crystal Water Company	Brooklyn Well No. 3	[redacted]	Public Water
Crystal Water Company	Plainfield Div. Well No. 1	[redacted]	Public Water
Crystal Water Company	Plainfield Div. Well No. 2	[redacted]	Public Water
Jewett City Water Company	Five Points	[redacted]	Public Water
Jewett City Water Company	Well No. 2	[redacted]	Public Water
Jewett City Water Company	Well No. 3	[redacted]	Public Water
Malerba Farm	Malerba Farm Withdrawal	[redacted]	Agriculture
Northeast Power Generation Co.	Tunnel Hydroelectric Dam	[redacted]	Hydropower
Rogers Corporation	Alexander Lake	[redacted]	Industrial
Rogers Corporation	Pond	[redacted]	Industrial
Rogers Corporation	Quinebaug River Canal	[redacted]	Industrial
Rogers Corporation	Well No. 1	[redacted]	Industrial
Rogers Corporation	Well No. 2	[redacted]	Industrial
Rogers Corporation	Well No. 3	[redacted]	Industrial
WyreWind, Inc.	Aspinook Pond Hydroelectric	[redacted]	Hydropower

Clearly, these registrations do not represent operating consumptive diversions. However, it does seem clear, based on this information, tha[redacted]er allocated, assuming all of the diversions presented above remain active.

Existing Land Uses / Land Use Compatibility
Land use in this watershed varies significantly due to the size of the drainage basin. The upper reaches consist of rural development in communities such as Thompson. Other areas of the watershed (Putnam, for example) are urbanized and contain commercial, industrial and residential development.

Conclusion
Th[redacted]in appears to be over allocated. If the volumes of the diversions (and whether they are still active) can be resolved, this basin may be able to support the development of locally significant water supplies. However, this does not appear to be the case based on current available information.

6.6.30 Myron Kinney Brook (Basin 3604)

Myron Kinney Brook is located within the Pachaug River Regional Basin and the Thames River Major Basin. The following is a summary of watershed characteristics:

- Watershed area: 6.09 square miles
- Stratified drift: 36%
- 7Q10 flow rate: 1.51 cfs
- Estimated groundwater well yield: 1.0 mgd

Existing Diversions
There are no existing registered or permitted diversions on file with DEP within this watershed.

Existing Land Uses / Land Use Compatibility
Land use in the watershed consists largely of state forest land. The Pachaug State forest covers the entire eastern portion of the watershed, providing protection for this resource. Remaining areas of the watershed have limited residential development.

Conclusion
Groundwater quality and existing land use in the Myron Kinney Brook watershed are compatible with the development of a public water supply. Additional analysis may be warranted to determine the volume of water that may be available. Existing USGS information indicates that up to 1.0 mgd may be available indicating groundwater wells in the watershed may be regionally significant. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.15 of this document.

6.6.31 Eightmile River (Basin 4800)

The Eightmile River watershed is located within the Eightmile River Regional basin and the Connecticut River major basin. The watershed lies in Salem, East Haddam, and Lyme. The following is a summary of Eightmile River watershed characteristics:

- Watershed area: 62.40 square miles
- Stratified drift: 18%
- 7Q10 flow rate: 8.04 cfs
- Estimated groundwater well yield: 0.5 to 1.20 mgd

Existing Diversions
While the East Haddam Fish and Game Club maintains a number of registered diversions in this watershed for irrigation purposes, the volumes associated with each diversion are not indicated. The Fox Hopyard Golf Club in East Haddam has a diversion permit to withdraw 0.25 mgd of water for irrigation purposes.

Existing Land Uses / Land Use Compatibility

Existing land use in the Eightmile River watershed ranges from rural low density residential to the high density development surrounding Lake Hayward in northern East Haddam.

Recharge areas in East Haddam are sparsely developed. The 1981 East Haddam Plan of Conservation and Development recommended an 878-acre Aquifer Protection Zone, covering the direct recharge zone. The Town of East Haddam is committed to maintaining and enhancing this watershed as a natural area and would like to discourage future large scale development.

In Lyme, the primary and secondary recharge areas are zoned two-acre residential, except for North Lyme village and are further protected by aquifer protection regulations.

Conclusion

Eightmile River may be suitable for the development of a public water supply source. However, the ability to develop a regionally significant source is questionable. The stratified drift deposits are narrow and limited to the area immediately surrounding the river. These deposits may not have adequate capacity for a regional supply. It should be noted that the towns of Salem, East Haddam, and Lyme have a compact to preserve, protect, and enhance the natural resources of this watershed. Any future development of groundwater supplies will need to consider this effort. Additionally, the Department of Environmental Protection has indicated that this basin represents a prime fisheries habitat and that all other feasible and prudent alternatives should be pursued prior to development of this resource for water supply. Potential impacts of developing a new source of supply in this basin are evaluated in Section 7.16 of this document.

6.6.32 East Branch Eightmile River (Basin 4802)

The East Branch of the Eightmile River encompasses portions of Colchester, Salem, Lyme and East Haddam. It is located within the Eightmile River Regional basin and the Connecticut River Major Basin. The majority of the stratified drift deposits in this watershed are located in southwestern Salem. The following is a summary of the East Branch Eightmile River watershed characteristics:

- Watershed area: 22.53 square miles
- Stratified drift: 16%
- 7Q10 flow rate: 2.60 cfs
- Estimated groundwater well yield: 0.4 to 1.20 mgd

Existing Diversions

There are no registered or permitted diversions from this watershed on file with the DEP.

Existing Land Uses / Land Use Compatibility

Land use in the watershed is limited to residential development with some commercial development. The East Branch watershed is located with Lyme and Salem. In Lyme, the primary and secondary recharge areas are zoned two-acre residential, except for North Lyme village and are further protected by aquifer protection regulations. There are no aquifer protection regulations within Salem at this time. However, Salem does have general regulations protecting groundwater.

Conclusion

The East Branch Eightmile River may be suitable for the development of a public water supply source. However, the ability to develop a regionally significant source is questionable. The stratified drift deposits are limited to one area in Salem. These deposits may not have adequate capacity for a regional supply.

6.7 Recommended Future Water Supply Sources

Based on the inventory and analysis conducted herein, Table 6-21 presents a list of future water supply sources that were recognized as having the greatest potential to provide regionally significant water supplies in the southeast Connecticut Region. This listing has been prioritized based upon input and comment from the Department of Environmental Protection as well as proximity to existing and projected water demands.

Of the supplies listed in Table 6-21, only the Yantic River and Sherman Brook have been identified by area water purveyors for future supply development.

TABLE 6-21
Recommended Future Water Supply Development Areas

Basin ID	Subregional Basin	Regional Basin	Type of Supply	Estimated Reservoir Yield (mgd)	Estimated Run-of-River Yield (mgd)	Estimated Ground Water Yield (mgd)	Environ-mental Sensitivity
1000	Pawcatuck River	Pawcatuck	G	N/A	N/A	7.2	Lowest
4000	Connecticut River	Connecticut	G	N/A	N/A	4.3	Lowest
1003	Ashaway River	Pawcatuck	S	11.1	1.3	N/A	Low
3903	Sherman Brook	Yantic	S	9.2	1.2	N/A	Low
1002	Green Fall River	Pawcatuck	S	9.0	1.1	N/A	Low
1001	Wyassup Brook	Pawcatuck	S	4.6	0.6	N/A	Low
3900	Yantic River	Yantic	G	N/A	N/A	4.9	Moderate
1004	Shunock River	Pawcatuck	S/G	6.6	0.8	1.3	Moderate
4705	Jeremy River	Salmon	S	17.0	2.2	N/A	Moderate
3002	Shewville Brook	Thames	S	5.8	0.7	N/A	Moderate
3006	Hunts Brook	Thames	S	5.2	0.7	N/A	Moderate
4800	Eightmile River	Eightmile	G	N/A	N/A	0.5-1.2	High
4802	E. Branch Eightmile	Eightmile	G	N/A	N/A	0.4-1.2	High
3605	Billings Brook	Pachaug	G	N/A	N/A	3.5	Highest
3601	Great Meadow Brook	Pachaug	G	N/A	N/A	2.8	Highest
2101	Anguilla Brook	SE Eastern	G	N/A	N/A	2.9	Highest
3604	Myron Kinney Brook	Pachaug	G	N/A	N/A	1.0	Highest
			TOTAL	**68.5**	**8.6**	**28.8 – 30.3**	

Future groundwater well locations identified by individual public water systems were presented in "Coordinated Public Water System Plan, Part I: Final Water Supply Assessment" completed in April 1999. Table 6-22 summarizes these aquifer locations.

Table 6-22
Summary of Future Groundwater Sources Targeted by Individual Public Water Systems

Public Water System	Potential Source	Source Watershed
Colchester Sewer and Water	Mikulski Well	Judd Brook
	Savin and Sullivan Farm Well	***Sherman Brook***
Connecticut-American Water Company	Whitford Brook Aquifer	Whitford Brook
	Copps Brook Aquifer	Copps Brook
[redacted]	[redacted]	[redacted]
Groton Utilities	Haley's Brook	Poquonock River
Jewett City Water Company	Quinebaug River Aquifer	Quinebaug River
	Pachaug River Aquifer	Pachaug River
	[redacted]	Pachaug River
Ledyard WPCA	Loftus Wellfield	Williams Brook/Whitford Brook
	Pfizer Well	Thames River Main Stem
New London WPCA	Polly Brook Well	
	Great Swamp	
Norwich Water Dept.	Yantic River	***Yantic River***
Sprague Water & Sewer Authority	New Baltic Reservoir Dam	Shetucket River
Waterford WPCA	Nevin/Jordan Brook Aquifer	Nevin/Jordan Brook

Note: Watersheds in ***bold, italics*** have been identified as potential regionally significant sources

6.8 Land Acquisition for Proposed Stratified Drift Wells

Figures 6-5 through 6-15 present the areas of stratified drift that should be protected for future development of water supplies. These stratified drift areas correlate to those groundwater supplies listed in Table 6-21.

6.9 Inventory of Potential Locally Significant Surface and Groundwater Supplies

Tables 6-23 and 6-24 present those potential supplies that may have local significance. These include groundwater aquifers and surface watercourses that potentially have yields in excess of 100,000 gpd, but that fell below the 1.0 mgd threshold established for a regionally significant supply. Only estimated run-of-river yields are presented, since construction of a reservoir for yields that are less than 1.0 mgd is not believed to be economically feasible.

Figure 6-5
Potential Groundwater Supply
Stratified Drift Area
Pawcatuck River Basin (1000)

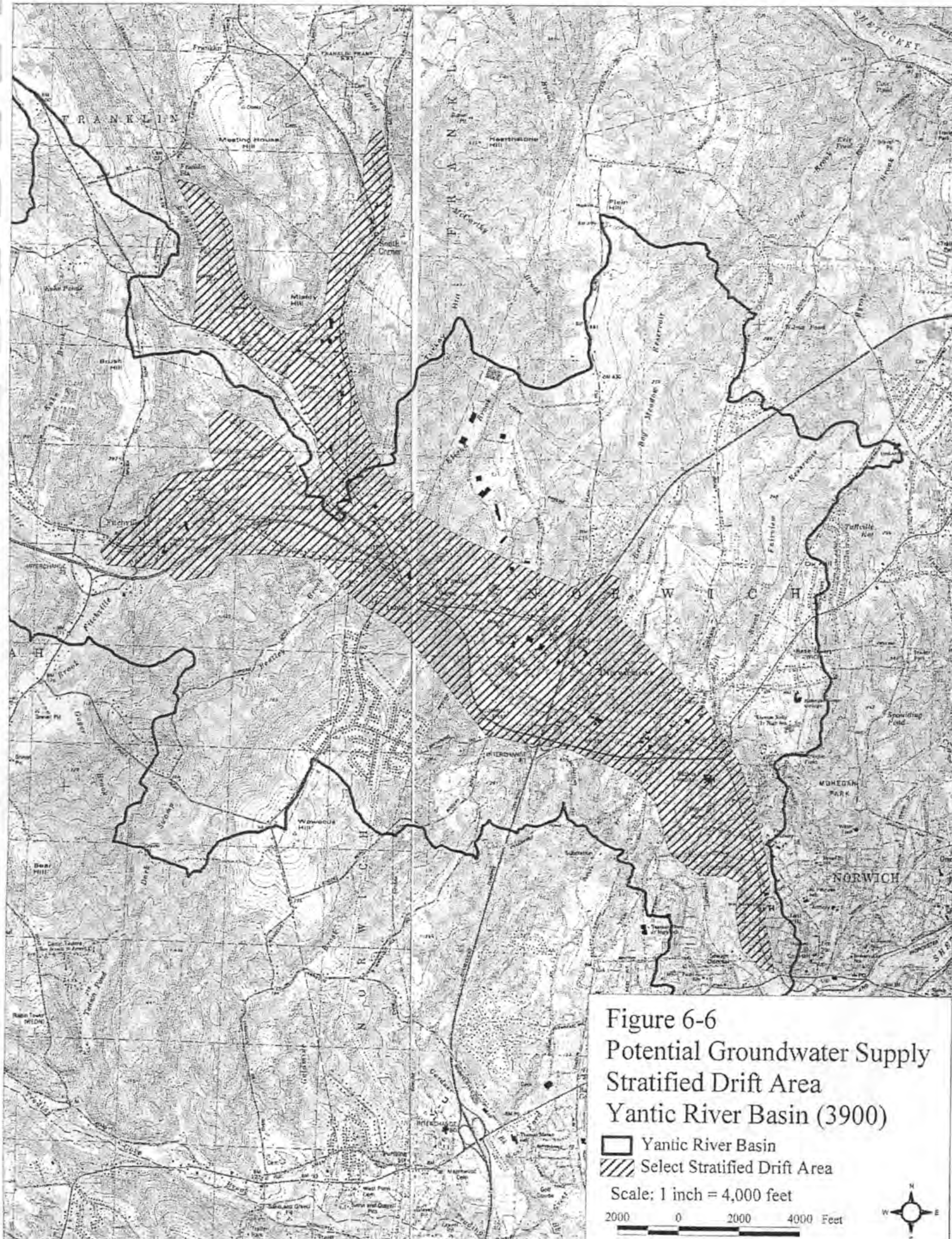


Figure 6-6
Potential Groundwater Supply
Stratified Drift Area
Yantic River Basin (3900)

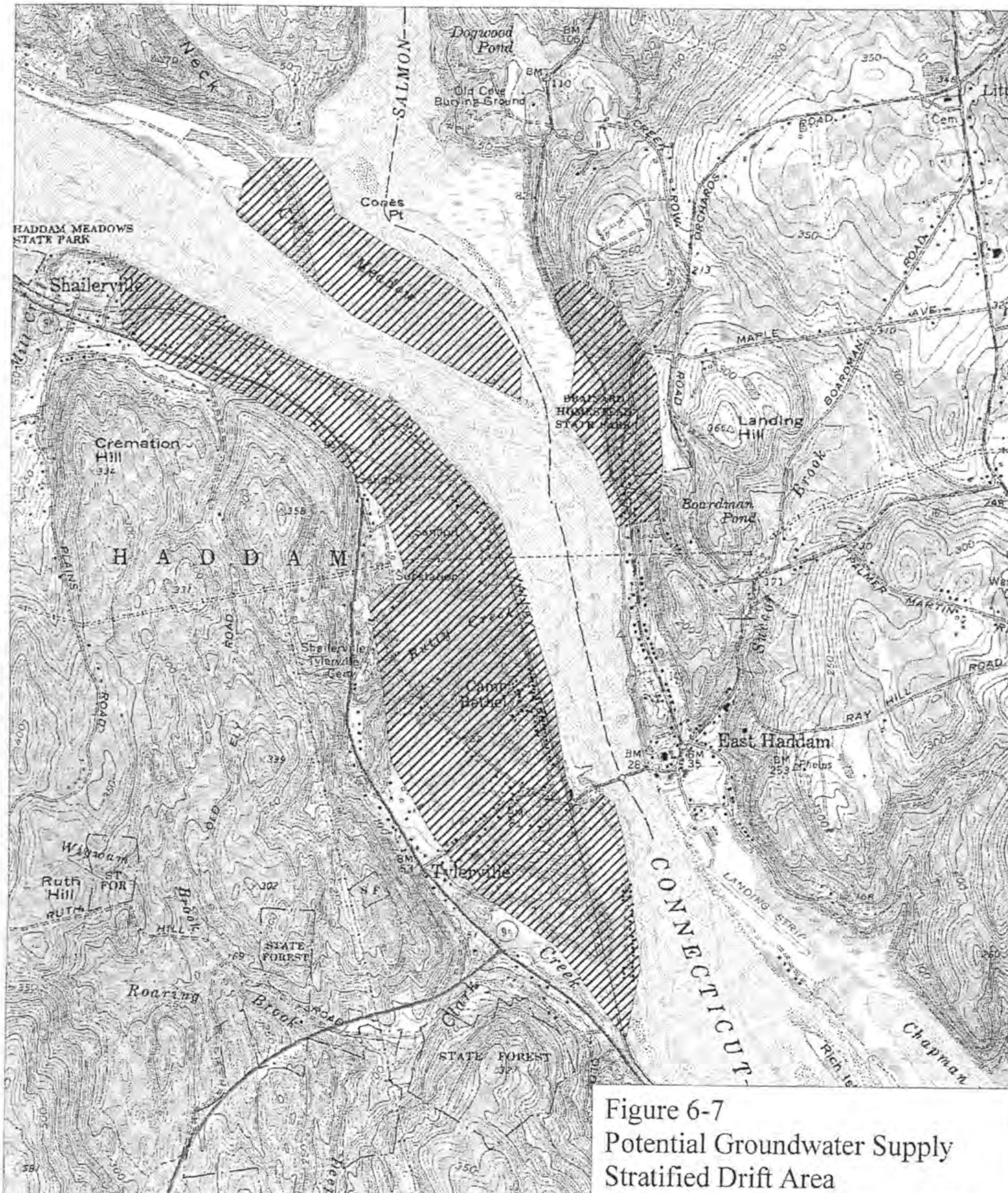


Figure 6-7
Potential Groundwater Supply
Stratified Drift Area
Connecticut River Basin (4000)

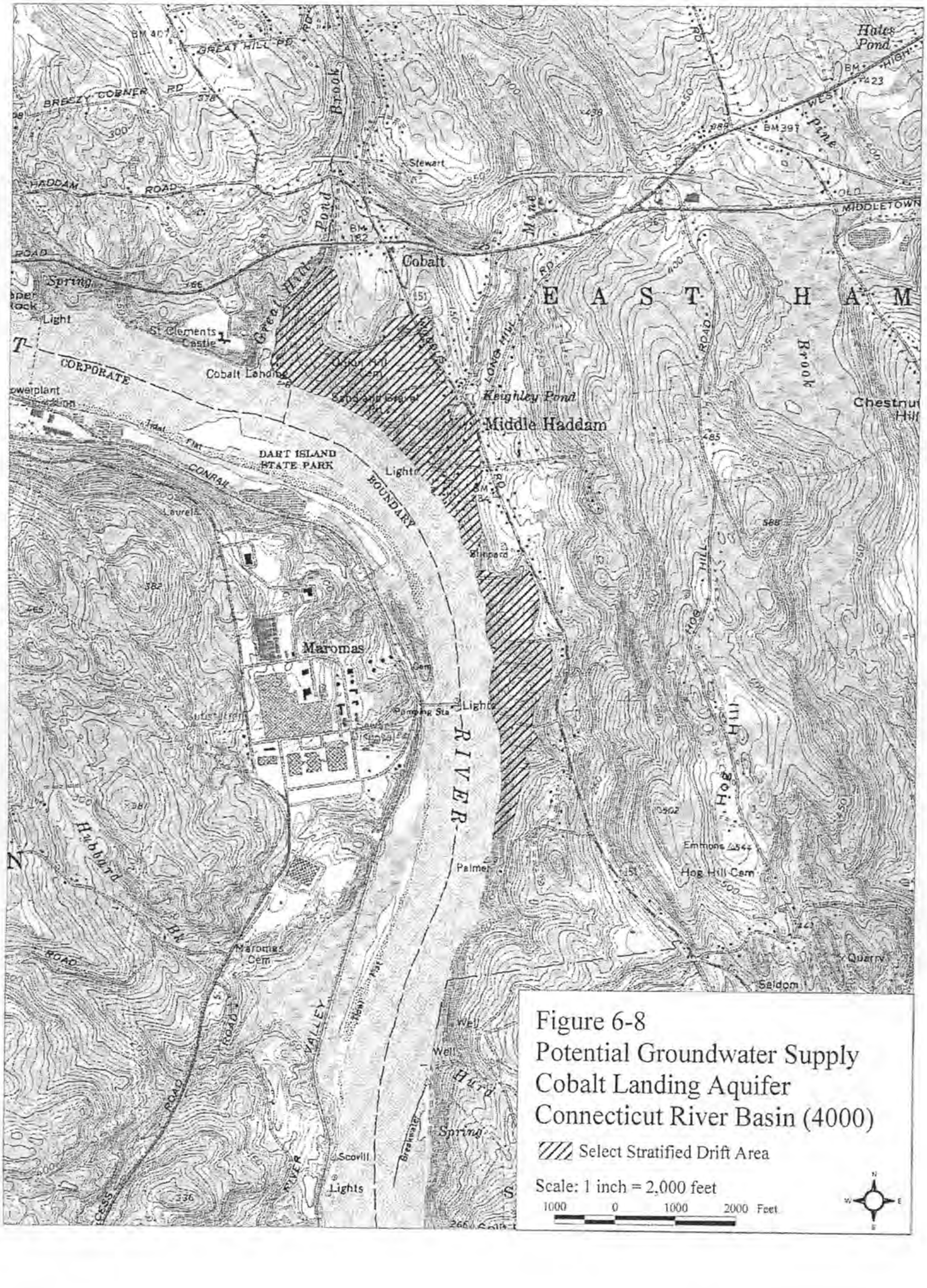


Figure 6-8
Potential Groundwater Supply
Cobalt Landing Aquifer
Connecticut River Basin (4000)

Select Stratified Drift Area

Scale: 1 inch = 2,000 feet

1000 0 1000 2000 Feet

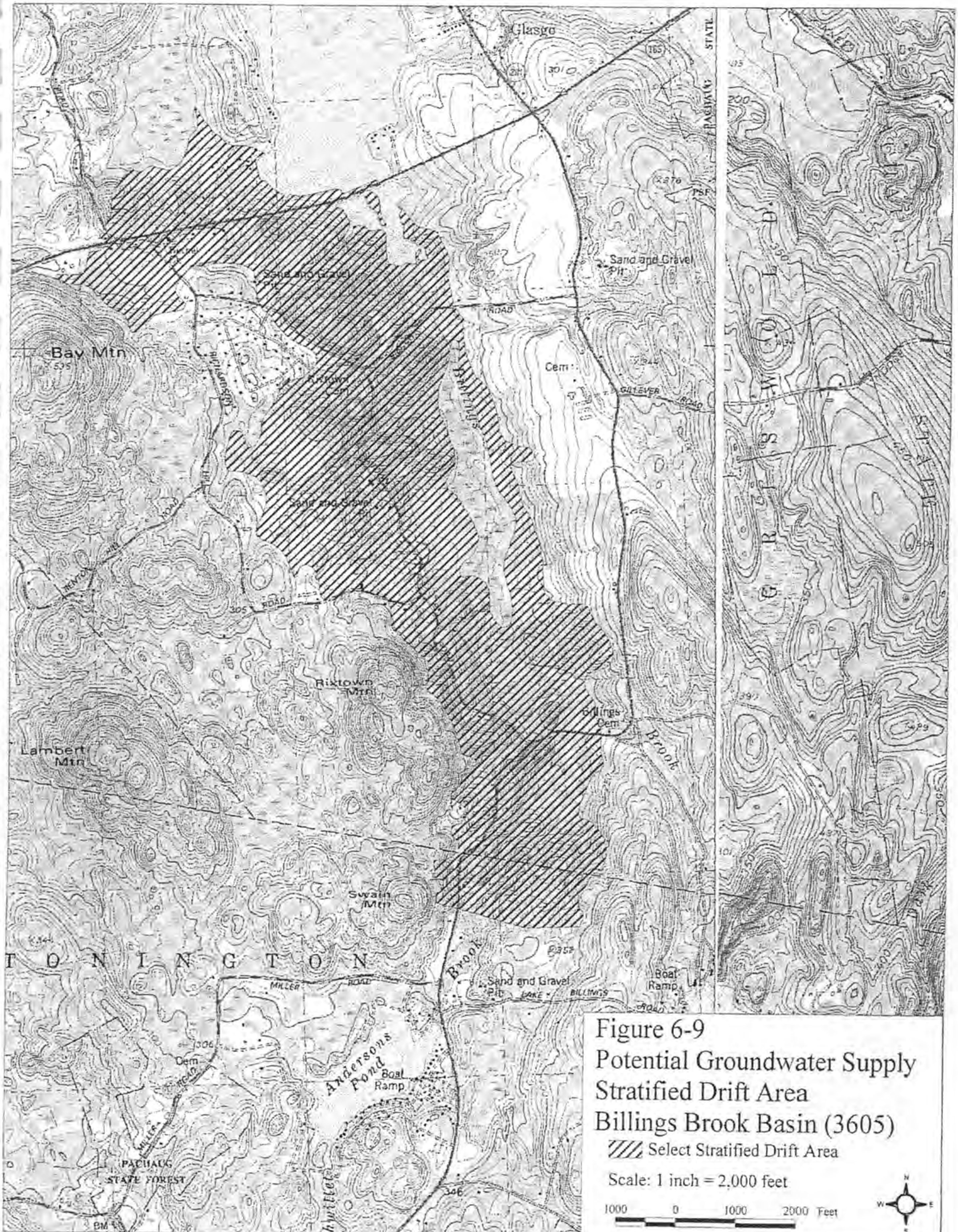


Figure 6-9
Potential Groundwater Supply
Stratified Drift Area
Billings Brook Basin (3605)

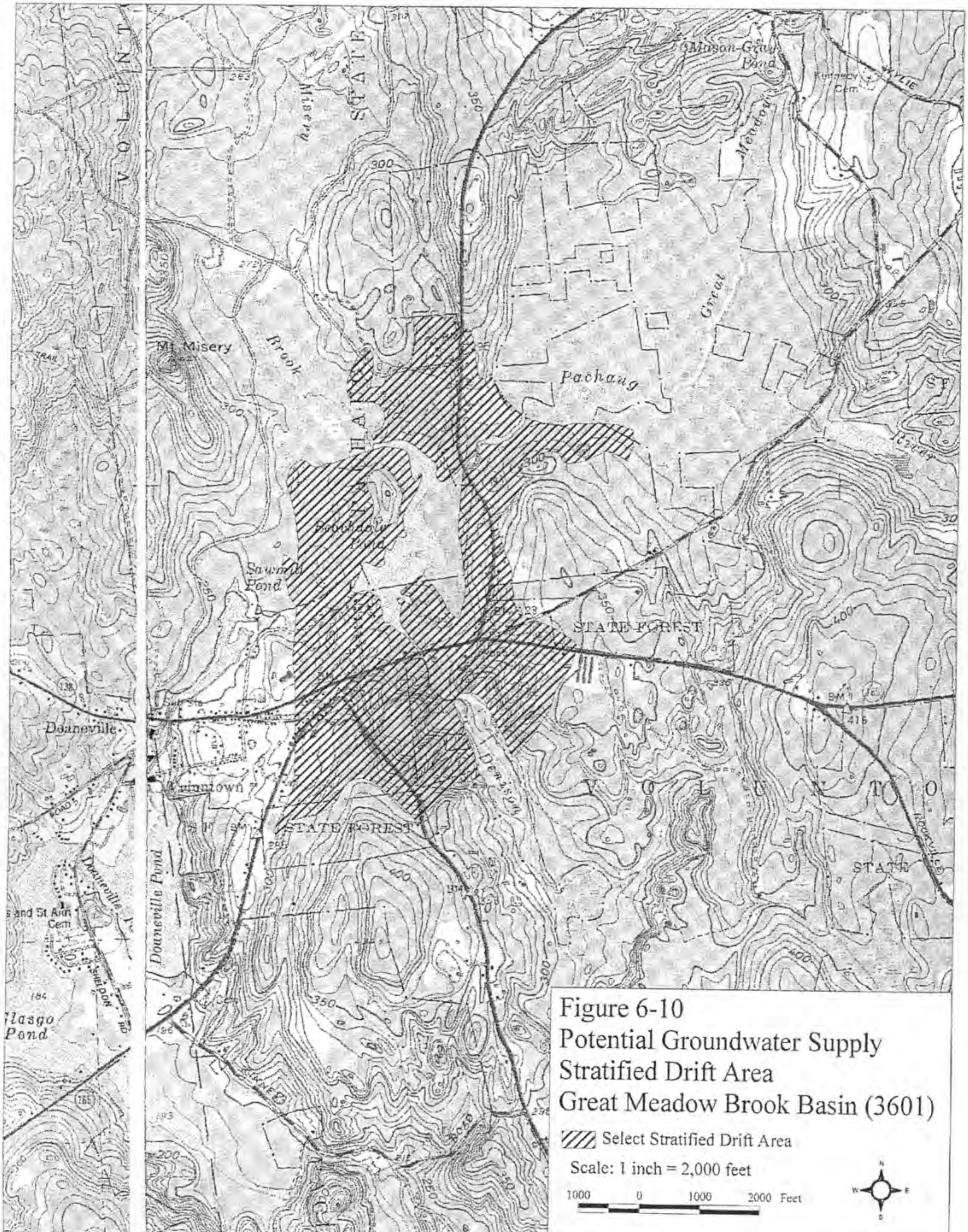


Figure 6-10
Potential Groundwater Supply
Stratified Drift Area
Great Meadow Brook Basin (3601)

Figure 6-11
Potential Groundwater Supply
Stratified Drift Area
Anguilla Brook Basin (2101)

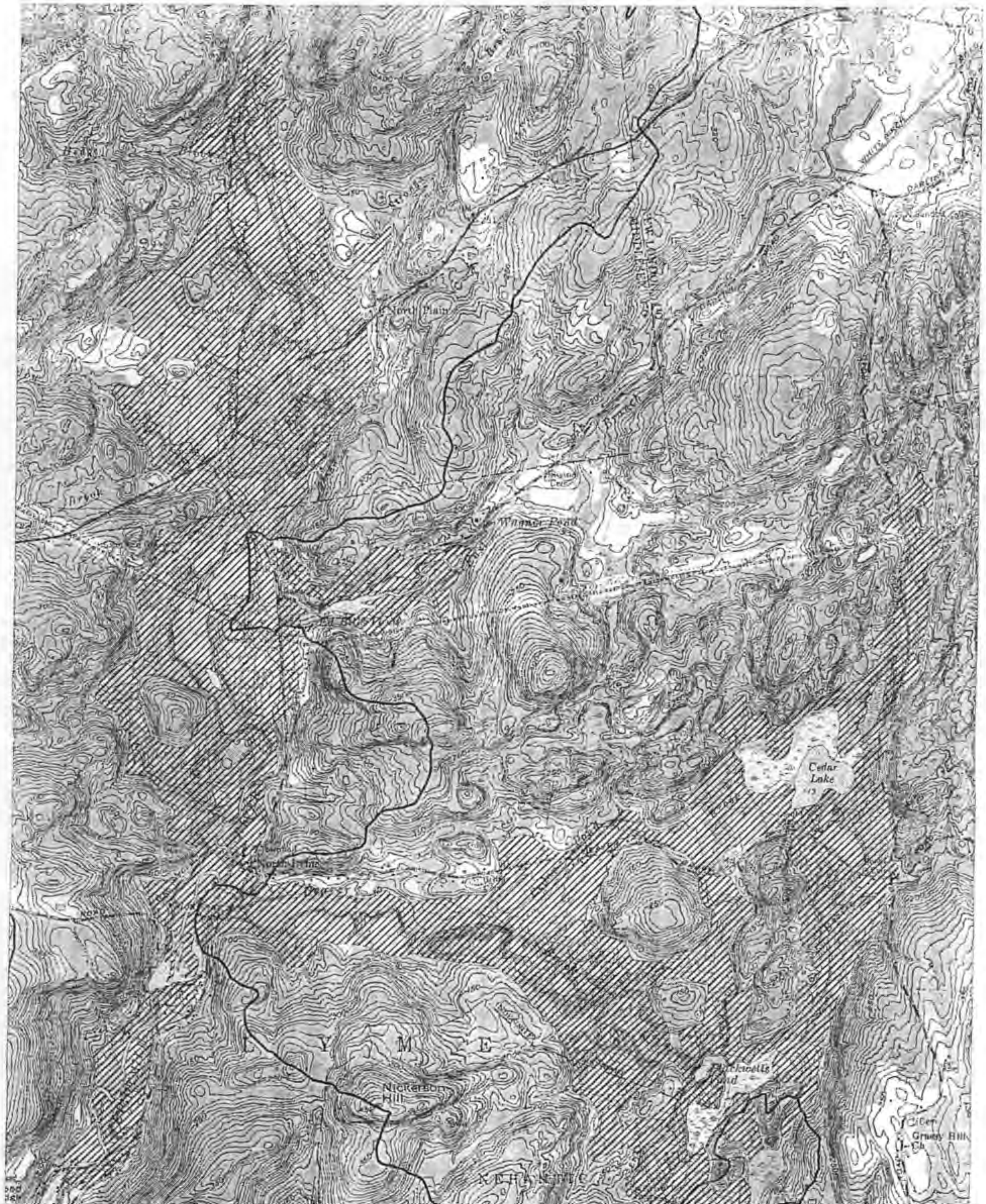


Figure 6-12
Potential Groundwater Supply
Stratified Drift Area
Eightmile River Basin (4800)

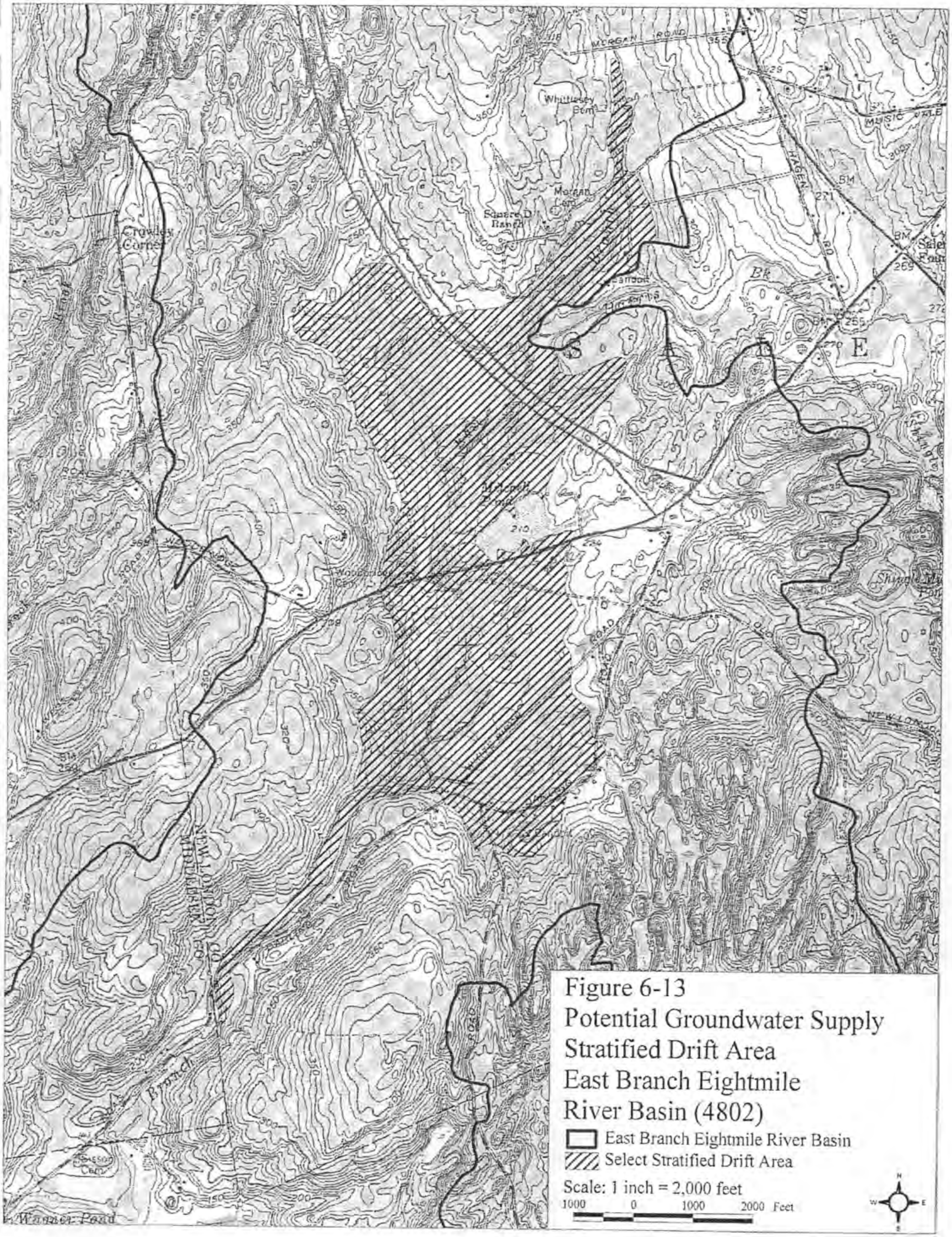


Figure 6-13
Potential Groundwater Supply
Stratified Drift Area
East Branch Eightmile
River Basin (4802)

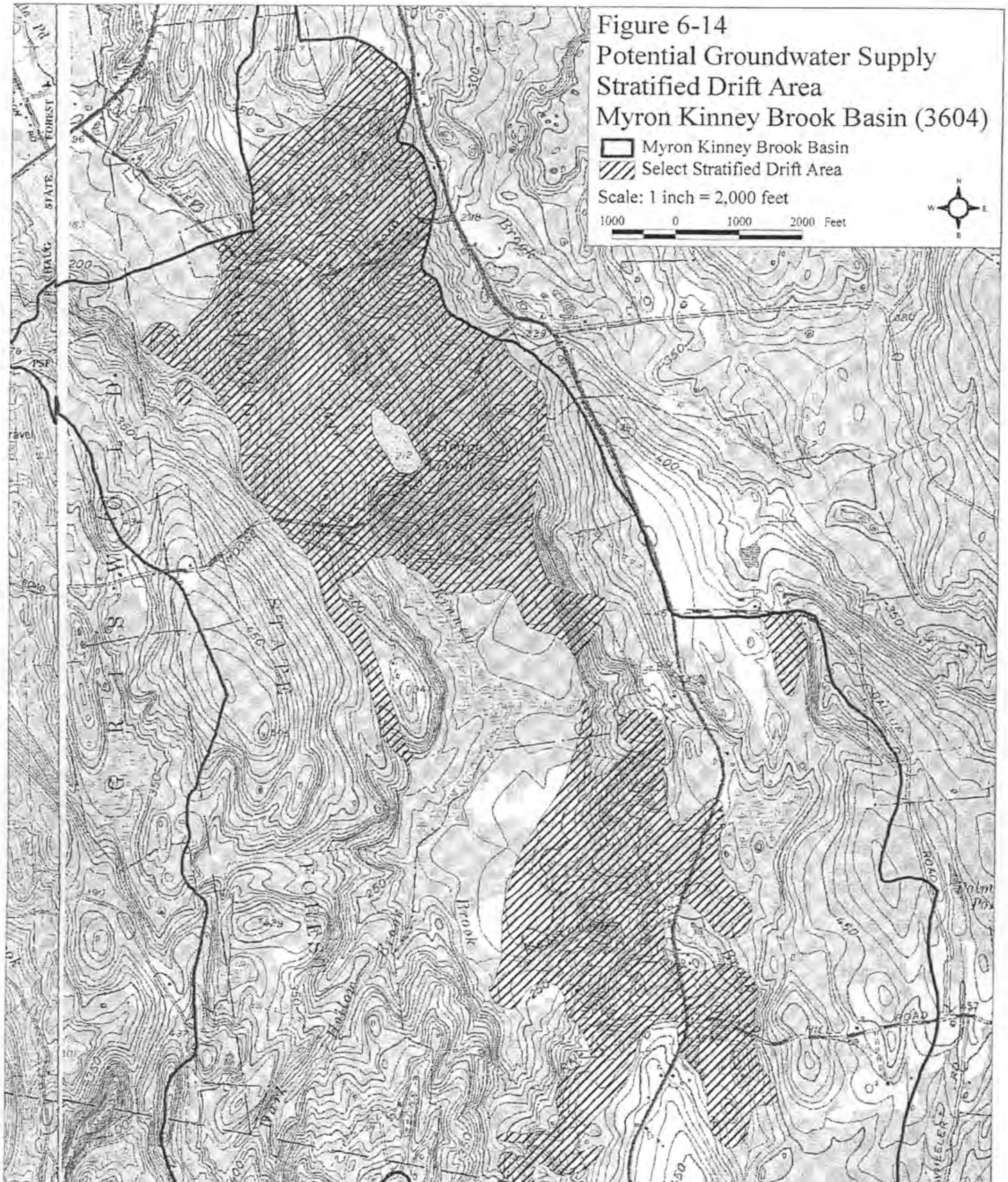


Figure 6-14
Potential Groundwater Supply
Stratified Drift Area
Myron Kinney Brook Basin (3604)

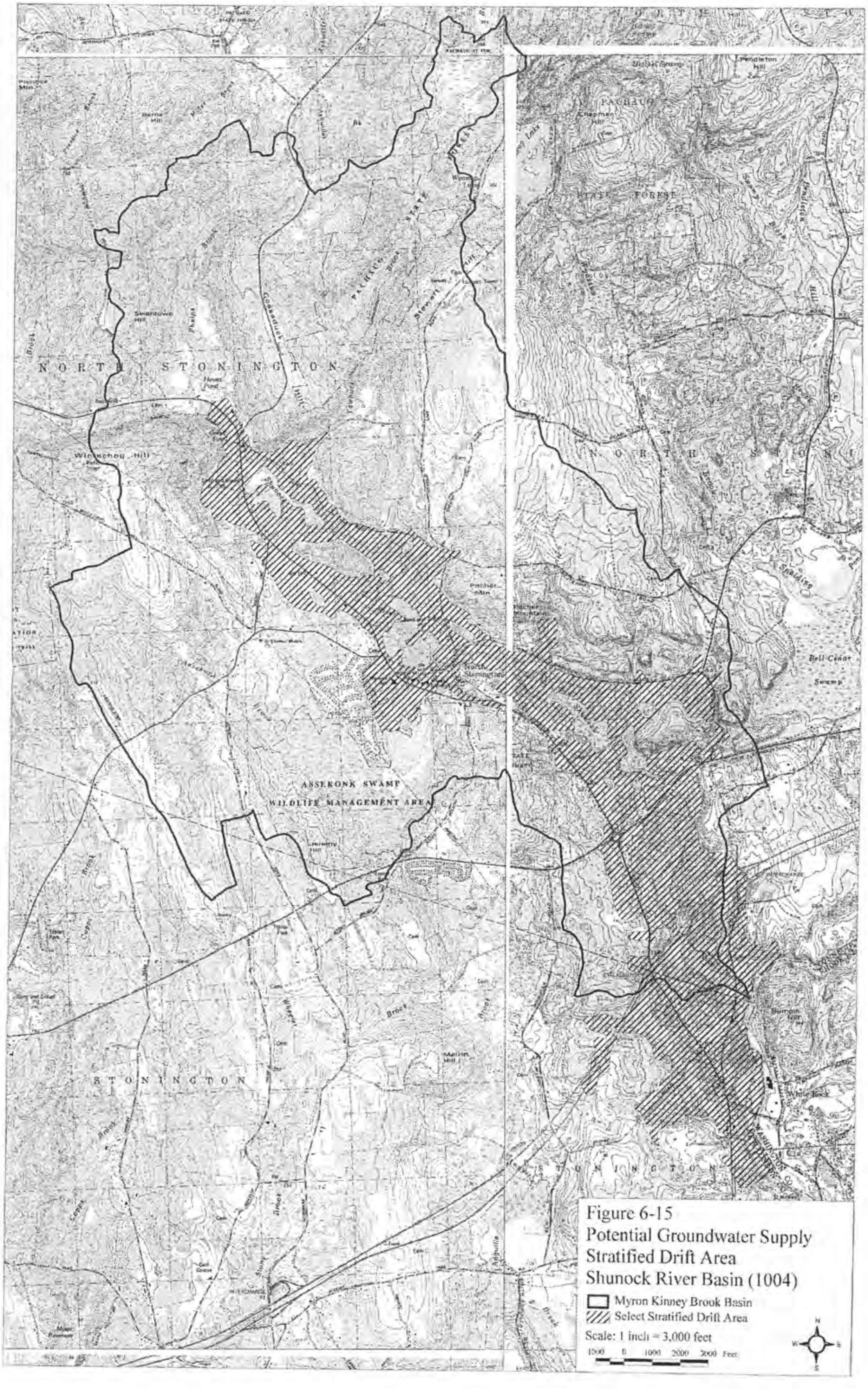


Figure 6-15
Potential Groundwater Supply
Stratified Drift Area
Shunock River Basin (1004)

Table 6-23
Inventory of Potential Ground Water Resources of Local Significance

Drainage Basin ID	Major Basin	Regional Basin	Subregional Basin	Drainage Basin Area (mi^2)	Approx. Percent Stratified Drift	Approx. 7Q10 (cfs)	Significant Saturated Stratified Drift Deposits	USGS Estimated Yield (MGD)	NDDB Areas in Basin?
1002	Pawcatuck	Pawcatuck Main Stem	Green Fall River	22.58	28%	4.40	Y	0.7	Y
2103	Southeast Coast	SE Eastern Complex	Williams Brook	6.19	20%	0.88	Y	1.4	Y
2201	Southeast Coast	SE Eastern Complex	Jordan Brook	7.57	28%	1.47	Y	0.7	Y
2202	Southeast Coast	SE Eastern Complex	Latimer Brook	17.74	18%	2.28	Y	0.3	Y
2206	Southeast Coast	SE Eastern Complex	Bride Brook	4.99	58%	1.96	Y	0.9	Y
2207	Southeast Coast	SE Eastern Complex	Fourmile River	6.56	34%	1.54	Y	0.9	Y
3600	Thames	Pachaug	Pachaug River	63.00	15%	6.87	Y	1.4	Y
3800	Thames	Shetucket	Shetucket River	1,265.38	15%	137.93	Y	0.3	Y
3805	Thames	Shetucket	Little River	43.28	19%	5.86	Y	0.3	N
3902	Thames	Yantic	Bartlett Brook	14.86	10%	1.13	Y	0.9	N
4020	Connecticut	Connecticut Main Stem	Lieutenant River	12.14	29%	2.45	Y	0.8	Y

Note: All referenced aquifers are Class A.

TABLE 6-24
Inventory of Potential Surface Water Resources of Local Significance

Drainage Basin ID	Major Basin	Regional Basin	Subregional Basin	Drainage Basin Area (mi^2)	Approx. 7Q10 (cfs)	Approx. 7Q10 (mgd)	Approx. Percent Stratified Drift	NDDB Areas in Basin?
1100	Pawcatuck	Wood	Wood River	9.09	0.39	0.25	5%	Y
1101	Pawcatuck	Wood	Brushy Brook	13.12	0.13	0.08	0%	Y
2101	Southeast Coast	SE Eastern Complex	Anguilla Brook	12.33	2.97	1.92	35%	Y
2102	Southeast Coast	SE Eastern Complex	Copps Brook	7.54	0.77	0.50	14%	Y
2105	Southeast Coast	SE Eastern Complex	Haleys Brook	7.56	1.17	0.76	22%	Y
2202	Southeast Coast	SE Eastern Complex	Latimer Brook	17.74	2.28	1.48	18%	Y
2203	Southeast Coast	SE Eastern Complex	Oil Mill Brook	5.21	1.15	0.74	32%	N
2207	Southeast Coast	SE Eastern Complex	Fourmile River	6.56	1.54	0.99	34%	Y
3601	Thames	Pachaug	Great Meadow Brook	6.31	1.02	0.66	23%	Y
3602	Thames	Pachaug	Mount Misery Brook	8.53	1.61	1.04	27%	Y
3603	Thames	Pachaug	Denison Brook	4.02	1.63	1.05	60%	N
3604	Thames	Pachaug	Myron Kinney Brook	6.09	1.51	0.97	36%	Y
3605	Thames	Pachaug	Billings Brook	5.92	1.70	1.10	42%	Y
3716	Thames	Quinebaug	Broad Brook	16.37	2.54	1.64	22%	N
3717	Thames	Quinebaug	Choate Brook	5.16	0.46	0.30	12%	Y
3804	Thames	Shetucket	Beaver Brook	11.33	1.91	1.23	24%	Y
3901	Thames	Yantic	Exeter Brook	5.55	0.94	0.60	24%	N
3905	Thames	Yantic	Pease Brook	12.31	1.10	0.71	12%	N
4008	Connecticut	Connecticut Main Stem	Cold Brook	7.48	1.11	0.72	21%	N
4011	Connecticut	Connecticut Main Stem	Reservoir Brook	6.98	0.76	0.49	15%	N
4012	Connecticut	Connecticut Main Stem	Carr Brook	6.77	0.83	0.53	17%	N
4016	Connecticut	Connecticut Main Stem	Whalebone Creek	14.63	1.30	0.84	12%	Y
4701	Connecticut	Salmon	Raymond Brook	9.05	0.69	0.44	10%	N
4702	Connecticut	Salmon	Judd Brook	5.11	1.43	0.93	41%	N
4703	Connecticut	Salmon	Meadow Brook	11.12	2.46	1.59	32%	Y
4706	Connecticut	Salmon	Fawn Brook	12.80	0.97	0.63	10%	Y
4801	Connecticut	Eightmile	Harris Brook	6.16	0.59	0.38	13%	N

Note: All referenced watercourses are Class A.

6.10 Implementation Strategy

The development of new water supply sources, both regionally and locally, will take considerable planning and analysis. The following is a summary of steps that would need to be taken for each source.

- Investigate potential yields through preliminary geologic investigation.
- Analyze area land use for compatibility with water supply source development.
- Meet with local, state and federal regulators to determine problem areas and assess the feasibility of obtaining permits. Meeting with regulatory agencies early in the source development process is critical to the financial success of the project, as source development testing is extremely costly.
- Complete analysis of potential environmental impacts. This should include analysis of instream flow rates, wetlands and wetland habitat, waste load allocation requirements, water quality, fish and wildlife habitat, and flood management issues.
- Develop a mitigation plan to offset projected impacts.
- Coordinate with host community.
- Submit permit applications to DEP and the Army Corps of Engineers as required.
- Submit permit applications to local boards and commissions as necessary.
- Install and develop test wells (for groundwater sources) and/or complete stream flow analysis (for surface water sources) to verify source yields and permit limits.
- Complete detailed land use analysis to determine necessary aquifer protections areas.
- Implement changes in land use regulations necessary to protect the source.

- Design and construct infrastructure necessary to deliver water to the distribution system, including any treatment and pumping systems.

Planning Issues

The majority of systems serving greater than 1,000 people need to secure new sources of water in order to satisfy projected demands. Most, but not all of these systems have identified potential supply sources. Several are currently involved in source exploration or permitting. Others have identified a future need, with no immediate plans. Given the time and potential expense associated with development of new supplies, some of these systems may be in jeopardy of not meeting system demands with an adequate margin of safety.

Each municipal Plan of Conservation and Development should address the realities of the municipality's water supply issues and needs. In those cases where there is currently not enough water to meet community growth plans, the community has two options: increase supply or reduce demand. Each municipal Plan of Conservation and Development should describe (1) how water supply sources are to be developed or acquired and/or (2) how demand (i.e. growth) is to be curtailed.

Permitting Issues

Permitting plays a critical role in the success of new source development. Meeting with regulators at the local, state and federal levels early in the development process is critical to establishing a successful implementation plan. Each potential source has distinct environmental issues associated with its development. Source developers will need to be aware of these issues before embarking on a program of costly testing and development.

At the State level, source development will require a diversion permit. It may also require a Stream Channel Encroachment Line permit and, for sources in tidal areas, a Structures, Dredging and Fill permit. 401 Water Quality Certification will also be required if the project is regulated by the Army Corps of Engineers. At the federal level the Army Corps of Engineers regulates the filling or discharge to wetlands and navigable waters. The development or expansion of surface water supplies typically requires Corps involvement.

Treatment Issues

Water quality analysis will dictate the treatment needs of each source. Surface water supplies will require construction of a treatment system that may include filtration, coagulation and flocculation, clarification, aeration, disinfection, and/or iron and manganese removal. Treatment facilities will generate waste process waters and sludges that must be disposed of off-site.

Groundwater sources typically require less treatment than surface waters. In many cases, the soil matrix provides sufficient filtration to sustain drinking water quality. Iron and manganese are the two most common constituents found in groundwater and may require treatment. Disinfection is required for groundwater systems and oftentimes pH adjustment is necessary before distribution.

Water Supply Needs and Infrastructure Requirements

Table 6-25 provides a summary of systems projecting deficits within the 50-year planning period and potential future supplies (and providers) to offset these deficits. Overall, future water supplies are predominantly located in the eastern portion of the study area. Demand centers are located throughout the region with concentrations in the center (Norwich, Montville, Preston), east (North Stonington) and the coast (East Lyme, New London, Groton, Stonington). Colchester and East Hampton in the western portion also project deficits.

The Norwich DPU may be able to develop sources in the Yantic River watershed to supplement existing supplies. Norwich has already begun assessing the feasibility of developing groundwater wells in Franklin to supplement its supplies. Franklin is within the existing service area of Norwich, indicating that the development of a source in this area may require minimal infrastructure improvements.

TABLE 6-25
Summary of Systems Requiring Additional Supplies in Excess of 100,000 gpd in the 50-Year Planning Period and Identification of Potential Future Sources/Providers

Deficit Area	Potential Future Source/Provider
East Region	
[redacted]	[redacted]
Colchester	Sherman Brook, Judd Brook [2]
Norwich	Yantic River
Western Montville	East Branch Eight Mile River via Salem, Oxoboxo Aquifer
Eastern Montville	New London Interconnection, Hunts Brook
East Lyme	Connecticut Water Company, Niantic River, Hunts Brook
West Region	
Preston	Shewville Brook
North Stonington	Shunock River, Billings Brook, Myron Kinney Brook, Green Fall River, Wyassup River, Ashaway River
Eastern Stonington	Anguilla Brook, Pawcatuck River
Groton/Stonington	From North Stonington via Ledyard or from Stonington
New London	Hunts Brook

Note:
1. Source identified in studies completed by East Hampton WPCA
2. Not regionally significant supplies

A number of potential sources are located within North Stonington. Infrastructure improvements would be necessary to transfer water from this area to Groton, New London, Stonington and beyond.

Water deficits are projected for Montville throughout the planning period. Preliminary planning indicates that eastern Montville may look to New London for supplies. At the present time New London has adequate capacity, but does project a deficit within the 20-year planning period. New London has been assessing the feasibility of developing supplies within Hunts Brook to supplement the exist[redacted]

East Lyme has projected a deficit within the five-year planning period and is working with Connecticut Water Company to meet future demands. The Niantic River may be a feasible source for a future groundwater supply, provided salt water intrusion does not preclude its use.

East Hampton and Colchester have been assessing future water supplies within their respective systems. Each system has targeted areas that have been determined as part this analysis to be regionally insignificant. The Jeremy River watershed is located in Hebron and Colchester and has been identified as a potential regionally significant source. Colchester may wish to assess the feasibility of developing supplies in this watershed. East Hampton has identified [redacted] a potential source. Preliminary investigation indicates that this aquifer may [redacted]

Potential Constraints

Downstream users of surface waters and environmental groups can pose restrictions on water supply development in addition to regulatory restrictions. The Connecticut Environmental Policy Act was recently used as a basis for intervention in a diversion permit application. The recreational and aesthetic value of a waterbody or watercourse, as well as downstream water usage, must be considered with the development of new water supplies and reactivation of inactive water supplies. Local municipal planning staff can be a good resource in determining downstream uses and potential conflicts.

The consequences of not developing new water supplies in the future include the potential for moratoriums on new connections, limits on economic development, increases in water pricing, and water rationing or allocation among users.

6.11 Recommendations

Based on planning data, the region will have excess water supply through the 50-year planning period if all available regional sources are developed (an unlikely scenario). The total potential yield of the regionally significant groundwater sources is 28.0 mgd as compared to the projected 20-year deficit of 0.3 mgd and the 50-year deficit of almost 16 mgd. While much of the previous discussion has focused on regional supplies, supply sources of local significance should also be pursued by individual systems to meet some or all their demand.

The following potential sources of regional significance should be considered for development based on their proximity to projected future system deficits: (1) Connecticut River Aquifer; (2) Hunts Brook; (3) Yantic River aquifer; (4) Shunock River; (5) Wyassup River; and (6) Shewville Brook. The total yield of these sources is estimated to be on the order of 12.5 mgd. Additional sources would need to be developed in the later portion of the 50-year planning period.

Source development should begin as early as possible with preliminary source investigation. Potential source locations should be reviewed with local, state and federal regulatory agencies as early as possible in the development process. Regulators should be involved in the development of plans to assess yields and potential impacts as early as possible. Involvement of regulatory agencies early in the development process will be critical to the successful development of new sources. The following recommendations are proposed:

1. Funding for additional study of regional water supply development is recommended. At its October 2000 meeting, the WUCC voted to request the Southeastern Connecticut Council of Governments to pursue funding for continued work toward resolution of the potential water supply shortfall in the southeast region. Such funding could address planning for future supply sources as well as development of a detailed implementation strategy. Additionally, this group could serve as the forum for a coalition of those communities that have potential future water supplies, and those in need of water.

2. The WUCC membership should play an active role in developments in diversion permitting in Connecticut. This program has been under review by numerous entities, including the Department of Environmental Protection. Future changes to the program are likely.

3. Serious consideration must be given to regional water management vis-à-vis interconnecting supplies as well as the managed use of surface water hydraulics and hydrology to make the most efficient use of existing storage impoundments. This could be accomplished in part though peak flow skimming, particularly during drought periods, and in instances where a contributing watershed is undersized in comparison to the storage capacity of the impoundment.

4. Investigate the use of regional supplies in conjunction with regional interconnections to better distribute available supplies to meet growing demands. This will require the cooperation of many entities, both public and private.

5. Consider and evaluate alternative treatment technologies, both now and in the future.

6.12 Demand Management Methods

As an alternative to developing new water supply sources (or at least to prolong the ability of existing supplies to meet demands), various long term planning objectives have been identified, including the use of non-potable supply sources for non-potable uses, water reuse, use of existing inactive water supplies, future potential reallocation of diversion permits, and consideration of alternative and innovative treatment techniques. Each is described below.

Use of Non-potable Sources of Supply for Non-potable Uses – Certain types of industrial, commercial, and agricultural users consume potable water in processes that do not require potable water. It may be possible to convert some of these users (e.g. golf course irrigation) to non-potable supply sources. Other high volume users should also be evaluated for their potential to use non-potable water. It is noted, however, that certain industrial uses require supply water that is of a higher quality than drinking water and some must further treat public water to meet their processing needs.

There are many Class B water users who have developed private sources and transmission systems. Examples of Class B users include farms, industrial cooling and wash water, nurseries, golf courses, quarries, and power plants. Public water companies may be able to either directly provide Class B water or help major water users to develop Class B sources as an alternative to potable water.

In order for a public water company to develop and provide Class B water, there would need to be sufficient demand from one or more customers. Coordination with DPH with regard to regulatory issues would be necessary, as would multiple controls to avoid cross connections with potable public water systems. Some industries will have limitations on the quality of non-potable water that they can accept (e.g. food processing or pharmaceutical manufacturers). Specific concerns could include pH, dissolved or suspended solids, trace metals, salinity, and algae causing nutrients.

If non-potable waters are returned to the source stream near the withdrawal point, there may be minimal impact on the aquatic ecosystem. However, if the water is consumed (e.g., irrigation, evaporative cooling) or returned elsewhere, then impacts could result. In this case, it would be preferable to obtain the water from one of the larger rivers to minimize flow diminution.

Water Reuse – Water reuse is a viable alternative to development of new water supplies. As an example of this, the shopping outlets at Clinton Crossing are equipped with a gray water reuse system. This type of technology reduces potable water demands and lessens the burden on subsurface disposal systems. Consideration of similar systems on future developments should be given.

Use of Existing Inactive Water Supplies – There are inactive water supplies in the southeast region that may have potential for reactivation. For instance, the Norwich Department of Public Utilities has several inactive reservoirs that may have the potential to be reactivated. Other systems have inactive or emergency supplies, such as Portland's Reservoir.

Future Potential Reallocation of Diversion Permits – At present, it is not possible to reassign or reallocate a diversion permit unless the use of the diversion remains consistent and written permission is received from the Commissioner of the Department of Environmental Protection. However, this could change in the future. There may be inactive diversions still "on the books" that could potentially be reassigned if there were a change in the diversion statutes and regulations. Similarly, there are instances where the registered or permitted diversion rates are many times greater than the safe yield or even peak daily withdrawals. A mechanism for reallocation of these diversions may be possible under future regulations.

Consideration of Alternative and Innovative Treatment Techniques – Innovative treatment and supply augmentation techniques should be considered. These could include anything from desalination of groundwater to artificial recharge, spreading basins, or induced streambed infiltration. It should be noted, however, that development of water supplies in waterbodies that receive direct waste discharges is not allowed under current statutes and regulations. Conversion of Class B resources to Class A is also a potential if point source discharges were eliminated or relocated. The WUCC recommends that investigation of future supply sources in GA aquifers be given priority, however if regulatory conditions change, GB aquifers may need to be investigated as well.

Section 7

7.0 POTENTIAL IMPACT OF THE COORDINATED PUBLIC WATER SYSTEM PLAN ON OTHER USES OF WATER RESOURCES

Information presented in this section evaluates the potential impact of developing future regional supply sources identified in Section 6.0. Potential impacts were evaluated with regard to the following resources:

- Water Quality
- Minimum Streamflow
- Flood Management
- Recreation
- Hydropower
- Natural Diversity Data Base Areas of Environmental Concern
- Aquatic Habitat
- Riparian Rights
- Waste Load Allocation

The review and information provided herein is based on published information only. Detailed review and field analysis of each source will be required prior to source development.

The projected aquifer and stream yield has been compared to the 7Q10 flowrate for each source. It is assumed that permits would not be issued for the development of a source where the yield is greater than 50% of the 7Q10 flow. While permit criteria varies depending on the resource, 50% of 7Q10 is used as a benchmark for planning purposes.

The only readily available information with regard to riparian rights is contained in the diversion permitting inventory maintained by the Department of Environmental Protection. Other riparian rights may exist as recorded in land record deeds, however, these have not been evaluated by the WUCC. Additionally, it is noted that conflicts may exist between those entities holding diversion permits and other individuals with legitimate riparian rights.

7.1 Jeremy River (Basin 4705)

The Jeremy River was identified as a potential surface water source. A run-of-river water supply system could potentially yield up to 2.2 mgd.

Water Quality and Minimum Streamflows

Water quality in the Jeremy River is Class A. The 7Q10 flow rate of the Jeremy River is 3.96 mgd. The mean flow rate of the Jeremy River is 77.7 mgd. The withdrawal of 2.2 mgd would represent 56% of this low flow and could potentially impact water quality. However, it may be possible to withdraw a lower volume with acceptable impacts. Well testing and instream flow analysis would likely be necessary to determine whether a groundwater well or wellfield would cause an unacceptable impact on the adjacent surface watercourse.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Impacts on recreation in the Jeremy River would occur if instream flows were significantly diminished. The river is stocked by DEP and has been the focus of a number of fisheries related improvement projects. Excessive reductions in streamflows could adversely impact recreational fishing.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there is one area of concern located in the upper reaches of the watershed near the Salmon River State Forest. This area would not likely be impacted by the development of future water supplies in the watershed. However, additional analysis would be needed.

Aquatic Habitat

See discussion under recreation.

Diversions

Current water users in this basin include DEP, which maintains a consumptive diversion for fisheries related uses. The Colchester Department of Public Works has a diversion permit pending for its [redacted], which is located within this basin. The allocation of water should be reviewed to determine the remaining capacity of the watershed.

Waste Load Allocations

There are no known wastewater discharges to the Jeremy River. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.2 Ashaway River (Basin 1003)

The Ashaway River was identified as a potential surface water source with an expected run-of-river yield in the range of 1.39 mgd.

Water Quality and Minimum Streamflows

Water quality in the Ashaway River as Class A. The 7Q10 flowrate is estimated to be 4.67 cfs. The withdrawal of 1.39 mgd (2.15 cfs) would represent 46% of the 7Q10 flowrate, and 6.6% of the mean annual flow of the river. It may be feasible to withdraw water in these volumes without causing adverse impacts to water quality. However instream flow analysis should be conducted to confirm this.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation on the Ashaway River is not expected to be significantly impacted by development of a water supply source. Although during drought periods, water surface elevations could be lowered. This should be analyzed in detail to determine if significant impacts to recreation would result.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there is one area of concern located on the Connecticut/Rhode Island border. This area would need to be investigated further before any supply source development activities are considered.

Aquatic Habitat

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rates. Site-specific analysis is necessary to adequately quantify potential impacts.

Diversions

There are no existing diversions within this watershed on file with DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations

The Ashaway River does not receive wastewater discharges at the present time. The Pawcatuck River may accept wastewater effluent in Westerly, however that portion of the Pawcatuck River is tidally influenced. Diversion of water from the Ashaway River is not expected to limit the waste assimilation capacity of the Pawcatuck River.

7.3 Sherman Brook (Basin 3903)

Sherman Brook is a subregional basin located in the Yantic River regional basin. The brook was identified as a potential source for up to 1.15 mgd from a run-of-river withdrawal.

Water Quality and Minimum Streamflows

Water quality in Sherman Brook is Class A. The diversion of 1.15 mgd (1.78 cfs) would represent 14.5% of the 7Q10 flowrate of the stream and 4% of the mean annual flow. It may be feasible to withdraw water at 1.15 mgd without causing adverse impacts on water quality. However, potential impacts on instream flows and water quality would need to be assessed further prior to development of a new supply source in this basin.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Sherman Brook is a small stream with existing recreational uses limited to fishing in the downstream reaches of the watershed. This is not likely to be impacted, provided a reasonable minimum streamflow is maintained.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

No areas of environmental concern have been identified within the Sherman Brook watershed based on a review of DEP's NDDB. However, potential impacts to wetlands and habitat would need to be reviewed in detail prior to the development of a new supply source.

Aquatic Habitat

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rate. Site-specific analysis will be necessary to adequately quantify potential impacts.

Diversions

There is one diversion registration on file for the Sherman Brook watershed. This diversion is for a non-consumptive use and development of new water supplies is not anticipated to impact existing diversions.

Waste Load Allocations

There are no known wastewater discharges to Sherman Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.4 Green Fall River (Basin 1002)

Green Fall River watershed was identified as a potential location for a surface water intake. The river is estimated to be able to provide up to 1.13 mgd from a run-of-river withdrawal.

Water Quality and Minimum Streamflows

Water quality in Green Fall River as Class A. The 7Q10 flowrate is estimated to be 4.40 cfs, indicating that the diversion of 1.13 mgd (1.75 cfs) would represent almost 40% of the 7Q10 low flow of the river. The withdrawal rate would represent approximately 4% of the 41.5 cfs mean flow. A diversion from this watershed has the potential to impact water quality during low flow periods and should be evaluated further. The flow reduction would be expected to have a negligible impact on water quality during mean flow periods.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation on the Green Fall River is limited to sport fishing. Impacts to recreation resulting from the development of a surface water supply would need to be assessed further.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are areas of concern located in the upper portion of this watershed. While this does not appear to be in conflict with development of water supplies in the lower basin, additional analysis would need to consider these areas to prevent any adverse impacts.

Aquatic Habitat

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rates. Site-specific analysis is necessary to adequately quantify potential impacts.

Diversions

There are no diversion registrations or permits on file with DEP for this watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations

There are no known wastewater discharges to Green Fall River. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.5 Shunock River (Basin 1004)

The 16.55 square mile Shunock River watershed is estimated to have the potential to supply up to 0.83 mgd from a run-of-river withdrawal. Groundwater wells are estimated to yield up to 1.3 mgd.

Water Quality and Minimum Streamflows

The Shunock River is a Class A surface water body. The 7Q10 flowrate is estimated to be 3.11 cfs, with an annual flow rate of 29.8 cfs. The withdrawal of 0.83 mgd (1.28 cfs) would represent 41% and 4% of the 7Q10 and mean flow rates respectively. While this volume has the potential to impact water quality during drought periods, it is not expected to result in significant impacts during mean flows.

Well testing and instream flow analysis would be necessary to determine whether a groundwater well or wellfield (or direct surface water withdrawal) would cause an unacceptable impact on the adjacent surface watercourse. Potential impacts associated with the development of groundwater supplies would need to be assessed based on the results of pump tests. The influence of well operations on the streamflows and water quality would be site specific.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation on the Shunock River could potentially be impacted by the development of a new water supply, particularly during low flow periods. The reduction in stream flow has the potential to impact fishing and boating activities. Groundwater wells may result in less overall impact.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there is one area of environmental concern within this watershed. While this area is in the upper portion of the watershed, additional analysis would need to assess potential adverse impacts to this area.

Aquatic Habitat

DEP Fisheries indicates that the Shunock River supports a regionally significant coldwater fishery (Brian Murphy, memo 11/22/00). The river is stocked with brook, brown and rainbow trout, blacknose dace, longnose dace, common shiner, fallfish, white sucker and American eel. The anadromous fish species alewives, blueback herring, and sea-run brown trout have also been identified in this river.

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rates. Site-specific analysis is necessary to adequately quantify potential impacts.

Diversions

The SCWA maintains a diversion of [redacted] r a groundwater well within the [redacted]. The development of any water supplies in this basin should assess the cumulative impacts of the existing and proposed diversions.

Waste Load Allocations

There are no known wastewater discharges to the Shunock River. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.6 Shewville Brook (Basin 3002)

Shewville Brook was identified as a potential surface water source with the ability to provide up to 0.7 mgd from a run-of-river withdrawal.

Water Quality and Minimum Streamflows

Shewville Brook is a Class A waterbody. This 14.46 square mile watershed has an estimated 7Q10 flow rate of 1.39 cfs and a mean flowrate of 16.9 cfs. The development of a 0.7 mgd (1.1 cfs) water supply source would represent 79% of the 7Q10 flowrate and 6.5% of the annual flowrate. It is believed unlikely that any water supply source would be permitted for volumes in excess of 50% of the 7Q10. Based on this assumption, the maximum diversion rate would be 0.695 cfs (0.45 mgd). Instream flow analysis would be necessary to assess the potential impact of a surface water withdrawal.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Maintaining a suitable minimum streamflow release rate would minimize impacts to recreation activities in Shewville Brook.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are areas of concern in both the lower and upper portions of the watershed. Three areas are identified in Cedar Swamp in the lower portion of the watershed. Additional analysis of potential supply source development in this basin would need to take these areas into consideration.

Aquatic Habitat

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rates. Site-specific analysis is necessary to adequately quantify potential impacts.

Diversions

There are no existing registered or permitted diversions in this watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations

There are no known wastewater discharges to Shewville Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.7 Hunts Brook (Basin 3006)

Hunts Brook was identified as a potential source for a run-of-river surface water supply up to 0.7 mgd (1.08 cfs).[redacted] can supply a reservoir yield in the Hunts Brook basin as well as a skimming yield.

Water Quality and Minimum Streamflows

Hunts Brook is considered to be a Class A waterbody. The 7Q10 flowrate is 1.43 cfs while the mean flow is 15.3 cfs. The withdrawal of 1.08 cfs would represent approximately 75% of the 7Q10 flow of the brook. Diversions in excess of 50% of the 7Q10 flowrate may not be permitted due to the potential for unacceptable environmental impacts. A diversion of up to 0.71 cfs (0.46 mgd) may be able to be permitted from this source. It is likely that instream flow analysis would be required to assess the potential impact of a surface water withdrawal.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation in the Hunts Brook watershed is not anticipated to significantly impacted at the diversion rate of 0.71 cfs. This rate would maintain streamflows of 14.5 cfs during mean flow periods.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there is an area of concern located at the mouth of Hunts Brook near the Thames River. Future analysis of potential water supplies would need to take this area into consideration to prevent any adverse impact.

Aquatic Habitat

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rates. Site-specific analysis is necessary to adequately quantify potential impacts.

Diversions

The New London Water Department maintains a diversion for 0.25 mgd from this watershed. The cumulative impacts of this diversion and any proposed diversion should be considered prior to development of any new sources.

Waste Load Allocations

There are no known wastewater discharges to Hunts Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.8 Wyassup Brook (Basin 1001)

Wyassup Brook was identified as a potential surface water source with an estimated run-of-river yield of 0.6 mgd (0.92 cfs).

Water Quality and Minimum Streamflows

Water quality in Wyassup Brook is Class A. The 7Q10 flowrate is estimated to be 3.9 cfs with a mean flow rate of 20.6 cfs. The withdrawal of 0.92 cfs would represent almost 24% of the 7Q10 flow and 4.5% of the mean flow of the stream. This volume is not expected to have a significant impact on water quality in the brook.

Flood Management

The development of surface water supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

The most predominant recreation activity in the basin is fishing. This is not expected to be significantly impacted at a withdrawal rate of 0.92 cfs.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are areas of concern located in the upper and lower reaches of the watershed. There are three areas of concern associated with Bell Cedar Swamp, located in the lower reaches of the watershed. Additional analysis of potential supply development would need to take these areas into consideration.

Aquatic Habitat

The potential exists to adversely impact aquatic habitat resources. Impacts are site specific and will be dependent upon the proposed withdrawal rates. Site-specific analysis is necessary to adequately quantify potential impacts.

Diversions

There are no existing registered or permitted diversions within this watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations
There are no known wastewater discharges to Wyassup Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.9 Pawcatuck River (Basin 1000)

The Pawcatuck River was identified as a potential location for the development of groundwater wells yielding up to 7.2 mgd (11.1 cfs).

Water Quality and Minimum Streamflows
While surface water in the Pawcatuck River is classified C/B, groundwater is mostly GA with some limited areas of GB and GC. The location of future water supply wells should be gauged against the areas of impacted water quality. The diversion of 11.1 cfs would represent 20% of the 7Q10 flow rate of the watershed, assuming a conservative 1:1 relationship between groundwater withdrawals and surface water impacts. The actual impacts to surface waters would need to be determined from pump tests and groundwater modeling.

Flood Management
The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation
The withdrawal of 11.1 cfs would not likely adversely impact recreation in the watershed. The withdrawal volume is a small fraction of the 7Q10 flowrate.

Hydropower
There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern
NDDB mapping dated July 2000 indicates there are areas of concern in this watershed located along the shoreline. These are not likely to be impacted by the development of groundwater wells, but this should be confirmed during the investigation of potential well sites.

Aquatic Habitat
Impacts to aquatic habitat resulting from the development of groundwater sources would likely be minimal. Impacts would be dependent on the relationship between groundwater withdrawal and surface water impacts. This would need to be determined through pump testing and analysis of instream flows.

Diversions
The Westerly Water Department maintains a diversion of 1.00 mgd for a groundwater well located in Stonington. Potential impacts of additional withdrawals would be dependent upon location and volume of withdrawal, and would need to be evaluated further prior to development of new supplies in this basin.

Waste Load Allocations
The Pawcatuck River is the receiving stream for effluent discharge from the City of Westerly. This discharge is located downstream of the stratified drift aquifers in a tidally influenced portion of the river. The development of groundwater wells is not expected to impact the assimilation capacity of the river.

7.10 Yantic River (Basin 3900)

Potential groundwater supplies in the Yantic River are estimated to yield [redacted]. While the main stem of the Yantic River is Class B, numerous tributaries which feed it are Class A streams with potential for surface water supplies. The combined surface water yield from the emergency supplies of [redacted] and [redacted] Reservoirs are estimated to be on the order of [redacted]

Water Quality and Minimum Streamflows
The development of groundwater supplies to yield 4.9 mgd could potentially impact water quality in the Yantic River, as it would represent 52% of the 9.4 mgd 7Q10 flowrate of the river. This assumes a 1:1 ratio of groundwater withdrawals to surface water flow diminution. It may be possible to withdraw a lower volume with acceptable impacts. Well testing and instream flow analysis would be necessary to determine whether a groundwater well or wellfield would cause an unacceptable impact on the adjacent surface watercourse. Impacts to instream flow rates associated with the development of groundwater wells would need to be assessed following pump testing and analysis.

Flood Management
The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

The DEP has established Stream Channel Encroachment Lines for most of the Yantic River through Norwich and Bozrah. Any development within the limits of this regulated area would need to be assessed in accordance with DEP requirements.

Recreation
Recreation is not likely to be adversely impacted by the development of groundwater supplies in this watershed so long as in-stream flows are not depleted. Potential impacts

will need to be assessed following pump testing when impacts to stream flows are determined.

Hydropower

Review of the DEP's diversion inventory indicates there are no hydropower operations located in the Yantic River watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are no areas of concern located within this basin.

Aquatic Habitat

DEP Fisheries, however, has indicated that the river is a significant recreational fisheries resource (Brian Murphy, memo 11/22/00). The river is stocked annually with rainbow, brook and brown trout. Fisheries issues will need to be assessed in detail prior to development of any supply sources.

Aquatic habitats could potentially be impacted by the development of groundwater sources. The occurrence of impacts would be directly related to the proposed withdrawal rate and the hydrogeology of the area. Potential impacts will need to be assessed in detail following pump testing and analysis.

Diversions

[redacted]

Waste Load Allocations

There are sewage treatment plants discharging to the Yantic River, hence its Class B water quality designation. Therefore any future diversion would need to evaluate potential impacts on waste assimilation.

7.11 Connecticut River (Basin 4000)

The Connecticut River aquifer was identified as a potential location for the development of groundwater wells with a potential yield of up to 4.3 mgd (6.7 cfs). Aquifers in Lyme and East Hampton were identified as areas with the potential for the largest supplies.

Water Quality and Minimum Streamflows

Water quality in the Connecticut River is Class B. The 7Q10 flow rate of the river is estimated to be over 850 cfs, indicating that the development of wells would not adversely impact water quality as they would withdraw only a small percentage of the total water available.

Flood Management

The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation in the Connecticut River is not expected to be impacted by the development of groundwater wells. The withdrawal of 6.7 cfs would represent only 0.8% of the 7Q10 flowrate of the river. Even with a 1:1 ratio of groundwater withdrawal to surface water impact, changes in river flow would not be discernible. The tidal nature of the river in its lower reaches indicates that water surface elevations and volumes would not be impacted by withdrawal of water.

Hydropower
There are a number of hydropower facilities operating within the Connecticut River basin. These facilities would not be impacted by the development of groundwater supply sources, as the volume of water withdrawn for drinking water would be negligible in comparison to river flows. Additionally, hydropower facilities are located in the upper Connecticut River basin.

NDDB Areas of Environmental Concern
There are a number of areas of environmental concern associated with the Connecticut River. The river itself is classified due to the presence of Atlantic Salmon and Shortnose sturgeon. Other areas adjacent to the river are also classified. Any site considered for development of a future source would need to be investigated to determine if it is located in an area of concern.

Aquatic Habitat
While the Connecticut River is classified as an area of environmental concern due to the presence of Shortnose Sturgeon and Atlantic Salmon, a groundwater diversion from the basin is not likely to adversely impact these fish species. This is supported by the fact that any groundwater diversion from within the southeast WUCC area would occur within a tidally influenced portion of the river. There would therefore be no measurable loss to river flows from a diversion in this area.

Diversions
There are a number of existing diversions from the Connecticut River basin. The withdrawal of groundwater adjacent to a tidally influenced section of the river is not expected to conflict with existing water uses.

Waste Load Allocations
While the Connecticut River accepts discharge from a number of treatment plants, the development of water supplies in the tidal portion of the river is not expected to adversely impact the waste assimilation capacity of the river.

7.12 Billings Brook (Basin 3605)

Billings Brook was identified as a potential location for the development of groundwater sources yielding up to 3.5 mgd (5.4 cfs).

Water Quality and Minimum Streamflows

Water quality in Billings Brook is Class A. The development of groundwater sources yielding 5.4 cfs would represent more than 100% of the 1.70 cfs 7Q10 flowrate, assuming a 1:1 ratio of groundwater to surface water impact. It may be possible to withdraw a lower volume with acceptable impacts. Well testing and instream flow analysis would be necessary to determine whether a groundwater well or wellfield would cause an unacceptable impact on the adjacent surface watercourse. Impacts to instream flow rates associated with the development of groundwater wells need to be assessed following pump testing and analysis. The relationship between groundwater and surface water impacts would need to be determined based on the results of pump testing and groundwater monitoring. The impacts to water quality will need to be assessed based on the results of further analysis.

Flood Management

The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

The proposed diversion could impact recreation if instream flows are significantly reduced.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are areas of concern in this watershed in the vicinity of Pachaug State Forest and the outlet of Billings Brook to Pachaug Pond. Development of any groundwater supply sources should take these areas into consideration.

Aquatic Habitat

Potential impacts to aquatic habitat would need to be assessed during the development of sources. Severe impacts to instream flows could impact aquatic resources of the stream.

Diversions

There are no existing registered or permitted diversions within the watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations

There are no known wastewater discharges to Billings Brook. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

7.13 Great Meadow Brook (Basin 3601)

Great Meadow Brook has a 6.3 square mile watershed within the Pachaug River regional basin. Previous water supply assessments have indicated that groundwater wells in this watershed may be capable of producing up to 2.8 mgd (4.33 cfs).

Water Quality and Minimum Streamflows

Surface and groundwater in Great Meadow Brook is considered to be Class A. A diversion of 4.33 cfs would represent more than 100% of the 0.86 cfs 7Q10 flow of the brook. Detailed analysis would need to be completed during pump testing to assess the relationship between groundwater withdrawals and streamflows. A 1:1 ratio would prevent this source from being a viable alternative for a regionally significant supply. However, it may be possible to withdraw a lower volume with acceptable impacts. Well testing and instream flow analysis would be necessary to determine whether a groundwater well or wellfield would cause an unacceptable impact on the adjacent surface watercourse. Impacts to instream flow rates associated with the development of groundwater wells need to be assessed following pump testing and analysis.

Flood Management

The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation in this watershed is largely passive. The Pachaug State Forest makes up a portion of the upper reaches of the watershed.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are areas of concern in this watershed. Development of any groundwater supply sources should take these areas into consideration.

Aquatic Habitat

Portions of this basin are listed in the DEP's NDDB, indicating the potential exists for a threatened or endangered species to be located here. Preliminary information obtained from DEP did not indicate if this species is associated with the riverine habitat. This species should be identified and evaluated during the preliminary source development phases. The withdrawal of groundwater could impact aquatic habitat significantly, especially if there is a relationship between withdrawal and instream flows. This brook has a significant wetland system associated with it and source development should make every effort to protect this system.

Diversions

There are no registered or permitted diversions within this watershed on file with DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Wasteload Allocation

There are no known wastewater discharges to Great Meadow Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.14 Anguilla Brook (Basin 2101)

Anguilla Brook was identified as a potential location for the development of groundwater wells yielding up to 3.5 mgd (5.4 cfs).

Water Quality and Minimum Streamflows

Surface water is Class A. Groundwater throughout most of the watershed is Class A, with one small area classified as GB. A diversion rate of 5.4 cfs would represent more than 100% of the 7Q10 flowrate of 2.97 cfs. However, it may be possible to withdraw a lower volume with acceptable impacts. The relationship between groundwater withdrawal and surface water impacts would need to be assessed through pump testing prior to the development of a water supply in the basin. Well testing and instream flow analysis would be necessary to determine whether a groundwater well or wellfield would cause an unacceptable impact on the adjacent surface watercourse. Impacts to instream flow rates associated with the development of groundwater wells need to be assessed following pump testing and analysis.

Flood Management

The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Recreation in this watershed is believed to be limited to sport fishing. This could be impacted if the operation of groundwater wells was found to significantly influence stream flows in the brook.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are areas of concern in this watershed that may be located within the Anguilla Brook river corridor. Development of any groundwater supply sources should take these areas into consideration.

Aquatic Habitat

Potential impacts to aquatic habitats could be significant if operation of wells impact water surface elevations. This would need to be evaluated further following pump testing.

Diversions

There are no existing registered or permitted diversions within this watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations

There are no known wastewater discharges to Anguilla Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.15 Myron Kinney Brook (Basin 3604)

Myron Kinney Brook was identified as a groundwater source with the potential to yield up to 1.0 mgd (1.5 cfs).

Water Quality and Minimum Streamflows

Water quality in this brook is Class A. The withdrawal of 1.5 cfs would represent 100% of the 7Q10 flow of the brook assuming a 1:1 ratio of groundwater to surface water. It may be possible to withdraw a lower volume with acceptable impacts. Pump testing will be needed to assess impacts associated with the development of groundwater supplies. Well testing and instream flow analysis would be necessary to determine whether a groundwater well or wellfield would cause an unacceptable impact on the adjacent surface watercourse. Impacts to instream flow rates associated with the development of groundwater wells would need to be assessed following pump testing and analysis.

Flood Management

The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Impacts to recreation in the watershed would be influenced by the impacts to streamflows. Significant impacts to streamflows could adversely impact recreation.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are a number of areas of concern in this watershed that appear to be associated with wetlands and habitat. The NDDB should be reviewed again to determine the potential impacts in specific locations prior to the development of any groundwater wells.

Aquatic Habitat

DEP Fisheries has indicated that the brook is listed as an area of concern due to a population of banded sunfish (*Ennecanthus obesus*) (Brian Murphy, memo 11/22/00). The brook and its watershed would need to be studied in detail to ensure the habitat and instream flow requirements of this species are maintained if a diversion is considered.

Impacts to aquatic habitats would be dependent on the potential impacts to water quality and instream flows. Diversity of the aquatic habitat and potential impacts to the habitat should be assessed during source development.

Diversions

There are no existing registered or permitted diversions within this watershed. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

Waste Load Allocations

There are no known wastewater discharges to Myron Kinny Brook. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.16 Eightmile River (Basin 4800)

The 62.4 square mile Eightmile River watershed was determined to have the potential to support groundwater wells yielding up to 1.2 mgd (1.8 cfs).

Water Quality and Minimum Streamflows

The estimated 7Q10 flowrate of watershed is 8.04 cfs. The withdrawal of 1.8 cfs of groundwater would represent 21% of the 7Q10 flowrate of the river (assuming a 1:1 relationship between groundwater withdrawal and surface water impacts). Pump testing and instream flow analysis would need to be conducted to quantify impacts to instream flows and water quality in the river.

Flood Management

The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation

Potential impacts to recreation may result if a reduction in streamflow occurs as a result of the groundwater withdrawal. This should be assessed following completion of pump testing and analysis.

Hydropower

There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern

NDDB mapping dated July 2000 indicates there are a number of areas of concern in this watershed that appear to be associated with the riverine wetlands and habitat. The

NDDB should be reviewed again to determine potential impacts in specific locations prior to the development of any groundwater wells.

Aquatic Habitat

DEP Fisheries has initiated a number of anadromous fish restoration projects in this watershed in recent years. This river is considered to be a valuable fisheries resource and instream flow maintenance would be a concern with any proposed diversion.

Impacts to aquatic habitat would be influenced by reductions in streamflow rates. These impacts should be assessed following testing to determine impacts to instream flows. Additionally, the Department of Environmental Protection has indicated that this basin represents a prime fisheries habitat and that all other feasible and prudent alternatives should be pursued prior to development of this resource for water supply.

Diversions

The East Haddam Fish and Game Club maintains a number of diversions of unspecified volumes from this basin. The Fox Hopyard Golf Club in East Haddam also maintains a diversion from this watershed for 0.25 mgd. The volumes of existing diversions from within this basin should be quantified and evaluated to determine if the basin has capacity to support the development of additional supplies.

Waste Load Allocations

There are no known wastewater discharges to the Eight Mile River. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

7.17 East Branch Eightmile River (Basin 4802)

The East Branch Eightmile River was identified as having the potential to support groundwater wells yielding up to 1.2 mgd (1.8 cfs).

Water Quality and Minimum Streamflows
The DEP has classified water quality in the East Branch as Class B. The withdrawal of 1.8 cfs from the basin would represent 70% of the 7Q10 flowrate of the watershed, assuming a 1:1 ratio of groundwater withdrawal to surface water impact. Pump testing and instream flow analysis would be necessary to determine the relationship between groundwater withdrawal and surface water impact.

Flood Management
The development of groundwater supplies is not expected to adversely impact flood management in the watershed. Pump houses and treatment buildings should be constructed outside of the floodplain to the greatest extent practical. Hydraulic analysis should be completed if facilities are to be constructed in the floodplain to ensure that increases in water surface elevations are prevented.

Recreation
Potential impacts to recreation may result if a reduction in streamflow occurs as a result of the groundwater withdrawal. This should be assessed following completion of pump testing and analysis.

Hydropower
There are no known hydropower facilities in the watershed based on review of the diversion records on file at DEP. Therefore no associated impacts are anticipated in conjunction with the development of new water supplies in this basin.

NDDB Areas of Environmental Concern
NDDB mapping dated July 2000 indicates there are two areas of concern in this watershed. One of these areas is in the vicinity of the stratified drift deposits in southeast Salem. The NDDB should be reviewed again to determine the proximity of this area of concern to any potential well locations. Additionally, federal legislation has been filed to begin the process of designating the Eight Mile river as a federal *Wild and Scenic River.*

Aquatic Habitat

DEP Fisheries has initiated a number of anadromous fish restoration projects in this watershed in recent years. The East Branch also supports wild trout populations. This river is considered to be a valuable fisheries resource and instream flow maintenance would be a concern with any proposed diversion.

Impacts to aquatic habitat would be influenced by reductions in streamflow rates. These impacts should be assessed following testing to determine impacts to instream flows.

Diversions

There are no existing or permitted diversions on file at the DEP for withdrawal from this watershed.

Waste Load Allocations

There are no known wastewater discharges to the East Branch Eight Mile River. Therefore no impacts to waste assimilation are anticipated in conjunction with development of new supply sources in this basin.

Section 8

8.0 FINANCIAL CONSIDERATIONS

8.1 Financing Issues

Financing issues are multi-faceted and include rate structures for customers, capitalization of improvements, and bonding. In the southeast Connecticut WUCC there is a broad cross section of financial structures, including those that are essentially an adjunct of a residential or multi-family housing complex, privately or investor-owned companies, and municipal public water systems. Each operates in a unique manner.

Financial Operation of Municipal Public Water Systems

Municipal public water systems may operate under a general municipal budget, with no direct connection of the user fees and water department budgets. Alternately, they may operate as an enterprise system of accounting, using operating revenues to fund operating and maintenance expenses as well as capital improvements. Major capital improvement projects are generally financed through revenues from water charges and general obligation bonds, with bonding expenses funded through the water department's revenues (i.e. user fees). Ideally, these systems review and analyze their water use rates such that operating and capital needs can be adequately met.

Financial Operation of Investor-Owned Public Water Systems

Investor-owned public water systems are regulated by the Department of Public Utility Control (DPUC), including regulation of the user rates that may be charged. Any increase in user fees must be justified and approved by the DPUC through a rate case process. Rate structures for investor-owned systems must provide a return on investment.

Financial Operation of Small Privately-Owned Public Water Systems

Small residential systems, such as condominium associations, may utilize a general association fee to cover miscellaneous water service expenses, with no long term capital improvement financial account.

Funding of Individual Public Water System Projects

Normal operation and maintenance costs of the public water systems in the southeast Connecticut region will continue to be supported by the individual systems. Development of many of the future supply sources will also likely be supported by the entity that is in need of such supply. These may include some of the potential future supply sources presented in Section 6.0 of this document. Interconnections among public water systems for ongoing supply and/or emergency situations are encouraged by the Department of Public Health. These types of interconnections would also likely be funded by the individual public water systems involved and have the potential for significant expenditures.

Those public water systems (municipal, private, and investor-owned) serving greater than 1,000 people are required to prepare individual water supply plans. One of the components of the individual plans is the identification of system improvements and maintenance activities. Generally, the individual plans include improvement schedules along with estimated costs and funding sources.

Funding of Regional Projects

The WUCC, as an organization, does not have an available budget with which to implement the recommendations included in this document or for other regional studies and analyses. Several possibilities exist with respect to funding of regional water supply projects in southeast Connecticut such as regional planning agency and/or state funding as described below.

Upon completion of the Coordinated Public Water System Plan, the southeast Connecticut WUCC plans to make a formal request to the Southeastern Connecticut Council of Governments to pursue funding for additional study of regional water supply development and continued work towards resolution of the potential water supply shortfall in the southeast region. Other projects of regional significance could potentially receive funding through the Department of Public Health's State Revolving Fund (SRF), which provides low interest funding for certain water supply projects.

In the absence of state or regional planning agency funding, development of regional supply sources and regional interconnections will likely be funded by the entities that would benefit from such development. This would require a collaborative effort and the necessary legal agreements with respect to the apportionment of capital expenditures and long-term operation and maintenance costs, ownership, and division of responsibilities throughout the life of the project.

8.2 Planning Cost Estimates for Implementation of Surface Supply Development

New surface water supplies must go through planning, investigation, permitting, and construction phases. Preliminary planning for future supply source development has been initiated by numerous public water systems in the region as presented in the individual water supply plans. This information was presented in summary format in the Water Supply Assessment of the Southeast Connecticut WUCC (April 1999). Preliminary region-wide planning with respect to future surface water supply source development is presented in Section 6.0 of this document.

The following discussion outlines the major aspects of implementation of surface water supply development and provides typical anticipated cost ranges. It should be noted that these cost ranges are provided for planning purposes only and specific project costs are dependent upon many site-specific factors, including the proximity of the source to the end-user, cost of land acquisition, extent of potential environmental impacts and the associated analysis required to evaluate such impact, volume of water to be withdrawn, water quality (i.e. required treatment), and site development issues.

For purposes of this document, the following discussion assumes that new surface supply sources are either run-of-river type of withdrawals or existing impoundments. The costs of land rights and construction of a new reservoir are not considered.

Source Investigation/Preliminary Design – Hydrologic and hydraulic investigation, as well as long term water quality monitoring, must be conducted prior to development of any new surface supply source. In the case of a supply from an existing impoundment, safe yield analysis will be necessary, typically with the use of a mass balance computer program, such as the Army Corps of Engineers' HEC-5 program or similar software. Source investigation, including conceptual design of facilities can range from $50,000 to well over $250,000.

Regulatory Permitting and Environmental Analysis – Regulatory permits and approvals are typically required at the local, state, and federal levels through local planning and zoning commissions and local inland wetlands commissions; the state Departments of Environmental Protection, Public Health, and Public Utility Control; and the federal Army Corps of Engineers. Environmental analysis is typically required for new source development with respect to wetlands, aquatic habitat, in-stream water flow, wildlife, vegetation, and the like. Competing uses must also be addressed, including the potential impacts on existing diversions, active and passive recreation, aesthetics, downstream waste assimilation, and other downstream uses. Regulatory permitting and environmental analysis can be extensive, depending on the exact nature of the supply source. Costs can range from under $100,000 to over $1,000,000. Future changes to the Water Diversion Act could potentially increase the costs associated with diversion permitting.

Engineering Design – Engineering design of intake structures, transmission piping, treatment systems, and distribution piping is necessary prior to construction of a new supply source. While this cost can be quite variable, and is particularly dependent upon the need for conventional treatment design, costs in the several hundred thousand dollar range are normal. This does not include the design of necessary transmission and distribution piping, or pumping stations.

Construction Costs – Construction of water intake and transmission piping and conventional treatment facilities for a surface water supply is highly variable. New conventional treatment facilities, while dependent upon capacity, are often in the several million dollar range. Less expensive, smaller package systems can be constructed for the treatment of low volumes of water.

Ongoing Maintenance Costs – Annual costs for a surface water supply source may include land leasing (if the property was not purchased), property taxes, electric supply, emergency (backup) power supply, water treatment equipment and chemicals, pipe and pump repairs and replacement, and regulatory compliance such as water testing. Of course, many of these costs will already be familiar to larger systems, and the incremental costs associated with a new supply source may not be significant after several years.

8.3 Planning Cost Estimates for Implementation of Groundwater Supply Development

Similar to surface water supply development, new groundwater supplies must go through planning, investigation, permitting, and construction phases. The following discussion outlines the major financial aspects of implementation of groundwater supply development. It should be noted that these numbers are typical ranges and that actual costs will vary significantly, depending upon the specific site and supply issues.

Development of a new ground water supply source, often known as a wellfield, is an extensive process. To first site a potential wellfield, available land must be located in a relatively undeveloped area, keeping in mind that property within 200 feet of each well must be in the direct control of the water purveyor, and that pending aquifer protection regulations will extend certain indirect controls outward from the 200-foot limit. Land purchase costs alone may be prohibitive in some cases. The wellfield must also be within an acceptable distance of the service area such that water main extension is feasible. Thus, these two goals are at odds (i.e. the wellfield cannot be within the most densely developed area, even though the water main costs would be lowest for such a case).

Source Investigation/Test Borings and Pump Testing –Source investigation includes review of geological information based on published data (bedrock and surface geological maps, soil survey maps, and well records) and evaluation of hydrogeologic conditions, including watershed size and recharge capability. Site inspections are also conducted in this phase to visually assess the area. Widely spaced test borings are then drilled to confirm subsurface conditions and, if conditions are favorable (i.e. suitable soil gradation, thickness of stratum, depth to water, etc.), small diameter well screens and standpipes are installed and the wells are pump tested. Water levels in the pumping well and surrounding observation wells are monitored throughout the test to evaluate aquifer response. Water quality samples are also typically collected and analyzed in the preliminary investigation phase.

Following initial investigations, large diameter wells and smaller diameter monitoring wells are typically installed and long term yield testing is conducted in accordance with DEP and DPH requirements to evaluate safe yield and for Level A aquifer modeling. Initial source investigation is generally in the range of $100,000 to $250,000.

Regulatory Permitting and Environmental Analysis – Similar to surface water supplies, groundwater supply development typically requires regulatory permits and approvals at the local, state, and federal levels. Municipal planning & zoning and inland wetlands permits and approvals must be obtained in most cases. If there are any direct wetland impacts (due to filling or construction) or indirect wetland impacts (due to groundwater drawdown), Army Corps of Engineers permitting will likely be necessary, as well as a 401 Water Quality Certification through the Department of Environmental Protection.

If the wellhead(s) must be raised above the 100-year flood elevation of the nearest surface water body, filling will be necessary. As a result, a hydraulic analysis of the floodplain must be completed to evaluate the need for FEMA map adjustment, or to design mitigation that will compensate for the filling. In some cases, the required filling will tie this process back to the wetland permitting.

A DEP water diversion permit must be obtained if the wellfield joins a system with daily withdrawals exceeding 50,000 gpd, even if the wellfield itself does not draw more than 50,000 gpd. In most cases, the water diversion permit application is the most extensively "supported" document of all the regulatory applications. For example, the wetland and hydraulic analyses described above are required, along with a report that discusses the results of a five-day aquifer pump test. If the wellfield is completed in stratified drift, numerical modeling must be completed in accordance with the Level A mapping regulations. The numerical model is used to predict the response of the aquifer and watercourses under different pumping scenarios. Other potential environmental and cultural resource impacts require evaluation prior to obtaining the necessary regulatory permits for groundwater withdrawal, often including instream flow modeling.

Regulatory permitting and associated environmental investigations can range from $50,000 to upwards of $1,000,000.

Engineering Design – Engineering design of production wells, transmission piping, treatment systems, and distribution piping is necessary prior to construction of a new groundwater supply source. Engineering will be necessary to design water main sizes and layouts, pump sizes and settings, treatment facility layout, and storage. Capital expenses include water mains, pipes, pumps, treatment facilities, fill material, access roads, fencing, a central pump house (or houses), and usually a clearwell or storage facility. Depending on the distance between the wellfield and the service area, and the difference in elevation, a booster pumping station may be necessary. While engineering design can be quite variable, costs in the several hundred thousand dollar range and higher are typical.

Construction Costs – Construction of water intake, transmission and distribution piping, and treatment facilities for a groundwater supply would be expected to be in the range of several hundred thousand dollars to over a million dollars, depending upon the specific project needs.

Ongoing Maintenance Costs – Similar to surface water supplies, annual costs for a wellfield may include land leasing (if the property was not purchased), property taxes, electric supply, emergency (backup) power supply, water treatment equipment and chemicals, pipe and pump repairs and replacement, and regulatory compliance such as water testing.

8.4 Planning Cost Estimates for Implementation of Regional Interconnections

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