11.0 ALTERNATIVE #7 – NEW WELLFIELD NEAR MANSFIELD HOLLOW LAKE

11.1 ASSESSMENT OF FEASIBILITY

Unlike an interconnection with an established supply source, the development of a new groundwater source cannot be evaluated with respect to existing available water. Instead, the ability to develop a particular yield from a new groundwater source is dependent upon available historical information from borings, monitoring wells, and site-specific studies. This data has been complied for each of five potential wellfields nearby Mansfield Hollow as follows:

- Alternative #7A is potential wellfield MH-2, located on the agricultural Commonfields owned by the Town of Mansfield located north of the western part of Bassett Bridge Road.

- Alternative #7B is potential wellfield MH-3, located in the forest behind Southeast Elementary School owned by the Town of Mansfield on the south side of Route 89.

- Alternative #7C is potential wellfield MH-4, located on federally-owned land north of Mansfield Hollow Lake.

- Alternative #7D is potential wellfield MH-5, located on federally-owned land east of Mansfield Hollow Lake, west of Kaya Lane, and near the Atwoodville Trail.

- Alternative #7E is potential wellfield MH-6, located on federally-owned land west of Mansfield Hollow Lake and southeast of Bassett Bridge Road.

A number of historic and more recent publications have analyzed potential groundwater aquifers in the Mansfield Hollow Lake area. These are briefly summarized below.

1960s era USGS Water Resource Bulletin

The U.S. Geological Survey (USGS) Report entitled *Water Resources Inventory of Connecticut, Part 2 – Shetucket River Basin* (1967) shows on Plate B that:

- The aquifer near MH-2, MH-3, and MH-6 consists of fine-grained stratified drift. The report notes that the average permeability of the deposits in the saturated section may range from 15 to 1,500 gallons per day per square foot (gpd/ft^2), equivalent to a hydraulic conductivity ranging from 2 to 200 feet per day (ft/d), but at most sites is reportedly less than 350 gpd/ft^2 (equivalent to a hydraulic conductivity of 47 ft/d). Plate B notes that an average permeability of greater than 600 gpd/ft^2 (equivalent to a hydraulic conductivity of 80 ft/d) can occur at sites with buried coarse-grained deposits. Plate D shows that that these wells do not lie within a "favorable ground water area." The nearest "favorable" area is located beneath Mansfield Hollow Reservoir.

- The aquifer near MH-4 consists of coarse-grained stratified drift. The report notes that the average permeability of the deposits in the saturated section at MH-4 may range from 530 to 4,700 gpd/ft^2 (equivalent to a hydraulic conductivity range from 71 feet per day to 630 ft/d).

Thick areas are believed capable of yielding more than 100 gallons per minute (gpm) to drilled screened wells (Plate B). Plate D indicates that the site lies on the eastern fringe of a "favorable groundwater area" (denoted as Area H on the map). Area H can reportedly support an average daily yield of 1.3 million gallons per day (mgd) seven years out of 10.

- The aquifer near MH-5 consists of fine-grained and coarse-grained stratified drift. This may have been inferred from nearby surficial materials, since borings were not available to support this above conclusion. Plate D indicates that the site lies on the eastern fringe of a "favorable groundwater area" (denoted as Area H on the map).

The extent of coarse-grained deposits at depth was not reported. The mapped area is relatively wide and encompasses much of the river valley and the area covered by Mansfield Hollow Reservoir. The mapped saturated thickness at the site reportedly is between 40 and 80 feet (Plate B) for MH-2, MH-3, MH-4, and MH-6 and reportedly between 10 and 40 feet at MH-5.

1978 Ground Water Availability Map

The 1978 *Groundwater Availability in Connecticut* map produced by the Connecticut Department of Energy and Environmental Protection (CT DEEP, formerly DEP) in cooperation with the USGS shows that the vicinity of the proposed well locations is underlain by coarse-grained stratified drift overlying fine-grained stratified drift capable of yielding moderate to large amounts of water (50 to 500 gpm). The authors noted that hydrogeologic data in the vicinity of MH-5 was incomplete and required further investigation.

1986 Stratified Drift Areas in Connecticut Map

The 1986 USGS *Ground-Water Yields for Selected Stratified-Drift Areas in Connecticut* map shows that MH-2, MH-3, MH-4, and MH-6 are located in a stratified drift area with a saturated thickness greater than 10 feet and thought to be capable of yielding moderate to large amounts of groundwater. The estimated long-term yield of the aquifer in this location is 1.2 mgd and assumes a distribution of approximately four wells per square mile of aquifer area (which includes the majority of Mansfield Hollow and the aquifer to the west). This suggests, at a minimum, that several wells would be needed to reach the necessary withdrawal rate.

The USGS map shows that MH-5 is not located in a stratified drift area with a saturated thickness greater than 10 feet. Therefore, this area was not thought to be capable of yielding moderate to large amounts of groundwater and that yields may be poor at this site despite the presence of Mansfield Hollow Reservoir.

2005 USGS Surficial Geology Mapping

The surficial geology at MH-2 is mapped on the 2005 *Quaternary Geologic Map of Connecticut* as the Mount Hope-Fenton River Deposit. This deposit consists of sand and gravel overlying sand overlying fines formed as a result of glacial-era sediment-dammed ponds. Immediately to the east and west is a similar deposit mapped as sand and gravel with an isolated till area defined to the east between MH-2 and Mansfield Hollow Lake. The mapped area is quite large in the vicinity of Mansfield Hollow Reservoir.

The surficial geology at MH-3 and MH-4 is mapped on the 2005 *Quaternary Geologic Map of Connecticut* as the Mount Hope-Fenton River Deposit. Immediately to the northwest is a similar deposit mapped as sand and gravel overlying sand overlying fines. The mapped area is quite large in the vicinity of Mansfield Hollow Reservoir and the lower section of the Fenton River. A mound of glacial till is located very close to MH-4 to the northwest across Route 89. A thin area of floodplain alluvium (alluvium overlying sand and gravel) is mapped adjacent to the Fenton River. The depositional environment for the alluvium includes postglacial deposits from the Holocene epoch.

The surficial geology at MH-5and MH-6 is also mapped as the Mount Hope-Fenton River deposit. The potential well location at MH-5 is very close to the glacial till boundary mapped to the east. The potential well location at MH-6 is located to the east of the glacial till deposits mapped and shown in boring logs to the east of MH-2.

A combination of floodplain alluvium and gravel is mapped at the existing Fenton River Wellfield, which is also part of the Mount Hope-Fenton River depositional environment. The stratigraphy is believed to be much coarser at depth in the vicinity of the Fenton River Wellfield. Still, the similar depositional environment implies that well yields similar to the wells at the Fenton River Wellfield may be obtained.

2008 Surficial Aquifer Potential Mapping

The 2008 *Surficial Aquifer Potential Map of Connecticut* compiled by the Connecticut Geological and Natural History Survey in cooperation with the CT DEEP (then DEP) shows that MH-2, MH-3, and MH-4 are located in an area mapped as "Other Glacial Meltwater Deposits with lower potential yield." This suggests a relatively heterogeneous mix of stratified-drift deposits are located in this area with limited banding of coarse-grained, water-bearing materials.

The map further shows that the vicinity of MH-5 and MH-6 is mapped as "Coarse-Grained Deposits" with a saturated thickness between 0 and 50 feet. This suggests that moderate depth stratified drift deposits with significant banding of coarse-grained layers are present beneath the area. The data on this map was reprinted from the 1992 Surficial Materials release by the USGS.

Department of Consumer Protection Private Well Logs

Well logs for private wells in Mansfield were obtained from the Connecticut Department of Consumer Protection for the period 1970 through 2010. While overburden stratigraphy on such logs is generally poor, the depths to bedrock on these logs can provide an excellent overview of bedrock elevations in the area. Logs found to be in the vicinity of the proposed well site were mapped in ArcGIS when reasonable accuracy was possible.

Well Location MH-2

Approximately 16 wells and test holes were mapped in the vicinity of the potential well site (including those mapped by the USGS in the 1960s-era *Water Resources Bulletin*). In particular, the United States Army Corps of Engineers (USACE) borings from the 1940s provide very detailed information. Overall, the well logs along Bassett Bridge Road showed a depth to bedrock ranging from 45 to 135 feet.

The normal surface water elevation in Mansfield Hollow Reservoir is approximately 210 feet based on the 1997 USGS topographic map, while the normal surface water elevation in Echo Lake is 245 feet. The normal water surface elevation in the Natchaug River below Mansfield Hollow Dam appears to be less than 190 feet (the normal water elevation in the Willimantic Reservoir is 181 feet). It is assumed that groundwater would be at an elevation of at least 215 feet in the vicinity of the proposed well site (which is approximately half-way between Echo Lake and the Natchaug River).

Table 11.1-1 compares topographic elevations from the State of Connecticut LiDAR two-foot topographic map contours with the depths to bedrock at the closest four well sites to determine a potential bedrock elevation. Of particular note is well log Ms 23th, which is associated with a test boring performed by the USACE south of Cemetery Road (approximately 900 feet northeast of the proposed well site). This test hole showed a very deep depth to bedrock, a water elevation of 226 feet, and a bedrock elevation of 127 feet. While the lower part of this log shows compact materials, the stratigraphy from 44 feet in depth to 90 feet in depth was loose, with coarser materials located between 44 feet in depth and 66 feet in depth (elevation 208 feet to 186 feet). The 22-foot coarse layer could be suitable for well development.

TABLE 11.1-1
USGS Borings near MH-2

Well ID	Location	Topographic Elevation	Depth to Bedrock	Bedrock Elevation	Stratigraphy
Ms 22th	300' Southwest of Echo Lake	252 (depth to water 8')	67	185	Topsoil to 1', gravel (loose) to 21', fine to medium sand (loose) to 44', fine silty sand to 47', fine to medium sand to 61', then till (gravel, medium-compact)
Ms 23th	South of Cemetery Road	263 (depth to water 37')	136	127	Gravel (medium-compact) to 10', fine to medium sand (medium-compact) to 34', fine to coarse sand (medium-compact) to 44', fine to medium sand (loose) to 50', sandy silt (loose) to 54', fine to medium sand (loose) to 66', fine silty sand (loose) to 90', silt (medium-compact) to 102', fine sand to 115', gravel (medium-compact) to 122', fine silty sand (compact) to 128', gravel (till) to 132',then till (gravel, very compact)
Ms 21th	Bassett Bridge Road near swamp	242 (depth to water 3')	44	198	Topsoil to 1', gravel (loose) to 4', medium to coarse sand (loose) to 16', gravel (medium-compact) 41', then fine to medium sand (medium-compact)
Ms 9	South of Cemetery Road	260	137	123	No log available, assumed to be similar to Ms 23th due to proximity (200 feet away)

The topographic elevation of the potential well site is approximately 262 feet NAVD 1988. Based on the available information, it appears that the bedrock elevation at the site could range between elevation 130 feet and elevation 190 feet, suggesting (at a minimum) a 70 foot depth to

bedrock and a minimum of 20 to 30 feet of saturated thickness. Note that it is likely that 50 feet of saturated thickness could occur at the site. However, test borings to the east of the site indicate the potential presence of glacial till between the well location and Mansfield Hollow Lake, such that this aquifer may be partially confined from the surface water in that area.

A 1987 Environmental Review Team Report for a previously proposed development at the MH-2 site states that the project engineer found that the sandier stratigraphy located at depths below 15 feet had permeability rates ranging from 1.2 to 101 ft/d. This permeability is lower than that estimated for the site in the 1960-era *Water Resource Inventory of Connecticut* report. However, limited information is available in the Environmental Review Team Report as 15-20 bedrock wells were proposed for that development as opposed to high-yielding sand and gravel wells.

Well Location MH-3

Approximately 27 wells and test holes were mapped in the vicinity of potential well site MH-3 (including those mapped by the USGS in the 1960s-era *Water Resources Bulletin*). In particular, the USACE borings from the 1940s provide very detailed information. Overall, the well logs along Route 89 and Pine Woods Lane showed a depth to bedrock ranging from 65 to 110 feet. Areas further south on Route 89 encountered bedrock at depths up to 115 feet. Note that a log for the Southeast School well could not be located.

Normal groundwater elevation in Mansfield Hollow Reservoir is approximately 210 feet based on the 1997 USGS topographic map; it is assumed that groundwater would be at a similar or higher elevation in the vicinity of the proposed well site. Table 11.1-2 compares topographic elevations from the State of Connecticut LiDAR two-foot topographic map contours with the depths to bedrock at nearby well sites to determine a potential bedrock elevation.

Of particular note is well log 33522 associated with the private well located at the eastern end of Pinewoods Lane and approximately 450 feet south of the proposed well site. This well is near the mound of till mapped east of the end of Pine Woods Lane. The shallow depth to bedrock (46 feet) suggests that bedrock in the vicinity of the till mound is at a higher elevation than other areas of the aquifer. Thus, the proposed well site may have a reduced yield due to the potentially lower saturated thickness as compared with other parts of the aquifer.

The topographic elevation of the potential well site is approximately 266 feet NAVD 1988. Based on the available information, it can be expected that the bedrock elevation will be no higher than 220 feet at the potential well site, and may be as deep as 150 feet in elevation. This would provide a depth to bedrock of 45 to 115 feet at the proposed well site, with a reasonable estimate of the bedrock elevation being approximately 170 feet.

Normal surface water levels in Mansfield Hollow Reservoir are approximately 210 feet, and surrounding groundwater levels are expected to be similar. Assuming a bedrock elevation of 170 feet, the aquifer at the proposed well site could have a saturated thickness of approximately 40 feet.

TABLE 11.1-2
Boring Descriptions near MH-3

Well ID	Location	Topographic Elevation	Depth to Bedrock	Bedrock Elevation	Stratigraphy
Ms 36th	Route 89 Bridge over Fenton River (Upstream)	214 (depth to water 3')	> 65	< 149	Stratified fine to medium sand & silt & gravel to 25', fine sand to 27', fine sand & gravel to 35', fine sand to 49', sand & gravel to 52', then medium sand
Ms 37th	Route 89 Bridge over Fenton River (Downstream)	212 (depth to water 1')	> 65	< 147	Silt and organics to 4', coarse sand & gravel 17', medium sand 19', sand & gravel 40', stratified fine to coarse sand & gravel to 53', then sand & gravel
Ms 31th	Route 89 across from Southeast School (dam)	271 (depth to water 48')	> 78	< 193	Gravel (loose) to 10', stratified fine sand and silt (medium compact) to 41', Gravel (medium-compact) to 50', medium to coarse sand (compact) to 55', fine to medium sand (medium-compact) to 61', gravel (loose) to 63', medium to coarse sand to 71', then gravel (loose)
Ms 32th	Route 89 across from Southeast School (dam)	222 (depth to water 1')	66	156	Peat to 2', gravel (loose) to 42', medium to coarse sand to 49', gravel to 57', silt (loose) to 63', then gravel (loose)
Ms 33th	Route 89 across from Southeast School (dam)	275 (depth to water +/-56')	122	153	Stratified fine to medium sand & gravel to 22', fine to medium sand to 39', medium sand to 47', fine to medium sand to 62', silt to fine sand to 69', fine sand to 75', fine to medium sand to 79', gravel to 86', very fine to fine sand to 97', silt to fine sand to 106', very fine to fine sand to 115', then medium sand
Ms 34th	Route 89 across from Southeast School (dam)	252 (depth to water 31')	> 51	< 201	Gravel (loose) to 8', medium to coarse sand (medium-compact) to 13', fine to medium sand (medium-compact) to 20', very fine to fine sand (medium-compact) to 31', fine to medium sand to 46', then gravel (medium-compact)
Ms 29	Route 89	280	109	171	Bedrock well, overburden not listed
110780	Route 89 - 108 Warrenville Rd.	279	120	159	Sand and gravel
68319	Route 89 – 94 Warrenville Rd.	278	104	174	Light sand and gravel
158072	11 Pinewoods Lane	275	84	191	Overburden
4814	(15?) Pinewoods Lane	266	100	166	Sand
33522	Pinewoods Lane	265	46	219	Gravel to 24', cemented gravel to 36', then gravel

Well Location MH-4

Approximately 11 wells were mapped in the vicinity of MH-4 (including those mapped by the USGS in the 1960s-era *Water Resources Bulletin*). Overall, the well logs along Route 89 showed a depth to bedrock ranging from 10 to 110 feet, with a steep decline occurring between houses on Route 89 near the potential well location. Table 11.1-3 compares topographic elevations from the State of Connecticut LiDAR two-foot topographic map contours with the depths to bedrock at nearby well sites to determine a potential bedrock elevation. It is notable is that well log 20941 at a nearby house is drilled in the stratified drift and has a yield of only 4 gpm.

TABLE 11.1-3
Boring Descriptions near MH-4

Well ID	Location	Topographic Elevation	Depth to Bedrock	Bedrock Elevation	Stratigraphy
Ms 15th	Northern edge of Mansfield Hollow Lake	210 (depth to water 4')	40	170	Medium to coarse sand and gravel, stratified
20941	Route 89 east of Wormwood Hill Road	250	> 98	< 152	Gravel to 30', then cemented gravel to 50', then gravel and sand
275	Route 89 east of Wormwood Hill Road	277	110	167	Sand and silt

The representative bedrock elevation in the vicinity of the potential well site appears to be no higher than 170 feet, although the presence of much shallower depths to bedrock at the nearby glacial till boundary to the northwest suggest that bedrock could be shallower at MH-4. The topographic elevation of the proposed well site is approximately 258 feet NAVD 1988. Based on the available information, a maximum depth to bedrock of 88 feet could be obtained at the potential well site.

Normal surface water levels in Mansfield Hollow Reservoir are approximately 210 feet, and surrounding groundwater levels are expected to be similar. Assuming a bedrock elevation of 170 feet, the aquifer at the potential well site could have a saturated thickness of 40 feet. If the bedrock were higher in elevation, saturated thickness would be lower.

Well Location MH-5

The nearest two well logs within the mapped stratified drift are more than 3,000 feet away from MH-5 in the vicinity of MH-4. Thus, existing well logs are not useful for determining the potential depth to bedrock, saturated thickness, and stratigraphy in this area.

Well Location MH-6

Approximately five wells were mapped in the vicinity of the potential well site (including those mapped by the USGS in the 1960s-era *Water Resources Bulletin*). In particular, the USACE borings from the 1940s provide very detailed information. Overall, the well logs along Bassett Bridge Road showed a depth to bedrock ranging from 25 to over 50 feet.

The normal surface water elevation in Mansfield Hollow Reservoir is approximately 210 feet based on the 1997 USGS topographic map. It is assumed that groundwater would be similar or higher in elevation in the vicinity of the proposed well site.

Table 11.-4 compares topographic elevations from the State of Connecticut LiDAR two-foot topographic map contours with the depths to bedrock at the closest three well sites to determine a potential bedrock elevation. Of particular note is well log Ms 22th, which is associated with a test boring performed by the United States Geological Survey to the north of Bassett Bridge Road and 1,300 feet north of the proposed well site. This test hole was drilled in the floor of a sand and gravel pit and showed a 41-foot thick layer of sand that was almost completely saturated. Bedrock was not encountered at this test hole, and the boring logs suggest that a bedrock ridge is located to the west of the potential well site, stretching north to south between Mansfield Hollow Reservoir and Echo Lake.

TABLE 11.1-4
Boring Descriptions near MH-6

Well ID	Location	Topographic Elevation	Depth to Bedrock	Bedrock Elevation	Stratigraphy
Ms 22th	1,300 feet north of MH-6	225 (depth to water 11	> 51	< 174	Pebbly medium to coarse sand and gravel to 8', sand to 49', then sandy till
Ms 29th	1,900 feet northwest of MH-6	258 (depth to water 21')	> 42	< 216	Gravel (loose) to 3', fine to medium sand and silt (stratified, loose) to 9', gravel (loose, medium to compact) to 25', then till (gravel, compact to medium-compact)
Ms 28th	Bassett Bridge Road near berm access road	254 (depth to water 10')	32	222	Topsoil to 1', then sand and gravel (loose to compact) to 15', then till (poorly sorted, compact gravel)

The topographic elevation of the potential well site is approximately 262 feet NAVD 1988. Based on the available information, it appears that the bedrock elevation at the site would be at a maximum elevation of 220 feet, suggesting a 40-foot depth to bedrock and virtually no saturated thickness. It is more likely that bedrock is deeper than 180 feet in elevation at the site, which would provide at least 30 feet of saturated thickness.

Town of Mansfield Investigations

In March 2012, the Town of Mansfield retained consulting services to undertake water supply test well exploration in the vicinity of MH-6. One test boring was installed to a depth of 122 feet where bedrock was encountered. The depth to groundwater in the boring was at 58 feet. The subsurface geology consisted predominately of fine sand with some medium sand and silt to 43 feet below the ground surface, overlaying primarily silt with a trace to some fine sand. The bedrock consisted of pink and gray granite. The sediment samples demonstrated a lack of a suitable screen zone, so a well was not installed nor was a short-term pumping test performed.

Based on the above information, the aquifer at MH-2 will likely have 50 feet of saturated thickness, while the aquifer at MH-3 and MH-4 will likely have 40 feet of saturated thickness.

The depth of the aquifer at MH-5 is uncertain due to the lack of boring information. The aquifer appears to have pockets of higher conductivity sand and gravel at a suitable depth to potentially support a moderate-yield well, but the stratigraphy of the area (and the USGS hydraulic conductivity estimates for the site) appear variable. For example, a specific capacity of 0.01 to 1.0 gpm/ft is estimated using the Driscoll method[1] from a transmissivity of 15 to 1,500 gpd/ft[2] and a specific capacity of 0.35 to 3.1 gpm/ft is estimated using the Driscoll method from a transmissivity of 530 to 4,700 gpd/ft[2].

- Assuming a 50-foot drawdown, the potential yield from one new well at MH-2 may not exceed 50 gpm.
- Assuming a 40-foot drawdown, the potential yield from one new well at MH-3 may not exceed 40 gpm.
- Assuming a 40-foot drawdown, the potential yield from one new well at MH-4 could be 124 gpm. However, the yield at MH-4 could also be as low as 4 gpm based on a nearby gravel-packed well.
- The aquifer at MH-5 does not have enough information to support an estimate of specific capacity and yield.
- The aquifer at MH-6 appears to consist of materials that are too fine-grained to support a moderate or high yielding well.

Without additional information, the potential well locations do not appear to be individually or cumulatively capable of supporting a yield that would fulfill the demands at the University and Town of Mansfield. Test wells installed in the immediate area of any potential well site would eliminate uncertainty in the above analysis. In total, less than 150,000 gpd may be available.

Potential Pollution Sources

The Connecticut DPH requires that new wells are located at least 200 feet from any potential pollution sources and at least 50 feet from any drains carrying surface water or a foundation drain. The following potential pollution sources have been identified that could impact each potential wellfield location.

Potential Wellfield MH-2

- A site-specific investigation of potential pollutant sources has not been performed, but this area is currently utilized as an agricultural field. This site appears to have been used for agriculture since before the 1930s. It is possible that fertilizers, herbicides, or pesticides have been applied to the fields. It is not known if any pollutants are located on or around the site, or if any dumping has occurred.
- The potential well location is located on a relatively high area of the site. The site is fairly flat. Limited localized mounding may be necessary to prevent surface wash.
- The Town of Mansfield has control of the entire 200-foot sanitary radius of the site.
- The proposed well site is located at least 270 feet from the nearest building. No dry wells are believed to be on the site.

[1] Driscoll, F.G., 1986, Groundwater and Wells, Second Edition

- Groundwater beneath the proposed well site is mapped as "GAA – May Be Impaired." The GAA designation appears to be related to surface water watershed that drains to the Willimantic Reservoir. The "May Be Impaired" designation appears to be related to the presence of a close mixed waste landfill near the end of Cemetery Road, approximately 2,300 feet to the northeast of the site. The site is listed as a leachate discharge site.
- Surface water quality in Echo Lake is rated Class AA. Surface water quality in the Natchaug River and Mansfield Hollow Reservoir is rated Class B/AA. The quality of the surface water is not expected to cause any water quality concerns at the proposed well site.
- The environmental database maintained by Environmental Data Resources, Inc. (EDR) was reviewed for the vicinity of the proposed well site. A variety of small spills were noted in the EDR database on Bassett Bridge Road. These were mostly related to automobile accidents that spilled antifreeze or fuel oil on the highway. The majority of these incidents were listed as being cleaned.
- A residential heating oil tank is likely located more than 200 feet to the west of the proposed well site
- Sanitary sewer service is not available on Bassett Bridge Road near the well site. The proposed well location appears to be more than 200 feet from any nearby septic system.
- The proposed well site appears to be located more than 500 feet away from the nearest wetland (locally known as "the floating bog") and is not located in or near the 1% annual chance floodplain. A GWUDI study would not be required.

Based on the above information, the aquifer at the MH-2 site has two potential sources of contamination, namely from potential fertilizer/herbicide/pesticide use on the agricultural fields and any leachate pollutants potentially related to the former landfill on Cemetery Road. In addition, the proposed well site is located in a GAA-May Be Impaired area (related to the former landfill). Preliminary water quality testing would need to be conducted to determine the groundwater quality prior to development of a production well.

Potential Wellfield MH-3

- This site has been a school for many years. It is possible that fertilizers have been applied to the baseball fields. The proposed well site is located approximately 140 feet down-gradient from the edge of the nearest baseball field.
- Field investigations have revealed scattered tires and scrap metal within the wooded area approximately 100 feet to the north of the proposed well site within the 200-foot protective sanitary radius.
- The potential well is at a lower elevation as compared to the surrounding area, although the site is fairly flat. Limited localized mounding may be necessary to prevent surface wash. Wetlands are not located nearby, and the site is elevated above the 1% annual chance floodplain of the Fenton River and Mansfield Hollow Lake. A GWUDI study would not be necessary.
- The Town of Mansfield does not have control of the entire 200-foot sanitary radius of the site. An agreement with USACE would be necessary to protect the sanitary radius.
- The well site is located over 400 feet from the nearest building. No dry wells are believed to be on the site.
- Groundwater beneath the proposed well site is mapped as "GAA – May Be Impaired." The "May Be Impaired" designation appears to be related to the presence of a close mixed waste

landfill near the end of Cemetery Road approximately 3,000 feet to the south of the site. An oil/chemical spill is also noted in the records, having occurred across Route 89 approximately 1,700 feet to the west of the well site. This spill appears to have its own GAA – May Be Impaired area designation. Groundwater surrounding the impaired areas is mapped as GAA.

- A second oil/chemical spill by Lehigh Petroleum occurred near the eastern end of Bakers Road (222 Warrenville Road). This spill is classified as inactive and did not appear to affect groundwater.
- The Mansfield Landfill previously operated off the end of Bakers Road approximately 4,800 feet northwest of the site. The Mansfield Transfer Station and Leaf Compost Facility continue to operate at the end of Bakers Road 3,000 feet northwest of the proposed well site. The facility accepts bottles, cans, plastics, mixed municipal waste, construction and demolition related waste, bulky waste, and mercury. As presented in the January 6, 2011 *Draft Report – Water Source Study for the Four Corners Area*, modeling shows that groundwater leaving the former landfill site is drawn to the Fenton River. It is possible that a high-yielding supply well could draw groundwater beneath the Fenton River in this area. If preliminary drilling and pump testing were conducted at the site, it would be prudent to also conduct preliminary modeling to determine if the well would be affected by groundwater from the landfill area.
- Surface water quality in the Fenton River and Mansfield Hollow Reservoir is rated Class B/AA. The quality of the surface water is not expected to cause any water quality concerns at the proposed well site.
- The environmental database maintained by EDR was reviewed for the vicinity of the proposed well site. A variety of small spills were noted in the EDR database on Route 89 and Route 275. These were mostly related to automobile accidents that spilled antifreeze or fuel oil on the highway. The majority of these incidents were listed as being cleaned. Route 89 is located 570 feet northeast of the proposed well site.
- A 10,000-gallon heating oil tank is located approximately 700 feet to the west of the proposed well site near the school building. If a leak occurred, groundwater flow could proceed north towards the Fenton River or east towards Mansfield Hollow Reservoir.
- Sanitary sewer service is not available on Route 89 near the well site. The proposed well location appears to be less than 200 feet from a septic system on the Southeast School property based on the map prepared by Environmental Partners. This septic system reportedly serves the adjacent concession stand and ballfield. The septic system for the school building is reportedly located in another part of the site.

Based on the above information, the aquifer at the MH-3 site has several potential sources of contamination, particularly from leachate pollutants potentially related to the former landfill and the existing transfer station located to the north across the Fenton River. Preliminary water quality testing would need to be conducted to determine the groundwater quality prior to development of a production well.

The proposed well site is also located within 200 feet of surficial debris (scrap metal, tires). A Connecticut licensed environmental professional (LEP) would need to evaluate these materials prior to drilling to determine potential threat to groundwater. The Town of Mansfield does not have control of the entire 200-foot sanitary radius of the well, so an agreement with USACE would be required. In addition, the proposed well site is located in a GAA-May Be Impaired area. Finally, the proposed well site is located within 200 feet of a septic system related to the ballfields. The proposed well site may be able to be moved to provide more than 200 feet from

the septic system, or the septic system would need to be relocated. Other locations on site could potentially be more suitable for well development from a sanitary perspective, but would likely have similar sanitary issues to those identified above.

Potential Wellfield MH-4

- This site appears to have been forested since before the 1930s. The USACE currently owns the property at the proposed well location. An agreement with USACE would be necessary to utilize the well location and protect the 200-foot sanitary radius. In addition, an agreement with a private property owner would be necessary to protect the 200-foot sanitary radius of the proposed well location.
- The proposed well location is located near the top of a hillside overlooking a slope down to Mansfield Hollow Reservoir. Localized mounding may be required to prevent surface wash.
- The proposed well site is located over 350 feet from the nearest building. Given its proximity to residences, it is possible that dumping may have occurred on the site. No dry wells are believed to be on the site.
- Groundwater beneath the proposed well site is mapped as "GAA." The GAA designation appears to be related to the watershed draining to the Willimantic Reservoir.
- The Mansfield Landfill previously operated off the end of Bakers Road approximately 3,500 feet northwest of the site. The Mansfield Transfer Station and Leaf Compost Facility continue to operate at the end of Bakers Road 2,500 feet west of the proposed well site. The facility accepts bottles, cans, plastics, mixed municipal waste, construction and demolition related waste, bulky waste, and mercury. According to the January 6, 2011 *Draft Report – Water Source Study for the Four Corners Area*, modeling has been conducted that shows that groundwater leaving the former landfill site is drawn to the Fenton River. It is possible that a high-yielding supply well could draw groundwater from this area towards the well. If preliminary drilling and pump testing were conducted at the site, it would be prudent to also conduct preliminary modeling to determine if the well would be affected by groundwater from the landfill area.
- An oil/chemical spill by Lehigh Petroleum occurred near the eastern end of Bakers Road (222 Warrenville Road). This spill is classified as inactive and did not appear to affect groundwater.
- Surface water quality in the Fenton River and Mansfield Hollow Reservoir is rated Class B/AA. The quality of the surface water is not expected to cause any water quality concerns at the proposed well site.
- The environmental database maintained by EDR was reviewed for the vicinity of the proposed well site. A variety of small spills were noted in the database on Route 89 and Route 275. These were mostly related to automobile accidents that spilled antifreeze or fuel oil on the highway. The majority of these incidents were listed as being cleaned. Route 89 is located within 500 feet of the proposed well site.
- Residential heating oil tanks are located at least 300 feet to the northwest of the proposed well site. If a leak occurred, leachate could flow could towards the proposed well site.
- Sanitary sewer service is not available on Route 89 near the well site. The proposed well location appears to be at least 200 feet from the nearest residential septic system.
- The proposed well location is believed to be located more than 50 feet from and above the high water mark of nearby wetlands and above the 1% annual chance flood elevation. In

addition, the well location is more than 800 feet from Mansfield Hollow Reservoir such that a GWUDI study would not be required.

Based on the above information, the aquifer at the MH-4 site has several potential sources of contamination, including leachate pollutants potentially related to the former landfill and the existing transfer station located to the north and northwest of the site. Preliminary water quality testing would need to be conducted to determine the groundwater quality prior to development of a production well. Finally, the proposed well site is located on land owned by the USACE. Agreements would be needed with the USACE to protect the 200-foot sanitary radius of the well, and with a private property owner to access the well site.

Potential Wellfield MH-5

- This site appears to have been forested since at least the 1930s. The well site and the 200-foot radius lie entirely on land controlled by the federal government. An agreement with USACE would be needed to protect the sanitary radius of the well.
- The proposed well location is located near the top of a hillside overlooking a slope down to Mansfield Hollow Reservoir. Localized mounding may be required to prevent surface wash. In addition, the eroding westward-facing slope would likely need to be stabilized.
- The nearest existing building to the site is located approximately 750 feet to the east and upgradient of the proposed well site.
- The ruins of an old building are on this site, perhaps within the 200-foot sanitary radius of the proposed well location. Local history suggests that this building was utilized as a hunting cabin. The remnants of the cabin's fire place and foundation footings are all that remain today. It is not clear if there was a septic system, well, or heating oil tank for the cabin.
- A shooting range was formerly located to the south and east of this well location and north of Bassett Bridge Road along the Atwoodville Trail. It existed until the nearby homes were constructed in the 1980s. The State formerly stocked the entire length of the trail with pheasant and quail. Deer and bird hunting is still allowed in the area. A cleanup of the range was reportedly never conducted; only the signs and the targets were removed.
- A small dumping area is located to the south and east of this potential well location near USACE boundary marker #249. This dumping area contains scrap metal, glass, old metal and rubber car parts, maple syrup equipment, pottery, and other debris. It appears that any wood, fabric, and organic material that may have been dumped is no longer identifiable.
- No dry wells are believed to be on the site, and no storm drainage appears to be routed through the site.
- Groundwater beneath the proposed well site is mapped as "GAA." The GAA designation appears to be related to surface water watershed that drains to the Willimantic Reservoir.
- Surface water quality in the Mansfield Hollow Reservoir is rated Class B/AA. The quality of the surface water is not expected to cause any water quality concerns at the proposed well site.
- The environmental database maintained by EDR was reviewed for the vicinity of the proposed well site. Nothing in the database was found for Kaya Lane to the east of the proposed well site, and any spills along Bassett Bridge Road are located downstream of the proposed well location.
- No residential heating oil tanks are likely located within 700 feet of the proposed well site.

- Sanitary sewer service is not available on Bassett Bridge Road near the well site. The proposed well location appears to be more than 200 feet any nearby septic system.
- The proposed well location is located more than 50 feet from and above the high water mark of nearby wetlands and above the 1% annual chance flood elevation. In addition, the well location is more than 200 feet from Mansfield Hollow Reservoir such that a GWUDI study would not be required.

Based on the above information, the aquifer at the MH-5 site has several potential sources of contamination related to nearby dumping and a former shooting area. Preliminary water quality testing would need to be conducted to determine the groundwater quality prior to development of a production well. Finally, the proposed well site is located on land owned by the USACE. Agreements would be needed with the USACE to protect the 200-foot sanitary radius of the well, and with a nearby private property owner to access the well location.

Potential Wellfield MH-6

- This site appears to have been forested since at least the 1930s. The potential well location is located on a mound above the spillway elevation of Mansfield Hollow Lake Dam. Localized mounding may be required to prevent surface wash. The proposed well location may be close to the 1% annual chance flood elevation, but is located more than 500 feet from nearby wetlands and watercourses. A GWUDI study would not be required.
- The well site and sanitary radius lie completely on federal land owned by the USACE. An agreement with USACE would be needed to protect the 200-foot sanitary radius.
- No buildings are near the site. No dry wells are believed to be on the site, and storm drainage does not appear to be routed through the site. If drainage systems occur along Bassett Bridge Road, they are more than 200 feet from the proposed well site.
- Groundwater beneath the proposed well site is mapped as "GAA." The GAA designation appears to be related to the surface water watershed that drains to the Willimantic Reservoir.
- A site-specific survey of the property has not been performed. It is not known if any pollutants are located on or around the site, or if any dumping has occurred.
- Surface water quality in the Mansfield Hollow Reservoir is rated Class B/AA. The quality of the surface water is not expected to cause any water quality concerns at the proposed well site.
- The environmental database maintained by EDR was reviewed for the vicinity of the proposed well site. A variety of small spills were noted in the database on Bassett Bridge Road. These were mostly related to automobile accidents that spilled antifreeze or fuel oil on the highway. The majority of these incidents were listed as being cleaned.
- No residential heating oil tanks are likely located within 1,500 feet of the proposed well site.
- Sanitary sewer service is not available on Bassett Bridge Road near the well site. The proposed well location appears to be more than 200 feet any nearby septic system.

Based on the above information, the aquifer at the MH-6 does not appear to have any proximal sources of contamination. Preliminary water quality testing would need to be conducted to determine the groundwater quality prior to development of a production well. The only sanitary concern would be related to whether or not the proposed well site is located above the 100-year flood elevation. This would need to be confirmed with an elevation survey.

Summary of Feasibility

The combined potential yield from wells near Mansfield Hollow are not expected to yield sufficient volume to serve the needs of the University and the Town of Mansfield, nor will they meet the project purpose and need. However, it is possible that the University and/or the Town of Mansfield could pursue development of new wells in the future for operational flexibility or for other unforeseen reasons. For this reason, an evaluation of potential impact has been evaluated herein.

11.2 LAND USE AND ZONING

The five potential wellfield locations near Mansfield Hollow Lake are currently utilized either for agriculture or open space as follows:

- Well location MH-2 is currently utilized as an agricultural field as part of the Town of Mansfield Commonfields (a historic park).
- Well location MH-3 is currently utilized as open space associated with Southeast Elementary School.
- Well locations MH-4, MH-5, and MH-6 are currently forested federal land utilized as part of Mansfield Hollow State Park.

The five potential well locations are located in areas of Existing Preserved Open Space as denoted on the State *Conservation and Development Plan Locational Guide Map*. The WinCOG regional plan notes that the wellfield locations are located in either priority Preservation Areas or permanently protected open space. These land designations are typical for many public water system sources and are consistent with the need to protect future sources of water supply. The proposed overlay zone will restrict usage of water along any potential pipeline routes to maintain consistency with nearby State Plan designations.

Well location MH-2 is currently utilized for agriculture. The majority of the upland soils on the site are considered prime farmland according to the 1987 Environmental Review Team Report. The town has a land-use agreement with a local farmer. The use of this site for the development of new wells would potentially restrict or preclude further use of this area for agriculture. Should this well site be utilized other farmland in Mansfield may need to be protected to offset potential losses.

Regardless of the well location selected, the aquifer protection area (APA) regulations in Mansfield would be affected by the presence of the new well. A new well would need to have Level A APA mapping performed to delineate the area of contribution and recharge of the groundwater flowing to the well. Thus, additional areas of Mansfield would be designated as APA areas following adoption of this alternative, and existing Aquifer Protection Agencies in the town would administer the APA regulations in these zones.

The creation of a new wellfield or wellfields near Mansfield Hollow Lake could locally affect land use at the wellfield sites; however, significant impact of land use beyond those sites is not likely to occur, particularly in light of the low yields that are anticipated from these wells.

11.3 SOCIOECONOMICS

Development of one or more wells near Mansfield Hollow could potentially provide a source of potable water supply to the University and/or the Town of Mansfield. The amount of water available to service these communities would be dependent upon the yield of the new wellfield(s).

The total population, average household size, percentage of low-income populations, and percentage of minority populations in areas of Mansfield and the region could increase slightly as a result of additional development as a result of a publicly available supply of water. The extent to which that could occur following development of groundwater supplies near Mansfield Hollow would be less than for a supply that could serve the full projected demands, as evaluated in Alternatives 3, 4, and 5 (interconnections with CWC, Metropolitan District Commission, and Windham Water Works respectively).

Some acquisitions and easements would be necessary to implement this alternative. The wellfield locations would need to be purchased or otherwise obtained. In the case of MH-4, MH-5, and MH-6, either the University or the Town of Mansfield would need to purchase the land from the federal government or an agreement would need to be made such that the University or Town would have control of the 200-foot sanitary radius of each well, and easements for infrastructure. Such an agreement could be challenging since the land was appropriated several decades ago by a federal congressional act. In addition, access to MH-4 and MH-5 may require the purchase of land or an easement from a private property owner.

The only water main that will not be installed beneath a public roadway would be at the new wellfields, pipeline segment 33 (federal property north of Lions Park), and pipeline segment 36 (unpaved utility access between Fenton Well D and the clearwell). If pipeline segment 37 (the line from the Fenton River Wellfield to Route 195) were replaced, a portion of that work would also occur in unpaved areas east of Horse Barn Hill Road.

While some land use acquisitions would be required to implement this alternative, significant socioeconomic impacts are not anticipated.

11.4 COMMUNITY FACILITIES AND SERVICES

The community facilities and services along the pipeline segments associated with the various new wellfield alternatives are summarized in Table 11.4-1 below.

TABLE 11.4-1
Summary of Community Facilities and Services
by Pipeline Segment along Potential Mansfield Hollow Lake Wellfield Scenarios

Pipeline Segment	Distance (ft)	School?	Potential Benefit from Fire Protection?	Recreation Area?
20	1,540	No	Commercial	No
21	3,400	Yes	Will be served by UConn	Proposed
23 (MH-5)	3,640	No	Residential / Park	Yes
24 (MH-6)	270	No	Park	Yes*
25	4,720	Yes	Residential / Park	Yes
26 (MH-2)	310	No	Park	Yes*
27	920	No	Residential & Commercial	Yes*
28	2,390	No	Residential & Commercial	No
29 (MH-3)	590	Yes	School	Yes
30	4,150	Yes	Residential	Yes
31	1,780	Yes	Residential	Yes
32 (MH-4)	2,470	No	Residential / Park	Yes*
33	8,780	No	Park, Residential	Yes
34	2,230	No	Residential	No
35	9,920	No	Residential & Commercial	Yes*
36	13,070	No	Residential	Yes*
37	6,400	Yes	Already served	Yes*
38	570	No	Residential	No
39	17,230	Yes	Residential & Commercial	Yes
40	14,900	No	Residential & Commercial	Yes*
45	3,410	Yes	Already served	Yes*
46	1,360	Yes	Already served	Yes
47	380	Yes	Already served	No
49	4,040	Yes	Already served	No
50	260	Yes	Already served	No

*Hiking trails only.

11.4.1 EDUCATION

As shown in Table 11.4-1 above, schools exist along potential pipeline segments associated with this alternative. These include the University and E. O. Smith High School, both of which are already served by public water, and Southeast Elementary School and Mansfield Middle School, both of which are served by on-site wells. The installation of a new water main at MH-3 or MH-4 could potentially provide water service to Southeast Elementary School, while routing option "2" from each potential well location would pass by Mansfield Middle School. Access to educational facilities would only be temporarily impacted during the construction period in areas where the new water mains are installed. Performing construction in this area during the summer would be the best method of avoiding this impact.

11.4.2 PUBLIC SAFETY AND EMERGENCY SERVICES

New water mains associated with this alternative would not have sufficient water to support fire flows with a few exceptions. The Insurance Services Organization (ISO) target fire flow for a

hydrant is 1,000 gpm for two hours. The amount of water from a single well or wellfield under this alternative would not generate sufficient flow to operate a fire hydrant to ISO standards. Therefore, only the options that connect directly to the University's distribution system (routing option "2" from each potential well location) and have connection to the University's storage supplies will have the capability of providing fire protection service to new areas.

Table 11.4-2 presents a comparison of the potential number of new hydrants that could be installed on the various routing scenarios.

Routing scenarios utilizing Maple Road (routing option "2") would provide a greater benefit in terms of the availability of fire protection water. Areas such as Mansfield Center and Mansfield Middle School would be able to have fire protection water under this option, and Southeast Elementary School would also have fire protection under routing options #7B-2 and #7C-2.

The construction period associated with this alternative will require the use of state and local police services to provide maintenance and protection of traffic.

TABLE 11.4-2
Potential Fire Protection Benefits from a New Wellfield nearby Mansfield Hollow Lake

Routing Scenario	Distance (ft)*	Number of Hydrants
#7A-1, #7A-3	1,540	4
#7A-2	25,190	52
#7B-1, #7B-3, #7B-4	1,540	4
#7B-2	26,310	54
#7C-1, #7C-3, #7C-4	1,540	4
#7C-2	29,970	61
#7D-1, #7D-3	1,540	4
#7D-2	33,240	68
#7E-1, #7E-3	1,540	4
#7E-2	29,870	61

* Does not include North Hillside Road extension which would have hydrants installed as part of the utility work with that project, nor areas of existing water service.

11.4.3 PARKS AND RECREATION

All of the five potential well locations are located within recreational areas (the Commonfields, Southeast Elementary School, or Mansfield Hollow State Park) coincident with the recreational areas noted in Table 11.4-1 above. The construction of a new well in these areas would inhibit but not likely eliminate existing recreational use. Passive uses in certain areas of Mansfield Hollow State Park, such along the Atwoodville Trail at MH-5, may need to be rerouted (which may require new easements from adjacent property owners). Hunting is also allowed in the vicinity of MH-5, an activity that may need to be discontinued to protect a new wellfield and infrastructure.

Parks and recreational facilities are located in Mansfield along the potential pipeline routes. Mansfield Middle School and the Spring Hill fields (pipeline segment 39) include a multi-use ball field, outdoor basketball hoops, tennis courts, and an indoor gym and auditorium. This area is located next to Schoolhouse Brook Park, which includes picnic areas, fishing, swimming, canoeing, cross-country skiing, and mountain biking. Lions Club Park (pipeline segment 33) includes multi-use ball fields, a snack bar, and a picnic pavilion. Southeast Elementary School and Southeast Park include multi-use ballfields, basketball hoops, a children's playscape, and an indoor gym and auditorium.

Other Town-owned recreational areas are also present that consist entirely of hiking or biking trails or are not already served with public water by the University. These areas are currently serviced by wells. A connection to a public water system could be beneficial to provide a backup supply for irrigation, sanitation, or drinking water.

A temporary minimal impact to parks and recreation would be expected during the construction period since there would be construction in the vicinity of one or more recreational areas. The areas where access impacts would be realized include the vicinity of Schoolhouse Brook Park and Mansfield Middle School, Southeast Elementary School, the Fenton River Wellfield, and Lions Club Park.

11.4.4 PUBLIC TRANSPORTATION

A temporary impact to public transportation would be realized during construction due to traffic delays dependent on the amount of pipeline being installed along existing major bus routes. In particular, traffic delays on Route 195 (routing option "3" from each well site) would be notable. Only a minimal impact to public transportation is expected for other routing options since they do not lie on established bus routes.

11.5 AESTHETIC AND CULTURAL RESOURCES

Aesthetic Resources

The entire Town of Mansfield is designated as a scenic resource in the 2006 *Plan of Conservation and Development.* Many of the proposed pipeline routes through Mansfield pass areas that are predominantly residential in nature, with generally sparse development along much of the roads. Trees grow right to the edge of the roadway, inhibiting long scenic views in most areas, instead providing a shady, tree-lined drive. Many areas are undeveloped, particularly along Mansfield Hollow State Park off Chaffeeville Road and Schoolhouse Brook Park on Clover Mill Road. The view over Spring Hill from just south of the University on southbound Route 195 (pipeline segment 40) is a particularly notable vista for University students, staff, and visitors as well as residents of Mansfield.

The development of a new wellfield at MH-2 or MH-5 would have a local impact on aesthetics at the well sites to support the new construction. Construction of a traditional brick or concrete pumphouse and treatment/control building on the site would be necessary; however, the pumphouse could be designed with exterior features in keeping with the surrounding area. Potential wellfield locations MH-4 and MH-6 are more isolated such that visual impacts will be

minimized, and potential wellfield MH-3 is located behind Southeast Elementary School such that visual impacts will not occur.

As the majority of new water mains will be installed within existing roadways or below ground, long-term impacts to aesthetic and visual resources is expected to be minimal. However, impacts could be realized if routing option #7B-4 or #7C-4 were utilized. These routes include pipeline segment 33 through an undeveloped portion of Mansfield Hollow State Park. A new utility corridor would need to be cut through vegetation to facilitate construction that would impact scenic resources in the area.

Historic and Cultural Resources

The 2006 *Plan of Conservation and Development* further identifies areas of archaeological sensitivity, historic site areas, and prehistoric site area in Mansfield. Areas of sensitivity are located along potential pipeline segments 23, 24, 25, 35, and 36. Prehistoric site areas are identified between Route 195 and Chaffeeville Road along pipeline segment 35 and 38, in the vicinity of potential well locations MH-5 and MH-6, and near the Towers storage tanks. Historic site areas are located throughout Mansfield Center with more limited areas near Spring Hill, Chaffeeville, Gurleyville, and the Storrs Campus.

The Barrows Cemetery (pipeline segment 34), Old Mansfield Center Cemetery (pipeline segment 28), Old Storrs Cemetery (pipeline segment 49), and Riverside Burying Ground (pipeline segment 36) are located along potential pipeline routes. The State Archaeologist and the State Historic Preservation Officer would be consulted prior to beginning work in these areas, as would the Mansfield Historic District Commission and the Cemetery Committee.

Mansfield Four Corners is considered a historic village and is located at the terminus of each of the potential water main scenarios. While the center of this village is located at the intersection of Moulton Road and Daleville Road with Route 44, many of the commercial buildings in this village are located near the intersection of Route 44 and Route 195. These commercial buildings are dilapidated and/or vacant. To the extent development of a new wellfield would serve this area, development could occur. Coordination with the Planning and Zoning Commission will be necessary to ensure that new development and redevelopment in Mansfield Four Corners is consistent with the historic aspects of this village.

Other historic districts include Mansfield Center, Chaffeeville, Gurleyville, and lands near the original Main Campus in Storrs. The potential pipeline routes pass by several historical properties and sites as noted in the 2006 *Plan of Conservation and Development* such as those on Route 195, Chaffeeville Road, Gurleyville Road, Maple Road, Spring Hill Road, and Clover Mill road. The extension of public water service past these properties will not impact the historic nature of these properties.

Note that Route 195 (pipeline segment 34) crosses a stone flume and culvert over Chapin Brook that may be a historic feature. This bridge could potentially be avoided through the use of directional drilling. Another potential mitigation measure would be to utilize Dodd Road and avoid this area. This would subtract approximately 100 feet of pipeline length from routing option “1” but add 800 feet to routing options “2” and “3” for each potential well location.

The construction of a new wellfield would typically require clearing, construction of a new access road, installation of test wells, installation of production wells, construction of a new pump house (and potentially a treatment/control building), and excavation to install water mains to the distribution system. Additional pump stations may also be required to move water into the distribution system. Each of these activities disturbs the earth and therefore could potentially have an impact on historical and archaeological resources. In particular, construction at MH-2 would occur on a historic site used as a drill and parade field by the local militia. Coordination with state and local historic officials will be necessary to mitigate any impacts.

Many cultural resources are located in Mansfield along potential pipeline routes. These include facilities at the University and the Town's Community Center that are already served by public water service. One house of worship (the First Church of Christ) is located in Mansfield Center. These cultural resources are not expected to be affected by this alternative.

11.6 PUBLIC WATER SUPPLY

Development of a supplemental source of supply adjacent to Mansfield Hollow could provide an increment of supply to the University system or independently to development within the Town of Mansfield. Connection to the University's existing system would require numerous components.

A connection to the University's distribution system on the Main Campus would require a 190 psi static discharge pressure. Mansfield's 2011 *Water Supply Plan* indicates that system pressures in the University system are typically in the range of 140 pounds per square inch (psi) to 175 psi, with the highest pressures typically being experienced at the central utility plant (CUP). These system pressures are much higher than the industry standard range of 35 psi to 125 psi. As such, individual pressure reducing devices may need to be utilized at any properties that connect to pipelines from new wells.

A connection to the Fenton River Wellfield (routing options "1" and "4") would not require as much pressure since water would only be routed to 300 feet in elevation (the Fenton River Wellfield clearwell) rather than pushing against a hydraulic grade line of over 710 feet. The discharge pressure in the line would likely be within industry standards.

The potential connection routes associated with this alternative pass several community, non-transient non-community (NTNC), and transient non-community (TNC) water systems. Rosal Apartments is located near Mansfield Four Corners and would likely be served by a new water main. In addition, NTNC and TNC systems are located along potential pipeline routes including Mansfield Shopping Center on Route 44, the Public America in Mansfield Four Corners, and 603 Middle Turnpike (Market & Deli). Each of these is near Mansfield Four Corners and included in potential Mansfield Four Corners demands.

Given the relatively limited new water available under this alternative, other Community, NTNC, and TNC systems located along potential pipeline routes would need to be reviewed and approved by the Water and Wastewater Advisory Committee prior to allowing the connection.

11.7 OTHER PUBLIC UTILITIES AND SERVICES

11.7.1 SANITARY SEWER

The 2007 *Water and Wastewater Master Plan* concluded that the capacity of the University's WPCF is sufficient for future wastewater treatment. Average daily flows at the WPCF typically average 27% to 44% (0.81 mgd to 1.32 mgd) of its average day capacity, while peak flows can utilize up to 90% of the plant's peak hourly capacity as a result of inflow and infiltration to the system, independent of the number of users discharging to the system. The University continues to take measures to alleviate this condition. Based on the likely additional flows to the University's WPCF (assuming the majority of new water customers would discharge to the sanitary sewer), the facility is believed to have sufficient capacity.

The withdrawal of water from a new wellfield near Mansfield Hollow Lake would be returned to the Willimantic River via the existing outflow pipe downstream of Eagleville Dam. Effluent discharges to the Willimantic River would increase at a rate similar to the pumping rate since the new water would be primarily utilized in areas with sewer service. The capability of the Willimantic River to assimilate treated waste water is not expected to be significantly impacted, given the magnitude of additional flow.

11.7.2 STORMWATER SYSTEMS, BRIDGES, AND CULVERTS

A variety of bridges, cross culverts, and stormwater systems can be found along the potential pipeline segments associated with a potential new wellfield nearby Mansfield Hollow Lake. Table 11.7-1 summarizes these watercourse crossings. Photographs of several of these crossings are presented in Appendix C.

Several major challenges related to bridges and culverts will need to be overcome in the various routing scenarios:

- The potentially historical stone archway over Chapin Brook lies along routing options 1, 2, and 3 for each potential wellfield. This structure could potentially be avoided by redirecting the water main along Dodd Road, although this road also has a bridge crossing for Chapin Brook.

- Connection to the Fenton River Wellfield (routing options 1 and 4) would potentially require crossings of the Fenton River in three locations. Routing option 1 for each well location crosses the Fenton River twice; routing options 2, 3, and 4 for MH-4 crosses the Fenton River once; and routing option 4 for MH-3 also crosses the Fenton River twice.

    - The first crossing for routing option 1 (pipeline segment 35) would be over the existing large box culvert on Chaffeeville Road. There may be enough clearance over the top of this culvert to install a water main in the roadway.

TABLE 11.7-1
Summary of Stormwater Systems by Pipeline Segment
Associated with a New Wellfield nearby Mansfield Hollow Lake

Pipeline Segment	Bridge	Storm Drainage Systems	Cross Culverts	Comment
20	None	Yes	Yes	Nearby pedestrian bridge.
21	None	Future	Future	Future North Hillside Road extension.
23 (MH-5)	Mansfield Hollow Lake Culvert	No	None observed	May have enough clearance to install water main beneath roadway.
24 (MH-6)	None	No	No	
25	None	No	Yes	
26 (MH-2)	None	No	No	
27	None	No	None observed	
28	None	Swales	None observed	
29 (MH-3)	None	No	None observed	
30	None	Yes	Yes	
31	Fenton River	No	None observed	Large culvert at Fenton River
32 (MH-4)	None	Yes	Yes	
33	No	No	Yes	
34	Chapin Brook	Swales	Yes	Stone arch over Chapin brook may be historical structure.
35	Fenton River	Swales	Yes	Large box culvert conveys Fenton River
36	Fenton River	Swales	Yes	May need to hang pipe on side of bridge.
37	No	Yes	No	Drainage on Horse Barn Hill Road
38	None	No	None observed	
39	None	Yes	Yes	Storm drainage near Silo Road. Top of Schoolhouse Brook culverts are near the level of the roadway – may need to hang water main.
40	None	Yes	Yes	
45	None	Yes	None observed	
46	None	Yes	None observed	
47	None	Yes	No	
48	None	Yes	Yes	Roberts Brook
49	None	Yes	No	
50	None	No	No	

- The second crossing is on Gurleyville Road near Fenton Well D (pipeline segment 26) where a pipe would need to be hung on the side of the bridge, or a different method (such as directional drilling beneath the river) would need to be employed. This is a design

issue that can affect the project cost but should not impact the viability of the bridge infrastructure.

  - The third crossing applicable only to MH-3 and MH-4 is the Route 89 crossing at Mansfield Hollow State Park. There is likely sufficient clearance above the culvert to permit installation of a water main beneath the roadway.

- Any routing from MH-5 will require crossing Mansfield Hollow Lake on Bassetts Bridge Road. Two large, corrugated metal pipes allow water in the lake to pass beneath the roadway. There may not be sufficient clearance between the roadway and the top of the pipe to allow for construction of a water main within the roadway. In that case, the water main would need to be exposed on the berm near the culverts or directionally drilled below the corrugated metal culverts.

Many minor crossings will also affect construction. Roberts Brook (pipeline segment 36) and Schoolhouse Brook (three crossings on pipeline segment 39), could present construction-related challenges, as could smaller shallow culverts beneath roadways. The installation of potential water mains will be designed to avoid interference with existing stormwater systems. If modifications to stormwater systems are necessary, they will need to be evaluated within the design phase of the eventual project.

New stormwater systems would be developed in concert with any new development served by a new supply.

11.7.3 ENERGY, ELECTRICITY, AND NATURAL GAS

A new wellfield or wellfields nearby Mansfield Hollow Lake would result in the following additional energy demands over current levels:

- Additional energy demands for pumping;
- Additional energy demands at existing treatment facilities or new water treatment facilities;
- Additional energy demands in new buildings on the North Campus and the Depot Campus that would be serviced by the proposed water supply, as well as in Mansfield Four Corners;
- Additional energy demands in the form of vehicle fuel and additional office work (computers, etc.) due to an increased service area for operations and maintenance personnel; and
- Additional energy demands (electricity, fuel) from new development and redevelopment spurred by the presence of the water main.

Electrical Service

As noted above, incremental electrical demands would be realized to support this project. These include using electricity for treating additional water at treatment facilities, additional pumping station demands to direct water into the distribution system, and potentially increased electrical demands from additional personnel and equipment.

As the yield of a new well or wells has not been determined, energy demands cannot be estimated at this time. However for planning purposes, it is assumed that the creation of a new well would result in an increase in electrical usage of 25% over the existing usage at the Fenton River

Wellfield. Additional wells would result in additional increases in electrical demand. The static discharge pressure will be much less to move water to the Fenton River Wellfield than directly into the distribution system, resulting in less overall energy expenditure for those routing scenarios that connect to the Fenton River Wellfield.

Electrical service would also be extended into any new developments including those spurred by the presence of the water main. New University buildings would partially or fully be serviced with electricity from the CUP. As exact building uses are not known at this time, estimates of electrical service cannot be provided. However, it is assumed that Connecticut Light & Power has sufficient supply to provide electrical service to any related incremental increases and new development.

Natural Gas Service

Expansion of natural gas is expected to occur to new buildings in North Campus and the Depot Campus; new buildings in the vicinity of Mansfield Four Corners may also be serviced with natural gas. While an estimated amount of new usage of natural gas in these areas cannot be quantified at this time as buildings have not been designed, it is assumed for the purposes of this EIE that sufficient supply exists to serve these developments. In addition, natural gas usage to create electricity at the CUP may increase to support proposed University development.

Coordination with these utilities will be necessary to determine the depth of the gas pipelines during the design phase in order to avoid interference. Additional protective controls such as extra casing may be necessary in the vicinity of the gas pipelines. No direct impact to natural gas service or existing pipelines (other than additional usage and service area) is expected.

Other Energy Sources

Development of a new groundwater supply would have an incremental impact on the amount of fuel utilized for backup generation at pump stations. Construction-related traffic delays will also cause an incremental increase in fuel consumption during the construction period. In addition, the construction period will involve a direct consumption of fuel by equipment that cannot immediately be quantified. Indirect impact to these fuel sources would likely occur through increased demand in the project area following development and redevelopment activities.

11.7.4 TELECOMMUNICATIONS SERVICE

Expansion of telecommunications service is expected to occur to any new buildings developed as a result of the availability of water supply. In addition, telecommunications service would be extended to any new wellfield to connect the equipment to the University's SCADA and alarm systems. It is assumed for the purposes of this EIE that sufficient capability exists to serve these developments. For example, University Information Technology Services (UITS) has indicated that it will be able to service any new buildings on the North Campus and the Depot Campus without issue. Coordination with existing utilities will be necessary to determine the depth of any underground wires during the design phase in order to avoid interference. No direct impact to telecommunications providers (other than additional usage and service area) is expected.

11.8 TRAFFIC, PARKING, AND OTHER TRANSPORTATION

The construction of a new wellfield nearby Mansfield Hollow Lake and associated pipelines may have several impacts related to parking, traffic, and other transportation. Table 11.8-1 presents the characteristics of roadways along potential pipeline segments associated with the new wellfield scenarios. The majority of these routes are well traveled roadways.

Based on the information in Table 11.8-1, the potential pipeline routes that more heavily utilize local roads and off-road areas would encounter less traffic during the construction period than those that utilize Route 195. In particular, routing option 4 (from MH-3 and MH-4) would have the least amount of traffic impacts due to the relatively reduced traffic volume on Chaffeeville Road and Gurleyville Road as compared with other areas. Routing options 1, and 2, would have an increased level of traffic impact, with routing option 3 having the highest overall impact.

TABLE 11.8-1
Traffic Characteristics along Potential
New Mansfield Hollow Lake Wellfield Pipeline Segments

Pipeline Segment	Distance (ft)	Road Type	Traffic Count	Speed Limit (mph)	Source
20	1,540	Arterial	9,000	40	2010 CT DOT
21	3,400	Future	-	N/A	-
23	3,640	Local	2,917	30	2005 Town of Mansfield
24	270	No Road	-	-	-
25	4,720	Local	2,917	30	2005 Town of Mansfield
26	310	No Road	-	-	-
27	920	Local	2,917	30	2005 Town of Mansfield
28	2,390	Arterial	11,700	40	2010 CT DOT
29	590	No Road	-	-	-
30	4,150	Collector	4,000	30	2010 CT DOT
31	1,780	Collector	3,300	30	2010 CT DOT
32	2,470	Collector	2,800	45	2010 CT DOT
33	8,780	Local	100	25	2008 CT DOT
34	2,230	Arterial	9,600	40	2010 CT DOT
35	9,920	Local	607	30	2009 Town of Mansfield
36	13,070	Local	964 / 1786[1]	30	2004 / 2001 Town of Mansfield
37	6,400	Local	1,800	30	2006 Town of Mansfield
38	570	Arterial	9,600	45	2010 CT DOT
39	17,230	Local	2,400	25	2005 Town of Mansfield
40	14,900	Arterial	9,600 / 11,300[2]	40 / 45	2010 CT DOT
45	3,410	Arterial	6,500	30	2010 CT DOT
46	1,360	Arterial	12,400	30	2010 CT DOT
47	380	Local	-	25	-
49	4,040	Arterial	16,800	25	2010 CT DOT
50	260	Utility	-	-	-

Notes: [1] Chaffeeville Road south of Gurleyville / Gurleyville Road west of Gurleyville
[2] Route 195 South / North of Spring Hill Road

The installation of new pipelines would cause temporary traffic impacts along any heavily travelled corridors during the construction period. Construction in most roadway areas would be constrained to one lane, resulting in alternating one-way traffic along most of the potential pipeline connection routes. These delays could also impact bus service in the area. State Police traffic protection would be required on many roadways. Construction activities may also temporarily restrict access to businesses and homes. Bikeways and sidewalks in the vicinity of the University (such as along Route 44) may need to have portions temporarily closed during the construction period. In addition, performing construction work during the summer period would minimize the volume of traffic passing the construction area near the University.

11.9 WETLAND RESOURCES

The construction and use of a new well and associated pipelines has the potential for direct wetland impacts due to the construction of new infrastructure as well as the potential for long-term impacts related to drawdown nearby the new supply sources. These are described in the following sections.

11.9.1 EXISTING WETLAND AREAS NEAR POTENTIAL WELLFIELD LOCATIONS

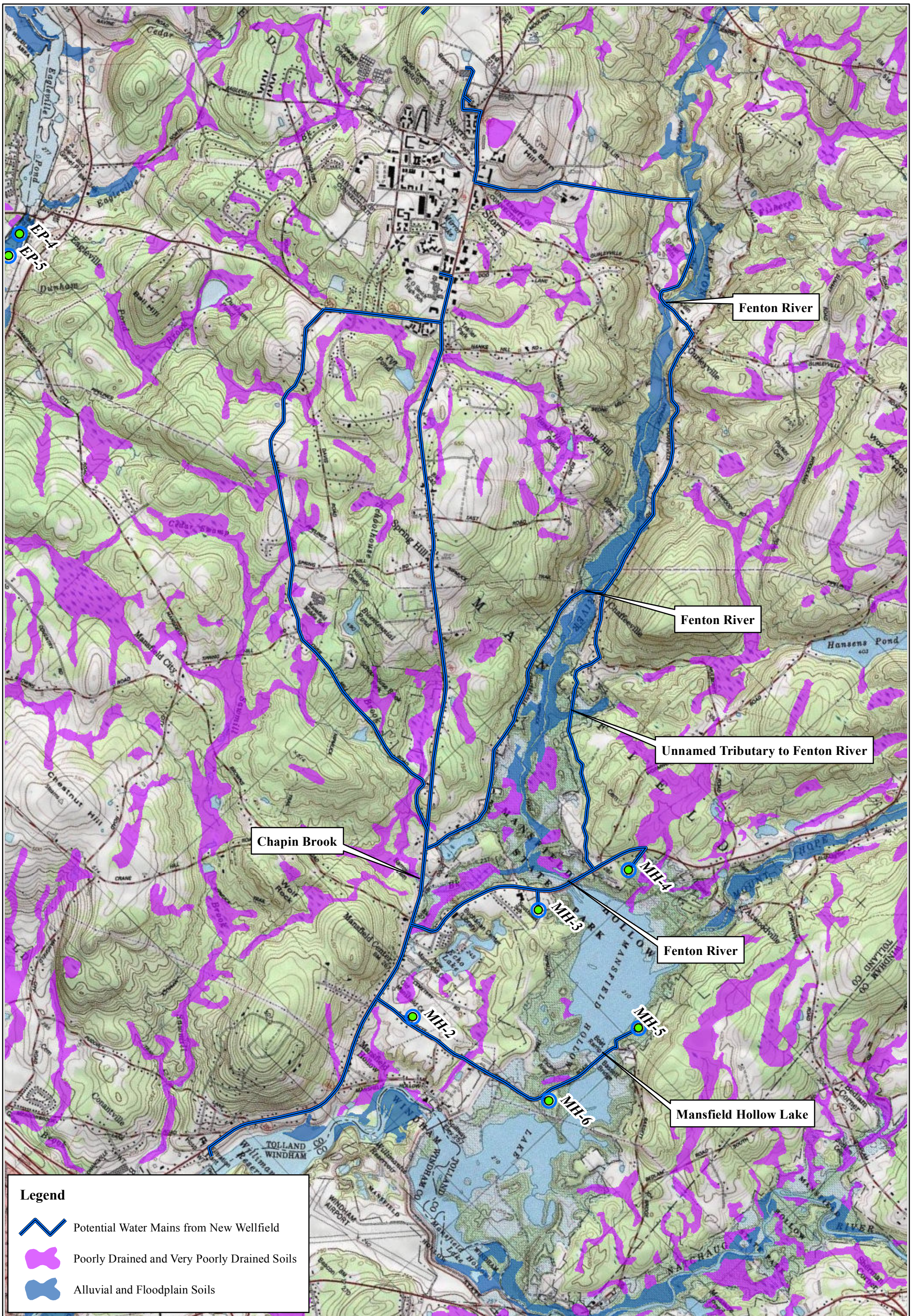
Installation of a new wellfield in the vicinity of Mansfield Hollow Lake would occur near a variety of wetlands and watercourses. Refer to Figure 11.9-1 for a depiction of inland wetland soils and watercourses adjacent to potential pipeline segments.

Potential Wellfield MH-2

Well location MH-2 is located in an upland cornfield with no immediate wetlands present. The nearest wetland is a wet depression of open water and shrub swamp located approximately 500 feet to the northwest that is locally known as the "floating bog." It may have been formed by a kettle hole according to the 1987 Environmental Review Team Report for the site. There is a shrubby border of silky dogwood and sedges around the bog, and the open water has a vegetated mat. Obligate wetland shrubs may include buttonbush. The far edge of the pond is a forested wetland dominated by red maple and American elm with scattered white pines. The depression likely supports amphibian breeding, warm water fish, and reptiles. Waterfowl would also utilize the pond for nesting and during migration.

The Town of Mansfield (in its Commonfields park guide) indicates that this bog offers nesting places for wetland birds and cover for turtles, geese, and other animals. The 1987 Environmental Review Team Report for the site indicates that ground water flow beneath the site is to the southeast and toward the Natchaug River, while surface water flow is generally to the northwest and towards this depression.

The potential well location lies on three parcels owned by the Town of Mansfield, totaling 8.3 acres. This area is sufficiently large to site two wells while maintaining a 200-foot sanitary radius on the property. While the closest well site is located more than 500 feet away from the "floating bog," this area could be more than minimally affected by drawdown associated with the new well or wells due to redirection of groundwater away from this area. The extent of the drawdown would have to be determined via a pumping test and numerical modeling.



SOURCE(S):
1997 USGS Topographic Map mosaic via ESRI
SSURGO Soils data from CT DEEP

Figure 11.9-1: Potential Wetlands along New Water Mains from Mansfield Hollow

Location:
Mansfield, CT

University of Connecticut
Environmental Impact Evaluation for
Potential New Source(s) of Water Supply

Map By: scottb
MMI#: 1958-59
MXD: H:\1958-59\GIS\Maps\Report\Figure11.9-1.mxd
1st Version: 03/12/2012
Revision: 9/14/2012
Scale: 1 in = 2,500 ft

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Potential Wellfield MH-3

Well location MH-3 is located in an upland forest area behind Southeast Elementary School. This is a wooded setting of white pine and mixed oaks close to the recreational fields. No nearby wetlands were observed. Some riparian wetlands may exist adjacent to the Fenton River where it intersects Mansfield Hollow Lake, as well as along the edge of Mansfield Hollow Lake. These are not expected to be affected by drawdown at the well due to the relatively stable water level in Mansfield hollow Lake.

This site lies on a 17.1-acre parcel owned by the Town of Mansfield associated with Southeast Elementary School and Southeast Park. The parcel is likely only large enough to site one well while maintaining a 200-foot sanitary radius on the property due to the required setbacks from the school and its septic system.

Potential Wellfield MH-4

Well location MH-4 is located an upland forest area of mixed oaks on the north side of Mansfield Hollow Lake. A wet trough/intermittent watercourse is located to the east of the proposed well location, and some riparian wetlands may also exist adjacent to Mansfield Hollow Lake. The potential well location lies on federal lands near Route 89. While several wells could be sited in the area, it would be challenging to find areas above the spillway elevation of Mansfield Hollow Reservoir (257 feet).

The nearby wet trough/intermittent watercourse would be affected by drawdown associated with the new well or wells, although it is likely dry for much of the year. The extent of the drawdown would have to be determined via a pumping test and modeling. Numerous mitigation measures are available, if necessary, including construction of a new wetland along another section of this property or on other University or Town property or using wells minimally or only for peaking. Wetlands adjacent to Mansfield Hollow Reservoir are unlikely to be affected by pumping. Coordination would need to be performed with CT DEEP and potentially USACE during the permitting processes.

Potential Wellfield MH-5

Well location MH-5 is located in an upland forest area of white pines and mixed hardwoods to the east of Mansfield Hollow Lake. The potential well location lies on federal lands east of Mansfield Hollow Lake and west of Kaya Lane. This area is believed large enough to site only two wells while maintaining a 200-foot sanitary radius due to the nearby property boundaries.

No nearby wetlands other than wetlands adjacent to Mansfield Hollow Lake were observed, and those wetlands are unlikely to be affected by a new wellfield. Mansfield Hollow Lake supports active fishery resources and provides associated recreational opportunities. Fauna utilize the lake and surrounding woodland for nesting and seasonal migration. A number of waterfowl species were observed on the lake in late 2011, including resident mute swan, Canada geese, mallard duck, and migrant common merganser. Woodpeckers were common in the hardwood stands.

Potential Wellfield MH-6

Well location MH-6 is located in an upland forest area to the west of Mansfield Hollow Lake consisting of white pines. Low-lying shrubs such as low-bush blueberry and bearberry dominate the area along with mountain laurel. The mixed woodland area provides good nesting and foraging habitat for songbirds and excellent nesting habitat for belted kingfisher.

No nearby wetlands other than wetlands adjacent to Mansfield Hollow Lake appear to be located within 500 feet; such wetlands are unlikely to be affected by a new wellfield. A few kettle holes are located to the more than 500 feet to the north of the potential well location that could potentially be impacted by drawdown at the well. This area is likely only large enough to site one well while maintaining a 200-foot sanitary radius due to the limited area elevated above the spillway of 257 feet. Mounding above the flood elevation would be needed if additional well areas were to be explored.

11.9.2 EXISTING WETLAND AREAS ALONG POTENTIAL PIPELINE SEGMENTS

The potential pipeline segments from a new wellfield near Mansfield Hollow Lake pass a variety of wetlands and watercourses. Refer to Figure 11.8-1 for a depiction of inland wetland soils and watercourses adjacent to potential pipeline segments. Direct wetland impacts are not expected to occur along these pipeline segments through the use of construction techniques that avoid construction in the wetlands (such as hanging pipes on bridges or directional drilling beneath wetlands and watercourses). Table 11.9-1 summarizes the wetlands found along each pipeline segment potential pipeline segments associated with a new wellfield near Mansfield Hollow Lake.

The wetlands presented in the table are described in more detail below.

- Pipeline Segment 20: A forested wetland is conveyed under Route 44 between Rosal Apartments and the former Zenny's restaurant. The wetland flows from south to north through an 18-inch pipe.

- Pipeline Segment 21: The reader is directed to the Final Environmental Impact Statement (FEIS) for the Technology Park related to impacts to wetlands, vernal pools, and intermittent watercourses along this pipeline segment.

- Pipeline Segment 23: A narrow forested riparian buffer encircles Mansfield Hollow Lake and is present near the trail leading to the MH-5 well site. Bassetts Bridge Road also crosses Mansfield Hollow Lake in this segment but the edges of the road embankment are heavily rip-rapped with no wetland resources present in this location.

- Pipeline Segment 25: A fire pond lies on the north side of Bassetts Bridge Road with a perennial watercourse flowing to the south.

- Pipeline Segment 26: Potential well location MH-2 is located on a cornfield without apparent wetlands. A wet depression of mostly open water lies nearby to the northwest. This shallow pond supports a shrub swamp.

TABLE 11.9-1
Wetlands along Potential Pipeline Segments Associated with a New Wellfield in the Vicinity of Mansfield Hollow Lake

Pipeline Segment	Number of Adjacent Wetland Areas	Total Adjacent Wetland Distance (ft)	Comment
20	1	50	Forested wetland
21	2	420	Intermittent watercourse / wetland, vernal pool
23	1	400	Narrow riparian buffer with Mansfield Hollow Lake
24	0	0	MH-6 well location on knoll
25	1	100	Fire pond and intermittent watercourse
26	1	0	MH-2 well location
27	0	-	
28	1	300	Seeps collecting on west side of road
29	0	0	MH-3 well location
30	1	100	Dug pond, toe wetlands
31	1	0	Fenton River culvert
32	1	440	Wet trough / intermittent watercourse
33	2	330	Bordering puddles / wet seeps, Unnamed perennial watercourse crossing
34	2	225	Barrows Cemetery Pond and intermittent watercourse
35	5	1,510	Large swamp, Fenton River floodplain and forested wetland
36	6	675	Several watercourses, the Fenton River, and a forested swamp
37	4	300	Potential vernal pools, forested wetlands, intermittent watercourses, wetland soils located in agricultural field
38	0	0	-
39	14	4,210	Forested wetlands and intermittent watercourses associated with Schoolhouse Brook, Mansfield Middle School, Sawmill Brook, Dunham Pond Brook
40	6	4,200	Large emergent wetland, forested wetland associated with Hank's Brook, intermittent watercourses
45	1	180	Forested wetland draining to Tift Pond
46	0	0	-
47	0	0	-
49	0	0	-
50	0	0	-

- Pipeline Segment 28: A series of seeps appear to drain into a trough on the west side of Route 195 just northwest of Old Mansfield Cemetery.

- Pipeline Segment 30: A dug pond exists on the north side of the road that may be used for fire protection. A forested wetland also exists at the bottom of the Route 89 slope west of the library. This wetland continues north towards the Fenton River but is relatively distant from Route 89 in most places.

- Pipeline Segment 31: The Fenton River enters Mansfield Hollow Lake through a culvert at the bottom of a high embankment that carries Route 89. The slopes of this embankment are rip-rapped providing minimal wetland habitat near the base.

- Pipeline Segment 32: Potential well location MH-4 lies in a dry, woodland area. The potential pipeline route crosses a wet trough/intermittent watercourse to reach Route 89.

- Pipeline Segment 33: This segment runs along Baker's Road into Lions Park. The paved road leading to Lions Park is at-grade and has several bordering puddles and wet seeps. The proposed pipeline route crosses a perennial watercourse with bordering forested wetlands. Wetlands were not noted adjacent to Olsen Drive. A small, roadside wet trough exists near the intersection of Mulberry Road and Chaffeeville Road.

- Pipeline Segment 34: A stone arch bridge conveys Chapin Brook southeast across Route 195. This watercourse is the outlet of Barrows Cemetery Pond, and appears to have narrow adjacent wetland areas on both sides of Route 195. A second intermittent watercourse crosses Route 195 to the southeast not far to the north of the stone arch bridge.

- Pipeline Segment 35: A large emergent marsh/open water/scrub-shrub swamp is located near the intersection of Dodd Road and Chaffeeville Road is parallel to the road approximately 50 feet away. The Fenton River has an associated forested floodplain with seeps at the toe of the road embankment. The floodplain has backwater pools and braided channels. Three intermittent watercourses that are tributaries to the Fenton River also cross Chaffeeville Road.

- Pipeline Segment 36: Three intermittent and one perennial watercourse cross Chaffeeville Road flowing west to the Fenton River. The perennial watercourse has associated forested wetlands. The Fenton River runs close to the road in some areas with a forested floodplain and backwater pools. A scrub swamp wetland that drains to the Fenton River is located near Fenton Well D. The unpaved utility access road from Well D to the pumping station crosses Roberts Brook.

- Pipeline Segment 37: Refer to Section 6.9 for a description of wetlands near the Fenton River Wellfield.

- Pipeline Segment 39: This pipeline route crosses Schoolhouse Brook and its associated forested wetlands in seven locations along Clover Mill Road. It also passes two palustrine forested wetlands near Mansfield Middle School; both may potentially support vernal pools. These wetlands also drain southeast to Schoolhouse Brook. A large marsh is located near the intersection of Clover Mill Road and Route 195 that supports cattails and invasive giant reed

(Phragmites) growing in open water. Further northwest, a palustrine forested / shrubby wetland is conveyed to the south across Maple Road just northwest of Spring Hill Road; this intermittent watercourse eventually discharges to Sawmill Brook. A potential vernal pool is located on the east side of the road. An intermittent watercourse with an associated palustrine forested wetland flows southwest across Maple Road northwest of the gas pipelines. Finally, a series of small farm or fire ponds and seeps lie adjacent to the road just south of the western end of Davis Road.

- Pipeline Segment 40: A large emergent wetland and watercourse system is located along most of this route south of Spring Hill Road. This system drains into Schoolhouse Brook. It lies close to the road in many places but is generally 10 feet below the level of the road. Route 195 impounds a stream locally known as Hanks Brook near the northern terminus of Flaherty Road. This perennial stream has a large palustrine forested wetland west of Route 195. Small intermittent watercourses also cross the road in several places; these drain from seeps or in some cases appear to be drainage swales.

- Pipeline Segment 45: A forested wetland is located south of Route 275 in the vicinity of Knollwood Apartments. This wetland drains to Tift Pond and eventually to Hanks Hill Brook. The Town of Mansfield has indicated that a vernal pool featuring frogs and salamanders is located within this wetland area.

Pipeline segments associated with a potential new wellfield near Mansfield Hollow Lake lie entirely beneath paved roadways with a few exceptions as noted above. Hanging pipes on the sides of culverts or bridges may be an option or directional drilling (such as along pipeline segment 33) could be utilized to avoid wetlands. These activities will not result in a wetland impact but may still require wetland permits. The use of best construction management practices for sedimentation, erosion, and debris controls would result in minimal impact to adjacent wetlands along the remainder of potential pipeline routes.

The above noted wetland areas were evaluated by a certified soil scientist and professional wetland scientist based on the presence of perennial streams, intermittent streams, and state wetland soils. Wetlands and vernal pools will need to be delineated along the selected pipeline scenario by a professional wetland scientist during the design phase.

A pumping test and numerical modeling would be required by the CT DEEP as part of any diversion permit application for a new wellfield. This modeling would help to quantify the potential level of impact of a new wellfield on nearby wetlands and watercourses and would likely drive the acceptable rates of withdrawal. New sources at these locations could likely be developed without significant wetland impact; however, the rate of withdrawal relative to the cost of the alternative would likely be a major consideration prior to developing such a source.

11.10 BIOLOGICAL ENVIRONMENT

Some clearing is believed to be required under this alternative. This would be limited to road edges where pipelines and pressure reducing valves would need to be installed as well as areas at potential well locations to support the pumphouse and associated infrastructure. Clearing would be minimized in order to preserve as much of the existing environment as possible. Potential well

location MH-2 would require the least amount of clearing, while the remaining locations would require clearing of the forest edge and interior areas.

The Natural Diversity Data Base (NDDB), FEIS for the Technology Park, and Mansfield's 2000 *Water Supply Plan* reference several state-listed species that have been identified along potential pipeline routes associated with a new wellfield in this area. These include grasshopper sparrows, showy lady's slipper, vesper sparrows, American kestrels, capillary pondweed, frosted elfin moth, northern spring salamanders, aquatic snails, bobolinks, eastern hognose snakes, eastern meadowlarks, savannah sparrows, and wood turtles. Descriptions of these species were presented in Section 4.9. Qualified personnel would need to perform a biological survey along the proposed construction route to determine if these species are present and to set a construction timetable to avoid these species.

11.11 INLAND FISHERIES

The water level in Mansfield Hollow Lake is regulated by the Mansfield Hollow Lake Dam. The dam has a spillway elevation of 257 feet. Typically, the surface water elevation in this impoundment is at 213 feet in the summertime and at 209 feet in the winter. A typical surface water elevation is 210 feet as reported by the USGS; this level covers 450 acres. The impoundment is utilized for flood control and has a total storage area of 1,880 acres. The maximum capacity of the lake is 49,200 acre-feet or 16.1 billion gallons. A dike surrounds the entire flood control reservoir at an elevation of 272 feet.

Flow is contributed to Mansfield Hollow Lake from the Fenton River, Mount Hope River, and Natchaug River. Water levels in the lake can fluctuate based on USACE requirements such as dam maintenance. However, the reservoir is typically operated as a run-of-the-river impoundment with inflows equaling outflows with two exceptions. During flood events the gates are closed and only a 15 cfs release is allowed. According to the 1995 *Instream Flow Study of the Natchaug River*, the USACE is required to release a minimum of 25 cfs to comply with the Federal Energy Regulatory Commission permit for the dam.

A new wellfield in the vicinity of the lake would have negligible fisheries impacts. Regardless of whether induced infiltration from the lake bottom or reduced groundwater discharge to the lake was occurring, groundwater withdrawals would be mitigated by the volume of the lake.

11.12 WATER QUALITY AND STORMWATER MANAGEMENT

11.12.1 SURFACE WATER RESOURCES

This alternative would withdraw additional water from the Natchaug River Basin. The watershed draining to Mansfield Hollow Lake includes over 159 square miles in Southbridge, Massachusetts, Union, Woodstock, Willington, Ashford, Eastford, Pomfret, Mansfield, Chaplin, Hampton, and Windham. The surface water in the Fenton River, Mount Hope River, Natchaug River, and Mansfield Hollow Lake is classified as B/AA throughout its length, indicating that is suitable for fish and wildlife habitat, recreation, navigation, and industrial and agricultural water supply. The State's long-term goal is to restore the water quality of the reservoir to Class AA.

Existing and former landfills located upstream on the Fenton and the Mount Hope Rivers and former industrial lagoons in Eastford appear to be the headwaters for the B/AA classification.

The Natchaug River is listed as not meeting the standard of designated use for recreation due to an unknown source of *E. Coli* bacteria. In addition, the river has a fish consumption advisory. The Fenton River is considered to meet the designated standards for aquatic life upstream of Mansfield Hollow Lake but not upstream of Gurleyville Road due to ground water withdrawals. In addition, this river has a fish consumption advisory.

11.12.2 GROUNDWATER RESOURCES

Potential well locations MH-4, MH-5, and MH-6 are designated as areas of high groundwater quality (Class GAA) designated for existing or proposed public drinking water supplies without treatment, groundwater in the area that contributes to a public drinking water supply well, and groundwater in areas that have been designated as a future water supply areas. It is presumed that groundwater in such areas is at a minimum suitable for drinking or other domestic use without treatment. The installation of a new well in these areas and associated water mains is consistent with this classification and will not lead to a deterioration of ground water quality. In addition, water withdrawn from one of these wellfields is expected to have similar quality to that already withdrawn from the Fenton River Wellfield such that blending of treated water is not expected to present any challenges to the University.

Potential well locations MH-2 and MH-3 are located in an area of impaired groundwater quality (Class GAA-Impaired) that may not meet the GAA standard. This classification is believed to be related to a closed mixed waste landfill on Cemetery Road. The installation of a new well in these areas and associated water mains is consistent with this classification and will not lead to a deterioration of ground water quality. However, groundwater in these areas may not be suitable for human consumption or other domestic use without treatment.

Groundwater beneath potential pipeline areas is primarily mapped as GAA with areas of GA mapped along Maple Road. Several areas along potential pipeline routes have reduced groundwater quality. Areas of GA-Impaired water quality are located in Mansfield Center between Bassetts Bridge Road and Route 89, Mansfield Four Corners, and south of Spring Hill on Route 195. The installation of water mains into and through such areas is not expected to reduce water quality. Instead, the installation of water mains to areas such as Mansfield Four Corners would eliminate public health concerns related to the historical contamination in the area.

Homeowners located in the vicinity of Mansfield Hollow currently utilize private water supply wells. The installation of a new well in this area and associated water mains is not expected to cause any impact to the water quantity available from those wells or the water quality within those wells. Most private wells are drilled into the underlying fractured bedrock aquifer, which is not significantly influenced by pumping of the overlying stratified drift. If private gravel packed or dug stratified drift wells are identified near the wellfield (such as one adjacent to MH-4), these wells would need to be monitored during any pumping tests to determine the potential impact. However, most areas served by wells are located relatively distant from the proposed well locations such that drawdown is not an anticipated outcome.

11.12.3 STORMWATER MANAGEMENT

Impacts to stormwater quality are not expected. Best management practices would be utilized during the construction period such that construction debris and sediment are not directly released to stormwater systems. New stormwater systems would be developed in concert with any new University development and would need to meet the University's design standards. In addition, new stormwater systems would be created during new development projects. The impacts of these systems will be evaluated during local permitting processes.

11.13 FLOOD HAZARD POTENTIAL

The Fenton River and Mansfield Hollow Lake have an associated 1% annual chance floodplain mapped in the vicinity of potential wellfields and pipeline routes. Flood elevation information is not available for these water bodies, although based on the delineation for Mansfield Hollow Lake, it appears the 1% annual chance flood elevation may approximately be the spillway elevation (257 feet). Based on information on the 1981 *Flood Insurance Rate Map*, potential well locations MH-5 and MH-6 appear to be within the 1% annual chance floodplain of Mansfield Hollow Lake, yet above the maximum lake flood elevation. The remaining three well locations are above the 1% annual chance flood elevation.

New well locations would need to comply with Connecticut DPH requirements for distance from annual high water marks. The Connecticut DPH requires that a new well be located at least 50 feet from the high water mark of nearby wetlands and watercourses. The potential well locations appear to meet this setback requirement. This distance would need to be confirmed in the field prior to the drilling of any test wells as it is part of the Well Site Application required by Connecticut DPH.

Potential pipeline routes that pass through floodplain areas will require regulatory review even if pipes are connected to bridges or drilled below-grade.

11.14 PHYSICAL ENVIRONMENT

11.14.1 TOPOGRAPHY

The topography of the potential well locations in the vicinity of Mansfield Hollow Lake varies. Potential wellfields MH-2 (elevation 260 feet) and MH-3 (elevation 270 feet) are located on fairly flat areas associated with a plateau west of Mansfield Hollow Lake. Potential well locations MH-4 (elevation 260 feet), MH-5 (elevation 260 feet), and MH-6 (elevation 260 feet) are located on forested hillsides overlooking Mansfield Hollow Lake. The location for any new well or wells would need to be in an area that is generally higher than the surrounding topography such that it is not be subject to direct runoff in order to comply with Connecticut DPH well siting requirements.

While MH-2, MH-6, and MH-3 are easily accessible from Bassetts Bridge Road and through Southeast Park, respectively, the steep topography surrounding Mansfield Hollow Lake would present access challenges for MH-4 and MH-5. MH-4 is located 20 feet below the elevation of

Route 89 and must be accessed across private property, so an easement or purchase of private property would be required.

MH-5 would need to be accessed via an easement or purchase of private property as the only direct access would be via the Atwoodville Trail located approximately 30 feet below the well site at the bottom of a steep grade. This slope is apparently being undercut by wind, runoff, and ice erosion with a beach area forming at the bottom of the slope. This slope would need to be stabilized if a new well were to be installed. In addition to the steep slope, the Atwoodville Trail is located below the level of spillway such that the well location could not be accessed by vehicle during flood events. An alternative means of access (such as on foot from Kaya Lane) would need to be identified during flood events.

MH-6 has a similar challenge on Bassetts Bridge Road relative to with flooding. It is possible that a well in this location may need to be shut down during major flood events using a SCADA system if flood levels did not recede within a day or two.

The potential connection points to the University system for the four alternatives include the Fenton River Wellfield clearwell (elevation 300) and the 12-inch diameter express main at Bolton Road (elevation 625 feet). A static pressure of 190 psi or more will be required to move water into the distribution system from the new well, but much lower pressure would be adequate to route water to the Fenton River Wellfield.

11.14.2 SURFICIAL GEOLOGY

Surficial geology is discussed in detail in Section 11.1 associated with a review of potential well site yields.

11.14.3 BEDROCK GEOLOGY

The bedrock geology at the Mansfield Hollow well locations is presented on the 1985 *Bedrock Geologic Map of Connecticut* as noted below:

- MH-2: The bedrock geology at the proposed well site is mapped as part of the Waterford Group. It is primarily gneiss, and surrounding map units also consist of granitic gneiss. The bedrock tends to strike east to west and dip 20 degrees to the north in the vicinity of the proposed well site.

- MH-3 & MH-4: The bedrock geology at the proposed well sites is mapped as part of the Waterford Group. It is primarily gneiss, and surrounding map units also consist of schist and gneiss. The bedrock tends to strike east to west and dip 75 degrees to the north in the vicinity of the proposed well sites. An inactive fault line lies 700 feet to the north of the proposed well sites which could cause mingling of overburden and bedrock water.

- MH-5: The bedrock geology at the proposed well site is mapped as part of the Tatnic Hill Formation. It is primarily gneiss and schist, and surrounding map units also consist of gneiss. The bedrock tends to strike northwest to southeast and dip 75 degrees to the northeast in the vicinity of the proposed well site.

- MH-6: The bedrock geology at the proposed well site is mapped as part of the Waterford Group on the 1985 *Bedrock Geologic Map of Connecticut*. It is primarily gneiss, and surrounding map units also consist of granitic gneiss. The bedrock tends to strike northwest to southeast and dip 75 degrees to the northeast in the vicinity of the proposed well site.

This alternative would not rely on bedrock well sources but instead would withdraw water from the stratified drift aquifer. These wells are located relatively far from surrounding residences (excepting MH-4) such that water quality or water quantity impacts to private wells is not expected to be an issue.

Fault lines are mapped along potential pipeline segments associated with this alternative. However, fault lines are considered to be inactive.

11.15 AIR QUALITY AND NOISE

The construction of pumping and treatment/control buildings, new water mains and utility work, and other associated construction will not result in a degradation of air quality. New buildings associated with this alternative would have interior equipment and would not be significant generators of air pollution.

Temporary construction impacts to air quality in the vicinity of the new wellfield or wellfields are expected and unavoidable. For example, additional construction traffic will be realized near a wellfield during the development period resulting in an increase in vehicular emissions near the site. Overall, these emissions are expected to have a minimal impact on air quality.

In addition, other construction activities are expected to generate fugitive dust and mobile source emissions. Such sources of dust are attributed to construction vehicle disturbance during hauling, loading, dumping, and bulldozing on any areas of proposed development or construction. Meteorological conditions, the intensity of the activities, and the soil moisture content govern the extent to which particles will become airborne.

The use of air pollution devices on construction equipment and other forms of controls that reduce the impact from fugitive dust emissions will be utilized during this project to minimize impacts to air quality. The proper phasing of construction will further minimize the length of time that soil remains exposed to wind and water. Activities will be conducted in accordance with proper protocols and regulations, and no washings will be directed to storm drainage.

The implementation of a new wellfield alternative near Mansfield Hollow and associated new water mains and utility work will not result in long-term noise impacts. New treatment facilities would be located either at the wellfield or tied into existing treatment at the Fenton River Wellfield with interior equipment that will not create significant noise at the street. While temporary impacts associated with the construction of new water mains would be realized along state and town roads, the noise generated by these construction activities will be minimal.

11.16 SOLID WASTE, HAZARDOUS MATERIALS, & POTENTIAL POLLUTION SOURCES

Regardless of the well location or locations chosen, some amount of construction and demolition-related waste will be generated by the project. Disposal of these wastes would be handled in accordance with applicable solid waste statues and regulations. Significant impacts are not anticipated.

11.17 OTHER PROJECT IMPACTS

11.17.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Certain adverse impacts are unavoidable. These are predominantly in the category of short-term construction related impacts. The project will undergo a construction phase wherein additional equipment will be utilized at the site or sites. Mitigation measures have been identified with respect to associated short-term air and noise quality. However, a certain degree of additional truck and equipment use and access will be necessary during this time period, which is unavoidable. Potential soil erosion and sedimentation impacts have also been identified. These will be largely mitigated through proper construction management techniques.

11.17.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The construction of a new wellfield and associated pipelines will utilize nonrenewable resources during the construction and implementation (i.e., construction supplies, fuel, personnel time, etc.). Since these resources cannot be reused, they are considered to be irreversibly and irretrievably committed. Specifically, these include the following actions:

- Clearing;
- Well drilling and development;
- Construction of new pump houses and treatment/control buildings;
- Installation of water mains to connect to the University and Mansfield; and
- Installation of associated infrastructure, individual pressure reducing valves, etc.

11.17.3 CUMULATIVE IMPACTS

Cumulative impacts are those that result from the incremental impact of the proposed action when added to other past, present, or reasonably foreseeable future actions. Cumulative impacts associated with the alternative include the following:

- Additional withdrawals from the Natchaug River/Mansfield Hollow Lake aquifer system (and subsequently from the Natchaug River) through reduced groundwater discharge and induced infiltration;
- Loss of agricultural uses at site MH-2;
- Incremental energy demands; and
- Incremental traffic density.

11.17.4 MITIGATION OPPORTUNITIES TO OFFSET ADVERSE ENVIRONMENTAL IMPACTS

Several mitigation opportunities have been identified for this alternative to minimize or offset adverse environmental impacts. These include the following:

- Continued adherence to the University's Wellfield Management Plan and water conservation policies, with potential incorporation of the new wells into the Wellfield Management Plan;
- Implementation of overlay zones and zoning regulation changes by local land use commissions in Mansfield to reduce future development density and creation of impervious surfaces along potential pipeline routes;
- Identification of alternate land for agricultural use to replace the loss of site MH-2;
- Coordination with various local departments, commissions, and committees regarding the proposed pipeline;
- Designs that hang pipe on bridges or include directional drilling to prevent direct wetland impacts;
- Construction occurring in the summer whenever possible to minimize traffic impacts near schools and the University;
- Performing a biological survey for endangered, threatened, or special concern species during the design phase to establish buffers and construction timetables to minimize the impact to these species;
- Adherence to best management practices to mitigate impacts to stormwater runoff; and
- Performance of construction activities during daylight hours to minimize noise impacts.

11.18 EVALUATION OF PROJECT COSTS

11.18.1 LAND ACQUISITION AND EASEMENT COSTS

The implementation of this alternative would require the purchase or easement of land for a new well or wells as well as wellfield access. The cost for these items could range from minimal (transfer of land from the other State agencies or the Town of Mansfield) to thousands of dollars (for private property at MH-4 and MH-5).

11.18.2 COSTS TO IMPROVE EXISTING INFRASTRUCTURE

Existing infrastructure may not need to be improved or replaced under this alternative. The exception is if the water line leading from the Fenton River Wellfield to the storage tanks is replaced (pipeline segments 37, 49, and 50).

11.18.3 CONSTRUCTION COSTS

Source-Related Costs

Because individual well sites have not been selected, preliminary cost estimates must be used for planning purposes. Elements of the cost estimates include:

- Cost of land to be acquired – approximately three acres is needed per well site to achieve full ownership of a 200-foot sanitary radius, although it is recognized that entire parcels will likely be acquired and assembled as needed.

- Drilling of test borings, completion of informal yield tests, and water quality testing to select permanent well sites.
- Drilling and development of production wells.
- Completion of 120-hour aquifer pumping test for diversion permitting.
- Completion of 72-hour yield test for proving safe yield and appropriate water quality (can be coincident with other testing).
- Completion of 120-hour aquifer pumping test for Level A mapping (can be coincident with other testing).
- Installation of pumps, discharge lines, and electrical service to well pumps.
- Installation of transmission pipes from wells to treatment building (if needed) or system.
- Grading and improvements for new access roads.
- Construction of treatment/control building or control building.

Table 11.18-1 presents cost estimates. Development of *two wells* is assumed per site (either one active well with one backup well, or two wells that operate lead-lag or in some other arrangement).

TABLE 11.18-1
Cost Estimates for a New Wellfield nearby Mansfield Hollow Lake

Item	Estimated Costs				
	MH-2	**MH-3**	**MH-4**	**MH-5**	**MH-6**
Cost of land	$0[1]	$0[1]	$100,000[2]	$100,000[2]	$100,000[2]
Drilling of test borings, completion of informal yield tests, and water quality testing to select permanent well sites.	$75,000	$75,000	$75,000	$75,000	$75,000
Drilling and development of two production wells (includes pumps and discharge lines)	$200,000	$200,000	$200,000	$200,000	$200,000
Completion of 120-hour aquifer pumping test for diversion permitting & Level A mapping	$50,000	$50,000	$50,000	$50,000	$50,000
Completion of 72-hour yield test for proving safe yield and appropriate water quality (can be coincident with other testing)	$20,000	$20,000	$20,000	$20,000	$20,000
Well houses at wellheads (includes structures, meters, piping) ($50,000 per well)	$100,000	$100,000	$100,000	$100,000	$100,000
Installation of transmission pipes from wells to treatment/control building ($50,000 per well)	$100,000	$100,000	$100,000	$100,000	$100,000
Construction of treatment/control building or control building (and contents)	$200,000	$200,000	$200,000	$200,000	$200,000
Grading and improvements for new access roads	$10,000	$10,000	$10,000	$10,000	$10,000
Totals	$755,000	$755,000	$855,000	$855,000	$855,000

1. Assumed donation of land from Town
2. Assumed cost for easement from Army Corps of Engineers

Pipeline and Associated Water Mains

The assumptions have been made relative to the cost of pipeline:

- Eight-inch transmission main
- Bends – one located per 1,000 feet of pipeline
- Isolation valves – one located per mile of pipeline
- Flush hydrants – one located per mile of pipeline
- Air release – one located per mile of pipeline
- Fire hydrants – none included

Table 11.18-2 lists the estimates.

TABLE 11.18-2
Construction Cost Estimates for Potential Pipeline Scenarios

Wellfield Location	Pipeline Route	Cost (million)
MH-2	#7A-1*	$6,672,000
	#7A-2	$5,061,000
	#7A-3	$4,200,000
MH-3	#7B-1*	$6,840,000
	#7B-2	$5,229,000
	#7B-3	$4,368,000
	#7B-4*	$5,979,000
MH-4	#7C-1*	$7,389,000
	#7C-2	$5,778,000
	#7C-3	$4,917,000
	#7C-4*	$5,994,000
MH-5	#7D-1*	$7,879,500
	#7D-2	$6,268,500
	#7D-3	$5,407,500
MH-6	#7E-1*	$7,374,000
	#7E-2	$5,763,000
	#7E-3	$4,902,000

*Includes replacement of pipeline from Fenton clearwell to campus

11.18.4 ANALYSIS OF ESTIMATED COSTS

The costs described above are summarized in Table 11.17-3. The lowest-cost pipeline option from Table 11.17-2 is carried forward to this table.

TABLE 11.17-3
Summary of Estimated Costs for Alternative #7

Component	Estimated Costs				
	MH-2	**MH-3**	**MH-4**	**MH-5**	**MH-6**
Wellfield investigation, development, and construction	$755,000	$755,000	$855,000	$855,000	$855,000
Transmission pipelines	$4,200,000	$4,368,000	$4,917,000	$5,407,500	$4,902,000
Design/contingency (20% of above)	*$991,000*	*$1,024,600*	*$1,154,400*	*$1,252,500*	*$1,151,400*
Permitting and Other Approvals	$150,000	$150,000	$150,000	$150,000	$150,000
Legal agreements and services	$100,000	$100,000	$100,000	$100,000	$100,000
Totals	**$6,196,000**	**$6,397,000**	**$7,176,000**	**$7,765,000**	**$7,158,000**

Most of the mitigation opportunities listed in Section 11.17.4 will have costs that are inherently incorporated into components of the alternative. For example, coordination with local departments and commissions regarding the pipeline are typically incorporated into design and regulatory costs, as are designs that hang pipe on bridges or include directional drilling to prevent direct wetland impacts, and construction in the summer whenever possible to minimize traffic impacts near the University. Thus, much of the mitigation does not have a separable cost. On the other hand, implementation of overlay zones in Mansfield will have a moderate cost on the order of $10,000.

Identification of alternate land for agricultural use to replace the loss of site MH-2 could have a cost impact to the Town of Mansfield. The cost for land purchase can be minimized by selecting properties that are Town-owned, but this may not be an option. Furthermore, even if costs of land can be minimized, the preparation of land for agriculture can have an associated expense. These costs cannot be estimated, but this document recognizes that costs may be incurred by the Town of Mansfield.

11.19 FINDING

Development of one or more wells near Mansfield Hollow is not likely to cause significant environmental impact; however, the yield and quality of water is uncertain. Development of wells at these locations will not meet the stated project purpose and need.