Assessment of Water Resources

Town of Maynard, MA
Department of Public Works

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Town of Maynard, MA
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woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

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1. INTRODUCTION

1.1 STUDY PURPOSE AND SCOPE

The Town of Maynard's (Town's) existing water supply sources includes three well sites; one located off Rockland Avenue, a second off of Old Marlboro Road, and a third located on Great Road (Well No. 4) in Maynard and a surface water supply at White Pond located in the Towns of Stow and Hudson. Currently, the Town receives most of its water supply from the Rockland Avenue Wells to meet the Town's water demands. However, if these wells have mechanical failure and go offline, the Town does not have sufficient redundancy to meet average and maximum day demands due to capacity and treatment deficiencies associated with the other available water resources.

The Town identified the need to assess their current water resources and identify redundant capacity in the event the Rockland Avenue Wells are offline. Woodard & Curran conducted an assessment to identify potential water source alternatives and the respective water yield, estimated cost, permitting requirements, and pros/cons to determine a recommended approach for how the Town should proceed with future water supply development.

As part of this study, Woodard & Curran reviewed previous study recommendations and findings that included the 1994 White Pond Design Report, White Pond Pilot Studies, Old Marlboro Well color treatment alternatives, MassDEP Annual Statistical Reports (ASRs), and other referenced reports.

The following potential water resource alternatives were identified and assessed by Woodard & Curran:

- White Pond Surface Water Treatment
- White Pond Well Development
- Old Marlboro Well Capacity and Treatment Alternatives
- New Well Development to Connect with Well No. 4

1.2 REPORT OUTLINE

This Assessment Report developed by Woodard and Curran includes the following sections:

Section	Description
2: Present Water System	Summary of groundwater and surface water supply sources, potential water yields, and permitted withdrawals.
3: Recent Water Consumption and Trends	Assessment of past water consumption demands and future trends based on population projections.
4: White Pond Surface Water Treatment	Evaluation of the White Pond surface water treatment alternative. Transmission line routing, treatment plant siting, and water treatment alternatives are included. Construction costs, environmental constraints, and permitting requirements are summarized.
5: Groundwater Source Alternatives	Evaluation of groundwater capacity and treatment alternatives for White Pond, Old Marlboro Wells, and Well No. 4. White Pond new well development potential, Old Marlboro Well color treatment and capacity alternatives, and new well development for connection with Well No. 4 are included. Construction costs, environmental constraints, and permitting requirements are summarized.
6: Inter-Municipal Water Connections	Feasibility for Town water connections with Hudson, Sudbury, and Stow.
7: Recommended Alternatives	Summary of proposed alternatives. A timeline for implementation of preliminary environmental studies and pilot tests, permitting, design, and construction for each alternative is provided.

2. PRESENT WATER SUPPLY

This section describes Maynard's existing water supply sources, including groundwater and surface water sources and their respective withdrawal capacities.

Overall, the Town is permitted to withdraw an average volume of 1.09 million gallons per day (MGD) or 397.85 million gallons per year (MGY) under the Massachusetts Water Management Act. The Town has eight (8) permitted and registered withdrawal points (supply sources) that include seven (7) groundwater wells and one (1) surface water source. These withdrawal points are described in Sections 2.1 and 2.2 and shown on Figure 1.

2.1 GROUNDWATER SOURCES

The Town of Maynard is permitted to withdraw water from seven source wells located in three different locations:

- Rockland Avenue : Rock Wells No. 2, 3, and 5
- Old Marlboro Road: Wells No. 1, 1A, and 3
- Green Meadow : Well No. 4

The Rockland Avenue Wellfield went online in 2000 and is currently the Town's main water supply.

At the Old Marlboro Road site, Satellite Well No. 1A serves to improve the ability of Well No. 1 to maintain capacity near the mechanical pumping capacity of 0.58 MGD. However, due to high color in the raw water Well No. 1 and 1A are presently only operated at approximately 25 percent of the rated capacity and Well No. 3 is offline.

Green Meadow Well No. 4 requires frequent cleaning due to clogging of the well screen with iron and manganese, which prevents the well from pumping at its rated capacity.

The mechanical and average flowrate pumped for each well is presented in Table 1. The mechanical pumping capacity is the maximum well production that the pump will allow based on the physical limitations of the pump. The average flowrate pumped is the most recent average flowrate pumped reported in the MassDEP Annual Statistical Reports (ASRs), which is sometimes less than the mechanical pumping capacity as high concentrations of iron and manganese in the groundwater accumulate on the well screen, thereby gradually reducing pump capacity until the well is redeveloped.

Average flowrate pumped can also be less than mechanical pumping capacity due to Water Management Act restrictions. Table 1 includes the MassDEP's permitted daily volumes for each well identified in the Water Management Act Permit and Renewal Registration. These permitted volumes are based on 24-hour duration. Well withdrawals cannot exceed the permitted daily volumes designated for each well and the combined total withdrawal from all wells cannot exceed 1.09 MGD or 397.85 MGY.

ROCK WELL #5

ROCK WELL #3

ROCK WELL #2

GP WELL #3
OLD MARLBORO ROAD

GP WELL #1 & 1A
OLD MARLBORO ROAD

GP WELL #4
GREAT ROAD RT 117

WHITE POND

CRANBERRY BOG WELL

ACTON

MAYNARD

STOW

HUDSON

SUDBURY

CONCORD

U S MILITARY RESERVATION
NATICK LABORATORIES

Legend

- Public Water Supply Well/ Surface Water Source
- Town Boundary
- Sub-basin Boundary

Aquifer

- High (> 300 gallons per minute)
- Medium (100-300 gpm)
- Low (< 50 gpm)
- Pond
- Till

0 1,000 2,000 4,000 6,000 Feet

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MAYNARD SUPPLY SOURCES

FIGURE 1

WOODARD &CURRAN

SCALE: 1" = 2000'	DOC: MaynardWTF_Fig1.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: DWP/JS	SOURCE: MassGIS

Table 1: Permitted and Rated Withdrawal from Groundwater Sources

Source	MassDEP Permitted Daily Volume[1]	Mechanical Pumping Capacity[2]	Average Flowrate Pumped Per Well[3]
	24-hr MGD	24-hr MGD	24-hr MGD
Rockland Avenue			
Rock Well #2	0.465	0.619	0.30
Rock Well #3	0.287	0.382	0.30
Rock Well #5	0.379	0.504	0.17
Old Marlboro Road			
Well #1	0.87	0.580	0.14
Well #1A			
Well #3		0.500	Offline
Green Meadow (Great Road Rte 117)			
Well #4	0.38	0.650	0.24
Total Permitted Withdrawal Volume from all Wells (Annual Average)	1.09		
Theoretical Total- 24 hrs from wells		3.24	
Actual Total- 24 hrs from wells			1.15

[1]Source: Water Withdrawal Permit No. 9P4-2-14-174.01 Issued May 31, 2000 and Modified May 6, 2009 and Renewal Registration Statement, Registration Number 21417401 Effective January 1, 2008.

[2] Mechanical pumping reflects maximum pumping capacity of wells. One pump capacity is included for sites with satellite wells (Maynard Well #1/#1A site is theoretically rated for 0.58 MGD with one or both wells operating).

[3] Average Flowrate Pumped reflects the most recent average flowrate pumping capacity reported by the Town in the 2006 through 2008 Annual Statistical Reports (ASRs); 2009 ASR pump data was not available and 2010 data was available. Average flowrate pumped is per site with one, or two wells (in the case of sites with satellite wells) pumping.

2.2 SURFACE WATER SOURCES

The Town has one inactive surface water supply, White Pond, located in the Towns of Stow and Hudson. White Pond is reported to have a safe yield of 0.72 MGD with a potential of 1 MGD withdrawal based on the 1994 Basis of Design Report and the 1999 Long Range Capital Planning Study. The White Pond treatment system consists of a chlorination and pumping station located in Stow near the Pond. Both the chlorination system and pumping station are inoperable.

A 13,100-ft, 10-inch diameter transite water transmission line built in 1942 pumped water from the Pond to Maynard until 1999 when White Pond became an inactive water source due to more stringent surface water standards under the EPA Surface Water Treatment Rule that requires filtration and disinfection. The Town never implemented the necessary treatment to meet the requirements of the EPA Surface Water Treatment Rule and as a result, White Pond became inactive.

3. RECENT WATER CONSUMPTION AND TRENDS

This section provides tabulated water consumption data available from 2000 to 2009 based on the MassDEP's Annual Statistical Reports (ASRs). This section also provides projections of water demand through the year 2035 using population projections from the Metropolitan Area Planning Council (MAPC). Projected water demands are used to determine source and pumping adequacy.

3.1 DEMANDS AND TRENDS

Average day, maximum day, and total annual demands identified in the MassDEP Annual Statistical Reports (ASRs) were summarized to trend the Town's current and future water needs. The average day demand is calculated using the total volume of water used per year divided by the number of days in the year. The maximum day demand is the greatest demand over a 24-hour period during the given year. The total annual demand is the average day demand over a one-year period.

The water consumption for 2000 to 2009 is summarized in Table 2. Population data is based on U.S. Census Data. Since 2000, demands have remained below the MassDEP Permitted daily average of 1.09 MGD.

Table 2: Projected Water Consumption

Year	Population (US Census and MAPC Projection)	Average Day Demand (MGD)	Overall Water Use (gpcd)	Maximum Day Demand (MGD)	Total Annual Demand (mg)
2000	10,433	1.02	98	1.38	372
2001	10,483	0.96	91	1.72	350
2002	10,429	0.93	89	N/A	340
2003	10,434	0.76	73	N/A	277
2004	10,370	0.82	79	1.55	298
2005	10,310	N/A	N/A	N/A	N/A
2006	10,238	0.68	66	N/A	248
2007	10,327	0.95	92	1.45	347
2008	10,444	0.83	79	N/A	303
2009	10,629	0.94	88	1.29	343
2010	10,106	N/A	N/A	N/A	N/A
Average		***0.88***	***84***	***1.48***	***320***
2020	**10,750**	**0.90**	**84**	**1.44**	
2030	**11,216**	**0.94**	**84**	**1.50**	
2035	**11,460**	**0.96**	**84**	**1.53**	

[1]N/A – Data Not Available.

Woodard & Curran approximated the average water demand projections for 2020, 2030, and 2035 using population projection data from the MAPC MetroFuture 2035 Update and the average per capita water demand (overall water use) for 2000 through 2009. The overall water use in gallons per capita day (gpcd)

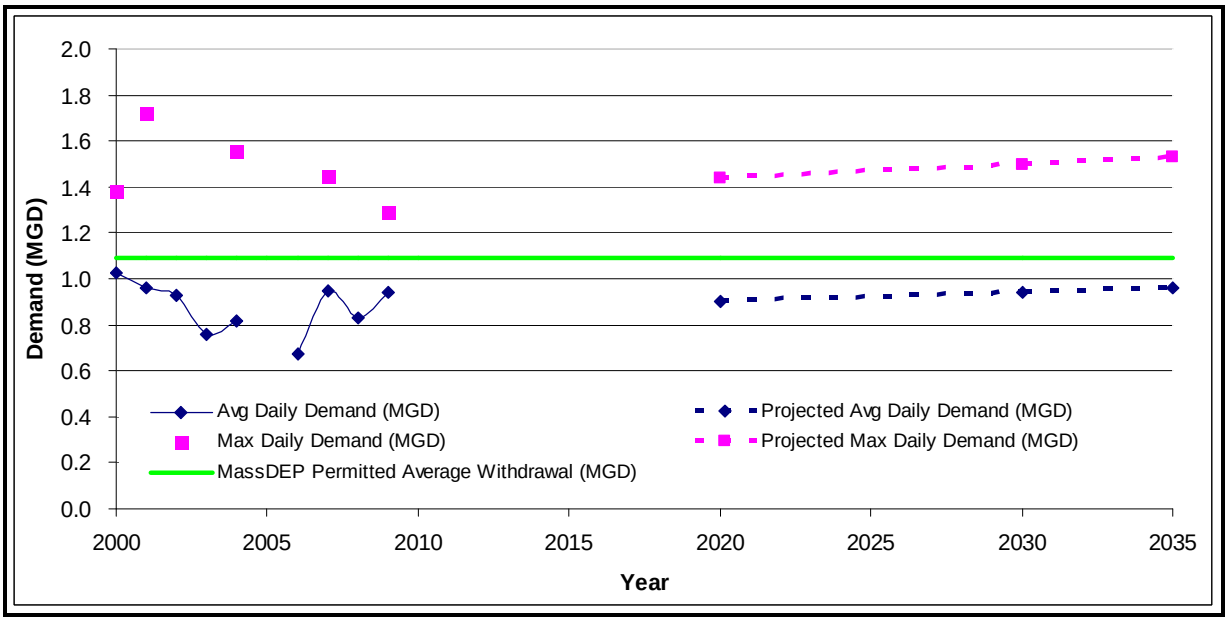
was calculated by dividing the average day demand by the population of the Town for that year. This average does not take into account the difference between water used by residents and by industry, but provides an overall summary of the water use of the population and the industry that serves them.

Table 2 shows the per capita overall water use average for 2000 through 2009 is 84 gallons per capita per day (gpcd). This average use applied to future population projects indicates average day demands of 0.90 to 0.96 for 2020 through 2035. Based on the this information summarized in Table 2, average day demands are expected to remain below the MassDEP Permitted Daily Volume of 1.09 MGD through 2035.

Woodard & Curran approximated the projected maximum day demands for 2020, 2030, and 2035 by applying the average maximum day to average day demand ratio available for 2000, 2001, 2004, 2007, and 2009 or 1.59. By applying a 1.59 ratio to the average day demand projections, future maximum day demands of 1.4 to 1.5 MGD are projected for 2020 through 2035. This information summarized in Table 2 indicates maximum day demands are expected to remain within current demands.

Figure 2 shows the demand trending and projections graphically. Based on this figure, the Town is not expected to require an increase in water capacity to meet demands through at least 2035, mostly attributable to a stabilized population and built-out conditions.

Figure 2: Average and Maximum Day Demands



4. WHITE POND SURFACE WATER TREATMENT ALTERNATIVES

As discussed in Section 2, White Pond can not be used as a water supply source since it does not have treatment that complies with the requirements of the EPA Surface Water Treatment Rule. In general, the Surface Water Treatment Rule requires that water systems filter and disinfect water from surface water sources to prevent waterborne diseases caused by viruses, *Legionella*, and *Giardia lamblia* by reducing the occurrence of unsafe levels of these microbes that may be present in the surface water.

In addition the existing transmission main that originally transported water from White Pond to the Town's water distribution system is in need of replacement due to its age (over 65 years old) and materials of construction (asbestos cement). Any White Pond alternative will require that the existing transmission main also be replaced.

This section describes the White Pond surface water treatment alternative. The transmission main routing, treatment plant siting, and water treatment alternatives are provided. Construction costs, environmental constraints, and permitting requirements for feasible alternatives are summarized.

4.1 TRANSMISSION MAIN ROUTING

An existing 13,100-ft, 10-inch diameter transite (asbestos cement) water transmission main connects White Pond to Maynard's water distribution system at Winter Street in the vicinity of the Town's Highway Garage. From White Pond the transmission main crosses State Road onto Sudbury Road, follows north along White Pond Road on land in Stow owned by the Commonwealth of Massachusetts (DCR) and the U.S. Fish and Wildlife (Assabet River National Wildlife Refuge), and continues into Maynard on property owned by FEMA, private lot 23-3, and the Town of Maynard. The transmission main ends at the Maynard Highway Department. The transmission main was physically disconnected from the Town's distribution system on Winter Street during the cleanup of a underground fuel tank leak at the Highway Garage. The existing route is shown in Figure 3.

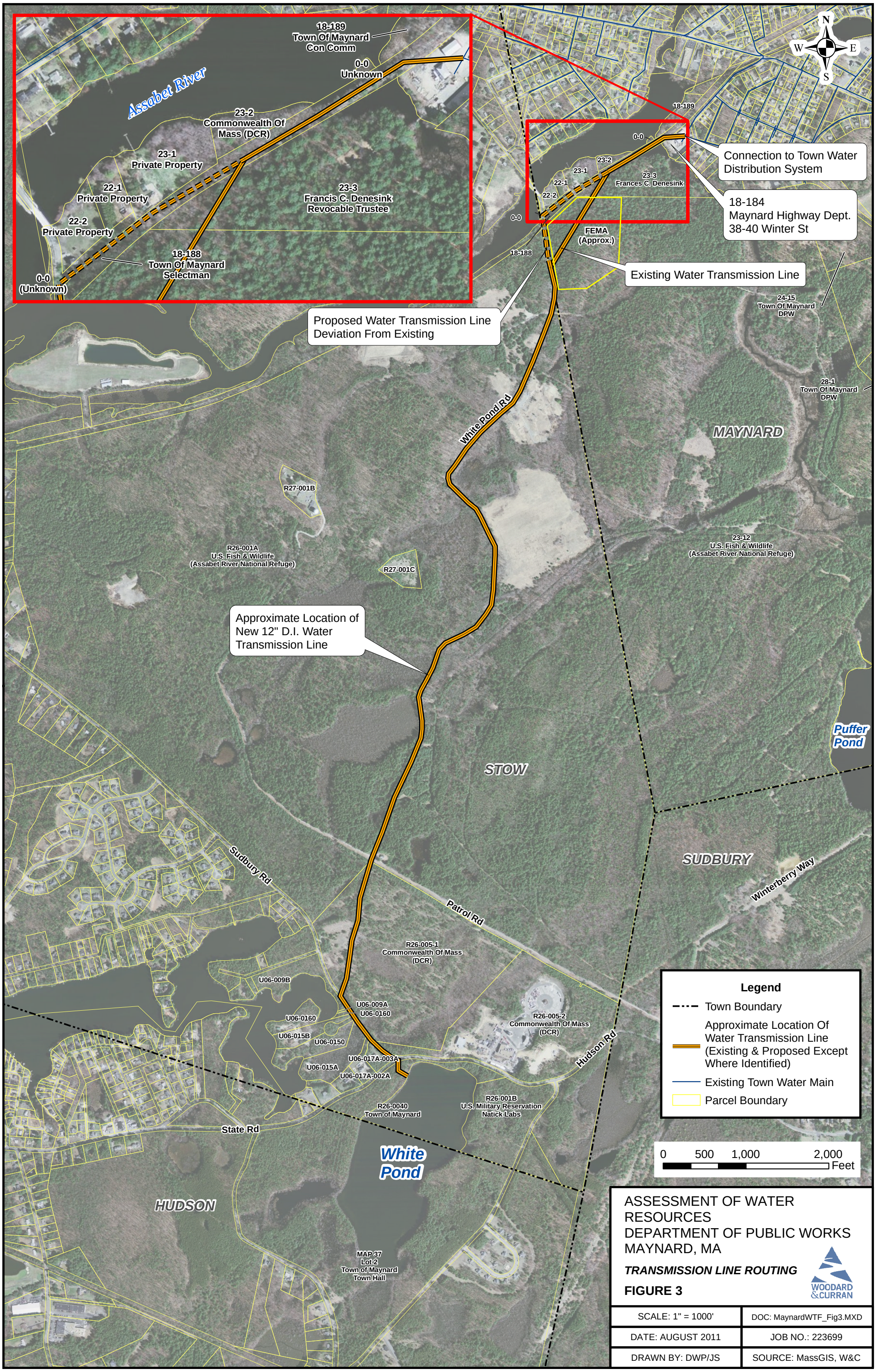
Woodard & Curran evaluated several potential routes for a new transmission line. The potential routes included the following;

1. A route adjacent to the existing transmission main;

2. A route adjacent to the existing transmission main except the new transmission main would stay within White Pond Road and bypass a wetland area (that the existing transmission main crosses) and rerouting the new transmission main as it crosses into Maynard to Town-owned Parcel 18-188 instead of Federal Emergency Management Agency (FEMA) property and privately-owned Parcel 23-3 to eliminate easement and private property restrictions;

3. A route that would parallel Hudson Road and enter the Assabet River Wildlife Refuge at the their main gate, and follow Winterberry Way to Old Marlborough Road;

4. A route that would bypass the Assabet River National Wildlife Refuge entirely by staying within existing roadways. This route would follow Hudson Road to the east, continue on Fairbank Road and head north on Route 27 into Maynard.



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TRANSMISSION LINE ROUTING

FIGURE 3

WOODARD &CURRAN

SCALE: 1" = 1000'	DOC: MaynardWTF_Fig3.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: DWP/JS	SOURCE: MassGIS, W&C

Of the four routes that were considered, Route 2 was recommended, based on environmental, cost and easement considerations. Route 1 has negative environmental impacts since it would require construction through a wetland, require the acquisition or an easement through private property and would not be looked upon favorably by the Assabet River Wildlife Refuge. Route 3 would also not be amenable to the Assabet River Wildlife Refuge since it was recently repaved and provided with drainage structure improvements. Although Route 4 is eliminates the need for work within the Assabet National Wildlife Refuge, the cost of installing the transmission main along this route would be significantly higher than Route 2.

The proposed route is shown on Figure 3 and discussed further in the following section.

4.1.1 Potential Environmental and Easement Constraints

The proposed route is based on existing environment constraints and feedback received from the Assabet River National Refuge. The existing transmission line is located extensively on the Assabet River National Refuge property along White Pond Road, an existing degraded area that minimizes impacts to the surrounding area that includes priority habitats for rare species and wetlands. The Refuge property manager favors a new water transmission line adjacent to the existing pipe due to these environmental concerns.

Although the proposed route addresses concerns expressed by the Assabet River National Refuge, the potential for environmental constraints still exist. Based on Figure 4, the most prominent constraints include wetlands, Natural Heritage Endangered Species Program (NHESP) Priority Habitats of Rare Species, and vernal pools regulated under the Massachusetts Wetland Protection Act and Massachusetts Endangered Species Act (MESA). However, since the proposed route is within the confines of White Pond Road, impacts to these environmental features should be minimal.

Easement constraints for the proposed route exist since the existing transmission line is located on land owned by federal, state, and local authorities in Stow and Maynard. Most of these parcels are recreational open space properties and conservation land, as shown in Figure 5, with no known available documentation granting Maynard easement access. Coordination with the various property owners for easement access will be necessary. In addition, Parcel R26-005-1 owned by the Department of Conservation and Recreation (DCR) and Parcel 18-188 owned by the Town of Maynard are state-owned and Article 97 land, respectively, that require State Legislation approval for easement access.

A summary of potential environmental and easement constraints is provided in Table 3. These constraints increase potential permitting requirements discussed in Section 4.6.

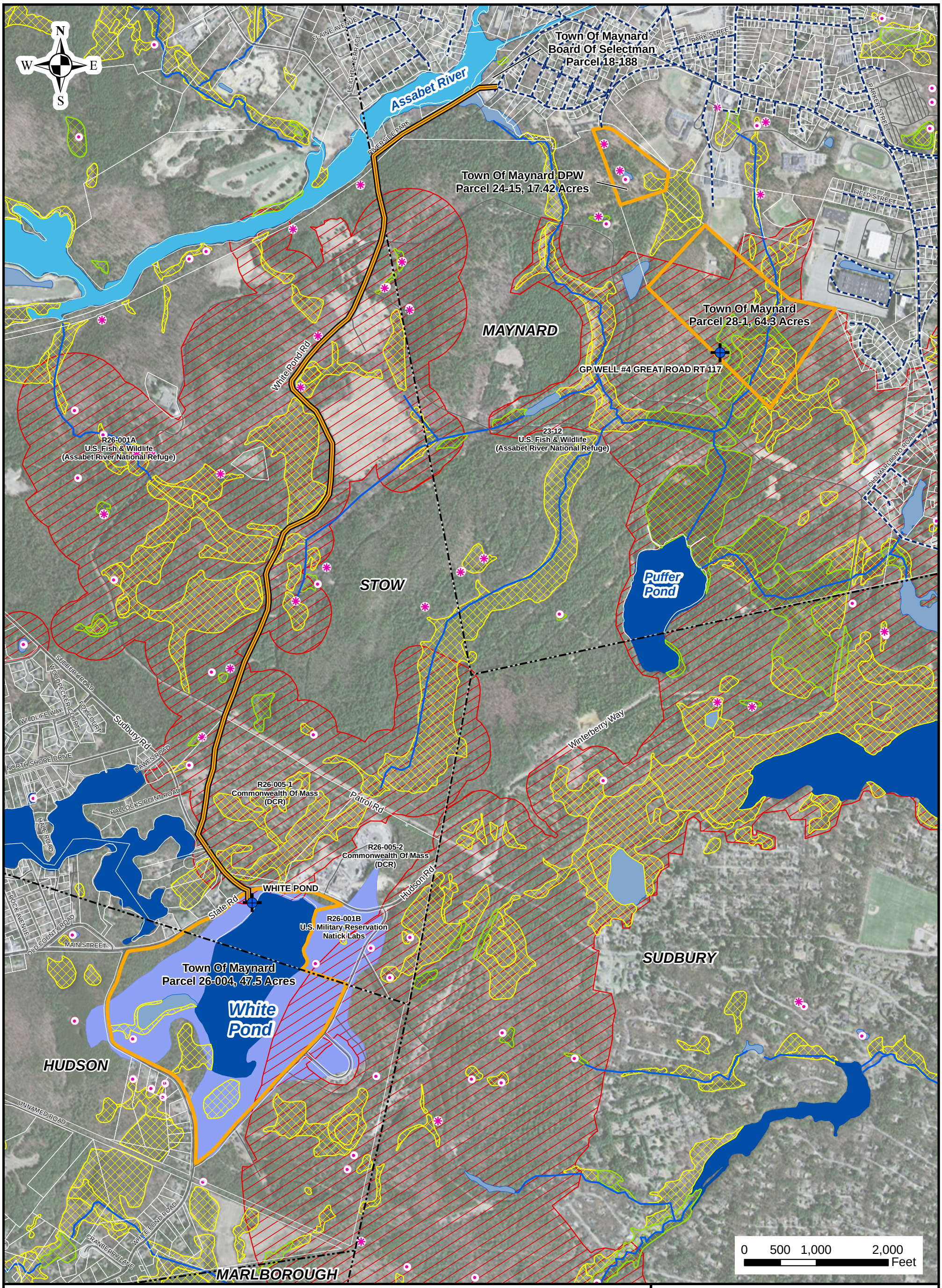
Table 3: Transmission Line Routing: Potential Permitting & Easement Constraints

Town	Parcel ID and Owner	Potential Environmental Constraints in Vicinity	Potential Easement Requirements
Stow	R26-004 Town of Maynard	• NHESP Priority Habitats of Rare Species	• None – property owned by Maynard

Town	Parcel ID and Owner	Potential Environmental Constraints in Vicinity	Potential Easement Requirements
Stow	State Road & Sudbury Road (maintained by Stow)	• None – roadway and easement are degraded, paved areas	• Stow Street Opening Permit
Stow	R26-005-1 (White Pond Road) Commonwealth of Mass (DCR)	• NHESP Priority Habitats of Rare Species • Wetlands	• Act of State Legislation to access state property without documented easement
Stow	R26-001A (White Pond Road) U.S. Fish & Wildlife (FWS) - Assabet River Refuge)	• NHESP Priority Habitats of Rare Species • Wetlands • Vernal Pools	• Regulated under FWS Regulation 340 FW 3, Rights-of-Way and Road Closings – requires environmental analysis, surveys, and cultural resource analysis
Maynard	18-188 Town of Maynard Board of Selectmen	• Article 97 Land – designated as open space	• 2/3 vote approval by Maynard Board of Selectmen • 2/3 vote approval by State Legislator with input by EOEA Division of Conservation Services
Maynard	18-184 Town of Maynard Highway Department	• None – existing built-out facility	• None – property owned by Maynard

4.1.2 Transmission Line Construction

Based on an initial site walk and review of the proposed route with MassGIS aerial photographs, the new transmission line can be installed with open cut methods as opposed to trenchless technologies since water body and wetland crossings are not within the proposed route. The proposed route is within the confines of existing roadways and developed areas with the exception of Parcel 18-188; however, Parcel 18-188 does not contain sensitive environmental sources such as wetlands and priority habitats.



Legend

- Public Water Supply Well/ Surface Water Source
- NHESP Certified Vernal Pools
- Potential Vernal Pools
- Parcels (White Lines)
- Roads
- National Wetland Inventory Rivers and Streams
- Town Water Main Pipe
- Town Boundary
- Proposed Water Transmission Line
- Water Treatment Facility Parcel Options
- ACECs (None in View)
- NHESP Priority Habitats of Rare Species

Outstanding Resource Waters

- ACEC (None In View)
- Public Water Supply Watershed
- Scenic/Protected River (None In View)
- Wildlife Refuge (None In View)

National Wetland Inventory

Wetland Areas

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

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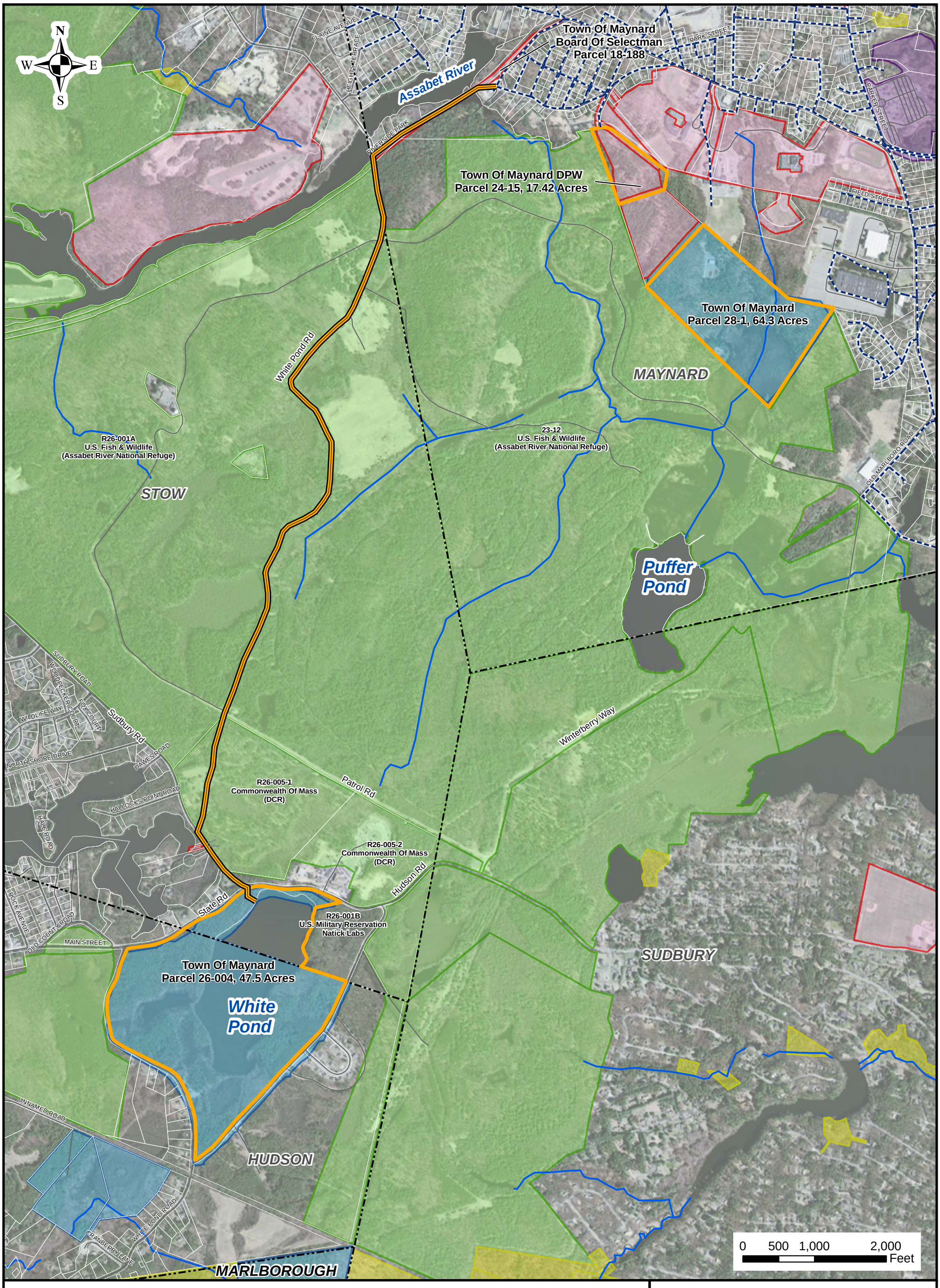
White Pond Water Treatment Facility & Transmission Line Options

Environmental Constraints
FIGURE 4

WOODARD &CURRAN

SCALE: 1" = 1,250'	DOC: MaynardWTF_Fig4.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: JS	SOURCE: MassGIS



Legend

- Proposed Water Transmission Line
- Town Water Main Pipe
- Roads
- National Wetland Inventory Rivers and Streams
- Town Boundary
- Parcels (White Lines)
- Water Treatment Facility Parcel Options

Protected and Recreational OpenSpace

- Conservation
- Recreation
- Recreation and Conservation
- Agriculture (None In View)
- Habitat (None In View)
- Historical/Cultural
- Scenic - Official Designation Only (None In View)
- Water Supply
- Flood Control (None In View)
- Underwater (None In View)

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White Pond Water Treatment Facility & Transmission Line Options

Open Space
FIGURE 5

WOODARD &CURRAN

SCALE: 1" = 1,250'	DOC: MaynardWTF_Fig5.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: JS	SOURCE: MassGIS

4.2 SITING EVALUATION

Woodard & Curran evaluated alternatives for siting the surface water treatment facility at White Pond and in the Town of Maynard. The siting evaluation assumed a treatment plant sized for a 1 MGD design capacity. Based on the availability of Town-owned land a conservative assumption that four acres is required to accommodate a water treatment facility, three potential alternatives were identified: a site adjacent to White Pond in Stow/Hudson and two sites in Maynard on Town-owned property, discussed below. It is noted that a parcel size less than four acres may be sufficient for a plant, but is unknown until further analysis is completed.

A feasible location for a treatment facility in Stow is adjacent to White Pond near the existing treatment building. White Pond is located on Parcel R26-004 (7.5 acres) in Stow and owned by the Town of Maynard. The property is designated for water supply use and there is sufficient land for an onsite water treatment facility. Raw water could be treated at the facility, pumped and transported through the new transmission line along White Road in Stow, and connected to Maynard's water distribution system at the Maynard Highway Department facility located at 38-40 Winters Street.

The 1994 Basis of Design Report included a conceptual design of a water treatment facility located in the northwest corner of White Pond in Stow. The Report indicated that subsurface material is adequate based on boring tests and all major utilities, with the exception of wastewater, are available. A subsurface disposal system for sanitary waste and a residual basin or temporary waste storage facility for the plant recycle waste stream is required. In terms of hydraulics, pumping is required twice to discharge to Maynard's distribution system: once to the treatment plant at White Pond and then again through the transmission line to the connection in Maynard.

As part of our siting evaluation for a location in Maynard, Woodard & Curran reviewed Town-owned parcels at least four acres in size to accommodate a water treatment facility. Based on these criteria, two potential parcels were identified: Parcel 24-15 (17.42 acres) and Parcel 28-1 (64.3 acres), both under DPW jurisdiction. Parcel 24-15 is currently used for recreation purposes, but could be designated for treatment plant use. Parcel 28-1 is designated for water supply use and includes Maynard Well No. 4. Untreated, raw water could be pumped through the new transmission line to the Maynard Highway Department, transported through a new transmission main extension to a new water treatment plant at Parcel 24-15 or 28-1, and then discharged to Maynard's water distribution system at the closest available connection.

The water treatment facility siting alternatives and potential environmental constraints are shown on Figure 4. Table 4 provides a summary of potential environmental constraints and potential permitting requirements are summarized in Section 4.6. Environmental constraints and permitting requirements are defined based on further environmental assessments that include, but are not limited to, wetland delineation, soil borings, and impact analyses for archaeological, historical, and environmental resources.

Table 4: Water Treatment Facility Siting: Potential Environmental Constraints

Constraint	White Pond (Parcel 26-004)	Town of Maynard DPW (Parcel 24-15)	Town of Maynard DPW (Parcel 28-1)
Location	Stow and Hudson	Maynard	Maynard
Land Ownership	Not Applicable – owned by Maynard	Not Applicable – owned by Maynard	Not Applicable – owned by Maynard
Land Designation	Water Supply Use	Recreation	Water Supply Use
Property Acreage	47.5 acres	17.42 acres	64.3 acres
Utility Availability	• Electric, gas, phone available in Stow • Sewer not available	• Electric, gas, phone, available in Maynard • Sewer available	• Electric, gas, phone, available in Maynard • Sewer available
100-ft Proximity to Wetlands(1)	No	Yes	Yes
Proximity to NHESP Priority Habitats of Rare Species	Yes	No	Yes
Proximity to NHESP Certified Vernal Pools	No	Yes	Yes
Archaeological and Historical	Unknown	Unknown	Unknown
Depth to Groundwater Depth to Bedrock	Shallow - 12 feet Low Impact - Greater than 70 feet	Unknown Unknown	Unknown Unknown
Proximity to Existing Roads/Access	Yes	Yes	Yes
Approximate length of new transmission line required for connection from White Pond to Town's Distribution System	13,100 feet -13,100: existing line replacement	15,600 feet -13,100: existing line replacement -2,500: additional line connection to treatment facility in Maynard	18,100 feet -13,100: existing line replacement -5,000: additional line connection to treatment facility in Maynard
Proximity to Residents	Yes	Yes	Yes

[1]Massachusetts Wetlands Protection Act defines a 100-ft buffer zone for bordering vegetated wetlands.

The main differences between a treatment facility located at White Pond and one in Maynard includes the following:

- Plant located at White Pond allows treated water to pass through new transmission line; plant located at Maynard allows untreated raw water. However, there are no impacts to the transmission line by allowing raw versus treated water to pass through.

- Plant located in White Pond requires subsurface disposal for sanitary waste and a residual basin, lined sand drying bed, or temporary waste storage facility for plant waste streams since Stow does not have a centralized wastewater treatment system. A lined sand drying bed is recommended over a residual basin since it does not require a groundwater discharge permit that is discouraged by regulatory agencies.

The preferred siting alternative is Parcel 28-1 since it is located in Maynard, alleviating the need for inter-municipal coordination with Stow and onsite wastewater facilities. This Parcel is designated for a water supply use and includes Well No. 4 and the associated Green Meadow Treatment Plant, but is a potentially more expensive alternative than Parcel 24-15 since it requires approximately 2,500 feet of additional transmission main.

4.3 PUMP HOUSE RELOCATION

The existing water pump station is located at an elevation of 192 feet, approximately 50 feet from the edge of White Pond that has an approximate surface water elevation of 187 feet. Based on FEMA maps, the 100-year floodplain for the pond is approximated to be near the pond edge of water. Woodard & Curran recommends that a new raw water intake pump station be moved at a higher elevation on the site that is adequately located outside of the 100-year floodplain.

The existing 12-inch intake structure is set at an invert elevation of 180.25 feet or seven (7) feet below surface water elevation. The pond is approximately 22 feet deep, allowing the intake structure to be lowered to provide for additional capacity within the pond. It is recommended that a new intake structure be constructed at a lower elevation of approximately 175 feet or 12 feet below surface water elevation to potentially increase the yield of the pond. An analysis of the pond's yield is beyond the scope of this report, but a new intake structure constructed at a lower elevation could increase the yield.

4.4 WATER TREATMENT FACILITY

4.4.1 Treatment Alternatives

The 1994 Basis of Design Report recommended a "Trident" treatment system, typically installed in the early 1990s for one to three MGD surface water treatment facilities. A "Trident" system is a packaged treatment system that includes an adsorption clarifier that combines flocculation and clarification in a single step, a mixed media filter for solids removal, underdrain screens to provide retention of the mixed media and backwash, and a chemical feed system.

"Trident" systems are chemical intensive systems that generate a large quantity of sludge. Based on two pilot studies conducted in March-April 1991 and August 1991, the water quality data does not indicate the need for a chemical intensive regiment provided by such a treatment system. In addition, these systems

can produce a high percent of backwash that is discouraged today due to the potential for disturbing the chemistry of the incoming water, concentrating microorganisms, and disinfection byproducts.

Due to technology improvements since 1994 and given the type of application, membrane treatment technology is a promising alternative based on the 1991 pilot study water quality data. Membrane treatment requires less chemical addition, a lower backwash percentage, backwash that can easily be recycled through a secondary, low-rate membrane side system, and a smaller footprint than traditional "Trident" systems.

Membrane treatment, such as ultra filtration, is a pressure-driven barrier to suspended solids, bacteria, viruses, and other pathogens that separates larger size solutes with a semi-permeable membrane. Water is pumped through membrane pores and enters inside hollow fibers to treat the water. These hollow fibers are capable of being backwashed, where filtered water is pushed backwards through the membrane to remove accumulated solids on the membrane surface. A separate clarification process is not necessary.

Prior to deciding on the treatment alternative, Woodard & Curran recommends that the 1991 Pilot Study be completed again to obtain updated water quality data that includes analyzing both summer and winter surface water conditions. This study will verify the adequacy of membrane treatment and if another treatment alternative is more viable. The Pilot Study will also determine the need for pretreatment to remove total organic content (TOC). For the purposes of this report, membrane treatment has been assumed for the treatment process and conceptual cost discussions.

4.4.2 Water Treatment System Process

A new water treatment facility most likely may include the following major unit operations and building structure:

Screen and Raw Water Intake Pumps: A new 12-inch intake structure conveys raw water from White Pond through a screen directed to a raw water pump station to transport raw water to the treatment facility (if treatment facility is located near White Pond) or directly to the new water transmission line (if treatment facility is located in Maynard).

Pretreatment System: If required, raw water discharges to a pretreatment system prior to the membrane system for organics removal. Pretreatment may include the addition of a coagulant in a flash mixing tank and flocculation in a separate tank to clarify the water.

Membrane Treatment System: Pretreated raw water is filtered for suspected solids, pathogens, and viruses.

Disinfection System: After membrane filtration, treated water may require further disinfected to remove parasites such as cryptosporidium with high intensity ultraviolet (UV) light or other technology. During further plant design, it will be determined if additional disinfection is needed. Chlorine is used as a final treatment step to maintain a disinfection level in the Town's distribution system.

Clearwell: A clearwell is required to collect water after it has been treated and prior to being pumped to the Town's distribution system. The clearwell also serves as a reservoir for the backwash pumping systems and provides adequate contact time for the disinfection process.

Chemical Feed Systems: Chemical feed systems include storage tanks, feed equipment, and pumps to provide chemical treatment. Potential chemicals include coagulants and polymers for pretreatment.

Pumping Systems: Major pumping systems include raw water intake, backwash, sludge, and finished water pumps.

Backwash and Sanitary Waste Disposal: Backwash and solids are disposed to an onsite residual basin, lined sand drying bed, or temporary storage tank for offsite disposal if plant is located at White Pond or directly to Maynard's wastewater treatment system if plant is located in Maynard. Sanitary waste is disposed to an onsite subsurface disposal system if plant is located at White Pond or to Maynard's wastewater treatment system if plant is located in Maynard.

Onsite Buildings and Site Layout: The membrane system, chemical feed systems, chemical storage tanks, and emergency generator are housed in a treatment facility building. Raw water pumps are housed in a covered pump station building. A typical facility site includes an access driveway, yard piping, and appropriate drainage. Electrical, instrumentation/control, security, HVAC, and plumbing systems are required.

4.5 COSTS

Woodard & Curran developed conceptual cost estimates for the following treatment plant siting alternatives:

- Water Treatment Facility located at White Pond
- Water Treatment Facility located in Maynard

Construction and operation/maintenance cost estimates are summarized in Table 5 for each of these alternatives.

Table 5: Conceptual Cost Estimate: White Pond Surface Water Treatment

Cost Item	Treatment Plant at White Pond	Treatment Plant in Maynard
Pilot Study to Characterize Water Quality	$115,000	$115,000
Treatment Plant Construction	$6,900,000	$6,900,000
Transmission Line Construction	$3,100,000 (assumed 13,100 lf)	$4,300,000 (assumed 18,100 lf)
Total Construction Cost	$10,000,000	$11,200,000
Engineering (20% of Total Construction Cost)	$2,000,000	$2,240,000
Permitting (5% of Total Construction Cost)	$500,000	$560,000
Project Cost	$12,500,000	$14,000,000
Contingency (15% of Project Cost)	$1,875,000	$2,100,000
Total Project Cost	$14,375,000	$16,100,000

Cost Item	Treatment Plant at White Pond	Treatment Plant in Maynard
Total Project Cost (inclusive of Pilot Study)	**14,490,000**	**$16,215,000**
Present Day Annual O&M Cost	**$250,000/year**	**$250,000/year**

Woodard & Curran used the following assumptions to develop potential costs:

- Costs are based on a plant design capacity of 1 MGD.
- A pilot study is required to assess the surface water quality for White Pond. A pilot study conducted for a 30-day period during summer and winter conditions to update the 1991 Pilot Study findings was assumed.
- Construction costs include the major components outlined in Section 4.4.2 that include a new treatment building, membrane filtration system, UV and chlorine disinfection, pumping and chemical feed systems, and specialty systems that include electrical, instrumentation/control, security, HVAC, and plumbing.
- The construction cost for a treatment plant location in Stow is slightly higher since subsurface disposal for sanitary waste and temporary backwash storage for offsite disposal are required.
- The construction cost for a transmission line is greater if the treatment plant is located in Maynard since the line must be extended for a connection to the treatment plant. For conservative budgetary purposes, a transmission line connected to Parcel 28-1 was assumed.
- Permitting costs are expected to be greater for the White Pond surface water treatment alternative than groundwater treatment alternatives discussed in Section 5 due to the environmental and easement constraints associated with construction of a new transmission line between Stow and Maynard and the permitting requirements associated with new water treatment plant construction.

4.6 REGULATORY PERMITTING

Potential local, state, and federal permits required for the water treatment facility and transmission line are summarized in Table 6. These permits include those for water treatment plant and water transmission line construction. Most of the permits are the same, whether the plant is located in Stow or Maynard, with the following exceptions:

- A groundwater discharge permit may be required if the plant is located at White Pond and a residual basin is implemented for backwash disposal. This permit is not required if the plant is located in Maynard since the Town has an existing wastewater system that may be able to accept any backwash waste generated by the proposed water treatment plant.
- A sewer connection permit is required if the plant is located in Maynard to discharge sanitary waste and plant waste streams to the local wastewater treatment plant.

Table 6: Water Treatment Facility Siting: Potential Permitting Requirements

Permit	Regulation	Reason for Permit
Groundwater Discharge Permit (Required if Plant located in Stow and residual basin implemented)	Massachusetts Ground Water Discharge Permit Program	No sewer in Stow; subsurface disposal near White Pond required.
Sewer Connection Permit (Required if Plant is located in Maynard)	Massachusetts Sewer Connection Permit	Connection to Maynard wastewater plant for residual solids disposal.
NOI for Construction Activities from Maynard, Stow, & Hudson Conservation Commissions	Massachusetts Wetland Regulations, Local Wetland Bylaws, Massachusetts Endangered Species Act (MESA)	Wetlands and priority habitats near White Pond and proposed transmission line route.
Request for Determination of Applicability (RDA) from Maynard, Stow, & Hudson Conservation Commissions	Massachusetts Wetland Regulations & Local Wetland Bylaws	Plant and transmission line construction requires test borings for soil characterization.
Stow Building Department & Health Department Permits	State & Local Regulations	Building construction and water quality/public health.
Natural Heritage Endangered Species Program (NHESP) Coordination	Massachusetts Endangered Species Act (MESA)	Priority habitats near White Pond and proposed transmission line route.
Massachusetts Historical Commission Project Notification Form (PNF)	MEPA Regulations	Identify endangered species, archaeological sites, and historical properties near construction activities.
MEPA Environmental Notification Form (ENF)	MEPA Regulations	Water withdrawal quantity, new transmission main length, and wetland disturbance may exceed permit thresholds.
Easement - Sudbury Road Access in Stow	Street Opening Permit	Proposed transmission line route located in Sudbury Road and State Road ROWs.
Easement - DCR (Parcel R26 5-1, located in Town of Stow)	DCR Approval - Act of State Legislation	Transmission Line construction on state property requires act of State Legislation; easement not identified.
Easement - Assabet River Refuge (Parcel R26 1A, located in Town of Stow)	Assabet River Refuge Approval	Transmission Line construction on property requires Environmental Study/Archeological Assessment.

Permit	Regulation	Reason for Permit
Easement - Town of Maynard, Board of Selectmen (Parcel 18-188, located in Town of Maynard) State Legislation Approval (Article 97 Land)	Board of Selectmen Approval and State Legislation Approval (Article 97 Land)	Transmission line construction requires approval by Board of Selectmen and State Legislation due to Article 97 Land designation.
Easement – Town of Maynard (Required if Plant is located in Maynard)	Street Opening Permit	Proposed transmission line will extend from Maynard DPW Facility along existing Town road ROWs to proposed Plant site.
Water Treatment Plant Pilot Study	Massachusetts Approval to Conduct Pilot Study & Approval of Pilot Study Report	State law requirement to verify proposed treatment technology meets MassDEP water quality regulations.
Water Treatment Plant Construction	Massachusetts Approval to Construct a Water Treatment Facility	State law requirement to verify state standards are met. Plans and specification approval required.

5. GROUNDWATER SOURCE ALTERNATIVES

This section describes the groundwater capacity and treatment alternatives for White Pond, Old Marlboro Road Wells, and Well No. 4. The White Pond subsurface exploration for a new well source, Old Marlboro Well color treatment and capacity alternatives, and new well development for connection with Well No. 4 are described. Construction costs, environmental constraints, and permitting requirements for feasible alternatives are summarized.

5.1 WHITE POND WELL DEVELOPMENT

5.1.1 Siting Evaluation

Geologic soils mapping surrounding White Pond on the east and west sides indicate the possibility of finding a suitable well site on property owned by the Town. Domestic wells in neighborhoods west of the pond closer to Lake Boon report high water yields (greater than 300 gpm) for their small diameter. Based on the promising geologic mapping and the history of domestic wells, Woodard & Curran made a preliminary attempt to locate a suitable municipal well site west of White Pond.

A review of the site conditions at White Pond made it evident that there is a limited area for well installation. Despite the sizable land owned by the Town at White Pond, state regulatory setbacks significantly limit the usable area for a municipal well site. These setbacks include the following:

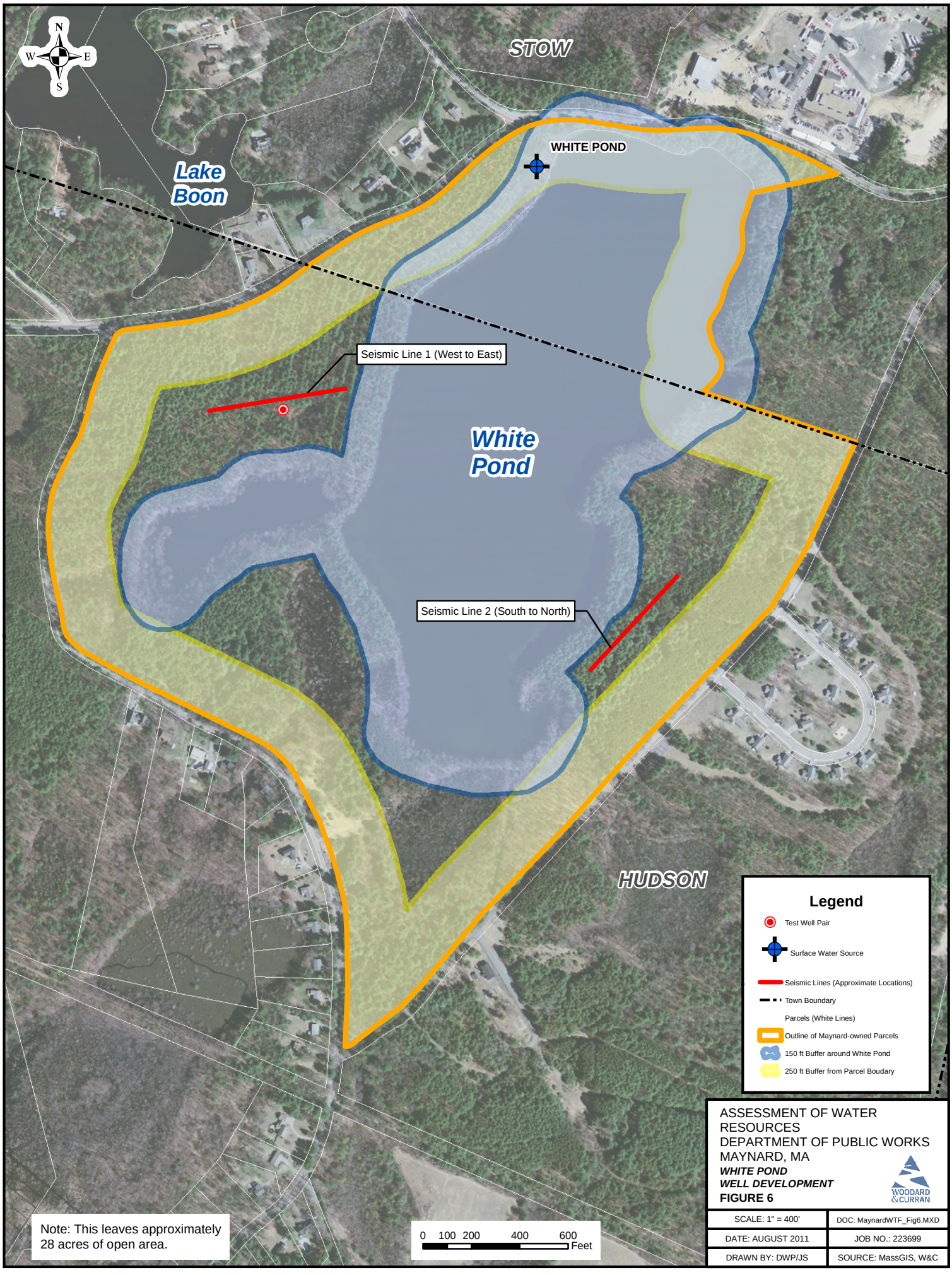
- Well is required to have a 400-ft radius Wellhead Protection Area (WPA) surrounding a well (or 250-ft radius for a wellfield).

- Well located closer than 150 feet to permanent standing water such as White Pond is subject to limitations under the Surface Water Rule from the EPA. Under this Rule, any well source closer than 150 feet to standing water must be tested for possible influence to quality from the surface water, also known as a Micro Particulate Analysis (MPA). This testing is complicated and cannot be satisfied until after the well owner has committed the full construction costs by building the well and having it in service for six (6) months. Thus for a practical matter, a 150-ft zone of exclusion from White Pond was assumed.

When the setbacks for the WPA and MPA are applied to the Town's White Pond property, it is clear that only the Wellfield approach with its 250-ft WPA will work for the site. Figure 6 presents the limitations imposed on the site by the regulatory setbacks. The remaining land available for well sites on the White Pond Property (both east and west of the Pond), is shown as the unshaded portions.

5.1.2 Geophysical Exploration (Seismic Refraction)

Once the Town land available for permitted well sites was defined on Figure 6, Woodard & Curran employed a geophysical subcontractor to complete a 500-ft long exploration line through the center of each area on each side of the Pond. The geophysical contactor used the seismic technique to establish the thickness of saturated soils above bedrock to identify if the area could provide a necessary saturated thickness for a possible well site. A seismic survey was assessed on east and west sides of White Pond. The locations of the seismic lines are shown on Figure 6.



Note: This leaves approximately 28 acres of open area.

ASSESSMENT OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
MAYNARD, MA
WHITE POND
WELL DEVELOPMENT
FIGURE 6

WOODARD &CURRAN

SCALE: 1" = 400'	DOC: MaynardWTF_Fig6.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: DWP/JS	SOURCE: MassGIS, W&C

The results of the seismic survey indicate that the available saturated thickness on both sides of the Pond ranges from 40 to 60 feet. If that thickness consists of suitable granular soils, then there is a possible well site on the property.

5.1.3 Subsurface Exploration

Woodard & Curran employed F.G. Sullivan Drilling to explore, sample, and test the soils on the seismic line on the east side of White Pond located near Lake Boon that has favorable conditions. A pair of 2.5-inch diameter test wells shown in Figure 6 were drilled, test pumped, and sampled for water quality.

The two wells indicated that there are suitable granular soils from just below the top soil to a depth of about 30 feet. At that depth, the soils are very fine grain sands and silt. From 35 feet to 70 feet deep the soils are gray silt, unfavorable for extracting well water. A test well screen was set and developed from 25 to 30 feet and pumped at 50 gallons per minute (gpm). A water quality sample collected after four hours of pumping tested suitable for use as a public water supply with routine treatment for iron and manganese.

The steady (static) depth to the groundwater table is about 12 feet below ground. Thus, despite the 40 to 60 feet of saturated soil at the site described above in Section 5.1.2, most of that saturated thickness to a depth of 70 feet is unsuitable silty soils. With the water table 12 feet below ground, there are only about 12 to 15 feet of saturated soils suitable for well withdrawal. Given the MassDEP regulations on well design, there is an estimated 50 to 70 gpm of well yield available to a single well at the White Pond property. This potential yield requires confirmation with a required long-term pumping test. However, if all conditions test favorably, 10 to 15 wells in a wellfield are required to secure 700 gpm well yield (1 MGD) to meet average day demand.

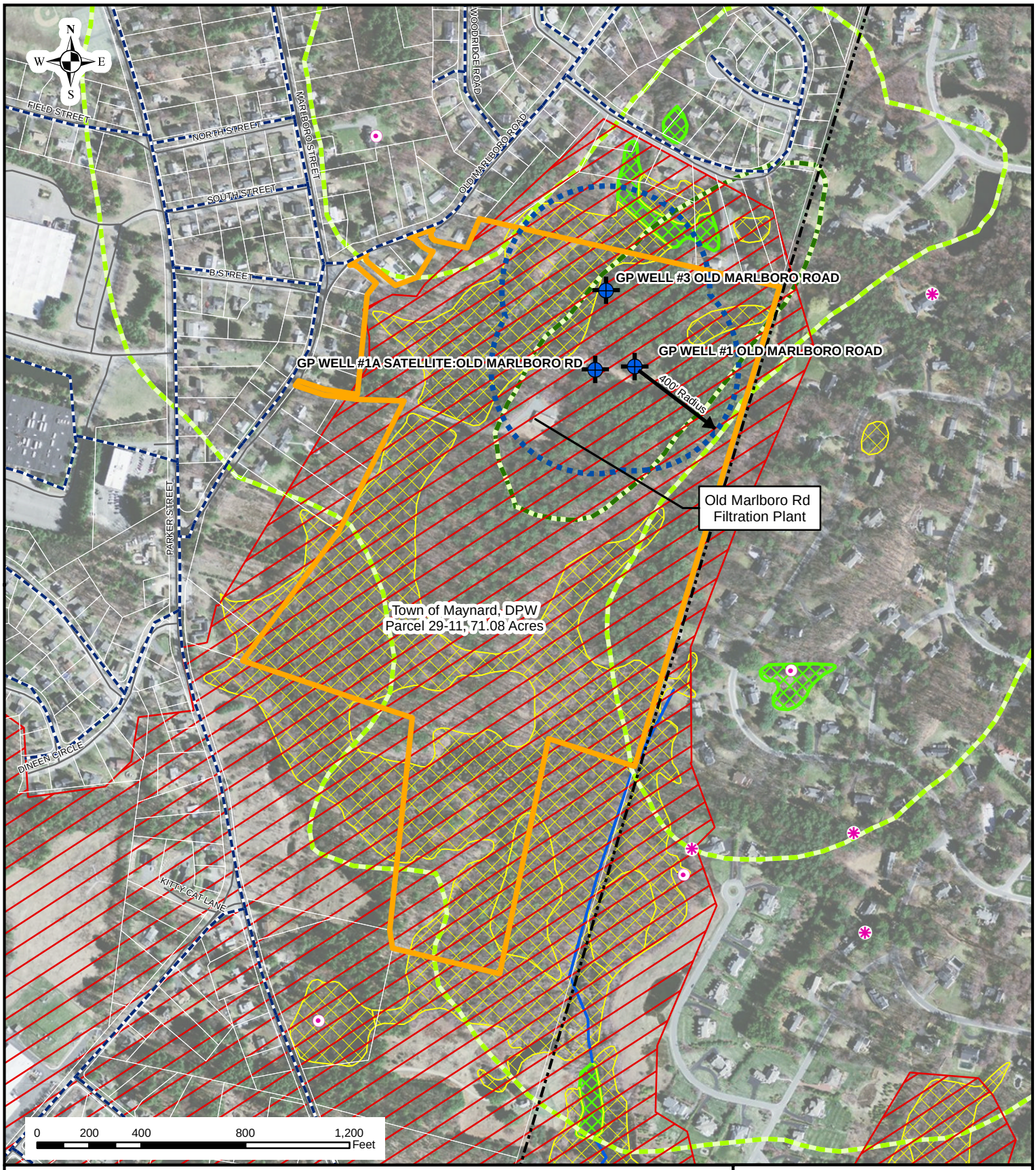
5.1.4 Conclusion

Based on the information gathered and reported above, Woodard & Curran does not recommend further exploration or testing for well sites on the Town property at White Pond. Well development at White Pond is not considered a feasible alternative and is not evaluated further as part of this assessment report.

5.2 OLD MARLBORO ROAD WELL CAPACITY AND TREATMENT ALTERNATIVES

The Old Marlboro Road Well Site consists of three wells treated by the Old Marlboro Road Water Treatment Plant on Parcel 29-11, as shown on Figure 7. The Old Marlboro Road Wells consist of Well Nos. 1, 3, and satellite 1A that have a total mechanical pumping capacity of approximately1.08 MGD and a MassDEP approved pumping volume of 0.87 MGD. The Old Marlboro Road Water Treatment Plant placed in service in 1998 consists of three (3) greensand filters, each rated for 0.36-MG that oxidize and treat raw groundwater to remove iron and manganese.

During the initial operation of the Plant, the raw water had high levels of color, but was treatable to acceptable iron, manganese, and color levels until 2004 when the water quality degraded considerably. In 2004, color increased from 100 to 500 color units and tannin levels between 3 to 6 mg/L were recorded. The high color and tannin levels are attributable to a high groundwater table and leaf biodegradation in the wetlands around the wells.



Legend

- Public Water Supply Well
- NHESP Certified Vernal Pools
- Potential Vernal Pools
- Roads
- Rivers and Streams
- Town Water Main Pipe
- Parcels (White Lines)
- Town Boundary
- 400-ft Wellhead Protection Area (WPA)
- Maynard Owned Parcel
- ACECs (None in View)
- NHESP Priority Habitats of Rare Species

National Wetland Inventory

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

Aquifers

- Potential High Yield (> 300 gpm)
- Potential Medium Yield (100-300 gpm)

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DEPARTMENT OF PUBLIC WORKS
MAYNARD, MA

OLD MARLBORO ROAD WELLS PROPERTY CONSTRAINTS

FIGURE 7

WOODARD & CURRAN

SCALE: 1" = 500'	DOC: MaynardWTF_Fig7.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: JS	SOURCE: MassGIS

MassDEP Annual Statistical Report (ASR) data shows that the available pumping capacity of the wells has decreased over the years; the 2009 ASR indicated Well Nos. 1 and 1A pumped an average of 0.14 MGD and Well No. 3 was offline. High color levels at the Plant continue to be an issue and prevent the plant from operating at its full design capacity.

5.2.1 Color Treatment

The existing greensand filters treat for iron and manganese, but do not treat for color. In order to improve performance, the existing Plant requires a color treatment process to pretreat the groundwater prior to greensand filtration. Before implementing a treatment alternative, a pilot test is required by MassDEP to confirm effectiveness. Woodard & Curran recommends a pilot test of two or three treatment systems. In order to determine the treatment alternatives best suited for a pilot test and coagulant doses, a jar test should be performed on the raw water. In addition to color treatment, there is the potential that the wells will require more frequent cleaning since the color treatment occurs after well pumping at the treatment plant. However, the frequency of cleanings is not known.

Based on a bench scale test performed in 2006, jar testing of Old Marlboro Road well raw water with over 1,000 color units indicated that dissolved air floatation and ballasted sedimentation (CoMag) were effective color removal treatments. Based on this bench scale study and advanced technology, three potential treatment alternatives for pilot test consideration include dissolved air floatation (DAF), ballasted flocculation (similar to ballasted sedimentation), and membrane treatment, described below.

Dissolved Air Floatation

A DAF system acts as a pretreatment system before the groundwater is treated through the existing greensand filters. The DAF application helps to float particles out of the water source. A typical system includes chemical oxidation, coagulation, flocculation, air injection, and floatation purchased as a packaged system.

Typically, potassium permanganate or other oxidant is added prior to a flash mixing tank, the water mixes in the mixing tank with a coagulant such as alum or ferric chloride to flocculate the suspended matter, and then flows to a flocculation tank. In the flocculation tank, tiny air bubbles attach to the particles and float solids to the surface where they are removed as floating sludge and disposed to the Town's wastewater treatment plant. The pretreated water flows to an equalization tank and pumped to the existing greensand filters for final treatment prior to discharge to the Town's distribution system.

The DAF system, chemicals, and feed systems for oxidation and coagulation require storage in a building.

A DAF system is relatively simple to operate and has a high recovery of flow. Estimated construction cost for a 1 MGD system can range around $1M.

Ballasted Flocculation

Ballasted flocculation, similar to DAF, is a pretreatment system before greensand filtration. The difference is that this process helps to sink instead of floating particles out of the water source. A typical system includes coagulation, flocculation, clarification, and separation purchased as a packaged system.

Typically, raw water is added with a coagulant in a flash mixing tank. The coagulated water is mixed with a polymer and micro sand in flocculation tanks. Flocculated water flows into a clarifier, where the floc and sand settle out and the clarified water flows to an equalization tank and pumped to the existing greensand filters for final treatment prior to discharge to the Town's distribution system. The settled floc and sand are pumped to a hydrocyclone where the sand is separated from the solids for reuse in the flocculation tanks and the solids are disposed at the Town's wastewater treatment plant.

The ballasted flocculation system, chemicals, and feed systems require storage in a building.

Ballasted flocculation is relatively simple to operate requiring a little more maintenance than DAF to replenish the micro sand. Flow recovery is lower than DAF. Estimated construction cost for a 1 MGD system is around $1M, similar to DAF.

Membrane Filtration

A membrane system, such as ultra filtration, is a hollow fiber pressure driven membrane with a 0.035-micron pore size. Raw water enters a coagulation system that consists of a mixing and flocculation tank where chemicals such as those for DAF and ballasted flocculation are added to precipitate the dissolved particles to filterable solids. The flow enters the membrane cells where the water is treated and then pulled through membrane pores, leaving the solids behind. The solids are periodically flushed out for disposal to the Town's wastewater treatment plant. A membrane system does not require use of the existing greensand filters.

The ballasted flocculation system, chemicals, and feed systems require storage in a building.

A membrane system requires a higher energy use than DAF and ballasted flocculation, but offers the highest recovery of flow. Construction cost for a 1 MGD system can range around $1.5M.

5.2.2 Additional Capacity

Due to the property limits and environmental constraints, as shown on Figure 7, there is limited land space to develop an additional well to increase capacity. MassDEP requires a new well installation at least 400 feet from other site wells and a 100-ft buffer to bordering vegetated wetlands.

5.2.3 Costs

Woodard & Curran developed conceptual cost estimates for implementing color treatment at the Old Marlboro Road Filtration Plant. Construction and operation/maintenance cost estimates are summarized in Table 7.

Table 7: Conceptual Cost Estimate: Old Marlboro Well Color Treatment

Cost Item	Treatment Plant at White Pond
Jar & Pilot Studies	$160,000
Color Treatment Process and Building Addition Construction Cost	$2,650,000
Engineering (20% of Total Construction Cost)	$530,000
Permitting (3% of Total Construction Cost)	$79,500
Project Cost	$3,259,500
Contingency (15% of Project Cost)	$488,925
Total Project Cost	$3,748,425
Total Project Cost (inclusive of Jar & Pilot Studies)	**$3,908,425**
Present Day Annual O&M Cost	**$150,000/year**

Woodard & Curran used the following assumptions to develop potential costs:

- A separate cost for jar testing to determine the most suitable color treatment alternatives to bench scale and a pilot test for three color treatment alternatives has been assumed.
- Construction costs include a treatment building addition to store color removal equipment, chemicals, tanks, and associated pumping and chemical feed systems. Site work, piping, and specialty systems (electrical, instrumentation/control, security, HVAC, and plumbing) are included.
- For conservative budgetary purposes, membrane treatment costs were used.
- Permitting costs are expected to be less than for the White Pond surface water treatment alternative. There are minimal environmental and easement constraints since the site is a developed Town-owned property.

5.2.4 Regulatory Permitting

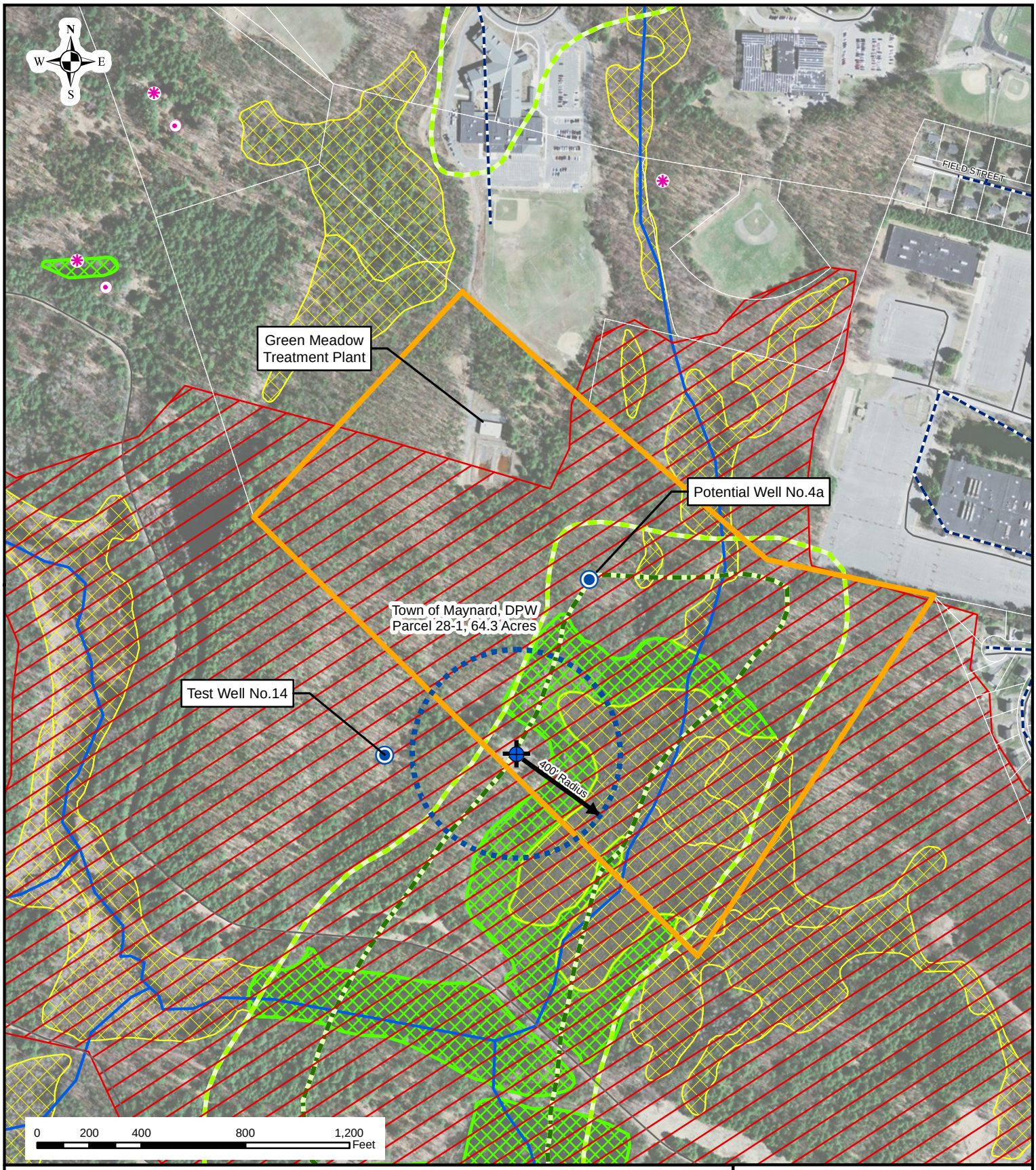
Potential local and state permits required for the color treatment are summarized in Table 8.

Table 8: Old Marlboro Well Upgrades: Potential Permitting Requirements

Permit Item	Regulation	Reason for Permit
Maynard Building Department	State & Local Regulations	Building Construction for color treatment system.
NOI for Construction Activities from Maynard Conservation Commissions	Massachusetts Wetland Regulations, Local Wetland Bylaws, Massachusetts Endangered Species Act (MESA)	Wetlands and priority habitats on Old Marlboro Well Site Property, Parcel 29-11.
Massachusetts Historical Commission Project Notification Form (PNF)	MEPA Regulations	Identity endangered species, archaeological sites, and historical properties near construction activities.
Natural Heritage Endangered Species Program (NHESP) Coordination	Massachusetts Endangered Species Act (MESA)	Priority habitats on Old Marlboro Well Site Property, Parcel 29-11.
Water Treatment Plant Pilot Study	Massachusetts Approval to Conduct Pilot Study & Approval of Pilot Study Report	Pilot study required to verify color treatment technology is adequate.
Water Treatment Plant Modification	Massachusetts Approval of Treatment Facility Modification	State law requirement to verify color treatment alternative is adequate.
Sewer Connection Permit	Massachusetts Sewer Connection Permit	Connection to Maynard wastewater treatment facility for backwash disposal.

5.3 GREEN MEADOW AQUIFER (WELL NO. 4) NEW GROUNDWATER SOURCE

Maynard is developed with few alternatives for new groundwater source locations. Potential alternatives include a connection with the Well No. 4 treatment system (Green Meadow Treatment Plant) located off Great Road on Town-owned Parcel 28-1, as shown on Figure 8. The Plant has a design capacity of approximately 1 MGD to meet the Town's average day demand and currently treats Well No. 4 with a mechanical pumping capacity of 0.65 MGD.



Legend

- Public Water Supply Well
- Test Well Or Potential Well
- NHESP Certified Vernal Pools
- Potential Vernal Pools
- Roads
- Rivers and Streams
- Town Water Main Pipe
- Parcels (White Lines)
- Town Boundary
- 400-ft Wellhead Protection Area (WPA)
- Maynard Owned Parcel
- ACECs (None in View)
- NHESP Priority Habitats of Rare Species

National Wetland Inventory

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland

Aquifers

- Potential High Yield (> 300 gpm)
- Potential Medium Yield (100-300 gpm)

ASSESSMENT OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
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WELL NO.4
NEW WELL PLACEMENT

FIGURE 8

WOODARD &CURRAN

SCALE: 1" = 500'	DOC: MaynardWTF_Fig8.MXD
DATE: AUGUST 2011	JOB NO.: 223699
DRAWN BY: JS	SOURCE: MassGIS

Test Well No. 14 located approximately 500 feet west of Well No. 4 on U.S. Fish and Wildlife (Assabet River Refuge) Property or a new groundwater source near Well No. 4 on Town-owned property are two potential alternatives to increase capacity at Well No. 4 to provide redundant capacity. These two alternatives are described below.

5.3.1 Test Well No. 14

Pumping tests for Test Well No. 14 installed in 1980 showed a yield of 0.32 MGD. However, approval of Test Well No. 14 as a groundwater source by MassDEP in 1981 was rescinded since the well is located on federal property currently under the jurisdiction of the U.S. Fish and Wildlife (Assabet River Refuge). The Refuge Property Manager indicated use of Test Well No. 14 by the Town is not feasible since the groundwater source is a federal resource not usable by the Town. The only available method to obtain access to the well would be to acquire land on and surrounding the well through a land acquisition by the federal government. However, land acquisition approval is highly unlikely. Therefore, this alternative is not considered feasible for further evaluation.

5.3.2 New Well Source

A review of land and geologic conditions suggest that an additional well could be installed and treated in conjunction with Well No. 4 at Town-owned Parcel 28-1. Well No. 4 is a located on a small peninsula of higher ground protruding into a swampy area near Voss Hill. Woodard & Curran identified a location 600 feet northeast of Well No. 4 with similar land and elevation features as Well No. 4. This area is referred as Potential Well No. 4a on Figure 8.

The area around Potential Well No. 4a has not been tested for water supply potential. Woodard & Curran conducted a preliminary geologic review of the area and concluded land requirements for a public well site are satisfied at this site for a potential well. Based on the field visit, it appears that the necessary 400-ft Wellhead Protection Area (WPA) buffer and 150-ft zone of exclusion from standing water is available.

A well developed at this site would most likely require iron and manganese treatment. However, there is sufficient capacity at the Green Meadow Treatment Plant to add the filtration volume for another well similar to Well No. 4. In addition, the land is available since the parcel is Town-owned and a transmission main to the Plant currently exists.

Given the Town's need for additional redundant supply capacity, Woodard & Curran recommends a subsurface exploration to explore, sample, test soils, and identify potential additional well yield, as performed at White Pond. Based on the test well results, it can be determined if a new well source is a feasible alternative to combine with Well No. 4 to meet the Town's demands.

5.3.3 Green Meadow Treatment Plant Upgrades

A new groundwater source combined with Well No. 4 requires the following:

- One additional greensand filter to increase Plant capacity to design capacity of 1 MGD.
- Potential deactivation of the existing residual basins; plant waste streams could be disposed at the Town's wastewater treatment facility.

- Continued well maintenance to achieve a sufficient pumping capacity.

5.3.4 Costs

Woodard & Curran developed conceptual cost estimates for constructing a new well tied into the Well No. 4 Treatment Plant. Construction and operation/maintenance cost estimates are summarized in Table 9.

Table 9: Conceptual Cost Estimate: Well No. 4 - New Well Source Development

Cost Item	Treatment Plant at White Pond
Subsurface Exploration	$450,000
New Well Development and Connection to Treatment Plant Construction Cost	$1,900,000
Engineering (20% of Total Construction Cost)	$380,000
Permitting (3% of Total Construction Cost)	$57,000
Project Cost	$2,337,000
Contingency (15% of Project Cost)	$350,550
Total Project Cost	$2,687,550
Total Project Cost (inclusive of Subsurface Exploration)	**$3,137,550**
Present Day Annual O&M Cost	**$125,000/year**

Woodard & Curran used the following assumptions to develop potential costs:

- Construction costs include new well development and associated equipment, pipe connection to the Green Meadow Treatment Plant, and treatment plant upgrades described in Section 5.3.3. Site work, piping, and specialty systems (electrical, instrumentation/control, security, HVAC, and plumbing) are included.

- Permitting costs are expected to be less than for the White Pond surface water treatment alternative. There are less environmental constraints and easements are not required since the property is Town-owned.

5.3.5 Regulatory Permitting

Potential local and state permits required for new source development are summarized in Table 10.

Table 10: New Source Development: Potential Permitting Requirements

Permit Item	Regulation	Reason for Permit
New Source Approval	Mass DEP Approval to Site a Source and Conduct a Pumping Test	Required by Mass DEP for new groundwater source
Site Screening Process		
Request for Site Exam/Pumping Test Proposal		
Mass DEP Site Exam/Pumping Test Proposal Review		
Pumping Test Performance		
Pumping Test Analyses and Calculated Approval Yield		
Source Final Report		
Maynard Building Department & Health Department Permits	State & Local Regulations	Building Construction and Water Quality/Public Health
Water Management Act Permit Amendment	Massachusetts Water Management Act	Additional water supply source requires a permit amendment.
NOI for Construction from Maynard, Stow, & Hudson Conservation Commissions	Massachusetts Wetland Regulations & Local Wetland Bylaws	Wetlands and Priority Habitats near White Pond and Transmission Line Route
Natural Heritage Endangered Species Program (NHESP) Coordination	Massachusetts Endangered Species Act (MESA) & Massachusetts Wetland Regulations	Priority Habitats near White Pond and Transmission Line Route
Massachusetts Historical Commission Project Notification Form (PNF)	MEPA Regulations	Verification that endangered species, archaeological sites, and historical properties will not be affected by construction
MEPA Environmental Notification Form (ENF)	MEPA Regulations	Water withdrawal quantity may exceed permit thresholds; potential for wetland disturbance threshold exceedance

Permit Item	Regulation	Reason for Permit
Water Treatment Plant Modification	Massachusetts Approval of Treatment Facility Modification	State law requirement to verify plant modifications are adequate.
Sewer Connection Permit	Massachusetts Sewer Connection Permit	Connection to Maynard wastewater treatment facility for plant waste streams.

6. INTER-MUNICIPAL WATER CONNECTIONS

This section assesses the feasibility of providing a water connection Hudson, Sudbury, and Stow to sell water to these communities.

6.1 HUDSON AND SUDBURY WHITE POND CONNECTION

Due to the close proximity of White Pond to the Towns of Hudson and Sudbury, Woodard & Curran evaluated the feasibility of supplying water from White Pond to the Towns of Hudson and Sudbury. Chapter 407 of the Acts of 1888 entitled "An Act to Supply the Town of Maynard with Water" (Act) granted under the Massachusetts state legislation allows the Town of Maynard water rights to White Pond. The Town's Town Council, Blatman, Bobroski, and Mead LLC, reviewed the act and it was Town Council's opinion that …"Because the Act specifies that the Town may draw the water that it requires from White Pond, it is clear that [the] Act intends the water to be used for the Town and not sold to any third party for use in another Town."…and recommended that the Town not sell water withdrawn from White Pond to another municipality and that only the Town of Maynard use the water.

Due to the legal review of White Pond, a connection to Hudson or Sudbury is not considered feasible and Woodard & Curran did not evaluate.

6.2 STOW CONNECTION

Stow expressed interest in obtaining an estimated 11,000 gallons per day from Maynard's water supply. Due to the legal review described in Section 6.1, it is not advisable for Maynard to provide water from White Pond to Stow. Connecting a water source to Stow from Maynard's groundwater sources is a potential but not practical alternative. Based on a 2009 Water Expansion Report submitted to Stow, water demands that averaged 58,500 gpd is projected to increase to 94,500 gpd by 2020. Supplying 11,000 gpd to Stow will not meet this projected increase. A more feasible alternative for Stow is to evaluate the use of the existing Assabet Water Company Water Treatment Plant. This plant's design capacity of 144,000 gpd could potentially meet Stow's projected water demand and alleviate the need for a separate connection with Maynard.

7. RECOMMENDED ALTERNATIVES

This section summarizes the recommended alternatives and a timeline for each to implement preliminary environmental studies and pilot tests, permitting, design, and construction. An estimated appropriation of funds is provided.

7.1 SUMMARY OF ALTERNATIVES

The Town of Maynard has three potentially viable alternatives for providing redundant public water supplies. The three alternatives include;

- White Pond surface water treatment with a facility located in-Town adjacent to the Well No. 4 Water Treatment Facility. This facility would have the capability of providing approximately 1.0 MGD of capacity. Estimated capital cost of this alternative is approximately $14,500,000. O&M cost is estimated to be approximately $250,000/year.

- Addition of a treatment system to remove color at the Old Marlborough Road Water Treatment Facility. Addition of color removal treatment has the potential to increase the capacity of the well to its MassDEP approved capacity of 0.87 MGD. Estimated capital cost of $3,800,000. The additional O&M cost associated with this alternative is approximately $150,000/year.

- Addition of a new well at the existing Well No. 4 with treatment at the Well No. 4 Water Treatment Facility. The Well No. 4 Water Treatment Facility has a design capacity of 1.0 MGD with the addition of a green sand filter unit. Estimated capital cost of $3,137,500. The O&M associated with this alternative is approximately $125,000/year.

All three alternatives require significant permitting and/or preliminary engineering to finalize the alternative and it is recommended that all three alternatives be pursued simultaneously as follows;

1. Begin the process of acquiring the easements necessary for reconstruction of the water transmission main from White Pond to the Town of Maynard. This will require State Legislation for approval and completion of an environmental assessment for approval from Fish and Wildlife.

2. While the legislative process and environmental assessments are being undertaken, commence with the jar testing and pilot study for the removal of color at the Old Marlborough Road Water Treatment Facility. Upon completion of the jar testing and pilot study the Town will have a better understanding of the viability of this alternative and the estimated construction costs.

3. In conjunction with pursuing Alternatives 1 and 2 it is recommended that the Town commence with preliminary groundwater investigation work at the Well No. 4 site to determine if this is a viable ground water supply. The preliminary groundwater investigations would start with installation of 2-1/2 inch test wells which will provide some indication of ground water quality and quantity. If these results look favorable, then the next step would be to perform a pumping test.

4. Pursuing all three alternatives provides the Town with a phased approach, allowing the Town to start/stop any alternative as the results dictate and not fully committing the Town to any one alternative. This will allow the Town to maximize all of its existing resources.

Table 11 summarizes these potential alternatives.

Table 11: Summary of Potential Alternatives

Alternative	White Pond Surface Water Treatment	Old Marlboro Color Treatment Upgrades	Well No. 4 – New Groundwater Source
Potential Yield	1 MGD	1 MGD	TBD based on a subsurface exploration
MassDEP Permitted Withdrawal **MassDEP Approval for Increased Withdrawal**	1 MGD No	0.87 MGD Yes	Well No. 4 – 0.65 MGD New Source – TBD based on a subsurface exploration Yes
Pilot Studies	$115,000	$160,000	$80,000
Estimated Capital Cost	$14,500,000	$3,800,000	$3,137,550
Estimated Annual O&M Cost	$250,000/year	$150,000/year	$125,000/year
Pros	• Water yield meets average day demand.	• Plant infrastructure in place.	• Plant infrastructure in place.
Cons	• Most expensive alternative. New plant and transmission line required. • Requires coordination with Stow. • Permit intensive. • Long lead time. • Requires easement approval from local, state, and federal agencies for transmission line construction. • Requires State Legislation approval for easements.	• Additional well maintenance may be required due to higher pumping capacities.	• Potential new well source may not have sufficient yield. • If new well source has sufficient yield, an amendment to the Water Management Act Permit is required for increased withdrawal. • Long lead time for permitting new source.

The following alternatives considered less feasible were not evaluated by Woodard & Curran, as discussed in this report:

- A new groundwater source at White Pond does not provide a yield to meet the 1 MGD average day demand.
- Connection of Test Well No. 14 with Well No. 4 is not a feasible alternative since the test well is located on federal property.
- New well development to connect with the Old Marlboro wells is not feasible due to lack of property space.

7.2 ALTERNATIVE IMPLEMENTATION TIMELINE

Table 12 provides a potential timeline for implementation of each of the proposed alternatives. The table summarizes estimated dates for completion of preliminary environmental studies and pilot tests, permitting, design, and construction. Estimated appropriation of funds required for each alternative and the total for a given fiscal year are provided.

Table 12: Alternative Implementation Timeline

Fiscal Year	White Pond Surface Water Treatment	Old Marlboro Color Treatment Upgrades	Well No. 4 – New Groundwater Source	Estimated Appropriation of Funds for Fiscal Year
2013	• Begin to acquire easements for transmission line construction. • Begin process to obtain State Legislation Approval for transmission line construction on State and Article 97 properties. • Conduct pilot test to characterize water quality.	• Conduct jar test to determine color treatment technologies to pilot test.	• Complete subsurface exploration to determine yield of a potential new well. • Based on results, determine if further commitment to alternative is warranted.	
Funds	$115,000	$10,000	$6,000	$131,000
2014	• Begin environmental studies and permit process.	• Conduct pilot test for two to three color treatment technologies to identify most suitable technology.	• Begin environmental studies and permit process.	
Funds	• $250,000	• $150,000	• $225,000	$625,000
2015	• Finish easement process that includes State Legislation Approval.	• Complete Engineering Design. •	• Continue environmental studies and permit process for new source approval.	
Funds	$250,000	$344,000	$225,000	$819,000
2016	• Complete environmental studies and	• Complete Old Marlboro Road Filtration Plant upgrades to address	• Complete environmental studies and	

Fiscal Year	White Pond Surface Water Treatment	Old Marlboro Color Treatment Upgrades	Well No. 4 – New Groundwater Source	Estimated Appropriation of Funds for Fiscal Year
	permit process. • Complete Engineering Design.	color. •	permit process. • Complete Engineering Design. •	
Funds	• $1,000,000	• $3,403,925	• $190,000	$4,593,925
2017	• Begin Plant Construction • Begin Transmission Line Construction		• Completed new well construction, connection to Green Meadow Treatment Plant, and Plant upgrades.	
Funds	$5,000,000		$2,440,550	$7,440,550
2018	• Complete Plant Construction • Complete Transmission Line Construction			
Funds	$5,000,000			$5,000,000
2019 Funds	$			$

7.3 FUNDING

Potential funding opportunities for water treatment infrastructure include the following:

- Drinking Water State Revolving Fund (DWSRF). Massachusetts subsidizes market interest rates down to two percent on DWSRF loans.

- MassWorks Infrastructure Program. This new program provides municipalities funding for infrastructure projects (inclusive of water treatment plants) that support economic development and job creation. The current funding round has $75 Million available.

- Community block and action grants.

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