Furnace Pond
Hydrologic Investigation

Draft Report

Town of Pembroke
Pembroke Watershed Association

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

Comprehensive Environmental Inc. (CEI) completed this Furnace Pond Hydrologic Study for the Pembroke Watershed Association to provide a better understanding of the inter-relationship between the local geology, hydrology of the pond, surrounding water bodies and groundwater. This study is a follow-up to the Furnace Pond Dredging Feasibility Study that was completed by CEI in 2007 to determine the feasibility of removing and disposing the accumulated sediment materials in the pond to improve water quality. The goal of this study is to identify the correlation between Furnace Pond and underlying soils and how the removal of the sediment layer could affect the hydraulic conductivity between the pond, groundwater and surrounding surface waters.

The 2007 Dredging Feasibility Study recommended additional geotechnical investigation below Furnace Pond. Soil borings below the pond were completed to classify the soils below the sediment layer and identify the presence or absence of an additional confining layer that might affect a connection to underlying groundwater. Validation of an additional confining layer is necessary to determine the effect of removing the sediment layer.

In addition to obtaining soil borings, two monitoring wells were installed in Furnace Pond to conduct groundwater monitoring over a one year period. The monitoring well observations provided information on the hydraulic relationship between the surface water in the pond and the underlying groundwater to determine if a net inflow or outflow would occur if the confining sediment layer were removed. Water elevations of the pond and the wells were recorded to develop a hydraulic gradient.

This letter report summarizes the soil characteristics recorded during the installation of two monitoring wells in Furnace Pond and the hydrologic observations during the study period. The report also offers conclusions and recommendations regarding the feasibility of a dredging project with consideration for the hydrological conditions of Furnace Pond.

2.0 Study Area and Monitoring Procedures

The area of hydrologic study was focused on Furnace Pond since the intent of the investigation was to assess the relationship between the pond and underlying groundwater. Furnace Pond is a 110-acre natural pond located southeast of Oldham Pond which is connected to Furnace Pond through a culvert, and east of Great Sandy Bottom Pond. The study took into account these two major surface waterbodies since they could significantly affect the hydrologic condition of Furnace Pond. Oldham Pond is a 235 acre pond located to the northwest of Furnace Pond and Great Sandy Bottom (GSB) Pond, located to the west, is 109 acres. Figure 1 illustrates the location of the ponds.

Oldham Pond provides the primary sources of surface water flow into Furnace Pond through a culvert that crosses under Mattakeesett Street. GSB Pond also has a culvert connection that flows in the direction of Furnace Pond. The water level of GSB Pond is controlled by the Abington/Rockland Joint Water Works and is typically maintained below the pipe invert and provides little if any surface flow to Furnace Pond throughout the year.

A third large land feature also located to the west of Furnace Pond is the Andruk property cranberry bog. This low lying area was included in the hydrologic investigation via two existing monitoring wells that are located in the bog near the northwest corner of Furnace Pond. The cranberry bog was recently purchased by the Town of Pembroke for open space preservation. A sluice gate that once controlled the flow through a culvert pipe that crosses under Mattakeesett Street now remains open since the bog is no longer used for cranberry production and does not require flooding during the harvest. The groundwater monitoring wells located on the eastern edge of the cranberry bog were used as a point of comparison to the surface water elevation of Furnace Pond and monitoring wells within the pond.

2.1 Soil Borings and Monitoring Wells

Soil borings were conducted according to ASTM standards with split spoon samples every 5’ or change in strata. A geologist from CEI was present during the installation of two monitoring wells (MW-3 and MW-4) to evaluate the core samples and classify the soils below Furnace Pond’s sediment layer. The two wells were located along the western shoreline of the pond, as shown in Figure 2. Boring logs of each well are provided in Figures 3 and 4.

A large raft equipped with an auger was used to carry the drilling equipment and well casings to complete the well installations in the pond. Once anchored, the auger and well casings were driven through the sediment and underlying soil to depths of approximately 32 feet. Bedrock was not encountered at this depth. The top of the casings were set 3 feet above the surface of the pond to prevent surface water from entering the monitoring well. Both wells were within 50 feet from the shore to reduce the risk of them interfering with boat traffic.

Bentonite clay was injected between the inner monitoring wells and outer protective casings to form a seal that would prevent surface water from entering the monitoring wells. With the clay seals in place, the well screens were isolated in the groundwater and the water in the monitoring wells would indicate the water table elevation. Comparing the water elevations in the wells with the surface of the pond would help determine the hydraulic gradient or connection between the surface of the pond and groundwater.

2.2 Field Monitoring

Four monitoring rounds were completed between 2009 and 2010. Field measurements of water levels were recorded at each of the monitoring wells located in Furnace Pond and the cranberry bog. Surface water elevations were also recorded for Furnace, GSB and Oldham. Monitoring measurements were related to the rim of the wells located in Furnace Pond to provide two control points that would be used to calculate relative water elevations and evaluate the hydrologic interconnection within the study area.

The monitoring wells located in Furnace Pond required two measurements to calculate the pond surface and groundwater elevations. Groundwater elevations were recorded by measuring the depth to water inside the well and the pond elevation was measured to the surface of the water on the outside of the casing. Both measurements were made from the rim of the well casing. Since the rim elevation of the casing was previously surveyed, the elevations of the groundwater and surface of the pond could be calculated by simply subtracting the recorded depths from the rim elevation.

Groundwater elevations of the monitoring wells located in the cranberry bog were measured from the rim of the casings and a staff gage, located at the culvert between Oldham Pond and Furnace Pond, was used to measure the surface of Oldham Pond. Surface measurements of GSB pond were made using a grade rod and survey equipment since there was no gage available.

3.0 Geologic and Hydrologic Features

This section provides geological characteristics of the investigation area information about Plymouth County as it relates to and influences the hydrologic relationship with adjacent surface and subsurface water sources.

3.1 Surficial Geology

A review of the United States Department of Agriculture (USDA) surficial geology maps indicates the soils in the study area are best described as glacier outwash deposits. Surficial stratified sediments that are often deposited on glacial ice include sand, gravel and clay. Furnace Pond is a naturally formed pond which marks the site of a large ice block left behind by the retreating glaciers. Today the pond occupies the depression left behind by the ice with underlying soils that are consistent with glacier deposits.

A variety of soils are identified on the USDA maps in the area surrounding Furnace Pond. The characteristics of these soils are primarily gravelly sand with the majority of soils classified as Hinckley (gravelly sandy loam) and Windsor (loamy sand). These soil classifications are described as having very rapid permeability, especially in areas where gravel deposits are found. Table 1 includes soil descriptions obtained through a soil survey developed by the USDA, Natural Resources Conservation Service (NRCS). Soil characteristics that lie below waterbodies are not classified on the USDA maps and are simply characterized as water. Figure 5 provides a soils map of the study area.

Table 3-1
USDA Soil Characteristics

Soil Attribute	Characteristics	
	Hinckley	**Windsor**
Drainage Class	Excessively drained	Excessively drained
Parent Material	Gravelly glacial fluvial deposits	Sandy glacial fluvial deposits
Permeability	Very rapid throughout	Rapid or very rapid throughout
Available Water Holding Capacity	Very low	Low
Depth to Bedrock	Greater than 65 inches	Greater than 65 inches
Seasonal High Watertable	Depth: greater than 5 feet Type: apparent	Depth: greater than 5 feet Type: apparent
Hydrologic Group	A	A
Hydraulic Conductivity	High or very high	High or very high
Hydric Soil	No	No
Flooding/Ponding Potential	Frequency and Type: None	Frequency and Type: None
Description	Very deep, nearly level, excessively drained soil formed in gravelly fluvial deposits. Hinckley soils are on terraces, deltas, kames, eskers and large, broad areas on outwash plains.	Very deep, excessively drained soils formed in sandy glacial outwash. Windsor soils are on glacial outwash plains, deltas, and on the tops of glacial stream terraces.

Soil profiles at MW-3 and MW-4 (Figures 3 and 4) are consistent with the USDA descriptions of the surrounding Hinckley and Windsor soils. The boring logs illustrate the soil profiles of the monitoring wells which show the composition of the soils below Furnace Pond. Once through the organically rich sediment layer found on the bottom of the pond, the subsoil becomes a sandy gravel complex.

3.2 Bedrock Characteristics

Hydraulic conductivity of bedrock can vary significantly. The extent and orientation of fractures in the bedrock will affect permeability and distribution of subsurface flow. The underlying bedrock in the investigation area is classified as Pennsylvanian aged. This is a sedimentary rock which is commonly composed of sandstone, siltstone, shale, coal, and limestone. The thickness of sedimentary can vary significantly and outcrop areas will commonly occur in upland areas.

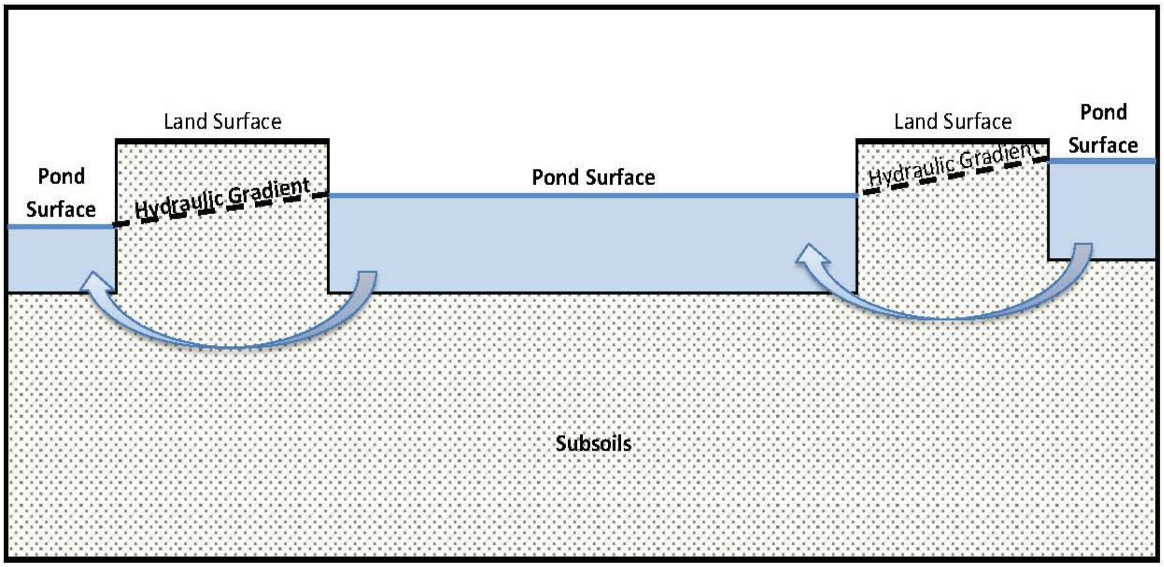
There were only a few significant bedrock outcrops observed to the west of Furnace Pond near Ridge Avenue. Based on the soil characteristics observed at the monitoring well locations and the lack of outcrops, bedrock does not appear to be a significant geological feature in this area and is presumed to have no affect the hydrologic relationship between the pond and groundwater water.

3.3 Hydraulic Conductivity

Several factors can affect the hydraulic conductivity of a lake bottom. A primary factor is the composition and thickness of the sediment layer. Lakes with organically rich or muddy sediment will have low porosity due to the small void spaces in the material. The small voids reduce the rate in which the surface or groundwater can seep through this confining layer. Likewise, a thicker and more extensive organic sediment layer will affect the hydraulic conductivity and water will seep slower through the material.

The surface elevation of two water bodies will affect the flow direction and slope of water between them. As the surface elevation of one water body increases, the downward head will increase and change the slope of water toward the other. This slope is known as the hydraulic gradient. Figure 6 illustrates a hydraulic gradient between three waterbodies. The amount of head created by the surface water can be affected by the porosity of the material between the water bodies. Soils with low hydraulic conductivity (e.g clay and mud) will restrict flow and cause the head of the upgradient water body to increase. Removing the restrictive material will allow the water to follow the hydraulic gradient and flow into the downgradient water body.

Figure 6
Hydraulic Gradient Illustration



The Dredging Feasibility Study included field collection of sediment samples to characterize the sediment material found in Furnace Pond. Sieve analysis results indicate the sediment has a high composition of fine particles with an average of 12.6% passing through a #200 sieve. Sediment thickness measurements made during the Dredging Feasibility Study found the pond has an average sediment thickness of approximately 8 feet with a maximum thickness of 16 feet.

Based on the monitoring observations of the wells located in Furnace Pond and the results of the Dredging Feasibility Study, it is apparent that the Pond's thick organically rich sediment layer restricts hydraulic conductivity. Groundwater elevations observed in the wells had mixed results, however they were not at equilibrium with the surface of the pond which indicates the hydraulic gradient is caused by the confining sediment layer.

3.4 Zone II Aquifer

Furnace pond is located in a high yield aquifer zone that supplies the Pembroke Water Department groundwater wells which supply drinking water to the public. The aquifer boundary represents the Zone II delineation for all five of the Town's supply wells. The closest well to Furnace Pond is the Windswept Bogs Well (GP Well #5) which is approximately 1,500 feet (0.3 miles) from the edge of the pond. A ridge of land along the western shore divides the subwatershed of the pond from the well. Aquifer boundaries produced by MassGIS indicate medium and high yield sand and gravel aquifers lie below the study area. Figure 7 shows the aquifer boundary and the location of the Windswept Bogs Well in relation to Furnace Pond.

The high hydraulic conductivity of the soils provide a good source of water for the town's supply wells. One of the concerns for dredging Furnace Pond and removing the sediment layer was the possibility of the pond water becoming directly hydraulically connected with the aquifer and affecting the Windswept Bogs Well. The aquifer yield transitions from high to medium along the ridge located between the well and pond, which indicates the soils along the ridge are less permeable. Due to the proximity of the well to and the topography separating it from the pond, dredging Furnace Pond does not present a contamination risk to the well.

3.5 Secondary Water Source

Furnace Pond is a secondary water source for the Brockton Water Commission. Whenever there is a water shortage there water from the pond is diverted into Silver Lake through Tubbs Meadow Brook. Diversions from Furnace Pond did not occur during the monitoring period and therefore did not influence the surface elevation of the pond.

4.0 Monitoring Results

The surface elevation of Furnace Pond was relatively constant during the one year monitoring period. Water elevation in the pond was slightly higher in the beginning of June, 2010 but averaged between 55 and 56 feet. This consistency provided a good reference point when comparing the pond's surface with seasonal changes of the groundwater table. Elevation measurements of surface water and groundwater are provided in Table 2.

Table 4-1
Water Elevation Monitoring Results

Monitoring Location	Summer 2009	Fall 2009	Late Spring 2010	Early Summer 2010
MW-1	54.76	54.23	55.89	54.79
MW-2	54.75	54.18	55.73	54.75
MW-3	55.03	54.84	56.33	55.47
MW-4	55.93	55.97	57.8	55.55
Furnace Pond Surface	55.18	55.08	56.41	55.77
Great Sandy Bottom Pond Surface	54.7	-	-	54.71
Oldham Pond Surface	55.45	-	-	56.06

Surface water elevations of Oldham pond and GSB Pond were measured twice during the monitoring period and were also found to maintain a constant elevation. The surface elevation of GSB Pond was maintained at a lower elevation than Furnace Pond by the Abington/Rockland Joint Water Works while Oldham Pond was slightly higher and flowing into Furnace Pond.

Observations of the monitoring wells indicated the groundwater table was at or slightly below the surface of Furnace Pond in three of the four monitoring well locations. Well locations MW-1, MW-2 and MW-3 had groundwater levels consistently below the pond elevation with the largest deviation occurring after a dry period during the summer of 2010. These wells are located in close proximity to each other and exhibited similar responses in the groundwater elevation throughout the monitoring period.

The groundwater elevations in MW-1, MW-2 and MW-3 that fall below the surface of Furnace Pond may be attributed to GSB Pond being maintained at a lower elevation. The low groundwater table observations indicate a vertical downward gradient with the hydraulic connection between the groundwater and GSB Pond affects the groundwater table below Furnace Pond. The monitoring results also indicate the water elevation in Furnace Pond has little influence on groundwater levels in the MW-1 and MW-2 due to the distance between the wells and pond.

In contrast, a significant vertical upward gradient that was measured between the groundwater in MW-4 and the surface of Furnace Pond indicates an upwelling of groundwater is restricted by the sediment. The result is a mounded water table at the southern end of the pond. These observations can be attributed to the geography of the land adjacent to the well. The hills that surround the south end of the pond cause a significant amount of surface and groundwater to flow toward the pond. Due to the poor hydraulic conductivity of the sediment layer, the groundwater cannot upwell into the pond which results in the mounded groundwater table at the base of the hill.

As indicated in Table 2, the groundwater elevation in MW-4 dropped below the surface of Furnace Pond in June of 2010. This drop in groundwater is likely due to the dry weather conditions that occurred in 2010. Precipitation data during the monitoring period is provided in Table 3. The decrease in rainfall reduced the amount of water available to recharge groundwater which lowered the water table.

Table 4-2
Monthly Precipitation (inches)

2009 Precipitation Records		
Month	**Monthly Precipitation**	**Historic Monthly Precipitation**
March	2.70	5.77
April	3.85	5.06
May	0.9	4.30
June	2.17	4.12
July	7.71	3.76
(Monitoring Round 1)		
August	5.35	
September	3.65	
(Monitoring Round 2)		
2010 Precipitation Records		
Month	**Monthly Precipitation**	**Historic Monthly Precipitation**
March	8.18	5.77
April	1.62	5.06
May	1.71	4.30
(Monitoring Round 3)		
June	1.61	4.13
(Monitoring Round 4)		
July	1.43	3.76

5.0 Conclusions and Recommendations

The two primary goals of the Furnace Pond hydrologic study were to develop information on the subsoil characteristics below the pond and determine if the sediment is a confining layer between the surface water and groundwater. Field observations of soil samples and monitoring wells were used to provide this information and develop recommendations to improve water quality in the pond.

Soil borings conducted in Furnace Pond confirmed that the soil characteristics below the sediment layer are similar to those surrounding the pond. The soils are a sandy/gravel complex with a high hydraulic conductivity which would naturally allow the pond to reach equilibrium with the groundwater. The soil borings also confirmed the sediment below Furnace Pond is composed of a silty/clay mud which creates a confining layer between the groundwater and the pond. Removing the sediment in Furnace Pond would provide unrestricted flow between the pond and underlying groundwater.

Monitoring well data collected during the study period demonstrates how complex the hydrological conditions are in Furnace Pond and the surrounding area. An assessment of the groundwater and surface water elevations indicates the hydraulic gradient between the surface water and groundwater varies from the north to south end of the pond. As previously discussed the geography and surrounding water bodies have a significant effect on the groundwater table. Due to the nature of these results, recommendations for improving water quality in Furnace Pond are provided, divided between each end of the pond and on a pond-wide basis.

5.1 Sediment Removal - North End

Several factors influence the hydrology in the north end of Furnace Pond due to the proximity to GSB Pond and Oldham Pond. The three waterbodies are hydraulically connected through surface water and groundwater which needs to be considered when making recommendations for improving water quality and removing the sediment layer in the pond.

Water elevations that are maintained in each waterbody creates a hydraulic gradient that slopes from Oldham Pond (highest surface elevation) toward GSB Pond (lowest surface elevation). Removing sediment in the north end of Furnace Pond would improve the pond's hydraulic connection to the groundwater and affect the hydraulic gradient between the waterbodies. The result would be a net loss of groundwater to GSB Pond at a lower gradient, however there would be a net gain from Oldham Pond at a higher gradient.

Removing sediment from the north end of Furnace Pond creates a concern for the quality of the groundwater that would be gained from Oldham Pond. Past water quality studies have indicated that Furnace Pond receives high levels of phosphorus from Oldham Pond. The Town is currently evaluating alternatives to treat surface water flowing out of Oldham Pond before entering Furnace Pond. These Best Management Systems (BMPs) are designed to remove nutrients from surface runoff but would not provide groundwater treatment. Improving the groundwater hydraulic connection between Furnace

Pond and Oldham Pond could create a new source of phosphorous that would need to be addressed in any dredge option in Furnace Pond.

An evaluation of the groundwater quality is needed in order to determine if the net gain of groundwater from Oldham Pond would be a benefit or detriment for improving water quality in Furnace Pond. Installation of two monitoring wells is recommended between Furnace Pond and Oldham Pond to collect groundwater samples for water quality analysis. Results from these samples could provide indications of how groundwater quality within Furnace Pond might be affected and help determine the extent of sediment that could be dredged from the north end of Furnace Pond to maximize water quality improvements.

Costs to dredge sediment from the north end of Furnace Pond using a wet hydraulic dredge with an on land staging is $4,700,000. The costs to install monitoring wells and perform 4 rounds of sampling to evaluate groundwater quality is $5,500.

5.2 Sediment Removal - South End

The hydraulic gradient of groundwater in the south end of Furnace Pond indicates a net inflow will occur with the removal of sediment. The surrounding hills effectively isolate the south end of the pond from adjacent surface waters that could impact the quality of groundwater in that area.

Removing sediment from the south end of Furnace Pond will improve water quality by removing nutrient sources and increasing groundwater inflow. The benefit of the groundwater inflow would primarily occur in the southern portion of the pond since the natural flow of the pond is toward of the south and would have limited circulation toward the north end of the pond. A notable benefit for dredging sediment in this area is the proximity to the semi-public beach. Dredging should include the shoreline along the beach to restore this site for recreational use.

Costs to dredge sediment from the south end of Furnace Pond using a wet hydraulic dredge with an on land staging is $3,300,000.

5.3 Sediment and Nutrient Removal

The 2007 Dredging Feasibility Study included volume and cost estimates for dredging the entire area of Furnace Pond. While removing all of the sediment in the pond is ideal for restoring water quality, there are significant volumes of sediment and costs associated with a dredging operation of that size.

An alternative to dredging the entire pond is to target specific areas where high concentrations of sediment have been measured. Focusing efforts in these areas will make the dredging process more efficient and will effectively remove large volumes of sediment and nutrients over a shorter period of time. Three focus areas are identified in Figure 8 where the thickest areas of sediment were measured and should be targeted for sediment removal.

Sediment removed from the targeted areas will increase the water depth and reduce sunlight reaching the bottom of the pond to inhibit growth of aquatic vegetation and algae. Control of aquatic vegetation through dredging will further improve if depths reach the sand/gravel layer which is too infertile to support plant growth. Dredging to greater depths will also help maintain a cooler temperature in Furnace Pond to better support aquatic life. Additional sediment removal will reduce the concentration of phosphorous and other nutrients which contribute to algae growth in the pond.

Costs to dredge sediment from the focused areas of Furnace Pond using a wet hydraulic dredge with an on land staging is $11,500,000.

Andruk Property

Due to the Town's recent acquisition of the Andruk property cranberry bog, the cost of dredging Furnace Pond could be significantly reduced. The location of the cranberry bog is close enough to be easily used for temporary staging or processing of the sediment that is removed from the pond. Use of the cranberry bog would eliminate the need for equipment such as a belt press and sediment tanks to process and prepare the sediment and for transporting. An advantage for staging or processing the sediment in the cranberry bog is the ability to recoup some of the dredging costs by selling the material for beneficial uses.

The cost benefits that the cranberry bog has to offer are not reflected in the recommendations since additional discussions with the Town to determine if the cranberry bog would be a feasible location for use in the dredging process. Dredging costs provided in the recommendations are consistent with those developed for the 2007 Dredging Feasibility Study. Using this site as a temporary staging area to process dredge material would require permitting in compliance with MassDEP and local regulations.

N
W E
S

0 500 1,000 1,500 2,000 Feet

0 0.1 0.2 0.3 0.4 0.5 Miles

Figure 1

Furnace Pond
Hydrologic Investigaton

Study Area

Comprehensive Environmental Inc.

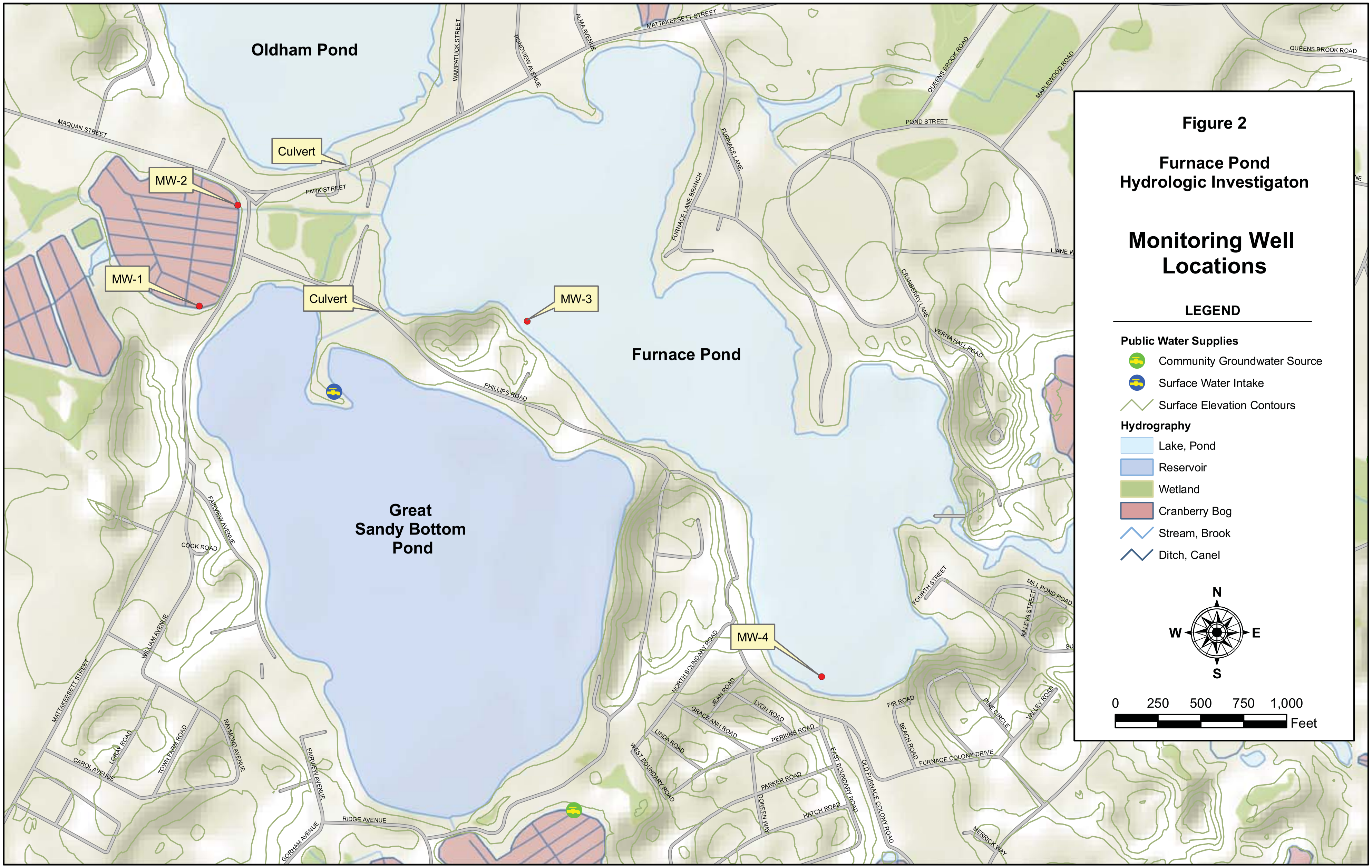


Figure 2
Furnace Pond
Hydrologic Investigaton
Monitoring Well Locations
LEGEND
Public Water Supplies
Community Groundwater Source
Surface Water Intake
Surface Elevation Contours
Hydrography
Lake, Pond
Reservoir
Wetland
Cranberry Bog
Stream, Brook
Ditch, Canel
N
W
E
S
0
250
500
750
1,000
Feet
Oldham Pond
Furnace Pond
Great Sandy Bottom Pond
Culvert
Culvert
MW-1
MW-2
MW-3
MW-4
MAQUAN STREET
PARK STREET
WAMPATUCK STREET
PONDVIEW AVENUE
ALMA AVENUE
MATTAKEESETT STREET
FURNACE LANE
FURNACE LANE BRANCH
QUEENS BROOK ROAD
MAPLEWOOD ROAD
POND STREET
CRANBERRY LANE
VERNA HALL ROAD
PHILLIPS ROAD
FAIRVIEW AVENUE
COOK ROAD
WILLIAM AVENUE
LORAY ROAD
TOWN FARM ROAD
RAYMOND AVENUE
CAROL AVENUE
GORHAM AVENUE
RIDGE AVENUE
NORTH BOUNDARY ROAD
JEAN ROAD
LYON ROAD
GRACE ANN ROAD
PERKINS ROAD
LINDA ROAD
WEST BOUNDARY ROAD
PARKER ROAD
DOREEN WAY
HATCH ROAD
EAST BOUNDARY ROAD
OLD FURNACE COLONY ROAD
FIR ROAD
BEACH ROAD
FURNACE COLONY DRIVE
PINE CIRCLE
VALLEY ROAD
FOURTH STREET
MILL POND ROAD
KALEVA STREET
MERRICK WAY

Figure 3
Monitoring Well Boring Log
MW-3

Report of Field Borings or Test Pits

Comprehensive Environmental
Incorprated
225 Cedar Hill Street
Marlborough, MA 01752

PROJECT:	Furbace Pond Hydrologic Investigation Groundwater Monitoring Wells Pembroke, MA 02359	BORING/TP: 1	Page 1 of 1
		LOCATION:	MW-3 Front of Holman house
		DATE:	SCALE: 1 inc = 0.5"

ELEV	Depth	Symbol	Description of Materials	BPF	WL	Remarks
0	0	WS	Water Surface			
	4	MH	Inorganic Silt Sediment / Mud			
	7	SM	Silty Sand Sand-Silt Mix	6		
	9	SW	Well Graded Sand Gravelly Sand w/ little/no fines	18		
	15			10		
	20			18		
	25			12		
	30			36		
	35					
	40					

Figure 4
Monitoring Well Boring Log
MW-4

Report of Field Borings or Test Pits

Comprehensive Environmental
Incorprated
225 Cedar Hill Street
Marlborough, MA 01752

PROJECT:	Furbace Pond Hydrologic Investigation Groundwater Monitoring Wells Pembroke, MA 02359	BORING/TP: 1	Page 1 of 1
		LOCATION:	MW-4 Southwest of beach
		DATE:	SCALE: 1 inc = 0.5"

ELEV	Depth	Symbol	Description of Materials	BPF	WL	Remarks
0	0	WS	Water Surface			
	5	OH	Organic Silt/Clay Mud / Organic			
		SM	Silty Sand Sand-Silt Mix	15		
	10	SW	Well Graded Sand Gravelly Sand w/ little/no fines	20		
	15			23		
	20	SM	Silty Sand Sand-Silt Mix Very soft, grey in color	3		
	25		Sand-Silt Mix Light brown in color	20		
	30			18		
	35					
	40					


Figure 5
Furnace Pond
Hydrologic Investigaton
Surficial Geology
LEGEND
Soil Characteristics
Boulder
Gravelly Sandy Loam
Sandy Complex
Sandy Boulder Complex
Sand
Sandy Loam
Loamy Sand
Muck
Gravel
Urban Complex
Water
N
W
E
S
0
250
500
750
1,000
Feet
Oldham Pond
Furnace Pond
Great
Sandy Bottom
Pond
MW-1
MW-2
MW-3
MW-4
MAQUAN STREET
TAYLOR POINT ROAD
PARK STREET
WAMPATUCK STREET
PONDVIEW AVENUE
ALMA AVENUE
MATTAKEESETT STREET
FURNACE LANE
FURNACE LANE BRANCH
POND STREET
QUEENS BROOK ROAD
CRANBERRY LANE
VERNA HALL ROAD
PHILLIPS ROAD
RIDGE AVENUE
FOURTH STREET
FAIRVIEW AVENUE
COOK ROAD
WILLIAM AVENUE
LORAY ROAD
TOWN FARM ROAD
RAYMOND AVENUE
CAROL AVENUE
NORTH BOUNDARY ROAD
JEAN ROAD
LYON ROAD
GRACEANN ROAD
PERKINS ROAD
LINDA ROAD
WEST BOUNDARY ROAD
PARKER ROAD
DOREEN WAY
HATCH ROAD
EAST BOUNDARY ROAD
OLD FURNACE COLONY ROAD
FIR ROAD
BEACH ROAD
FURNACE COLONY DRIVE
PINE CIRCLE

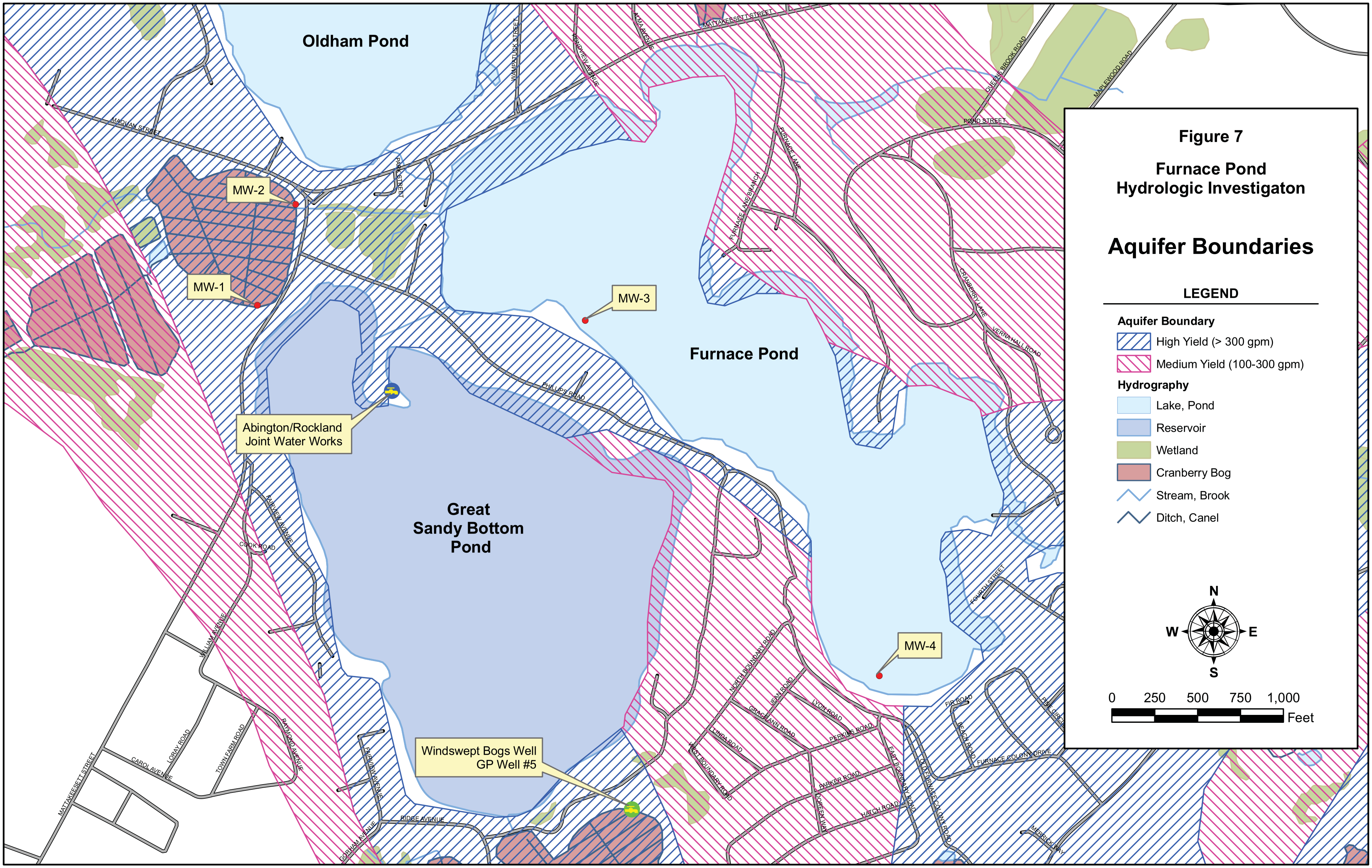


Figure 7
Furnace Pond
Hydrologic Investigaton
Aquifer Boundaries
LEGEND
Aquifer Boundary
High Yield (> 300 gpm)
Medium Yield (100-300 gpm)
Hydrography
Lake, Pond
Reservoir
Wetland
Cranberry Bog
Stream, Brook
Ditch, Canel
N
W
E
S
0
250
500
750
1,000
Feet
Oldham Pond
Furnace Pond
Great
Sandy Bottom
Pond
MW-1
MW-2
MW-3
MW-4
Abington/Rockland
Joint Water Works
Windswept Bogs Well
GP Well #5
MAQUAN STREET
PARK STREET
WAMPATUCK STREET
PONDVIEW AVENUE
ALMA AVENUE
MATTAKEESETT STREET
FURNACE LANE
FURNACE LANE BRANCH
CRANBERRY LANE
VERNA HALL ROAD
POND STREET
QUEENS BROOK ROAD
MAPLEWOOD ROAD
PHILLIPS ROAD
FAIRVIEW AVENUE
COOK ROAD
WILLIAM AVENUE
LORAY ROAD
TOWN FARM ROAD
CAROL AVENUE
RAYMOND AVENUE
RIDGE AVENUE
GORHAM AVENUE
NORTH BOUNDARY ROAD
JEAN ROAD
LYON ROAD
GRASSLAND ROAD
LINDA ROAD
WEST BOUNDARY ROAD
PERKINS ROAD
PARKER ROAD
DOREEN WAY
HATCH ROAD
EAST BOUNDARY ROAD
OLD FURNACE COLONY ROAD
FURNACE COLONY DRIVE
BEACH ROAD
FIR ROAD
FOURTH STREET
MERRICK WAY

Figure 8
Furnace Pond
Hydrologic Investigaton
Limited Dredge Areas
LEGEND
Limited Dredge Areas
Sediment Thickness
8'-10'
11'-14'
15'-16'
Hydrography
Lake, Pond
Reservoir
Wetland
Cranberry Bog
Stream, Brook
Ditch, Canel
N
W
E
S
0
250
500
750
1,000
Feet
Oldham Pond
Furnace Pond
Great Sandy Bottom Pond
Culvert
Culvert
MW-1
MW-2
MW-3
MW-4
MAQUAN STREET
MATTAKEESETT STREET
FURNACE LANE BRANCH
FURNACE LANE
QUEENS BROOK ROAD
CRANBERRY LANE
PHILLIPS ROAD
RIDGE AVENUE
FAIRVIEW AVENUE
WILLIAM AVENUE
LORAY ROAD
TOWN FARM ROAD
RAYMOND AVENUE
CAROL AVENUE
NORTH BOUNDARY ROAD
WEST BOUNDARY ROAD
JEAN ROAD
LINDA ROAD
PERKINS ROAD
PARKER ROAD
HATCH ROAD
EAST BOUNDARY ROAD
OLD FURNACE COLONY ROAD
FURNACE COLONY DRIVE
FIR ROAD
MERRICK WAY