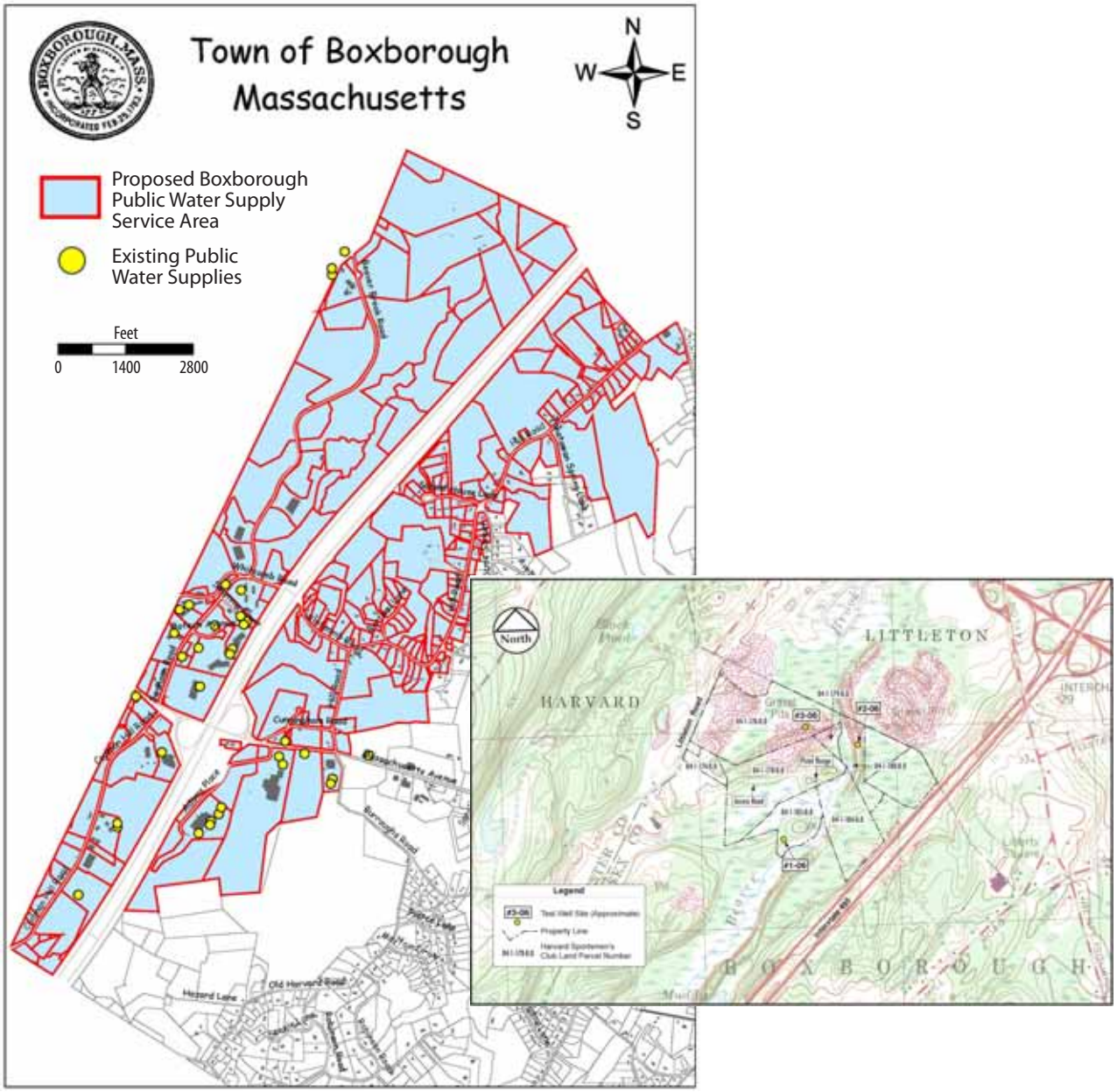
Town of Boxborough, Massachusetts

Water Distribution System Feasibility Study

April 2008



Final Report

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April 25, 2008

Mr. Michael Willis, Chair
Water Resources Committee
Town of Boxborough
Town Hall
29 Middle Road
Boxborough, Massachusetts 01719-1402

Subject: Final Report - Water Distribution System Feasibility Study
Town of Boxborough, Massachusetts

Dear Mr. Willis:

In fulfillment of our contract dated August 15, 2007, Camp Dresser & McKee Inc. (CDM) is pleased to present to the Town of Boxborough this *Final Report on the Water Distribution System Feasibility Study*. Working with the Town's Water Resources Committee, our efforts have focused on identifying the infrastructure needs of an initial water system service area that could over the long-term lead to a municipal water system extending to many areas of Boxborough.

Specifically, the report presents three conceptual alternatives for the development of a new water distribution system to serve the Town's initial proposed service area, located in the western portion of Boxborough. This area was selected for the initial phasing of a water system given the many documented groundwater quality issues impacting private drinking water wells serving residents and businesses in this area. The three alternatives presented in the report include conceptual facility layouts for developing a water distribution system for this proposed service area taking into consideration water demands, infrastructure components and project cost estimates. All of the alternatives assume development of a 1.0 million gallons per day groundwater supply and water treatment plant at the Harvard Sportsmen's Club.

If the Town chooses to pursue a municipal water system for this initial proposed service area, CDM recommends that the Town consider Alternative #2A, which assumes a regional approach with the Town of Littleton. This approach allows shared water supply and hydraulic capacity to meet the needs of the service area. Management and operation of the

system would be performed by Littleton. Alternative #2A would proceed in two phases. Phase I would serve a low service area in Boxborough west of I-495 and along Massachusetts Avenue east to Hill Road and north to Whitcomb Road. The advantages of this approach are that it includes the primary area of current water quality concerns, allows shared well capacity with Littleton through an interconnection at Monarch Drive, provides system redundancy and reliability via this interconnection, and allows use of Littleton's Oak Hill Tank to meet water distribution storage requirements.

At a later date, the Town could proceed with construction of the Phase II high service area on Hill Road, inclusive of a booster pumping station and storage tank. Implementing Phase I first will allow the actual water demand requirements to be determined, such that an appropriately sized water storage tank could be designed for the Phase II high service system.

There are a number of steps to be undertaken by the Town of Boxborough in pursuit of a municipal water system. To further the consideration of a new municipal water system, CDM recommends the following actions:

- meet with the Massachusetts Department of Environmental Protection (MassDEP) to present the results of this report and discuss approaches to permitting of a municipal well and establishment of a municipal water system;
- continue coordination with Littleton regarding the potential for water system regionalization to ensure that goals are mutually compatible and achievable;
- initiate discussions with Cisco Systems regarding the availability of potential infrastructure and water supply for incorporation into a new municipal water distribution system;
- initiate discussions with the Harvard Sportsmen's Club regarding protection of the well site, future land acquisition, and potential facility layout;
- perform outreach to the businesses and residents of Boxborough as a means of educating the public with regard to a municipal water system and to garner public support;
- consider groundwater supply exploration of additional sites throughout Town, as indicated in the *Final Report – Water Resources Analysis Study* (CDM, December 2002), for the purpose of preserving and protecting future supply sources;

- continue considering a phased approach to implementation of a new municipal water system, based on areas of need in Town (i.e., areas of concern relative to groundwater quality and/or quantity); and,

- move forward in appropriating $250,000 by July 1, 2008, to take advantage of the Town's eligibility for a low interest loan from the 2008 Drinking Water State Revolving Fund to conduct planning aspects of the project such as groundwater supply testing and further analysis of distribution system phasing.

With the appropriation of funding, the Town will be positioned to move forward with the planning aspects for a new well and distribution system. Primary to this process is establishment of a municipal supply through additional test well exploration. This might include initiating the MassDEP New Source Approval Process for the site(s) at the Harvard Sportsmen's Club or other preferred sites in Town determined to be favorable for groundwater supply testing. It should be recognized that production well yield and water quality are critical to the sizing of treatment and distribution system hydraulic components.

We appreciate the opportunity to have developed this conceptual plan for a new water system in the Town of Boxborough. At your convenience, we are available to meet and further discuss the report recommendations. We look forward to assisting the Water Resources Committee and other officials in Boxborough, as you continue to assess the water supply needs of the community.

Very truly yours,

Andrew B. Miller, P.E.
Associate
Camp Dresser & McKee Inc.

cc: Selina Shaw, Town Administrator
Savas Danos, Littleton Electric, Light & Water Department
William Pauk, CDM

Tables

Figures

Section 1
Introduction

1.1 Background

Over the last several years, the Town of Boxborough has been exploring the possibility of developing a municipal public water system. Currently, residences, businesses and institutional users in Boxborough are served by individual private wells. There are some exceptions, as a few residential developments bordering Acton and Littleton are served by the Acton Water District and the Town of Littleton, respectively. Many of the private wells in Boxborough serving larger users such as apartment complexes, condominium developments, municipal and institutional facilities, and commercial/business entities are in fact Public Water Systems (PWS), as regulated by the Massachusetts Department of Environmental Protection (MassDEP) Drinking Water Regulations (310 CMR 22.00).

Given the dependence on individual private wells, there has been concern regarding the maintenance of high groundwater quality and quantity for residents and the Public Water Systems in town. Specifically, there have been several known groundwater quality issues which have affected individual wells. These have included high concentrations of sodium (i.e., salt), the gasoline constituent methyl tertiary butyl ether (MTBE), perchlorate, and radiological contaminants. In addition to these contaminants, there are also the more typical groundwater quality issues such as high levels of iron and manganese, and water hardness, which are not necessarily health-based concerns, but impact the aesthetics of drinking water (i.e., staining of fixtures, buildup of scale, etc.). Many of the PWS provide treatment to address the specific contaminants of concern at their source, in addition to providing lead and copper control, softening to reduce hardness, iron and/or manganese removal, and disinfection. Residential wells are more likely to have filters for iron/manganese removal and softeners to reduce hardness.

In addition to the water quality concerns, the Town wishes to ensure adequate fire protection for the purpose of public safety. Currently, water for fire protection in Boxborough is provided by a series of fire ponds and underground cisterns. There are 56 such sources available in Boxborough. Approximately 40 of the locations are cisterns which are owned, operated and maintained by the Town. The remaining fire protection sources (approximately 16) are fire ponds owned by private property owners.

To help ensure high quality drinking water and provide fire protection, the Town has recognized the need to manage water supply at the municipal level. In an effort to further these goals, the Town established a Water Resources Committee (the Committee). The first objective of the Committee became the identification, protection and preservation of the Town's groundwater supply sources in areas of town where potential sources of supply remain available. To accomplish this objective, the Town appropriated funds in 2000 for a study of the town's water resources. In 2002, Camp Dresser & McKee Inc. (CDM) in association with Boart Longyear Company (formerly

D.L. Maher) completed the *Final Report – Water Resources Analysis Study* (CDM, December 2002). The Water Resources Analysis Study summarized existing hydrogeologic data for the Town, provided Geographic Information Systems (GIS) mapping of water resources, recommended sites for municipal test well exploration in overburden deposits (i.e., sand and gravel) and bedrock, and developed estimates of town-wide water supply demands based upon expected build-out.

As a follow-on to that study, additional funds were appropriated for implementation of the recommendations regarding municipal test well exploration. CDM, in association with Boart Longyear, performed test well exploration during 2006 at several locations in town[1,2]. More recently, bedrock well testing has been conducted at the town owned Steele Farm Site. To date, the most favorable results were found from overburden drilling on land owned by the Harvard Sportsmen's Club, located in the northwest corner of town. Specifically, two sites at which 2.5-inch diameter test wells were installed (Sites #1-06 and #3-06) were recommended for further exploration (see Figure 1-1). Based on the preliminary testing conducted, it was estimated that a single gravel-packed production well at Site #1-06 could yield from 500-700 gallons per minute or more. Site #3-06 could potentially provide a similar yield if developed as a wellfield consisting of three or more wells. CDM recommended Site #1-06 as being preferable, given its greater saturated thickness of permeable soils and proximity to multiple recharge sources. Further testing, including an extended-duration pumping test in accordance with the MassDEP New Source Approval Process, is necessary to confirm these yield estimates. If both sites were to be developed, some reduction in total safe yield would be expected due to well drawdown interference and limited recharge area.

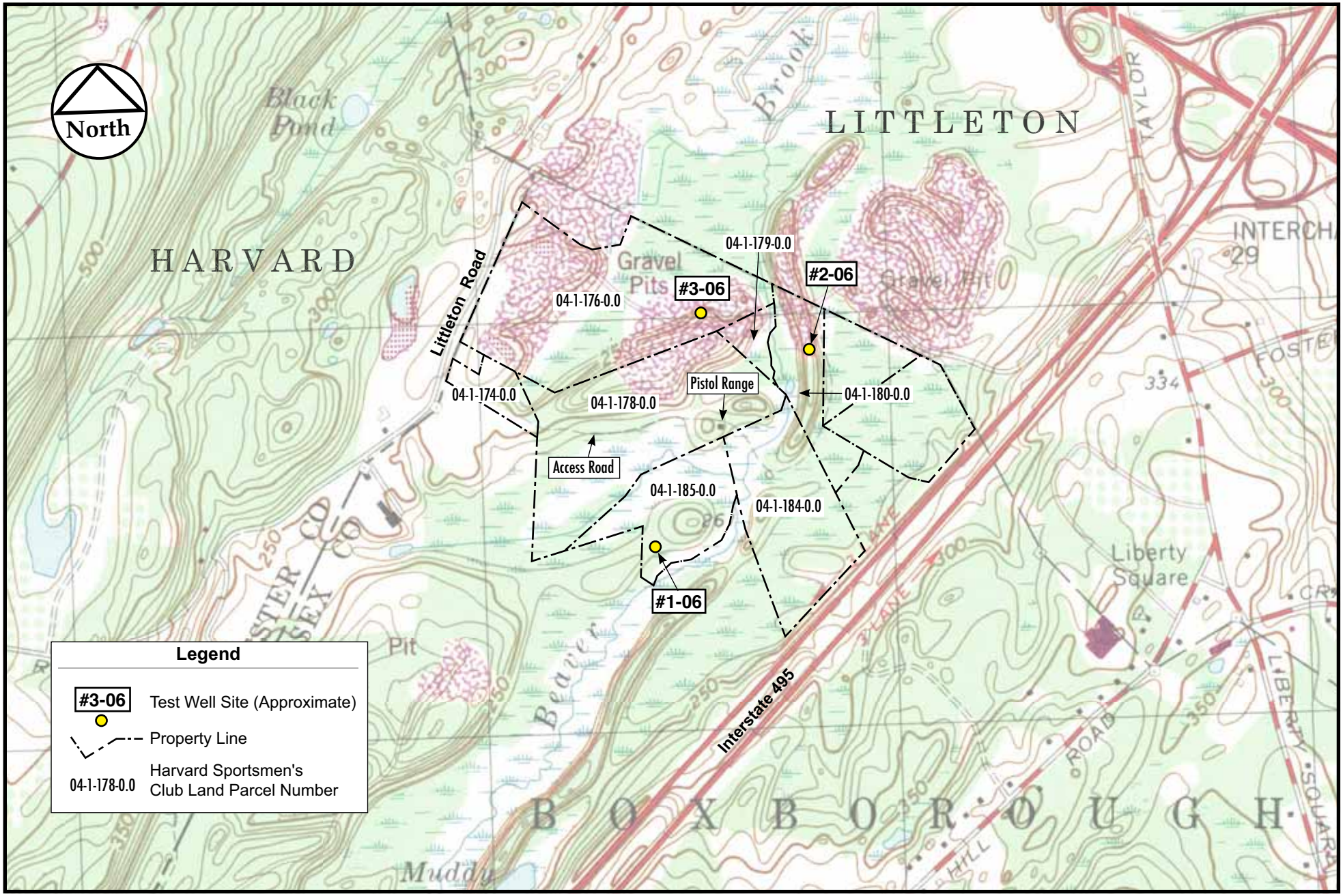
With the identification of a potentially viable municipal groundwater supply source at the Harvard Sportsmen's Club property, the Town recognized the need to move forward with an engineering assessment to determine the feasibility and cost of establishing a municipal water supply and distribution system.

1.2 Project Objectives

The Town has expressed interest in developing a municipal groundwater supply on the Harvard Sportsmen's Club (HSC) property. Development of two production wells would provide redundancy for the short-term and potentially allow for increased supply capability over the longer term. Given the well site's close proximity to the Town of Littleton's water distribution system (approximately 2,700 feet), a logical consideration is an interconnection with Littleton to provide additional redundancy and/or shared capacity of the new supply.

[1] CDM, September 15, 2006. Letter Report: Summary of 2.5-inch Test Well Installations in Unconsolidated Sand & Gravel Deposits, Groundwater Exploration Program, Town of Boxborough, Massachusetts

[2] CDM, November 16, 2006. Letter Report: Summary of Final Bedrock Test Well Installations at Wolf Swamp, Groundwater Exploration Program: Town of Boxborough, Massachusetts.



Town of Boxborough, Massachusetts
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Figure 1-1
2.5-Inch Test Well Installations-Harvard Sportsmen's Club (HSC)

CDM

The goals of this feasibility study are therefore to identify on a preliminary basis the infrastructure and capital costs of a municipal water system in Boxborough that may be self-sufficient or connected regionally with Littleton, based on the development of a municipal groundwater supply on the HSC property. Recognizing that implementation of a municipal water system would best be phased over time, this feasibility study has focused on a proposed initial service area (further described in Section 1.2.1) selected by the Town based on need. Specifically, the proposed service area, which is located in the western portion of town along I-495, is an area where significant groundwater quality issues have adversely impacted the drinking water of residents and businesses. Therefore, the primary objective of this study has been to assess the feasibility of providing a municipal water supply and distribution system to this area of town.

Added success factors for municipal water system development in Boxborough include:

- Providing adequate supply capacity to meet water demands of the selected service area in Boxborough;
- Ensuring reliability in the event of any unexpected shutdown of the supply;
- Providing adequate hydraulic capacity and controls to meet peak water demands and system pressures;
- Providing adequate storage for fire protection of the service area;
- Providing properly treated water that meets Safe Drinking Water Act (SDWA) requirements; and,
- Providing protection of the Wellhead Protection Area, referred to as Zone II in Massachusetts.

To meet these objectives, CDM has defined and evaluated three conceptual options for development of a distribution system in Boxborough to serve the initial proposed service area. For each option, capital costs have been estimated for project planning purposes. It should be recognized that for this feasibility study, the options presented are conceptual plans for the Town's consideration. Detailed engineering analysis and facility planning would be required to further define design criteria and project costs. In addition, groundwater testing at the HSC site must still be conducted to verify the preliminary estimates of site yield.

1.2.1 Proposed Service Area in Boxborough

The Town of Boxborough has identified an area in the western portion of town, along I-495 that would be served by this initial phase of the proposed water distribution system. As shown on Figure 1-2, the proposed service area extends west from Hill Road to the Harvard town line and is bordered by the Town of Littleton to the north, Harvard to the east, and Stow to the south. This area was selected due to the known significant groundwater quality issues (i.e., salt, MTBE, perchlorate, etc.) impacting residential and business drinking water wells along I-495.

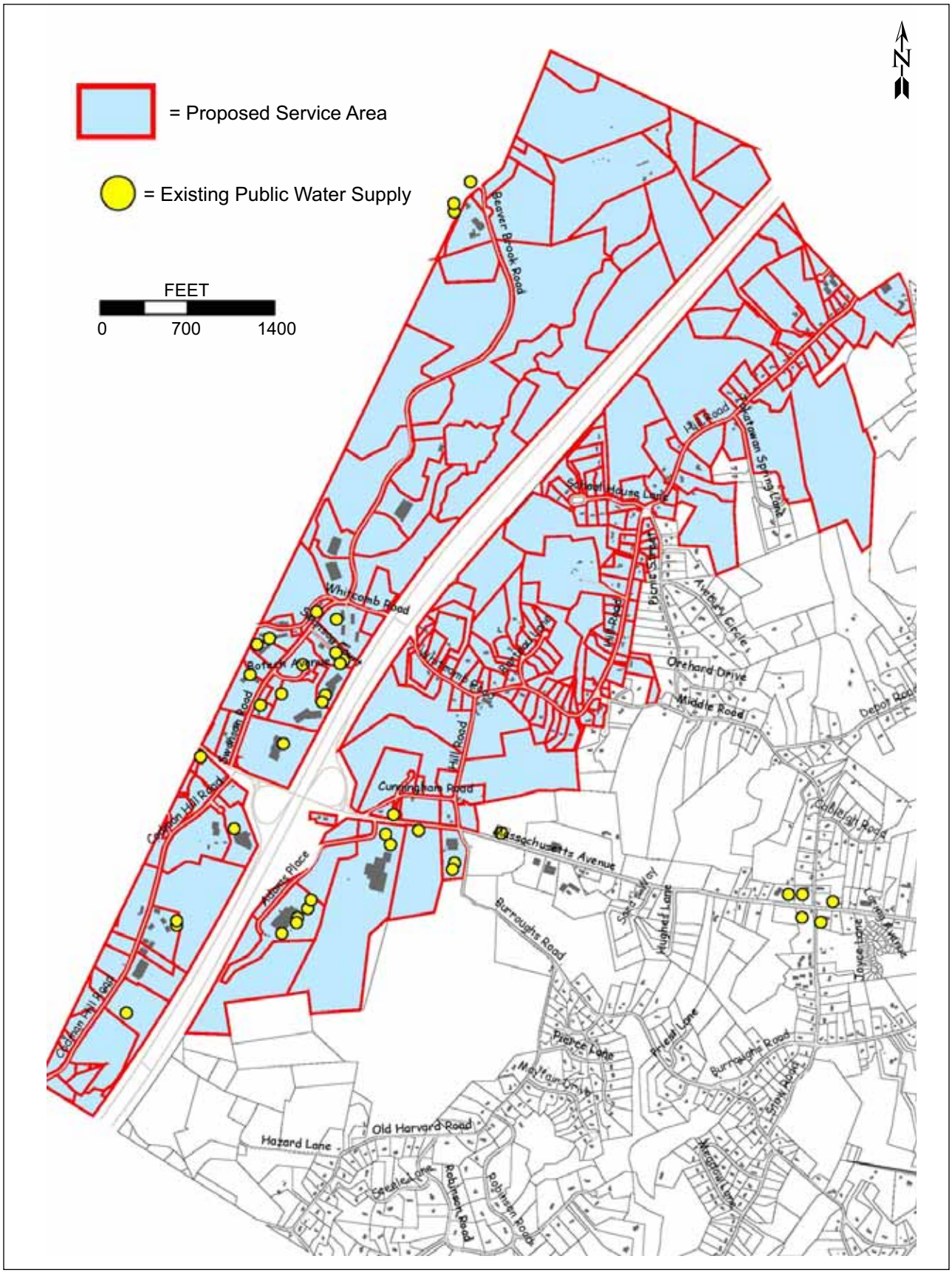

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Figure 1-2
Proposed Distribution System Service Area

CDM

The proposed service area includes the main "business district" on the western side of I-495 and residential neighborhoods along Hill Road. The "business district" contains some large users of water such as Cisco Systems and Holiday Inn, as well as several large condominium complexes.

The Town's selection of this Service Area for the initial phase of the water distribution system has several benefits:

- The Service Area would offer safe and reliable drinking water to residents and businesses which have experienced groundwater contamination issues and the resulting impacts to their drinking water quality.
- The Service Area includes a significant number of PWS, which would presumably connect to the distribution system, thereby, eliminating the need for individual supply management and treatment.
- The Service Area is in close proximity to the favorable test well sites at the HSC, thereby, minimizing transmission main construction.
- The Service Area borders the Town of Littleton, which allows for ease of interconnection and supply redundancy.

1.2.2 Regional Considerations with Littleton

The Town of Littleton has indicated that although it does not have available water supply capacity to serve Boxborough, Littleton does have interest in any supply capacity that Boxborough could provide to Littleton. Furthermore, Littleton has expressed interest in managing and operating a water distribution system in Boxborough. This could include an interconnected system, with hydraulic controls provided by Littleton's water distribution system. This approach would also address low pressure concerns in Littleton at the Boxborough townline near Hill Road. As discussed with Littleton, this regional approach could take several forms:

- One option would be for Boxborough to develop its own independent system, with an interconnection to Littleton for supply redundancy in an emergency. Under this scenario, water system management and operations could be conducted by Littleton or a private water supply company hired by Boxborough, or the Town of Boxborough itself.
- A second option would be for Boxborough to become an extension of the Littleton water system, with shared hydraulic controls and management/operations by Littleton.

1.3 Project Approach

CDM's approach to this study recognizes the Town's objective to assess the feasibility of a new water distribution system for the proposed initial Service Area based upon financial viability. Determining the financial viability has been dependent upon

obtaining an understanding of the water demand requirements, hydraulic components, infrastructure needs, operational controls, and capital costs. Key components of the study have included:

- ***Estimating Water Demands of the Service Area:*** Working with the Town Planner, Town Clerk, and the Board of Health, CDM has developed water demand estimates for residential and business uses within the Service Area. In addition, fire flow needs have been estimated in coordination with Fire Department personnel, and is based upon Insurance Services Offices (ISO) guidelines.

- ***Conceptual Understanding of Hydraulic Components and Operations:*** An understanding of the hydraulic components needed for successful operation of the water distribution system has been critical for this facility planning effort. On a preliminary basis, CDM has identified conceptually the approximate size and location of key hydraulic components such as pump stations, interconnections, storage tanks, pressure zones, transmission mains and water mains. The objective has been to ensure that these facilities provide adequate service pressure for the water demand conditions anticipated, based on USGS topographic information.

- ***Phasing of the Distribution System:*** Alternatives have been developed for phasing of distribution system implementation. An advantage of phasing is that capital costs may be distributed over a longer time period. The alternatives for phasing have been developed in consideration of the regionalization options with Littleton; therefore, institutional issues will also have some bearing on selection of an alternative. Phasing is also based on the hydraulic requirements for the two pressure zones within the proposed service area.

- ***Infrastructure Needs and Capital Costs:*** For each conceptual alternative presented, infrastructure needs have been identified along with an associated capital cost estimate for planning purposes. This includes not only all hydraulic components, but also production wells and water treatment facilities.

The result is a presentation of three alternatives for development of a water distribution system for the initial Service Area in Boxborough. Other considerations addressed in the report include alternative water storage tank sizing, should the Town wish to expand the water distribution system in the future. In addition, a meeting was conducted with Cisco Systems (Cisco) to determine the viability of incorporating existing Cisco water infrastructure into the distribution system. These are concepts for further discussion and consideration in the future, as the Town moves forward with facility planning efforts.

1.4 Report Organization

This Water Distribution System Feasibility Study Report is divided into five sections; those sections following this introduction are:

- ***Section 2 – Water Supply, Demand, and Fire Flow Needs:*** Evaluates the proposed area to be served by the water distribution system including water supply sources, population trends and projections, water demand projections and an assessment of fire protection volume.

- ***Section 3 – Water Supply and Distribution System Facilities:*** Discussion of water supply and distribution facilities required for a water distribution system and the methodologies for preliminary sizing of these facilities.

- ***Section 4 – Distribution System Alternatives and Capital Costs for Implementation:*** Presentation of the distribution system alternatives, or scenarios, with the development of estimated planning level capital costs.

- ***Section 5 – Conclusions and Recommendations:*** Presentation of conclusions from the engineering analysis and recommended approach to implementation. Based upon the MassDEP New Source Approval Process, the next steps for planning a new water distribution system are presented over both the short-term and long-term.

Section 2
Water Supply, Demand, and Fire Flow Needs

2.1 Introduction

Prior to development of a conceptual water distribution system layout, it was necessary to identify and determine the quantity and location of future supply and demand points throughout the proposed service area, within the Town of Boxborough. Along with fire flow demand estimates, described later in this Section, the supply source locations and expected demands are the driving factors behind the sizing and layout of proposed water distribution system facilities.

2.2 Water Supply Sources

In order to design a distribution system around the most likely future source(s) of supply, it was appropriate to first consider all possible sources. These potential sources include the development of groundwater supply wells in the Town, along with the sharing of water from adjacent communities.

2.2.1 Groundwater Supply

Based on test well explorations conducted to date, a potential municipal groundwater supply site has been identified at property owned by the Harvard Sportsmen's Club (HSC) in the northwest corner of Town. The test well program and potential site yield is documented in CDM's letter report of September 15, 2006 (Appendix A).

It has been assumed that the proposed Service Area would be served by a municipal production well constructed at Site #1 (see Figure 1-1) on the HSC property. Based on preliminary testing, the expected yield of this well is 500-700 gpm. An extended-duration pumping test would be required in accordance with the MassDEP New Source Approval Process to confirm both the site yield and water quality. To ensure water supply redundancy and provide backup supply during well maintenance, a second well would be required in the same vicinity, with a similar yield.

Establishment of a municipal production wellfield would also require land acquisition around each well. MassDEP Drinking Water Regulations (310 CMR 22.00) require that the water supplier own a 400 foot protective radius around each production well. This area is referred to in Massachusetts as Zone I.

2.2.2 Adjacent Community Supply

The Town of Littleton, which borders Boxborough to the north, has expressed interest in forming a regional water system that will enable the Towns to share water supplies and system pressures produced by elevated storage tanks (see Littleton correspondence in Appendix B). The Littleton distribution system could connect to the proposed Boxborough distribution system via water mains on Monarch Drive and

Hill Road. Interconnections at these points would facilitate the exchange of water and system pressures as described in Section 3 of this report.

The General Manger of the Littleton Electric Light and Water Department has noted that Littleton does not have available additional capacity by which to serve Boxborough. However, an interconnection with Littleton does offer the opportunity for supply redundancy in the event of a water supply emergency and/or shutdown of Boxborough's wellfield.

2.3 Population Trends and Projections

Development of water supply demand estimates for the proposed service area first requires an estimate of population.

2.3.1 Population Trends

Historic and future population trends are generally used to predict future water consumption in a community. Table 2-1 shows the historic census population in Boxborough from 1980.

Table 2-1
Population Census Counts - Townwide

Year	*Federal Census Population*	*Percentage Increase Over Previous Census Year*
1980	2,995	----
1990	3,229	+ 7.8
2000	4,695	+ 45.4

The population of the Town rapidly increased between 1990 and 2000 due in part to its desirable location along I-495, an area with significant population, business, and economic growth over this period.

To estimate the future water supply needs of the Town, population projections and business development/expansion were reviewed from independent sources and meetings with Town planning officials.

In July 2003, the Massachusetts Institute for Social and Economic Research (MISER) released the latest population projections for Massachusetts and its counties, cities and towns. MISER prepared population projections based on the 2000 federal census data and Massachusetts births, deaths and institutional population data. The MISER population projections for the entire Town of Boxborough are listed below in Table 2-2.

Table 2-2
Townwide Population Projections (MISER, 2003)

Year	Projected Population	Percent Change
2000	4,695	--
2010	5,358	+14%
2020	5,707	+7%

Although Table 2-2 summarizes the current population trends for the entire Town of Boxborough, it is necessary that this feasibility study focus on the proposed water distribution system service area, described earlier in Section 1.2.1 (see Figure 1-2).

2.3.2 Population of Proposed Service Area

To determine the current population of the proposed service area, the Boxborough Town Clerk produced a report indicating the number of residents living on streets that are included within the service area. The current single-family home population is shown in Table 2-3.

The number of people residing in condominiums and apartment complexes was determined by evaluating occupancy records of the condominium and apartments located within the service area. These records were also provided to CDM by the Boxborough Town Clerk. The population of people living in condominiums or apartments is shown in Table 2-3.

Table 2-3
Current Population in Proposed Service Area[a]

Residency Type	Current Population
Single-Family Homes	396
Condominiums/Apartments	712
Subtotal	**1,108**
Contingency[b]	92
Total	**1,200**

[a] Based on the Town of Boxborough 2007 Census

[b] (8.5%) Accounts for residents who did not answer the census

In addition to the current population of the proposed service area, it is also necessary to consider residential developments which have been proposed and/or permitted, but not yet constructed. Information on proposed and permitted residential development was gathered from the Town Planner. Residential development is considered to include single-family and condominium/apartment dwellings. For this exercise, the number of people per condominium or apartment was based on an average per unit of the current population in such units.

There are currently two residential complexes permitted or proposed within the service area. There are also two additional houses and two senior housing complexes proposed. An estimate of population for these proposed or permitted dwelling units is shown in Table 2-4.

Another source of population comes from condominiums and apartments that are currently vacant. As reported by the Town Clerk, there are currently 89 vacant units in the proposed service area. The estimated population of these currently vacant units is also shown in Table 2-4.

Table 2-4
Population Estimate for
Proposed, Permitted and Vacant Dwellings
within the Proposed Service Area

Dwelling Type	*Estimated Population for Proposed, Permitted and Vacant Dwellings*
Single-Family Homes[a]	7
Condominium/Apartments[b]	560
Senior Housing[c]	30
Vacant Units[d]	164
Total	**761**

[a] Includes two single-family homes proposed as part of the Gutierrez project off of Hill Road.

[b] Includes 449 people for the Gutierrez apartment complex and 111 people for the Whitcomb Ridge apartments.

[c] Two proposed senior housing centers on Hill Road.

[d] Vacant units refer to uninhabited units based on the 2007 Census.

For the purpose of this study, CDM recommends planning for water demands based on existing population of the proposed service area plus those anticipated from vacant, permitted and planned dwelling units. The design population is anticipated to be the current population (1,200), plus the population of all permitted and proposed dwelling units (761). Based on Tables 2-3 and 2-4, the corresponding projected population for the proposed service area is estimated to be 1,961, as shown in Table 2-5. This represents about 37 percent of Boxborough's population townwide.

Table 2-5
Population Estimate of Proposed Service Area

Description of Residences	*Population Estimate*
Current Residences	1,200
Proposed Dwellings Permitted and Vacant	761
Total	**1,961**

2.4 Water Demand Estimates

Water demand represents the total water usage required within a distribution system, inclusive of residential, commercial, industrial, agricultural, and institutional needs. For any new system, allowances must also be made for unmetered uses such as system operations and maintenance (i.e., flushing), unexpected leakage, fire fighting needs, construction, etc. The following sub-sections describe the methodology in this study for the estimation of water demand in the proposed service area.

2.4.1 Residential Water Demand of Service Area

Trends in historical water use are generally used to determine future consumption. Due to the limited amount of data from the many private wells which service homes in Boxborough, estimates were developed based on conservative, planning level values. The assumptions used in developing the residential water demand estimate were as follows:

- Service Area Design Population of 1,961
- Per Capita Consumption of 65 – 80 gallons per day for Residential Demand

Using the water use assumptions listed above, the current residential water demand of the proposed service area has been estimated to be 127,500 to 156,900 gallons per day (gpd).

The 65 residential gallons per capita per day (rgpcd) is adopted from the Massachusetts Water Resources Commission (WRC) Water Conservation Standards (2006). This standard will be applied during future permitting of a new water supply under the Water Management Act (WMA). From an engineering design standpoint, the 65 rgpcd may be considered an operational goal to achieve water conservation, but not a standard on which to base the design of a new water distribution system. Therefore, CDM recommends that for design considerations, residential demand be based on 80 rgpcd. The resulting residential demand estimate for the Service Area is then 156,900 gpd (see Table 2-6) or 0.16 million gallons per day (mgd).

Table 2-6
Residential Water Demand Estimate

Number of Residents	1,961
Per Capita Consumption	80 rgpcd
Residential Water Demand	156,900 gpd

rgpcd: residential gallons per capita per day
gpd: gallons per day

As a check of this estimate, we also used one of two methods provided in the MassDEP Guidelines and Policies for Public Water Systems (2001). This method requires that the total number of service connections (i.e., 910 dwelling units) be multiplied by 1.6 to estimate the residential population, then be multiplied by a water

use factor of 100 rgpcd. Using this method, the resulting residential demand in the proposed Service Area is 145,600 gpd. This result is consistent with the CDM method above. For planning purposes relative to the proposed water distribution system, the more conservative estimate of 156,900 gpd is recommended by CDM as the residential water demand for this study.

This residential water demand estimate includes all existing, permitted, and proposed dwelling units within the proposed service area, which is sufficient for the purpose of this planning level feasibility study. However, a future facilities plan should include a "build-out" analysis to project the future population and water demands over a 20 to 30 year planning period. Such a comprehensive analysis would expand upon the current projections and project demands based on development of all potentially developable parcels within the service area.

2.4.2 Commercial Water Demand in Service Area

The water demand for a commercial building may be estimated based on the square footage of the building itself. Therefore, it has been necessary to determine the total square footage currently used as commercial space within the proposed service area, as well as the square footage of any proposed and/or permitted business developments. The assumptions used in generating a commercial water demand estimate were as follows:

- Commercial Demand of 75 gallons per day per 1,000 square feet, based on the Metropolitan Area Planning Council (MAPC) standard.

Existing Commercial Space and Water Demand

The amount of existing commercial square footage was obtained by using the Town's Geographic Information System (GIS) as well as site visits to identify commercial properties. The total square footage of existing commercial space in the proposed service area (excluding Holiday Inn) is approximately 1,271,100 square feet.

Using the Metropolitan Area Planning Council's (MAPC) standard of 75 gpd/ 1,000 square feet, an average day demand was calculated for all existing commercial properties in the proposed service area. That average day demand is 95,300 gpd; or approximately 0.1 mgd.

Holiday Inn Water Demand

The Holiday Inn is a large hotel with 143 rooms, 30,000 square feet of meeting/conference space, a swimming pool, and a restaurant with as many as 80 seats. Thus, the water demand for this particular commercial enterprise is far greater than the other commercial businesses evaluated within the proposed service area. Due to the significant water demand generated by the Holiday Inn, it was decided to evaluate the demand separately from the other commercial buildings.

The demand for Holiday Inn was calculated using Title V Wastewater Usage Guidelines based on usage rates per room, restaurant seating, etc. Table 2-7 shows how Title V estimates were used to estimate the water demand.

Table 2-7
Holiday Inn – Water Demand Estimate

Type of Establishment	Usage Rate*	Demand (gpd)
143 Rooms	110 gpd/room	15,730
80 Restaurant Seats	35 gpd/seat	2,800
30,000 sq/ft Meeting Space	75 gpd/1,000 sq/ft	2,250
200 Person Swimming Pool	10 gpd/person	2,000
Total	**-----**	**22,780**

* From the MassDEP System Sewage Flow Design Criteria

Permitted Commercial Space and Water Demand

Water demand estimates have also included commercial developments permitted and approved by the Town of Boxborough. Information was provided by the Town Planner regarding these permitted commercial/business developments within the service area, which have not yet been constructed. These include:

- One new office building permitted in the service area, off of Codman Hill Road. The building is permitted for up to 100,000 square feet of office space. Using the commercial demand estimate of 75 gpd/1,000 square feet, the new commercial space could demand up to 7,500 gpd of water.

- Four additional buildings were permitted as part of the original office park plan for Cisco Systems, and have not yet been constructed. The square footage of the four remaining buildings is 467,894 square feet, with a potential demand of 35,100 gpd.

In addition, Cisco Systems has in the past proposed to build three additional office buildings with up to 500,000 square feet at the Cisco Campus on Swanson Road. Because this development was never approved, it is not included within the commercial water demand presented herein.

The result is a total of 567,894 square footage of additional office space in the service area, which could demand up to 42,600 gpd.

Summary of Commercial Water Demand

The following Table 2-8 summarizes the expected water demand of all existing and permitted commercial buildings within the service area.

Table 2-8
Commercial Water Demand Estimates

Type	*Water Demand (gpd)*
Existing Commercial Space	95,300
Holiday Inn	22,800
Proposed/Permitted Commercial Space – to be constructed	42,600
Total	**160,700**

2.5 Summary of Proposed Service Area Water Demands

Table 2-9 summarizes the average day water demands estimated for residential and commercial uses within the proposed service area. In addition, a 15% allowance has been incorporated to account for unexpected water loss in the distribution system through leakage, unmetered usage, and other incidental uses of water such as operation and maintenance, flushing, fire fighting training, street sweeping, construction, etc. As a result, the total average day water demand for the proposed service area is estimated to be 365,200 gpd or 0.37 mgd.

Table 2-9
Average Day Water Demand Summary
By Usage for Proposed Service Area

Usage	Average Day Demand (gpd)
Residential	156,900
Commercial	160,700
Allowance*	47,600
Total	**365,200**

*Assume 15% for system loss, unmetered and other incidental uses

A water distribution system's average day demand represents the average daily water used on an annual basis. In establishing and operating a water distribution system, there are other water demand measures which must also be considered.

Maximum day demand represents the greatest amount of water used on a singe day, over the course of a year. Typically, the maximum day demand will occur during the summer months.

Peak hour demand represents the maximum amount of water used by the system over a one hour period within a single day. This usually occurs during the morning hours when people are waking up and getting ready for the day, and/or in the evening when most people return home from work and prepare dinner for themselves and their families.

The following Table 2-10 summarizes the average day, maximum day, and peak hour water demands for the proposed service area. These demands provide the basis for establishing facility requirements of the water distribution system.

Table 2-10
Summary of Water Demands
Proposed Service Area

	Water Demand
Average Day Demand (gpd)	365,200
Maximum Day Demand (gpd)*	967,800
Peak Hour Demand (gpd)**	1,679,900

* Peaking Factor = 2.65

** Peaking Factor = 4.60

To assist in determining a reasonable estimate for the maximum day and peak hour demands, CDM applied a maximum day to average day ratio (peaking factor) of 2.65, and a peaking factor of 4.60 for the peak hour demand, based on the "Merrimack Curve"[1]. The "Merrimack Curve" is a graph that illustrates the ratio of extreme flows to average daily flow originally developed by CDM for the "Report on Pollution Control for the Merrimack River" (December 1963). The maximum, minimum and extreme trend-lines on the "Merrimack Curve" have since reappeared in a number of design guidance manuals and is commonly referred to when existing data is unavailable.

Using a 2.65 factor to estimate maximum day demand from average day demand provides a fairly conservative estimate for the purpose of system design. It is commonplace today for water utilities to expend significant effort to reduce water use through water conservation efforts. Water conservation is actually a requirement of the MassDEP Water Management Act (WMA) issued permits for water supply sources. Such efforts will not only likely reduce the average day demand projected above, but also more significantly reduce the expected maximum day demand. In fact, most water utilities currently operate with a maximum day to average day ratio below a factor of 2. It would be expected that in Boxborough, once a distribution system is established, home owners and business/residential users may continue use of their existing domestic wells for irrigation and other outdoor water use. This would reduce the demands required on the Service Area.

In summary, the water demand estimates provided in Table 2-10 are suitably conservative for proceeding with the preliminary identification and sizing of facilities for the purpose of this water distribution system feasibility study. As the project moves forward, these demands must be updated prior to any final design as part of a more rigorous facility planning effort. Such updates should also consider projected

[1] American Society of Civil Engineers and Water Pollution Control Federation. Design and Construction of Sanitary and Storm Sewers. New York and Washington: 1969

water demands based on anticipated build-out of the proposed service area over a 20 to 30 year planning period.

It should also be noted that these demands do not address water usage in the remaining areas of town. Should there be a desire to serve additional areas in Boxborough, demand estimates would have to be redetermined which may impact the sizing of certain facilities and resulting costs.

2.6 Fire Flow Protection

2.6.1 General

The ability of the distribution system to provide adequate flow during fires is typically evaluated based on fire flow requirements established for the Town by the Insurance Services Office (ISO). The ISO is an association of insurance companies that compiles data that are used to establish insurance premiums and fire protection policies for both residential and commercial buildings. ISO typically estimates fire flow requirements at several locations within a community. The ISO locations are selected according to their relative representation of the higher fire flow requirements across the community. Accordingly, only fire flow requirements for a small portion of the community are actually estimated by ISO.

ISO last updated the fire flow analysis for the Town of Boxborough in 1998. At that time, the Town went from a Class 9 community to a Class 5. According to the ISO testing results and letter included in Appendix C, the resulting class change lowered insurance premiums in the Town. The development of a water distribution system will enhance fire protection capabilities and likely drive down insurance premiums even further for that portion of Town served.

2.6.2 ISO Methodology

To determine the required fire flow rate, ISO uses the Fire Suppression Rating Schedule (1980). A fire flow requirement is the flow required to fight a fire at a certain location. Generally, each location is rated based on the building in the area with the largest rated fire flow requirement.

Estimates for fire flow requirements for commercial buildings are based on a complex formula considering land use, building construction, size, occupancy characteristics, spacing between buildings, and the existence of individual building fire protection systems, such as sprinklers.

Generally, the water system must be capable of delivering a fire flow up to a maximum of 3,500 gpm and still maintain 20 psi throughout the rest of the service area to obtain the best overall town-wide insurance rating. Large commercial, institutional, and industrial buildings with fire protection needs that exceed 3,500 gpm must be supplied by individual fire protection connections and fire pumps, if necessary, to meet requirements. Alternatively, as was noted earlier, a sprinkler system can be used to reduce the fire flow requirements for these larger commercial

buildings. The provision of this additional flow, above the 3,500 gpm requirement, is generally the responsibility of the owner of the building. However, in the case of public schools, the Town is the owner; thus fire flow delivery rates greater than 3,500 gpm should be considered for school buildings.

In contrast, fire flow requirements for residential areas are relatively simple to estimate using ISO guidelines. For one or two family homes, not exceeding two stories in height, the following fire flows are applicable:

Table 2-11
Residential Fire Flow Requirements

Distance Between Buildings	*Required Fire Flow*
> 100 feet	500 gpm
31 – 100 feet	750 gpm
11 – 30 feet	1,000 gpm
< 10 feet	1,500 gpm

* Guide for Determination of Needed Fire Flow, ISO (2006)

2.6.3 Estimated Fire Flow Requirements

2.6.3.1 Residential

Due to the rural nature of the Town of Boxborough, most, if not all homes are separated by at least 31 feet. Therefore, based on Table 2-11 above, the required fire flow for residential property in the Town should be between 500 and 750 GPM. Based on the current zoning and the spacing of homes in the residential portion of the proposed service area, it is anticipated, for the purpose of this study, that a general fire flow requirement of 750 gpm will be required by ISO.

2.6.3.2 Commercial/Industrial

In the "business district" on the western side of I-495, there are many large commercial buildings and condominium complexes. Therefore, the fire suppression rating in this portion of Town is significantly greater than in other, more residential areas.

Based on discussions with officials in adjoining, similar, communities, it is estimated that a maximum fire flow of 2,500 gpm is adequate for fire protection for commercial and industrial buildings. However, the Fire Chief in the Town of Boxborough expressed a comfort level of around 3,000 gpm for fire protection in areas with commercial and/or industrial buildings. Therefore, for the purpose of this study, a range has been established for fire flow needs in commercial/industrial areas of 2,500 to 3,000 gpm. It should be noted that these are planning level flow requirements and are subject to change based on site-specific evaluations.

Neither of these estimates match the maximum fire flow of 3,500 gpm proposed by ISO to obtain the best insurance rating. However, the Fire Department is under the impression that the existing fire ponds and cisterns currently used for fire protection

would remain online even after the development of a new distribution system. Therefore, the new system will simply enhance the Town's current ability to provide fire flow needs.

Section 3
Water Supply and Distribution System Facilities

3.1 Development of Facilities

Water distribution storage, pumping, and piping facilities are sized to provide for maximum day demands and fire protection throughout the service area. System demands and fire flow needs, as discussed in Section 2, have been used as the basis for this evaluation. CDM has sized proposed facilities based on typical water system requirements and then assessed the proposed system's ability to meet these goals. This section presents the results of CDM's analysis of Boxborough's proposed facilities.

It should also be recognized that any new water supply and distribution facilities are subject to the review and approval of the MassDEP. MassDEP has in place a New Source Approval Process governing the review and approval of any new water supply source, inclusive of treatment facilities. This process is integrated with the associated environmental review requirements and related permitting to address withdrawal impacts of a new supply on surrounding sensitive receptors (i.e., wetlands, streamflow, endangered species/habitat, private wells, contaminant sources, etc.).

MassDEP has recently revised the New Source Approval (NSA) Process to a 25-step process, per the new 2008 Guidelines for Public Water Systems. Previously, this process consisted of 15-steps. Table 3-1 summarizes the 25 steps of the NSA process.

Table 3-1
New Source Approval Steps
Planning for a New Municipal Water Supply and Distribution System

The following outlines the 25 steps of the MassDEP New Source Approval Process to bring a new groundwater supply on-line, in accordance with the "*2008 MassDEP Guidelines and Policies for Public Water Systems*."	
Step 1	**Explore Potential Sources of Groundwater** - Test well installations - Water quality sampling - Coordinate with Conservation Commission
Step 2	**Water Management Program Site Screening Requirements** - Early Notice – Environmental Monitor - Water Conservation Plan - Site Screening Worksheet (inclusive of preliminary evaluation of streamflow impacts) - Alternative Analysis

Table 3-1 (Cont'd)
New Source Approval Steps
Planning for a New Municipal Water Supply and Distribution System

Step 3	**Application for Approval to Site a Source and Conduct a Pumping Test**
	- Request for Site Exam/Pumping Test Proposal
	  - Mapping
	  - Specify pumping test procedures
	  - Identify potential contaminant sources
	  - Preliminary Zone II delineation
	  - Identify existing and proposed wellhead protection controls
	  - Method of final Zone II delineation
	- Other Requirements (relative to test well exploration)
	  - Wetlands Permit / MA Wetlands Protection Act compliance
	  - Massachusetts Endangered Species Act (MESA) Permit Application compliance (if required)
	  - Army Corps of Engineers 404 Permit (if required)

Step 4	**MassDEP Conducts Site Exam/Pumping Test Proposal Approval** Public Water Supplier to inform municipal officials of wellhead protection requirements
Step 5	**Federal Notice of Intent Application 404 Permit / MassDEP 401 Water Quality Certification Program** (if required)
Step 6	**Conduct Pumping Test**
Step 7	**Pumping Test Shut Down (only after consultation with MassDEP)**
Step 8	**Submit Source Final Report** - Pumping test data (tabular and graphical formats) - Calculated aquifer characteristics - Groundwater contour maps before and after pumping test - Potentially approvable yield calculations - Water quality analysis results - Treatment options - Hydraulic connections to nearby surface water features - Assess impact of the well's proposed pumping schedule on water table and sensitive receptors

Step 9	**Assess Capacity (Community and NTNC systems only)**
	- Submit a business plan in a format approved by MassDEP demonstrating proficiency in the three capacity areas of:
	  - Technical
	  - Managerial
	  - Financial
	- Draft plan submitted during initial stages of the Source Approval process
	- Complete plan shall be submitted prior to obtaining final on-line approval

Table 3-1 (Cont'd)
New Source Approval Steps
Planning for a New Municipal Water Supply and Distribution System

The following steps are all permit applications related to environmental impacts of well drawdowns	
Step 10	**Water Management Permit Application** - Submitted at the same time the Source Final Report is submitted
Step 11	**Submit Interbasin Transfer Application to DCR** (if required)
Step 12	**Submit Environmental Notification Form (ENF) to MEPA** - 30-day public review period; notification in the Environmental Monitor - Projects with significant environmental impact may require an Environmental Impact Report (EIR)
Step 13	**Submit MassDEP 401 Application** (if required)
Step 14	**Submit Draft Environmental Impact Report (DEIR) to MEPA** (if required)
Step 15	**Submit Final Environmental Impact Report (FEIR) to MEPA** (if required)
Step 16	**Submit 404 Permit Application to Army Corps of Engineers (Clean Water Act of 1977)** (if required)
Step 17	**Source Final Report Approved** - Water Management Act permit approval
Step 18	**Submit Design Plan for Permanent Works**
Step 19	**Begin the Wellhead Protection and/or Best Effort Compliance Process** - Submit Zone II and wellhead protection regulations 310 CMR 22.21(2) to local officials - Achieve compliance before well goes on-line
Step 20	**Submit Notice of Intent (NOI) to Local Conservation Commission (for facility construction)**
Step 21	**Notify MassDEP Regional Office When Construction is Complete**
Step 22	**Site Inspection of Permanent Works**
Step 23	**Final Source Approval**
Step 24	**Meet Requirements of the Surface Water Treatment Rule (SWTR)** - SDWA requires that groundwater sources under the direct influence of surface water and at risk for carrying waterborne contaminants be identified. - Identify compliance method: obtain exemption to SWTR; institute wellhead/watershed protection and adequate disinfection; or, install filtration, disinfection and disinfection contact time.
Step 25	**Implications of the Groundwater Rule**

Because this project essentially represents a new water distribution system, we would expect that Step 9 – Assess Capacity would also apply. Under this step, preparation of a business plan is required to address the technical, managerial and financial aspects of the system. The scope of this effort will be dependent on the regional approach

taken with the Town of Littleton relative to water system management and operations.

In addition to MassDEP review and approval of facility designs for the new water supply source (i.e., production wells and treatment) under the New Source Approval Process, there may also be need for MassDEP review and approval of distribution system components such as the storage tank. Use of loans from the State Revolving Fund (SRF) for construction will also require MassDEP technical review of all design documents.

3.2 Water Supply and Treatment Facilities

Water supply demands were developed in Section 2 based on the estimated water needs of the Service Area for existing, permitted and proposed development. As a typical design standard, water supply facilities must be sized to meet a 24-hour maximum day demand. Based on Table 2.10, the maximum day demand of the service area is estimated to be 0.97 mgd.

3.2.1 Production Wells

Preferred Site #1-06, proposed for municipal groundwater supply development on the Harvard Sportsmen's Club property, has a preliminary estimated yield of 500 to 700 gpm (0.72 to 1.0 mgd). Assuming a 1.0 mgd supply, the proposed well site would be able to meet the maximum day demand design criteria. If based upon groundwater supply testing Site #1 was determined unable to meet the required water supply capacity, then development could also be considered of Site #3 as a supplemental source. In any case, at least two production wells are required to allow for redundancy and ensure reliability when a well is out-of-service. Additional redundancy and emergency supply can also be provided by an appropriately sized interconnection with the Town of Littleton.

For the purpose of developing a planning level cost estimate of required facilities, CDM has assumed two municipal production wells at Site #1, approximately 100-200 feet apart. Each well has an assumed capacity of 1.0 mgd. Therefore, operations would require only one well operating at a time. As Site #1 has a deeper overburden depth, its selection for facility pricing is adequate, as compared to the more shallow depths encountered at Site #3 on the HSC property.

Each production well would be located remotely from the water treatment facility and be equipped with a pitless well adapter and submersible pump. Related wellfield facilities include cross-country water main, electrical power below grade, instrumentation, mechanical piping and valves, and any related site/civil facilities such as a gravel access road and fencing around each well site.

Selection and testing of a municipal production well site is subject to the MassDEP New Source Approval Process (see Table 3-1). This process also includes requirements to address well drawdown impacts through the associated environmental permitting

processes. The final wellfield yield and withdrawal rate will be subject to the approval of these permit agencies.

3.2.2 Water Treatment Plant

On a preliminary basis, water samples collected from test well sites at the HSC property appeared favorable for groundwater supply development. Additional water quality sampling and analysis must be conducted during future test well exploration in the area and during the extended-duration pumping test(s) of selected production well site(s). These water quality results will govern the need for and type of water treatment necessary to ensure compliance with the federally mandated Safe Drinking Water Act (SDWA). Furthermore, pilot testing may be required in association with the extended-duration pumping test to assess particular water quality parameters and trends, and to pilot preferred treatment technologies to ensure that SDWA requirements are met.

Given the availability of only minimal site water quality data at this project stage, CDM has made assumptions regarding expected treatment needs based on typical high yielding municipal groundwater supplies in the area. These assumptions are necessary to develop a planning level cost estimate for the water treatment plant. Assumptions include:

- 1.0 mgd Water Treatment Facility, inclusive of wellfield operational controls for two production wells;
- All related mechanical, electrical, instrumentation, HVAC, plumbing, architectural and structural facilities;
- Gravel access road and site/civil engineering, including all yard piping;
- Stand-by power;
- Treatment assumes: iron/manganese removal (green sand filtration), corrosion control using potassium hydroxide, disinfection using sodium hypochlorite, manganese oxidation using potassium permanganate, and the option for fluoridation to prevent dental decay.

3.2.3 SCADA

It is expected that the Town would wish to incorporate Supervisory Control and Data Acquisition (SCADA) technology to assist in water system operations. SCADA systems use information technology to connect all facilities via telephone lines and/or radio frequency to allow for remote operational control, continuous data recording, and alarming. An advantage is that it allows for remote access via computer for utility operators to review current operations (i.e., tank level, well pump on/off, metered flow, etc.) The technology has become commonplace in the water industry to enhance and provide a safety net relative to operations.

It is assumed that SCADA would be incorporated at all waterworks facilities (i.e., water treatment facility, wells, storage tank, interconnection, pump stations, etc.), in addition to a central control station and alarms to the Police and Fire Departments. If the distribution system is interconnected with Littleton, additional telemetry and SCADA controls may be desired with Littleton.

3.3 Storage Tank Analysis

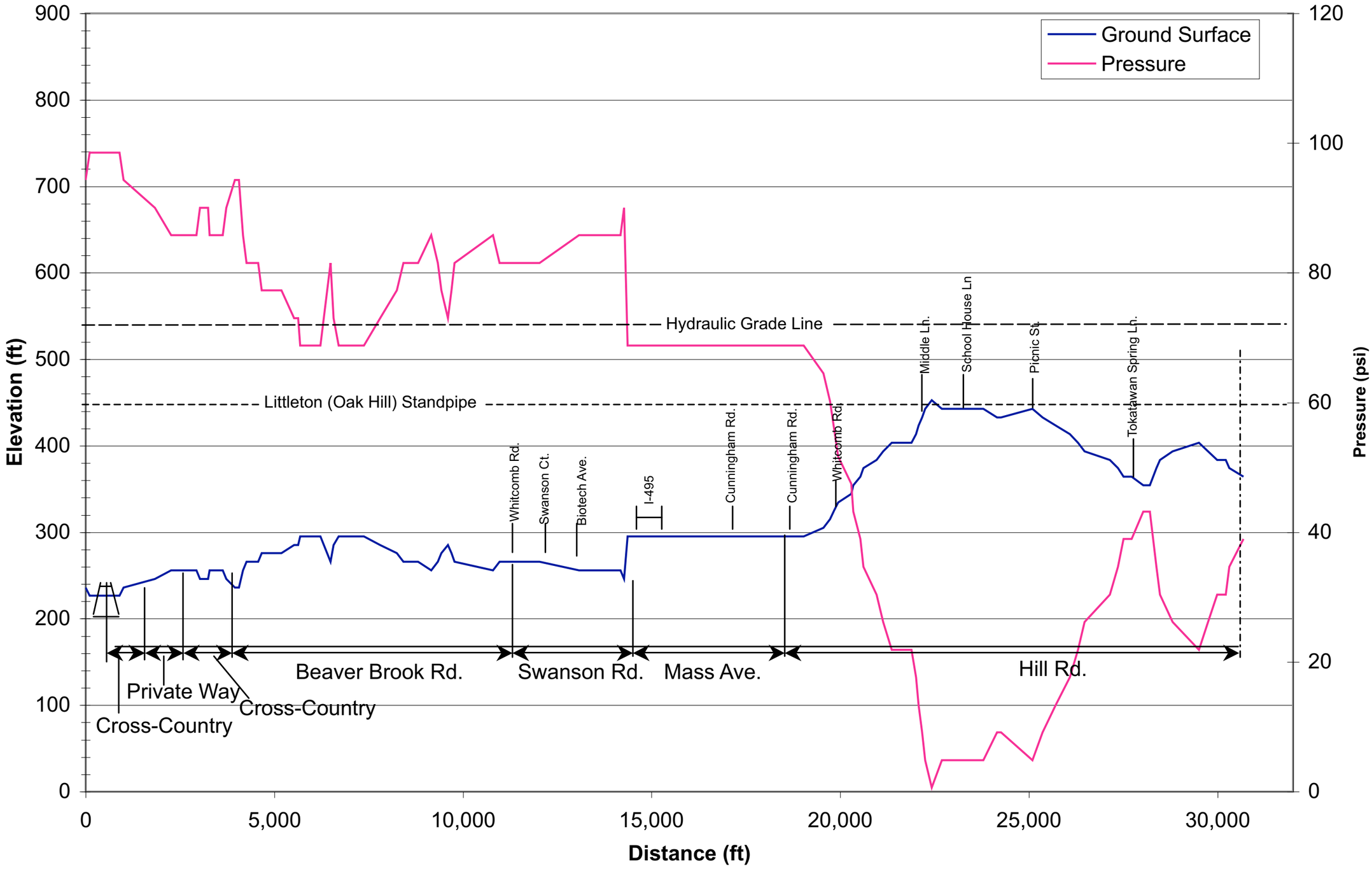
3.3.1 Maintaining System Pressure

Since water pressure decreases with increased elevation, the topography of the land greatly influences the water pressure and the resulting design of the distribution system. Existing elevations within the proposed service area range from approximately 225 feet to 455 feet above mean sea level. Due to this difference in elevations within the service area, it was important to develop a better understanding of the topography and resulting pressures by creating a graphical representation (see Figure 3-1).

General waterworks practice suggests that every public water distribution system should be capable of maintaining a minimum pressure of 35 psi during the peak hour demand period at ground elevation in all regions of the service area. National fire protection standards also dictate that during a maximum day flow period, combined with a coincidental fire flow, a minimum of 20 psi should be maintained throughout the system. The Massachusetts Department of Environmental Protection (MassDEP) has also established a minimum water system pressure requirement of 20 psi under all operating conditions. This standard helps to avoid potential cross-connections and negative pressures (vacuum) that could occur at service connections in higher elevations during fire flow needs or other significant demand events. The piping network should also be capable of refilling total peak hourly storage fluctuation volume in approximately 6-8 hours during the minimum (nighttime) demand period on the maximum day.

General waterworks practice also suggests that the maximum desirable pressure in a water main be in the vicinity of 100 psi, and generally not be greater than 130 psi. Though not ideal, systems can be designed with pressures greater than 100 psi, without any adverse effects. The use of pressure reducing valves (PRVs) can be used to reduce the pressure in a water main or in a service connection, and bring it down to a more desirable pressure.

Based on a review of Figure 3-1, it is apparent that water system pressure requirements can easily be met for most of the service area, with the exception of Hill Road. The higher topography of Hill Road requires that distribution system facilities be sized to provide adequate system pressure in this area.



Town of Boxborough, Massachusetts
Water Distribution System Feasibility Study

Figure 3-1

Topographic and Hydraulic Profile of Water Service Area

CDM

3.3.2 Recommended Storage Requirements

Storage is provided in a water distribution system to:

- Dampen hourly demand fluctuations that otherwise would be met by the supply sources, thereby reducing operating costs.
- Meet required fire flow, thus reducing pumping capacity (and costs) at supply sources, as well as reducing piping capacity requirements.
- Provide a volume of water for emergencies in case of pipeline breaks, mechanical equipment malfunctions, or power failures.
- Equalize pressure throughout the distribution system to provide surge relief, and to help control pumping operations.

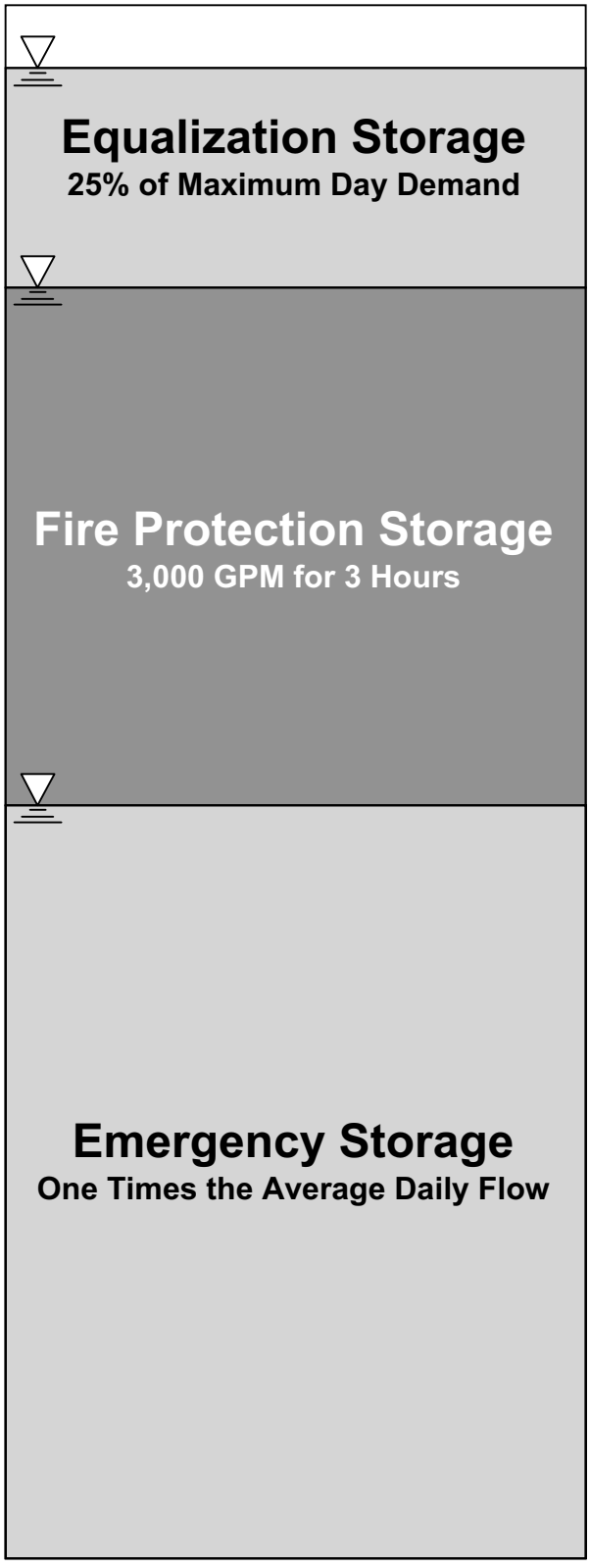
In distribution systems that provide adequate storage, water supply pumping facilities should be sized for a flow rate equal to maximum day demands. When system demands are greater than maximum day demands (i.e., during peak hour demand conditions), these additional demands are met by active storage (equalization storage).

In addition to hourly fluctuation storage, storage facilities are also sized to provide fire protection volume and emergency volume.

The basis for these storage requirements is summarized below:

- ***Equalization Storage*** – the total volume required to meet hourly demands that exceed the maximum day demands. This volume is generally stated as a percentage of the maximum day demand based on existing system records or general guidelines developed from similar systems.
- ***Fire Protection Storage*** – the total volume of water to provide fire flows. To determine this volume, the largest fire flow required by the Insurance Service Office (ISO) is typically selected along with the appropriate duration (typically 2-3 hours based on the magnitude of the fire flow) for each zone.
- ***Emergency Storage*** – the volume of storage allocated in case of a power failure, pipeline break, or equipment malfunction. In most cases, if a community has an adequate emergency standby power source at its water supplies and pumping stations, emergency storage is considered to be a lower priority requirement. However, when planning level estimates are being developed, a common rule is to use one times the average daily flow.

Refer to Figure 3-2 for a graphical representation of the three components that make up the storage volume requirements described above.



Town of Boxborough, Massachusetts
Water Distribution System Feasibility Study

Figure 3-2
Water Storage Tank Sizing Components

CDM

Distribution system storage facilities are considered adequate if the existing active storage volume meets equalization, fire protection and emergency requirements for the community. Active storage is determined by local topography and represents the volume of water in storage that provides a minimum acceptable pressure (i.e., 35 psi during peak hour and/or 20 psi during fires or emergencies) at the highest service elevation in the distribution system. To determine equalization storage, a minimum normal system operational pressure of 35 psi was adopted for this analysis. For fire flow volume, the minimum pressure requirement is 20 psi during a fire flow event, based on ISO guidelines discussed in Section 2.

In addition to having adequate storage in a water system, it is important that the water system have adequate pumping and piping capacity to refill the system storage at night. Generally, total equalization volume for peak hour fluctuations must be refilled within approximately eight hours during the nighttime period following maximum day demand period.

3.3.3 Storage Tank Sizing

The size of the storage tank required for the proposed water distribution system falls within a range of values. This is due to the fact that the Town of Boxborough has multiple options as to the configuration of the distribution system and the connection of the system to adjacent communities, such as Littleton. In all cases however, it is important to locate the storage tank at the highest point in the service area in order to realize the full advantage of the storage.

3.3.3.1 Storage Requirements without Connecting to Littleton

If the Town of Boxborough creates a water distribution system that is self-sufficient (i.e., not relying on any adjacent communities for system pressures, water supply, etc.), the storage tank must be capable of providing for the three types of storage discussed above.

- ***Equalization Storage:*** The equalization storage component for the proposed service area was estimated based on the maximum daily flow. Accordingly, 25 percent of the maximum day demand was used to determine the equalization storage volume.

- ***Fire Flow Storage:*** The largest estimated ISO required fire flow in the proposed service area is 3,500 gpm, but as discussed earlier, the maximum fire flow that will be used in this evaluation is 3,000 gpm.

- ***Emergency Storage:*** Since this is only a planning level estimate, the emergency storage component was based on one times the average daily flow. Therefore, the emergency storage component is 0.37 MG.

Table 3-2
Storage Tank Sizing with No Connection to Littleton

Storage Component	Current Required Usable Storage (Million Gallons)
Equalization Storage – 25% of Max Day (0.97 MG)	0.24
Fire Protection – 3,000 gpm for 3 Hours	0.54
Emergency Storage – One Average Day	0.37
Total	**1.15**

3.3.3.2 Storage Requirements with Connection to Littleton

If the Town of Boxborough decides to take a regional approach to the new water distribution system, and forms a partnership with the Town of Littleton in which the two distribution systems are hydraulically connected, Boxborough may be able to construct a storage tank with less volume. The three components of the storage tank still apply; however, the fire flow component can be much smaller because Littleton will provide a portion of the fire flow protection as part of the partnership.

- ***Equalization Storage:*** The equalization storage component for the proposed service area was estimated based on the maximum daily flow. Accordingly, 25 percent of the maximum day demand was used to determine the equalization storage volume. Therefore, the future equalization storage volume requirement is about 0.24 million gallons (MG).

- ***Fire Flow Storage:*** Since the Town of Littleton will provide fire flow protection to Boxborough through a regional partnership, the amount of storage allocated for fire flow protection could be much smaller. Thus, the fire flow storage component in this scenario is estimated to be 750 gpm for three hours, or 0.14 MG based on similar requirements that Littleton is currently using for residential neighborhoods.

- ***Emergency Storage:*** Since this is only a planning level estimate, the emergency storage component was based on one times the average daily flow. Therefore, the emergency storage component is 0.37 MG.

Table 3-3
Storage Tank Sizing with Connection to Littleton

Storage Component	Current Required Usable Storage (Million Gallons)
Equalization Storage – 25% of Max Day (0.97 MG)	0.24
Fire Protection – 750 gpm for 3 Hours	0.14
Emergency Storage – One Average Day	0.37
Total	**0.75**

3.3.4 Storage Tank Siting Options

USGS Topographic mapping of Boxborough was reviewed to determine the high elevation areas in the proposed service area that might be suitable as sites for the proposed storage tank. Potential sites close to the water treatment plant site were eliminated because it is difficult to operate storage effectively when it is too close to the source of supply. In addition, sites at great distances from the system's proposed water mains are not cost-effective because they would require lengthy transmission mains to reach the main system. Finally, undeveloped or town owned properties were preferred over developed properties.

The highest elevations in the service area are on the east side of I-495, on or adjacent to Hill Road. Because of the existing topography, water storage for the proposed distribution system must reach an elevation of 545 feet above mean sea level (ft-msl), or above, in order to provide adequate pressures to homes in the highest elevations of the service area. CDM has identified three locations on Hill Road where the ground surface elevation is at least 450 ft-msl, making the required height of the tank approximately 95 feet tall, see Figure 3-3. It should be noted that the highest point in Boxborough is the nearby Picnic Hill (elevation 470 ft-msl), off of Picnic Street just east of the proposed service area.

3.4 Piping System Analysis

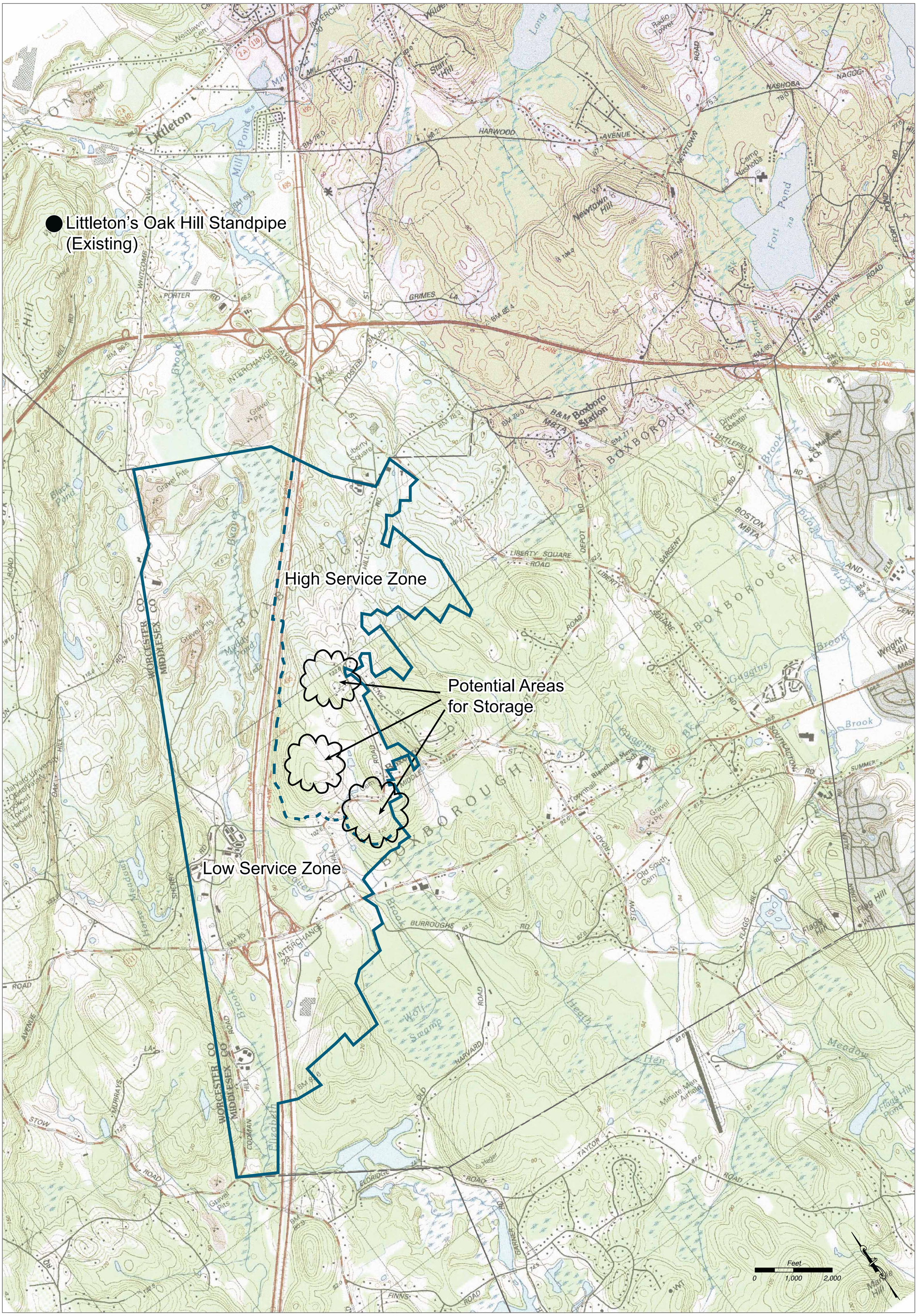
3.4.1 General

A water distribution system's network of piping must be able to deliver water for consumption and fire flow needs in all areas of the proposed distribution system. For this preliminary assessment of pipe sizing and layout the following conditions were evaluated:

- ***Maximum Day Demand Plus Fire Flow*** – This analysis evaluated the distribution system's ability to meet maximum day demands with a coincidental fire flow. The minimum acceptable residual pressure was 20 psi.

- ***Peak Hour Demand*** – This analysis evaluated the distribution system's ability to meet peak hour demands. The minimum acceptable residual pressure was 35 psi.

- ***Nighttime Refill*** – This analysis evaluated the distribution system's ability to refill the storage tank overnight after a day of maximum demands. As long as the water treatment plant pumps water into the system at a minimum rate equal to the max-day demand (0.97 mgd) over 24 hours, the tanks will always be refilled. If, however, the WTP is operated at fewer hours per day, the pumping rate would need to be pro-rated depending on the operation schedule.



Town of Boxborough, Massachusetts
Water Distribution System Feasibility Study

Figure 3-3

Potential Storage Tank Sites and Pressure Zones

CDM

3.4.2 Piping System Sizing

Under fire flow conditions, small diameter mains can only convey flow for a limited distance before the friction between the wall of the pipe and the water result in less than adequate flows and pressures at the hydrant. Therefore, standard water works practice suggests a minimum pipe diameter of 8-inches be used in systems designed for fire flow purposes. However, as a result of the sprawling nature of the road network, a minimum pipe size of 12-inches in diameter has been assumed along the primary roads when laying out the proposed Boxborough water distribution system. In addition, pressure reducing valves (PRV's) may be required to reduce system pressures in some of the lower elevation areas of the service area.

It is important to note that the proposed water system piping layout maximizes the use of pipe loops to minimize pipe diameters. Also, the smaller pipe diameters help to maximize pipe velocities thereby enhancing water quality.

3.5 Pumping Station Analysis

To overcome the elevations of Hill Road and ensure supply to the storage tank, a lift pumping station may be required within the distribution system.

3.5.1 Recommended Pumping Requirements

When a distribution system relies on storage volume to meet peak hour demands, the total capacity of a pumping station should equal the maximum day demand of the service area if the station is operating 24-hours per day.

As a result of the proposed storage tank located on Hill Road, the pumping station must be able to meet a maximum day demand for that high service area.

3.6 Interconnections with Littleton

It is expected that the Boxborough service area will include two interconnections with the Town of Littleton. Interconnections would likely be located at Monarch Drive and Hill Road. The primary purpose of an interconnection would be to provide supply redundancy in an emergency. In such circumstances, a meter vault with associated mechanical piping, valves, instrumentation, and electrical components would be installed.

Should a regional approach be undertaken with regard to water supply and operations, the Boxborough system would become an extension of the Littleton water system. In this case, construction of an interconnection meter vault may not be necessary.

3.7 Service Connections and Metering

For each home, residential development, and business that will connect to the distribution system, a new service connection would be required. The service

connection would extend from the water main valve box in the street, to the building's plumbing. Disconnection from any existing private well will be required.

To account for consumer water use, a meter would be installed at the service connection of each building. Remote meter readers are typically employed, which allow drive-by meter reads.

Typically, service connections are conducted at the expense of the home owner or business with a meter provided by the water utility.

Section 4
Distribution System Alternatives and Capital Costs for Implementation

4.1 Summary of Distribution System Facilities

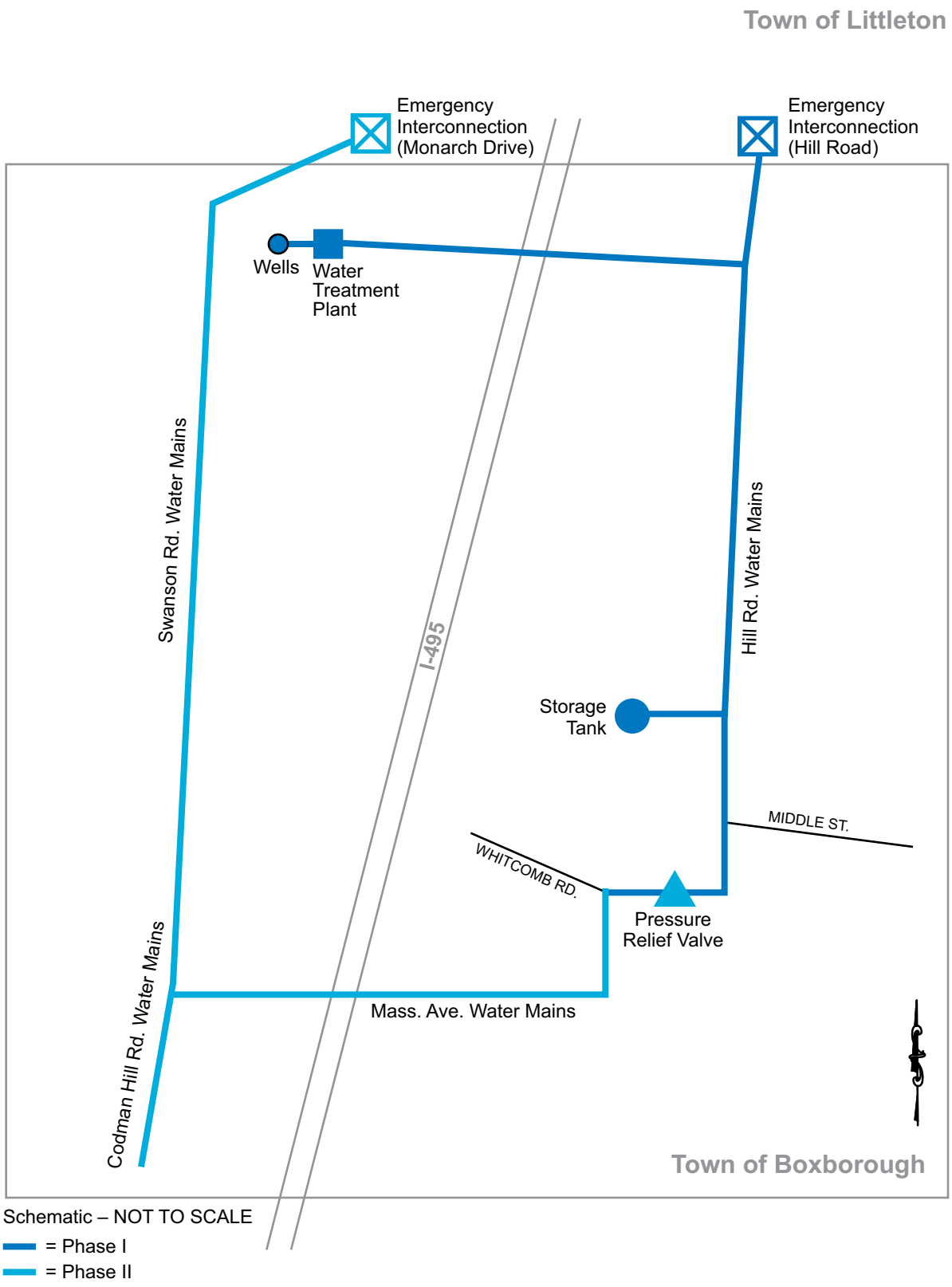
Section 3 provided an overview of the facilities that will most likely be needed in the development of a water distribution system in the Town of Boxborough. This section presents three scenarios or alternatives, which incorporate these facilities, and are feasible for the stated goal of developing a water distribution system in the Town. A possible phased approach to the implementation of each alternative is provided for consideration. Phasing of each alternative considers the need for a high pressure zone along Hill Road. It should be realized that going forward, as source location and volume are determined and regionalization evaluated, the alternatives may require modification. In addition, further analysis and evaluation will be required to firmly establish the operating parameters for the design and implementation of the distribution system.

4.1.1 Alternative #1 – Independent System

This alternative assumes that the Town of Boxborough will develop an independent, self-sufficient water distribution system with a contracted operator that will facilitate billing, operations, and other administrative duties to help run the system. An emergency interconnection to Littleton would be provided at two locations; one on Hill Road and another on Monarch Drive, both at the town-line. If desired, Alternative #1 can proceed in two phases, with the high pressure zone consisting of the more costly facilities being constructed in Phase I. Figure 4-1 is a schematic showing the proposed Alternative #1. The following is a breakdown of an anticipated phased approach.

Phase I

- Develop production well(s) and a water treatment plant on the Harvard Sportsmen's Club property.
- Construct water mains from the well(s) and treatment plant, eastward, under I-495 by the possible use of directional drilling, to Hill Road. Otherwise, piping would be constructed through Littleton to reach Hill Road in Boxborough.
- Construct water mains south along Hill Road to Middle Road.
- Construct a 1.2 million gallon elevated storage tank on Hill Road with an overflow elevation of 545 msl. Assuming the tank is constructed on ground that is at elevation 450 ft-msl, the tank should be approximately 95 feet tall and its location will be decided among the three likely candidate sites shown in Figure 3-3.



Town of Boxborough, Massachusetts
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Figure 4-1
Alternative 1 – Independent System

CDM

- Construct an emergency interconnection with Littleton on Hill Road. However, because of topographic elevations and system hydraulics, this connection would only allow water to flow into Littleton. For the Littleton system to feed water to Boxborough, a pumper truck would be required to pump water from Littleton into Boxborough's system. This method could be used to feed Boxborough in emergencies. Alternatively, Boxborough could elect to construct a pump station to increase reliability. In addition, a pressure reducing valve (PRV) and check valve vault would need to be constructed within Littleton to prevent the higher pressures generated by the Boxborough tank from overwhelming the lower areas in Littleton's distribution system. A separate hydraulic analysis would be needed to determine the optimum location and sizing of this vault, and address interconnection approaches.

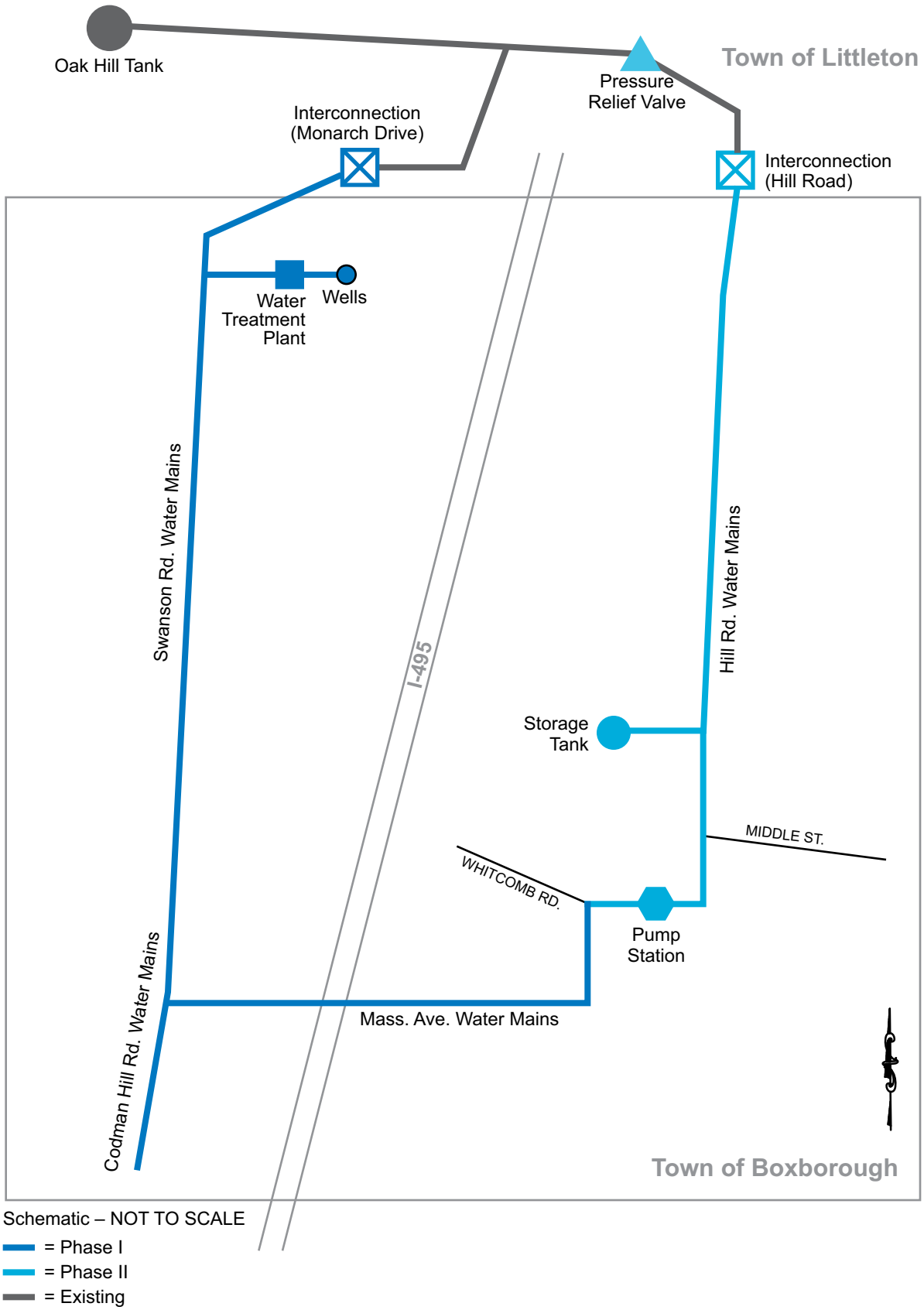
Phase II

- Connect Hill Road Phase I water mains to Route 111 west (Massachusetts Avenue), Codman Hill Road, Swanson Road, and Beaver Brook Road, with a pressure reducing valve (PRV).

- A second emergency connection could also be made at Monarch Drive in Littleton. Based on system hydraulics, this emergency connection would allow flow in two directions; either to Littleton or from Littleton. Therefore, a connection on Monarch Drive provides system redundancy to Boxborough, with the availability of supply from Littleton in emergency situations. Since the emergency connection on Hill Road does not easily allow Boxborough to receive water from Littleton, the Monarch Drive interconnection would become the primary connection point for this purpose. The interconnection would likely consist of a meter vault with associated mechanical piping, valves, instrumentation, and electricity.

4.1.2 Alternative #2 – Regional System Starting West of I-495

This alternative assumes that the Town of Boxborough will enter into an agreement with Littleton to develop a regional water system. The proposed water distribution system in Boxborough would essentially become an extension of Littleton's existing water distribution system. The Littleton Electric Light and Water Department (LELWD) would handle billing, operations, and other administrative duties that help run the system. Littleton's Oak Hill storage tank would service the "business district" of Boxborough, west of I-495 (i.e., the low pressure zone). Due to the nature of the phased approach, this area could be serviced immediately, thereby, forgoing construction of the Boxborough storage tank during Phase I. Additionally, utilizing water storage and fire flow availability from Littleton's Oak Hill storage tank will reduce the proposed storage tank volume needed in Boxborough, thereby reducing cost. Another aspect of this regional water system arrangement is that upon completion of both phases, Littleton will receive pressurized water from Boxborough on the east side of I-495, thereby alleviating low pressure issues that currently exist in this area. Figure 4-2 is a schematic showing the proposed scenario, based on the hydraulic profile presented in Figure 3-1. The following is a breakdown of the anticipated phased approach.



Town of Boxborough, Massachusetts
Water Distribution System Feasibility Study

Figure 4-2
Alternative 2 – Regional System Starting West of I-495

CDM

Phase I

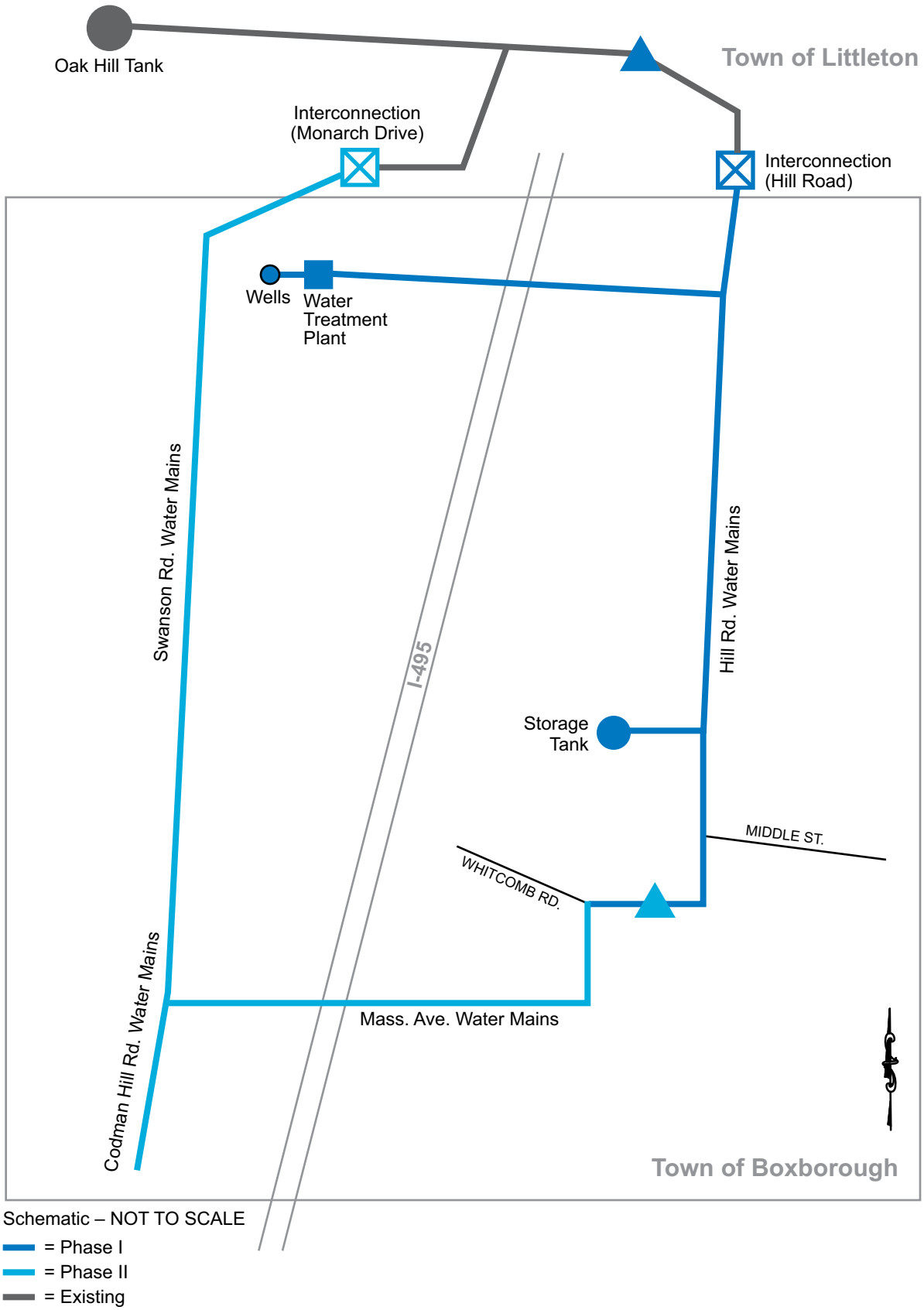
- Develop production well(s) and a water treatment plant on the Harvard Sportsmen's Club property.
- Connect to the Littleton water distribution system at Monarch Drive.
- Construct water mains from the wells and treatment plant, south on Beaver Brook Road, Swanson Road and Codman Hill Road. This area will be serviced by Littleton's Oak Hill storage tank. More detailed hydraulic modeling analysis will be required.
- Extend water mains on Route 111 east (Massachusetts Avenue) and on Hill Road to the intersection with Whitcomb Road.

Phase II

- Construct a pump station on Hill Road to pump water to a new storage tank off of Hill Road. The pump station must have sufficient capacity to meet the maximum day demands for the area on Hill Road and the existing low pressure zone within Littleton. Further demand and hydraulic analyses are needed to determine the pump capacity and pressure needs for Littleton in the low pressure zone.
- Construct a new elevated storage tank off of Hill Road at the highest point available, with an overflow elevation of 545 msl. The storage tank capacity would be 0.75 million gallons to provide hourly fluctuation storage, emergency storage and sufficient fire flow storage to properly meet the residential fire flow requirements currently estimated for this service area. For the purposes of this conceptual study, a fire flow of 750 gallons per minute for three hours was used.
- Extend water main north on Hill Road to the town line with Littleton.
- Construct an interconnection with Littleton on Hill Road (Littleton will need a PRV and check valve) to create a looped system. This portion of the work will allow Littleton to resolve pressure issues in their system on the eastern side of I-495.

4.1.3 Alternative #3 – Regional System Starting East of I-495

This alternative also assumes that the Town of Boxborough will enter into an agreement with Littleton to develop a regional water system. Similar to Alternative #2, the proposed water distribution system in Boxborough under Alternative #3 would essentially become an extension of Littleton's existing water distribution system. The Littleton Electric Light and Water Department (LELWD) would handle billing, operations, and other administrative duties to operate the system. However, in this case the service area would be constructed to initially serve the high pressure zone on the east side of I-495 such that Littleton's pressure issues would be addressed during Phase I. Littleton's Oak Hill storage tank could still service the "business district" of Boxborough, west of I-495 and the capacity needed for Boxborough's proposed storage tank will be reduced, thus reducing cost. Figure 4-3 is a schematic showing the proposed scenario. The following is a breakdown of the anticipated phased approach.



Town of Boxborough, Massachusetts
Water Distribution System Feasibility Study

Figure 4-3
Alternative 3 – Regional System Starting East of I-495

CDM

Phase I

- Develop production well(s) and a water treatment plant on the Harvard Sportsmen's Club property.
- Construct water mains from the well(s) and treatment plant, eastward under I-495 by the possible use of directional drilling, to Hill Road. Otherwise, piping would be constructed through Littleton to reach Hill Road in Boxborough.
- Construct an interconnection with Littleton on Hill Road, at the town line. This interconnection would allow flow into Littleton, thereby increasing system pressures in that area. A pressure reducing valve (PRV) would likely be needed in Littleton; this would require further hydraulic analysis. To ensure water supply reliability for Boxborough, a pump station may be required at the interconnection. Otherwise, a pumper truck would be needed to boost water from Littleton to Boxborough at Hill Road.
- Construct new water mains south on Hill Road and a new storage tank approximately 95 feet tall (from an estimated ground elevation of 450 ft-msl to a required overflow elevation of 545 ft-msl) with a 0.75 million gallon capacity on Hill Road.

Phase II

- Install a PRV and connect Hill Road Phase I water mains to Route 111 west (Massachusetts Avenue), Swanson Road, and Codman Hill Road.
- Connect water mains on Swanson Road, along Beaver Brook Road to Monarch Drive in Littleton, with an interconnection in Littleton to create a looped system.

4.2 Estimate of Project Costs by Alternative

CDM has developed a planning level project cost estimate for each of the alternatives presented in Section 4.1. The cost estimate of each alternative is based upon the individual facility requirements and associated assumptions presented in Section 3.0. Selection of a preferred alternative can then proceed based on the estimated project cost and consideration of institutional factors.

The following identifies key assumptions in development of this project cost estimate:

- Whenever available, CDM has based individual facility construction cost estimates on similar projects recently bid;
- For other facilities, industry standard cost estimating procedures have been employed or allowances provided, as appropriate;
- Costs presented are in current dollars, based on the Engineering News Record (ENR) Construction Cost Index of 8094 for February 2008;
- No allowance for future inflation to the mid-point of construction is included;

- No allowance for legal fees, land taking, or easements;
- No allowance to negotiate intermunicipal agreements, contracts and purchase price;
- An allowance for construction contingency is included, to cover unexpected costs during construction (i.e., additional bedrock removal, change orders, etc.);
- An allowance for project contingency is included to cover unexpected, not yet identified, or changed facility components (i.e., added wells, different treatment, additional hydraulic components for operations);
- Allowances for engineering and implementation (i.e., facility planning, New Source Approval, permits, design, engineering services during construction, etc.) are included.

Presented in Table 4-1 is an opinion of probable project cost for each distribution system alternative presented in Section 4.1. Based on the assumptions above and facility needs provided in Section 3, Table 4-1 presents costs assuming phased implementation of each alternative. Phasing would allow implementation of the distribution system to serve higher prioritized areas first. To ensure that hydraulic requirements are addressed, phasing is based on facilities required to serve each of the two pressure zones within the service area. The following briefly reviews key components of each facility relative to the cost estimate:

- ***Well and Water Treatment Facility:*** Assumes a 1.0 mgd supply at the HSC, comprised of two production wells, a water treatment plant (green sand filtration and chemical addition), stand-by power, and all civil, site, mechanical, electrical, plumbing, HVAC, instrumentation, and structural appurtenances.
- ***Storage Tank:*** A new storage tank would be located on Hill Road, near the intersection with Middle Road. Assuming a ground surface elevation of 450 ft-msl, the tank will be 95 feet tall to provide adequate pressures and fire protection. If the Town elects to proceed with an independent system (Alternative #1), the required storage tank capacity is estimated to be 1.2 million gallons. If the Town elects to enter into a regional water system utilizing some water storage capacity already existing in the Town of Littleton (Alternatives #2 and #3), the tank capacity will be approximately 0.75 million gallons. Pricing assumes a cylindrical tank constructed of steel.
- ***Water Mains:*** Pipe sizes of 8-inch and 12-inch water main are assumed to satisfy ISO fire flow requirements and maintenance of pressures at high points and system extremities during peak demand events. Consideration was also given to pipe length constructed along Mass Highway (Rt. 111) and the expectation that significant bedrock will be encountered along Hill Road, increasing costs along those roadways. Costs also assume directional drilling beneath I-495; however, further investigation regarding presence of bedrock is needed to determine the viability of this approach. The alternative would be to route the water main from the well site, through Littleton, to Hill Road.

Table 4-1
Estimate of Probable Cost

Phase I	***Independent System***	***West of I-495***	***East of I-495***
	Alternate #1	***Alternate #2***	***Alternate #3***
Wells/Water Treatment Plant	$2,800,000	$2,800,000	$2,800,000
Storage Tank	$2,300,000	-----	$2,140,000
Water Mains	$3,265,000	$6,195,000	$3,265,000
Pump Station	-----	-----	-----
Interconnections	$500,000	-----	$700,000
Pressure Reducing Valve (PRV) Vault	-----	-----	-----
Supervisory Control And Data Acquisition (SCADA)	$200,000	$125,000	$200,000
Subtotal Construction Cost	**$9,065,000**	**$9,120,000**	**$9,105,000**
Construction Contingency (25%)	$2,266,000	$2,280,000	$2,276,000
Total Opinion of Probable Construction Cost	**$11,331,000**	**$11,400,000**	**$11,381,000**
Project Contingency (20%)	$2,266,000	$2,280,000	$2,276,000
Subtotal	**$13,597,000**	**$13,680,000**	**$13,657,000**
Engineering & Implementation (25%)	$3,399,000	$3,420,000	$3,414,000
New Source Approval & Facility Planning Allowance	$1,500,000	$1,500,000	$1,500,000
Total Opinion of Probable Cost - Phase I	**$18,496,000**	**$18,600,000**	**$18,571,000**

Phase II	***Alternate #1***	***Alternate #2***	***Alternate #3***
Wells/Water Treatment Plant	-----	-----	-----
Storage Tank	-----	$2,140,000	-----
Water Mains	$5,953,000	$2,432,000	$5,953,000
Pump Station	-----	$750,000	-----
Interconnections	$500,000	-----	-----
Pressure Reducing Valve (PRV) Vault	$300,000	-----	$300,000
Supervisory Control And Data Acquisition (SCADA)	-----	$75,000	-----
Subtotal Construction Cost	**$6,753,000**	**$5,397,000**	**$6,253,000**
Construction Contingency (25%)	$1,688,000	$1,349,000	$1,563,000
Total Opinion of Probable Construction Cost	**$8,441,000**	**$6,746,000**	**$7,816,000**
Project Contingency (20%)	$1,688,000	$1,349,200	$1,563,000
Subtotal	**$10,129,000**	**$8,095,000**	**$9,379,000**
Engineering & Implementation (25%)	$2,532,000	$2,024,000	$2,345,000
Total Opinion of Probable Cost - Phase II	**$12,661,000**	**$10,119,000**	**$11,724,000**
Total of Phase I and Phase II	**$31,157,000**	**$28,719,000**	**$30,295,000**

Notes:
- Costs in current dollars; Engineering News Record (ENR) 8094 (February 2008)
- Includes construction contingencies, project contingencies, engineering & implementation
- No allowance for inflation
- No allowance for legal fees, land taking or easements
- No allowance to negotiate intermunicipal agreements, contracts & purchase price
- Service connections & customer meters are not included; assumed to be at customer's cost

- ***Pump Station:*** Assumes a distribution system pump station on Hill Road near the proposed storage tank to pump from the low to high service system. The station would be equipped with standby power, and all required mechanical, electrical and instrumentation appurtenances.

- ***Interconnection:*** Alternative #1 – Independent System assumes two interconnections with Littleton, consisting of a vault, meter and associated mechanical piping and instrumentation. With a regional system under Alternatives #2 and #3, there may not be need for a meter vault which would reduce costs. However, if phasing proceeds with the Hill Road high pressure zone first, an allowance for an interconnection/pump station is included to ensure redundancy. Interconnection approaches would have to be explored further with Littleton during future facility planning efforts.

- ***Pressure Reducing Valves (PRVs):*** PRV vaults would be necessary within Boxborough in Alternatives #1 and #3. These would consist of a vault, PRV and associated mechanical and instrumentation appurtenances.

- ***SCADA:*** A Supervisory Control and Data Acquisition (SCADA) system is included to allow remote operations, continuous data collection, and alarming. The supply sources, treatment facility and hydraulic appurtenances would all be connected to SCADA, with a central control station. SCADA tie into Littleton is assumed under Alternatives #2 and #3.

4.2.1 Other Cost Considerations

- The Town may wish to consider storage tank sizing to accommodate future growth of the water distribution system to other areas of town. To meet this objective, CDM has estimated a storage tank volume of 2.0 million gallons based on future build-out analysis presented in the *Final Report – Water Resources Analysis Study*, (CDM, 2002). The resulting storage tank construction cost would be greater than that shown in Table 4-1.

- There may be an opportunity to incorporate Cisco water system infrastructure into the proposed service area. Cisco's water system includes three irrigation wells yielding 0.156 mgd and a drinking water well yielding 0.097 mgd. Associated infrastructure includes a 6-inch water main ~2,500 feet in length on Beaver Brook Road. The Town might consider discussing with Cisco the possibility of incorporating the drinking water well into the distribution system and using the associated infrastructure. This would not only provide valuable water yield, but also provide a capital cost savings to the Town. To further consider this concept, discussions would first be necessary with Cisco to obtain more detailed facility information, followed by an engineering and hydraulic assessment. The consideration of Cisco infrastructure might be considered during a future distribution system facility planning effort.

- If during groundwater exploration the extended-duration pumping test reveals that the site can not meet the anticipated maximum day demand, efforts and funds will be required to locate an additional groundwater supply source. Depending upon the location of such a source, additional supply and distribution system facilities might be required. Treatment requirements may also vary from those assumed for this project cost estimate.

Section 5
Conclusions and Recommendations

5.1 Conclusions

The selection of an alternative for phased water distribution system implementation will likely be highly dependent on capital costs and institutional considerations. The Town must also recognize the necessity for providing adequate supply with redundancy and ensuring that hydraulic requirements can be met through proper system operations. The alternatives presented in Section 4.1 consider these engineering needs for the proposed initial service area (Figure 1-2), relative to the possibility of inter-municipal cooperation with the Town of Littleton.

Through the engineering analysis and development of alternatives, CDM has concluded that:

- Estimated water demands of the proposed service area, inclusive of current, permitted and proposed development are as follows:

  Average day demand: 0.37 mgd
  Maximum day demand: 0.97 mgd
  Peak hour demand: 1.68 mgd

  A new well supply at the Harvard Sportsmen's Club of 1.0 mgd capacity would be adequate to meet the expected maximum day demand. However, further groundwater exploration, including an extended-duration pumping test, is required to verify site yield. It may be determined that an additional supply source is necessary. Treatment requirements of a new supply must still be determined.

- Development of a water distribution system in the proposed service area will require two pressure zones. Based on topography, a low pressure zone would operate for all areas west of I-495 and in areas east of I-495 from Massachusetts Avenue, north along Hill Road to Whitcomb Road. Areas along Hill Road north of Whitcomb Road to the Littleton town-line are of significantly higher topography, requiring the establishment of a high pressure zone.

- The low pressure zone could in fact operate off the Town of Littleton's water distribution system with a connection at Monarch Drive, north of the proposed well site at the Harvard Sportsmen's Club property. In this case, Littleton's Oak Hill Tank would provide the necessary water storage components for Boxborough's low pressure zone. In addition, this interconnection between Boxborough and Littleton would allow flow in either direction; therefore, allowing shared capacity of a new production well.

- The high pressure zone will require a water storage tank on Hill Road, in the vicinity of Whitcomb Road. The tank overflow is estimated to be 545 ft-msl. Given topographic elevation in the area of 450 ft-msl, tank height is estimated to be 95 feet. If the Boxborough system operates regionally with Littleton, a storage tank

capacity of 0.75 million gallons is sufficient. However, if Boxborough proceeds independently, with Littleton just providing emergency supply, then the required tank capacity is 1.2 million gallons.

- An independent system (Alternative #1) requires a water storage tank from the outset. Thus, phasing of Alternative #1 would require construction of the high pressure zone first, inclusive of Hill Road and the storage tank.

- With the regional approaches (Alternatives #2 and #3), Boxborough could implement either the low or high pressure zone first. If the low pressure zone is implemented first (Alternative #2), then a pumping station is required to boost water to the high pressure zone and storage tank along Hill Road.

- In the event that the Boxborough wellfield were to be off-line for an extended period, Alternative #2 would provide the most protection with regard to supply redundancy. The connection to Littleton at Monarch Drive and the presence of a booster station on Hill Road pumping into the high pressure zone would help ensure adequate supply to the entire service area. The proposed interconnection at Hill Road only allows flow from Boxborough to Littleton. Under Alternatives #1 and #3, a pumper truck would be required at Hill Road to boost water into the high pressure zone from Littleton in the event of an emergency.

- If expansion of the proposed service area is considered to other areas of town, the storage tank size may increase to 2.0 mg. Under this scenario, water main sizing would have to be further evaluated to determine if increased pipe diameters are warranted.

5.2 Recommendation

Based on these technical conclusions, the Town should consider the institutional issues associated with establishing a regional water system with Littleton. There is precedence for regionalization in that Boxborough is served electricity by the Littleton Electric, Light and Water Department. If regionalization is preferred, CDM recommends consideration of Alternative #2, with a phased approach. This would allow implementation of the low pressure zone first, which provides municipal water supply to those areas of town having the most significantly impacted groundwater quality. Once the well is operating and water demands in the low pressure zone are understood, the Town could consider expanding the service area to Hill Road, inclusive of the booster pump station and storage tank. This also provides time for the Town to consider water service extension to other areas of Boxborough, east of Hill Road. Planning for the high pressure zone tank and pump station could then consider these future needs, inclusive of any other supply sources identified.

An advantage of Alternative #2 is that it best ensures water supply redundancy from Littleton, for both Phase I and Phase II implementation. With this approach, resolution of Littleton's pressure issues at Hill Road would be addressed in Phase II.

Following discussions with the Boxborough Board of Health, several revisions have been incorporated into the Alternative #2 approach, which result in a reduction in Phase I cost. This revised approach is referred to as Alternative #2A. Table 5-1 shows

the revised project cost estimate for Alternate #2A. Additionally, Figure 5-1 presents the conceptual facility layout of Alternative #2A, with Phase I and Phase II system components identified.

The most notable change associated with Alternative #2A involves connecting the western and eastern ends of Whitcomb Road with a 12-inch water main, hanging inside an existing drainage box culvert beneath I-495. This connection will create a looped system under Phase I, thus increasing system reliability.

Other changes associated with Alternative #2A include shortening water mains on Codman Hill Road, Adams Place and Cunningham Road. Recognizing that customers will be responsible for all service connections, water main stubs will be left-in-place for future connections by apartment complexes, condominiums and large business developments.

5.3 Approach to Implementation

There are a variety of steps to be undertaken as the Town continues to consider development of a water distribution system. These include tasks over the short-term to move the project forward, in anticipation of more extensive engineering efforts to be conducted over the long-term. Implementation of a new water system should follow the MassDEP New Source Approval Process (see Table 3-1).

5.3.1 Short-Term Efforts

- ***Continue Test Well Exploration at HSC:*** A supply source must be established with regard to both quality and quantity. This requires further exploration at the Harvard Sportsmen's Club (HSC) to verify the anticipated yield. The CDM letter report of September 15, 2006 regarding the testing program at the HSC satisfies Step 1 of the New Source Approval Process (see Table 3-1). Therefore, the Town could move forward with Step 2 – Water Management Act Program Site Screening Requirements. In association with Step 2, CDM recommends that the Town also initiate Step 3 – Application for Approval to Site a Source and Conduct a Pumping Test. Completion of Steps 2 and 3 should provide an indication of the viability of the site from an environmental screening standpoint. These efforts, once approved by MassDEP, will set the stage for performance of a pumping test (Steps 6 and 7), preparation of a Source Final Report (Step 8) and preparation of a Water Management Act (WMA) permit application (Step 9). Given the numerous permits required of any new groundwater supply to address well drawdown impacts, the Town should expect a 5-7 year permitting process.

- ***Ensure Adequate Supply Capacity:*** Establishment of well yield will allow confirmation that water demands can be met. If testing reveals the well yield at the HSC to be insufficient, additional sources of supply would require development. The Town is currently continuing to explore for test well sites. It is recommended that these efforts continue, with additional sites for potential supply held for future development.

Table 5-1
Alternative #2A – Estimate of Probable Cost

Phase I	***West of I-495 Alternate #2A***
Wells/Water Treatment Plant	$2,800,000
Storage Tank	-----
Water Mains	$5,132,000
Pump Station	-----
Interconnections	-----
Pressure Reducing Valve (PRV) Vault	-----
Supervisory Control And Data Acquisition (SCADA)	$125,000
Subtotal Construction Cost	**$8,057,000**
Construction Contingency (25%)	$2,014,000
Total Opinion of Probable Construction Cost	**$10,071,000**
Project Contingency (20%)	$2,014,000
Subtotal	**$12,085,000**
Engineering & Implementation (25%)	$3,021,000
New Source Approval & Facility Planning Allowance	$1,500,000
Total Opinion of Probable Cost - Phase I	**$16,607,000**

Phase II	***Alternate #2A***
Wells/Water Treatment Plant	-----
Storage Tank	$2,140,000
Water Mains	$2,432,000
Pump Station	$750,000
Interconnections	-----
Pressure Reducing Valve (PRV) Vault	-----
Supervisory Control And Data Acquisition (SCADA)	$75,000
Subtotal Construction Cost	**$5,397,000**
Construction Contingency (25%)	$1,349,000
Total Opinion of Probable Construction Cost	**$6,746,000**
Project Contingency (20%)	$1,349,000
Subtotal	**$8,095,000**
Engineering & Implementation (25%)	$2,024,000
Total Opinion of Probable Cost - Phase II	**$10,119,000**
Total of Phase I and Phase II	**$26,726,000**

Notes:
- Costs in current dollars; Engineering News Record (ENR) 8094 (February 2008)
- Includes construction contingencies, project contingencies, engineering and implementation
- No allowance for inflation
- No allowance for legal fees, land taking or easements
- No allowance to negotiate intermunicipal agreements, contracts & purchase price
- No allowance for service connections and meters; assumed a customer cost.

Oak Hill Standpipe

6”

8”

6”

8”

10”

10”

10”

Littleton

Boxborough

Interconnection (Monarch Drive)

Pressure Reducing Valve (Approx.)

Interconnection (Hill Road)

Water Treatment Plant

Wells

High Service Area

Low Service Area

Pump Station

Service Area Limit

WHITCOMB RD

SWANSON RD

MASS AVE

CODMAN HILL RD

HILL RD

BEAVER BROOK RD

8" Phase I – Low Service Area

12" Phase I – Low Service Area

8" Phase II – High Service Area

12" Phase II – High Service Area

Existing Town of Littleton Water Mains

= Potential Areas for Storage Tank

Feet

0 1,000 2,000

Town of Boxborough, Massachusetts
Water Distribution System Feasibility Study

Figure 5-1

Alternative 2A – Conceptual Facility Layout

CDM

- ***Evaluate Regionalization with Littleton:*** Discussions with the Town of Littleton should continue regarding the concept of regionalization versus an independent system. In either circumstance, Littleton has a role to play, whether as an emergency supply source, contract operator, or as part of a regional system with interdependent hydraulic operations.

- ***Coordinate with Cisco Systems:*** The Town should initiate discussions with Cisco Systems on a variety of items.

  - In developing the water demand estimate, it is apparent that Cisco would be the largest user once buildout is achieved on the Cisco campus. However, it may be that Cisco, having its own water supply sources, does not have interest in joining a municipal water system. Further, if the Cisco campus is not going to be fully developed, anticipated water demands of the Boxborough system could be substantially less. The result would be less water required and a possible reduction in infrastructure needs. Therefore, having an understanding of Cisco's plans could help in refining facilities and capital costs.

  - If Cisco were to join the municipal system, there may be an opportunity to use or acquire some of Cisco's water system infrastructure. For instance, Cisco's production well is approved to supply 0.097 mgd, which could conceivably become a component of the Town's supply. Also, the water main along Beaver Brook Road could be assessed relative to its use as part of the service area distribution piping.

- ***Further Discussions with the Harvard Sportsmen's Club:*** Enter into preliminary discussions with the HSC regarding a future land acquisition for the production wells, 400 foot protective radius and treatment facility. Although land acquisition would not likely occur until the test site is approved as a production well by MassDEP, an understanding of facilities needed and potential location to minimize impacts on HSC would benefit the facility planning process.

- ***Develop a Facility Plan:*** Facility planning efforts should continue, with this feasibility study serving as the guide. Further discussions with Littleton, Cisco and the HSC may help the Town in selection of a preferred alternative and the siting of facilities. Other efforts include:

  - Refinement of the population, commercial growth and water demand estimates as time passes. In addition, demand projections over a minimum 20 year period for the service area should be developed to ensure sufficient capacity.

  - Consideration of storage tank location with regard to siting and land acquisition should be initiated relative to design requirements, parcel availability and neighbor concerns.

  - Hydraulic analysis of Littleton's system relative to a regional connection with Boxborough is necessary to establish current pressures and fire flow at the

town-line. Storage tank sizing may be impacted by the potential need for the high pressure service area to extend into Littleton.

- ISO updates are appropriate to more firmly establish fire flow requirements. This in turn may impact water tank sizing.

- Based on the results of groundwater exploration at the HSC and the selection of production well sites, facility planning can proceed for water supply development. This would include a preliminary assessment of water quality piloting, treatment, pump station components, standby power, transmission main, instrumentation, etc.

- The incorporation of SCADA into the project will require some decisions on the use of telemetry or radio signals. Compatibility with Littleton's SCADA system may be required. Consideration should be given to selecting the most appropriate SCADA for Boxborough and determining the means by which it will be established.

- Update of the project's capital costs should be conducted periodically as new information becomes available. Refinement of project phasing is also appropriate based on funding availability and project requirements.

- ***Develop a Business Plan:*** Step 9 of the New Source Approval (NSA) Process (see Table 3-1) requires that new systems "assess capacity" for the purpose of addressing technical, managerial, and financial capacity. The contents of this business plan will be highly dependent on the Town's approach to proceed independently (Alternative #1) or to regionalize with Littleton (Alternative #2 or #3). Based on the MassDEP guidelines, it is expected that portions of the business plan will be initiated during Steps 2 and 3 of the NSA.

- ***Establish a Funding Mechanism:*** The Town should initiate consideration of the funding mechanism(s) over both the short-term and long-term. Short-term funding for proceeding with the New Source Approval Process and associated facility planning can be obtained from the CY2008 Drinking Water State Revolving Fund (SRF) loan program. The project is on the SRF Intended Use Plan (IUP) for $500,000. To use the SRF, the Town must appropriate funds by June 30, 2008 and submit a SRF application by October 15, 2008. The Town should also be considering long-term funding approaches for future capital costs, whether from Town meeting, and/or other grant/loan programs.

5.3.2 Long-Term Efforts

- ***Permit New Supply Source:*** Steps 11-16 of the NSA focus on the environmental permitting aspects of a new supply source. These might include: compliance with the Water Management Act, Interbasin Transfer Act, Massachusetts Environmental Policy Act (MEPA), Army Corps of Engineers wetlands permitting, and 401 Water Quality Certification. The Town would not likely initiate these permits until the Source Final Report is submitted. Furthermore, it would be expected that MEPA

compliance will require an Environmental Impact Report (EIR) to focus on the distribution system in addition to well drawdown issues.

- ***Design Facilities:*** Facility design of the production wells and associated treatment represents Step 18 of the NSA Process. A water quality pilot program and design criteria report would likely be required to first establish water treatment facility needs. Distribution system components will also require the establishment of specific design criteria preceding design. This may include hydraulic modeling of the proposed system to verify system components, in association with Littleton.

- ***Construction:*** A phased construction program is anticipated, once all permits are in hand. Multiple construction contracts would likely be bid and managed to ensure appropriate contractors for each facility.

Appendix A

CDM, September 15, 2005
Summary of 2.5-Inch Test Well Installations in Unconsolidated Sand and Gravel Deposits, Groundwater Exploration Program
Town of Boxborough, Massachusetts

One Cambridge Place, 50 Hampshire Street
Cambridge, Massachusetts 02139
tel: 617 452-6000
fax: 617 452-8000

September 15, 2006

Mr. Michael Willis, Chairperson
Water Resources Committee
Town Hall
29 Middle Road
Boxborough, Massachusetts 01719-1402

Subject: Summary of 2.5-inch Test Well Installations in Unconsolidated Sand & Gravel Deposits
Groundwater Exploration Program
Town of Boxborough, Massachusetts

Dear Mr. Willis:

At your request, Camp Dresser & McKee Inc. (CDM) is pleased to present this letter report summarizing the results of the recent 2.5-inch test well installations conducted in unconsolidated sand and gravel deposits. The work has been performed for the Town of Boxborough as part of the ongoing Groundwater Exploration Program.

The 2.5-inch test wells were conducted at two locations within Boxborough:

- On private property owned by the Harvard Sportsmen's Club; and,
- On town owned property off of Hazard Lane.

The results of each test site are discussed below and in the attached report prepared by D.L. Maher a division of Boart Longyear (Maher).

2.5-inch Test Well Installations – Harvard Sportsmen's Club

An assessment of potential water quantity and quality available for municipal well development was conducted at property owned by the Harvard Sportsmen's Club (HSC) in the northwest corner of Boxborough. Three sites (referred to as Sites #1-06, #2-06 and #3-06) were identified by Maher for testing on HSC property (see Figure 1). These sites were selected by Maher based upon the following factors:

- Favorable hydrogeologic conditions based upon a review of site topography, geomorphology, and previous area-wide testing results;

- Recharge potential suitable to sustain a viable withdrawal rate;
- Sufficient area for future land acquisition to satisfy the MassDEP protective radius known as Zone I for municipal well supply development[1];
- Sufficiently set-back from any known or potential sources of pollution.

Once the Town obtained access permission from the HSC and approval from the Boxborough Conservation Commission, test well installations proceeded by Maher, serving as a subcontractor to CDM. Maher's report (see Attachment 1) presents the test well program results, along with test well logs and water quality sample results for general chemistry parameters and volatile organic compounds (VOCs). Table 1 summarizes all test well installations. Table 2 summarizes the water quality results.

Site #1-06: Site #1-06 is located about 1,200 feet southwest of the HSC clubhouse. At a depth of 56 feet, the test well yield was 75 gpm. Following a short-duration pumping test, samples were collected for general chemistry and VOC analysis. Laboratory results indicated favorable water quality. Based upon the high yield and favorable water quality, further exploration of this site should be considered.

Site #2-06: Site #2-06 was conducted adjacent to an existing 2.5-inch test well installed in the 1970s or 1980s as part of a Littleton groundwater exploration program. The test well was driven to only 35 feet below ground surface. The well's yield was not favorable and gray strata present at this location suggested that high iron and/or manganese concentrations may be likely. A water sample analyzed for general chemistry parameters indicated iron and manganese exceeding drinking water Secondary Maximum Contaminant Levels (SMCLs). These concentrations may also have been representative of sediment present in the sample, as indicated by high turbidity, color and total dissolved solids. Based upon the low yield and less than favorable water quality, no further exploration is recommended at this site.

Site #3-06: Site #3-06 is located approximately 1,200 feet north-northwest of the HSC clubhouse near the Littleton/Boxborough townline. The test well, driven to 35 feet below ground surface, had a favorable yield of 75 gpm. A short-duration pumping test was conducted with water quality samples collected. Laboratory results indicated favorable water

[1] Per MassDEP Drinking Water Regulations (310 CMR 22.00), Zone I is the protective radius required around a public water supply well or wellfield. For wells with approved yields of 0.1 mgd or more, the Zone I radius is 400 feet; for tubular wellfields the protective radius requirement is 250 feet.

quality. Based upon the high yield and favorable water quality, further exploration of this site should be considered.

2.5-inch Test Well Installation – Hazard Lane

A single 2.5-inch test well was installed on town owned property off of Hazard Lane (Site #4-06 as shown on Figure 2), located in the southwest corner of Boxborough. Although the work proposed was not in a wetland resource area, prior approval of the Boxborough Conservation Commission was required as the property is town owned conservation land.

Given the size of the parcel, proximity to wetlands, and the need to ensure a MassDEP required protected radius (Zone I), only one test well was installed. The test well at Site #4-06 was drilled to 53 feet below ground surface (see Table 1). Strata encountered consisted of fine sand, silt and clay. The well yield was only 5 gpm, which is not considered favorable for further exploration. A water sample analyzed for general chemistry parameters indicated iron and manganese concentrations exceeding their respective SMCLs (see water quality data summarized on Table 2). Consequently, no further exploration is warranted at Hazard Lane.

Conclusions and Recommendations

Based on the results of the 2.5-inch test well program, the following conclusions are offered:

- Sites #1-06 and #3-06 on the Harvard Sportsmen's Club property are considered favorable for potential municipal groundwater supply development. Based on the preliminary testing conducted, it is estimated that a single gravel-packed production well at #1-06 could yield from 500 – 700 gpm or more. Site #3-06 could potentially provide a similar yield if developed as a wellfield consisting of three wells or more. However, Site #1-06 is preferable given the greater saturated thickness of permeable soils and proximity to multiple recharge sources. Further testing, inclusive of additional 2.5-inch test well installations, an extended-duration pumping test (minimum 5-day duration) and water quality sampling/analysis, would need to be conducted to confirm these yield estimates. If both sites were to be developed, we would expect some reduction in total safe yield due to well drawdown interference and limited recharge area.

- Water samples collected at #1-06 and #3-06 are of favorable quality, though several parameters such as alkalinity, hardness, nitrate, sulfate and chloride had higher concentrations at #3-06. Additional sampling will be required, including a more expansive parameter list, during any future testing to confirm these results. It should also be noted that although iron and manganese concentrations were favorable, it would not be unusual

for these concentrations to increase from long-term pumping operations of a final production well.

- Final yields of any municipal well supply are subject to the approval of the MassDEP, through the New Source Approval Process. This 15 step process is summarized in Attachment 2. The initial step, "*Step 1 – Explore Potential Groundwater Sources*" may be considered complete based upon the submission of this report. If the Town elects to pursue a site for groundwater supply development, the next step would be preparation of a *Request for Site Exam* for submittal to MassDEP. Please note that MassDEP is in the process of updating the New Source Approval Process, such that the steps outlined in Attachment 2 may be revised in the future.

- Any new well which will yield more than 0.1 mgd will require a permit from MassDEP in accordance with the Water Management Act (WMA). Submission of an Environmental Notification Form (ENF) in accordance with the Massachusetts Environmental Policy Act (MEPA) would also be required[2]. The charge of the WMA is to regulate the quantity of water withdrawn to ensure adequate water supplies for current and future needs. WMA review includes evaluation of such issues as environmental, ecologic, and hydrologic (i.e., streamflow) impacts as well as an assessment of impacts to other supply sources including those located downstream of the proposed well(s). As a result of this review, MassDEP issues a WMA permit, which will include well operation restrictions such as a maximum daily yield. WMA policy continues to undergo revision at the state-level, thus it is not entirely possible to identify the level of effort and requirements associated with this permitting process. The New Source Approval Process outline provided in Attachment 2 does identify how WMA and MEPA are currently intended to coordinate with the New Source Approval Process.

- The test well sites at the Harvard Sportsmen's Club are located in the Stony Brook portion of the Merrimack River Basin. The Massachusetts Water Resources Commission (WRC) of the Executive Office of Environmental Affairs (EOEA) is responsible for assessing the stress level (i.e., environmental vulnerability) of all river basins within the Commonwealth of Massachusetts. There are three levels of stress – low, medium and high. The Merrimack River Basin within Boxborough has been designated as "low stress" by the WRC. Though a

[2] Regarding groundwater supply development, an Environmental Impact Report (EIR) is categorically required for a proposed well yielding 1.5 mgd or more; and, for an interbasin transfer of 1.0 mgd or more or any amount determined significant by the WRC. Separate from the MEPA requirements for groundwater supply development, an EIR is also categorically required for a new municipal water system, new service to a water district across a municipal boundary, and construction of new water mains of ten miles or more in length.

site specific assessment is still necessary, this designation is the most favorable relative to the potential for water supply development with limited permit restrictions.

- The Interbasin Transfer Act (ITA) governs the transfer of water and wastewater between river basins within the Commonwealth of Massachusetts. If Boxborough develops and operates a new water supply, with consumers solely within Boxborough (assuming continued discharge to local septic systems), the ITA will not apply. However, if Boxborough jointly pursues a new supply with an adjacent community, the ITA may apply depending upon the service area and basin boundaries within that community. Therefore, applicability of the ITA will require consideration in the future depending on how Boxborough chooses to pursue source development. If an ITA permit is deemed necessary, application to the Water Resources Commission would be required. A permit, if granted, would include conditions governing water system operations and future requirements to ensure integrated water resource planning (i.e., relative to water, stormwater and wastewater).

The Next Steps

Based upon the conclusions presented above and the regulatory requirements associated with municipal well supply development, the town may consider the next steps relative to groundwater exploration in unconsolidated sand and gravel deposits:

1. A copy of this report should be forwarded to the Harvard Sportsmen's Club (HSC), in accordance with the Town/HSC "License Agreement" by which HSC granted access permission for 2.5-inch test well installations on their property.

2. Consideration should be given to further groundwater testing at Sites #1-06 and #3-06 at the HSC property, with Site #1-06 the preferable location of the two based on the greater thickness of sand deposits.

3. The Town should use GPS to more accurately locate test wells at Sites #1-06 and #3-06. By inputting this data into the Town's GIS assessor layer, distance to property lines can better be determined. During future testing phases, test wells representing potential production well locations should be cited to ensure opportunity for needed land acquisition. This may include field survey and flagging of property lines to ensure required setbacks when siting future test well installations.

4. Given the favorable results of groundwater exploration at Site #1-06 and #3-06, the town might seek a right of first refusal with HSC for acquisition of these sites and the

associated Zone I area radii, should HSC ever consider selling this property. Another option might be to seek an easement for water supply protection/development purposes from HSC, which would eliminate the potential for land use change (i.e., building construction) by HSC. Either option would enhance protection of this site for potential groundwater supply development purposes.

5. Once the bedrock test well exploration program is complete at Wolf Swamp and perhaps other areas of town, a re-assessment of all groundwater supply development alternatives should be undertaken. Specifically, this will include consideration of potential site yields, water quality, regional approaches to water supply/system development, need for back-up supply, institutional issues, regulatory requirements, and costs. Discussions with adjacent communities regarding a joint regional approach may also be appropriate at that time. Based on the results of this assessment, the Town would select the preferred site(s) for pursuit of a new well supply. A Request for Site Exam would then be prepared for that site for submittal to MassDEP, thereby, formally initiating the New Source Approval Process.

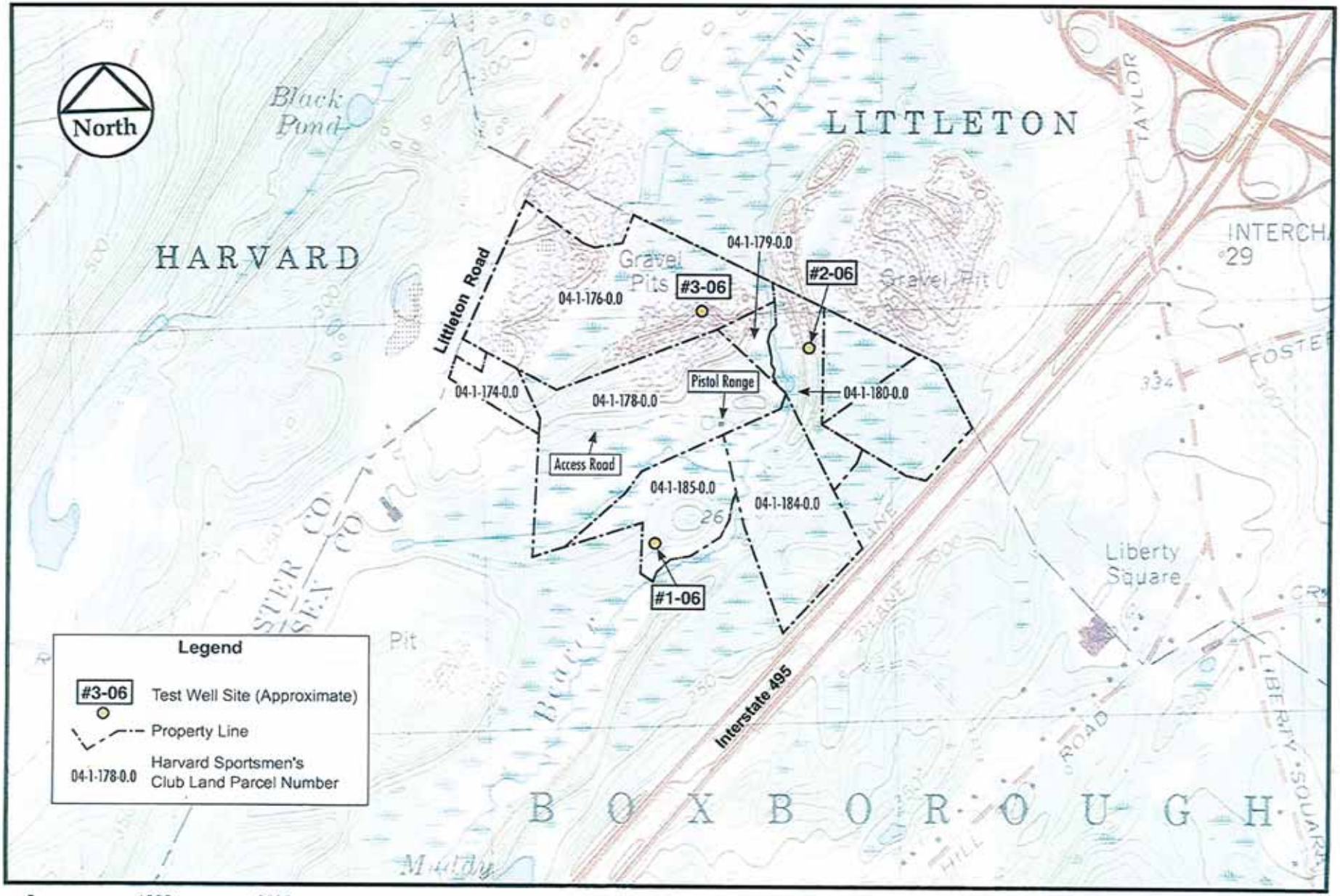
We look forward to continuing the groundwater exploration program at Wolf Swamp. In the meantime, please feel free to call me at (617) 452-6532 if you have any questions or require additional information.

Very truly yours,

Andrew B. Miller, P.E.
Principal Engineer
Camp Dresser & McKee Inc.

Attachments

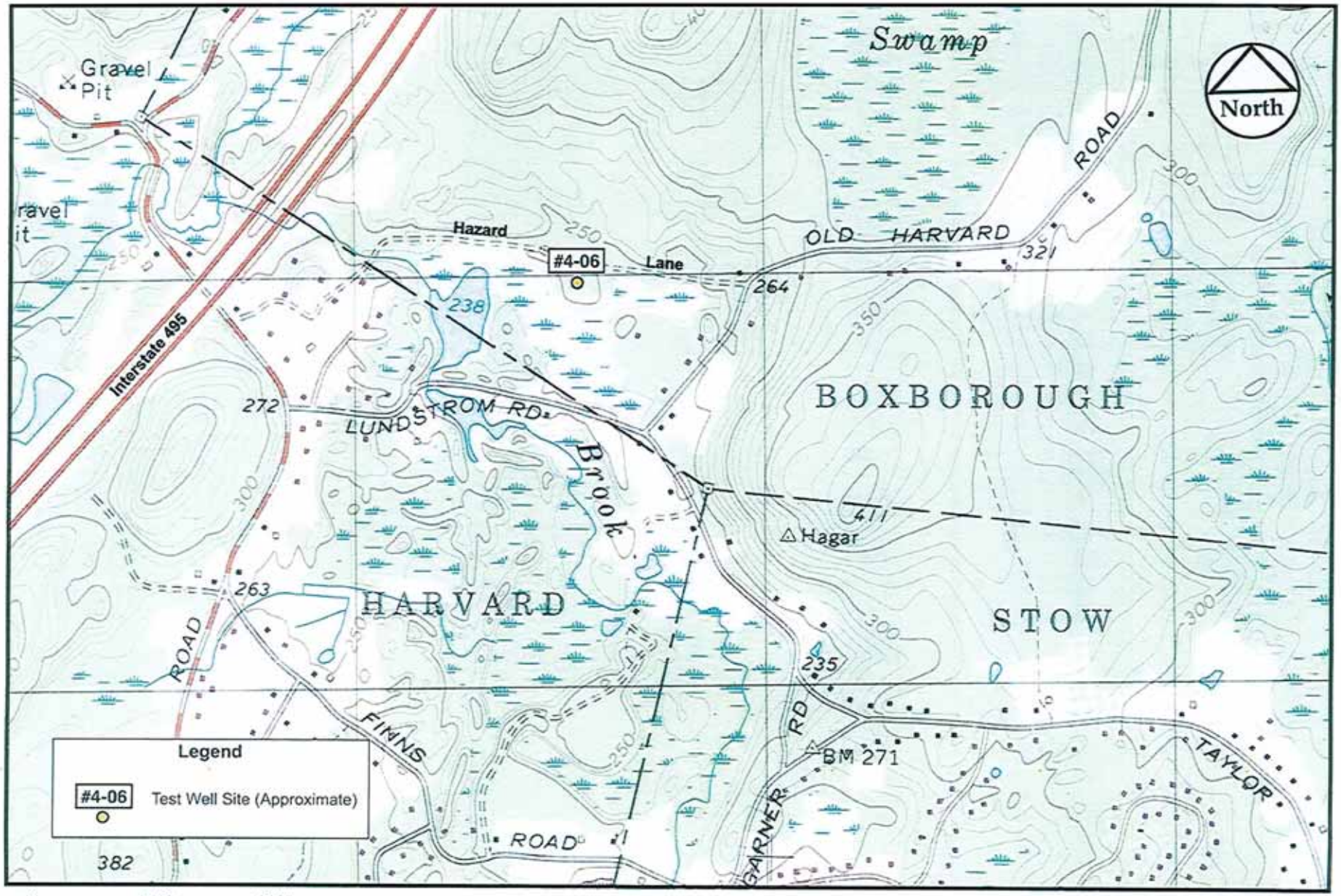
cc: Selina Shaw, Boxborough Acting Town Administrator
J. Theodore Morine – D.L. Maher a division of Bourt Longyear
William Pauk - CDM



CDM

Town of Boxborough, Massachusetts
Groundwater Exploration Program

Figure 1
2.5-Inch Test Well Installations-Harvard Sportsmen's Club (HSC)



Town of Boxborough, Massachusetts
Groundwater Exploration Program

Figure 2
2.5-Inch Test Well Installations-Hazard Lane

CDM

Table 1
Summary of 2.5-inch Test Well Installations
Groundwater Exploration Program - 2006
Town of Boxborough, Massachusetts

Test Well	Date	Driller	Drilling Depth (feet-bgs)	Well Completion Depth (feet-bgs)	Screen			Pumping Rate		Depth to Water (feet-bgs)	Short-Duration Pumping Test				Well Left-in-Place or Removed?
					Length (feet)	Interval (feet-bgs)	Slot Size (inches)	Rate (gpm)	Vacuum (inches)		Well Status	Date	Duration (hours)	Pumping Rate (gpm)	
Harvard Sportsmen's Club (HSC)															
1-06	5/15/2006	Maher	73 R	56	6	50 - 56	0.06	60	21	8.4	observation	5/17/2006	2	-	removed
1-06 obs	5/16/2006	Maher	56	55	6	49 - 55	0.08	75	19		pumping			75	left-in-place
2-06	5/18/2006	Maher	35	-	-	-	-	-	-	1.65	-	-	-	-	removed
3-06	5/17/2006	Maher	38 R	35	6	29 - 35	0.04	75	20	4.8	observation	5/18/2006	2	-	removed
3-06 obs	5/17/2006	Maher	35	35	6	29 - 35	0.05	75	20		pumping			75	left-in-place
Hazard Lane															
4-06	5/19/2006	Maher	53 R	35	6	29 - 35	0.02	3-5	28	14.0	-	-	-	-	removed

Notes:
feet-bgs: feet below ground surface
gpm: gallons per minute
R: indicated refusal encountered

Table 2
Summary of Water Quality Data
2.5-inch Test Wells
Groundwater Exploration Program
Town of Boxborough, Massachusetts

Parameter	Unit	Standard (a)	Sampling Results			
			Harvard Sportsmen's Club			Hazard Lane
			1-06	2-06	3-06	4-06
General Chemistry						
Turbidity	NTU	1 (b)	0.34	2.9	0.5	2.4
Total Dissolved Solids	ppm	500 (c)	25	515	98	45
Color	Color Units	15 (c)	0	25	0	5
pH	S.U.	6.5-8.5 (c)	6.0	6.0	6.1	6.2
Total Alkalinity	ppm	(d)	12.0	32.0	28.0	32.5
Total Hardness	ppm	(d)	10	145	54	20.0
Calcium	ppm	(d)	3.0	42.5	17.6	6.1
Magnesium	ppm	(d)	0.5	9.4	2.5	1.1
Aluminum	ppm	0.05 to 0.2 (c)	ND	ND	ND	0.14
Potassium	ppm	(d)	0.6	6.4	1.4	1.2
Total Iron	ppm	0.3 (c)	0.02	28.90	0.02	0.66
Total Manganese	ppm	0.05 (c)	ND	0.79	ND	0.08
Sulfate	ppm	250 (c)	2.5	16.9	17.5	8.0
Chloride	ppm	250 (c)	1.3	158.0	8.2	6.0
Silver	ppm	0.10 (c)	ND	ND	ND	ND
Copper	ppm	1.0 (c)	ND	ND	ND	ND
Zinc	ppm	5 (c)	0.02	ND	ND	0.02
Sodium	ppm	20 (e)	3.3	48.5	5.3	3.6
Nitrate	ppm	10 (b)	0.05	ND	2.6	0.15
Nitrite	ppm	1 (b)	ND	ND	ND	ND
Volatile Organic Compounds	ppb	---	ND	---	ND	---

ABBREVIATIONS:
ND: not detected (less than reporting limit)
NTU: nephelometric turbidity units
ppb: parts per billion (ug/L)
ppm: parts per million (mg/L)
---: not analyzed

NOTES:
(a) Federal and state drinking water standards
(b) Maximum Contaminant Level (MCL)
(c) Secondary Maximum Contaminant Level (SMCL)
(d) No standard
(e) Massachusetts drinking water guideline

Attachment 1

D.L. Maher Report
July 6, 2006
"Test Well Exploration with Unconsolidated Sediment,"
Boxborough, Massachusetts

BOART LONGYEAR

Boart Longyear Company
Drilling Services

DL Maher Division

71 Concord Street, North Reading, MA 01864
Tel: 781-933-3210 / Fax: 978-664-3299

www.boartlongyear.com

July 6, 2006

Mr. Andrew B. Miller, PE
Camp, Dresser & McKee
One Cambridge Place
50 Hampshire Street
Cambridge, MA 02139

RE: Test Well Exploration within unconsolidated sediments
Boxborough, Massachusetts

Dear Sir:

A town wide study to ascertain the likelihood for the development of potential public water supply wells had determined that certain areas might be suitable for shallow sand and gravel aquifers where other localities were better suited for deep rock wells. The information contain herein relates to the recent work undertaken within two parts of Boxborough where the geomorphology suggested that favorable saturated sediments might be found. Both of the areas being considered had sufficient area to circumscribe the required D.E.P protective radius know as Zone I, had recharge potential suitable to sustain a viable withdrawal rate, and were set back from known sources of pollution. Although other areas within the eastern and southern part of town had hydrogeologic conditions which might be favorable for the development of moderate yielding wells, development had encroached upon these sites thereby eliminating them from further consideration. The two remaining areas were the Harvard Sportsmen's Club in the northwestern part of town and Hazard Lane in the southwest. Because the Sportsmen's Club encompassed a much greater area and thereby offered many more potential drilling sites, this parcel was given a higher priority and therefore was evaluated first.

TW #1-06 is located about 1200 feet southwest of the Sportsmen's Clubhouse in the saddle between two small hillocks. Two and one half inch diameter steel test well casing was advanced to a depth of 73 feet below grade where refusal (Bedrock) was encountered. Wash samples were flushed from within the casing at seven foot intervals. The sediments were classified by color, grain size, and noted loss of wash water. With the stratigraphy indentified, the driller noted that favorable water bearing sediments terminated at 56 feet and were underlain by fine gray sand with silt. The casing was pulled back to 56 feet where a six foot length of .060 slot screen was set and exposed. After development by means of a diaphragm pump, the well was rated with a centrifugal pump at 60 GPM (gallons per minute) with 21 inches of vacuum. The static or natural ground water elevation was 9.90 feet below the top of the test well casing. Next, the driller moved two linear feet away and drove a second test casing to 56 feet. However, within this well he set six feet of .075 slot screen. With the coarser screen, this well was rated at 75 GPM and the vacuum dropped to 19 inches. A two hour pumping test was now conducted at 75 GPM with water level measurements being recorded in the first test well. The total drawdown measured was 1.31 feet. Recovery was within 0.04 feet of static after 15 minutes. Prior to shutdown, water samples were collected for Secondary Contaminants and Volatile Organic Compounds (V.O.C.'s). The original test well was pulled out of the ground.

TW #2-06 was driven adjacent to an existing two and one half inch test well which had originally been part of a testing program undertaken for Littleton Light and Water. Driven to the same depth (35.0 feet) the sediments to the 16 feet were fine to medium brown sand with some coarser particles. However, below this depth the color became gray with the sand and gravel mixed with silt. Although driven in the middle of an esker, the yield was poor and the gray color suggested that elevated iron and/or manganese concentrations were likely. The new test well was pulled out after a water sample was collected for Secondary Contaminants only.

The last site evaluated during this initial phase of Sportmen's Club exploration was TW #3-06. It lies about 1200 feet north northwest of the clubhouse not far from the Littleton-Boxborough

Town Line. Refusal was logged at 38 feet below grade which indicates that this site is nearer to the western edge of the north-south trending pre-glacial valley. Although shallower then TW #1-06, the fine to coarse brown sand with some gravel showed excellent transmissive potential. At 35 feet the driller set six feet of .040 slot screen. When developed, the well pumped 75 GPM with 20 inches of vacuum. The static water level was 6.80 feet below the top of the casing. An observation well was driven two linear feet away also to a depth of 35 feet. In this well the driller set and developed six feet of .050 slot screen. This well also yielded 75 GPM. During a two hour pumping test at 75 GPM the drawdown recorded two feet away was 1.74 feet. Water samples were collected for Secondary Contaminants and V.O.C.'s. TW #3-06 was pulled out.

The driller now moved across town to Hazard Lane, a non-paved east-west trending path west of Old Harvard Road. TW #4-06 was driven south of the lane near the northern-eastern part of Eldridge Pond about 2300 feet west of I-495. Depth to refusal was much greater than expected at 53 feet below grade. However, the sediments penetrated contained high concentrations of fine sand, clay and silt. The driller set six feet of .020 slot screen at 35 feet but the yield was only 5 GPM with a vacuum, a very high 28 inches. The static water level was 14.0 feet below the top of the casing. A water sample was collected for Secondary Contaminants before the well was removed.

The results of the chemical analysis show that the water quality at sites TW #1-06 and TW #3-06 is excellent. Both have low Iron and no Manganese. The Sodium is very low at both locations. There are no V.O.C.'s at either well site. However, the water at TW #3-06 has a higher Nitrate level as well as Hardness and Alkalinity. The water quality at TW #2-06 is extremely poor with very high Iron and Manganese. Sodium is above the recommended Maximum Contaminant Level (MCL). The Hardness is very high as is the Total Dissolved Solids. The water quality at TW #4-06 is excellent but as the test well showed little potential for yield the issue may be moot.

It is our belief that at the Harvard Sportmen's Club property two sources have been found, each of which has the potential to become a public water supply well or wellfield. Of the two locations, we believe that TW #1-06 is the most favorable. A single gravel packed well constructed at this site should produce from 500 -700 GPM. At TW #3-06, we would suggest that three gravel wells 50 feet on center also could produce a combined yield in the range of 500 – 700 GPM. However, please be aware that limited upgradient watershed would limit the safe yield should both of the proven sites be developed.

Due to the exceptional nature of these potential well sites, we recommend that the Town of Boxborough seek a Right of First Refusal from the Harvard Sportsmen's club to insure that any future land use will not encroach upon either location.

If we may provide any additional information, please contact us.

Very truly yours,

J. Theodore Morine

J. Theodore Morine
Senior Hydrogeologist

Boart Longyear Company
D.L. Maher Division

WELL LOG

D.L. MAHER CO. GROUND WATER CONSULTING • DRILLING SERVICES

71 CONCORD STREET, NORTH READING, MASSACHUSETTS 01864
617/933-3210 FAX: 508/664-3299

Well No. 1-06 D.L.M. Job No. 3450 3282-T

Driller B Callahan Helper J Malho

Job Name Boxboro MA

Location Harvard Sportsman's Club

Owner's Representative CDM

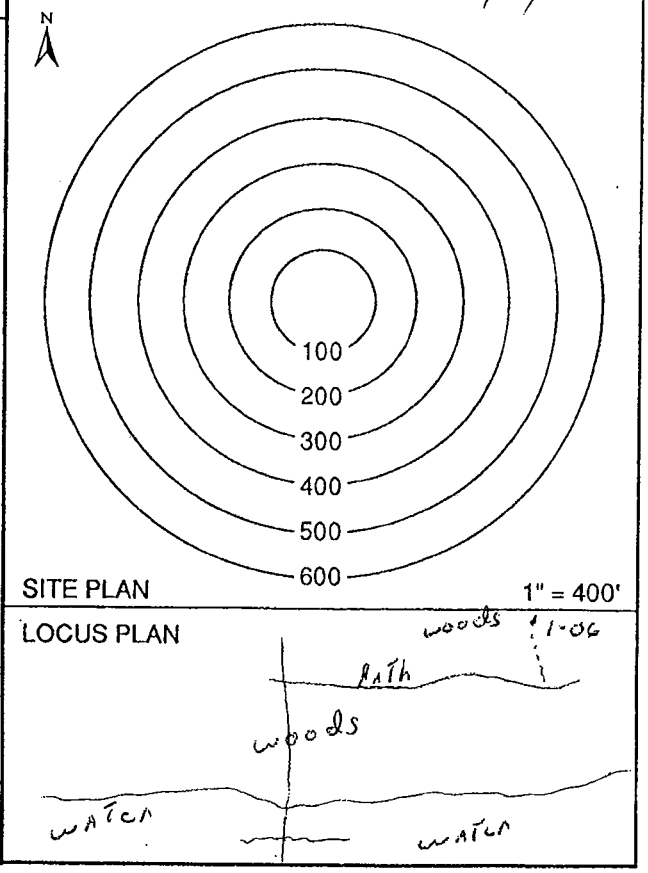
Date Started: 5/15/06 Date Finished: 5/17/06

DEPTH From	DEPTH To	Soil Classification	Loss of Wash Water
0	22'	Fine brown sand, Trace of silt	
22'	33'	Fine brown sand, some med brown sand	
33'	55'	Fine brown sand, Some med To coarse brown sand	Tr5
55'	65'	Fine To med grey sand Some coarse grey sand grey silt	
65'	73'	Fine grey sand, silt	
	73'	Refusal	

STATIC (From Top of Pipe) 8.40

DEPTH COMPLETED 56'

DEPTH TOTAL 73'



Well No.	Diam.	Total Depth	Comp. Depth	Casing Left	SCREEN Length	SCREEN Exposed	SCREEN Material	SCREEN Slot Size	SCREEN Riser	Hours Dev.	Hours Pumped
1-06	2"	73'	56'		6'	6'	SS	60	5'	2	4
2'	2"	56'	55'	49'	6'	6'	SS	80	5'	12	2

Pump Test Data

Well # 1-06 2'

Date / Time	G.P.M.	VAC	Water Levels Obs. No.	Obs. No.	Obs. No.
	Static				
	60	21"			
8.40	75	19"			

REMARKS:

pulled @ 1-06 5/17/06

Water Sample Collected

Date 5/17/06 Time 0900

Sent To: Thoestrasse lab

BOART LONGYEAR

DL Maher Division

Well No.: 1-06 2'ob

Location: Boxboro MA

RECORD OF TEST

Contract: 3450 3282-T

How Q Measured:

Date	Time (HHMM)	Elapsed Time	Pumping Rate	Well 1-06	Well	Well	Well	Well	Well	Well	Well	Well	Well	Remarks
Static				9.90										75 GPM
5/17														
1				11.02										
2				11.06										
3				11.08										
4				11.09										
5				11.10										
10				11.13										
20				11.15										
30				11.17										
40				11.18										
50				11.19										
1				11.20										
1½				11.20										
2				11.21		Took a water sample								
Recovery's														
1				1008										
3				1001										
5				999										
10				997										
15				994										

WELL LOG

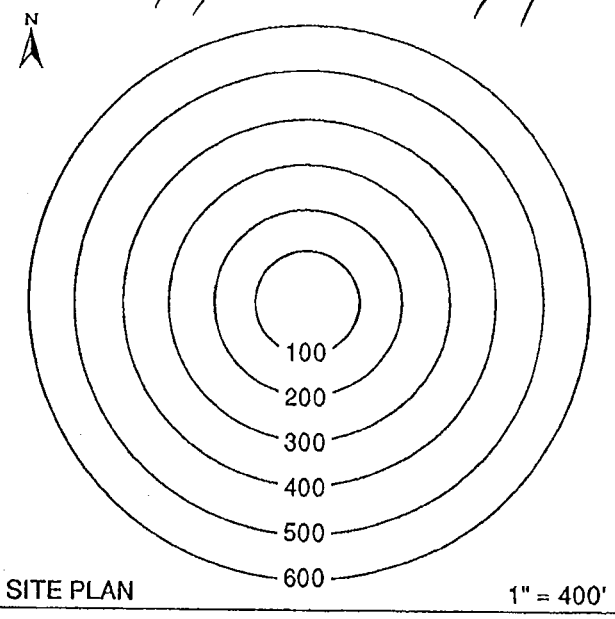
D.L. MAHER CO. GROUND WATER CONSULTING • DRILLING SERVICES

71 CONCORD STREET, NORTH READING, MASSACHUSETTS 01864
617/933-3210 FAX: 508/664-3299

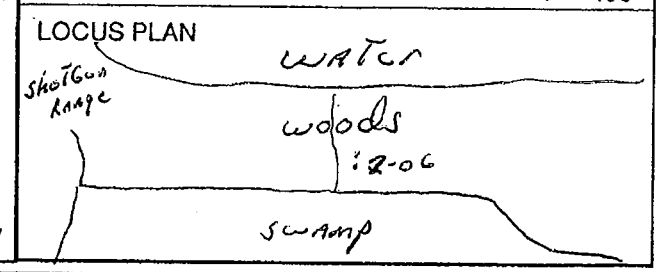
Well No. 2-06 D.L.M. Job No. 3450 3282-T
Driller BCallahan Helper J Malko
Job Name Boxboro MA
Location Harvard Sportsman's Club
Owner's Representative COM
Date Started: 5/18/06 Date Finished: 5/19/06

DEPTH From	DEPTH To	Soil Classification	Loss of Wash Water
0	16'	Fine To med brown sand, Some coarse sand	
16'	25'	Fine To coarse grey sand, sharp - broken gravel, silt	
25'	35'	Fine grey sand, Some med grey sand, silt	

STATIC (From Top of Pipe) 1.6'
DEPTH COMPLETED 0'
DEPTH TOTAL 0'



SITE PLAN 1" = 400'



Well No.	Diam.	Total Depth	Comp. Depth	Casing Left	SCREEN Length	SCREEN Exposed	SCREEN Material	SCREEN Slot Size	SCREEN Riser	Hours Dev.	Hours Pumped
2-06	2"	35'	0'	0'	-	-	✓	✓	-	-	-

Pump Test Data

Well #			Water Levels		
Date			Obs.	Obs.	Obs.
Time	G.P.M.	VAC	No.	No.	No.
	Static				

REMARKS:

pulled The well 5/19/06

Water Sample Collected
Date 5/18/06 Time 1400
Sent To: Thorstenson

WELL LOG

D.L. MAHER CO. GROUND WATER CONSULTING • DRILLING SERVICES

71 CONCORD STREET, NORTH READING, MASSACHUSETTS 01864
617/933-3210 FAX: 508/664-3299

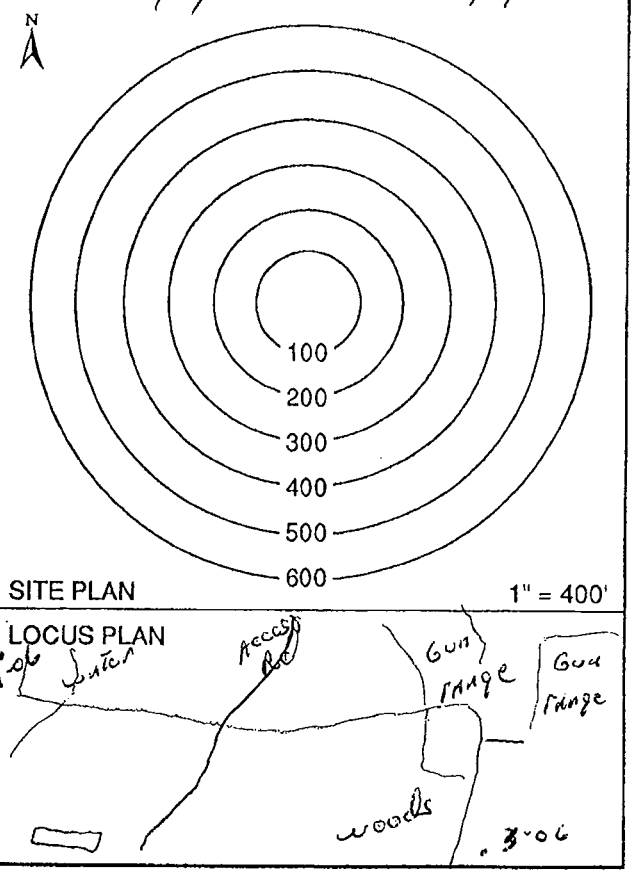
Well No. 3-06	D.L.M. Job No. 3450 3282-T
Driller A Callahan	Helper J malko
Job Name Boxboro MA	
Location Harvard Sportsmen's Club	
Owner's Representative CDM	
Date Started: 5/17/06	Date Finished: 5/18/06

DEPTH From	DEPTH To	Soil Classification	Loss of Wash Water
0	25'	Fine to med brown sand, some coarse brown sand, some gravel	
25'	38'	Fine Tannish brown sand, some med sand	
	38'	Refusal	

STATIC (From Top of Pipe) 4.80

DEPTH COMPLETED 35'

DEPTH TOTAL 38'



Well No.	Diam.	Total Depth	Comp. Depth	Casing Left	SCREEN Length	SCREEN Exposed	SCREEN Material	SCREEN Slot Size	SCREEN Riser	Hours Dev.	Hours Pumped
3-06	2.5	38'	35'		6'	6'	SS	40	5'	1½	½
2'	2.5	35'	35'	28'	6'	6'	SS	50	5'	2½	2

Pump Test Data

Well # 2-06 2'

Date	Time	G.P.M.	VAC	Water Levels Obs. No.	Obs. No.	Obs. No.
		Static				
4.80		25"	20"			

REMARKS:

pulled 3-06 5/18/06

Water Sample Collected

Date 5/18/06 Time 1300

Sent To: Thorstensen lab

BOART LONGYEAR

DL Maher Division

Well No.: 2-06

Location: Boxboro MA

RECORD OF TEST

Contract: 3450 3282-T

How Q Measured:

Date 5/18	Time (HHMM)	Elapsed Time	Pumping Rate	Well 2-06	Well	Well	Well	Well	Well	Well	Well	Well	Well	Remarks
Static				6.85'										75 GPM
1				8.53										
2				8.55										
3				8.54										
4				8.54										
5				8.55'										
10				8.56										
20				8.56										
30				8.56										
40				8.57										
50				8.57										
1				8.58										
1½				8.59										
2				8.59	Took a water sample									
recovery's														
1				6.92										
3				6.89										
5				6.86										

WELL LOG

D.L. MAHER CO. GROUND WATER CONSULTING · DRILLING SERVICES

71 CONCORD STREET, NORTH READING, MASSACHUSETTS 01864
617/933-3210 FAX: 508/664-3299

Well No. 4-06 D.L.M. Job No. 3450 3282-T
Driller B Callahan Helper J Malbo
Job Name Boxboro MA
Location Hazard Way
Owner's Representative COM
Date Started: 5/19/06 Date Finished: 5/22/06

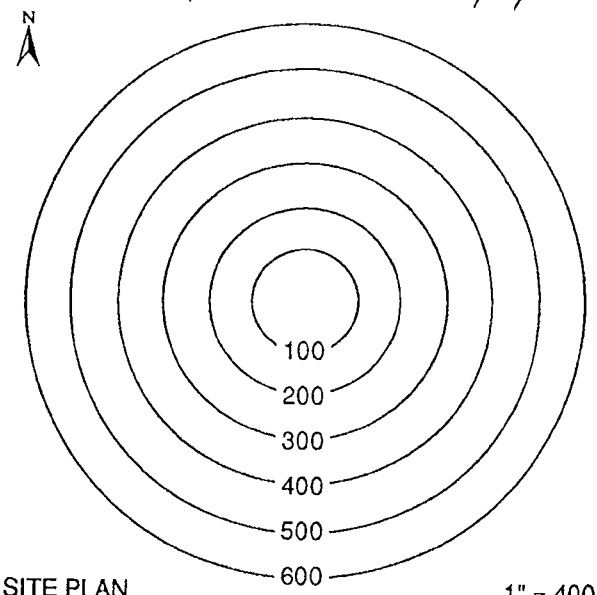
DEPTH From	DEPTH To	Soil Classification
0	6'	Fine To coarse brown sand, Gravel, cobbles chos. brown silt
6'	24'	Fine To coarse brown sand, Gravel, sharp and Broken, Traces of silt
24'	46'	Fine brown sand mica, silt
46'	53'	grey clay mixed with sharp broken gravel
	53'	Refusal

Loss of Wash Water

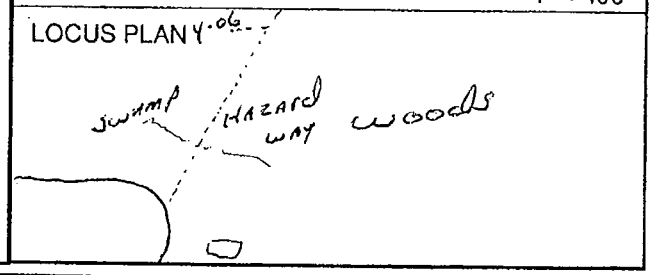
STATIC (From Top of Pipe) 14.00

DEPTH COMPLETED 35'

DEPTH TOTAL 53'



SITE PLAN 1" = 400'



Well No.	Diam.	Total Depth	Comp. Depth	Casing Left	SCREEN Length	SCREEN Exposed	SCREEN Material	SCREEN Slot Size	SCREEN Riser	Hours Dev.	Hours Pumped
4-06	2.5"	53'	35'	28'	6'	6'	SS	20	5'3	2½	1

Pump Test Data

Well # 4-06

Date	Time	G.P.M.	VAC	Water Levels Obs. No.	Obs. No.	Obs. No.
		Static				
	14.00	3-5	28"			

REMARKS:

Hard driving

Took a water sample pulled the well 5/22/06

Water Sample Collected
Date 5/22/06 Time 1230
Sent To: Thorstensen lab

Thorstensen Laboratory, Inc.
66 LITTLETON ROAD, WESTFORD, MA 01886 (978) 692-8395 FAX (978) 692-0023 1-800-649-TEST

Report Number: 100053
Report Date: 7/6/06

Client:

D.L. Maher
71 Concord Street
N. Reading MA 01864

PWS ID#:
Name: Harvard Gun Club
Town: Boxboro
Date Collected: 5/17/06
Collected by: D.L. Maher Staff
Location ID's:

	Number:	Name:
A:	2" observation	Well 1-06
B:		
C:		
D:		

Test Parameter	Date of Analysis	EPA Maximum	A	B	C	D	Detection Limit	Units	Analytical Method
Aluminum	5/18/06	Not Spec	ND				0.01	mg/L	200.7
Calcium	5/18/06	Not Spec	3				0.01	mg/L	200.7
Copper	5/18/06	1.3	ND				0.01	mg/L	200.7
Iron	5/18/06	0.3	0.02				0.01	mg/L	200.7
Magnesium	5/18/06	Not Spec	0.5				0.01	mg/L	200.7
Manganese	5/18/06	0.05	ND				0.01	mg/L	200.7
Sodium	5/18/06	none	3.3				0.1	mg/L	200.7
Potassium	5/18/06	Not Spec	0.6				0.1	mg/L	200.7
Silver	6/12/06	0.1	ND				0.001	mg/L	200.9
Zinc	5/18/06	5	0.02				0.01	mg/L	200.7
Alkalinity	5/17/06	Not Spec	12				1	mg/L	SM2320B
Chloride	5/17/06	250	1.3				0.1	mg/L	300.0
Color	5/17/06	15	0				0	CPU	SM2120B
Hardness	5/17/06	Not Spec	10				2	mg/L	SM2340B
pH	5/17/06	6.5-8.5	6.0					SU	150.1
Odor	5/17/06	3	0				0	TON	SM2150B
Sulfates	5/17/06	250	2.5				0.1	mg/L	300.0
Turbidity	5/17/06	1-5	0.34				0.1	NTU	SM2130B
TDS	5/23/06	500	25				1	mg/L	SM2540C
Nitrate	5/17/06	10.0	0.05				0.01	mg/L	300.0
Nitrite	5/17/06	1.0	ND				0.01	mg/L	300.0

ND=None Detected

Massachusetts State Certified
Testing Laboratory #MA048

Michael P. Carlson, for
Thorstensen Laboratory, Inc.

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

SECONDARY CONTAMINANT REPORT
(Thorstensen Replacement FORM #12.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:	2" observation	Well 1-06	5/17/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Was the sample collected after treatment? NO
11. Manifolded: [ ] If applicable, list the connected sources:

12. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Lab Sample ID	----	----	----	100053				
Turbidity NTU	SM2130B	0.1	5/17/06	0.34				
TDS	SM2540C	1	5/23/06	25				
Color (Color units)	SM2120B	0	5/17/06	0				
Odor(TON)	SM2150B	0	5/17/06					
pH	150.1		5/17/06	6.0				
Alkalinity total(CaCO3)	SM2320B	1	5/17/06	12.0				
Hardness	SM2340B	2	5/17/06	10				
Calcium(Ca)	200.7	0.01	5/18/06	3				
Magnesium(Mg)	200.7	0.01	5/18/06	0.5				
Aluminum(Al)	200.7	0.01	5/18/06	ND				
Potassium(K)	200.7	0.1	5/18/06	0.6				
Iron (Fe)	200.7	0.01	5/18/06	0.02				
Manganese(Mn)	200.7	0.01	5/18/06	ND				
Sulfate(SO4)	300.0	0.1	5/17/06	2.5				

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Chloride (Cl)	300.0	0.1	5/17/06	1.3				
Silver (Ag)	200.9	0.001	6/12/06	ND				
Copper (Cu)	200.7	0.01	5/18/06	ND				
Zinc (Zn)	200.7	0.01	5/18/06	0.02				

Laboratory Director Signature and Date Michael Carlson 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

N

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRATE REPORT
(Thorstensen Replacement FORM #1B.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:	2" observation	Well 1-06	5/17/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Is the sample Chlorinated? NO
11. Was the sample collected after treatment? NO
12. Manifolded: [ ] If applicable, list the connected sources:
13. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	0.05			
MCL (mg/L)	10.0			
Detection Limit (mg/L)	0.01			
Analytical Method	300.0			
Date Analyzed*	5/17/06			
Lab Sample ID#	100053			

* Holding time for chlorinated samples is 48 hours. Holding time for non-chlorinated samples is 14 days.

Laboratory Director Signature and Date Michael J. Carlton 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRITE REPORT
(Thorstensen Replacement FORM #1C.2)

I. PWS INFORMATION:

1. PWS ID#: 2. City/Town: Boxboro

3. PWS Name: Harvard Gun Club 4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:	2" observation	Well 1-06	5/17/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO 10. Was the sample collected after treatment? NO

11. Manifolded: [ ] If applicable, list the connected sources:

12. Routine [X] Special[ ] (explain below)

Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048

Subcontracted? N (use symbols to relate each analyte to a specific lab)

Sub Lab Name: Sub.Lab Cert.#:

Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	ND			
MCL (mg/L)	1.0			
Detection Limit (mg/L)	0.01			
Analytical Method	EPA 300.0			
Date Analyzed	5/17/06			
Lab Sample ID#	100053			

Laboratory Director Signature and Date Michael P. Carlson 7/6/06

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For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY
VOLATILE ORGANIC CONTAMINANT REPORT
(Thorstensen Replacement FORM #7.3)

I. PWS INFORMATION:

1. PWS ID#: _____ 2. City/Town: Boxboro

3. PWS Name: Harvard Gun Club 4. PWS Class (circle one) COM, NTNC, NC

5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by
2" Observ.	Well 1-06	5/18/06	D.L. Maher Staff

9. Is the Source Treated? 10. Was the Sample Collected after Treatment?

11. Manifolded [ ] If applicable, list the connected sources:

---

12. Routine [ ] Special [ ] (explain below)

Notes: ----

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert. #: M-MA048

Subcontracted? Y Lab Sample ID#: 100053

Sub Lab Name: New England Chromachem Sub. Lab Cert. #:MA072

Composited [ ] If applicable, list the composited sources:

Notes:

Compound (Regulated - has MCL)	Result µg/L	MCL µg/L	Detection Limit µg/L	Analytical Method	Date Analyzed
Benzene	ND	5.0	0.5	524.2	5/19/06
Carbon Tetrachloride	ND	5.0	0.5	524.2	5/19/06
1, 1-Dichloroethylene	ND	7.0	0.5	524.2	5/19/06
1, 2-Dichloroethane	ND	5.0	0.5	524.2	5/19/06
p-Dichlorobenzene	ND	5.0	0.5	524.2	5/19/06
Trichloroethylene	ND	5.0	0.5	524.2	5/19/06
1,1,1-Trichloroethane	ND	200.0	0.5	524.2	5/19/06
Vinyl Chloride	ND	2.0	0.5	524.2	5/19/06
Monochlorobenzene	ND	100.0	0.5	524.2	5/19/06
ortho-Dichlorobenzene	ND	600.0	0.5	524.2	5/19/06
trans-1,2-Dichloroethylene	ND	100.0	0.5	524.2	5/19/06
cis-1,2-Dichloroethylene	ND	70.0	0.5	524.2	5/19/06
1,2 -Dichloropropane	ND	5.0	0.5	524.2	5/19/06
Ethylbenzene	ND	700.0	0.5	524.2	5/19/06
Styrene	ND	100.0	0.5	524.2	5/19/06
Tetrachloroethylene	ND	5.0	0.5	524.2	5/19/06
Toluene	ND	1000.0	0.5	524.2	5/19/06
Xylene (total)	ND	10000.0	0.5	524.2	5/19/06
Dichloromethane	ND	5.0	0.5	524.2	5/19/06
1,2,4-Trichlorobenzene	ND	70.0	0.5	524.2	5/19/06
1,1,2-Trichloroethane	ND	5.0	0.5	524.2	5/19/06

Compound (Regulated - has MCL)	Result µg/L	Detection Limit µg/L	Analytical Method	Date Analyzed
Chloroform	ND	0.5	524.2	5/19/06
Bromodichloromethane	ND	0.5	524.2	5/19/06
Chlorodibromomethane	ND	0.5	524.2	5/19/06
Bromoform	ND	0.5	524.2	5/19/06
m-Dichlorobenzene	ND	0.5	524.2	5/19/06
Dibromomethane	ND	0.5	524.2	5/19/06
1,1-Dichloropropene	ND	0.5	524.2	5/19/06
1,1-Dichloroethane	ND	0.5	524.2	5/19/06
1,1,2,2-Tetrachloroethane	ND	0.5	524.2	5/19/06
1,3 -Dichloropropane	ND	0.5	524.2	5/19/06
Chloromethane	ND	0.5	524.2	5/19/06
Bromomethane	ND	0.5	524.2	5/19/06
1,2,3-Trichloropropane	ND	0.5	524.2	5/19/06
1,1,1,2-Tetrachloroethane	ND	0.5	524.2	5/19/06
Chloroethane	ND	0.5	524.2	5/19/06
2,2-Dichloropropane	ND	0.5	524.2	5/19/06
o-Chlorotoluene	ND	0.5	524.2	5/19/06
p-Chlorotoluene	ND	0.5	524.2	5/19/06
Bromobenzene	ND	0.5	524.2	5/19/06
1,3-Dichloropropene	ND	0.5	524.2	5/19/06
1,2,4-Trimethylbenzene	ND	0.5	524.2	5/19/06
1,2,3-Trichlorobenzene	ND	0.5	524.2	5/19/06
n-Propylbenzene	ND	0.5	524.2	5/19/06
n-Butylbenzene	ND	0.5	524.2	5/19/06
Naphthalene	ND	0.5	524.2	5/19/06
Hexachlorobutadiene	ND	0.5	524.2	5/19/06
1,3,5-Trimethylbenzene	ND	0.5	524.2	5/19/06
p-Isopropyltoluene	ND	0.5	524.2	5/19/06
Isopropylbenzene	ND	0.5	524.2	5/19/06
Tert-Butylbenzene	ND	0.5	524.2	5/19/06

Compound (Regulated - has MCL)	Result µg/L	Detection Limit µg/L	Analytical Method	Date Analyzed
sec-Butylbenzene	ND	0.5	524.2	5/19/06
Fluorotrichloromethane	ND	0.5	524.2	5/19/06
Dichlorodifluoromethane	ND	0.5	524.2	5/19/06
Bromochloromethane	ND	0.5	524.2	5/19/06
Methyl Tertiary Butyl Ether*	ND	0.5	524.2	5/19/06

*optional

Surrogate Recoveries (As required by EPA methods 524.2)

Compound	% Recovered	QC Limits (%)
4-bromofluorobenzene	99	80-120
1,2-dichlorobenzene-d_4	113	80-120

The QA/QC required matrix spike sample information is on file at our office.

Laboratory Director Signature and Date Michael P. Carlon 7/6/06

Attention: Mail TWO copies of this report to your **DEP Regional Office** within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

FOR DEP/DWS USE ONLY: PLEASE INITIAL AND DATE AS COMPLETED

Accepted:	Disapproved:	Date Entered into WQTS:
Comments:		

Thorstensen Laboratory, Inc.

66 LITTLETON ROAD, WESTFORD, MA 01886 (978) 692-8395 FAX (978) 692-0023 1-800-649-TEST

Report Number: 100118
Report Date: 7/6/06
Client:

PWS ID#:
Name: Harvard Gun Club
Town: Boxboro
Date Collected: 5/19/06
Collected by: D.L. Maher Staff
Location ID's:

	Number:	Name:
A:	Exist 2.5	Well 2-06
B:		
C:		
D:		

D.L. Maher
71 Concord Street
N. Reading MA 01864

Test Parameter	Date of Analysis	EPA Maximum	A	B	C	D	Detection Limit	Units	Analytical Method
Aluminum	5/22/06	Not Spec	ND				0.005	mg/L	200.9
Calcium	5/22/06	Not Spec	42.5				0.01	mg/L	200.7
Copper	5/22/06	1.3	ND				0.01	mg/L	200.7
Iron	5/22/06	0.3	28.9				0.01	mg/L	200.7
Magnesium	5/22/06	Not Spec	9.4				0.01	mg/L	200.7
Manganese	5/22/06	0.05	0.79				0.01	mg/L	200.7
Sodium	5/22/06	none	48.5				0.1	mg/L	200.7
Potassium	5/22/06	Not Spec	6.4				0.1	mg/L	200.7
Silver	6/12/06	0.1	ND				0.001	mg/L	200.9
Zinc	5/22/06	5	ND				0.01	mg/L	200.7
Alkalinity	5/19/06	Not Spec	32				1	mg/L	SM2320B
Chloride	5/19/06	250	158				0.1	mg/L	300.0
Color	5/19/06	15	25				0	CPU	SM2120B
Hardness	5/19/06	Not Spec	145				2	mg/L	SM2340B
pH	5/19/06	6.5-8.5	6.0					SU	150.1
Odor	5/19/06	3	0				0	TON	SM2150B
Sulfates	5/19/06	250	16.9				0.1	mg/L	300.0
Turbidity	5/19/06	1-5	2.9				0.1	NTU	SM2130B
TDS	5/23/06	500	515				1	mg/L	SM2540C
Nitrate	5/19/06	10.0	ND				0.01	mg/L	300.0
Nitrite	5/19/06	1.0	ND				0.01	mg/L	300.0

ND=None Detected

Massachusetts State Certified
Testing Laboratory #MA048

Michael P. Carlson, for
Thorstensen Laboratory, Inc.

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

SECONDARY CONTAMINANT REPORT
(Thorstensen Replacement FORM #12.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:	Exist 2.5	Well 2-06	5/19/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Was the sample collected after treatment? NO
11. Manifolded: [ ] If applicable, list the connected sources:

12. Routine [X] Special[ ] (explain below)

Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Lab Sample ID	----	----	----	100118				
Turbidity NTU	SM2130B	0.1	5/19/06	2.9				
TDS	SM2540C	1	5/23/06	515				
Color (Color units)	SM2120B	0	5/19/06	25				
Odor(TON)	SM2150B	0	5/19/06					
pH	150.1		5/19/06	6.0				
Alkalinity total(CaCO3)	SM2320B	1	5/19/06	32.0				
Hardness	SM2340B	2	5/19/06	145				
Calcium(Ca)	200.7	0.01	5/22/06	42.5				
Magnesium(Mg)	200.7	0.01	5/22/06	9.4				
Aluminum(Al)	200.7	0.01	5/22/06	ND				
Potassium(K)	200.7	0.1	5/22/06	6.4				
Iron (Fe)	200.7	0.01	5/22/06	28.9				
Manganese(Mn)	200.7	0.01	5/22/06	0.79				
Sulfate(SO4)	300.0	0.1	5/19/06	16.9				

PWSID#: (Form #12.2) Town: Boxboro

SEC_CON

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Chloride (Cl)	300.0	0.1	5/19/06	158.0				
Silver (Ag)	200.9	0.001	6/12/06	ND				
Copper (Cu)	200.7	0.01	5/22/06	ND				
Zinc (Zn)	200.7	0.01	5/22/06	ND				

Laboratory Director Signature and Date Michael J Carlson 7/8/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

N

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRATE REPORT
(Thorstensen Replacement FORM #1B.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:	Exist 2.5	Well 2-06	5/19/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Is the sample Chlorinated? NO
11. Was the sample collected after treatment? NO
12. Manifolded: [ ] If applicable, list the connected sources:
13. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	ND			
MCL (mg/L)	10.0			
Detection Limit (mg/L)	0.01			
Analytical Method	300.0			
Date Analyzed*	5/19/06			
Lab Sample ID#	100118			

* Holding time for chlorinated samples is 48 hours. Holding time for non-chlorinated samples is 14 days.

Laboratory Director Signature and Date Michael P. Carlson 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRITE REPORT
(Thorstensen Replacement FORM #1C.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:	Exist 2.5	Well 2-06	5/19/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Was the sample collected after treatment? NO
11. Manifolded: [ ] If applicable, list the connected sources:
12. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	ND			
MCL (mg/L)	1.0			
Detection Limit (mg/L)	0.01			
Analytical Method	EPA 300.0			
Date Analyzed	5/19/06			
Lab Sample ID#	100118			

Laboratory Director Signature and Date Michael P. Carlson 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

Thorstensen Laboratory, Inc.

66 LITTLETON ROAD, WESTFORD, MA 01886 (978) 692-8395 FAX (978) 692-0023 1-800-649-TEST

Report Number: 100091
Report Date: 7/6/06

Client:

D.L. Maher
71 Concord Street
N. Reading MA 01864

PWS ID#:
Name: Harvard Gun Club
Town: Boxboro
Date Collected: 5/18/06
Collected by: D.L. Maher Staff
Location ID's:

	Number:	Name:
A:		Well 3-06
B:		
C:		
D:		

Test Parameter	Date of Analysis	EPA Maximum	A	B	C	D	Detection Limit	Units	Analytical Method
Aluminum	5/19/06	Not Spec	ND				0.01	mg/L	200.7
Calcium	5/19/06	Not Spec	17.6				0.01	mg/L	200.7
Copper	5/19/06	1.3	ND				0.01	mg/L	200.7
Iron	5/19/06	0.3	0.02				0.01	mg/L	200.7
Magnesium	5/19/06	Not Spec	2.5				0.01	mg/L	200.7
Manganese	5/19/06	0.05	ND				0.01	mg/L	200.7
Sodium	5/19/06	none	5.3				0.1	mg/L	200.7
Potassium	5/19/06	Not Spec	1.4				0.1	mg/L	200.7
Silver	6/12/06	0.1	ND				0.001	mg/L	200.9
Zinc	5/19/06	5	ND				0.01	mg/L	200.7
Alkalinity	5/18/06	Not Spec	28				1	mg/L	SM2320B
Chloride	5/18/06	250	8.2				0.1	mg/L	300.0
Color	5/18/06	15	0				0	CPU	SM2120B
Hardness	5/18/06	Not Spec	54				2	mg/L	SM2340B
pH	5/18/06	6.5-8.5	6.1					SU	150.1
Odor	5/18/06	3	0				0	TON	SM2150B
Sulfates	5/18/06	250	17.5				0.1	mg/L	300.0
Turbidity	5/18/06	1-5	0.5				0.1	NTU	SM2130B
TDS	5/23/06	500	98				1	mg/L	SM2540C
Nitrate	5/18/06	10.0	2.6				0.01	mg/L	300.0
Nitrite	5/18/06	1.0	ND				0.01	mg/L	300.0

ND=None Detected

Massachusetts State Certified
Testing Laboratory #MA048

Michael P. Carlson, for
Thorstensen Laboratory, Inc.

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

SECONDARY CONTAMINANT REPORT
(Thorstensen Replacement FORM #12.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:		Well 3-06	5/18/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Was the sample collected after treatment? NO
11. Manifolded: [ ] If applicable, list the connected sources:

12. Routine [X] Special[ ] (explain below)

Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Lab Sample ID	----	----	----	100091				
Turbidity NTU	SM2130B	0.1	5/18/06	0.5				
TDS	SM2540C	1	5/23/06	98				
Color (Color units)	SM2120B	0	5/18/06	0				
Odor(TON)	SM2150B	0	5/18/06					
pH	150.1		5/18/06	6.1				
Alkalinity total(CaCO3)	SM2320B	1	5/18/06	28.0				
Hardness	SM2340B	2	5/18/06	54				
Calcium(Ca)	200.7	0.01	5/19/06	17.6				
Magnesium(Mg)	200.7	0.01	5/19/06	2.5				
Aluminum(Al)	200.7	0.01	5/19/06	ND				
Potassium(K)	200.7	0.1	5/19/06	1.4				
Iron (Fe)	200.7	0.01	5/19/06	0.02				
Manganese(Mn)	200.7	0.01	5/19/06	ND				
Sulfate(SO4)	300.0	0.1	5/18/06	17.5				

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Chloride (Cl)	300.0	0.1	5/18/06	8.2				
Silver (Ag)	200.9	0.001	6/12/06	ND				
Copper (Cu)	200.7	0.01	5/19/06	ND				
Zinc (Zn)	200.7	0.01	5/19/06	ND				

Laboratory Director Signature and Date Michael Carlson 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

N

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRATE REPORT
(Thorstensen Replacement FORM #1B.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:		Well 3-06	5/18/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Is the sample Chlorinated? NO
11. Was the sample collected after treatment? NO
12. Manifolded: [ ] If applicable, list the connected sources:
13. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	2.6			
MCL (mg/L)	10.0			
Detection Limit (mg/L)	0.01			
Analytical Method	300.0			
Date Analyzed*	5/18/06			
Lab Sample ID#	100091			

* Holding time for chlorinated samples is 48 hours. Holding time for non-chlorinated samples is 14 days.

Laboratory Director Signature and Date: Michael P. Carlson 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRITE REPORT
(Thorstensen Replacement FORM #1C.2)

I. PWS INFORMATION:

1. PWS ID#: 2. City/Town: Boxboro

3. PWS Name: Harvard Gun Club 4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:		Well 3-06	5/18/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO 10. Was the sample collected after treatment? NO

11. Manifolded: [ ] If applicable, list the connected sources:

12. Routine [X] Special[ ] (explain below)

Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048

Subcontracted? N (use symbols to relate each analyte to a specific lab)

Sub Lab Name: Sub.Lab Cert.#:

Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	ND			
MCL (mg/L)	1.0			
Detection Limit (mg/L)	0.01			
Analytical Method	EPA 300.0			
Date Analyzed	5/18/06			
Lab Sample ID#	100091			

Laboratory Director Signature and Date Michael J Carlson 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY
VOLATILE ORGANIC CONTAMINANT REPORT
(Thorstensen Replacement FORM #7.3)

I. PWS INFORMATION:

1. PWS ID#: _____ 2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club 4. PWS Class (circle one) COM, NTNC, NC

5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by
	Well 3-06	5/18/06	D.L. Maher Staff

9. Is the Source Treated? 10. Was the Sample Collected after Treatment?
11. Manifolded [ ] If applicable, list the connected sources:

---

12. Routine [ ] Special [ ] (explain below)
Notes: ----

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert. #: M-MA048
Subcontracted? Y Lab Sample ID#: 100091
Sub Lab Name: New England Chromachem Sub. Lab Cert. #:MA072
Composited [ ] If applicable, list the composited sources:

Notes:

Compound (Regulated - has MCL)	Result µg/L	MCL µg/L	Detection Limit µg/L	Analytical Method	Date Analyzed
Benzene	ND	5.0	0.5	524.2	5/20/06
Carbon Tetrachloride	ND	5.0	0.5	524.2	5/20/06
1, 1-Dichloroethylene	ND	7.0	0.5	524.2	5/20/06
1, 2-Dichloroethane	ND	5.0	0.5	524.2	5/20/06
p-Dichlorobenzene	ND	5.0	0.5	524.2	5/20/06
Trichloroethylene	ND	5.0	0.5	524.2	5/20/06
1,1,1-Trichloroethane	ND	200.0	0.5	524.2	5/20/06
Vinyl Chloride	ND	2.0	0.5	524.2	5/20/06
Monochlorobenzene	ND	100.0	0.5	524.2	5/20/06
ortho-Dichlorobenzene	ND	600.0	0.5	524.2	5/20/06
trans-1,2-Dichloroethylene	ND	100.0	0.5	524.2	5/20/06
cis-1,2-Dichloroethylene	ND	70.0	0.5	524.2	5/20/06
1,2 -Dichloropropane	ND	5.0	0.5	524.2	5/20/06
Ethylbenzene	ND	700.0	0.5	524.2	5/20/06
Styrene	ND	100.0	0.5	524.2	5/20/06
Tetrachloroethylene	ND	5.0	0.5	524.2	5/20/06
Toluene	ND	1000.0	0.5	524.2	5/20/06
Xylene (total)	ND	10000.0	0.5	524.2	5/20/06
Dichloromethane	ND	5.0	0.5	524.2	5/20/06
1,2,4-Trichlorobenzene	ND	70.0	0.5	524.2	5/20/06
1,1,2-Trichloroethane	ND	5.0	0.5	524.2	5/20/06

PWS ID #: Well 3-06 (Form #7.3) Town: Boxboro

Compound (Regulated - has MCL)	Result µg/L	Detection Limit µg/L	Analytical Method	Date Analyzed
Chloroform	ND	0.5	524.2	5/20/06
Bromodichloromethane	ND	0.5	524.2	5/20/06
Chlorodibromomethane	ND	0.5	524.2	5/20/06
Bromoform	ND	0.5	524.2	5/20/06
m-Dichlorobenzene	ND	0.5	524.2	5/20/06
Dibromomethane	ND	0.5	524.2	5/20/06
1,1-Dichloropropene	ND	0.5	524.2	5/20/06
1,1-Dichloroethane	ND	0.5	524.2	5/20/06
1,1,2,2-Tetrachloroethane	ND	0.5	524.2	5/20/06
1,3 -Dichloropropane	ND	0.5	524.2	5/20/06
Chloromethane	ND	0.5	524.2	5/20/06
Bromomethane	ND	0.5	524.2	5/20/06
1,2,3-Trichloropropane	ND	0.5	524.2	5/20/06
1,1,1,2-Tetrachloroethane	ND	0.5	524.2	5/20/06
Chloroethane	ND	0.5	524.2	5/20/06
2,2-Dichloropropane	ND	0.5	524.2	5/20/06
o-Chlorotoluene	ND	0.5	524.2	5/20/06
p-Chlorotoluene	ND	0.5	524.2	5/20/06
Bromobenzene	ND	0.5	524.2	5/20/06
1,3-Dichloropropene	ND	0.5	524.2	5/20/06
1,2,4-Trimethylbenzene	ND	0.5	524.2	5/20/06
1,2,3-Trichlorobenzene	ND	0.5	524.2	5/20/06
n-Propylbenzene	ND	0.5	524.2	5/20/06
n-Butylbenzene	ND	0.5	524.2	5/20/06
Naphthalene	ND	0.5	524.2	5/20/06
Hexachlorobutadiene	ND	0.5	524.2	5/20/06
1,3,5-Trimethylbenzene	ND	0.5	524.2	5/20/06
p-Isopropyltoluene	ND	0.5	524.2	5/20/06
Isopropylbenzene	ND	0.5	524.2	5/20/06
Tert-Butylbenzene	ND	0.5	524.2	5/20/06

Compound (Regulated - has MCL)	Result µg/L	Detection Limit µg/L	Analytical Method	Date Analyzed
sec-Butylbenzene	ND	0.5	524.2	5/20/06
Fluorotrichloromethane	ND	0.5	524.2	5/20/06
Dichlorodifluoromethane	ND	0.5	524.2	5/20/06
Bromochloromethane	ND	0.5	524.2	5/20/06
Methyl Tertiary Butyl Ether*	ND	0.5	524.2	5/20/06

*optional

Surrogate Recoveries (As required by EPA methods 524.2)

Compound	% Recovered	QC Limits (%)
4-bromofluorobenzene	99	80-120
1,2-dichlorobenzene-d_4	115	80-120

The QA/QC required matrix spike sample information is on file at our office.

Laboratory Director Signature and Date Michael P Carlson 7/6/06

Attention: Mail TWO copies of this report to your **DEP Regional Office** within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

FOR DEP/DWS USE ONLY: PLEASE INITIAL AND DATE AS COMPLETED

Accepted:	Disapproved:	Date Entered into WQTS:
Comments:		

Thorstensen Laboratory, Inc.

66 LITTLETON ROAD, WESTFORD, MA 01886 (978) 692-8395 FAX (978) 692-0023 1-800-649-TEST

Report Number: 1000163
Report Date: 7/6/06
Client:
PWS ID#:
Name: Harvard Gun Club
Town: Boxboro
Date Collected: 5/22/06
Collected by: D.L. Maher Staff
Location ID's:

D.L. Maher
71 Concord Street
N. Reading MA 01864

	Number:	Name:
A:		Well 4-06
B:		
C:		
D:		

Test Parameter	Date of Analysis	EPA Maximum	A	B	C	D	Detection Limit	Units	Analytical Method
Aluminum	5/23/06	Not Spec	0.14				0.01	mg/L	200.7
Calcium	5/23/06	Not Spec	6.1				0.01	mg/L	200.7
Copper	5/23/06	1.3	ND				0.01	mg/L	200.7
Iron	5/23/06	0.3	0.66				0.01	mg/L	200.7
Magnesium	5/23/06	Not Spec	1.1				0.01	mg/L	200.7
Manganese	5/23/06	0.05	0.08				0.01	mg/L	200.7
Sodium	5/23/06	none	3.6				0.1	mg/L	200.7
Potassium	5/23/06	Not Spec	1.2				0.1	mg/L	200.7
Silver	6/12/06	0.1	ND				0.001	mg/L	200.9
Zinc	5/23/06	5	0.02				0.01	mg/L	200.7
Alkalinity	5/22/06	Not Spec	32.5				1	mg/L	SM2320B
Chloride	5/22/06	250	6				0.1	mg/L	300.0
Color	5/22/06	15	5				0	CPU	SM2120B
Hardness	5/22/06	Not Spec	20				2	mg/L	SM2340B
pH	5/22/06	6.5-8.5	6.2					SU	150.1
Odor	5/22/06	3	4				0	TON	SM2150B
Sulfates	5/22/06	250	8.0				0.1	mg/L	300.0
Turbidity	5/22/06	1-5	2.4				0.1	NTU	SM2130B
TDS	5/25/06	500	45				1	mg/L	SM2540C
Nitrate	5/22/06	10.0	0.15				0.01	mg/L	300.0
Nitrite	5/22/06	1.0	ND				0.01	mg/L	300.0

ND=None Detected

Massachusetts State Certified
Testing Laboratory #MA048

Michael P. Carlson, for
Thorstensen Laboratory, Inc.

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

SECONDARY CONTAMINANT REPORT
(Thorstensen Replacement FORM #12.2)

I. PWS INFORMATION:

1. PWS ID#: 2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club 4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:		Well 4-06	5/22/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO 10. Was the sample collected after treatment? NO
11. Manifolded: [ ] If applicable, list the connected sources:

12. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Lab Sample ID	----	----	----	1000163				
Turbidity NTU	SM2130B	0.1	5/22/06	2.4				
TDS	SM2540C	1	5/25/06	45				
Color (Color units)	SM2120B	0	5/22/06	5				
Odor(TON)	SM2150B	0	5/22/06	4				
pH	150.1		5/22/06	6.2				
Alkalinity total(CaCO3)	SM2320B	1	5/22/06	32.5				
Hardness	SM2340B	2	5/22/06	20				
Calcium(Ca)	200.7	0.01	5/23/06	6.1				
Magnesium(Mg)	200.7	0.01	5/23/06	1.1				
Aluminum(Al)	200.7	0.01	5/23/06	0.14				
Potassium(K)	200.7	0.1	5/23/06	1.2				
Iron (Fe)	200.7	0.01	5/23/06	0.66				
Manganese(Mn)	200.7	0.01	5/23/06	0.08				
Sulfate(SO4)	300.0	0.1	5/22/06	8.0				

	Analytical Method	Detection Limit mg/L	Date Analyzed	Results mg/L A	B	C	D	Lab Symbol
Chloride (Cl)	300.0	0.1	5/22/06	6.0				
Silver (Ag)	200.9	0.001	6/12/06	ND				
Copper (Cu)	200.7	0.01	5/23/06	ND				
Zinc (Zn)	200.7	0.01	5/23/06	0.02				

Laboratory Director Signature and Date Michael McCarthy 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

N

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRATE REPORT
(Thorstensen Replacement FORM #1B.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:		Well 4-06	5/22/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Is the sample Chlorinated? NO
11. Was the sample collected after treatment? NO
12. Manifolded: [ ] If applicable, list the connected sources:
13. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	0.15			
MCL (mg/L)	10.0			
Detection Limit (mg/L)	0.01			
Analytical Method	300.0			
Date Analyzed*	5/22/06			
Lab Sample ID#	1000163			

* Holding time for chlorinated samples is 48 hours. Holding time for non-chlorinated samples is 14 days.

Laboratory Director Signature and Date Michael McCabe 7/8/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

MASSACHUSETTS DEP/DIVISION OF WATER SUPPLY

NITRITE REPORT
(Thorstensen Replacement FORM #1C.2)

I. PWS INFORMATION:

1. PWS ID#:
2. City/Town: Boxboro
3. PWS Name: Harvard Gun Club
4. PWS Class (circle one): COM, NTNC, NC

	5. DEP Source Code/Location ID	6. Sample Location	7. Date Collected	8. Collected by:
A:		Well 4-06	5/22/06	D.L. Maher Staff
B:				
C:				
D:				

9. Is the source Treated? NO
10. Was the sample collected after treatment? NO
11. Manifolded: [ ] If applicable, list the connected sources:
12. Routine [X] Special[ ] (explain below)
Notes:

II. LABORATORY ANALYTICAL INFORMATION:

Lab Name: Thorstensen Laboratory, Inc. Lab Cert.#: M-MA048
Subcontracted? N (use symbols to relate each analyte to a specific lab)
Sub Lab Name: Sub.Lab Cert.#:
Composited[ ] If applicable, list the composited sources:

Notes:

	Sample A	Sample B	Sample C	Sample D
Result (mg/L)	ND			
MCL (mg/L)	1.0			
Detection Limit (mg/L)	0.01			
Analytical Method	EPA 300.0			
Date Analyzed	5/22/06			
Lab Sample ID#	1000163			

Laboratory Director Signature and Date Michael F Carlton 7/6/06

Attention: Mail TWO copies of this report to your DEP Regional Office within 30 days of receipt of results and no later than 10 days after the end of the reporting period.

For DEP/DWS USE ONLY: PLEASE INITIAL & DATE AS COMPLETED

Accepted: Disapproved: Data entered into WQTS:

Comments:

Attachment 2

Outline of Current MassDEP New Source Approval Process

Attachment 2

Outline of Current MassDEP New Source Approval Process

September 13, 2006

The following outlines the current 15-step Source Approval process for bringing a new groundwater supply on-line, in accordance with the "2001 MassDEP Guidelines and Policies for Public Water Systems". Revisions to the Source Approval process are expected later this year. The outline below also incorporates requirements of the Water Management Program and Massachusetts Environmental Policy Act (MEPA).

Step 1 Explore Potential Groundwater Sources

Test well installations
Water quality sampling
Coordinate with Conservation Commission

Step 2 Submit "Request for Site Exam" to MassDEP

Land use review
Surveyed site plan
Preliminary review of environmental impacts
Water demand forecast
Wellhead protection strategy
Army Corps of Engineers Alternatives Analysis (in necessary)
Water Management Program Requirements (September 15, 2000)

- Site Screening Worksheet (inclusive of preliminary evaluation of streamflow impacts)
- Water Conservation Plan
- Alternative Analysis
- Early Notice – Environmental Monitor

Step 3 MassDEP Conducts Site Exam

Step 4 Small System Viability Assessment (for new small systems serving less than 1,000 people)

Step 5 Submit "Pumping Test Proposal" to MassDEP

Specify all testing procedures
Submit draft zoning and non-zoning groundwater protection controls
Coordinate with Conservation Commission

Step 6 MassDEP Approves Pumping Test Proposal
Need Conservation Commission approval

Step 7 Conduct Pumping Test

Step 8 Obtain MassDEP Approval to Shut Down Pumping Test

Step 9 Submit "Source Final Report" to MassDEP

Analysis of all test results
Assessment of effects upon surface waters, wetlands, nearby wells
Zone II delineation
Discussion of permanent well operating schedule
Final, or final draft, protection controls and protection district map
Proposed long-term groundwater monitoring program
Groundwater treatment requirements
Include complete application for Water Management Act permit
Army Corps of Engineers (ACOE) permit application (if appropriate)

Though not specified in the MassDEP Guidelines, these items should be added:

Preliminary facilities plan for water supply development
Construction cost estimate and schedule

Step 10 MassDEP Approves Source Final Report

Submit Environmental Notification Form (ENF) to comply with MEPA
Preparation of Environmental Impact Report (EIR), if required by MEPA
Interbasin Transfer Act (ITA) Compliance, if applicable
Obtain Water Management Act Permit

Step 11 Submit Design Plans for Permanent Works to MassDEP

Demonstrate Zone I site ownership

Step 12 MassDEP Approves Design Plans

Step 13 Notify MassDEP when Construction is Complete

Step 14 MassDEP Inspection of Permanent Works

Step 15 Meet Requirements of Surface Water Treatment Rule (SWTR)

Demonstrate the well meets SWTR exemption criteria, or take samples during long-term operation for microscopic particulates

Typical Phasing of Source Approval Programs

Phase I	Step 1, Groundwater Testing
Phase II	Pumping Test and Environmental Compliance
Phase IIA	Steps 2-4, Site Exam
Phase IIB	Steps 5-6, Pump Test Proposal
Phase IIC	Steps 7-10, Pumping Test and Source Final Report
Phase IID	MEPA and WMA Compliance
	ITA Compliance, if applicable
	ACOE Compliance, if applicable
Phase III	Facility Design and Construction
Phase IIIA	Steps 11-12, Design and Site Ownership
Phase IIIB	Steps 13-14, Construction
Phase IIIC	Step 15, SWTR Compliance

Appendix B

Letter of Support from the Town of Littleton regarding Boxborough Water District

LITTLETON
LELWD
ELECTRIC LIGHT & WATER DEPARTMENTS

39 Ayer Road, P. O. Box 2406
Littleton, MA 01460-3406
Telephone (978) 486-3104
Fax (978) 486-8549
www.lelwd.com

Savas C. Danos, General Manager

August 29, 2007

Via fax and 1st Class Mail
(617) 452-6532
1 of 5 pages

Andrew B. Miller, P.E.
Principal Engineer
Camp Dresser & McKee, Inc.
One Cambridge Place
50 Hampshire Street
Cambridge, MA 02139

RE: Boxborough Water District Support

Dear Mr. Miller:

Pursuant to the many discussions and meeting I have had, both with the Boxborough Water Advisory Committee and your office, I approached the Littleton Board of Water Commissioners at their regularly scheduled meeting on December 18th, 2006. The details of the Boxboro proposal are summarized on the attached memo, distributed and discussed at that Board Meeting.

The Board authorized me to continue to work with CDM (and/or any other consulting engineers) and the Boxborough Water Advisory Committee (and/or any other duly elected/appointed town board/committee) towards the goals as outlined in the proposal summarized on pages 2 and 3 of the attached memo.

I look forward to our continued pursuit of a water district for the Town of Boxborough, operated and managed by the Littleton Water Department, in a manner similar to the operation and management of our electric distribution facilities in Boxborough.

Best regards,

Savas C. Danos
General Manager

enc (4)

Water Commissioners

Memo

To: Board of Commissioners

From: G.M. - SCD

Date: 12/14/2006

Re: **Discussion – Boxboro Water District**

I have been offering LWDs consulting services to the Town of Boxboro for the past 5-years as they look towards the formation of a water district.

This has come about for a number of reasons:

1. A significant number of non-municipal water supplies are located along Codman Hill Rd, Swanson Rd and Mass Ave
2. These non-transient public water supplies include Commercial properties, apt complexes, condominium developments and some retail/office space
3. Over the past 5 –years, there has been documentation of numerous water quality issues in the deep bedrock wells
    - High sodium and chloride levels from highway salting and the State salt shed located at Swanson and Mass Ave.
    - MTBe contamination associated with the Exxon Station at Mass Ave and Hill Rd
    - Perchlorate contamination associated with blasting of new septic systems at one of the Apt. complex
4. Lack of fire flow protection for these large complexes.

Recently, testing has been concluded to located possible municipal quantity and quality groundwater sources. Boxboro has found a high yielding area in the Harvard Sportsman's Club with a capacity in the vicinity of 1 million gallons per day.

A number of issues are on the table:

1. It has been my view that we help Boxboro create a district and hire staff or contract services for its operations.

2. The next phase of the work is to hire a consultant to determine the total cost for the creation of a district, including the installation of a well, storage tank, water main and appurtenances, connections to property and other costs. This will constitute the total betterment to be assessed (possibly w/o CISCO) to the properties affected.

3. Currently, the small water systems usage is in the vicinity of 250,000 per day. We will determine the total daily usage once the survey and assessment work is done.

3. A desirable 40B with apts. Complex has been proposed for Hill Rd. The town would like this to be connected to the district rather than have its own water supply in the interim, until the district is built.

4. The State through the Highway Department is at great risk of litigation from the NaCl contamination and is interested in helping finance the district.

5. Boxboro, as they have used the services of the Littleton Electric Light Dept since 1926, would like LWD to run the Boxboro District (if and when formed)

The tentative proposal:

1. Boxboro develop and build the water district to include a 1 mgd source with oversight by LWD.

2. All costs for the development of the district to be borne by the users as a betterment on their water bills.

3. The 40B developer pay for the installation of water main, appurtenances and a 1 million gallon storage tank from existing LWD system on Liberty Square Rd/Hill Rd to the 40B development

4. The district connect to this location, allowing connection with LWD

5. CISCO is not assessed a betterment, but "gifts" their existing water main on Swanson Rd and their two high yielding bedrock wells on Swanson and Mass Ave to the district.

6. In exchange for LWD's oversight and ownership of the district once complete, LWD agrees to incorporate Boxboro users as our own, and have access and use of the excess ½ million gallons per day capacity from the Boxboro system.

7. All rates and fees for Boxboro customers will be as they are for LWD customers, with the exception of the betterment assessment. There will be no

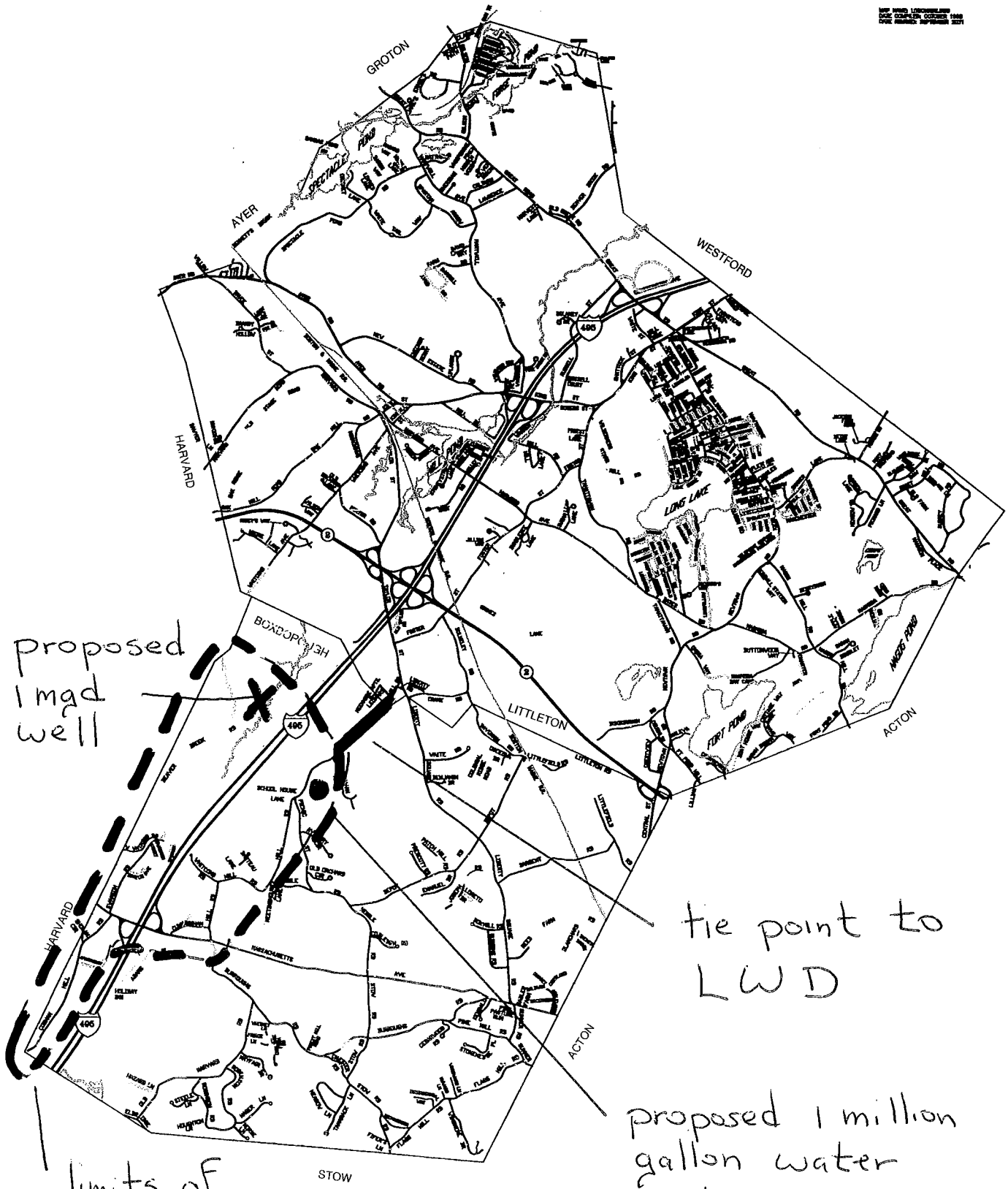
connection fees for the initial district as the betterments will include the cost of all infrastructure to service the initial district.

8. Any additional expansion of the district is as it would be within the LWD system.

This is in the preliminary phase and frankly, I thought is was an ideological study only.

Because of the water quality problems, high yield and quality of the supply found, interest in support by the state, involvement by the 40B developer and significant interest by many of the commercial property owners (led by David Winstanley who has worked with me and LWD on a betterment in Littleton in 1986 and eager to have LWD service his properties (2), this proposal is now gaining significant legs and needs input and discussion by the Board.

Thank you



LITTLETON LELWD

LITTLETON - BOXBOROUGH STREET MAP

Appendix C
ISO Correspondence

INSURANCE SERVICES OFFICE, INC.
400 CROWN COLONY DRIVE SUITE 201 QUINCY, MA 02169 (617) 770-3555 FAX: (617) 773-6217

February 16, 1998

Susan S. Elenbaas, Chairman
Board Of Selectmen
Town Of Boxborough
29 Middle Rd
Boxborough, Ma 01719

Dear Ms. Elenbaas

We wish to thank you, William E. Clayton fire chief and others for the cooperation given to our representative during our recent survey. We have completed our evaluation of the fire insurance classification for your town and advise that the protection class has improved to 5.

Formerly Class 9 applied; the new classification will result in a decrease in the property insurance premium calculations for many insured commercial properties within the town. The new class will be effective 4/1/98.

The purposes of our visit was to gather information needed to determine a fire insurance classification which may be use to develop property insurance premium calculations. This survey was not conducted for property loss prevention or life safety purposes and no life safety or property loss prevention recommendations will be made.

The change from 9 to 5 may affect property insurance premium calculations for residential occupancies insured under Homeowners type policies and some other special schedule surveyed property. The property insurance premium calculations for sprinklered properties will decrease by about 20%. The change will affect typical mercantile properties to a degree depending upon the type of building construction, the hazard of occupancy and other property insurance premium calculation factors. The overall effect is usually about 25%. However, variations in construction, occupancy and private protection can result in increases or decreases from this average.

The above estimates apply only for insurance companies using ISO property insurance premium calculations. However, numerous insurance companies use other than ISO property insurance premium calculations so that the effect of the change in class may be different for their policy holders.

The town classification applies to properties with a needed fire flow of 3500 gpm or less. The private and public protection at properties with larger needed fire flows are individually evaluated and may vary from the town classification.

Anthony Crescente
Customer Service Rep./Public Protection

enclosure

CLASSIFICATION DETAILS

Municipality: Boxborough | State: Mass | Population: 4700

Date Surveyed: 10/97 | Total Credit: 58.26 | Class: 5

SUMMARY OF CREDIT

FEATURE	ASSIGNED	MAXIMUM CREDIT
Receiving and Handling Fire Alarms	8.50%	10.0%
Fire Department	25.57	50.00
Water Supply	27.93	40.00
*Divergence	-3.74%	
Total:	58.26	100.00

The Public Protection Class is based on the total percentage credit as follows:

Class	%
1	90.00 or more
2	80.00 to 89.99
3	70.00 to 79.99
4	60.00 to 69.99
5	50.00 to 59.99
6	40.00 to 49.99
7	30.00 to 39.99
8	20.00 to 29.99
9	10.00 to 19.99

*Divergence is a reduction in credit to reflect a difference in the relative credits for Fire Department and Water Supply.

The above classification has been developed for use in property insurance premium calculations only.

ISO

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