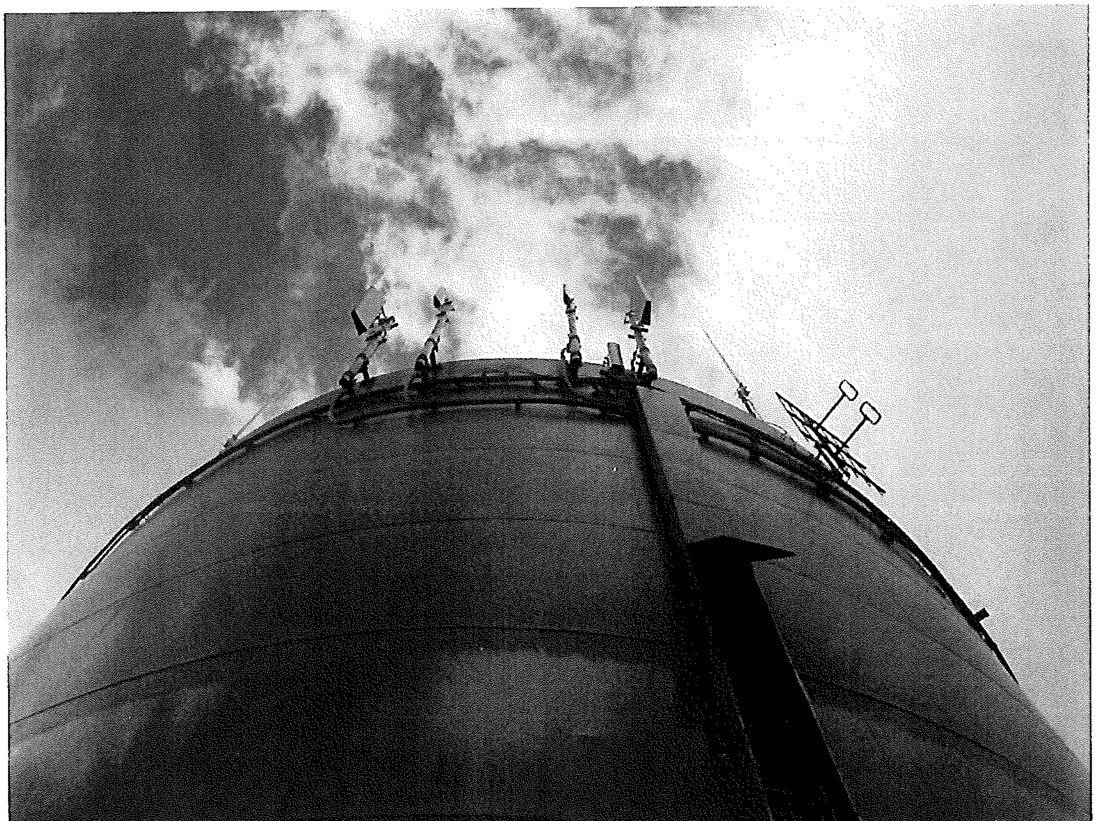

Town of Newmarket, New Hampshire

Water System Update and Capital Improvement Plan

Prepared for:
Town of Newmarket
Water Department
186 Main Street
Newmarket, NH 03857

Prepared by:
AECOM
South Portland, Maine
October 27, 2010

AECOM Project No. 60160735

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October 27, 2010

Mr. Sean Greig
Water & Wastewater Superintendent
Department of Public Works
Newmarket Town Hall
196 Main Street
Newmarket, NH 03657

Subject: Draft Report, Water System Update and Capital Improvement Plan

Dear Sean:

AECOM is pleased to present this Water System Update and Capital Improvement Plan draft report to the Town of Newmarket. This study was initiated by the Town to confirm previous water system improvement recommendations, validate the need for proposed improvements, and develop a Capital Improvements Program (CIP) for water system needs.

AECOM will incorporate draft report comments received from the Town into a Final Report to be presented to the Town Council.

We appreciate the opportunity to work with the Town of Newmarket on this important project. Please contact us with any questions regarding this study.

Best Regards,

AECOM

Terry Desmarais, Jr., P.E.
Project Manager

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Executive Summary

Project History and Purpose

The Town of Newmarket selected AECOM Technical Services, Inc. to complete its Water System Update and Capital Improvements Plan (CIP) in August 2010. This study was initiated by the Town to confirm previous water system improvement recommendations, validate the need for proposed improvements, and develop a Capital Improvements Program (CIP) for water system needs.

To confirm previous recommendations and improvements, AECOM evaluated the capacity of Newmarket's water system to meet current and projected water demands. AECOM compared available water supply production and storage to current and projected demands and identified improvements needed to satisfy future demands. This was done in part by updating the Town's water system model. The model was used to evaluate needs and was most valuable in determining proposed piping improvements to strengthen the distribution system, address insufficient available fire flows, improve high head loss and identify aged or undersized pipelines needing replacement.

It is important to note that Newmarket has ongoing water projects and projects that have been under strong consideration of the Council. These include development of the McIntosh Well supply, evaluation of a potential supply at the Tucker Well site and a new water storage tank. The McIntosh Well development is in the preliminary design stage and the Town is evaluating water quality treatment options for this supply. A second water storage tank adjacent to the Town's existing and only water storage tank was recommended by a previous study and was a major focus of this evaluation as well. This project has not been pursued to date.

The Town's last CIP was completed in 2001. The 2001 CIP was comprised primarily of pipeline improvement projects. To date, very few of the recommended projects have been implemented.

Evaluation

Existing and future water demands were identified to evaluate Newmarket's water system needs for improvements. Demand projections from previous studies were compared against actual pumping records and the closest projection, made by Underwood Engineers, Inc. (UEI), was selected for use in this study. The average day demand (ADD) and maximum day demand (MDD) projections are summarized in Table ES-1.

Table ES-1. Demand Projections

Year	UEI ADD (gpd)	UEI MDD (gpd)
2010	484,450	770,276
2015	500,850	796,352
2020	517,300	822,500
2025	533,700	848,600
2030	550,150	874,750

AECOM evaluated the water system using desktop analyses and an updated hydraulic water system model. The following summarizes the system analyses completed as part of this study:

- *Water Supply*

  Ability to meet existing and future demands based on safe pumping capacity of sources of supply

- *Storage*

  Evaluation of adequate water storage for average day demand, equalization volume, fire protection and emergency supply

The evaluation of supply and storage is summarized in Table ES-2.

Table ES-2. Supply and Storage Evaluation Summary

Condition	Capacity (gpd)	2030 Maximum Day Projection 874,750 Surplus (Deficit) (gpd)	Need Additional Supply (Yes or No)	Need Storage (Yes or No)	Need Storage and Supply (Yes or No)
Existing Supply - Bennett and Sewall					
24 hour pumping	691,200	-184,000	Yes	Yes	Yes
16 hour pumping	460,800	-414,000	Yes	Yes	Yes
Safe pumping	**211,200**	**-664,000**	**Yes**	**Yes**	**Yes**
Future Supply - Bennett, Sewall and McIntosh					
24 hour pumping	1,123,200	248,000	No	Yes	No
16 hour pumping	748,800	-126,000	Yes	Yes	Yes
Safe pumping	**460,800**	**-414,000**	**Yes**	**Yes**	**Yes**
Potential Supply - Bennett, Sewall, McIntosh and Tucker					
24 hour pumping	1,519,200	644,000	No	Yes	No
16 hour pumping	1,012,800	138,000	Yes	Yes	Yes
Safe pumping	**724,800**	**-150,000**	**Yes**	**Yes**	**Yes**

- *Distribution and Transmission*

  The existing transmission and distribution system was evaluated for fire flows, pressures and velocities using a hydraulic model of the system. Locations of pipeline deficiencies were identified based on the hydraulic model results. These projects were categorized as low, medium, and high priority and are summarized in Sections 4 and 5 of this report.

- *Facilities*

  AECOM visited existing facilities to review their general condition and evaluate the existing facility for current electrical code compliance. The details of these observations are presented in Section 4 of this report.

Conclusions and Recommendations

The water system evaluation concluded that water system improvements are necessary to adequately meet projected water demands for the Town. The following was concluded:

- *Supply*

  The safe pumping capacity evaluation indicates that the Town is in need of additional supply. The McIntosh well will improve the supply deficit of the Town, but additional supply should be developed. If the Town develops the Tucker Well site, the safe pumping capacity will nearly meet projected 2030 maximum day demand.

- *Storage*

  The Town's existing storage volume is inadequate. With the McIntosh and Tucker wells online, the ability to replenish storage will be improved, however additional storage will be needed to provide for water for equalization, fire fighting and emergency supply.

- *Transmission and Distribution System*

  Portions of the Town's water transmission and distribution system consist of unlined cast iron pipelines, undersized mains, pipelines with low roughness coefficients likely due to tuberculation, dead end mains and low fire flows. These locations were identified using a hydraulic model of the system. Nearly thirty water distribution improvements were identified. In the high hydraulic priority category were seven major projects that addressed the following:

  1. Increasing pipe size to 12-inch diameter along Main Street from Railroad Street to Wadleigh Falls Road
  2. Increasing pipe size to 12-inch diameter along South Main Street and Creighton Street
  3. Improving roughness coefficient of existing 10-inch diameter pipeline along Packers Falls Road (South Main Street to Elm Street) by replacement or pipe lining
  4. Increasing pipe size to 8-inch diameter along Elm Street
  5. Increasing pipe size to 16-inch diameter from the Great Hill Tank to Route 108
  6. Increasing pipe size to 16-inch diameter from the Route 108 at the Great Hill Tank to the car wash on Route 108
  7. Increasing pipe size to 12-inch diameter along Grant Road from Wadleigh Falls Road to Brialla Circle

- *Facilities*

  Recommendations were made to upgrade existing facilities to correct architectural and electrical deficiencies that were noted during AECOM's site evaluation.

In order to meet projected water system demands, the Town must increase system supply and storage and make pipeline improvements to better distribute water to its customers. The top priority for improvements is supply and storage. It is recommended the Town follow through on its development of the McIntosh Well, which is an ongoing project. It is further recommended that the Town develop the Tucker Well for production in the near future. With all four wells online pumping 16 hours per day, the Town will have approximately the capacity to meet projected maximum day conditions. However, fire flow and peak hour demands will need to be provided by a new storage tank. If the largest of these wells is out of service as per the safe pumping capacity analysis, the Town will not be able to meet year 2030 maximum day conditions. Therefore, it is recommended that the Town develop both the McIntosh and Tucker wells and install a new water storage tank.

It is recommended that the highest hydraulic priority pipeline improvements be addressed following implementation of adequate supply and storage projects. These high hydraulic priority projects improve the backbone of the distribution system. Piping improvements that are associated with supply or storage should be included with the applicable supply or storage project.

The existing Sewall and Bennett Pump Stations are generally undersized for the equipment they contain. As a result, there are many electrical code violations that present safety hazards to the Town's staff. In addition, the environmental conditions with electrical panels in close proximity to moisture and chemicals, existing equipment will likely deteriorate prematurely. It is recommended the stations be upgraded and expanded to provide dedicated electrical spaces. This will resolve many of the noted violations. Coupled with general maintenance improvements, the life expectancy of these structures will be enhanced. It is recommended the Great Hill Water Tank below grade vault be upgraded as well with a new above ground building to house electrical equipment. This will prevent premature deterioration of the electrical equipment and resolve electrical code clearance violations.

CIP Development

Recommended projects were compiled into a 10 year CIP to assist the Town in planning for project design and implementation. A weighted criteria matrix was used to evaluate project importance. All the projects were compiled in the matrix and ranked based on their weighted score in relation to each other. The top ranked projects were then evaluated further and developed into the CIP. Projects that were associated with a supply or storage recommendation, such as pipeline improvements, were shifted to develop comprehensive CIP projects that would provide the greatest benefit to Newmarket's water system.

Four projects were recommended for implementation in the CIP planning period. Table ES-3 presents these projects by level of importance.

Table ES-3 CIP Projects

Project No.	Description	Cost (2010 Dollars)
1	Development of McIntosh Well	$3,000,000
2	New Water Storage Tank and Water Main	$2,240,000
3	Pump Station Upgrades	$200,000
4	New Well Development (Tucker Well)	$1,400,000
TOTAL:		**$6,840,000**

1 Introduction

1.1 Purpose and Scope of Services

The primary objective of this study was to evaluate the water needs for theTown of Newmarket, New Hampshire through the year 2030 and develop a corresponding Capital Improvement Program (CIP). The evaluation was inclusive of all components of the water system including supply, storage, distribution, and pumping.

Specifically, this evaluation included an inventory and evaluation of existing facilities, confirmed population and water system growth projections and evaluated the adequacy of the existing system to meet projected growth in the water system through the year 2030. The study concludes with a capital improvement program (CIP) to guide financial expenditures and capital improvements to the water system.

The major tasks associated with the project are summarized below.

1.1.1 Review Existing Facilities

Current conditions of water system were described, including sources of supply, treatment and pumping facilities, water storage facilities, transmission and distribution mains and general service facilities. This work was completed by reviewing previous studies, available information and during a site visit to all facilities.

Existing reports used in the assessment of existing system included:

- "Water System Computer Model and Capital Improvement Plan", Dufresne-Henry, 2001,
- "Water Storage and Distribution Improvements, Preliminary Design Report", Underwood Engineers, Inc., 2006,
- "Inspection and Cleaning of the Great Hill Tank", Underwater Solutions Inc., 2008
- "New Village Water, Sewer, and Drainage Improvements Plans", Stantec, 2009
- "The Value of Artificial Recharge", Emery & Garrett Groundwater Inc., 2009
- "Town of Newmarket Master Plan", Chapter 1 – Water Resources, Strafford Regional Planning Commission, 2009
- Summary Letter, "56-Day Water Quality Assessment and Pumping Program of Newmarket Production Well #3", Emery & Garrett Groundwater Inc. (EGGI), 2010
- New Hampshire Department of Transportation (NHDOT) Draft Ten Year Transportation Plan (2011-2020), issued December 9, 2009
- "56-Day Water Quality Assessment and Pumping Program, Well NGE-2B (McIntosh), Letter Report," Emery & Garrett Groundwater Inc., May 24, 2010
- "Sharon Tucker Well Water Quality, Blending Potential and Pipe Routing Options Memorandum," Weston & Sampson Engineers, Inc., August 6, 2010

A summary of this data was provided in Section 2 of this report.

1.1.2 Confirm Water Demand Projections

AECOM reviewed previous water demand projections developed for the Town of Newmarket. Based on the review of previous studies and comparison with actual pumping records, the basis of average day and maximum day water demand for this study was developed.

Projections were provided in Section 3 of this report.

1.1.3 Evaluate Existing System

The system was evaluated using industry standard criteria and/or criteria developed by AECOM for its capacity to supply water and meet system pressures, fire flows and storage requirements. As part of this evaluation, AECOM updated the hydraulic model to represent current conditions of the system based on information provided by the Town and fire flow testing.

A summary of this data is provided in Section 4 of this report.

1.1.4 Develop Recommendations

Based on the evaluation, improvements were recommended to address deficiencies. Proposed recommendations were provided with associated project costs. Recommendations were separated into supply, storage, distribution piping, facilities, water quality and maintenance projects.

Recommendations were provided in Section 5 of this report.

1.1.5 Capital Improvement Plan (CIP)

AECOM compiled recommendations and ranked projects using a weighted criteria matrix. Highly ranked projects were further developed into a ten year CIP implementation schedule for the Town's consideration. The CIP addresses the most important projects for the Town to address.

The CIP was provided in Section 6 of this report.

2 Description of Existing System

The Newmarket Water System is operated by the Town's Water Department. Newmarket's existing water system serves approximately 5,000 of the Town's 9,436 residents, based on the 2008 census and in 2010 the Town has approximately 2,000 water service accounts.

The water system can be broken down into three distinct components: supply, storage, and distribution. Although these components are interrelated, they will be discussed separately in the following subsections.

The existing system is shown on Figure 2-1.

2.1 Water Supply

This section presents information on the groundwater and surface water supplies for Newmarket. The well supplies are summarized and then the facilities associated with the supply are summarized.

2.1.1 Existing Groundwater Supply Wells

The Town of Newmarket, located in Rockingham County has a public water supply system that presently withdraws water from two groundwater sources, the Bennett and Sewell Wells. These production wells are located approximately 2,250 feet apart in the Newmarket Plains Aquifer, a sand and gravel aquifer that is situated within the town boundaries of Newmarket, Lee and Durham. A summary of the existing groundwater supply characteristics is presented in the Table 2-1.

Table 2-1 Groundwater Supply Summary[i]

Item	Bennett Well	Sewell Well
Year of Installation	1974	1986
Well Depth (ft below ground surface)	48	81
Length of Well Screen (ft)	10	10
Current Pumping Rate (gallons per minute)[ii]	260	220
Initial static water level (ft), in 1964-65[iii]	7	4
Static Water Level (ft), November 1998	22	30
Static Water Level (ft), September 30, 2007	15	28
Pumping water level (ft), November 1998	28	60
Lowest safe pumping water level (ft), (5 ft above screen)	33	66

i Parts taken from "The Value of Artificial Recharge", Emery & Garrett Groundwater Inc. (EGGI), 2009

ii Pumping rate values provided by Town of Newmarket, August 2010

iii Initial test well data from R.E. Chapman Co., July 1964 (Bennett Site) and January 1965 (Sewell Site)

The Town noted that in 2000 the aquifer pumping water level was approximately one foot above the well screen. This was during a dry period and in the years following the pumping water level has improved. The test well locations are shown on Figure 2-1. Both wells have an associated station discussed later in this section.

2.1.2 Bedrock Test Wells

In 2005 the Town initiated a test well investigation program with the goal of identifying additional groundwater supplies. Five test wells were drilled in the bedrock aquifer in 2006 and 2007. 8-day pumping tests were performed on the two most promising test wells; NGE-1A (Tucker Well) and NGE-2B (McIntosh Well) in the fall of 2009. A 56-day pump test was performed on Test Well NGE-2B in the spring of 2010 to confirm yield and water quality. The bedrock wells are located southwest of the existing water distribution system (southeast of Grant Road).

Production wells have been installed at both sites and the Town is proceeding with developing the McIntosh Site as a source of supply. Further discussion on the bedrock well yields and water quality is included in Section 4.5.1 of this report.

2.1.3 Surface Water Supply (Packers Falls WTP)

Newmarket formerly operated a WTP located on Packers Falls Road near the Newmarket/Durham Town line. The system was intended to treat surface water from a backwater tributary to the Lamprey River using parallel process trains of clarification, filtration and disinfection.

Photograph 2-1. Packers Falls WTP

The WTP was originally placed on line in 1924 and had a design capacity of 1.0 MGD (with largest pump out of service). It was modified several times with the most recent and significant upgrade occurring in the 1980's. It was operated until an extended shut down beginning in 1991 and was permanently shut down in 2005. Difficult source water characteristics combined with a number of operational deficiencies impacted the Town's ability to consistently produce quality treated water. The WTP was decommissioned and the Town has relied on groundwater wells for their water supply.

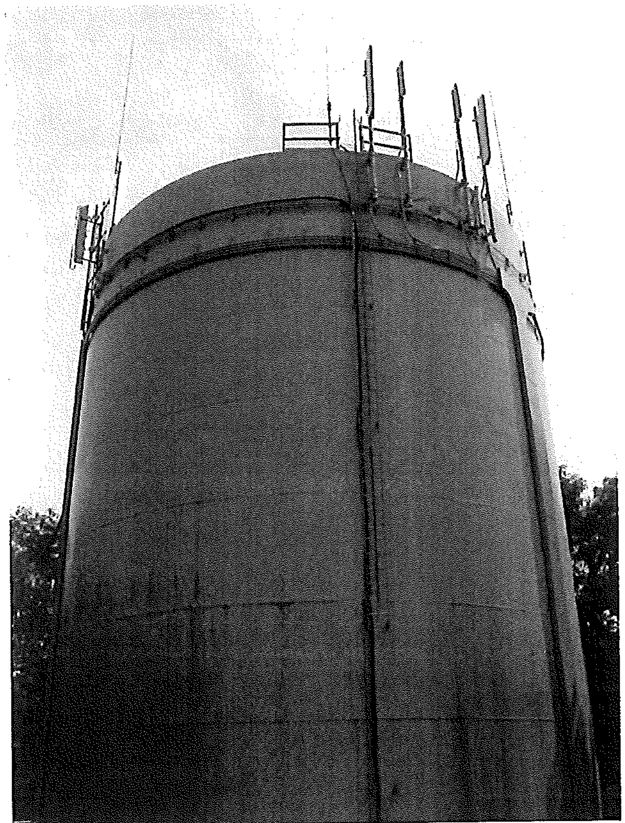
Although the Town never plans to use the WTP as a surface water supply source, the Town utilizes its storage space, meeting room and office space. The Town's central water SCADA equipment is also located at the WTP. The Town plans to relocate the central SCADA System to the Wastewater Treatment Facility in the future.

The WTP was not considered further in this evaluation.

2.2 Storage

The storage of water within the distribution system is another essential element of a water system. Storage facilities serve the following purposes:

- Supplies water for fighting fires.
- Supplies water to meet domestic water demands.
- Provides more uniform pressures within the system.
- Provides a pressure relief outlet in the system to reduce the effects of pressure surges, commonly referred to as "water hammer".



Photograph 2-2. Great Hill Storage Tank

The Great Hill Storage Tank was constructed in 1978 to replace an open storage tank that occupied the site since the initial water system construction in 1884. The Great Hill Storage Tank is a 46.5 foot diameter by 60 foot tall welded steel tank with a capacity of 0.75 million gallons. The tank connects to the distribution system through two water mains. The connections are a 10-inch diameter ductile pipe installed in 1978 and a 10-inch diameter unlined cast iron pipe that was part of the original system and storage tank.

The characteristics of the Great Hill Storage Tank are summarized in Table 2-2.

Table 2-2 Great Hill Storage Tank

Storage Tank Feature	Data
Overflow Elevation	251.00
Total Tank Wall Height (ft above ground) (elev)	60 (2---)
Type of Construction	Welded Steel Plate
Tank Diameter (ft)	46.5
Tank Volume per foot (gallons)	12,700
Usable Storage Volume (gallons)[i]	228,600
Non-Usable Storage Volume[ii]	521,400
Total Storage Volume	750,000

[i] Volume based on difference between high operating level of 56 feet and level at which customers start to lose water pressure, 38 feet.

[ii] Volume below 38 feet in the tank and volume from level 56 to the top of the tank.

The normal high operating level in the tank is 56 feet above the ground and the normal low level in the tank is 53 feet above the ground. This three foot normal operating range equates to a volume of approximately 38,100 gallons. The Town indicated that customers begin to call to complain about system pressures when the tank level drops to 38 feet above the ground. The volume of water between the high level (56 ft) and level 38 ft is approximately 228,600 gallons.

The Great Hill Storage Tank is painted on the interior and exterior. The Town has leased out part of the site to a cellular phone company, which has installed their antennas on top of the tank. The Town's emergency services antennas are also located on the top of the tank. The interior of the tank can be accesses when empty by a grade level manway. The tank does not have any internal mixing equipment. An emergency overflow exists near the top of the tank.

A below grade concrete vault contains flanged ductile iron piping and valves, telemetry and electrical equipment. The vault is accessed by a double leaf aluminum hatch at grade. The vault has a sump pit with no pump. Antenna cabling runs up the outside of the tank.

2.3 Water Distribution System

Newmarket's water distribution system transports water to customers and generally consists of transmission and distribution piping, isolation valves, hydrants and one booster pump station.

The distribution system is divided into two pressure zones. The low pressure zone comprises the majority of the system with pressure provided by the Great Hill Storage Tank. The high pressure zone is located in the Folsom Drive area and includes supply to approximately 40 homes.

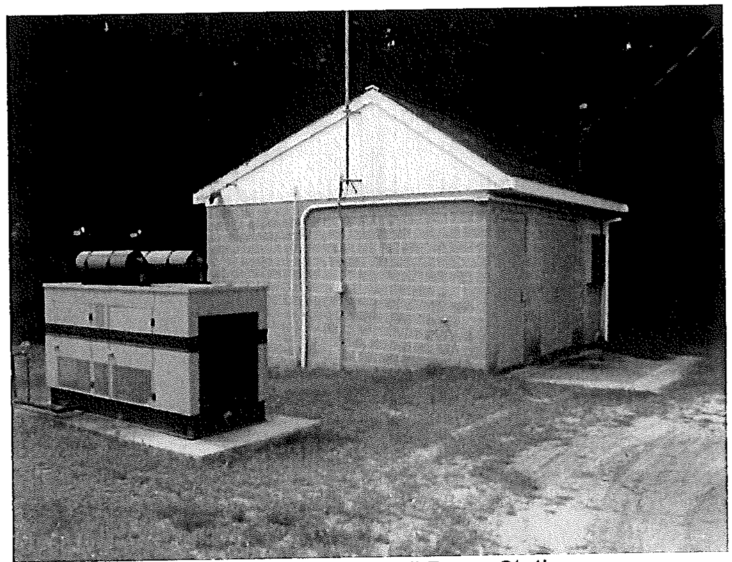
The water distribution system is comprised of water mains ranging in size from 4- inch to 16-inch diameter. Water services are typically 5/8-inch diameter for residential customers and as large as 2-inch diameter for larger water customers. The system consists of approximately 27 to 30 miles of water mains, hydrants, and valves. Hydrant bonnets have been painted different colors based on modeled system pressure from previous studies.

The distribution system consists of cement-lined ductile iron, unlined cast iron and asbestos cement (AC) piping. Unlined cast iron comprises the majority of the 6-inch diameter distribution pipelines, which are part of the original water distribution system dating back to the 19th century. In addition, unlined cast iron was used for the 10-inch main on Route 108 that is still in service to the Great Hill Storage Tank. Approximately 1,500 linear feet of AC water main exists in the vicinity of Dame Road and Lamprey Street.

The extent of the various pipe materials is unknown. Consumption is measured using water meters at the customer's water service. The Town is currently replacing its existing water meter system, which was incomplete. The new system will have Orion readers/transmitters for all of its service connections, including Town properties. This will improve billing accuracy. Approximately 600 meters remain to be installed with a completion date expected in fall 2010. Along with the meter improvement project, the Town has changed its billing rate structure from one with minimum volume charges to full consumption basis.

2.4 Pump Station Facilities

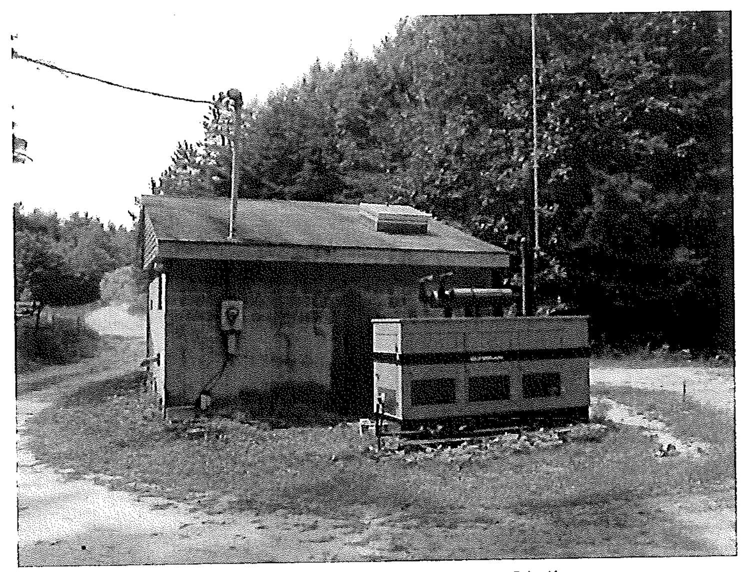
2.4.1 Sewell Pump Station



Photograph 2-3. Sewell Pump Station

The Sewell Well Pump Station is a single story structure that contains a pump, electrical equipment, chemicals and appurtenances. The structure consists of unpainted masonry walls with a wood framed gabled roof. The building appears to be uninsulated. The roof consists of asphalt shingles with soffit and ridge vents and painted wood trim. There is evidence of a roof gutter system that is missing except for the downspouts. Access to the station is provided by two separate doorways. Doors are painted hollow metal. The interior of the building is split into two sections; one section houses the pump, piping, appurtenances and controls and the other, separated by a low concrete wall houses the chemical storage. Interior finish is unpainted masonry block and a painted plywood ceiling. Access to the attic area is through a hatch in the ceiling. In the chemical storage area two 500-gallon tanks contain sodium hydroxide and caustic for pH control. A 4-inch wide by 24-inch high unfinished masonry wall provides secondary containment. The containment volume was not confirmed for adequacy. An Accu-Tab Chlorinator system is located in the main pump room and uses sodium hypochlorite tablets for disinfecting the source water. An emergency eyewash station is located in the chemical storage room. Electrical power for the structure is supplied overhead to a utility mast and is 480 volts, 3-phase with a small transformer that provides 120 volt power. Emergency power is provided to the station by a propane powered emergency generator located outside the building on a separate concrete pad. Station telemetry is provided by radio with an antenna mounted on the side of the station.

2.4.2 Bennett Pump Station

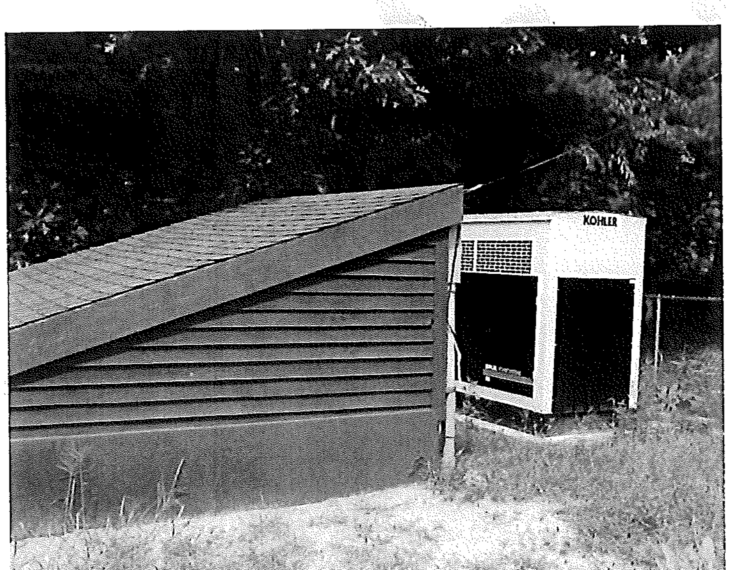


Photograph 2-4. Bennett Pump Station

The Bennett Well Pump Station is a single story structure containing a pump, chemicals, electrical equipment and appurtenances. The structure consists of an original building of unpainted concrete and masonry walls and a wood framed addition. The building appears to be mostly uninsulated and it was noted that the interior of the masonry block walls were filled with stone. The roof consists of asphalt shingles of two different ages with vinyl soffit and ridge vents and painted wood trim. Access to the station is provided by a single doorway. The door is painted hollow metal. The interior of the building is split into two rooms including the original building and the addition; the original building houses the pump, piping, appurtenances, chemical feeds system, instrumentation, and sodium hydroxide storage (300 gallons, no containment). The addition houses the entryway and caustic storage (500 gallons, double-wall tank) for pH control. The containment volume was not confirmed for adequacy. An Accu-Tab Chlorinator system is located in the main pump room and uses sodium hypochlorite tablets for disinfecting the source water. The interior finish of the original building is unpainted masonry block and a painted plywood ceiling. Interior finish of the addition is painted plywood walls and ceiling. An emergency eyewash station is located in the original building. Electrical power for the structure is supplied overhead to a utility mast and is 480 volts, 3-phase with a small transformer that provides 120 volt power. Emergency power is provided to the station by a propane powered emergency generator located outside the building on a separate concrete pad. Station telemetry is provided by radio with an antenna mounted on the side of the station.

2.4.3 Folsom Drive Booster Station

Newmarket's only water booster pumping station is located on Folsom Drive near the intersection with Hersey Lane. The station houses a booster pump, electrical equipment and appurtenances. It serves approximately 40 homes on Great Hill. This area previously experienced low pressures due to its elevation relative to the Great Hill Tank.



Photograph 2-5. Folsom Drive Booster Pump Station

The station is a small, semi-buried structure constructed of concrete walls and stained wood clapboards. Based on existing reports and discussions with the Town, it is understood that the structure was built in 1984.The roof is wood framed with fiberglass shingles and stained wood trim. Exposed concrete walls were covered with rigid insulation and cement fiber boards. Access to the station is provided by a single painted hollow metal doorway. The interior is a single room and finishes are painted concrete walls and painted plywood ceiling. Electrical power for the structure is supplied overhead to a utility mast and is 120 volt, single phase. Emergency power is provided underground to the station by a 30 kW Kohler propane powered emergency generator located outside the building on a separate concrete pad. Emergency power is automatically provided via an automatic transfer switch. The booster station is not incorporated into the Town's SCADA for the water distribution system.

Mechanical equipment consists of consists of a 119-gallon hydro pneumatic bladder tank, two (2) Berkeley model pumps (8 hp each), and variable frequency drives (VFD's) to provide constant pressure control to the Great Hill neighborhood. The major components of the booster station were replaced in 2009 and 2010.

2.5 System Operation and Controls

The system is operated using the Supervisory Control and Data Acquisition (SCADA) system located at the Packers Falls WTP. The SCADA system consists of the following:

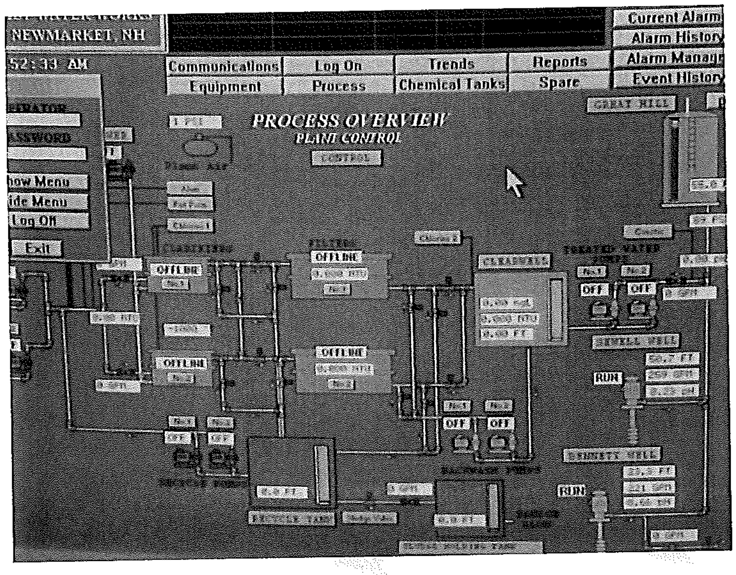
- Allen Bradley PLC.
- WonderWare Software.
- OPS 32 Software.

A computer monitor provides a visual display of the water system components. Each component of the system has specific status indicators shown on the SCADA screen. The water department staff can modify the system's operation through the SCADA system. The following items are shown on the process overview screen:

- WTP equipment and tank status (no longer in use).
- Well pump status, pumping level in well, flow rate, and water pH.
- Storage tank water level and pressure.
- Alarm conditions.

The Folsom Drive Booster Station was not included on the SCADA system at the time of the this evaluation but the Town was in the process of adding it to the SCADA system.

Currently, the existing Bennett and Sewell well pumps operate based on the water level in the Great Hill Storage Tank. The tank water level fluctuates between low level at 53 (pumps on) feet above ground to high level at 53 feet (pumps off) above ground. The pumps start sequentially in response to the storage tank water level. As the system demand increases, the storage tank water level continues to drop until the pumping stations are operating to overcome the system demand. The "surplus" pumped water will then start to fill the storage tank. As the storage tank fills and the water level increases, the pumping stations are shut off sequentially. The goal is to achieve a fairly constant water level in the storage tank while allowing some level fluctuation to eliminate potential stagnation and freezing problems.



Photograph 2-6. SCADA Process Overview

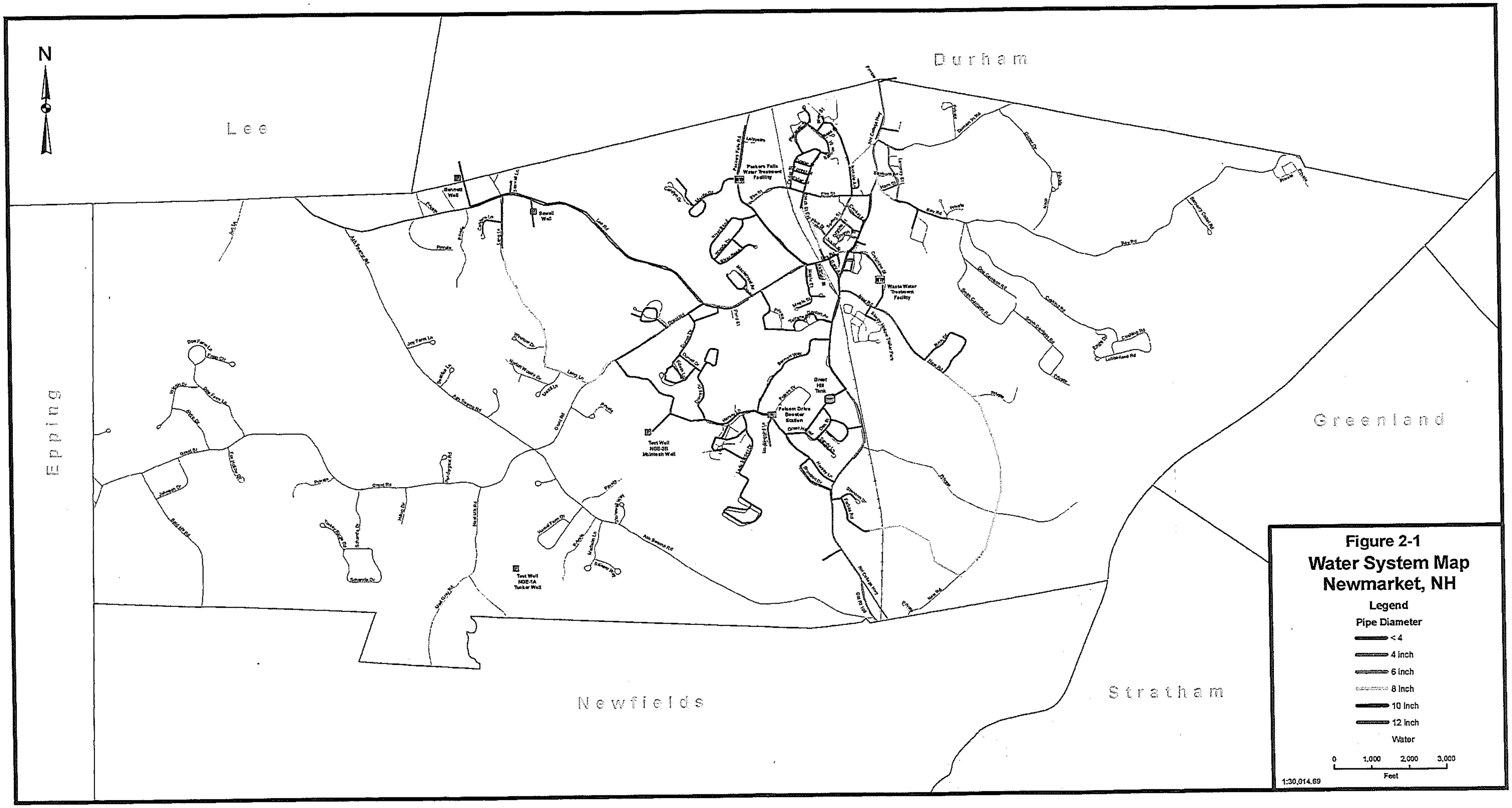
2.6 Water Quality

In 2009, water samples taken from Newmarket's water distribution system met all U.S. Environmental Protection Agency (EPA) and state drinking water health standards. Samples are taken from the distribution system after pH adjustment. The Town's water quality data from its most recent Consumer Confidence Report (CCR) is provided in the following table:

Table 2-3 Finished Water Quality Summary

Parameter	MCLG	MCL	Units	Violation (Y/N)	Sewell Well	Bennett Well
Total Coliform	0	>40 samples 5% are positive	mg/L	N	0	0
***E.* coli**	0	0	mg/L	N	0	0
Total Organic Carbon	N/A	TT	ppm	N	2.33 (avg.) Range (ND-3.2)	2.15 (avg.) Range (1.1-3.1)
Radon	0	NE	pCi/L	N	1200 (10/28/03)	1500 (10/28/03)
Compliance Gross Alpha	0	15	pCi/L	N	0 (10/28/03)	1 (10/28/03)
Combined Radium	0	5	pCi/L	N	BDL (10/28/03)	2 (10/28/03)
Arsenic	0	0	ppb	N	0.0015	ND
Barium	2	2	ppm	N	0.0147	0.0096
Copper	1.3	1.3	ppm	N	0.0055	0.026 (1/1/08)
Lead	0	15	ppb	N	2 (1/1/08)	2 (1/1/08)
Nitrate	10	10	ppm	N	2.3	1.4
Chlorine	MRDLG = 4	MRDL = 4	ppm	N	0.51	0.51
Haloacetic Acids	NA	60	ppb	N	ND	ND
1,1,1-Trichloroethane	200	200	ppb	N	0.5	ND
TTHM's (Total Trihalomethanes – Total of following contaminants: Dibromochloromethane Bromoform, Dichloromethane Chloroform	NA	80	ppb	N	1.6	ND

MCLG: Maximum Contaminant Level Goal, or the level of a contaminant in drinking water below which there is no known expected risk to health. MCLGs allow for a margin of safety.
MCL: Maximum Contaminant Level, or the highest level of a contaminant that is allowed in drinking water. They are set as close to the MCLGs as feasible using the best available treatment technology.
TT: Treatment technique or a required process intended to reduce the level of a contaminant in drinking water.
MRDLG: Maximum residual disinfectant level goal or the level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLG's do not reflect the benefits if the use of disinfectants to control microbial contaminants.
MRDL: Maximum residual disinfectant level or the highest level of a disinfectant allowed in drinking water. There is convincing evidence that the addition of a disinfectant is necessary for control of microbial contaminants.
ppm: parts per million
ppb: parts per billion
N/A: Not applicable
ND: Not detected


N
Lee
Durham
Epping
Newfields
Stratham
Greenland
Figure 2-1
Water System Map
Newmarket, NH
Legend
Pipe Diameter
< 4
4 inch
6 inch
8 inch
10 inch
12 inch
Water
0
1,000
2,000
3,000
Feet
1:30,014.69

3 Population and Water Consumption Trends and Projections

AECOM reviewed previous demand projections developed for Newmarket. Previous methodologies used NHOEP population data, water pumping records, and billing information trendlines to project average day water demand. This section summarizes projections by others and the projections used as the basis of this study. A detailed projection including a full build out analysis was beyond the scope of this study. The Town does not anticipate full buildout to occur within the timeframe of this planning study (year 2030).

Projections from the following studies were compared to actual pumping records:

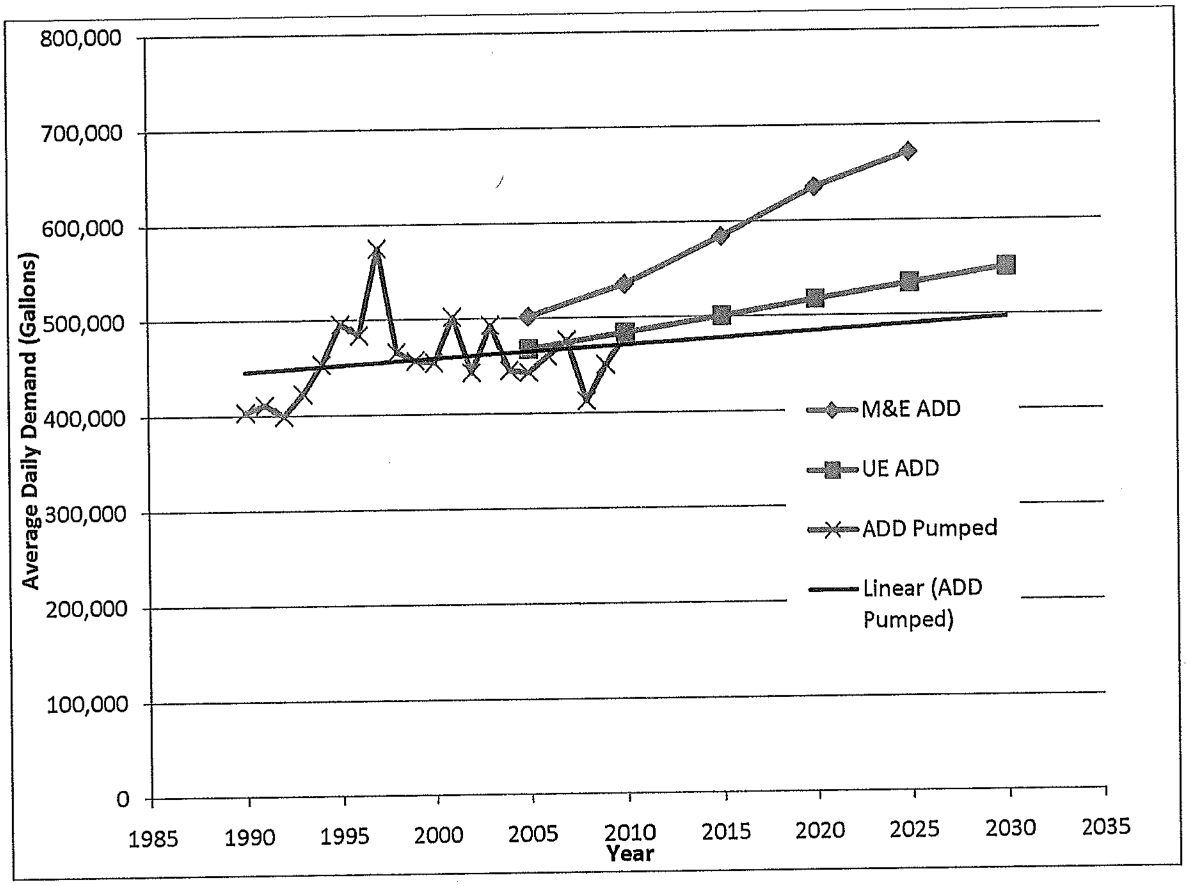
- "Water System Demand Study for the Town of Newmarket, New Hampshire", Metcalf &Eddy, 2004.
- "Water Storage and Distribution Improvements, Preliminary Design Report", Underwood Engineers, Inc., 2006.

Table 3-1 and Figure 3-1 summarize average daily demand projections.

Table 3-1 Average Day Demand Projections

Year	M&E (gpd)	UEI (gpd)	Pump Records (gpd)
2005	501,765	468,000	443,221
2010	535,040	484,450	481,000
2015	584,155	500,850	N/A
2020	635,140	517,300	N/A
2025	671,000	533,700	N/A
2030	N/A	550,150	N/A

Figure 3-1 Average Day Demand Projections



Historical annual pumped rates were from pump records for the years 1990 to 2010.

AECOM and the Town compared the UEI and M&E demand projections to the historical pumping records and agreed that the UEI projection was the closest fit to the historical pumping records. AECOM and the Town further reviewed the UEI methodology and agreed to use the UEI projections for the purpose of this study. AECOM and the Town discussed a detailed analysis to evaluate demand projections based on multiple criteria, including land use and build out, but determined such an analysis would be costly and results would not have a significant impact on the recommended capital improvement projects.

UEI's methodology can be briefly describes as follows:

1. Determine project population increase over the study period. UEI evaluated population projections from several sources (Town of Newmarket, New Hampshire Office of Energy & Planning (NEOEP)). UEI took the average between the NHOEP projection (which they felt was low) and the historical population data between 1960 and 2000 (which they felt was too high) and determined the population project over their 20 year study period (2010 to 2030) to be 17.5% (0.81% per year compounded annually).
2. Project daily water consumption over the planning period at the same rate as the projected population increase.

3. Project average daily water demand by adding historical unaccounted for water to the projected daily water consumption. UEI calculated unaccounted for water to be 107,400 gallons per day based on historic records of pumped vs. billed data for the years 2001 to 2005.

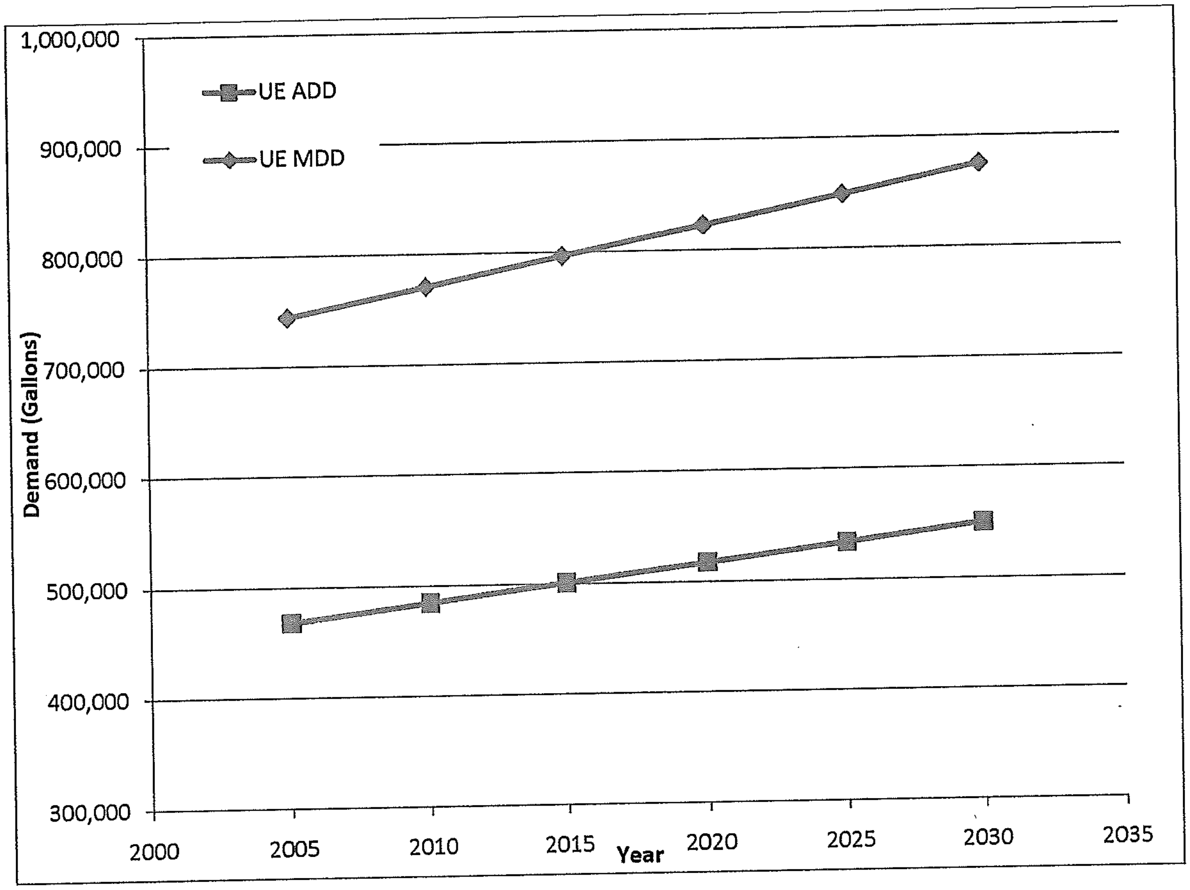
For maximum day demand UEI's values were also used. UEI used a peaking factor of 1.59 for maximum day projections. The basis of this value was not described in the UEI report, but should be confirmed. AECOM reviewed the Town's historical pumping records to determine the historical peaking factor, but the data was not adequate to compute the value. According to American Water Works Association's 2000 edition of "Water Distribution Systems Handbook", maximum day peaking factors range from 1.5 to 3.5. UEI's peaking factor is within the range of this reference and was not modified for the purpose of this study. The following table and figure summarize the projected average day and maximum day demands over the study period.

Table 3-2 Average and Maximum Day Demand Projections

Year	UEI ADD (gpd)	UEI MDD (gpd)
2010	484,450	770,276
2015	500,850	796,352
2020	517,300	822,500
2025	533,700	848,600
2030	550,150	874,750

i Maximum day peaking factor 1.59 times greater than average daily demand value

Figure 3-2 Average and Maximum Day Demand Projections



4 Evaluation of Water System

AECOM's evaluation of the water system consisted of an architectural condition assessment and electrical code review of existing facilities, a desktop evaluation of the adequacy of the existing supply, and a hydraulic modeling analysis of the distribution system.

Evaluation criteria were defined for the water system evaluation. These criteria established the minimum acceptable standard for the particular component under evaluation. The criteria used for evaluating Newmarket's system are summarized in the following table:

Table 4-1 Evaluation Criteria

Parameter	Definition	Source	Notes
Safe Yield	• The amount of naturally occurring groundwater that can economically and legally withdrawn from an aquifer on a sustained basis without impairing the native groundwater quality or creating an undesirable effect such as environmental damage	*Applied Hydrogeology (C.W. Fetter, 1994)*	
Safe Pumping Capacity	• Pumped capacity with the largest pump out of service • Hydraulic capacity of the well system not to exceed an average pumping rate of 16 hours/day	"Ten State Standards" AECOM recommended practice	
System Pressure – Fire Flows	• The system should be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system	"Ten State Standards"	
System Pressure – Normal Working Pressure	• Normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi	"Ten State Standards"	
Fire Flow	• Minimum flow (gallons per minute) required for fire protection	"Ten State Standards," New Hampshire Insurance Services Office (NH ISO)	Typically 500 gpm for domestic protection. As an exception, ISO recommended fire protection the Rivermoor Mill (Main St at Chapel St) to be 5,500 gpm for 4 hour duration.
Usable Storage Volume	• Volume of water (gallons) between tank high water level (56 ft) and level at which customers start to have pressure problems (38 ft)	Town of Newmarket	Approximately 224,000 gallons
Equalization Storage Volume	• Difference (gallons) between safe pumping capacity and demand under maximum day conditions	*Water Distribution Systems Handbook* (AWWA, 2000)	Approximately 150,000 gallons under 2030 MDD conditions with McIntosh and Tucker installed. Approximately 414,000 gallons under 2030 MDD conditions with McIntosh only installed.
Fire Protection Storage Volume	• 3,000 gallons per minute for 3 hour duration	*Water Distribution Systems Handbook* (AWWA, 2000)	Approximately 540,000 gallons
Emergency Supply Storage Volume	• Amount of storage available if all supply sources are unavailable	*Water Distribution Systems Handbook* (AWWA, 2000)	

4.1 Water Supply

In general, a water system is considered to have adequate supply if it can meet the following system standards:

- The ***safe yield*** of the sources of supply should exceed the average day system demand while pumping no more than 16 out of 24 hours per day over the projected planning period, and
- The ***safe pumping capacity*** of the system, with the largest unit out of service, should be greater than or equal to the maximum day demand.

To meet the ***safe yield***, the Town's well supply should exceed the projected average-day demands in the system through year 2030. A safe yield analysis of each well was not part of this report; however, the Town's historic use of the Bennett and Sewell wells indicates that the wells have yielded a combined capacity of 480 gpm for 16 hours in the past. This results in a yield of 460,800 gpd. The safe yield of the well supply (460,800 gpd) is less than the projected average-day demand for the year 2030 (550,150 gpd). Table 4-2 presents the safe yield deficit over the project period:

Table 4-2 2010 Safe Yield Deficit

Year	UEI ADD (gpd)	Safe Yield Deficit (gpd)
2010	484,450	-23,650
2015	500,850	-40,050
2020	517,300	-56,500
2025	533,700	-72,900
2030	550,150	-89,350

The existing well supply is considered inadequate for both present and future demands.

The safe yield of the McIntosh Well is unknown, but assuming that it can safely yield its proposed pump rate of 300 gpm for 16 hours without significant aquifer impact, the supply safe yield will increase to a combined capacity of 780 gpm for 16 hours, or a yield of 748,800 gpd. In this case the Town would have a surplus based on the safe yield analysis. The following table shows the safe yield surplus over the planning period:

Table 4-3 Safe Yield Surplus with the Incorporation of the McIntosh Well into the Water Supply System

Year	UEI ADD	Safe Yield Surplus
2010	484,450	264,350
2015	500,850	247,950
2020	517,300	231,500
2025	533,700	215,100
2030	550,150	198,650

The existing well supply plus the McIntosh well is considered adequate in terms of both present and future day safe yield to the year 2030, based on current demand projections.

The ***safe pumping capacity*** is defined as the pumped capacity with the largest pump out of service. In addition, hydraulic capacity of the well system should not exceed an average operating time of 16 hours per day. For design condition, the safe pumping capacity should be greater than or equal to the maximum day demand.

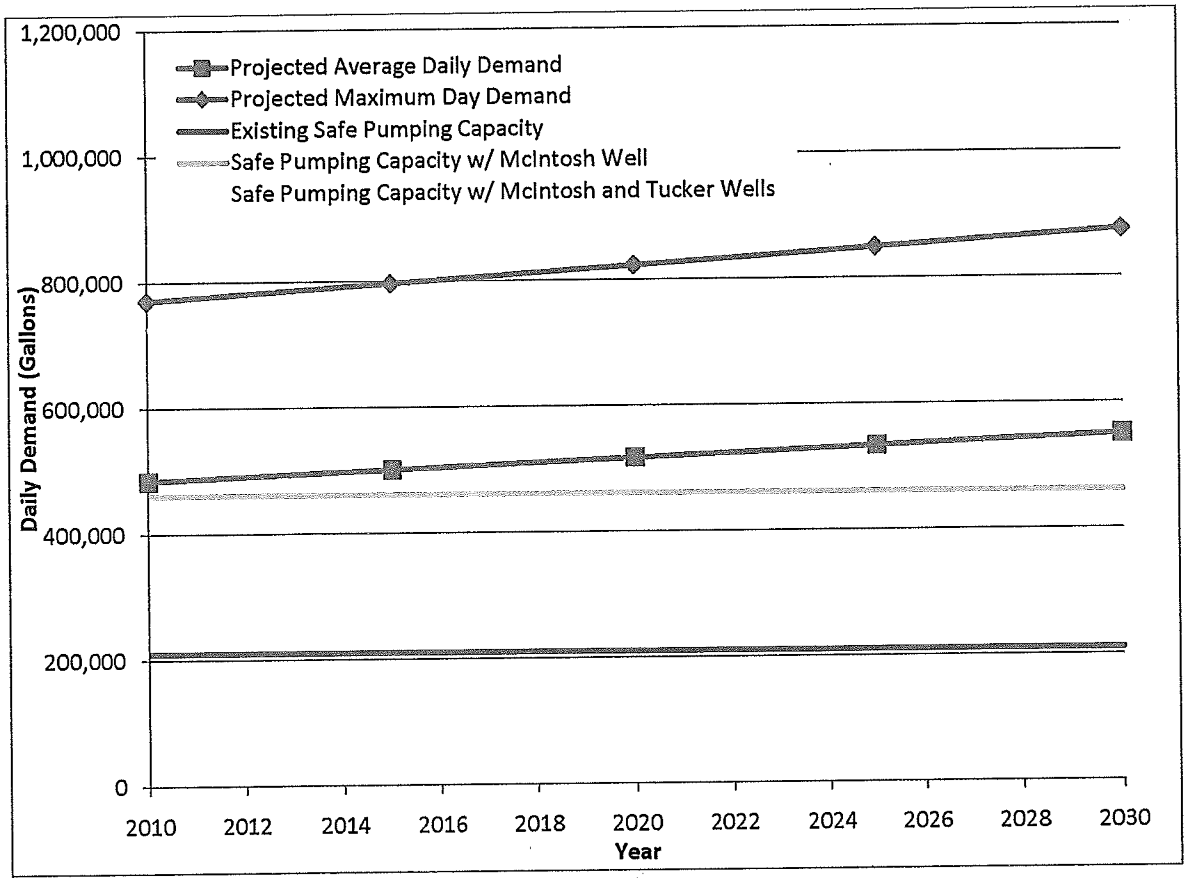
The safe pumping capacity rates are shown in the table below. Since the existing supplies of the Bennett and Sewell wells are not adequate from a safe yield standpoint, the McIntosh and Tucker Wells were included in the analysis.

Table 4-4 Safe Pumping Capacity

	Bennett Well (gpm)	Sewell Well (gpm)	McIntosh Well (gpm)	Tucker Well (gpm)	Total (gpm)	Total at 16 hours pumping per day (gpd)	Projected 2030 MDD (gpd)	Surplus (Deficit) (gpd rounded)
Well Capacity	260	220	300	275	1105	N/A	874,750	N/A
Existing Safe Pumping Capacity	Offline	220	Not in operation	Not in operation	220	211,200	874,750	(664,000)
Future Safe Pumping Capacity (w/McIntosh Online)	260	220	Offline	Not in operation	480	460,800	874,750	(414,000)
Potential Safe Pumping Capacity (w/McIntosh and Tucker Online	260	220	Offline	275	755	724,800	874,750	(150,000)

The safe pumping capacity analysis is summarized graphically on Figure 4-1 Safe Pumping Capacity.

Figure 4-1 Safe Pumping Capacity



Based on the safe pump capacity analysis the Town of Newmarket's existing wells are inadequate to meet present day water demands in the system. Further, with the Bennett, Sewell and McIntosh Well in operation and the largest well offline (McIntosh), the system is marginally capable of meeting the current average day demand. With the Bennett, Sewell, McIntosh and Tucker Wells in operation and the largest supply offline (McIntosh Well) the system would be capable of marginally meeting current maximum day demand.

It is important to note that this analysis does not include any capacity available from the existing storage tank. This will be discussed further in Section 5 of this report.

4.2 Storage

The safe yield and safe pumping capacity analyses indicate that the safe pumping capacity is a limiting factor in the Newmarket's ability to supply water. Storage capacity can be used to compensate for insufficient supply provided the supply is adequate to refill the tank during diurnal low demand periods. The water storage tank will also be source of water to fight fires, so in Newmarket's case the tank must have adequate storage to compensate for supply limitations and provide volume for fire fighting.

Usable volume at the Great Hill Tank is from level 56 above the ground to level 38 feet above ground, which is when the water department has historically received complaints from users. This equates to an approximate volume of 228,000 gallons. The volume of water below level 38 feet above ground is available for use but with decreasing level in the tank, system pressures with be reduced.

NHDES adopted the "Recommended Standards for Water Works" which indicates storage sizing should meet domestic demands plus the amount needed for fire flow. For the purpose of this evaluation peak fire flow was defined as 3,000 gpm for 3 hours, which equates to 540,000 gallons. The amount needed for domestic use is equal to the future 2030 average day demand or 558,000 gallons. This requires a total storage volume of 1,098,000 gallons. Existing storage volume is 750,000 gallons, so an additional 348,000 gallons is necessary by this analysis.

According to American Water Works Association's 2000 edition of the "Water Distribution Systems Handbook", the storage volume should serve equalization storage, fire protection and emergency supply. Equalization storage requirements depend on pumping regime and essentially equal the difference between supply and demand at future 2030 maximum day. This was already determined in Table 4-4 Safe Pumping Capacity to be 664,000 gallons, 414,000 gallons and 150,000 gallons under existing safe pumping capacity, future with McIntosh Well online and future with McIntosh and Tucker wells online, respectively. The fire storage requirement is 540,000 gallons. Emergency reserve is in case all supplies were offline or otherwise unavailable. Assuming water could be pumped from the tank below level 38, it is necessary to compare the usable volume to the equalization storage needs. This is summarized in the following table:

Table 4-5 Storage Analysis - Equalization Volume

	Existing Safe Pumping Capacity	Future Safe Pumping Capacity (w/McIntosh Online)	Potential Safe Pumping Capacity (w/McIntosh and Tucker Online
Equalization Storage Volume Required (gals)	664,000	414,000	150,000
1 Tank Usable Storage Volume (gals)	228,600	228,600	228,600
1 Tank Surplus (Deficit) (gals)	(435,400)	(185,400)	78,600
2 Tanks Usable Storage Volume (gals)	457,200	457,200	457,200
2 Tank Surplus (Deficit) (gals)	(206,800)	43,200	307,200

The need for another storage tank can also be demonstrated by evaluating the available volume for emergency supply based on total storage volume as summarized in Table 4-6.

Table 4-6 Storage Analysis - Emergency Volume

	Existing Safe Pumping Capacity	Future Safe Pumping Capacity (w/McIntosh Online)	Potential Safe Pumping Capacity (w/McIntosh and Tucker Online
Equalization Storage Volume Required (gals)	664,000	414,000	150,000
Fire Flow Requirement (gals)	540,000	540,000	540,000
Subtotal	1,204,000	954,000	690,000
1 Tank Total Storage Volume (gals)	750,000	750,000	750,000
1 Tank Emergency Storage Volume (gals)	(454,000)	(204,000)	60,000
2 Tanks Total Storage Volume (gals)	1,500,000	1,500,000	1,500,000
2 Tanks Emergency Storage Volume (gals)	296,000	546,000	810,000
2 Tank Emergency Storage Volume as % of 2030 Max Day Demand	34%	62%	93%

This analysis demonstrates that the Town would need additional storage volume. Even with the Bennett, Sewell, McIntosh and Tucker Wells online the maximum emergency capacity available with two tanks would be equivalent to 93% of maximum day conditions. This means that the tank total storage capacity (two tanks) would be depleted in a condition of an approximately 2 days sustained maximum day demand and fire flow equivalent to 3,000 gpm for three hours. For this analysis it was assumed that a second storage tank (750,000 gallon) would be installed adjacent to the existing tank, which is consistent with the UEI recommendation.

A dynamic model was used to simulate the tank, water supplies and distribution system and is presented in the next section of this report.

4.3 Distribution and Transmission System Evaluation

The distribution and transmission piping system were evaluated using steady state hydraulic modeling software. The model was used to determine available fire flows and pressures at various locations throughout the distribution system.

4.3.1 Distribution System Computer Model

The distribution system was analyzed for its capacity to meet current and future demand conditions and its ability to handle anticipated fire flows within the Town. This was done by simulating the following current (year 2010) and future (year 2030) demand conditions on a computer model of the water system:

- Peak hour on maximum day

- Maximum day with various fire flows
- Maximum day

Under peak hour demand conditions, a minimum pressure of 35 psi should be provided to the entire service area. Under average day and maximum day demand conditions, minimum pressures of 40 psi or greater should be provided to the entire service area. Under the maximum day with fire flow requirement conditions, the system must be capable of providing the needed fire flow to the locations being evaluated (needed fire flows at designated ISO test locations and 500 gpm at all other locations) with a residual pressure of no less than 20 psi anywhere in the distribution system.

The Town's distribution system was evaluated using a computerized hydraulic simulation modeling program called WaterGEMS, developed by Bentley/Haestad Methods. The base model was provided to AECOM by the Town. AECOM updated the model to be consistent with the current water system configuration. This model simulates the hydraulic flow conditions of the water supply pumping facilities, the transmission piping, the distribution system piping, and the storage facilities. The model was calibrated to closely approximate the results measured in a field testing program. The model was then used to simulate system operation under varying demand conditions, both current and future. Where the model simulations indicated that the system could not meet established standards of service, alternative improvements were modeled, and recommendations are made based on the hydraulics.

A schematic of the hydraulic model of the system, model run scenarios, and outputs are included Appendix A

4.3.2 Field Testing Program

Six fire flow tests were performed on September 9, 2010 by AECOM and the Town's water department personnel. The results of the flow tests are summarized in Table 4-7 Hydrant Flow Test Results.

The field testing program was performed for the following reasons:

- To provide data to confirm calibration of the computer model,
- To estimate the flow available for fire protection at specific location,
- To indicate the relative strengths and weaknesses of the system,
- To assess the impacts of recent improvements in the system.

The fire flow test locations were generally selected at points distributed throughout the distribution system remote from sources of supply and storage facilities.

At each test location two, or more, nearby hydrants were used; one to monitor system pressure and the other the measure flow. The intent of the flow test is to stress the system. As shown in Table 5-1, the static pressure represents the system pressure at the test location before imposing the hydrant flow. The residual pressure represents the system pressure at the test location while the hydrant is flowing.

This recent testing confirms the results of the recent ISO testing performed in 2002, which is included in Appendix C. Exceptions include areas near recent improvements along Main Street and in the New Village area. However, as a result of the flow testing program, several of the areas tested were found to be deficient in terms of available fire flow.

Note that the results of any flow test only indicate the available flow based on system conditions at the time of the flow test, which relate to specific tank levels, pumping station operation, and system demands. These system conditions vary daily and seasonally, thereby affecting the available fire flow. The computer modeling, discussed later in this section, accounts for worst case conditions.

The Hazen-Williams C-value (or "roughness" coefficient) is a relative measure of the hydraulic capacity of a water main. The C-values in the model were estimated by other consultants during previous modeling efforts. In general, C-values are based on the age and material of the pipes and are adjusted to match field conditions Lower C-values indicate lower carrying capacity of the pipe. Typical C-values for new cement-lined ductile iron pipe are 120 to 140. In Newmarket, older, unlined cast iron pipes could have C-values as low as 24.

Table 4-7 Hydrant Flow Test Results

Test ID	Measure-ment Type	Field Data: Hydrant ID	Model Node ID	Pitot Pressure, psi	Static Pressure, psi	Adj. Static Pressure, psi	Residual Pressure, psi	Pressure Drop Due to Hydrant Flow, psi	Adj. Residua Pressure, psi	Hydrant Flow, gpm	Available Flow at 20 psi, gpm	Model Results: Static Conditions: Demand (gpm)	Pressure (psi)	Pressure Difference (Field - Model), psi	Residual Conditions: Demand	Pressure	Pressure Difference (Field - Model), psi	Model Pressure Drop, psi	Diff in Pressure Drop (Field - Model), psi
1	Flow	368	J960	45	93	93.7	57	37	57.2	1,188	1,733	1.0	87.7	6.0	1,189	53.1			
1	Gauge	376	J945		95	95.1	53	43	52.6			1.0	88.2	6.9	1	54.0	-1.5	34.2	8
1	Gauge	372	J955		93	92.7	62	31	62.2			4.0	87.7	5.0	4	60.9	1.1	26.8	4
2	Flow	324	J820	6	92	92.1	81	11	81.4	434	1,208	1.0	90.3	1.8	435	49.0			
2	Gauge	330	J810		97	97.2	87	10	87.2			1.0	97.7	-0.5	1	91.6	-5.1	6.1	4
2	Gauge	328	J806		97	96.4	85	12	84.9			0.0	92.3	4.1	-	85.2	-0.2	7.1	4
3	Flow	224	J540	58	77	68.3	59	17	53.1	1,349	2,573	1.0	65.9	2.4	1,353	42.5			
3	Gauge	230	J165		87	87.7	69	18	69.7			4.0	86.7	1.0	-	64.0	5.0	22.7	-5
3	Gauge	220	J535		81	78.5	67	14	64.5			0.0	73.1	5.4	1	58.7	8.3	14.4	0
4	Flow	107	J340	53	71	71.7	54	17	57.7	1,289	2,336	0.0	70.8	0.9	1,289	45.2			
4	Gauge	106	J345		72	76.2	57	15	57.8			0.0	71.2	5.0	-	48.7	8.3	22.5	-8
4	Gauge	103	J325		74	74.2	61	13	61.2			4.0	74.1	0.1	6	55.1	5.9	19.0	-6
5	Flow	278	J730	8	77	78.8	48	30	35.1	507	723	0.0	71.4	7.4	507	22.3			
5	Gauge	274	J735		84	84.5	40	45	40.0			1.0	76.9	7.6	1	40.3	-0.8	36.6	8
5	Gauge	290	J725		79	79.1	36	43	36.6			1.0	72.2	6.9	1	46.4	-10.4	25.8	17
6	Flow	164	J438	3	68	71.7	67	1	70.5	286	2,161	0.0	64.9	6.8	286	9.1			
6	Gauge	148	J490		72	71.5	71	1	70.5			1.0	68.1	3.4	1	67.4	3.6	0.7	0
6	Gauge	134	J410		65	63.9	63	1	62.7			7.0	54.0	9.9	11	53.4	9.9	0.6	1

4.3.3 Fire Flow Requirements

The Insurance Services Organization (ISO) routinely conducts hydrant flow tests in water systems to assess the ability of those systems to supply needed flows for fire fighting. ISO most recently conducted tests in Newmarket in 2004 and the results of these tests are included in Appendix A. In general, a minimum flow rate for firefighting is needed for proper system operation. For the purposes of this study, an available fire flow of 500 gpm with all system pressures above 20 psi was assumed as the minimum acceptable level of service. Using the modeling software, the available fire flow with a minimum system pressure of 20 psi was determined for all locations under current and future maximum day demand conditions. The results of these analyses are presented in graphical form in the Figures at the end of this section. Locations with available fire flows less than the needed fire flow indicated by ISO or less than 500 gpm are indicated on these figures in red. These locations are considered hydraulically deficient and are listed in Table 4-8 Areas of Available Fire Flow Deficiencies.

The system model was also run to identify available flows for firefighting while maintaining system pressures at 20 psi or above. Demand conditions for these analyses included 2010 MDDs and 2030 MDDs with the system conditions indicated in Table 4-10.

Table 4-8 Areas of Available Fire Flow Deficiencies

Model Node ID	Location	Needed Fire Flow, gpm	Available Fire Flow (2010), gpm	Available Fire Flow (2030), gpm	Satisfies Fire Flow Constraint?
J930	Simons Lane at Durham Line	500	230	230	INSUFFICIENT
J925	Rte 108 at Durham Line	500	231	231	INSUFFICIENT
J920	N. Main St. near Durham Line	500	252	252	INSUFFICIENT
J915	N. Main St. near Durham Line	500	361	361	INSUFFICIENT
J910	Private Rd. off N. Main St.	500	398	398	INSUFFICIENT
J905	N. Main St. at Private Rd.	500	411	411	INSUFFICIENT
J900	N. Main St at Durham Pt. Rd.	1,500	570	570	INSUFFICIENT
J890	Durham Pt. Rd at end of line	500	383	383	INSUFFICIENT
J835	Bay Rd. near Schultz Place	500	376	376	INSUFFICIENT
J830	Lamprey River Trailer Park	500	376	376	INSUFFICIENT
J825	Bay Rd. at Lamprey River Trailer Park	500	402	402	INSUFFICIENT
J805	End of Line on Ham St.	500	220	220	INSUFFICIENT
J740	Pine St. at Beech St. Ext.	500	287	287	INSUFFICIENT
J730	Spring St. between Pine St. and Chapel St.	500	480	480	INSUFFICIENT
J700	Church St. near Granite St.	500	379	379	INSUFFICIENT
J660	End of Tasker Ln.	500	243	243	INSUFFICIENT
J657	Prescott St.	500	455	455	INSUFFICIENT
J595	Birch Dr. and New Rd.	500	328	328	INSUFFICIENT
J590	Birch Dr. and New Rd.	500	377	377	INSUFFICIENT
J585	New Rd. north of Birch Rd.	500	411	411	INSUFFICIENT

Model Node ID	Location	Needed Fire Flow, gpm	Available Fire Flow (2010), gpm	Available Fire Flow (2030), gpm	Satisfies Fire Flow Constraint?
J580	New Rd. north of Birch Rd.	500	432	432	INSUFFICIENT
J450	End of Main on Forbes Rd.	2,500	2,014	2,015	INSUFFICIENT
J440	Rte. 108 south of Forbes Rd.	500	316	316	INSUFFICIENT
J438	Rte. 108 near Rockingham Country Club	500	228	228	INSUFFICIENT
J435	Rte. 108 near Ash Swamp Rd.	3,000	179	179	INSUFFICIENT
J430	Rte. 108 at Newfields line	500	170	170	INSUFFICIENT
J380	Great Hill Dr. at tank connection	500	0	-	INSUFFICIENT
J365	Folsom Dr. upstream of booster	500	0	-	INSUFFICIENT
J360	Folsom Dr. at Hersey Ln.	500	307	310	INSUFFICIENT
J200	Grant Rd. at Brialla Cir.	500	336	336	INSUFFICIENT
J195	Brialla Cir.	500	360	360	INSUFFICIENT
J190	Brialla Cir.	500	376	376	INSUFFICIENT
J185	Brialla Cir.	500	390	390	INSUFFICIENT
J180	Brialla Cir.	500	396	396	INSUFFICIENT
J175	Grant Rd. at Brialla Cir.	500	400	400	INSUFFICIENT
J145	Lee Rd. at Maplecrest Dr.	3,000	1,246	1,246	INSUFFICIENT
J1135	End of Moonlight Dr.	500	488	488	INSUFFICIENT
J1075	Packers Falls Rd. at River Bend	1,750	1,125	1,125	INSUFFICIENT
J1030	Packers Falls Rd. at Lafayette	500	467	467	INSUFFICIENT
J1025	Packers Falls Rd. at Durham Line	500	368	368	INSUFFICIENT

4.3.4 Available Water System Pressures

The system model was run for average day, maximum day and peak hour demand conditions to assess expected pressures in the system as well as to indicate hydraulic bottlenecks, namely pipes with high velocities and head losses, which may be leading to lower pressures. These simulations were run under current (year 2010) and future (year 2030) demand conditions. System operating conditions for these scenarios are listed in Table 4-9:

Table 4-9 System Operating Condition Used in Hydraulic Model

Model Scenario	System Demand, gpm	Status of Bennett Well	Status of Sewell Well	Great Hill Tank Level, ft
2010 Average Day	336.4	Off	Off	53
2010 Maximum Day	533.5	On	On	38
2010 Peak Hour	822.2	On	On	38
2030 Average Day	382.0	Off	Off	53
2030 Maximum Day	607.5	On	On	38
2030 Peak Hour	936.2	On	On	38

A 2.44 peak factor was estimated based on a reported drop in tank level of 16 feet while both pumps were running. It was assumed that this drop in level took place over about 10 hours. This results in a draining flow rate of 341gpm, which when added to the pumping rate of 480 gpm is 821 gpm. This is 2.44 times higher than the average day demand of 336.4 gpm.

Areas of the system with pressures below 40 psi for average and maximum day demands or lower than 30 psi for peak hour demands were considered deficient for normal system operations. Based on the resulting water system pressures from analysis of year 2010 and projected year 2030 peak-hour demands, the majority of the water distribution system can meet the required minimum system pressure of 30 psi. Exceptions occur in the area along Hersey Lane between Great Hill Drive and Ledgewood Drive, as well as along the end of Ladyslipper Drive near Hersey Lane.

Results of the modeling analyses are presented in Appendix A.

4.3.5 Storage Requirements

The system model was used to determine the outflow from the storage tanks when demands exceed the available supply from the wells. Table 4-10 Tank Draining Rate lists the system demands and tank outflow under year 2010 and projected year 2030 conditions along with the tank outflow. Also included in the table is an estimate of the drop in tank level. For maximum day conditions, the drop in level is based on 24-hour sustained demand and for peak hour conditions the drop in level is based on a three hour sustained demand. Storage tanks also have to supply flows for firefighting while maintaining system pressures. In a worst case situation, a fire flow of as much as 3,000 gpm could be required for up to three hours which would require 540,000 gallons total over and above any tank flows needed to serve customers. This volume represents about 43 feet of storage in the tank, or nearly the entire volume of the 60 foot high tank. Under high demand conditions, system demands are already in excess of supply so fire flows would be drawn from the tank.

Table 4-10 Tank Draining Rate

Demand Condition	System Demand, gpm	Tank Outflow (inflow), gpm				Volume Withdrawn from Tank, gallons				Drop in Tank Level, ft			
		Existing Pumping Capacity	2010 Safe Pumping Capacity	2012 Safe Pumping Capacity (With McIntosh Online)	Future Safe Pumping Capacity (With McIntosh and Tucker Online)	Existing Pumping Capacity	Safe Pumping Capacity	Safe Pumping Capacity (With McIntosh Online)	Safe Pumping Capacity (With McIntosh and Tucker Online)	Existing Pumping Capacity	Safe Pumping Capacity	Safe Pumping Capacity (With McIntosh Online)	Safe Pumping Capacity (With McIntosh and Tucker Online)
2010 Maximum Day	533.5	53.5	313.5	53.5	(221.5)	77,040	451,440	77,040	(318,960)	6.2	36.3	6.2	0.0
2010 Peak Hour	822.2	342.2	602.2	342.2	67.2	61,596	108,396	61,596	12,096	5.0	8.7	5.0	1.0
2030 Maximum Day	607.5	127.5	387.5	127.5	(147.5)	183,600	558,000	183,600	(212,400)	14.8	44.9	14.8	0.0
2030 Peak Hour	936.2	456.2	716.2	456.2	181.2	82,116	128,916	82,116	32,616	6.6	10.4	6.6	2.6

4.4 Facilities

4.4.1 Sewell Pump Station

A site visit to the Sewell Pump Station was conducted on September 29, 2010. General observations of the facilities are as follows:

- Equipment appears to be fully functional but aged; a results of use and the environment
- There is limited space within the structure for equipment

The following observations were noted during the architectural condition review of the pump station:

- The structure is generally in good condition.
- Rotted wood trim was observed.
- Soffit vents are in need of cleaning and painting.
- The roof consists of asphalt shingles which has evidence of moss and a remaining life expectancy of about three to five years.
- The gutter is missing at the front of the building but the downspouts still remain at the corners.
- The painted hollow metal doors are beginning to rust. Wooden 2x4's were observed behind the door sills most likely as a weatherstripping measure. The new doors should be made of corrosion resistant aluminum or fiberglass and should be equipped with weatherstripping.
- A hose bib on the side of the facility was observed to be leaking.
- The structure appeared to be uninsulated.
- The interior finishes of the station were in good condition. Interior finishes consisted of unpainted CMU block and a painted plywood ceiling.
- The chemical containment area does not have a protective coating and deterioration of the concrete slab was observed.
- The emergency eyewash/shower has no tempered water supply which is a current code requirement.
- Wood trim around the roof hatch opening was damaged.

The following items were noted during the electrical review of the pump station. The review was based on the 2008 National Electrical Code (NEC):

- The generator started and ran well although the stand-by system has only a manual transfer switch and not an automatic transfer switch.
- The existing VFD has recently been replaced with a new AB PowerFlex 400. The enclosure is now much larger than required. The bottom of the enclosure has been removed and is open to the floor.
- The ceiling has open holes. Even though no signs of rodents were present, this affords a potential opportunity for access and damage.
- The generator has a minor leak that appears to be oil under the engine. There are signs that small animals have been nesting on the engine block, which can cause engine damage or a fire.
- Conduits located on the exterior of the building and at the generator do not have expansion fittings to compensate for ground movement, which is a violation of the NEC Article 300.5.J
- The exterior PVC conduit secured to the concrete does not have supports located at the spacing required by the NEC. The required maximum spacing for a 2" PVC schedule 40

conduit is 5 ft. The installed supports exceed this distance. One ½" PVC conduit on the side of the building has no support, although it should be supported every three feet for code compliance. In the front of the building a 2" conduit was observed to be sagging, in violation of NEC Article 352.30 and table 352.30.B. This sagging is caused by hot summer sun and the weight of the conduit. Additional supports will help to minimize any additional sagging.

- The electrical mast rising above the utility meter enclosure is missing the support that is required within 3 feet of the top of the enclosure, which is a violation of NEC Article 344.30.
- The working clearance between the well pump / and piping and the electrical gear is less than 42 inches as as required for a 480 volt system. This is a violation of NEC Article 110.26. It should be noted that based on the size of the structure and the location of the well and piping, this is the best that could be expected with such limited space.
- The panelboard, manual transfer switch and wireway are all rated for dry areas (NEMA 1) and not areas subject to ambient moisture of spraying water. Equipment is showing signs of minor rust due to moisture and stored chemicals in the area. This could be considered a violation of NEC 300.6, 110.11.
- The ground in the VFD enclosure has been installed without a ground lug and is in violation of NEC Article 110.3.B.
- Throughout the electrical distribution gear a combination of very old conductors and newer aluminum conductors were observed. This is not a NEC violation. However it was noted in the manual transfer switch that the enclosure has interior rusting and the lug connectors are corroding and have signs of aluminum dust on top of them. This is concerning and most likely is being caused by subtle amounts of chemicals in the air. Over time this will cause the electrical connection to loosen and possibly result in overheating and damage. This is a violation of NEC 300.6, 110.11.
- The small electrical panel under the main electrical panel is missing the cover screw, and therefore, the cover is not being held in place. The panel's interior wiring is in a state of disrepair.
- Two conductors have been placed under one of the main lugs, which is a violation of NEC Article 110.3.B. A twisted shielded cable has been installed as a branch circuit, connecting it to a 20 amp breaker. The 16/2 shielded conductor is rated for only 8 amp per NEC. This cable is designed to be attached to a current limiting instrumentation circuit. It normally has an insulation standard of 300 volts and is installed in with conductors having 600 volt insulation. This is a violation of NEC Articles 110.3.B, 725, 400 & 402.
- Motor termination box is not supported as required by NEC Article 314.23.F.
- Well pump piping is not bonded as required by NEC Article 250.104.

4.4.2 Bennett Pump Station

A visit to the Bennett Pump Station was conducted on September 29, 2010. General observations of the facilities are as follows:

- Equipment seems to be fully functional but aged; which is a result of use and environment.
- The limited space within the structure is small for the equipment.
- Equipment with enclosures rated for the location show little environmental damage while the NEMA 1 (dry type enclosures) have started to corrode and will continue to shorten the overall life of the system. It appears that the manual transfer switch is newer then the Cutler Hammer Main Panel. Other incidental equipment has been changed over time.

The following items were observed during the architectural condition review of the Bennett Pump Station:

- The structure is generally in good condition.
- The rear roof of the original structure has a life expectancy of about 5 years while the front, newer roof should last another 10 – 15 years.
- No provision was provided for chemical containment of sodium hydroxide.
- The emergency eyewash/shower has no hot water for tempered supply which is a current code requirement.
- A tripping hazard was observed at one of the interior door openings.

The following items were noted during the electrical review of the Bennett Pump Station. The review was based on the 2008 National Electrical Code (NEC):

- Conduits located on the exterior of the building and at the generator do not have expansion fittings to compensate for ground movement. This is a violation of NEC Article 300.5.J
- The generator started and ran well although the stand-by system has only a manual transfer switch and not an automatic transfer switch.
- The working clearance between the well pump and piping and the electrical gear is approximately 28-inches, which is less than the required 36-inches for a 120/208 volt system. This is a violation of NEC Article 110.26. It should be noted that based on the size of the structure and the location of the well and piping, this is the best that could be expected with such limited space. In essence the building is too small for the amount of equipment required within.
- In several areas conduits are not supported as required by the NEC. PVC conduit at the motor is lacking support from ceiling to floor. This is a Violation of NEC 352.30 & Table 352.30.B.
- Extension cords and data cables run freely along the wall supporting electrical and control panels. This is an industrial environment; electrical power and data should be protected with a conduit system. Power cords for equipment should be no longer than 6 feet and ample 120 volt outlets should be provided in areas where needed.
- Panelboard, manual transfer switch and wireway are all rated for dry areas (NEMA 1) and not areas subject to ambient moisture or spraying water. Equipment is rusting due to moisture and stored chemicals in the area, in violation of NEC Article 300.6; 110.11
- Motor termination box is not supported as required for compliance with NEC 314.23.F.
- The SCADA cabinet is crowded with loose equipment. The field wiring is disorganized.
- In the motor VFD, the feed ground conductor has been installed on a back plate mounting bolt, rather than the required dedicated grounding lug in violation of NEC 314.40.D.
- Well pump piping is not bonded in violation of NEC 250.104
- Rodent droppings were found in the bottom of the Main Service Panel. Rodents are known to move into electrical equipment. Their presence is detrimental to the equipment and can be the cause of VFD and other electrical equipment failure. This panel has a hole in the top and is most likely the entry point. This uncovered hole is also a NEC violation.

4.4.3 Storage Facilities

General observations made during the site visit to the Great Hill Storage Tank conducted on September 29, 2010 are as follows:

- Electrical components in the underground vault require relocation to an aboveground, suitable location.

The following items were noted during the architectural condition review of the tank:

- The tank appears to need recoating in the near future.

- The vault had standing water on the floor with a sump pit but no sump pump.
- The ladder to the vault was in good condition but should receive a pole extension for fall prevention for personnel entering the vault.
- Observed piping within the vault lacked proper coatings to minimize corrosion.

The following items were noted during the electrical review of the Great Hill Storage Tank. The review was based on the 2008 National Electrical Code (NEC):

- The Control Panel and the Power Panel are located within the pit with valves and piping and do not meet the requirements for working clearance as outlined in NEC Article 110.26. In order to work in the Control Panel or on the Power Panel, an employee needs to stand on the piping system, which is not recommended. Generally this is not a good location for this equipment.
- The small electrical panel located under the pit's concrete over hang is rated NEMA 3R.The panel should meet a NEMA 4X classification with a gasket and resistant to corrosion. A NEMA 4X environment is an area which is expected to be damp all year. The current electrical panel allows moisture to enter the enclosure and perpetuate corrosion. This is a violation of NEC 300.6, Article 110.11.
- It was not evident that the piping was grounded in accordance with NEC 250.104
- There are two grounding conductors attached to a ground bar located on the side of the tank. They appear to penetrate into the ground, however, this is the only point that grounding to the tank was observed.
- No lightning protection was noted on the top of the tank and the tank shows no signs of being grounded at its base. The antenna system for the cellular telephone system appears to be fully grounded at its supports and equipment enclosures. As noted above it appears that this equipment does not add to the tanks grounding but has been kept separated by design.
- The SCADA cabinet was found not to be tightly closed. Signs of moisture and leaves were found at the bottom of the cabinet.

A report following internal and external inspection of the Great Hill Tank conducted by Underwater Solutions Inc. in July 2008 made the following conclusions:

- The water tank appeared generally sound and without leakage.
- The exterior walls appeared sound and without obvious fatigue (pitting) of the steel at the time of the inspection.
- The protective coating applied to the wall surfaces was found to have generally good adhesion value while numerous coating chips, caused by objects striking the wall surfaces, have exposed the steel causing moderate surface corrosion.
- All the roof dome surfaces were found without fatigue or failure of the steel at the time of the inspection.
- The protective coating applied to the roof panel surfaces, as well as to the welds between the panels, was found to have with reduced film thickness due to weathering and has caused the coating to become chalky.
- Graffiti, carved into the coating of the roof dome in various areas, has exposed the underlying steel causing mild surface corrosion.
- All components affixed to the structure were found properly installed. The screen vent and overflow were found to be secure preventing access to the interior.
- All interior walls and overhead surfaces were found to have good coating adhesion and sound conditions at the time of the inspection.
- The coating applied to the floor surfaces was found to have poor adhesion value, causing blistering of the coating. Numerous ruptured blisters expose the underlying steel have

caused surface corrosion, yet there were no indications of fatigue (pitting) of the steel witnessed at the time of the inspection.

Underwater Solutions, Inc. recommended recoating the entire structure within 24 months (by July 2010) using an ANSI/NSF 61 approved coating for use in structures containing potable water, as continued exposure of the steel will result in metal fatigue (pitting) and eventually result in failure.

4.4.4 Folsom Booster Station

General observations made during the site visit to the Folsom Booster Station conducted on September 29, 2010 are as follows:

- It was assumed that the Town was continuing to upgrade this facility and noted items are to be addressed as part of the current work.

The following items were noted during the architectural review of the pump station:

- Roof shingles appeared new and should last another 25 to 30 years.
- The wood clapboard siding should be stained and nails reset where "popping" is occurring.
- Some wood trim in contact with soil is deteriorating and should be replaced. Soil should be re-graded in these areas to be kept away from the wood.
- Rigid insulation was applied to exposed concrete walls and covered with cement fiber boards. These boards should be inspected and repaired/replaced if necessary. The insulation is exposed in areas and should be covered before it deteriorates further.
- The entrance door is beginning to show signs of deterioration and should be replaced in the future.
- The interior finishes are in good condition but may require painting in a few years.
- Egress from the structure is currently provided by a movable wood step, which is higher than egress codes allow. This should be replaced with a permanent code compliant stair.

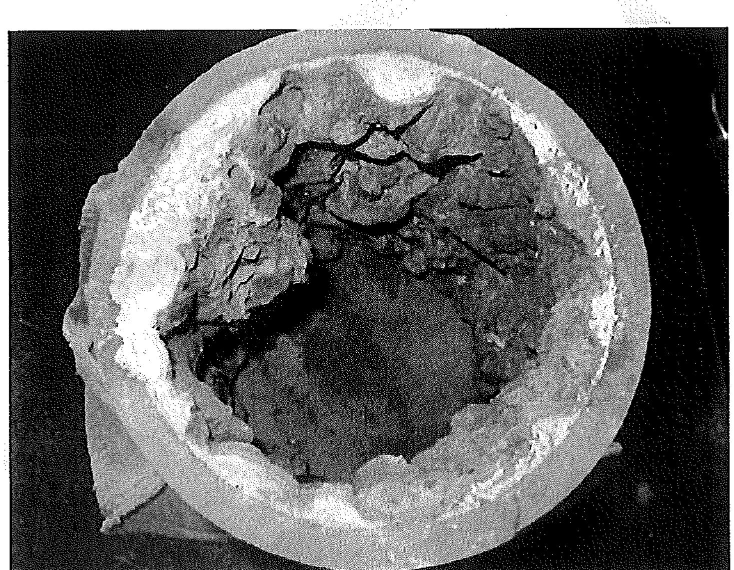
The following items were noted during the electrical review of the pump station. The review was based on the 2008 National Electrical Code (NEC):

- Conduits located on the exterior of the building do not have expansion fittings to compensate for ground movement. This is a violation of the NEC, Article 300.5.J
- Most of the equipment that has been installed is rated as NEMA 4 or 12 with the exception of the Main Panelboard, which is NEMA 1. Due to the proximity to water pumping this could be considered a violation of NEC 300.6, Article 110.11.The local inspector will need to make the final determination.
- Sealtight has been secured to PVC Conduit with tie-wraps. This is an violation of NEC Article 300.7.B
- The conduit system that attaches to the Verbatim Control Panel are not supported, which is not compliant with NEC.
- An extension cord has been attached to the Verbatim enclosure, rather than pipe and wire. Extension cords are typically used for temporary installation and should not be used as a permanent means of power.
- The piping under the Verbatim Control Panel is not capped but rather the conduit is open on the end, which is a violation of NEC Article 314.17.
- In the Kohler Automatic Transfer Switch enclosure, it was noted that the locknut for the PVC feeder nipple was installed backwards. In doing so the locknut is not allowed to bite into the steel enclosure creating a bond for the conduit system. This is a violation of NEC 110.3.B.

- Incomplete Cat 5 cable and conduit installation was observed. Cable and devices were hanging free.
- The Pump Control Panel has loose wiring inside the enclosure. The ground conductor lifted from the bus and panduit covers have been removed.
- The Pump Control Panel, conductors, and cable do not appear to have nomenclature or numbered tags affixed.

4.5 Water Quality Evaluation

The Town has high quality groundwater supply that meets regulatory drinking water quality standards. However, system operators have noted a number of concerns, including lack of flushing, that may impact future water quality. Due to lack of adequate storage, the Town has not flushed their distribution mains since 2004. This has resulted in areas of the distribution system with reduced flow and build up of deposits within their distribution system piping. For example, sections of Exeter Road and Elm Street have historically had poor water quality due to tuberculated piping conditions. The tuberculated piping within the Elm Street area is shown in Photograph 4-1.



Photograph 4-1. Elm Street Pipe Section with Significant Tuberculation

4.5.1 Proposed Bedrock Well Sources

Water quality at the proposed McIntosh and Tucker Well Sites has been evaluated by others and treatment will most likely be necessary. Evaluation of proposed treatment options is not within the scope of this report; however the Town should continue to evaluate treatment options for these wells prior to their incorporation into the water system.

An 8-day water quality assessment and pumping program conducted by EGGI in the fall of 2009 on the Tucker Well (Production Well NGE-1A) and McIntosh Well (Production Well NGE-2B) indicated several water quality parameters exceeded the established MCL while pumped at a rates of 275 and 300 gpm respectively. Initial water quality results indicated elevated levels of manganese, sodium, chloride, arsenic, and radon.

A 56-Day Water Quality Assessment and Pumping Program conducted by EGGI in the spring of 2010 on the McIntosh Well (NGE-2B) indicated favorable water quality requiring little treatment while pumped at a rate of 300 gallons per minute (gpm). Initial pumping indicated elevated levels of chloride, arsenic, and manganese although levels of these contaminants decreased over the course of the pump test.

The safe yields of the McIntosh and Tucker were not available from the information provided, but for the purposes of this evaluation, it was assumed that a pumping rate of 300 gpm for the McIntosh Well and 275 gpm for the Tucker Well for a duration of 16 hours per day was acceptable.

Water quality from the 8-day pump test at the Tucker Site and 56-day pump test at the McIntosh Well Site is summarized in the Table below:

Table 4-11: Bedrock Well Water Quality

Parameter	Recommended Limit	McIntosh Well (NGE-2B)1	Tucker Well (NGE-1A)2
Manganese	0.05 mg/L	0.057 mg/L	0.058 to 0.047 mg/L
Sodium	100 to 250 mg/L	176 mg/L	90 to 140 mg/L
Chloride	250 mg/L	200 to 220 mg/L	140 to 180 mg/L
Arsenic	0.010 mg/L	0.006 to 0.01	0.009 to 0.013 mg/L
Radon	300 to 4,000 pCi/L	Not Available	4,100 pCi/L

[1]1 Pumping rate 300 gpm. Analysis occurred during 56-day pump test, February 25 to April 22, 2010.

2 Pumping rate 275 gpm. Analysis occurred during 8-day pumping test, October 27 to November 4, 2010.

A memorandum dated August 6, 2010 prepared by Weston & Sampson Engineers, Inc. concluded that elevated contaminant levels in the Tucker Well could be reduced by blending with the McIntosh Well. Additional conversations with the Town indicate that two primary water treatment options are being considered to treat water from the McIntosh and Tucker wells:

1. Mixing source water from both wells to reduce Tucker Well elevated contaminant levels.
    a. Predicted to result in water quality acceptable to regulatory standards but at higher levels than source water from the McIntosh well alone
    b. Dependent on operation of both wells. If McIntosh well is offline blending would no longer be possible
2. EDR (membrane) treatment
    a. High water quality not dependent on the operation of both wells
    b. More expensive than blending option

Reduction of arsenic from the Tucker well may require treatment in addition to the methods listed above.

The pump station with chemical addition for the McIntosh Well is currently in preliminary design. Capital funds for the design and construction of the McIntosh Well treatment plant and connection to the distribution system have not been allocated at the time of this study. Plans for developing the Tucker Well are subject to the recommendations of this study.

4.5.2 Water Quality Regulations

Several regulations that have recently become effective or are currently scheduled for promulgation by EPA may impact treatment requirements in the future in Newmarket. Each of these regulations and their potential impact on the Newmarket water system are discussed in the following sections.

4.5.3 The Radon Rule

The Radon Rule was scheduled to become a final rule by August 2000. However, promulgation has been delayed. The rule will establish an MCL of 300 Pico curies per liter (pCi/l) for individual water systems serving 25 customers or more that use groundwater or mixed ground and surface water. The rule also established an alternate maximum contaminant level of 4,000 pCi/l for states which developed multimedia mitigation plans (MMM) to mitigate indoor radon levels. Treatment will be waived for supplies with radon levels between 300 pCi/l and 4,000 pCi/l in these states. Systems with radon levels above 4,000 pCi/l will require treatment. The rule is unique in that it is the first time an air and water borne health risk has been addressed in the same rule.

The radon levels in the Town's wells are between 1,200 and 1,500 pCi/l and, therefore, will not be subject to treatment if the state of New Hampshire implements a multimedia mitigation program. However, preliminary testing of the proposed Tucker well site indicates that water from this source may need to be treated for radon. The Town should track final development and promulgation of this rule before taking any action to address the requirements of the rule.

4.5.4 The Groundwater Rule (GWR)

The Groundwater Rule (GWR) applies to all public water systems using groundwater. The GWR requirements began in March 2009 with 6-months investigative monitoring (IM) for source water E.coli, for systems currently applying disinfection only. All other requirements for the GWR began in Dec 2009. The Groundwater Rule established the following general requirements for all water utilities using groundwater supplies:

- Sanitary Surveys – Sanitary surveys will be required for all community water systems every three years.
- Hydrogeologic Sensitivity Assessments - Hydrogeologic sensitivity assessments will be required for all groundwater systems which do not provide a 4-log (99.99%) inactivation/removal of viruses. Unconfined gravel aquifers, fractured bedrock and Karst formation aquifers will be considered "sensitive" to microbial contamination.
- Source Water Monitoring – Supplies within "sensitive" aquifers which do not provide a 4-log removal/inactivation or viruses will be required to monitor wells monthly for fecal indicators. Sources will be required to provide a 4-log removal/inactivation if they fail source water monitoring criteria.
- Compliance Monitoring – Groundwater systems required to disinfect will be required to monitor disinfectant residuals continuously.

The Town has been diligent implementing source water protection areas around their well supplies. In addition, the wells are chlorinated at the source. Both wells are located greater than 150 feet from a surface water body and therefore, should not be classified as being groundwater under the influence of surface water. However, the Town should continue to monitor bacteria at their sources in accordance with this rule.

4.5.5 D-DBP Rule

The purpose of the Disinfectant – Disinfection Byproducts Rule (D-DBP) is to provide moderate protection against risk from known and unknown disinfection byproducts. The Rule established maximum contaminant levels (MCLs) for trihalomethanes (THMs) and haloacetic acids (HAA5s). These compounds form when free chlorine radicals react with assimilable organic carbon (Natural Organic Matter) in a water supply. The rule requires four quarterly samples be taken in the distribution system, with one sample location selected at the point of maximum residence time in the distribution system.

The D-DBP rules apply to all community water systems using a disinfectant such as chlorine, chloramines, ozone and chlorine dioxide. Compliance with the Stage 1 DBP requirements began in 2000. The Stage 2 DBP requirements began in 2006 with the Initial Distribution System Evaluation (IDSE). Compliance monitoring for the Stage 2 DBP begins in April 2012.

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) rule applies to all water systems using surface water, groundwater under the influence of a surface water, as well as groundwater/surface water blends. The LT2 requirements began in 2006 with the characterization of raw water Cryptosporidium and E.coli levels. Systems serving <10,000 customers are required to monitor for E.coli only every two weeks for one year. Compliance with the LT2 requirements will begin in April 2013.

Groundwater supplies such as those in Newmarket are typically very low in organic matter. Therefore the Town should be able to meet the requirements of this rule. The Town should continue to be diligent in testing and should closely monitor any changes in groundwater quality. In particular, if water from the Packers Falls WTP is to be reactivated into the system very close attention should be made of its quality and potential DBP formation.

4.6 Water Management Evaluation

4.6.1 Wellhead Protection

The Town has established an Aquifer Overlay District (Zoning Ordinance Section 5.01) to provide regulatory protection for the Newmarket Plains Aquifer where the Bennett and Sewell Wells are located. In addition, a wellhead protection district (WHPD) has been established to provide additional protection to the zones of contribution to the wells, as delineated by Comprehensive Environmental Inc. in their October 2006 Report, "Delineation of Newmarket Plains Aquifer Wellhead Protection Area." These protection areas limit use of practices that may affect that quality of groundwater to the wells. The Town of Newmarket's Master Plan further described the purpose of the Aquifer Protection Overlay District as:

- Protect, preserve and maintain existing and potential groundwater supplies and related groundwater recharge areas within the Town,
- Prevent development and land use practices that would increase risk of contamination or reduce the recharge of identified aquifers,
- Provide for future growth and development of the Town, in accordance with the Master Plan, by insuring the future availability of public and private water supplies,

- Encourage uses that can appropriately and safely be located in the aquifer recharge areas.

The Town should continue to adapt and expand local wellhead protection areas and uses as the Town and water system grows. The potential addition of the McIntosh and Tucker bedrock well sites will require the establishment of a wellhead protection area for these sources.

4.6.2 Water Conservation Program

During dry periods the Town uses a staged approach to limit water use according to available water capacity. The conservation stage in effect is posted at locations entering Town, on the Town Hall marquee, Television Channel 13, the Town web site and in the local newspapers. The conservation stages have been developed to ensure that the Great Hill Storage Tank remains ¾ full, allowing for adequate pressure and fire protection. If this amount of water cannot be replenished during non-watering times, more restrictive measures may go into effect. Descriptions of each stage are below:

Stage 1 – Voluntary Water Conservation
The public is requested to refrain voluntarily from watering lawns and encouraged to conserve water in all practical ways.

Stage 2 – Mandatory Odd/Even Watering
The public is required to restrict lawn watering to every other day based on address and calendar day. Example – Even address/even calendar day, odd address/odd calendar day

Stage 3 – Mandatory Two-Day Restrictions on Lawn Watering by Address
Each address is restricted to watering on two (2) days per week between the hours of 5-8 am and 6-9 pm on the following schedule.

Allowed Days/Street Address	
Mon., Wed.	Odd Number
Tues., Thurs.	Even Number

No washing of driveways, sidewalks, autos, or boats is allowed.

Stage 4 – Mandatory Outside Water Ban
All outside water use is banned.

In addition to the stages listed above, the Town also offers the following water saving tips in their Annual Water Quality Report:

- Check your toilet for leaks
- Install water saver shower heads or restrictors
- Check faucets and pipes for leaks.
- Use your dishwasher only when full
- Use washing machine with full loads only.
- Keep a bottle of drinking water in the refrigerator.
- Water your lawn only when it needs it.
- Water during cool parts of the day.
- Don't wash down driveways or gutters.
- Plant drought – resistant trees and plants.
- Cover swimming pool to reduce evaporation.

5 Conclusions and Recommendations

This section summarizes AECOM's conclusions and recommendations for this study. Many of the recommendations are required to meet projected water demands.

5.1 Supply

The capacities of the existing Bennett and Sewall wells are not adequate to meet current system average day demands based on the safe yield analysis. The estimated deficit ranges from approximately 24,000 gpd in year 2010 to 90,000 gpd in year 2030. With the McIntosh well online, the system will be able to meet average day demands based on the safe yield analysis.

The capacity of the existing Bennett and Sewall wells are not adequate to meet current system maximum day demand based on the safe pumping capacity analysis. The estimated deficit ranges from approximately 560,000 gpd in 2010 to 660,000 gpd in 2030. With the Bennett, Sewall and McIntosh wells online, the deficit ranges from approximately 310,000 gpd in 2010 to 410,000 gpd in 2030. With the Bennett, Sewall, McIntosh and Tucker wells online, the deficit ranges from approximately 45,000 gpd in 2010 to 150,000 gpd in the year 2030. The safe pumping capacity analysis assumes the largest well is offline and daily capacity is limited to 16 hours of run time for each well. This deficits listed above do not include any additional water available from storage.

It is recommended the Town complete their design and construction project to bring the McIntosh well online and pursue an additional water source for redundancy purposes. The Town recently completed a 56-day pump test to confirm water quality of the McIntosh well. It was determined that some level of treatment will be needed to meet water quality standards. The Town and its consultant evaluated different treatment options including blending and a membrane treatment technology. This evaluation is ongoing and the Town is currently working on permitting this well. It is anticipated the proposed treatment system will need to be piloted before implementation. The Town estimated the well will not be placed online until late in the year 2012. It should be confirmed that the McIntosh well will be able to operate 16 hours per day at its proposed rate of 300 gpm without exceeding the safe yield of the aquifer.

Even after the McIntosh well is in operation, the Town is in need of a fourth well as a redundant water source. This is particularly true if the blending the McIntosh well water with one the existing supply sources is required to meet water quality standards. In this scenario, the McIntosh well could not be quantified as an individual source because of its dependency on another water supply. For the purpose of this evaluation the future water supply was assumed to be the Tucker Well. It should be confirmed that the Tucker well will be able to operate 16 hours per day at its proposed rate of 275 gpm without exceeding the safe yield of the aquifer. With Tucker well online the safe pumping capacity of the four wells would be 725,000 gpd. The year 2030 maximum day demand is 874,750 gpd. A fifth well was not considered for this evaluation because storage can be used to compensate for demand conditions.

The following is a summary of recommended supply projects and associated costs (denoted with the suffix S):

Table 5-1: Recommended Supply Improvements

Recommended Improvement	Goal and Objective of the Project	Additional Notes
S-1. McIntosh Well Development	Safe Pumping Capacity	Ongoing Project
S-2. New Well Development (Tucker Well)	Safe Pumping Capacity	None

5.2 Storage

AECOM performed two separate analyses to determine Newmarket's storage needs. Based on the evaluation results, Newmarket is in need of additional storage capacity. For the analyses it was assumed a second 750,000 gallon tank would be constructed adjacent to the existing. A second equal sized tank was assumed because of previous storage recommendations. Alternative tank options (e.g. type, size, etc.) were not within the scope of this study. It was determined that the Town would need significantly more storage to meet year 2030 MDD conditions with their current supplies (Bennett and Sewall Wells) under all pumping conditions (24 hour, 16 hour and safe pumping capacity). With a second tank it was demonstrated that the Town would have sufficient supply and storage to provide for an approximate 2 day sustained MDD and a fire flow need for 540,000 total gallons if all four wells were online, but the largest well is not in service (safe pumping capacity). This will provide the needed storage capacity without creating an excess of water storage that could potentially lead to water quality issues. The Town may choose to accept the risk associated with less than the safe pumping capacity, but it is not recommended. It is recommended the Town of Newmarket install an additional tank adjacent to the existing tank of similar size (750,000 gallons) as previously recommended in the UEI report. The tank improvements should be coupled with the water main size increase from the Great Hill Tank to the carwash on Route 108 and miscellaneous improvements inside the existing Great Hill Tank noted in previous recommendations.

The existing Great Hill Storage Tank and below grade vault is in need of repair and improvements. The existing tank is a painted steel water storage tank with a below grade vault housing piping, valves and electrical equipment. Previous recommendation include resurfacing the tank inside and out to address failing paint. This has not been completed and remains a recommended project. The Town may consider reducing the costs of this work by repairing the paint with a new brushed surface. Storage tank improvement cannot be completed until a new storage tank is placed online.

Electrical equipment is showing signs of corrosion and should be removed from the below grade vault. This will also address noted electrical code and safety deficiencies. A sump pump should be installed in the sump pit to remove standing water in the vault. The ladder to the vault was in good condition but should receive a pole extension for fall prevention as personnel access the vault. All piping in the vault should be repainted. . It is recommended the Great Hill Tank be resurfaced inside and out as previously recommended, but not until a new tank is constructed.

The following is a summary of recommended Storage projects and associated costs (denoted with the suffix St):

Table 5-2 Recommended Storage Improvements

Recommended Improvement	Goal and Objective of the Project	Additional Notes
St-1. New Water Storage Tank	Improved capacity, fire flows, and water quality	To be coupled with water main improvements
St-2. Great Hill Tank Improvements (Surface Rehab)	Storage reliability, water quality	Tank painting may be repaired (brush coat) at half the cost of full resurface

5.3 Distribution System

Recommended distribution piping improvements were developed for Newmarket's water distribution system for each of the following objectives:

- Transmission Main Strengthening
- Fire Flow Enhancement
- Improved System Pressures
- Improved Pipe Looping
- Improved Distribution Water Quality
- Improved System Reliability
- Replace aging pipes
- Allow for system expansion

Recommended piping improvements are summarized in

Table 5-3 through Table 5-5.

5.3.1 Piping Recommendations for Improved System Reliability

The strength of a system is determined by the amount of looping, which reduces the flow in any single pipe serving an area and thus head losses. The distribution system has several large diameter (10, 12 and 16-inch) major transmission mains which form the main skeleton loops of the distribution system. Currently, supply from the two wells must pass through an 8-inch pipe on Wadleigh Falls Road and South Main Street. The South Main Street pipe is quite old and has a low roughness coefficient value, which indicates poor carrying capacity. In addition, the existing 10-inch from the Great Hill tank to the main in Exeter Road is small and has a low roughness coefficient value. The older pipes with lower roughness coefficient values increase head losses in the system and affect the output from the well pumps. These pipes are recommended for replacement with new 12-inch pipes. Other parts of the main network include pipes in Packers Falls Road and Elm Street, which are older and tuberculated, as well as pipes on Durell Road, Hersey Lane and Bennett Way, which are newer but are undersized. All of these pipes are recommended to be replaced with a new pipe with minimum diameter of 8-inches.

Other pipes in the system located mainly in the center of Town, form a secondary skeleton network. In general, any pipe on a loop with a low roughness coefficient or less than 8-inches in diameter is recommended to be replaced with a new pipe with minimum diameter of 8-inches.

5.3.2 Piping Improvements for Fire Flow Enhancement

There are several locations in the Newmarket water system that do not have adequate available fire flows for year 2010 or projected year 2030 conditions. A minimum fire flow requirement of 500 gpm was generally assumed for all residential areas not tested by ISO. The value of 500 gpm was used as a conservative measure to identify where the greatest need would be to address fire flow deficiencies. It is likely that many of the residential areas in the Town have a minimum fire flow requirement greater than 500 gpm but localized estimation of needed fire flow was beyond the scope of this study.

The available fire flow deficiencies are summarized on Table 4-8 Areas of Available Fire Flow Deficiencies. The minimum recommended service pressure is 20 psi under all demand conditions, including fire flows. The pipeline improvements recommended for system strengthening will improve fire flow availability throughout the system. Selected dead end mains with low roughness coefficients may still have low available fire flows.

5.3.3 Piping Recommendations for System Expansion

Parts of the system on the periphery could be locations for system expansion. One of the most likely locations would be Forbes Drive and New Road. New piping here could better serve the industrial park. Other options for system expansion would be North Main Street near Durham and Exeter Road south of Forbes Street. These are older, rough pipes that should be considered for replacement but at a lower priority than the recommendations for system strengthening or fire flow improvements. Improvements to expand the system are dependent on additional supply sources being placed online.

5.3.4 Piping Recommendations for Adequate System Pressures

A service pressure of 35 psi is generally recommended as a minimum service pressure under non-emergency conditions. Based on the resulting water system pressures from analysis of 2010 and projected year 2030 peak-hour demands, the majority of the water distribution system can meet the required minimum system pressure of 35 psi. One exception to this is the area along Hersey Lane between Great Hill Drive and Ledgewood Drive, as well as along the end of Ladyslipper Drive near Hersey Lane. The cause of the low pressures in this area is the elevation of this area in relation to the water level in the tank. The only way to increase the pressures in this area so they do not fall below minimum acceptable levels would be to create a boosted pressure zone similar to the one on Folsom Drive.

Pressure contours were also developed for the water system under the peak-hour condition. This data is useful in identifying areas of the distribution system where pressures exceed 100 psi and where pressure reduction on service connections should be considered. There are no specific recommendations related to system pressure adequacy.

Figures of the hydraulic modeling scenarios are included in Appendix A of this report. Improvements were modeled as follows:

Year 2010:

- High hydraulic priority improvements
- High and medium hydraulic priority improvements
- Great Hill Tank level at 38 feet and Sewall and Bennett wells ON

Year 2030

- High and medium hydraulic priority improvements

- High, medium and low hydraulic priority improvements
- Tank level at 38 feet and Sewall, Bennett and McIntosh wells on

The following is a summary of recommended piping projects and associated costs (denoted with the suffix P):

Table 5-3 Recommended Distribution System Piping Improvements - High Hydraulic Priority

Recommended Improvement	Existing Water Main Diameter (Inches)	Proposed Water Main Diameter (Inches)	Proposed Project Length (ft)	Goal and Objective of the Project	Additional Notes
P-1. South Main St (Between Wadleigh Falls Rd & Railroad St)	6, 10	12	3,300	Transmission main strengthening, fire flow, aged pipe	
P-2. South Main St (to Gerry Ave) & Creighton St	8, 10	12	600	Transmission main strengthening, fire flow, aged pipe	
P-3. Packer Falls Rd (South Main St to Elm St)	10	10	2,250	Transmission main strengthening, fire flow, aged pipe	Potential candidate for cleaning & lining
P-4. Elm St	6	8	2,600	Transmission main strengthening, fire flow, aged pipe	
P-5. Exeter Rd (Great Hill Tank to car wash)	10	16	1,000	Transmission main strengthening, fire flow, aged pipe	
P-6. Cross-country main from Great Hill Tank to Rt. 108	10	16	330	Transmission main strengthening, fire flow, aged pipe	
P-7. Grant Rd (Wadleigh Falls Rd to Brialla Circle)	6	12	1,550	Transmission main strengthening, fire flow, aged pipe	

Table 5-4 Recommended Distribution System Piping Improvements – Medium Hydraulic Priority

Recommended Improvement	Existing Water Main Diameter (Inches)	Proposed Water Main Diameter (Inches)	Proposed Project Length (ft)	Goal and Objective of the Project	Additional Notes
P-8. Exeter Rd (Great Hill Tank to Forbes Rd)	6	8	3,100	Distribution main strengthening, fire flow, aged pipe	
P-9. Spring St Area (Spring, Central, Chapel, Rock, and Church Streets)	6	8	3,750	Distribution main strengthening, fire flow, aged pipe	
P-10. Beech St Extension (to Pine St)	-	8	1,200	Distribution main strengthening, fire flow, aged pipe	
P-11. Hersey Lane & McIntosh Well Connector	-	12	5,920	Distribution main strengthening, fire flow, aged pipe	
P-12. North Main St (Sanborn to Dame and Bay Rd)	6,8	8	1,100	Distribution main strengthening, fire flow, aged pipe	Existing 8-inch potential candidate for cleaning & lining
P-13. New Rd and Lamprey St	6,8	8	2,700	Distribution main strengthening, fire flow, aged pipe	Existing 8-inch potential candidate for cleaning & lining
P-14. Pine St	6	8	500	Distribution main strengthening, fire flow, aged pipe	
P-15. New Rd	6	8	1,100	Distribution main strengthening, fire flow, aged pipe	
P-16. Bay Rd and Dame Rd	6,8	8	1,150	Distribution main strengthening, fire flow, aged pipe	Existing 8-inch potential candidate for cleaning & lining

Recommended Improvement	Existing Water Main Diameter (Inches)	Proposed Water Main Diameter (Inches)	Proposed Project Length (ft)	Goal and Objective of the Project	Additional Notes
P-17. Creighton St	4	8	560	Distribution main strengthening, fire flow, aged pipe	
P-18. Route 108 (Bay Rd to Simons Lane)	6	8	925	Distribution main strengthening, fire flow, aged pipe	
P-20. Exeter Rd (south of Forbes Rd)	6	8	3,850	Distribution main strengthening, fire flow, aged pipe	
P-21. Lang's Lane	-	10	5,725	Distribution main strengthening, fire flow, aged pipe	
P-22. New subaqueous crossing downstream of Rt 108 Bridge	6	12	450	Distribution main strengthening, fire flow, aged pipe	

Table 5-5 Recommended Distribution System Piping Improvements – Low Hydraulic Priority

Recommended Improvement	Existing Water Main Diameter (Inches)	Proposed Water Main Diameter (Inches)	Proposed Project Length (ft)	Goal and Objective of the Project	Additional Notes
P-23. Ham St	4	8	400	Fire flow, aged pipe	
P-24. Church St (between Rock and Granite Streets)	6	8	350	Fire flow	
P-25. New Road	6	8	810	Fire flow	
P-26. Route 108 (Bay Rd to Simons Lane)	6	8	1,600	Fire flows, aged pipe, system expansion	
P-27. Dame Rd.	6	8	400	Fire flows, aged pipe	
P-28. Second river crossing to Durham	-	10	1,030	System strengthening, expansion	Dependent on additional water supply sources being added
P-29. Forbes Rd Extension	-	8	8,650	System strengthening, expansion	Dependent on additional water supply sources being added

5.3.5 Coordination with Other Infrastructure Projects

The NHDOT Draft Ten Year Transportation Plan (years 2011 through 2020) was consulted for the purpose of coordinating distribution piping improvements with other infrastructure projects. A component of the NHDOT Plan for this period is to construct 4-foot wide bike shoulders along Rt. 108 in Durham from the Oyster River Bridge to Dame Road and Sanborn Avenue in Newmarket (NHDOT Project #98-17TE). No other NHDOT projects are identified over the ten-year period in Newmarket. It is recommended that distribution piping improvements are scheduled to coincide with the work planned by the NHDOT.

5.3.6 Distribution System Maintenance Recommendations

A comprehensive leak detection survey is recommended every five to 10 years in the distribution system. A comprehensive leak survey includes soundings for valve, hydrants and the water main at approximate intervals of 8-feet. Further, regular sounding surveys of the valves and hydrants are recommended every two years. Newmarket's unaccounted-for water is estimated to be 23-28% of the total system demands. This amount of unaccounted for water is significant considering Newmarket's inadequate supply capacity. A leak detection survey will provide a checklist of lost water sources to be targeted for reduction.

It is recommended that the Town implement a routine valve and hydrant inspection, exercising and maintenance program. The program is a sound maintenance practice and the costs for this type of project could likely be included in the Town's annual maintenance budget.

The following is a summary of recommended distribution system maintenance projects (denoted with the suffix M):

Table 5-6 Recommended Maintenance Improvements

Recommended Improvement	Goal and Objective of the Project	Additional Notes
M-1. Leak detection program	Maximize supply capacity, increase reliability	Begin with comprehensive study and continue with 2 year and 5 year programs
M-2. Valve and Hydrant Maintenance Program	Increase Reliability	Incorporate into annual budget

5.3.7 System Mapping

It is recommended that the Town update their current mapping system into a digital format. Current mapping is hard copy based and is outdated. Digital mapping can be integrated into a GIS format.

The following is a summary of recommended distribution system management projects (denoted with the suffix Ma):

Table 5-7 Recommended Management Projects

Recommended Improvement	Goal and Objective of the Project	Additional Notes
Ma-1. Water GIS Mapping	Increase Operator Efficiency	

5.4 Facilities

5.4.1 Bennett Pump Station

The Bennett Well Pump Station is in good condition but could use some general maintenance as follows:

- Clean the vinyl siding
- Clearing and regarding the soil around the structure
- Replace the rear roof of the original structure in approximately 5 year
- Replace the front roof of the structure in approximately 10 to 15 years
- Re-pointing the masonry in areas where needed
- Inspect and re-caulk wood siding
- Re-paint the structure in approximately 5 years
- Repair damaged vinyl soffits at the rear of the building
- Install weatherstripping at the hollow metal entrance door
- Re-paint entrance door in approximately 5 years

The following projects are recommended in the near term:

- Eliminate tripping hazard at the interior door opening with fill concrete
- Move existing electrical equipment out of the pump room and into a separate room with better environmental conditions (e.g. dry) and more space to address electrical code violations
- Address noted electrical code violations
- Add an automatic transfer switch to the station so that emergency power is automatically engaged upon grid power failure

Any upgrades to the station should include adding tempered water to the emergency eyewash/shower to meet current code requirements.

It would be beneficial for the Town to lump the recommended improvements into a single upgrade project. For the purpose of this study, the recommended upgrade project includes a new addition (approximately 12-feet by 16-feet) which would house the relocated sodium hydroxide storage and chemical pumps. The existing entrance area would serve as a new electrical room. An interior wall would be built to separate the existing pump room and proposed electrical room. Existing electrical and control panels would be relocated to the electrical room.

5.4.2 Sewell Pump Station

The Sewell Well Pump Station is in good condition but could use some general maintenance as follows:

- Clean the vinyl siding
- Inspect, repair and/or replace damaged wood trim
- Clean and paint soffit vents
- Re-pointing the masonry in areas where needed
- Clear and re-grade soil around the structure to improve drainage
- Replace the roof of the structure in approximately 3 to 5 years

- Replace the missing gutter in the front of the building
- Replace the hollow metal entrance doors that are rusted with new corrosion resistant doors and weather stripping
- Replace wood trim around roof hatch opening

The following projects are recommended in the near term:

- Repair leaking hose bib on side of building
- Install chemical resistant coating in chemical containment area
- Move existing electrical equipment out of the pump room and into a separate room with better environmental conditions (e.g. dry) and more space to address electrical code violations
- Address noted electrical code violations
- Add an automatic transfer switch to the station so that emergency power is automatically engaged upon grid power failure

Any upgrades to the station should include adding tempered water to the emergency eyewash/shower to meet current code requirements.

It would be beneficial for the Town to lump the recommended improvements into a single upgrade project. For the purpose of this study, the recommended upgrade project includes a new addition (approximately 12-feet by 16-feet) which would house the relocated sodium hydroxide storage and chemical pumps. The existing chemical storage area would serve as a new electrical room. An interior wall would be built to separate the existing pump room and proposed electrical room. Existing electrical and control panels would be relocated to the electrical room.

5.4.3 Folsom Drive Booster Station

The Booster Station is generally in good condition. The station is under an ongoing project to upgrade the mechanical and electrical components. Some general maintenance items could be recommended including:

- Stain and reset nails in the wood clapboards.
- Replace deteriorated wood trim in contact with soil and re-grade soil in these areas
- Inspect and repair/replace cement fiber boards covering rigid insulation on the exposed concrete walls and cover any exposed insulation
- Replace the deteriorated entrance door
- Re-paint interior painted surfaces in the next few years
- Replace moveable egress step with a code compliant permanent stair

These items should be addressed as part of the Town's ongoing project at the booster station.

5.4.4 Storage Tank Vault

It is recommended that the electrical and instrumentation equipment located in the below grade vault be removed and placed in an above grade building enclosure. A manual electrical transfer switch and generator outlet should also be installed on this structure. This will allow a portable generator to be plugged during a power failure. A pole extension should be added to the ladder to assist personnel that access the vault. All piping within the vault should be re-painted to reduce corrosion. An automatically operated sump pump should be installed in the sump pit to remove any water in the vault.

For the purpose of this study, the recommended upgrade project for the vault includes a new building (approximately 12-feet by 16-feet) which would house the relocated electrical and control panels from the existing vault. Existing vault improvements include the ladder pole extension, painting existing piping and installation of a new sump pump.

5.4.5 Facilities Summary

The following is a summary of recommended Facilities projects and associated costs (denoted with the suffix F):

Table 5-8 Recommended Facilities Improvements

Recommended Improvement	Goal and Objective of the Project	Additional Notes
F-1. Bennett Pump Station Upgrade	Safety, System Reliability	
F-2. Sewall Pump Station Upgrade	Safety, System Reliability	
F-3. Water Storage Tank Vault Improvements	Safety, System Reliability	

5.5 Water Quality

An engineered uni-directional flushing program is recommended to improve water quality in the Town's distribution system. Due to lack of supply and storage, the Town has not flushed their water mains since 2004. A uni-directional flushing program, designed with the assistance of the revised hydraulic model, will improve both fire flows and water quality by removing the accumulated deposits and sediment in the system. Once the program is designed, the Town can modify the program on its own for changes in the water system.

The following is a summary of recommended Water Quality projects and associated costs (denoted with the suffix Wq):

Table 5-9 Recommended Water Quality Improvements

Recommended Improvement	Goal and Objective of the Project	Additional Notes
Wq-1. Uni-directional Flushing Program	Water Quality, Fire Flows, System Reliability	

5.6 Regulatory Compliance

The Town of Newmarket's water system is required to meet the regulatory requirements of the NHDES regarding public health matters and the New Hampshire Public Utilities Commission (PUC) regarding water rates and other financial and managerial matters. In addition, the Town is also required to be in compliance with all regulations administered directly by the EPA.

A list of upcoming and recently implemented rules and regulations was provided in **Error! Reference source not found. Error! Reference source not found.**. It is not anticipated Newmarket will need to plan for any projects to meet proposed rules and regulations at this time.

5.7 Environmental Impact of Recommendations

The implementation of some of the recommendations contained in this report may require state and federal permits. In general, distribution piping improvements will be constructed within the existing road right-of-ways. Stream crossings, if required, would necessitate permitting in accordance with State of New Hampshire's Natural Resources Protection Act (NRPA). Specific permitting requirements would need to be addressed prior to construction on a case by case basis.

5.8 Opinion of Cost

The cost estimates shown have been prepared to provide guidance in project evaluation and implementation and are based upon information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, final project costs, implementation schedule and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

The American Association of Cost Engineers (per ANSI Standard Z94.0-1989) has defined levels of accuracy that are commonly used by professional cost estimators. Three categories of accuracy include: (1) order-of- magnitude, (2) budget, and (3) definitive estimates. The estimates of comparative cost presented in this report are considered order-of-magnitude and were developed with limited engineering detail for comparison purposes and assumes a midpoint of construction. If construction occurs within a different time frame, then the cost estimating will need to be re-evaluated. Order-of-magnitude costs were developed from historical water pipeline projects constructed in New England, scaling of similar project experience, or other similar methods.

The opinion of construction cost is the costs for physical installation of the proposed improvement and includes the contractor's labor, materials, equipment and contactor's overhead and profit. The project cost is inclusive of engineering design fee, engineering services fee and project contingency. For this study planning level engineering fees were estimated at 10% of construction cost, engineering services during construction (ESDC) were estimated at 15% of construction cost. A project contingency was carried in the amount of 20% of the total estimate of construction, engineering and ESDC fees.

A summary of the basis for opinion of costs are provided below:

Pipeline construction projects estimates were developed by applying a per linear foot cost to the proposed project total length. The per linear foot unit price assumes one gate valve every 300 linear feet, one service every 100 linear feet, a hydrant every 500 linear feet and two main branch tie-ins approximately every 3,000 linear feet. The unit prices include trench width permanent pavement repairs. These unit prices were based on recent water main replacement project bid costs in New England. Rock excavation varied amongst the projects used to determine unit prices. Unit prices were not adjusted for each project based on specific conditions in Newmarket. Unit prices used for estimating pipeline costs are shown in

Table 5-10: Estimated Water Main Unit Prices.

Table 5-10: Estimated Water Main Unit Prices

Water Main Diameter (in)	Construction Cost (linear ft)
8	$170
10	$190
12	$200
16	$280
8, 10 Subaqueous Crossings	$400

All estimated pipeline project costs are based on full pipe replacement for this evaluation. In some cases cleaning and lining an existing pipeline would improve the roughness of a pipeline and would be considered and acceptable repair. The condition of the existing pipeline would need to be further evaluated to determine if this is feasible for a cost savings. In general, cleaning and lining projects are estimated to cost approximately 75 percent of the replacement cost. Cleaning and lining costs were not used.

The estimated costs above were not used for P5 and P6 including new 16-inch main from the proposed tank to the car wash on Route 108. Estimates for these projects were taken from the UEI report.

- Facilities upgrades such as the Bennett and Sewell Pump Station upgrade and the existing Great Hill Tank Vault improvements were developed with itemized spreadsheets. Estimates for these improvements were conceptual level and do not include every particular item or piece of equipment that may be needed. Contingencies are applied to account for ancillary costs not included in the estimates. Cost estimate spreadsheets are provided in Appendix B.
- New well development was based on costs provide by the Town. The McIntosh development costs include a design and construction of pipeline and a building to house the selected treatment system. The pipeline and treatment building will be sized to accept the additional supply of the Tucker well in the future. The Town is currently developing the costs for this work and estimated design and construction to be $3,000,000 including all contingencies. The cost for the Tucker well was also provided by the Town and was estimated to be $1,400,000 including design, construction, contingency for the new well and infrastructure to connect to the proposed McIntosh treatment system. This estimate does not include any costs for land acquisition and/or easements.
- New tank costs were taken from the Final Draft of the UEI report because this work has been advance past the conceptual level. The project includes a new tank constructed adjacent to the existing Great Hill Tank and new 16-inch water main from new tank/Great Hill Tank to the car wash on Route 108. UEI's costs were separated for the

purpose of this study. UEI's engineering fees and contingencies were used. UEI's Opinion of Probable Costs are provided in Appendix B.

- Tank resurfacing costs were provided to AECOM from the Town. The Town indicated that the quote for resurfacing was $460,000.00 including contractor's labor, materials, equipment, contactor's overhead and profit and contingencies. No engineering fees were included. It was noted that the cost could be cut in half if painting repair was completed, which is brush applied surface.
- The cost estimate for a uni-directional flushing program represents the engineering fees only to develop a program. It was assumed that costs for implementation of the program will be part of the Water Department's annual budget. After initial development of the program, it can be adjusted in the field by the Department staff.
- The costs estimate for the leak detection studies was based on recent quotes received from leak detection contractors. The costs include contractor's labor, materials, equipment and contactor's overhead and profit. Recent quotes ranged in costs from approximately $100 to $180 per mile of water main in the system to complete a valve and hydrant survey, where the contractor listens for leaks on hydrants and valves. This type of survey is recommended every two years. A more comprehensive program is recommended every 5 years that includes a survey of valve and hydrants and the water main at 8 to 10-foot intervals. The more comprehensive program is typically 20% more and would range from $120 to $220 per mile of water main. For this study it was assumed no engineering fees would be needed for this program. The costs used for this study were $140 per mile of water main for the 2-year level survey and $170 per mile of water main for the 5-year level survey.

Opinions of costs for projects identified in this Section are summarized in Appendix B.

Table 5-11 Opinion of Cost

Project ID	Description	Estimated Construction Cost	Engineering (10%)	ESDC (15%)	Contingency (20%)	Opinion of Cost (Rounded)
S1	McIntosh Well Development		From Town			$ 3,000,000
S2	New Well Development (Tucker)		From Town			$ 1,400,000
St1	New Water Storage Tank		From previous estimate			$ 1,370,000
St2	Paint Existing Water Storage Tank		From Town			$ 416,000
F1	Bennett Pump Station Upgrade	$ 73,000	$ 7,300	$ 10,950	$ 18,250	$ 110,000
F2	Sewall Pump Station Upgrade	$ 73,000	$ 7,300	$ 10,950	$ 18,250	$ 110,000
F3	Water Storage Tank Vault Improvements	$ 20,000	$ 2,000	$ 3,000	$ 5,000	$ 30,000
P1	South Main St (Between Wadleigh Falls Rd & Railroad St)	$ 660,000	$ 66,000	$ 99,000	$ 165,000	$ 990,000
P2	South Main St (to Gerry Ave) & Creighton St	$ 120,000	$ 12,000	$ 18,000	$ 30,000	$ 180,000
P3	Packer Falls Rd (South Main St to Elm St)	$ 427,500	$ 42,750	$ 64,125	$ 106,875	$ 641,000
P4	Elm St	$ 442,000	$ 44,200	$ 66,300	$ 110,500	$ 663,000
P5	Exeter Rd (Great Hill Tank to car wash)		From previous estimate			$ 625,000
P6	Cross-country main from Great Hill Tank to Rt. 108		From previous estimate			$ 210,000
P7	Grant Rd (Wadleigh Falls Rd to Brialla Circle)	$ 310,000	$ 31,000	$ 46,500	$ 77,500	$ 465,000
P8	Exeter Rd (Great Hill Tank to Forbes Rd)	$ 527,000	$ 52,700	$ 79,050	$ 131,750	$ 791,000
P9	Spring St Area (Spring, Central, Chapel, Rock, and Church Streets)	$ 637,500	$ 63,750	$ 95,625	$ 159,375	$ 956,000
P10	Beech St Extension (to Pine St)	$ 204,000	$ 20,400	$ 30,600	$ 51,000	$ 306,000
P11	Hersey Lane & McIntosh Well Connector	$ 1,184,000	$ 118,400	$ 177,600	$ 296,000	$ 1,776,000
P12	North Main St (Sanborn to Dame and Bay Rd)	$ 187,000	$ 18,700	$ 28,050	$ 46,750	$ 281,000
P13	Dame Rd, New Rd, and Lamprey St	$ 459,000	$ 45,900	$ 68,850	$ 114,750	$ 689,000
P14	Pine St	$ 85,000	$ 8,500	$ 12,750	$ 21,250	$ 128,000
P15	New Rd	$ 187,000	$ 18,700	$ 28,050	$ 46,750	$ 281,000
P16	Bay Rd and Dame Rd	$ 195,500	$ 19,550	$ 29,325	$ 48,875	$ 293,000
P17	Creighton St	$ 95,200	$ 9,520	$ 14,280	$ 23,800	$ 143,000
P18	Route 108 (Bay Rd to Simons Lane)	$ 157,250	$ 15,725	$ 23,588	$ 39,313	$ 236,000
P20	Exeter Rd (south of Forbes Rd)	$ 654,500	$ 65,450	$ 98,175	$ 163,625	$ 982,000
P21	Lang's Lane	$ 1,087,750	$ 108,775	$ 163,163	$ 271,938	$ 1,632,000
P22	New subaqueous crossing downstream of Rt 108 Bridge	$ 90,000	$ 9,000	$ 13,500	$ 22,500	$ 135,000
P23	Ham St	$ 68,000	$ 6,800	$ 10,200	$ 17,000	$ 102,000
P24	Church St (between Rock and Granite Streets)	$ 59,500	$ 5,950	$ 8,925	$ 14,875	$ 89,000
P25	New Road	$ 137,700	$ 13,770	$ 20,655	$ 34,425	$ 207,000
P26	Route 108 (Bay Rd to Simons Lane)	$ 272,000	$ 27,200	$ 40,800	$ 68,000	$ 408,000
P27	Dame Rd	$ 68,000	$ 6,800	$ 10,200	$ 17,000	$ 102,000
P28	Second river crossing to Durham	$ 195,700	$ 19,570	$ 29,355	$ 48,925	$ 294,000
P29	Forbes Rd Extension	$ 1,470,500	$ 147,050	$ 220,575	$ 367,625	$ 2,206,000
Wq1	Uni-directional flushing program	N/A	$ 20,000	N/A	N/A	$ 20,000
M1	Leak detection program	$ 5,100	N/A	N/A	N/A	$ 5,000
Ma1	Water GIS Mapping	N/A	$ 5,000	N/A	N/A	$ 5,000

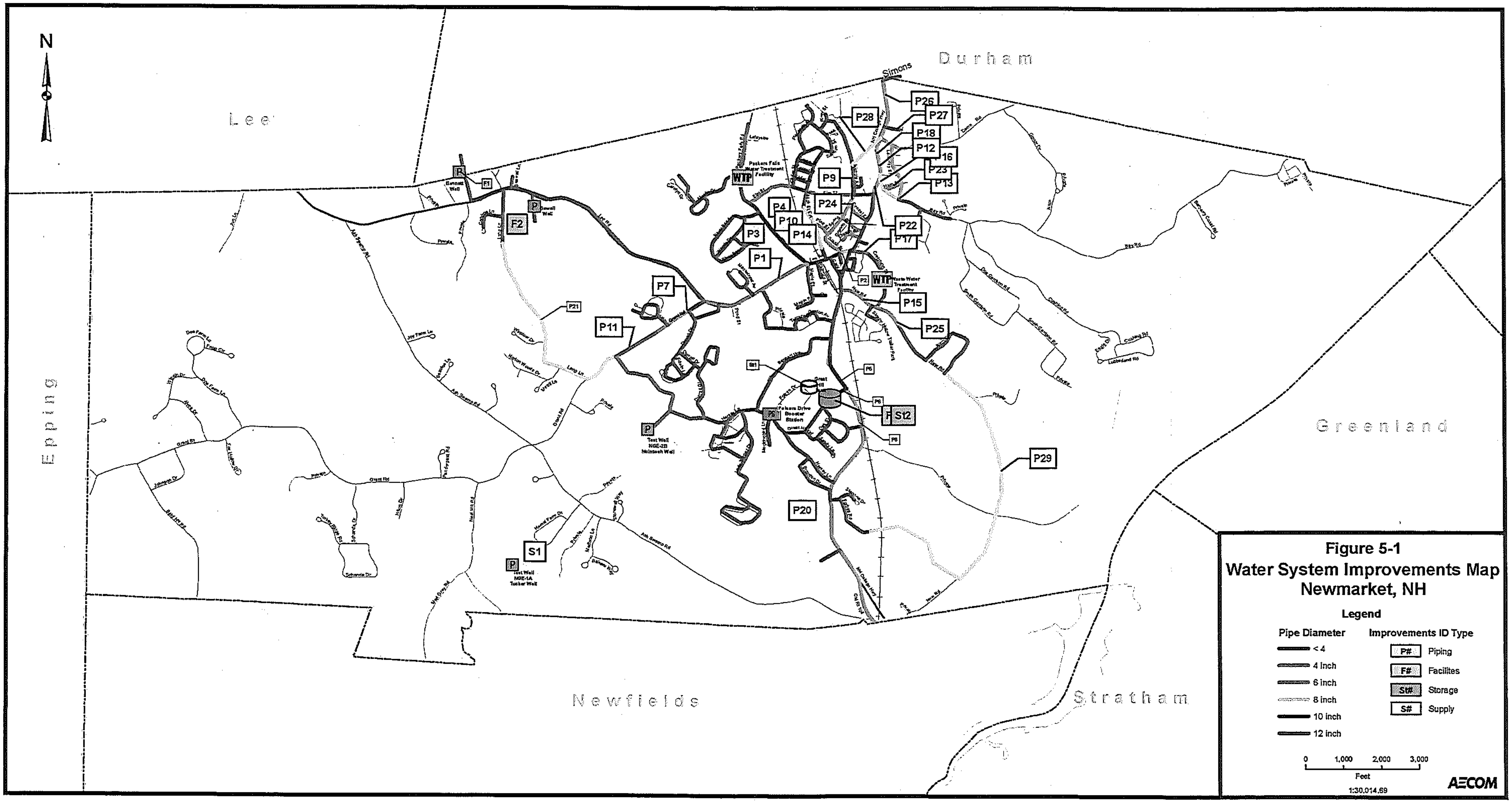


Figure 5-1
Water System Improvements Map
Newmarket, NH
Legend
Pipe Diameter
< 4
4 Inch
6 Inch
8 Inch
10 Inch
12 Inch
Improvements ID Type
P# Piping
F# Facilites
St# Storage
S# Supply
0 1,000 2,000 3,000
Feet
1:30,014.69
AECOM
N
Durham
Lee
Epping
Newfields
Stratham
Greenland
Simons
P1
P3
P4
P7
P9
P10
P11
P12
P13
P14
P15
16
P17
P18
P20
P22
P23
P24
P25
P26
P27
P28
P29
F2
S1
St2
WTP
Packers Falls Water Treatment Facility
Waste Water Treatment Facility
Bennett Well
Sewall Well
Packers Drive Booster Station
Great Hill
Test Well NGE-2B McIntosh Well
Test Well NGE-1A Tucker Well
Lee Rd
Ash Swamp Rd
Grant Rd

6 Capital Improvement Plan

AECOM developed a suggested Capital Improvement Plan (CIP) from the recommended projects presented in the Section 5 of this report. The recommended projects were ranked based on a set of weighted criteria. Using a weighted criteria matrix, high priority projects were developed and organized into an implementation schedule forming the basis of the suggested CIP.

The goal of the suggested CIP is to establish an implementation plan for priority water system projects. This allows the Town to assess the cost impact and financial requirements of the highest priority projects. The Town's fiscal year runs from July 1 to June 30th of each year.

Although the water system evaluation was completed over a 20 year period extending from year 2010 through year 2030, the suggested CIP planning period extends only ten years, or through year 2020. This planning period was chosen because it is understood AECOM's recommended CIP will likely be modified by the Town for its own planning needs. In addition, the Town revises the CIP annually to include new projects, reflect changes in priorities and to extend their plan each year. Projects not included in the suggested 10-year CIP are still provided a ranking for the Town's use in future planning projects.

6.1 Prioritization Criteria and Ranking

A weighted criteria matrix is a tool used to evaluate alternatives based on specific evaluation criteria weighted by importance. Each project was evaluated based on their priority with respect to individual criteria. Using this methodology a value for each project was developed, which could then be ranked in order of its importance relative to all the projects. Descriptions of the evaluation criteria are provided in Table 6-1 Prioritization Criteria:

Table 6-1 Prioritization Criteria

Criteria	Description	Importance	Criteria Weight
Safety	Defined as a project that impacts the potential health and safety of Town personnel or reduces the risk of harm to human health.	A project proposed that does not improve fire flow receives low priority.	7
Ability to Supply Water	Defined as a project needed to meet safe pumping capacity and/or storage volume needs.	A project that is not needed to meet safe supply capacity receives lower priority	6
Potential Critical Failure and/or Redundancy	Defined as a project where the end of useful life is imminent, the condition is of critical nature, or the failure would remove the only source of service	A project that will not result in a critical failure receives a low priority	6
Critical Customer Impact	Defined as a project that impacts a critical user or customers such as a large water consumer.	A project that does not impact a critical user receives a low priority.	6
Fire Flow	Defined as a project that impacts fire flows at hydrant locations by improving fire flow conditions.	A project proposed that does not improve fire flow receives low priority.	5
Cost	Defined by the Opinion of Project cost including construction costs, project contingency and engineering costs.	Higher cost projects have a lower priority	4
Water Quality Impact	Defined as a project that improves the water quality of potable water system (e.g. mixing in tank to improve mixing)	A project proposed that has no positive impact on water quality has a lower priority.	3
Hydraulic Priority	Defined as a project that improves water system hydraulics by improving roughness coefficient, completing system loops, increasing pipe size, etc.	Proposed pipeline projects were assigned a low, medium and high priority in Section 5 of this report.	3
Other Project Coordination	Defined as a project that will be in conjunction or recommended due to other public works or utility or roadway projects.	A project that does is not in conjunction with other projects receives a low priority.	2
Environmental Impact and Permitting	Defined as impact to existing water resources such as wetland, wetland buffer areas, areas of critical environmental concerns, wellhead protection areas, etc.	Projects with significant environmental impact have a lower priority	1

Evaluation criteria weight scale from 1 low to 7 high
Importance scale from 1 low to 3 medium to 5 high

The ten criterion for which each project was scored were weighted based on importance and assigned a value from one, which indicates a low importance to 7, which indicates a high importance in comparison to the other criterion. Some criterion held equal weight in the weighted matrix. Each criterion was then evaluated for each project. For each project, the importance values ranged from one, which indicates a low importance to 5, which indicates a high importance. This was on a per project basis. After applying the appropriate evaluation criteria and importance scale to the matrix, the weighted score was calculated by summing the weighted score for each criterion.

The importance value selected for each project criterion was completed as objectively as possible and was based on best engineering judgment, AECOM's understanding of the recommended projects, history of the system provided through previous studies and discussions with Town personnel.

The results of the weighted criteria matrix evaluation are shown in **Error! Reference source not found.**:

Table 6-2 Weighted Criteria Matrix

	Criterion		Safety		Ability to Supply Water		Potential Critical Failure and/or Redundancy		Critical Customer Impact		Fire Flow		Cost		Water Quality Impacts		Hydraulic Priority		Other Project Coordination		Enviornmental Impact and Permitting			
	Weight		7		6		6		6		5		4		3		3		2		1		Total	
Project ID	Description	Cost (Rounded)	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Score	Rank
St1	New Water Storage Tank	$ 1,370,000	1	7	5	30	4	24	1	6	5	25	2	8	3	9	5	15	1	2	3	3	129	1
F1	Bennett Pump Station Upgrade	$ 110,000	5	35	3	18	4	24	1	6	1	5	5	20	1	3	2	6	1	2	5	5	124	2
F2	Sewall Pump Station Upgrade	$ 110,000	5	35	3	18	4	24	1	6	1	5	5	20	1	3	2	6	1	2	5	5	124	2
S1	New Well Development (Tucker)	$ 1,400,000	1	7	5	30	5	30	1	6	3	15	2	8	1	3	5	15	1	2	3	3	119	4
F3	Water Storage Tank Vault Improvements	$ 30,000	5	35	3	18	3	18	1	6	1	5	5	20	1	3	2	6	1	2	5	5	118	5
P2	South Main St (to Gerry Ave) & Creighton St	$ 180,000	1	7	1	6	1	6	5	30	4	20	5	20	1	3	5	15	1	2	5	5	114	6
P1	South Main St (Between Wadleigh Falls Rd & Railroad St)	$ 990,000	1	7	1	6	1	6	5	30	4	20	3	12	1	3	5	15	1	2	5	5	106	7
P6	Cross-country main from Great Hill Tank to Rt. 108	$ 210,000	1	7	4	24	1	6	1	6	4	20	5	20	1	3	5	15	1	2	3	3	106	7
P5	Exeter Rd (Great Hill Tank to car wash)	$ 625,000	1	7	4	24	1	6	1	6	4	20	4	16	1	3	5	15	1	2	5	5	104	9
P8	Exeter Rd (Great Hill Tank to Forbes Rd)	$ 791,000	1	7	1	6	1	6	5	30	4	20	4	16	1	3	3	9	1	2	3	3	102	10
Wq1	Uni-directional flushing program	$ 20,000	1	7	2	12	1	6	1	6	1	5	5	20	5	15	4	12	1	2	5	5	90	11
P10	Beech St Extension (to Pine St)	$ 306,000	1	7	1	6	1	6	1	6	4	20	5	20	3	9	3	9	1	2	5	5	90	11
P11	Hersey Lane & McIntosh	$ 1,776,000	1	7	1	6	1	6	5	30	4	20	1	4	1	3	3	9	1	2	3	3	90	11

Project ID	Description	Criterion / Weight / Cost (Rounded)	Safety (7) Raw Score	Safety (7) Wtd Score	Ability to Supply Water (6) Raw Score	Ability to Supply Water (6) Wtd Score	Potential Critical Failure and/or Redundancy (6) Raw Score	Potential Critical Failure and/or Redundancy (6) Wtd Score	Critical Customer Impact (6) Raw Score	Critical Customer Impact (6) Wtd Score	Fire Flow (5) Raw Score	Fire Flow (5) Wtd Score	Cost (4) Raw Score	Cost (4) Wtd Score	Water Quality Impacts (3) Raw Score	Water Quality Impacts (3) Wtd Score	Hydraulic Priority (3) Raw Score	Hydraulic Priority (3) Wtd Score	Other Project Coordination (2) Raw Score	Other Project Coordination (2) Wtd Score	Enviornmental Impact and Permitting (1) Raw Score	Enviornmental Impact and Permitting (1) Wtd Score	Total Score	Rank
	Well Connector																							
P3	Packer Falls Rd (South Main St to Elm St)	$ 641,000	1	7	1	6	1	6	1	6	4	20	4	16	1	3	5	15	1	2	5	5	86	14
P4	Elm St	$ 663,000	1	7	1	6	1	6	1	6	4	20	4	16	1	3	5	15	1	2	5	5	86	14
P7	Grant Rd (Wadleigh Falls Rd to Brialla Circle)	$ 465,000	1	7	1	6	1	6	1	6	4	20	4	16	1	3	5	15	1	2	5	5	86	14
P12	North Main St (Sanborn to Dame and Bay Rd)	$ 281,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	5	5	84	17
P14	Pine St	$ 128,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	5	5	84	17
P15	New Rd	$ 281,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	5	5	84	17
P16	Bay Rd and Dame Rd	$ 293,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	5	5	84	17
P17	Creighton St	$ 143,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	5	5	84	17
P18	Route 108 (Bay Rd to Simons Lane)	$ 236,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	5	5	84	17
P26	Route 108 (Bay Rd to Simons Lane)	$ 408,000	1	7	1	6	1	6	1	6	4	20	4	16	1	3	1	3	4	8	5	5	80	23
P13	Dame Rd, New Rd, and Lamprey St	$ 689,000	1	7	1	6	1	6	1	6	4	20	4	16	1	3	3	9	1	2	5	5	80	23
P22	New subaqueous crossing downstream of Rt 108 Bridge	$ 135,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	3	9	1	2	1	1	80	23
P28	Second river crossing to Durham	$ 294,000	1	7	1	6	1	6	5	30	1	5	4	16	1	3	1	3	1	2	1	1	79	26
P23	Ham St	$ 102,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	1	3	1	2	5	5	78	27
P24	Church St (between Rock and Granite	$ 89,000	1	7	1	6	1	6	1	6	4	20	5	20	1	3	1	3	1	2	5	5	78	27

Table 6-2 Weighted Criteria Matrix

	Criterion	Safety		Ability to Supply Water		Potential Critical Failure and/or Redundancy		Critical Customer Impact		Fire Flow		Cost		Water Quality Impacts		Hydraulic Priority		Other Project Coordination		Enviornmental Impact and Permitting			
	Weight	7		6		6		6		5		4		3		3		2		1		Total	
Project ID	Description	Cost (Rounded)	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Raw Score	Wtd Score	Score	Rank
St1	New Water Storage Tank	$ 1,370,000	1	7	5	30	4	24	1	6	5	25	2	8	3	9	5	15	1	2	3	3	129	1
F1	Bennett Pump Station Upgrade	$ 110,000	5	35	3	18	4	24	1	6	1	5	5	20	1	3	2	6	1	2	5	5	124	2
F2	Sewall Pump Station Upgrade	$ 110,000	5	35	3	18	4	24	1	6	1	5	5	20	1	3	2	6	1	2	5	5	124	2
S1	New Well Development (Tucker)	$ 1,400,000	1	7	5	30	5	30	1	6	3	15	2	8	1	3	5	15	1	2	3	3	119	4
F3	Water Storage Tank Vault Improvements	$ 30,000	5	35	3	18	3	18	1	6	1	5	5	20	1	3	2	6	1	2	5	5	118	5
P2	South Main St (to Gerry Ave) & Creighton St	$ 180,000	1	7	1	6	1	6	5	30	4	20	5	20	1	3	5	15	1	2	5	5	114	6
P1	South Main St (Between Wadleigh Falls Rd & Railroad St)	$ 990,000	1	7	1	6	1	6	5	30	4	20	3	12	1	3	5	15	1	2	5	5	106	7
P6	Cross-country main from Great Hill Tank to Rt. 108	$ 210,000	1	7	4	24	1	6	1	6	4	20	5	20	1	3	5	15	1	2	3	3	106	7
P5	Exeter Rd (Great Hill Tank to car wash)	$ 625,000	1	7	4	24	1	6	1	6	4	20	4	16	1	3	5	15	1	2	5	5	104	9
P8	Exeter Rd (Great Hill Tank to Forbes Rd)	$ 791,000	1	7	1	6	1	6	5	30	4	20	4	16	1	3	3	9	1	2	3	3	102	10
Wq1	Uni-directional flushing program	$ 20,000	1	7	2	12	1	6	1	6	1	5	5	20	5	15	4	12	1	2	5	5	90	11
P10	Beech St Extension (to Pine St)	$ 306,000	1	7	1	6	1	6	1	6	4	20	5	20	3	9	3	9	1	2	5	5	90	11
P11	Hersey Lane & McIntosh	$ 1,776,000	1	7	1	6	1	6	5	30	4	20	1	4	1	3	3	9	1	2	3	3	90	11

6.2 Recommended CIP

The recommended CIP was developed from the ranked projects in the previous section of this report. In development of the recommended CIP, the top ranked projects were further considered and grouped into recommended projects. The grouped project list is provided in **Error! Reference source not found.**.

Certain projects were grouped because of their dependence on other projects, constructability and for maintenance of operations. As a result, some lower priority projects were grouped with higher priority projects to form a single CIP project. For example, project St1 New Storage Tank, F3 Water Storage Tank Vault Improvements and P5 and P6 Water Main Replacement from the tanks to the car wash on Route 108 were grouped into one project. The hydraulic benefit of the tank will not be fully achieved until the undersized mains between the car wash and the tanks are replaced with new 16-inch transmission mains. The tank vault improvements are included because of the existing work being done in the vicinity of the Great Hill Tank. This will likely reduce the cost of this project compared to installing the new electrical room as a standalone project.

The Bennett and Sewell pump station upgrades were grouped into a single project because the work is of similar nature and could be completed by the same Contractor. The Town would benefit by combining these into one project because mobilization and demobilization costs would be shared between two station upgrades verses single station upgrade projects. This work is proposed to take place once the McIntosh well is online (approximately 2012) allowing for down time at these stations.

Transmission main projects P1 and P2 South Main Street water main improvements were grouped because with these improvements some of the most critical water users will be better served. The High School, Middle School and a healthcare facility are served via these transmission mains.

Table 6-3 Recommended Capital Improvement Projects

Project ID	Description	Opinion of Cost	Rank	Project Number	Additional Considerations
S1	McIntosh Well Development	$3,000,000	N/A	1	Ongoing project currrently in preliminary design stage
St1	New Water Storage Tank	$ 1,370,000	1	2	Required to meet fire flows. Still required to meet fire flows if additonal wells are added to the system based on a safe pumping capacity basis
F1	Bennett Pump Station Upgrade	$ 110,000	2	3	
F2	Sewall Pump Station Upgrade	$ 110,000	2	3	
S2	New Well Development (Tucker)	$ 1,400,000	4	2	Needed to meet safe puping capacity and reduce demand on Plains Aquifer wells which have seen observed past low static water levels
F3	Water Storage Tank Vault Improvements	$ 30,000	5	1	
P2	South Main St (to Gerry Ave) & Creighton St	$ 210,000	6	4	Improves service to High School and Middle School
P1	South Main St (Between Wadleigh Falls Rd & Railroad St)	$ 990,000	7	4	Improves service to High School and Middle School
P6	Cross-country main from Great Hill Tank to Rt. 108	$ 210,000	7	1	Necessary improvement to realize the benefit of a new tank. Recommended project completed as part of tank upgrade
P5	Exeter Rd (Great Hill Tank to car wash)	$ 625,000	9	1	Necessary improvement to realize the benefit of a new tank. Recommended project completed as part of tank upgrade
P8	Exeter Rd (Great Hill Tank to Forbes Rd)	$ 791,000	10	5	Necessary improvement to realize the benefit of a new tank. Recommended project completed as part of tank upgrade
Wq1	Uni-directional flushing program	$ 20,000	11	6	Cannot be effectively executed until additona storage and/or supply is provided
P10	Beech St Extension (to Pine St)	$ 306,000	11	7	Strengthens distirbution system, addresses low fire flows and aged pipes
P11	Hersey Lane & McIntosh Well Connector	$ 1,776,000	11	8	Strengthens distirbution system, addresses low fire flows and aged pipes
P3	Packer Falls Rd (South Main St to Elm St)	$ 641,000	14	9	Strengthens distirbution system, addresses low fire flows and aged pipes Candidate for clean and lining for an estiamted 25% capital cost savings
P4	Elm St	$ 663,000	14	10	Strengthens distirbution system, addresses low fire flows and aged pipes
P7	Grant Rd (Wadleigh Falls Rd to Brialla Circle)	$ 465,000	14	11	Strengthens distirbution system, addresses low fire flows and aged pipes
P12	North Main St (Sanborn to Dame and Bay Rd)	$ 281,000	17	13	Strengthens distirbution system, addresses low fire flows and aged pipes
P14	Pine St	$ 128,000	17	14	Strengthens distirbution system, addresses low fire flows and aged pipes
P15	New Road	$ 281,000	17	15	Strengthens distirbution system, addresses low fire flows and aged pipes
P16	Bay Rd and Dame Rd	$ 293,000	17	16	Strengthens distirbution system, addresses low fire flows and aged pipes Candidate for clean and lining for an estiamted 25% capital cost savings

The CIP is intended to be flexible and subject to adjustment and modification as the financial capacity of the Town changes, as additional projects become important and as needed to meet the needs of the service area. As this CIP is specific to water projects only, it is understood the Town will need to balance the proposed water projects with other capital improvement needs of the Town. All projects have been provided with an estimated cost, rank and priority so that the CIP could be developed. It is recommended the CIP be revisited annually and updated accordingly.

The recommended CIP includes four major projects over the next ten years. The four projects comprise the top 9 ranked projects grouped to best address system needs. The CIP is shown as an implementation schedule with estimated fund appropriation, design and construction timeframes. Once the proposed schedule was completed, costs were escalated to the midpoint of construction. To obtain the escalated cost from October 2010 to midpoint of construction, the Real Discount Rate (2.8%) from the Office of Management and Budget was implemented. The escalated cost is the appropriation need for design and construction of the project. Actual project costs may vary from this conceptual estimate as a result of additional engineering detail and other cost-related variables. Project fund requirements should be further evaluated before any funds are appropriated. For the purpose of this study, it was assumed the Town would bond each project and the associated annual debt service is shown in the CIP implementation schedule.

AECOM estimated the impact of the proposed debt service resulting from the recommended projects on a per billing unit basis for order of magnitude comparison. Newmarket currently has approximately 1,900 accounts including a total of 3,500 billing units. Assuming the number of accounts increases proportionally to the population, the number of accounts will increase to approximately 4,100 units in year 2030. The cost of debt service was divided by the total number of units to estimate the annual impact from debt service. The debt service will increase incrementally as each project is bonded and repaid. Assuming the Town currently has zero debt service, project one will result in an annual debt service of $167,000. This will result in an annual rate increase of approximately $48 per unit. The maximum cumulative debt service for the proposed CIP will be realized in the years 2022 through 2042 at $527,000 annually. This will result in an annual rate increase of approximately $130 per unit with 4,100 billing units served.

Table 6-4: Capital Improvement Program

Project No.	Project ID	Description	Cost (Year 2010 Dollars)	Escalated Cost at Midpoint of Construction (rounded)	Annual Debt Service for 30 Year Bond at 3.5% Interest	Fiscal Year (July through June) 2011	2012	2013	2014	2015	2016	2017
1	S1	Development of McIntosh Well	$ 3,000,000	$ 3,090,000	$ 167,000	$ 3,090,000						
2	St1, F3, P6, P5	New Water Storage Tank, Water Mains and Existing Tank Vault	$ 2,238,000	$ 2,593,000	$ 140,000			$ 2,593,000				
3	F1, F2	Pump Station Upgades	$ 200,000	$ 254,000	$ 14,000							$ 254,000
4	S2	New Well Development (Tucker)	$ 1,400,000	$ 1,882,000	$ 101,000							
5	P1, P2	South Main St (to Gerry Ave) & Creighton St South Main St (Between Wadleigh Falls Rd & Railroad St)	$ 1,365,000	$ 1,947,000	$ 105,000							

Project No.	Project ID	Description	Cost (Year 2010 Dollars)	Escalated Cost at Midpoint of Construction (rounded)	Annual Debt Service for 30 Year Bond at 3.5% Interest	Fiscal Year (July through June) 2018	2019	2020	2021	2022	2023
3	F1, F2	Pump Station Upgades	$ 200,000	$ 254,000	$ 14,000						
4	S2	New Well Development (Tucker)	$ 1,400,000	$ 1,882,000	$ 101,000		$ 1,882,000				
5	P1, P2	South Main St (to Gerry Ave) & Creighton St South Main St (Between Wadleigh Falls Rd & Railroad St)	$ 1,365,000	$ 1,947,000	$ 105,000				$ 1,947,000		

Legend

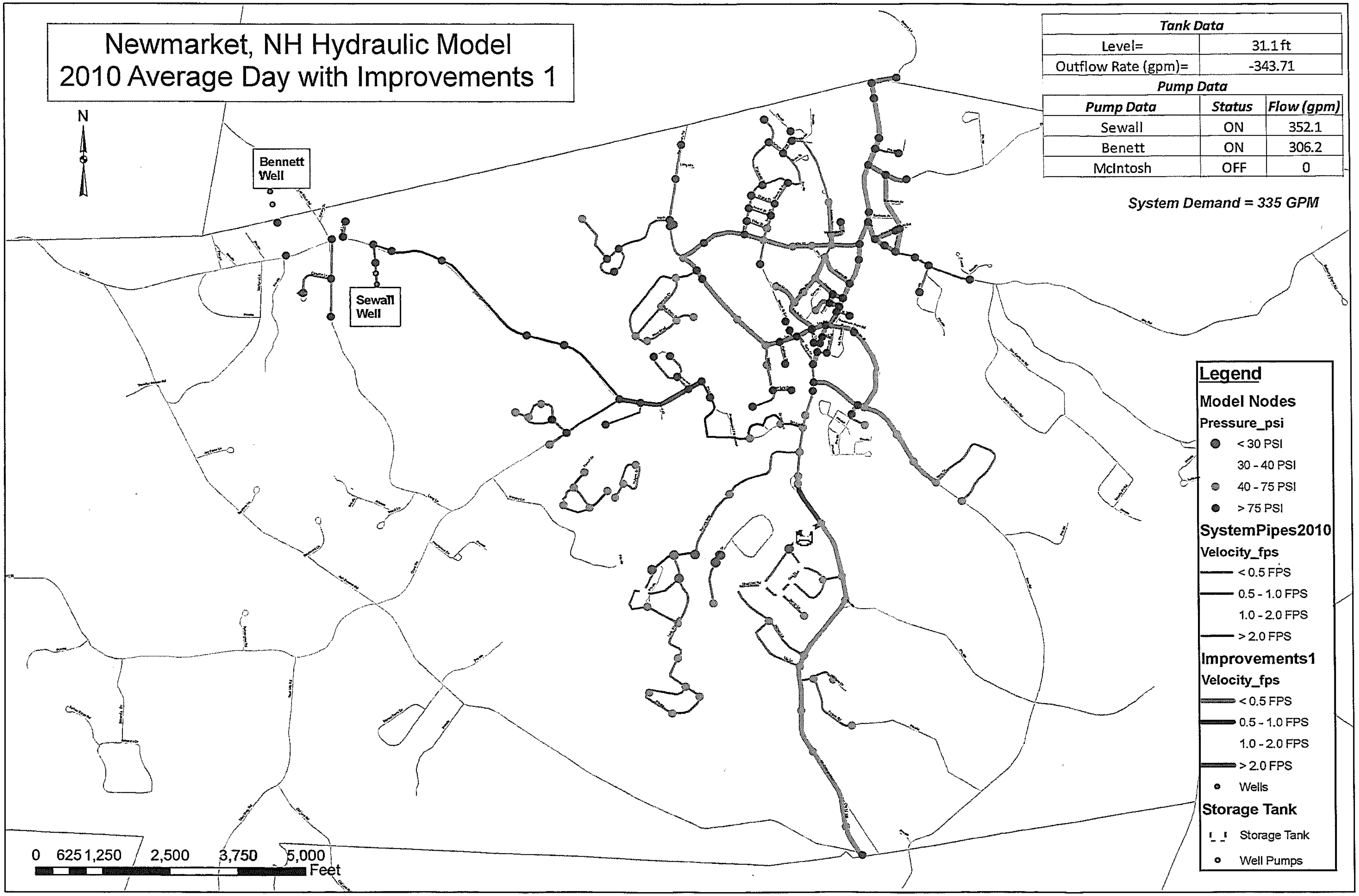
Appropriate Funds for Design and Construction

Design and Construct

Costs escalated to midpoint of construction at 3% per year

Appendix A. Hydraulic Modeling Scenarios and Maps

Newmarket, NH Hydraulic Model
2010 Average Day with Improvements 1



Tank Data

Level=	31.1 ft
Outflow Rate (gpm)=	-343.71

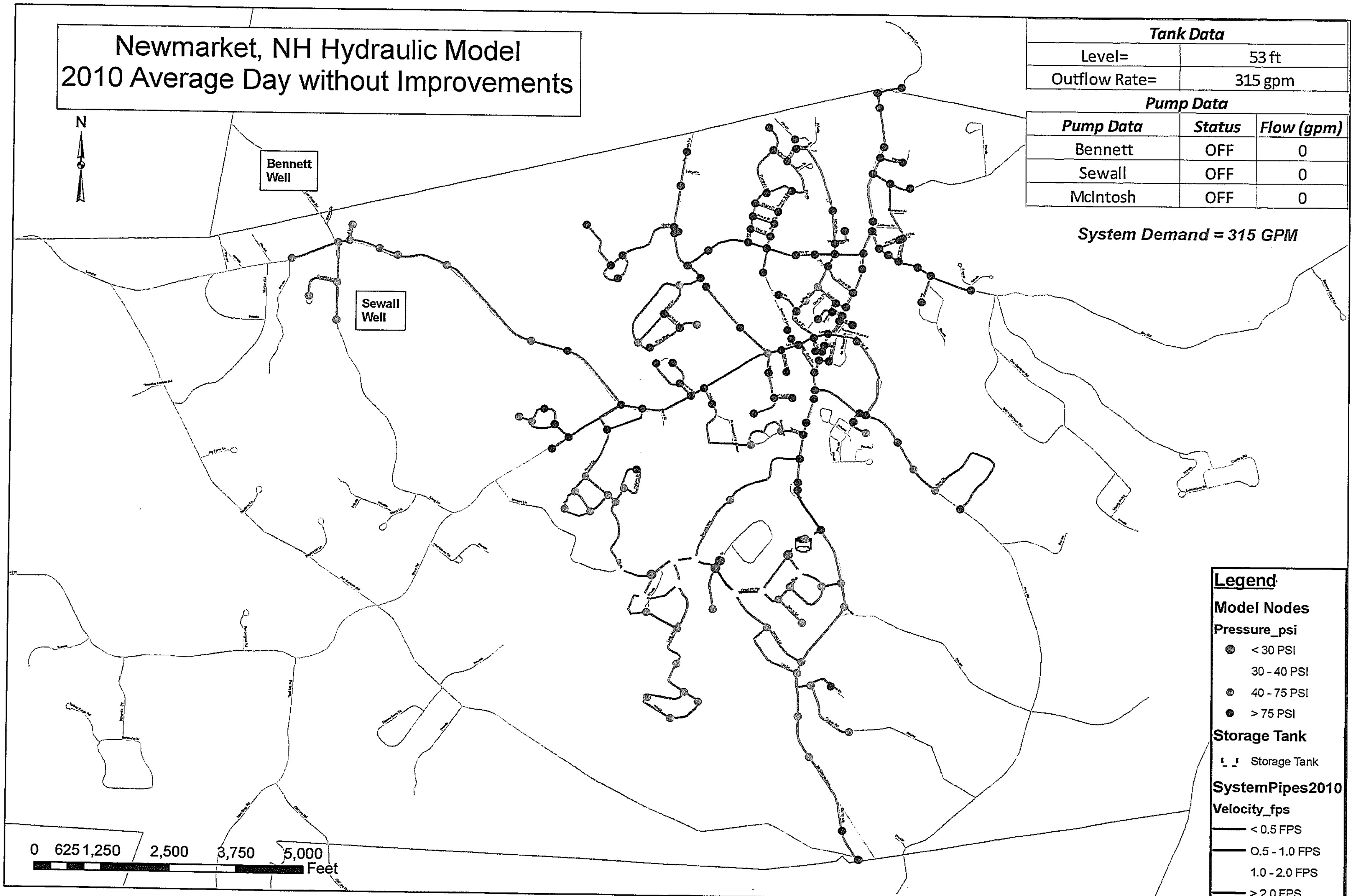
Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	352.1
Benett	ON	306.2
McIntosh	OFF	0

System Demand = 335 GPM

October 11, 2010

Newmarket, NH Hydraulic Model
2010 Average Day without Improvements



Tank Data	
Level=	53 ft
Outflow Rate=	315 gpm

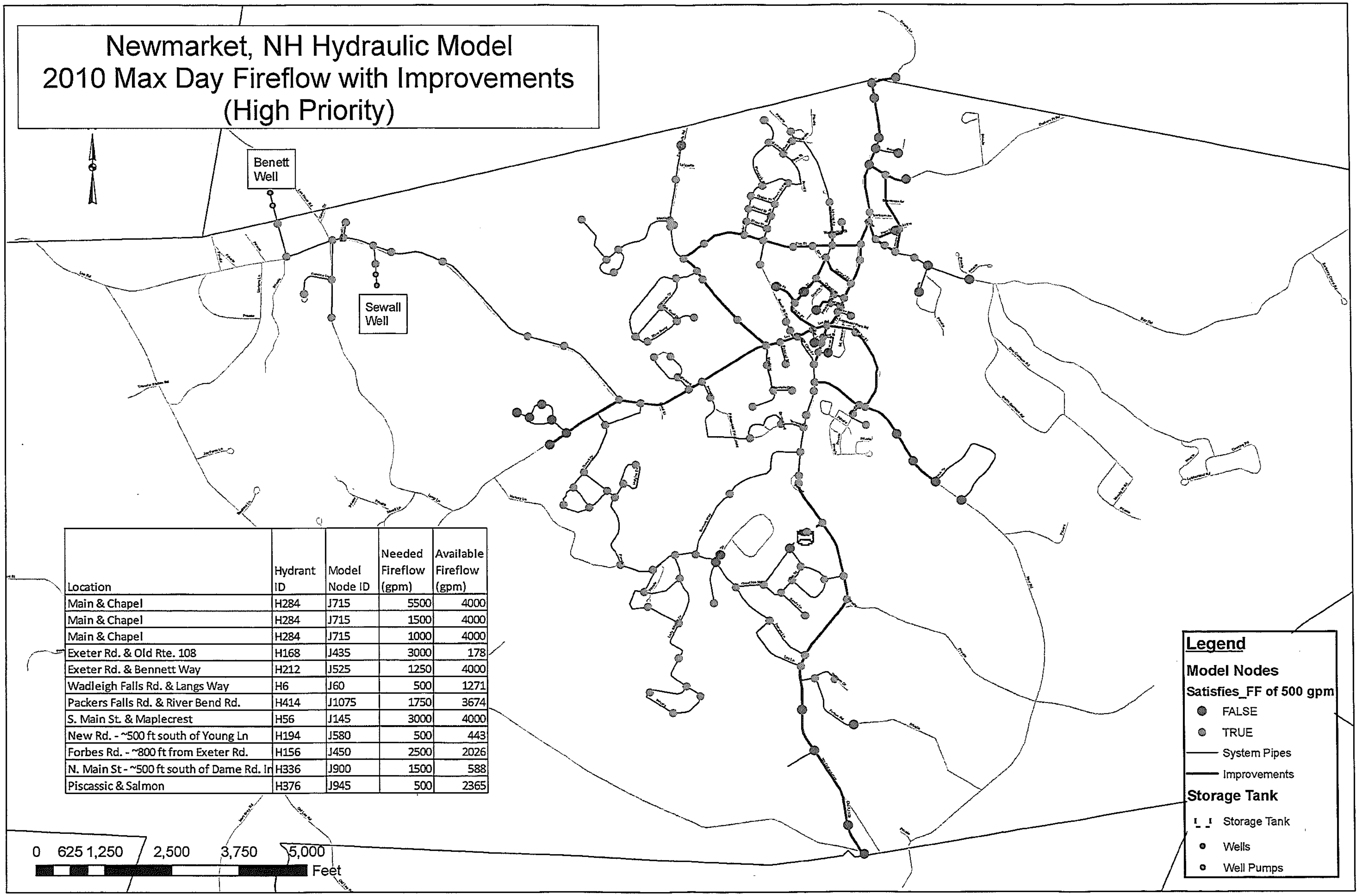
Pump Data

Pump Data	*Status*	*Flow (gpm)*
Bennett	OFF	0
Sewall	OFF	0
McIntosh	OFF	0

System Demand = 315 GPM

October 11, 2010

Newmarket, NH Hydraulic Model
2010 Max Day Fireflow with Improvements
(High Priority)



Location	Hydrant ID	Model Node ID	Needed Fireflow (gpm)	Available Fireflow (gpm)
Main & Chapel	H284	J715	5500	4000
Main & Chapel	H284	J715	1500	4000
Main & Chapel	H284	J715	1000	4000
Exeter Rd. & Old Rte. 108	H168	J435	3000	178
Exeter Rd. & Bennett Way	H212	J525	1250	4000
Wadleigh Falls Rd. & Langs Way	H6	J60	500	1271
Packers Falls Rd. & River Bend Rd.	H414	J1075	1750	3674
S. Main St. & Maplecrest	H56	J145	3000	4000
New Rd. - ~500 ft south of Young Ln	H194	J580	500	443
Forbes Rd. - ~800 ft from Exeter Rd.	H156	J450	2500	2026
N. Main St - ~500 ft south of Dame Rd. Ir	H336	J900	1500	588
Piscassic & Salmon	H376	J945	500	2365

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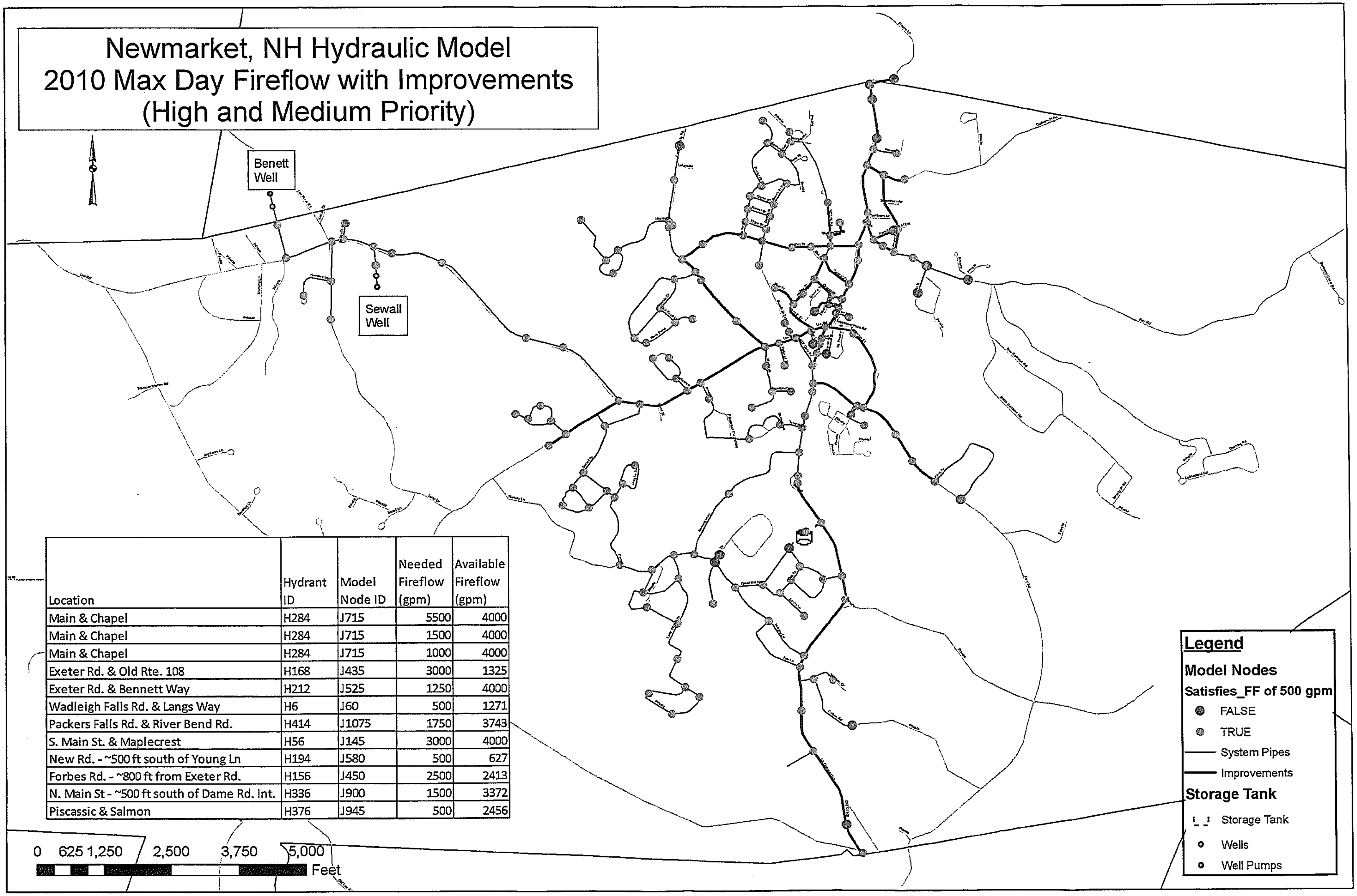
Newmarket, NH Hydraulic Model
2010 Max Day Fireflow with Improvements
(High and Medium Priority)



Location	Hydrant ID	Model Node ID	Needed Fireflow (gpm)	Available Fireflow (gpm)
Main & Chapel	H284	J715	5500	4000
Main & Chapel	H284	J715	1500	4000
Main & Chapel	H284	J715	1000	4000
Exeter Rd. & Old Rte. 108	H168	J435	3000	1325
Exeter Rd. & Bennett Way	H212	J525	1250	4000
Wadleigh Falls Rd. & Langs Way	H6	J60	500	1271
Packers Falls Rd. & River Bend Rd.	H414	J1075	1750	3743
S. Main St. & Maplecrest	H56	J145	3000	4000
New Rd. - ~500 ft south of Young Ln	H194	J580	500	627
Forbes Rd. - ~800 ft from Exeter Rd.	H156	J450	2500	2413
N. Main St - ~500 ft south of Dame Rd. Int.	H336	J900	1500	3372
Piscassic & Salmon	H376	J945	500	2456

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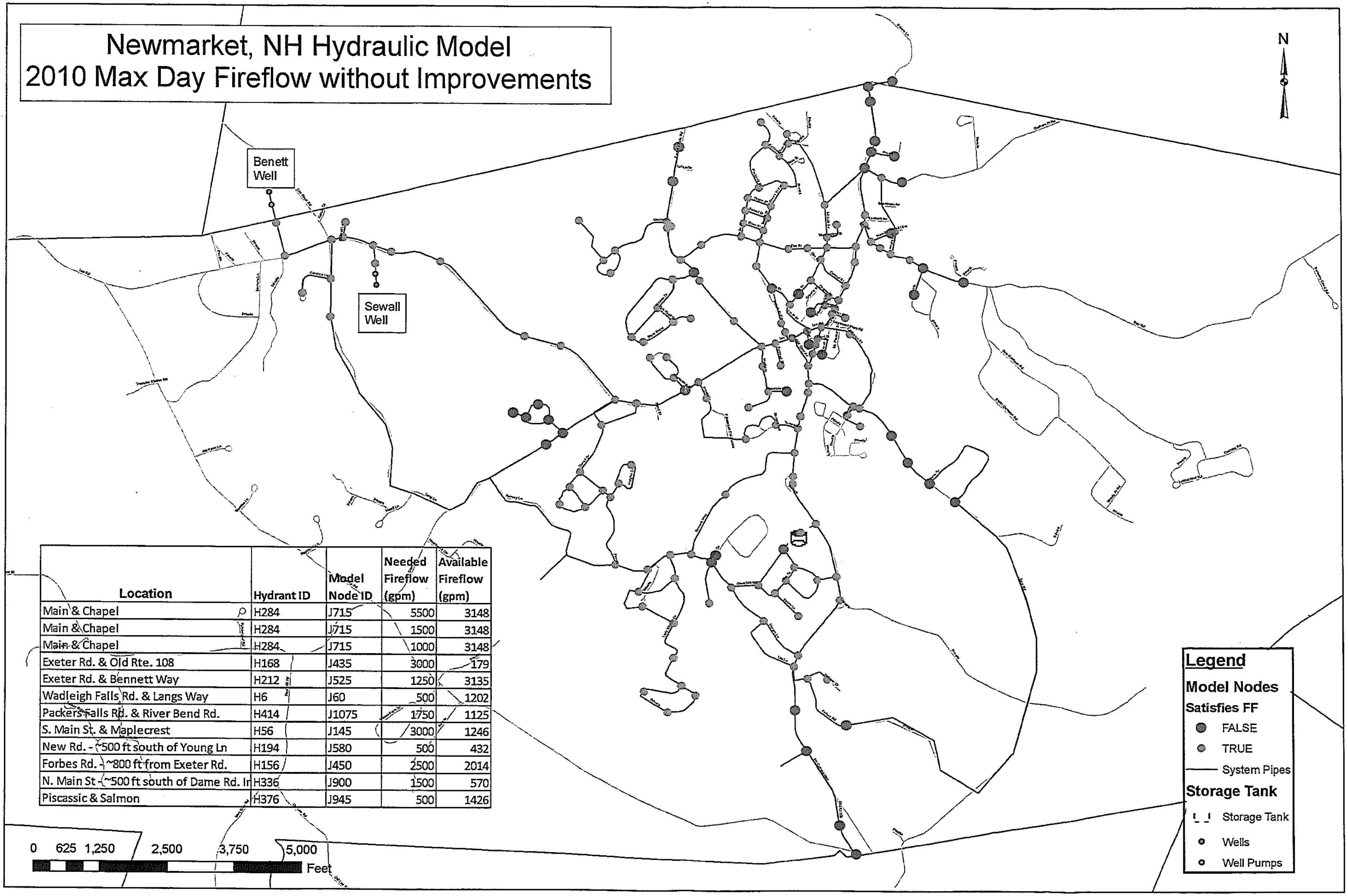
Newmarket, NH Hydraulic Model
2010 Max Day Fireflow without Improvements



Location	Hydrant ID	Model Node ID	Needed Fireflow (gpm)	Available Fireflow (gpm)
Main & Chapel	H284	J715	5500	3148
Main & Chapel	H284	J715	1500	3148
Main & Chapel	H284	J715	1000	3148
Exeter Rd. & Old Rte. 108	H168	J435	3000	179
Exeter Rd. & Bennett Way	H212	J525	1250	3135
Wadleigh Falls Rd. & Langs Way	H6	J60	500	1202
Packers Falls Rd. & River Bend Rd.	H414	J1075	1750	1125
S. Main St. & Maplecrest	H56	J145	3000	1246
New Rd. - ~500 ft south of Young Ln	H194	J580	500	432
Forbes Rd. - ~800 ft from Exeter Rd.	H156	J450	2500	2014
N. Main St - ~500 ft south of Dame Rd. Ir	H336	J900	1500	570
Piscassic & Salmon	H376	J945	500	1426

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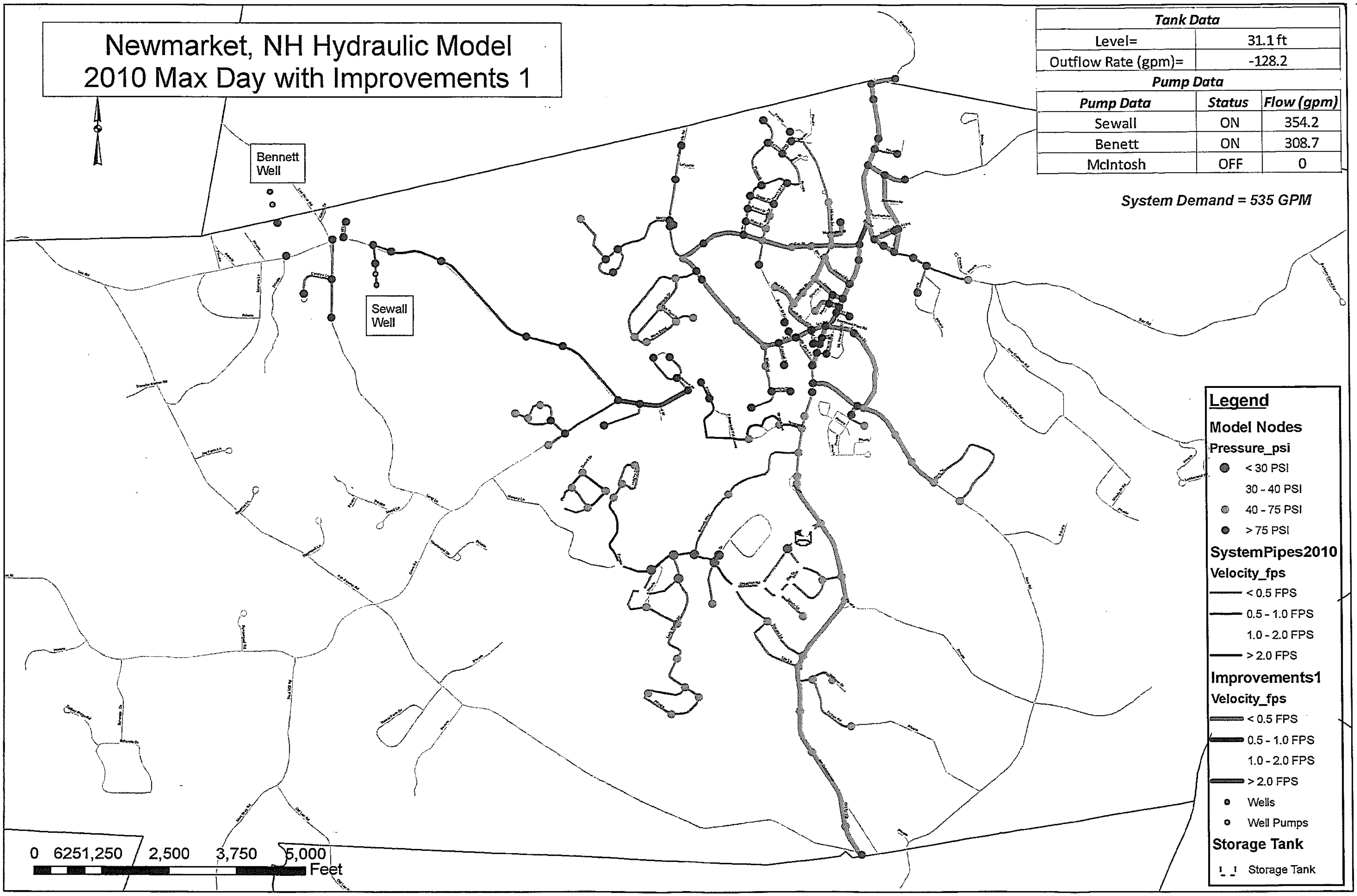

Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	-128.2

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	354.2
Benett	ON	308.7
McIntosh	OFF	0

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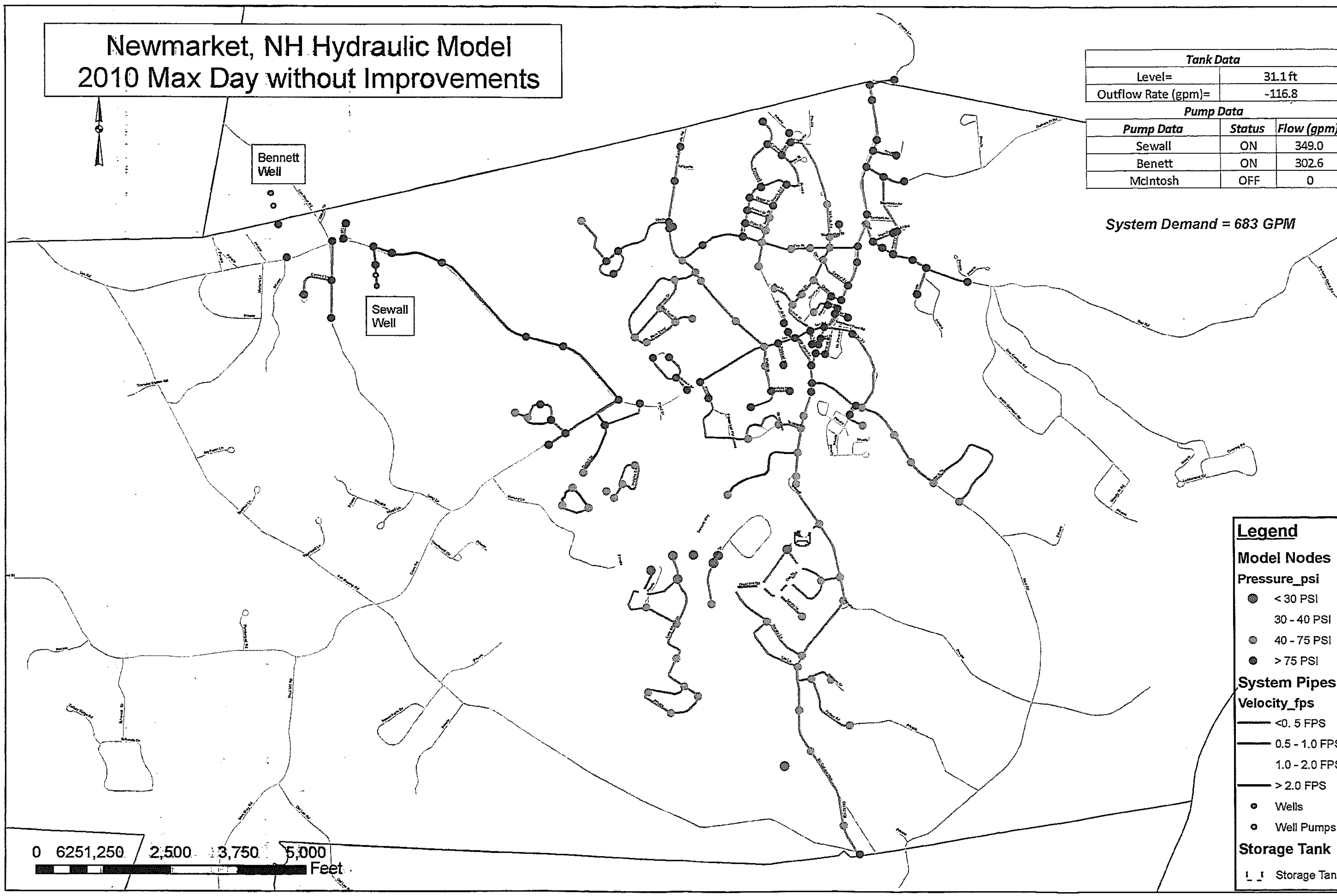
Newmarket, NH Hydraulic Model
2010 Max Day without Improvements



Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	-116.8

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	349.0
Benett	ON	302.6
McIntosh	OFF	0

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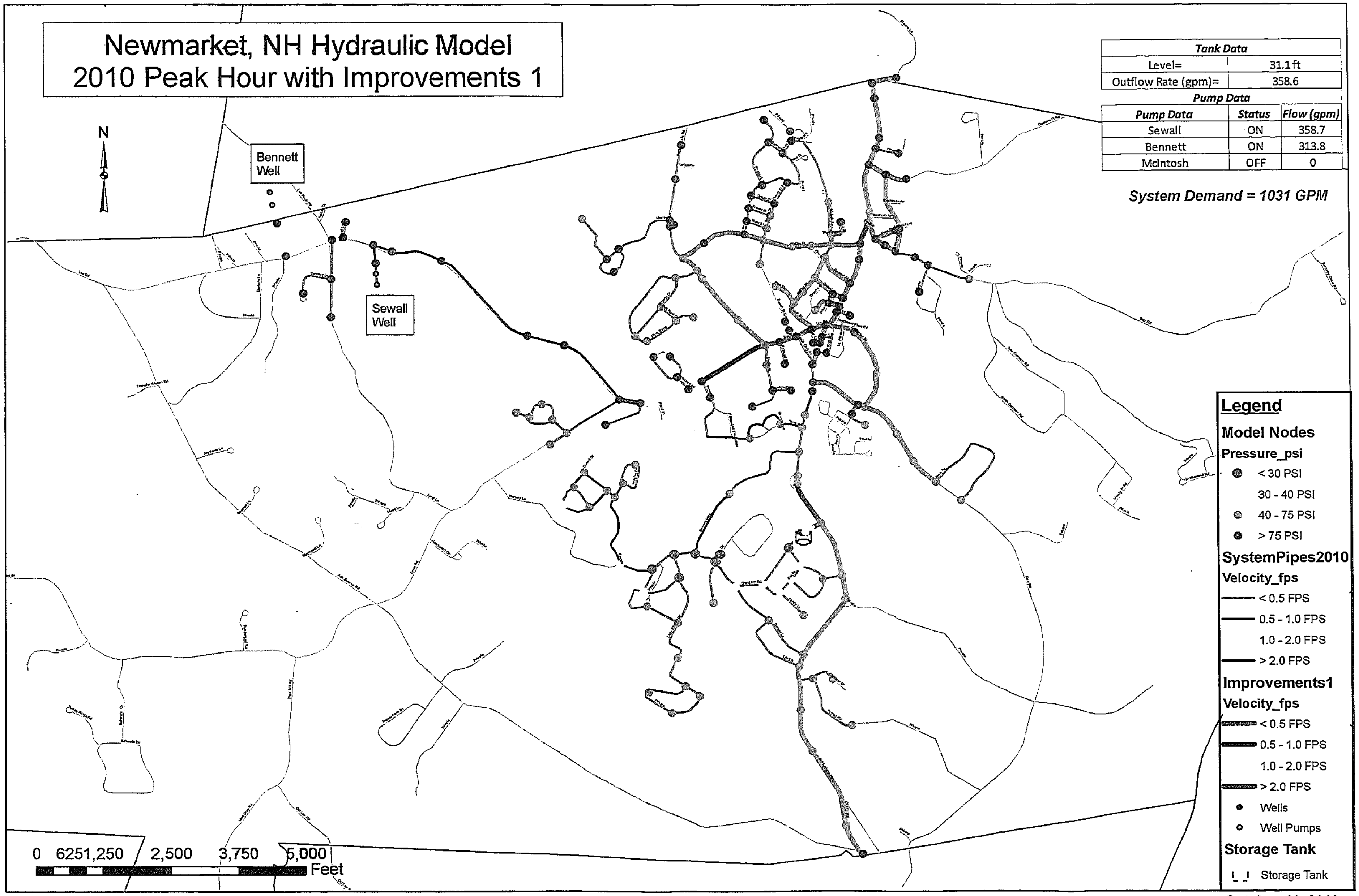
Newmarket, NH Hydraulic Model
2010 Peak Hour with Improvements 1



Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	358.6

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	358.7
Bennett	ON	313.8
McIntosh	OFF	0

System Demand = 1031 GPM

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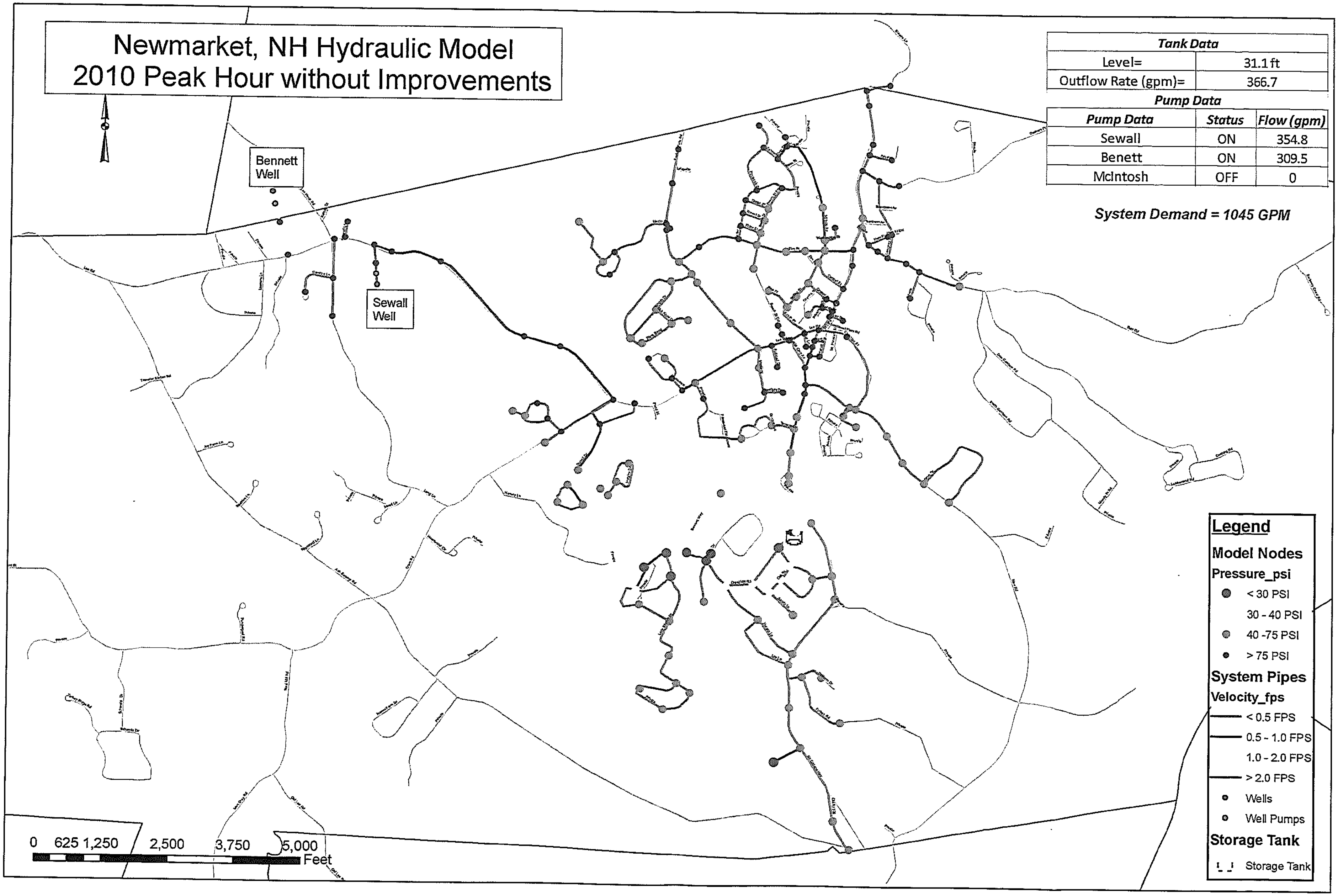
Newmarket, NH Hydraulic Model
2010 Peak Hour without Improvements



Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	366.7

Pump Data

Pump Data	*Status*	*Flow (gpm)*
Sewall	ON	354.8
Benett	ON	309.5
McIntosh	OFF	0

System Demand = 1045 GPM

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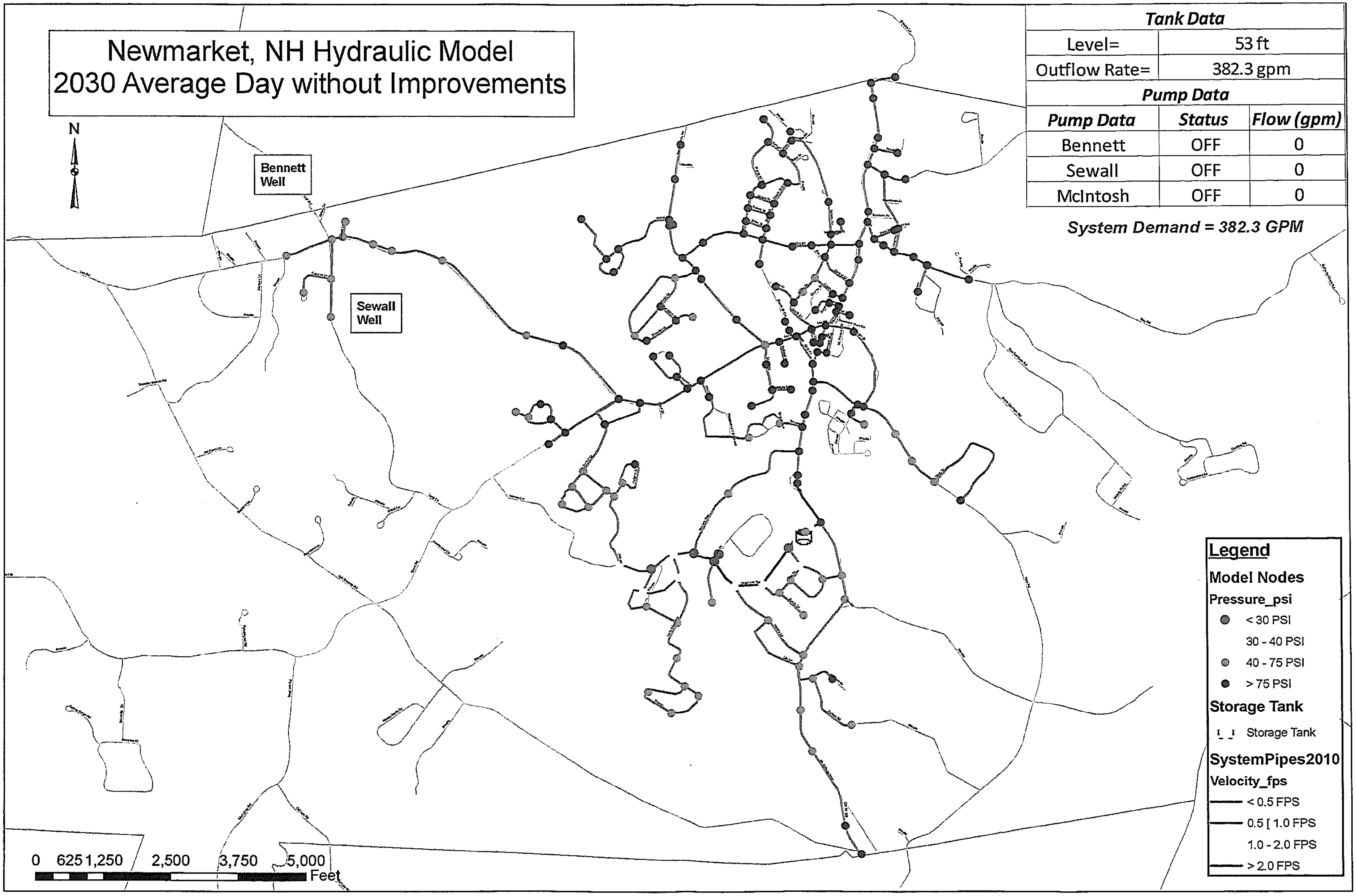
Newmarket, NH Hydraulic Model
2030 Average Day without Improvements

Tank Data	
Level=	53 ft
Outflow Rate=	382.3 gpm

Pump Data

Pump Data	Status	Flow (gpm)
Bennett	OFF	0
Sewall	OFF	0
McIntosh	OFF	0

System Demand = 382.3 GPM



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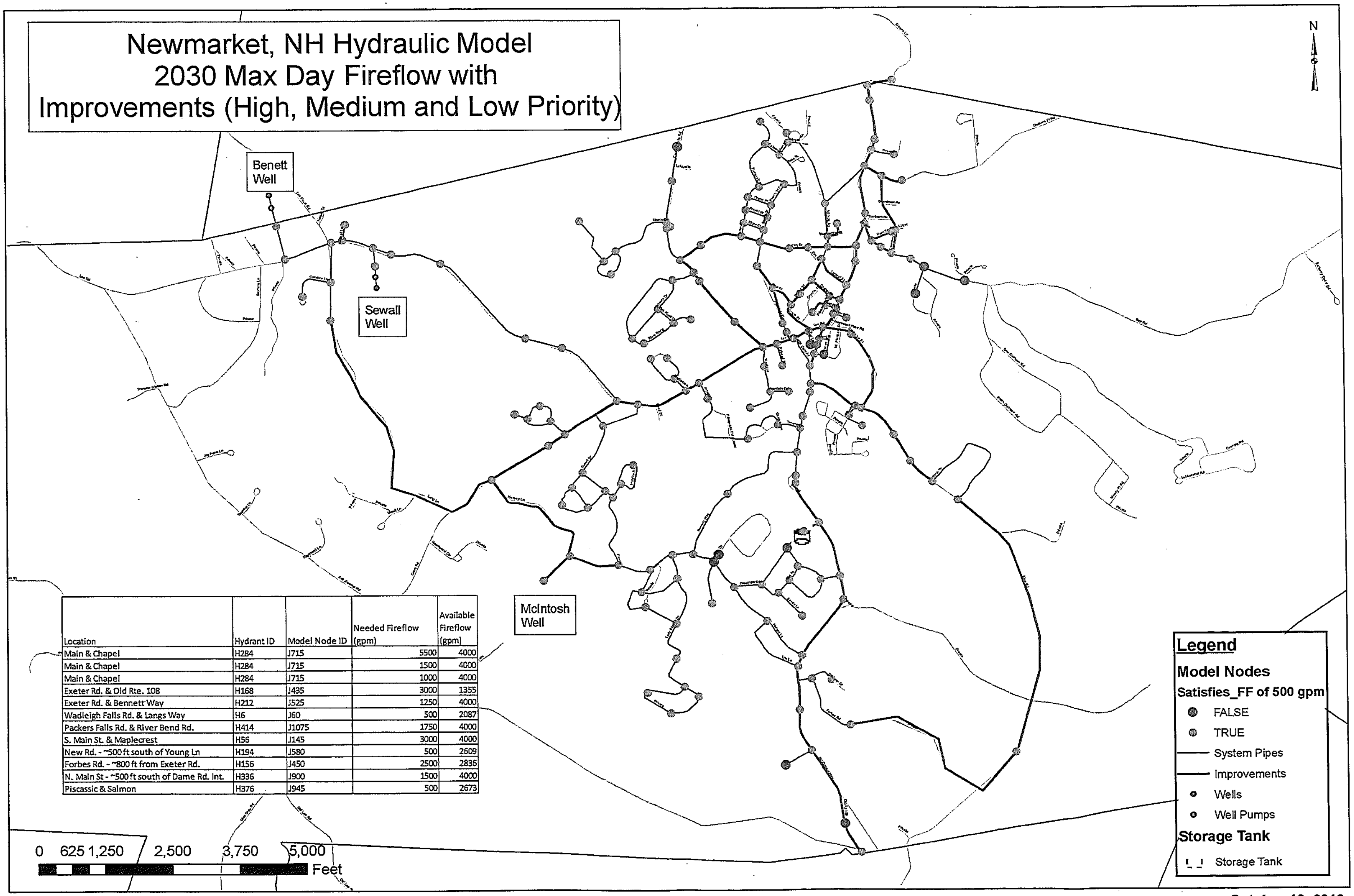
Newmarket, NH Hydraulic Model
2030 Max Day Fireflow with Improvements (High, Medium and Low Priority)



Location	Hydrant ID	Model Node ID	Needed Fireflow (gpm)	Available Fireflow (gpm)
Main & Chapel	H284	J715	5500	4000
Main & Chapel	H284	J715	1500	4000
Main & Chapel	H284	J715	1000	4000
Exeter Rd. & Old Rte. 108	H168	J435	3000	1355
Exeter Rd. & Bennett Way	H212	J525	1250	4000
Wadleigh Falls Rd. & Langs Way	H6	J60	500	2087
Packers Falls Rd. & River Bend Rd.	H414	J1075	1750	4000
S. Main St. & Maplecrest	H56	J145	3000	4000
New Rd. - ~500 ft south of Young Ln	H194	J580	500	2609
Forbes Rd. - ~800 ft from Exeter Rd.	H156	J450	2500	2836
N. Main St - ~500 ft south of Dame Rd. Int.	H336	J900	1500	4000
Piscassic & Salmon	H376	J945	500	2673

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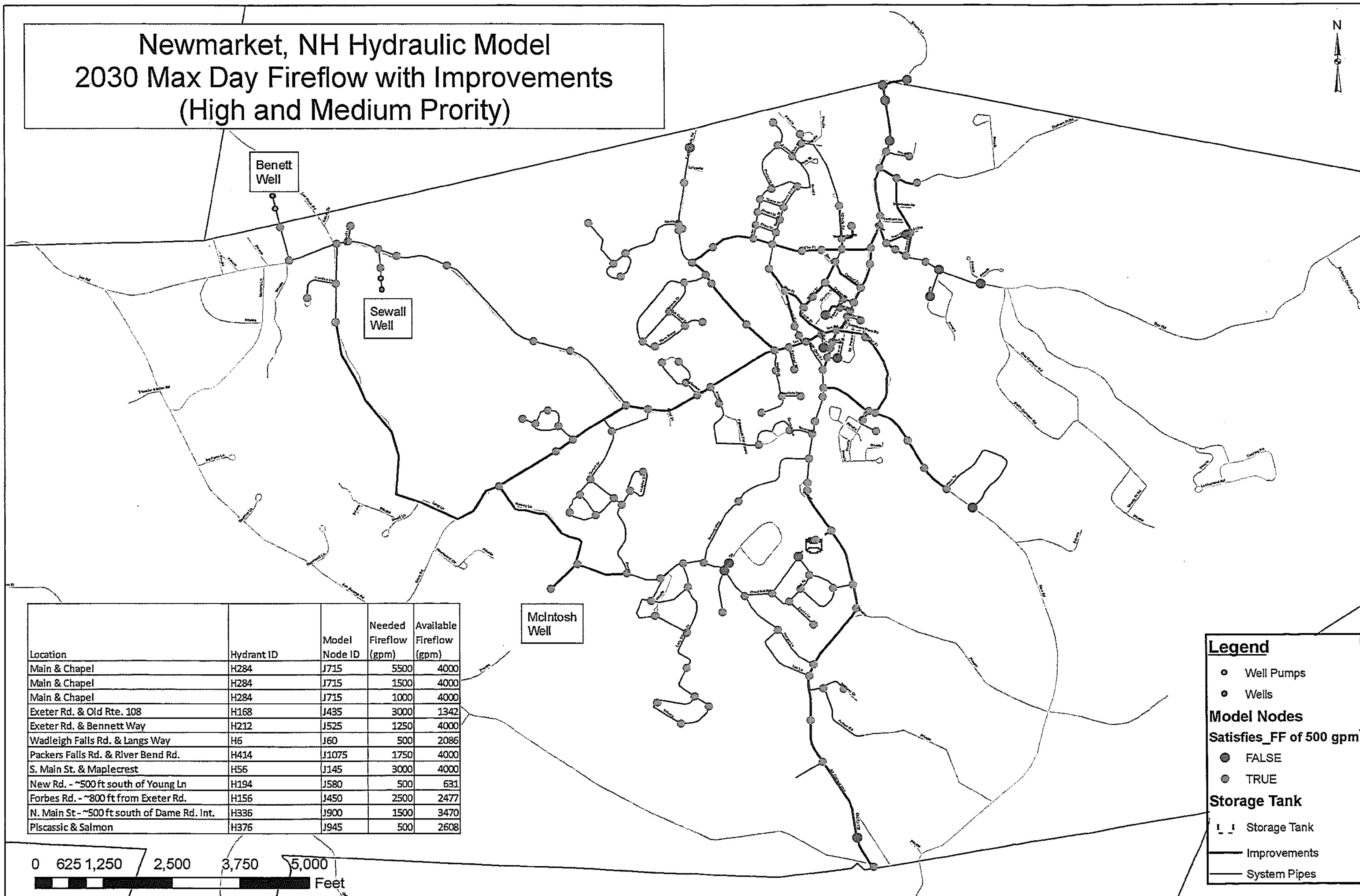
Newmarket, NH Hydraulic Model
2030 Max Day Fireflow with Improvements
(High and Medium Prority)



Location	Hydrant ID	Model Node ID	Needed Fireflow (gpm)	Available Fireflow (gpm)
Main & Chapel	H284	J715	5500	4000
Main & Chapel	H284	J715	1500	4000
Main & Chapel	H284	J715	1000	4000
Exeter Rd. & Old Rte. 108	H168	J435	3000	1342
Exeter Rd. & Bennett Way	H212	J525	1250	4000
Wadleigh Falls Rd. & Langs Way	H6	J60	500	2086
Packers Falls Rd. & River Bend Rd.	H414	J1075	1750	4000
S. Main St. & Maplecrest	H56	J145	3000	4000
New Rd. - ~500 ft south of Young Ln	H194	J580	500	631
Forbes Rd. - ~800 ft from Exeter Rd.	H156	J450	2500	2477
N. Main St - ~500 ft south of Dame Rd. Int.	H336	J900	1500	3470
Piscassic & Salmon	H376	J945	500	2608

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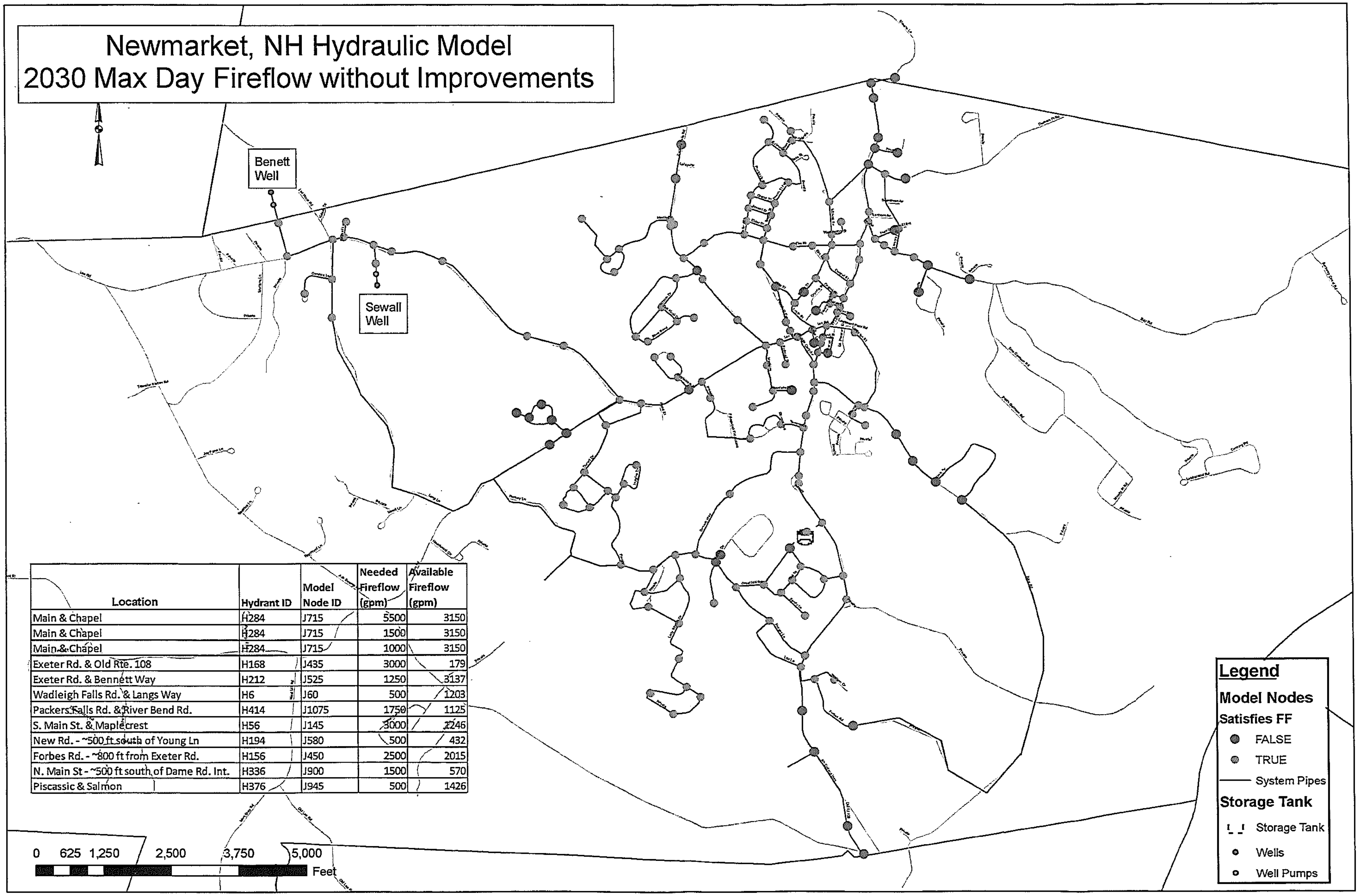
Newmarket, NH Hydraulic Model
2030 Max Day Fireflow without Improvements



Location	Hydrant ID	Model Node ID	Needed Fireflow (gpm)	Available Fireflow (gpm)
Main & Chapel	H284	J715	5500	3150
Main & Chapel	H284	J715	1500	3150
Main & Chapel	H284	J715	1000	3150
Exeter Rd. & Old Rte. 108	H168	J435	3000	179
Exeter Rd. & Bennett Way	H212	J525	1250	3137
Wadleigh Falls Rd. & Langs Way	H6	J60	500	1203
Packers Falls Rd. & River Bend Rd.	H414	J1075	1750	1125
S. Main St. & Maplecrest	H56	J145	3000	2246
New Rd. - ~500 ft south of Young Ln	H194	J580	500	432
Forbes Rd. - ~800 ft from Exeter Rd.	H156	J450	2500	2015
N. Main St - ~500 ft south of Dame Rd. Int.	H336	J900	1500	570
Piscassic & Salmon	H376	J945	500	1426

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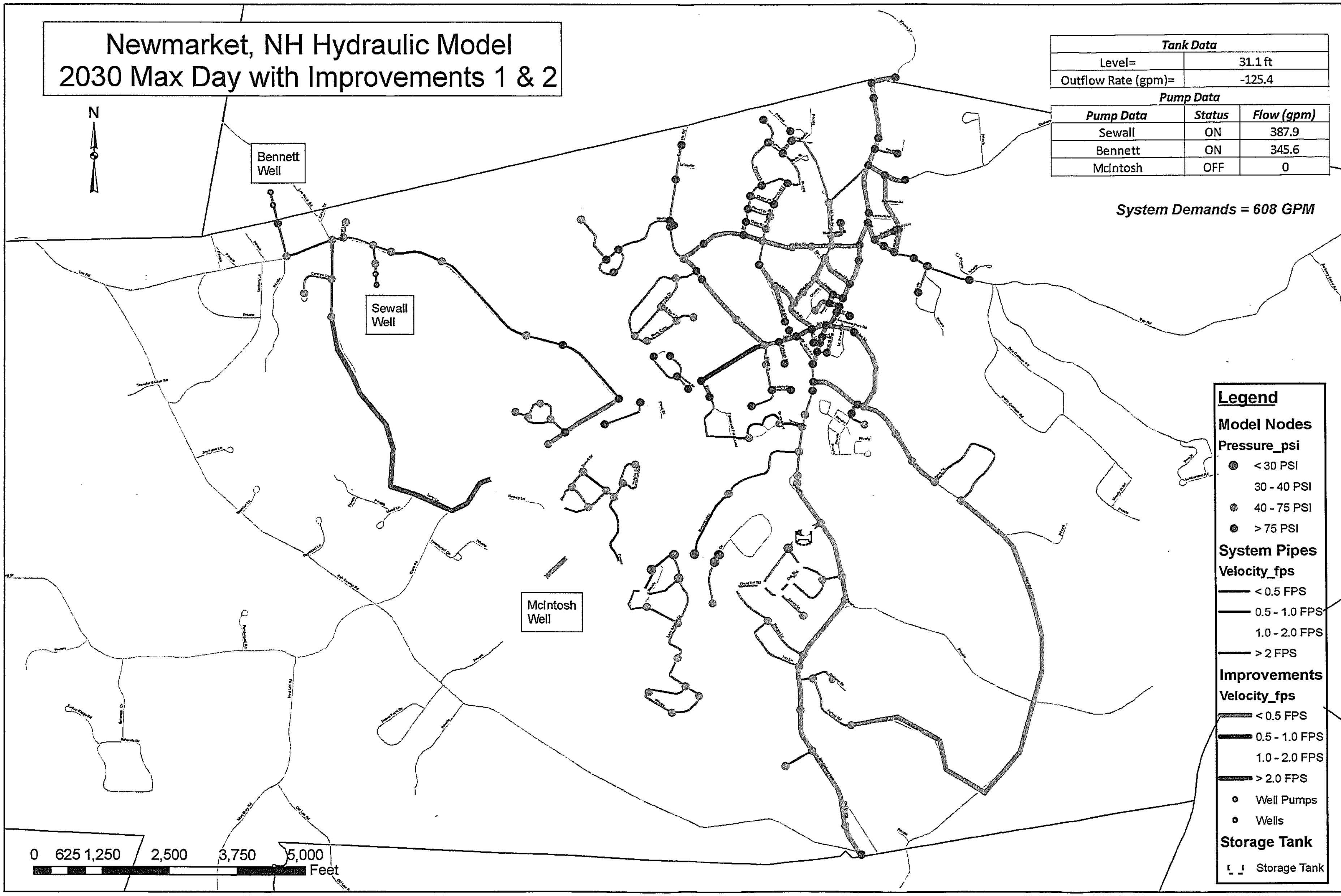

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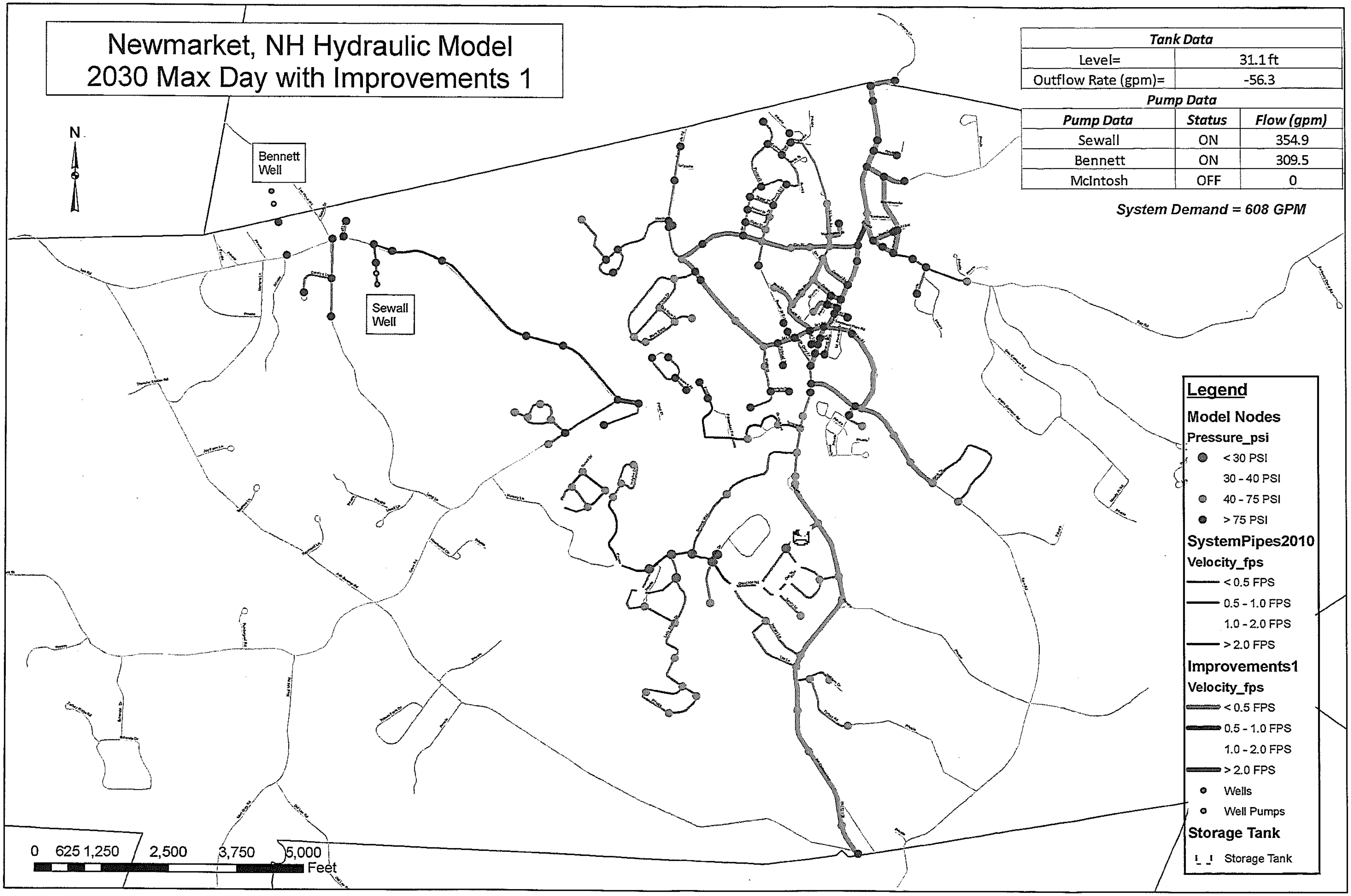
Newmarket, NH Hydraulic Model
2030 Max Day with Improvements 1

Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	-56.3

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	354.9
Bennett	ON	309.5
McIntosh	OFF	0

System Demand = 608 GPM



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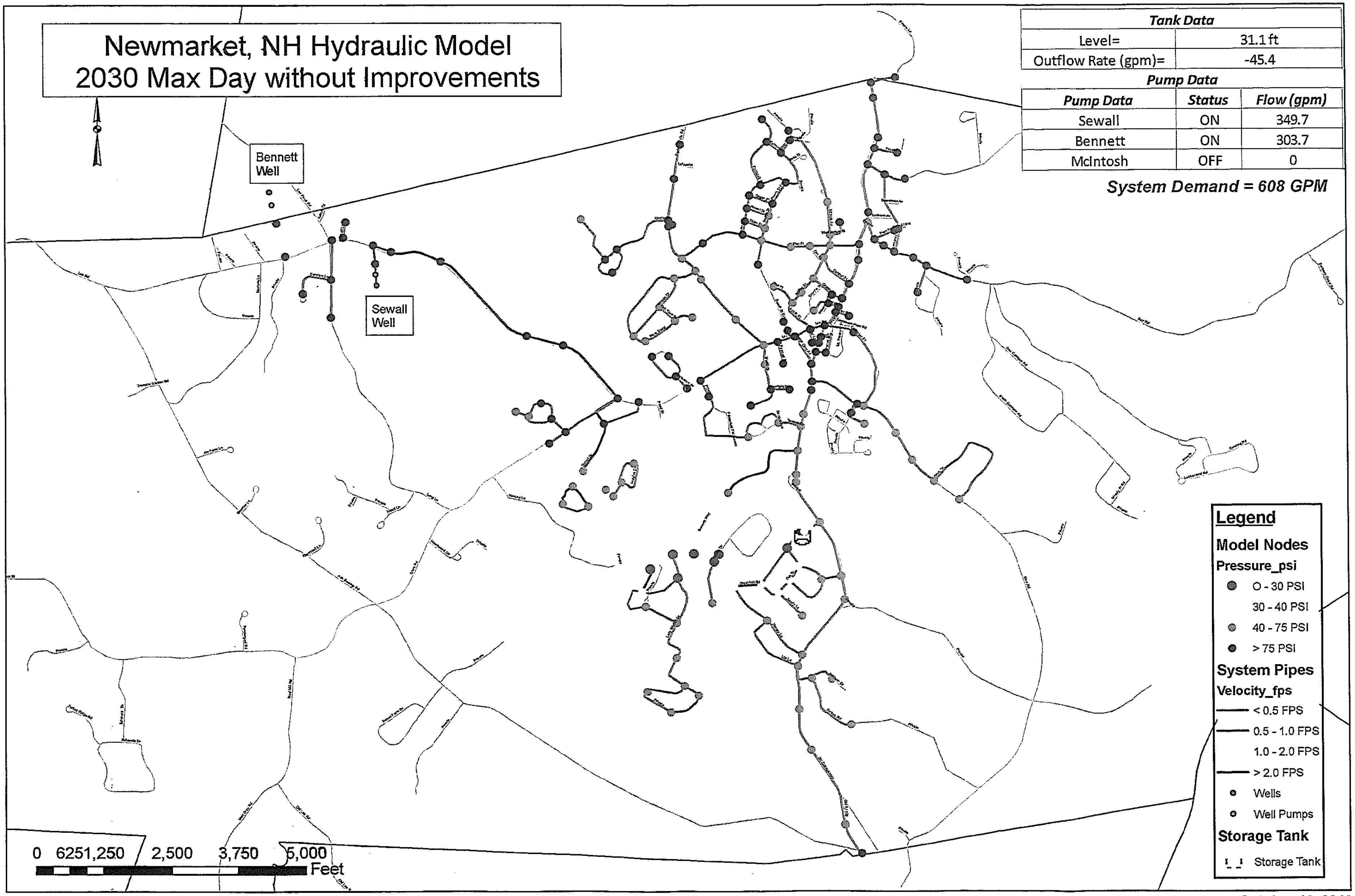
Newmarket, NH Hydraulic Model
2030 Max Day without Improvements



Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	-45.4

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	349.7
Bennett	ON	303.7
McIntosh	OFF	0

System Demand = 608 GPM

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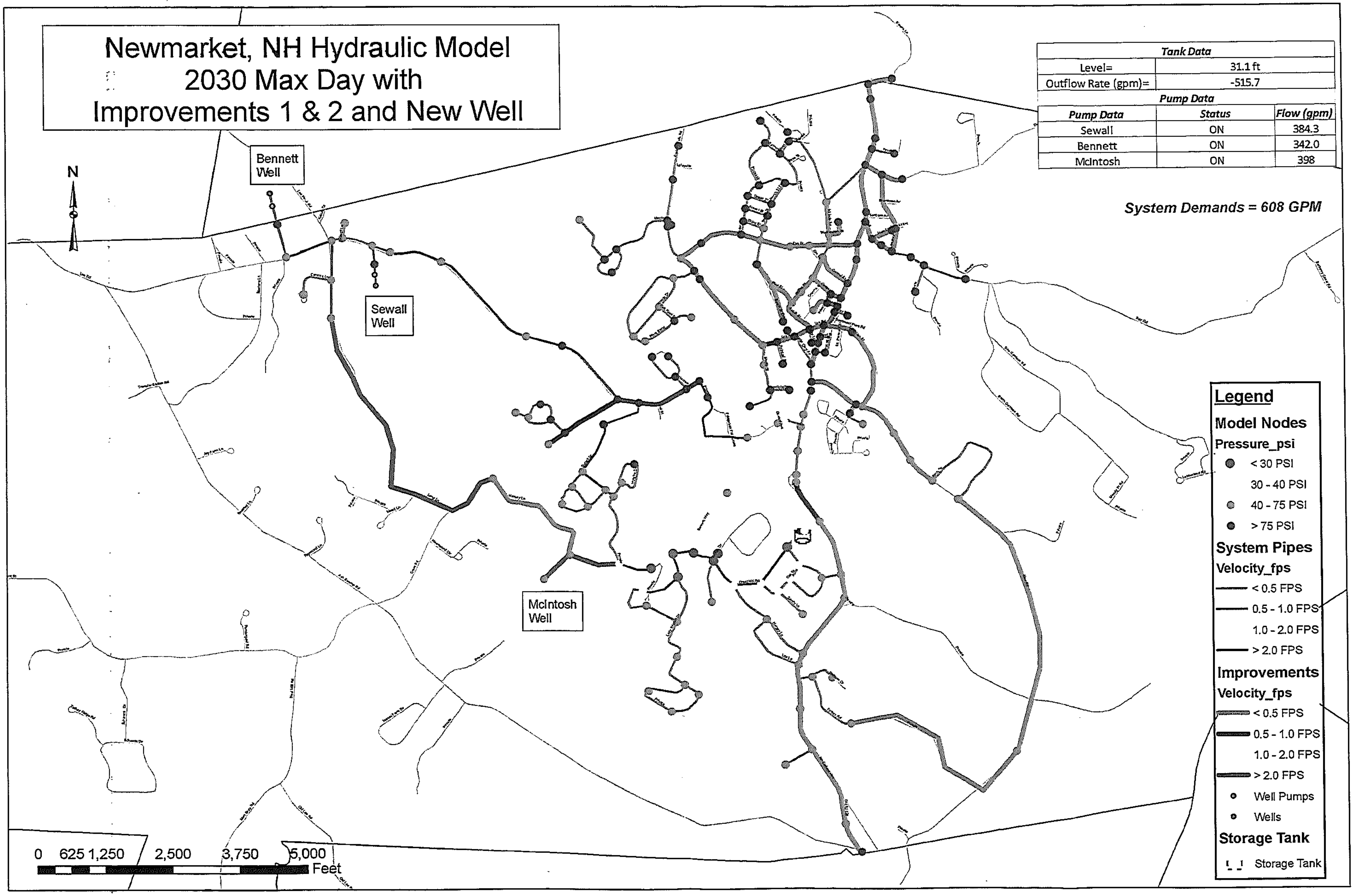
Newmarket, NH Hydraulic Model 2030 Max Day with Improvements 1 & 2 and New Well

Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	-515.7

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	384.3
Bennett	ON	342.0
McIntosh	ON	398

System Demands = 608 GPM



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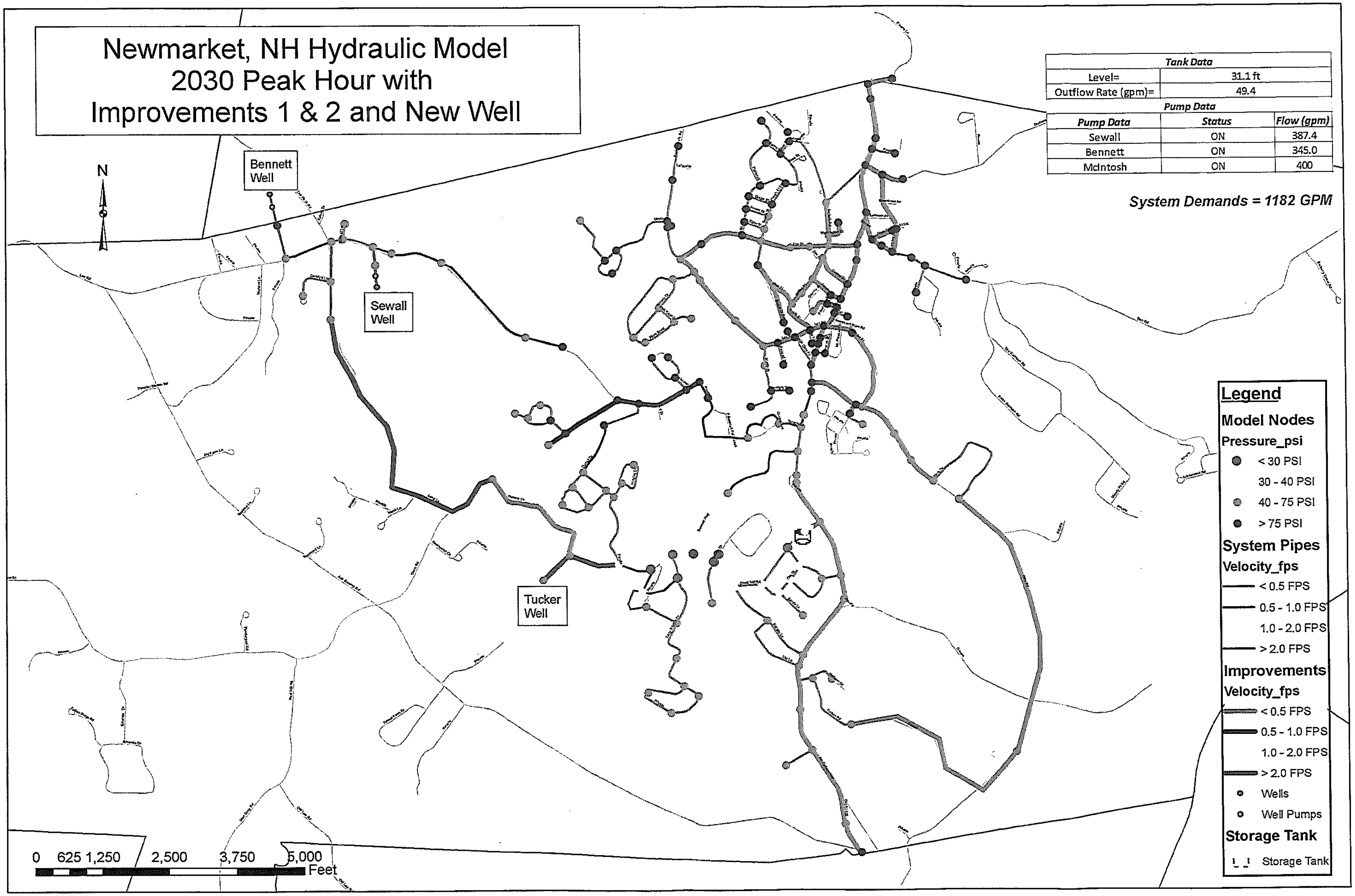
Newmarket, NH Hydraulic Model 2030 Peak Hour with Improvements 1 & 2 and New Well



Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	49.4

Pump Data

Pump Data	*Status*	*Flow (gpm)*
Sewall	ON	387.4
Bennett	ON	345.0
McIntosh	ON	400

System Demands = 1182 GPM

October 11, 2010

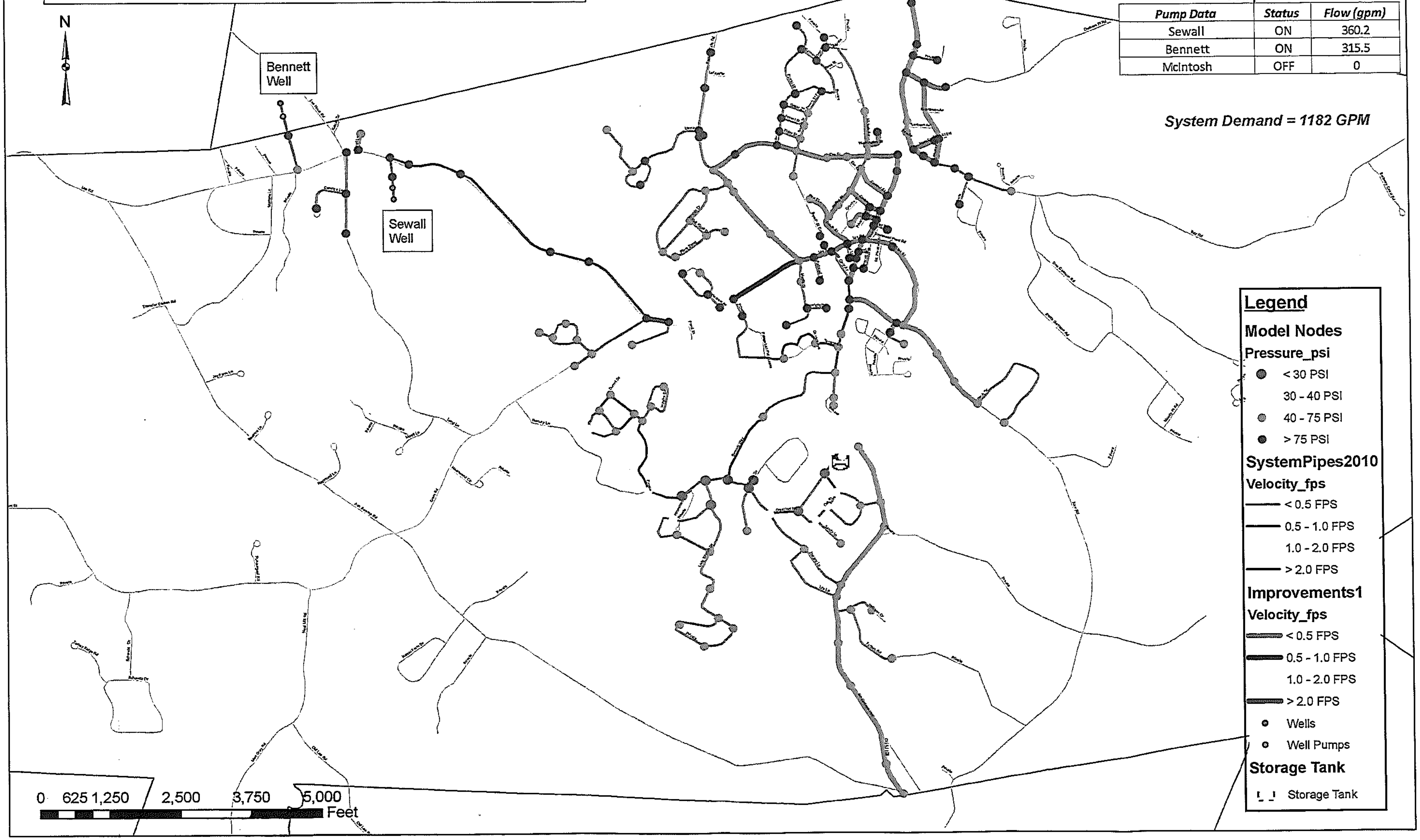
Newmarket, NH Hydraulic Model
2030 Peak Hour with Improvements 1

Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	505.8

Pump Data

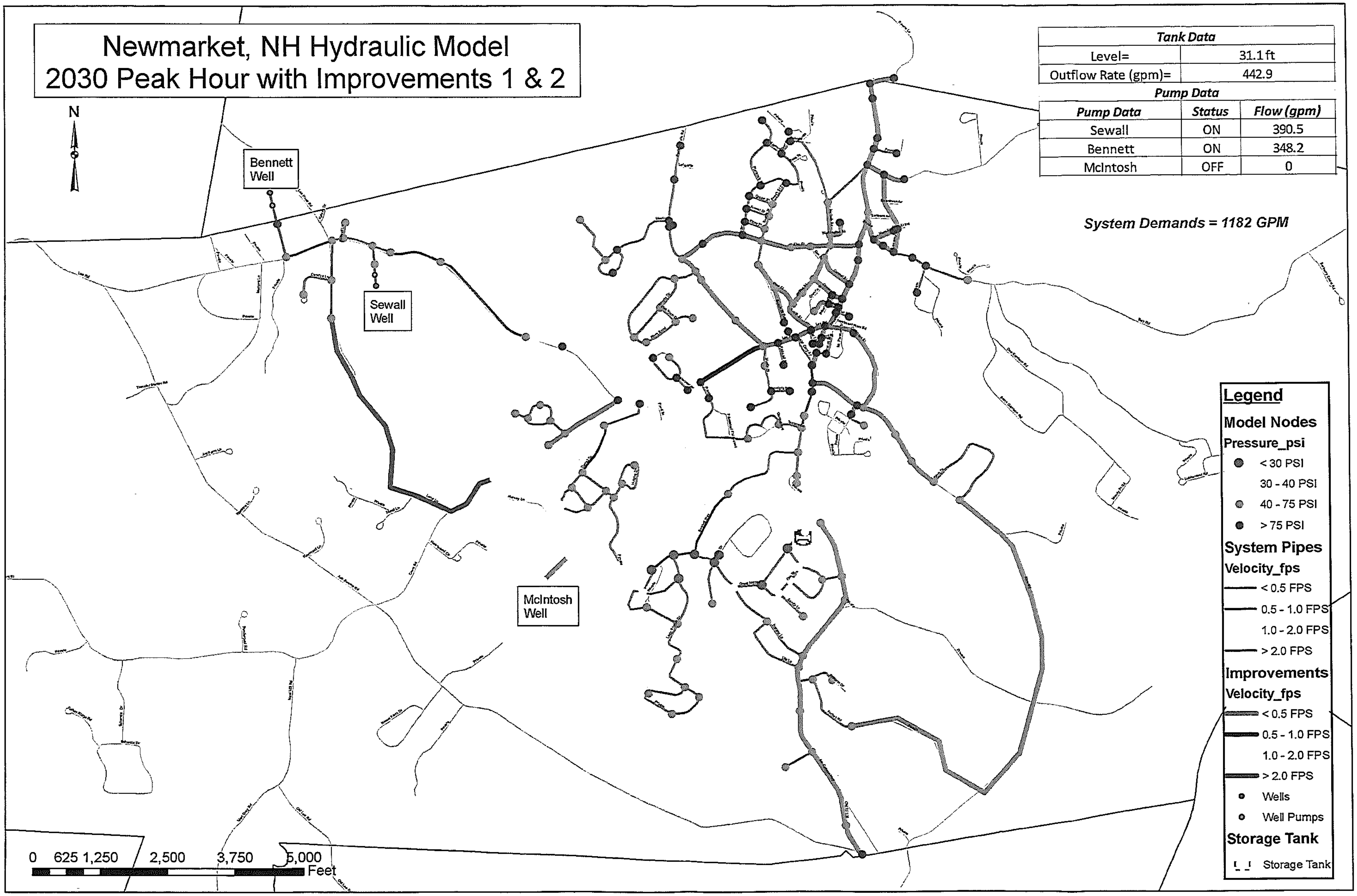
Pump Data	Status	Flow (gpm)
Sewall	ON	360.2
Bennett	ON	315.5
McIntosh	OFF	0

System Demand = 1182 GPM



October 11, 2010

Newmarket, NH Hydraulic Model
2030 Peak Hour with Improvements 1 & 2



Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	442.9

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	390.5
Bennett	ON	348.2
McIntosh	OFF	0

October 11, 2010

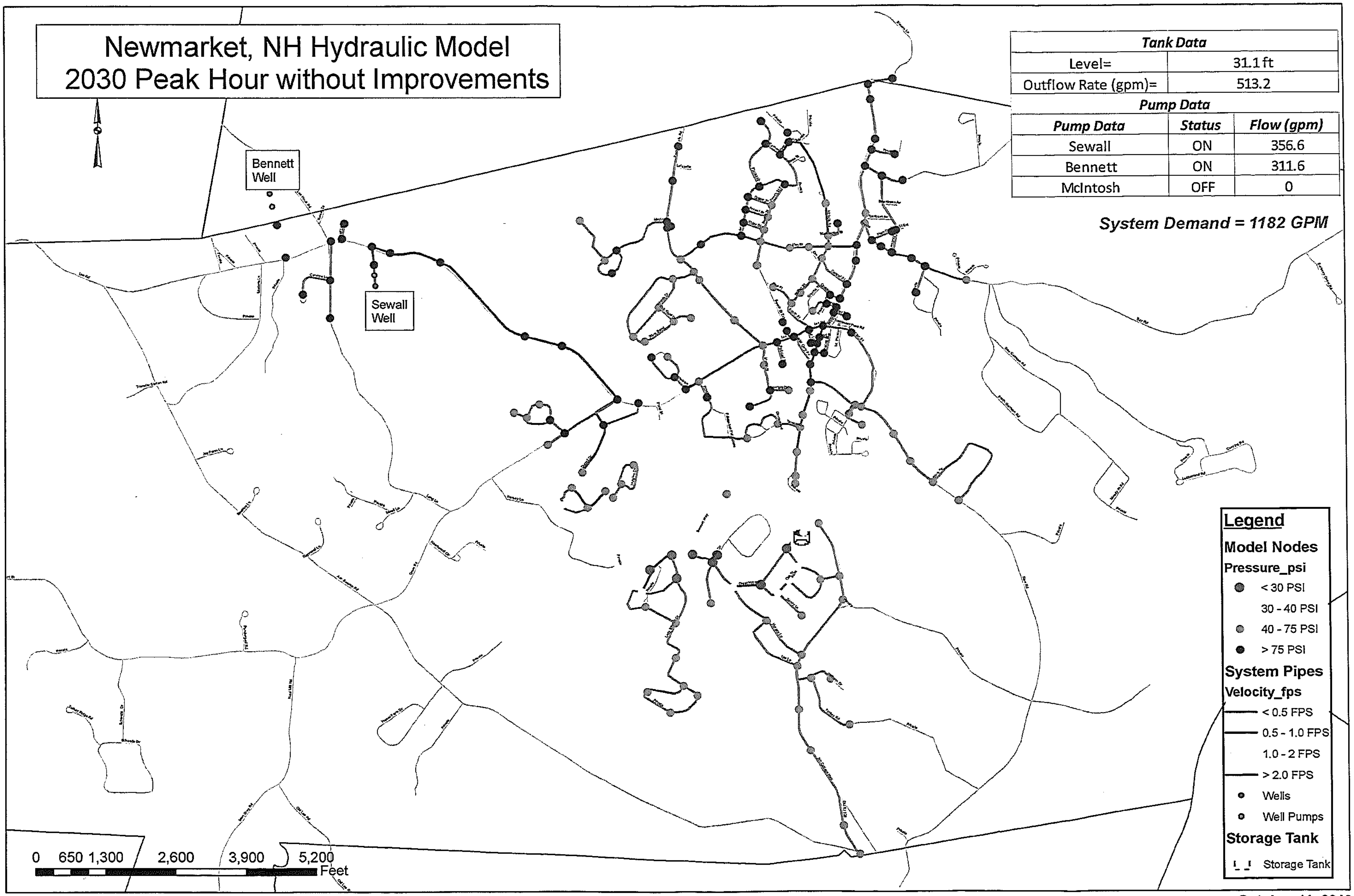
Newmarket, NH Hydraulic Model
2030 Peak Hour without Improvements

Tank Data	
Level=	31.1 ft
Outflow Rate (gpm)=	513.2

Pump Data

Pump Data	Status	Flow (gpm)
Sewall	ON	356.6
Bennett	ON	311.6
McIntosh	OFF	0

System Demand = 1182 GPM



October 11, 2010

Appendix B. Cost Estimate Information

Date: 9/29/10

Opinion of Cost
Storage Tank Vault Upgrade

ITEM	QUANTITY	UNIT	UNIT PRICE		AMOUNT		Subtotal	
New Structure (including low voltage electrical, HVAC and pluming)	64	SF	$	200	$	12,800		
Structure Slab	4	CY	$	500	$	2,000		
Existing Vault Modifications	1	Allowance	$	1,000	$	1,000		
Existing Vault Improvements	1	Allowance	$	500	$	500		
SUBTOTAL							**$**	**16,300**
Site Work (5%)							$	815
Electrical (12%)							$	1,956
Instrumentation and Controls (3%)							$	489
SUBTOTAL CONSTRUCTION COST (rounded)							**$**	**20,000**

Date: 9/29/10

Opinion of Cost
Well Pump Station Upgrade - Sewell

ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	Subtotal
Structure Addition (including low voltage electrical, HVAC and plumbing)	192	SF	$ 200	$ 38,400	
Structure Slab	10	CY	$ 500	$ 5,000	
Existing Structure Modifications	1	Allowance	$ 3,000	$ 3,000	
Demolition of interior containment					
Interior Partition Wall					
Existing Structure Maintenance	1	Allowance	$ 7,500	$ 7,500	
Replace Doors					
Paint					
Repair Hose Bib					
Repoint Masonry					
Repair Gutters					
Miscellaneous					
Equipment (installed cost):					
Chemical Tanks	2	EA	$ 1,800	$ 5,220	
Chemical Pumps	2	EA	$ 500	$ 1,450	
SUBTOTAL					**$ 60,570**
Site Work (5%)					$ 3,029
Electrical (12%)					$ 7,268
Instrumentation and Controls (3%)					$ 1,817
SUBTOTAL CONSTRUCTION COST (rounded)					$ 73,000

Date: 9/29/10

Opinion of Cost
Well Pump Station Upgrade - Bennett

ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	Subtotal
Structure Addition (including low voltage electrical, HVAC and plumbing)	192	SF	$ 200	$ 38,400	
Structure Slab	10	CY	$ 500	$ 5,000	
Existing Structure Modifications	1	Allowance	$ 3,000	$ 3,000	
Interior Partition Wall					
Existing Structure Maintenance	1	Allowance	$ 7,500	$ 7,500	
Replace Doors					
Paint					
Repoint Masonry					
Replace Roof					
Miscellaneous					
Equipment (installed cost):					
Chemical Tanks	2	EA	$ 1,800	$ 5,220	
Chemical Pumps	2	EA	$ 500	$ 1,450	
SUBTOTAL					$ 60,570
Site Work (5%)					$ 3,029
Electrical (12%)					$ 7,268
Instrumentation and Controls (3%)					$ 1,817
SUBTOTAL CONSTRUCTION COST (rounded)					$ 73,000