REPORT

Five-Year Update of the Water System Master Plan

Town of Salem,
New Hampshire

February 2013
(Finalized August 2013)

CDM Smith

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February 15, 2013
(Finalized August 20, 2013)

Mr. Rick Russell, Director
Department of Public Works
Town Hall
33 Geremonty Drive
Salem, New Hampshire 03079

Subject: Five-Year Update of the Water System Master Plan

Dear Mr. Russell:

CDM Smith is pleased to submit this Update Report of the 2008 Water System Master Plan.

Our 2008 Master Plan presented a full description of the water system, population and water demand projections, assessments of various system components, alternatives for future expansion, organizational and financial management evaluations, a Capital Improvement Plan, and more.

This Update Report is intended to be a supplement to, and not a replacement of, the 2008 Master Plan. The two Master Plan reports will function as companion volumes. As you directed, CDM Smith has updated various items in the 2008 Master Plan, and each new item is included as an Appendix in this Update Report.

These Appendices are described below:

- Appendix A – Water System Map. We have updated Figure 2-1, the water distribution system map.
- Appendix B – Section 3, Population and Water Consumption. This is an entirely-new version of Section 3, which supersedes the version in the 2008 Master Plan.
- Appendix C – Section 4, Assessment of Water Quality and Treatment. This appendix is a supplement to, not a replacement of, the 2008 version of Section 4. It presents information provided by Wright-Pierce regarding their work performed in recent years at the Water Treatment Plant, and their anticipated directions of upcoming work.

- Appendix D – Section 5, Analysis of Existing Distribution System. This appendix consists of updates to several subsections of Section 5. It represents a supplement to, not a replacement of, the 2008 version.

- Appendix E – Section 8, Supply Source Issues. This appendix is a supplement to, not a replacement of, the 2008 version of Section 8. It updates several issues related to supply sources, especially the former groundwater supply sources.

- Appendix F – Section 11, Capital Improvement Planning. This is an entirely-new version of Section 11, which supersedes the version in the 2008 Master Plan.

- Appendix G – Other Documents. This appendix includes various documents, or excerpts of documents, that are referenced in this report.

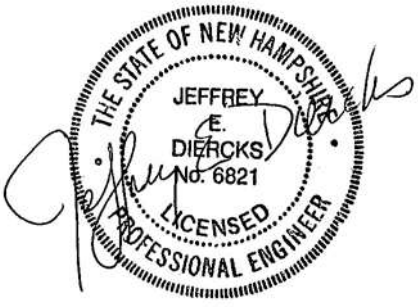
We are grateful for the opportunity to work with you on this project. We also thank Mr. Frank Giordano, Utilities Manager, and Mr. Glenn Burton, Distribution/Construction Foreman, for their assistance.

This report was prepared under the general supervision of Mr. David G. Polcari, client service manager, by Mr. Jeffrey E. Diercks, project manager, and Mr. Brian E. Pitta, project engineer.

Very truly yours,

Jeffrey E. Diercks, P.E.
Associate
CDM Smith Inc.

David G. Polcari, P.E.
Associate
CDM Smith Inc.



Appendices

A: Updated Water System Map, Figure 2-1 (supersedes 2008 version)

B: Section 3, Population and Water Consumption (supersedes 2008 version)

C: Section 4, Assessment of Water Quality and Treatment (supplements 2008 version)

D: Section 5, Analysis of Existing Distribution System (supplements 2008 version)

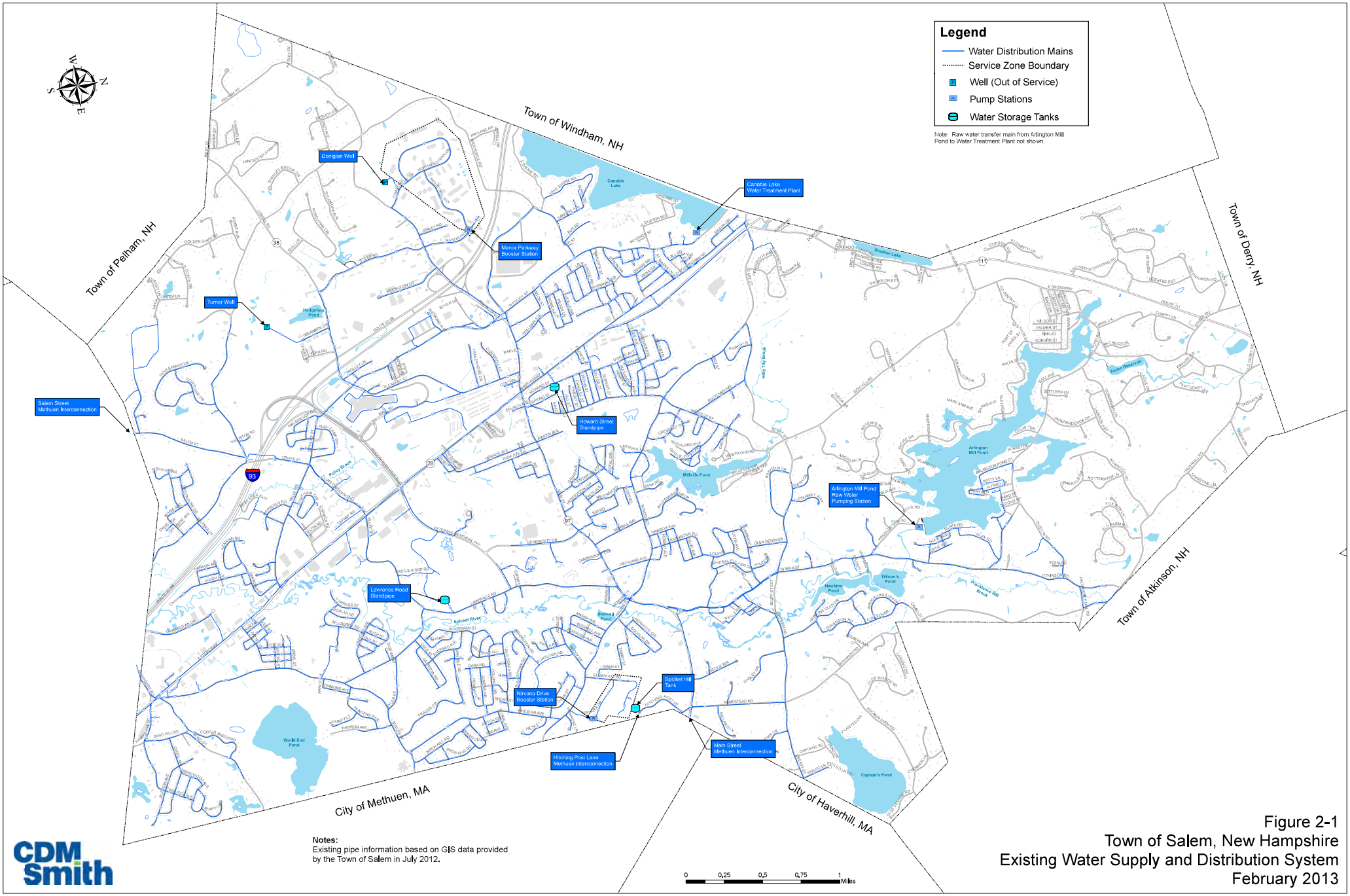
E: Section 8, Supply Source Issues (supplements 2008 version)

F: Section 11, Capital Improvement Planning (supersedes 2008 version)

G: Other Documents

Appendix A

Updated Water System Map, Figure 2-1 (supersedes 2008 version)



Notes:
Existing pipe information based on GIS data provided by the Town of Salem in July 2012.

CDM Smith

Figure 2-1
Town of Salem, New Hampshire
Existing Water Supply and Distribution System
February 2013

Appendix B

Section 3, Population and Water Consumption (supersedes 2008 version)

Section 3 (2013 Update)

Population and Water Consumption

3.1 Recent Population

The 2008 Water Master Plan used the 2000 U.S. Census and interim estimates provided by the New Hampshire Office of Energy and Planning (NHOEP). According to the U.S. Census, the population of the Town was 28,112 in 2000. NHOEP showed some growth in the 2006 estimate of 29,885. The 2010 U.S. Census, the newest information available, calculated Salem's population to be 28,776, a 2.4% increase from 2000. However, this is also a 3.7% decrease from the 2006 NHOEP estimate. The newest U.S. census data indicates either NHOEP overestimated Salem's growth in the 2000s or there has been a slight population reduction in the Town.

Not all of Salem is connected to the Town's water system, as is evident from the water distribution system map in Figure 2-1 (see Appendix A). The serviced population was estimated to be 72% in the original 2008 master plan. Using updated GIS data provided by the Town, CDM Smith re-evaluated the serviced population by counting property parcels and buildings inside and outside the service areas. This analysis revealed that there have been no major changes to the percent of the Town that is serviced by the water system and 72% is still an accurate estimate.

3.2 Population Projections

The 2008 Water Master Plan used population projections provided by NHOEP, which no longer produces population projections or estimates. Updated population projections were calculated by adjusting NHOEP's projections from the 2008 report. The 2010 census was 7% lower than the NHOEP projection for 2010; thus, all future projections were reduced by 7%. This simplified method preserves NHOEP's original population growth assumptions for the Town, but readjusts the starting point to the 2010 census. The updated projection forecasts that Salem will eventually reach NHOEP's original population estimate, but in a longer time frame. Table 3-1 shows the adjusted population projections from 2015 to 2030.

As discussed in the 2008 Water Master Plan, a town's population cannot grow indefinitely; rather, there is a buildout population that is constrained by zoning regulations. The 2001 Town of Salem Master Plan evaluated the buildout population for two zoning scenarios. The first assumed the zoning regulations would remain constant and this led to a buildout projection of 35,780. The second scenario assumed sewer expansion would result in 1,862 acres of rural land being rezoned as residential and increased the buildout projection to 37,426. Our recent discussions with the Town's planning department confirmed there have been no new buildout projections since the 2001 report.

Year	Population
2010*	28,776
2015	29,650
2020	30,478
2025	31,324
2030	32,031
Buildout (Existing Zoning)	35,780
Buildout (Potential Zoning)	37,426

*U.S. Census data.

Table 3-1
Population Projections

The serviced population is more difficult to project because it is also dependent on the Town's water service expansion. We used the same methods as the 2008 report for establishing a lower- and upper-bound serviced population. The lower-bound estimate assumes the serviced population percentage remains constant through the planning period. In theory, the serviced population percentage could decrease if the population increases in non-serviced area with no service expansion. However, this seems improbable since there will likely be some water system expansion and some of the growth will occur in the serviced areas.

The upper-bound scenario assumes the Town will expand water service to all residents by 2030, creating a serviced population equal to the total population in 2030. This is a conservative assumption from the point of view of water system planning. We assumed a linear growth in serviced population from 72% in 2011 to 100% in 2030. The upper-bound in the 2008 report estimated the 2010 serviced population to be 76%. However, as previously discussed, the NHOEP's estimated 2010 population was overestimated, which also led to an overestimated serviced population. This also indicates that in planning for the future, the lower-bound estimate will be the better predictor. These figures are summarized in Table 3-3, located in Section 3.4.

3.3 Recent Water Demands

Table 3-2 displays water production and consumption data from 1997 through 2012. The 2008 Water Master Plan included data through 2007. The Town has indicated that enhanced metering installed in 2010 and more detailed recordkeeping has significantly improved the records in recent years.

The "total pumped" column reflects Salem's Water Treatment Plant's (WTP) production, and the remaining columns track the usage. Residential use was Salem's largest consumption category averaging 46% of total water produced from 1999-2012 (note that the 2012 residential percentage was 46%, confirming the long-term average). Salem's commercial water usage averaged 34% of the total water produced during the same time period, and was 34% in 2012.

The remaining water is categorized as "unmetered water". Unmetered water includes water used in such events as hydrant testing, fire department training, firefighting, main breaks, leaks, underregistration of customer meters, and more. The percentage of unmetered water has been declining recently, which is likely attributable to various DPW efforts discussed later herein. In 2012,

the unmetered water was 17%, the lowest value in a decade. Some of this unmetered water can actually be estimated and accounted for. Examples include water used during hydrant flushing, firefighting, and main breaks. The Town now estimates and subtracts such water usage from the unmetered water, to estimate the "unaccounted-for water". In 2012, the unaccounted-for water was 16%.

Table 3-3 also lists the maximum day demand, which is of significant interest in water planning. Data from 1999-2002 are not considered reliable by the Town and are not shown in the table. The average maximum day demand from 2003 to 2012 was 4.23 MGD.

The 2008 Water Master Plan identified a peaking factor (the ratio of Maximum Day Demand to Average Day Demand) of 1.85 based on the two most recent years at that time (2006 and 2007). Two of the most recent years of record available now (2010 and 2011) indicate the peaking factor may be closer to 2.0. Residentially-dominated water systems often have peaking values around 2. Because commercial water use does not peak as much in the summer, commercially-dominated systems may have a peaking factor of 1.5 or less. Along with having a large residential demand, some of Salem's major commercial areas (Canobie Lake Park and Rockingham Park) are seasonal in nature and keep the peaking factor close to that associated with a residential area.

Year	Total Pumped (MGD)	Residential Metered (MGD)	Commercial Metered (MGD)	Unmetered Water* (MGD)	Unmetered Water* (%)	Un-accounted For Water *(%)	Max. Day Pumped (MGD)
1999	2.30	1.14	0.93	0.23	10%	N/A	N/A
2000	2.19	1.05	0.84	0.30	14%	N/A	N/A
2001	2.38	1.15	0.85	0.38	16%	N/A	N/A
2002	2.24	1.09	0.82	0.32	14%	N/A	N/A
2003	2.25	1.08	0.77	0.41	18%	N/A	3.96
2004	2.37	1.08	0.79	0.50	21%	N/A	3.93
2005	2.39	1.13	0.82	0.44	18%	N/A	4.07
2006	2.41	1.07	0.79	0.55	23%	N/A	4.47
2007	2.50	1.15	0.78	0.56	22%	N/A	4.61
2008	2.40	1.02	0.74	0.64	27%	N/A	4.18
2009	2.28	0.96	0.71	0.61	27%	N/A	3.82
2010	2.42	1.15	0.76	0.51	21%	20%	4.65
2011	2.18	0.98	0.76	0.44	20%	18%	4.56
2012	2.20	1.01	0.81	0.38	17%	16%	4.05

*See text for definitions.

Table 3-2
Historical Water Demands, 1999–2012

3.4 Water Demand Projections

CDM Smith prepared new demand projections using both the lower-bound and upper-bound serviced population projections discussed previously. At the time of this work, 2011 was the most recent year of available information. The following assumptions were employed:

- Commercial water use will increase proportionally to residential water use.
- The residential per-capita consumption of 52.5 gallons per person per day used in the 2008 Water Master Plan will remain constant until 2030.
- The 2011 peaking factor of 2.1 will remain constant.
- Future unmetered water set to 15% of total water production, reflecting the Town's demonstrated commitment to improving its water conservation and demand management measures as discussed later herein.

The 2011 residential water demand was approximately 47 gallons per person per day, showing a decrease from the value used in the 2008 report. However, since the Town is just beginning its meter program to improve residential meters, we feel this number could be low and does not necessarily predict the Town's future conditions. The newer meters will be more accurate, especially at capturing low flows that were not previously metered, thus raising the residential per capita water demand. For this reason, the same value (52.5 gallons per person per day) as was used in the 2008 report was used for future projections. This is within a benchmark of less than 65 gallons per capita per day, which Salem should continue to pursue as an upper boundary that should not be exceeded.

The 2011 unmetered water was approximately 20% of the total produced water. Salem's recent leak detection and repair efforts in addition to the metering program will lower this value, as indicated in the 2012 Salem Water Audit prepared by Wright-Pierce, the Executive Summary of which appears in Appendix G. Unmetered water accounting for 15% of the total production provides a reasonable estimate while taking into account the Town's recent efforts to lower the value.

The water demand projections based on the above assumptions are shown on Table 3-3 and Figure 3-1. The lower-bound assumptions (serviced area remains constant) project the average day demand will increase to approximately 2.53 MGD in 2030. The maximum day demand for the same conditions increases to approximately 5.31 MGD in 2030. The upper-bound condition, which assumes linear growth in serviced population to 100% in 2030, projects the average day demand will increase to 3.17 MGD and the maximum day demand will increase to 6.66 MGD in 2030. As noted earlier, we believe the lower-bound assumptions provide a more-accurate projection of Salem's future conditions.

In both scenarios, the average and maximum day demands are lower than the 2008 Water Master Plan. The updated population projections and peaking factor were the major changes that contributed to the updated values.

Year	Total Population	Lower-Bound Estimate (limited water main extension)				Upper-Bound Estimate (extension to all Salem)			
		Percent Served	Service Population	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Percent Served	Service Population	Average Day Demand (MGD)	Maximum Day Demand (MGD)
2010	28,776	72%	20,719	2.42	5.08	72%	20,719	2.42	5.08
2011	28,951	72%	20,845	2.05	4.30	72%	20,845	2.05	4.30
2015	29,650	72%	21,348	2.34	4.92	78%	23,096	2.53	5.32
2020	30,478	72%	21,944	2.41	5.05	85%	25,987	2.76	5.79
2025	31,324	72%	22,554	2.47	5.19	93%	29,016	2.97	6.23
2030	32,031	72%	23,062	2.53	5.31	100%	32,031	3.17	6.66

Table 3-3

Population and Water Demand Projections

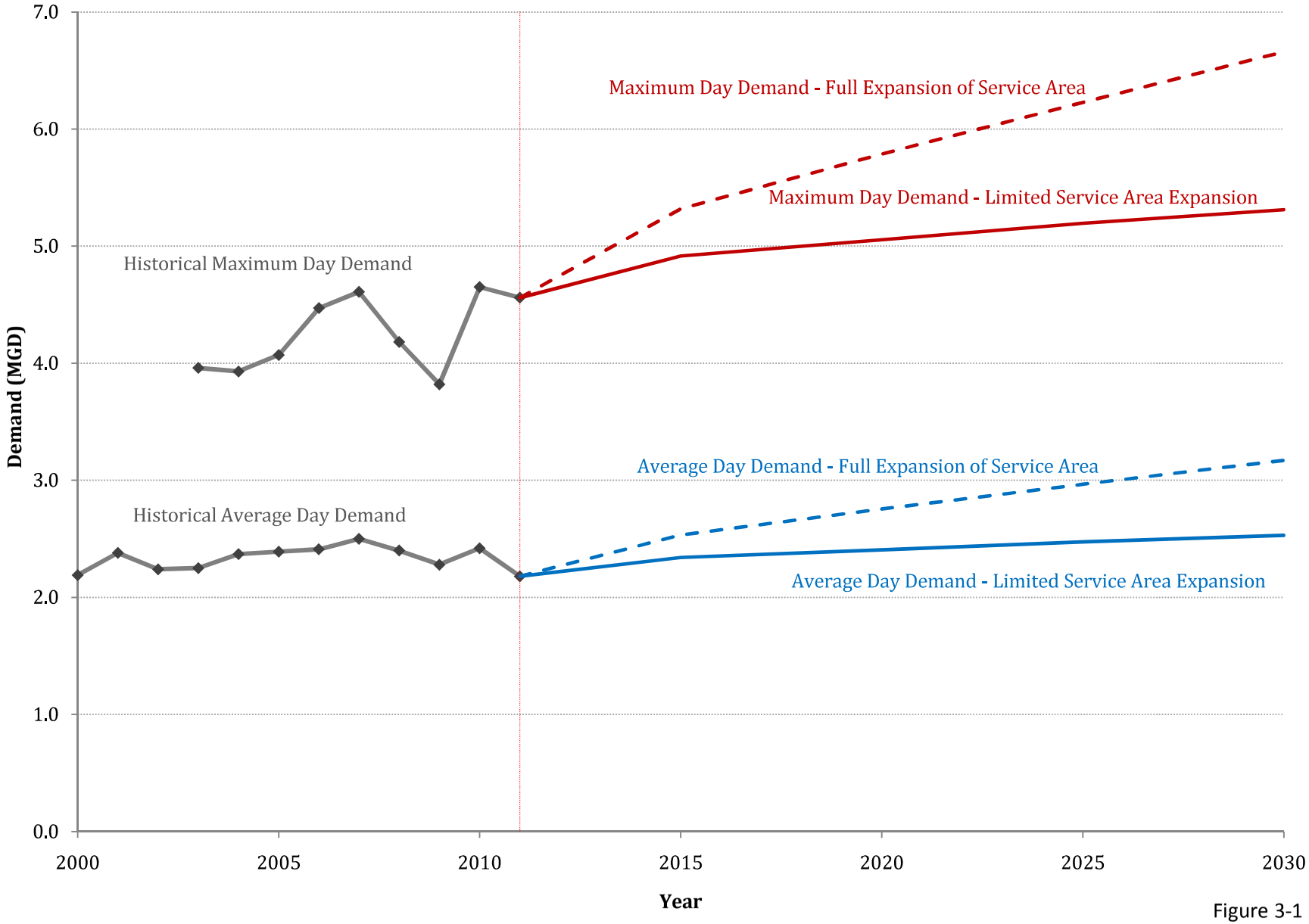


Figure 3-1
Water Demand Projections

3.5 Water Conservation and Demand Management

3.5.1 Progress Since 2008

The 2008 Water System Master Plan provided a detailed review of Salem's water conservation efforts and demand management efforts, including comparison to NHDES regulations (Env-Ws 390, redesignated as Env-Wq 2101) and industry standards. Three "key areas" for improvement were highlighted at that time:

- Key Area No. 1: Water Audit
- Key Area No. 2: Leak Detection
- Key Area No. 3: Consumer Metering

Since that time, Salem has made substantial progress in all three key areas, as summarized below.

Key Area No. 1: Water Audit

A rigorous Water Audit was conducted by Wright-Pierce and presented in their August 2012 report titled "2012 Water System Audit", the Executive Summary of which appears in Appendix G. The report quantified water production, consumption, and losses in the water system. The report also offered a number of recommendations regarding water conservation and demand management which are listed later herein.

Key Area No. 2: Leak Detection

In 2010–2011, Arthur Pyburn and Sons, Inc. surveyed leaks throughout the water distribution system. Their leakage reports are appended to Wright-Pierce's Water System Audit report. Nineteen leaks, including several major ones, were identified and corrected.

Key Area No. 3: Consumer Metering

In 2011–2012, Salem issued an RFP for water meter and automatic meter reading (AMR) equipment, and also issued bidding documents for meter installation services. The procurement documents were prepared by CDM Smith, which is assisting during program implementation. Salem elected to construct a fixed-network AMR system, which is capable of receiving meter readings throughout the water service area by radio and transmitting them to a central computer located at Town Hall. As of this writing, the AMR network is operational and the meter installation program is underway. Salem plans to perform additional meter replacements annually, subject to appropriation, until the entire water system is operating on the new AMR network in late 2015.

3.5.2 Past NHDES Position on Salem's Water Conservation Efforts

On February 20, 1996, NHDES issued Administrative Order (AO) WSPCD 96-02 regarding Salem's water system. Copies of the AO and other NHDES correspondence described herein are included in Appendix G.

In a letter dated January 9, 2008, NHDES summarized their view of Salem's progress on AO-related efforts. The 2008 letter addresses two areas: Drought Management (including supply adequacy) and Water Conservation. The latter is discussed below.

NHDES noted that, at that time, Salem had done the following:

- Expanded public outreach
- Imposed summer odd/even outdoor watering schedules
- Was validating accuracy of commercial meters and obtaining auditing services from Energy New England

NHDES, however, noted the following deficiencies:

- "Based on the information provided by the Town … the Town does not have the residential metering infrastructure or the staffing required to measure unaccounted-for water in the water system."
- "The Town also has not committed resources to maintain a water system leak detection and repair program."

NHDES stated that Salem should follow NHDES regulations "when establishing an unaccounted-for water program and leak detection and repair program."

In addition to addressing those issues, NHDES indicated that they believe Salem should pursue additional measures:

> "Given the Town's population density and the availability of water resources in southern New Hampshire, DES believes the Town should consider implementing more than just the basic water conservation measures described above. These measures may include:
>
> 1. Establishing water efficiency standards for new connections to the water system that require water efficient landscaping and use of water efficient fixtures and appliances.
> 2. Implementing a rate structure that encourages water conservation by increasing the price of a unit volume used as use exceeds certain thresholds.
> 3. Establishing a water fixture replacement or retrofitting program. This program could be applied to public buildings (such as schools) and private buildings. Investing in improving the efficiency of water fixtures will reduce water demand which essentially has the same effect as developing new sources of supply. Funding for this program could be through ratemaking or these improvements could be paid for as 'offsets' by new customers of the water system."

On December 29, 2010, NHDES issued a letter that listed "measures Salem's Water Department needs to take in the short-term to comply with Administrative Order 96-02." In brief, the three listed issues were as follows:

1. "Install and operate accurate water meters for all users in the system."
2. "In the near term, Salem needs to extend its use of Arlington Pond as a source of water when pond elevations exceed the thresholds specified in the agreement with the Arlington Pond Protective Association. … A surface water source use plan needs to be developed and implemented under the current watershed management scenario for Salem's two water sources. The plan should optimize the use of the two water bodies based on their recharge and storage properties."

3. "Salem needs to make improvements to the water treatment plant to reduce the amount of water wasted and discharged to the sewer system during the treatment process."

We are not aware of any NHDES observations issued since 2010 regarding Salem's water conservation and demand management efforts.

3.5.3 Recommendations from Water Audit Report

In the Water Audit Report, Wright-Pierce offered recommendations to Salem in several areas regarding tracking and reducing non-revenue water. Most of these recommendations are presented in Section 5 of that report. The recommendations are briefly summarized below, and additional details are available in the Water Audit Report:

- Meter System Upgrade. "It is recommended that the Town replace meters with new, accurate meters using current AMR devices and flow measurement technology." (page 14) CDM Smith notes that this program is underway, with scheduled completion in 2015, and that additional funding will be needed annually for the 2014 and 2015 project years.
- Leak Detection. "Contract with an experienced leak survey consultant on a yearly basis until meters are sufficiently upgraded, and then bi-annually after that. Keep detailed records of distribution system leak repairs and estimated flow rate of repaired leaks." (page 2)
- Unmetered Consumption Tracking. "In order to accurately track the effectiveness of measures implemented by the Town to reduce non-revenue water it is important the unmetered consumption estimates are carefully tracked using consistent methodology." (page 14) Several examples are given.
- Capital Improvement: Distribution System. "The Town should keep records of water main leaks and breaks as a way to track problem areas." (page 14) The report continues that such areas should be prioritized for upgrades, and that any bleeds and blowoffs should be eliminated.
- Future Water Audits. "Water audits should be conducted every five years in order to track water accountability and provide measurements of effectiveness for loss prevention activities undertaken by the Town." (page 15) This refers to the rigorous audit of the type conducted by Wright-Pierce; DPW calculates its unmetered water on an annual basis also, which provides additional information on effectiveness of its water conservation and demand management measures.
- Water Treatment Plant (WTP) Flow Meters. "Hire a qualified instrumentation technician to volumetrically calibrate the raw, finished and carbon dioxide motive water flow meters each year." (page 2)
- WTP Water Audit. "Perform a usage audit on the water treatment plant to assess production water efficiency internal to the facility operations." (page 2)

With respect to WTP water use, consideration is being given to constructing a larger clearwell and recycling backwash water, as discussed in Section 4.

3.5.4 Other Recommendations

Water Rates

With respect to water rates, Salem currently has a flat rate of $3.45 per hundred cubic feet, with no minimum amount or service charge. NHDES suggested Salem consider an inclining-block structure, as noted earlier. We recommend that two other items also be evaluated when Salem next considers modifying its rates:

- "Seasonal rates" are not in use in New England but are used in other areas of the country. Such rate structures increase the cost of water during the high-demand season, with the goal of reducing the peak demand. Seasonal rate structures are difficult to administer with manual water meter readings, but could be readily implemented if desired once the AMR program is completed in 2015.

- Salem could also consider a minimum bill amount. As one example, the City of Methuen has a service charge of $15 for its quarterly billing on all accounts, residential and commercial, with a senior citizen discount of $15. This is in addition to the usage charge, which for commercial customers is a flat rate of $3.55 per hundred cubic feet and which for residential customers has an inclining block structure starting at $1.62 per hundred cubic feet for the lowest block and increasing to $3.25 per hundred cubic feet for the highest block. As another example, the Town of Hudson, NH, has a monthly service charge based on meter size, on top of its flat usage rate of $3.30 per hundred cubic feet. The monthly service charge ranges from $10.69 for a 5/8-inch meter up to $911.49 for a 10-inch meter.

Commercial Meter Testing

Salem has not historically had a testing program for its large commercial meters. These meters are expected to be replaced as part of the above-referenced meter system upgrade, and thus will soon be in very good condition. We recommend that, subsequently, the Town develop a testing program to monitor the inevitable meter efficiency loss over time. This efficiency loss is directly related to revenue loss and increase in unaccounted-for water.

As a municipal water system, Salem is not subject to the regulations of the New Hampshire Public Utilities Commission (NHPUC). NHPUC does, nevertheless, have regulations regarding consumer meter testing, and Salem could consider the PUC regulations as guidelines when establishing its own program in the future. These regulations can be found at "PART Puc 605 METER ACCURACY AND TESTING" (http://www.puc.nh.gov/Regulatory/Rules/puc600.pdf).

Of particular interest in the regulations is Table 6.5.2, which establishes the following meter testing frequency:

Meter Size (inches)	Maximum Frequency Between Tests
5/8 and ¾	10 years
1 to 2	4 years
3	2 years
4 and 6	1 year

This table can provide an initial guide to Salem. In the long run, if the cost of the testing were to be borne by the Town, Salem could adjust the testing frequency based on the actual efficiency losses measured during the testing, to assure that the testing program is cost-effective. Alternatively, the

Town could consider establishing an ordinance requiring the testing to be funded by the facility owner.

NHDES Administrative Order Compliance

With respect to establishing compliance with the 1996 Administrative Order, further discussions are needed between Salem and NHDES. We recommend that Salem provide NHDES with information on its recent water conservation efforts and future intent, and submit a draft Water Conservation Plan to NHDES. We suggest this "Plan" be a short letter that refers to other documents as needed, rather than providing extensive details and appendices. The Town should then seek an indication from NHDES that such efforts when fully implemented would suffice for issuing a Notice of Compliance for Administrative Order 96-02, at least with respect to Water Conservation issues. Once Salem is assured that its plans will result in lifting of the AO with respect to Water Conservation issues, we recommend that the brief Water Conservation Plan be formally adopted as policy by the Town.

Appendix C

Section 4, Assessment of Water Quality and Treatment (supplements 2008 version)

Section 4 (2013 Update)

Assessment of Water Quality and Treatment

This section of the 2013 Update presents supplementary materials to Section 4 of the 2008 Master Plan.

4.1 Summary of Recommendations from Wright-Pierce

In recent years, the Town has considered a number of capital and operational issues at the Water Treatment Plant (WTP) with the assistance of Wright-Pierce of Portsmouth, New Hampshire. At the request of the Town and as an outgrowth of their recent work, Wright-Pierce has developed several recommended projects for inclusion in this Update Report. They are listed here:

Water Treatment Plant Improvements

- Plant Waste Discharge Management $750,000
- Primary Disinfection $700,000

Chemical Treatment Improvements for Arlington Pond Water

- Bench-Scale Study $15,000
- Initial Implementation $10,000
- Permanent Facilities $40,000

The remaining paragraphs in this section describe these projects, and were provided in their entirety by Mr. Christopher M. Silke, P.E., Senior Project Engineer with Wright-Pierce. Mr. Silke also noted that the projects should be prioritized as follows:

- First priority: Plant Waste Discharge Management
- Second priority: Chemical Treatment Improvements for Arlington Pond Water
- Third priority: Primary Disinfection

4.2 Water Treatment Plant Improvements

Background

With the assistance from Salem Water Plant Operations staff, Wright-Pierce has identified two treatment process impediments that impart strain on the plant's ability to meet the daily water production needs of the Town under two scenarios that occur each year. One of the events transpires when customers exert a maximum daily water demand during the warm/dry weather months. Filters and clarifiers experience near design capacity loading, thus shortening the run times. Filter wash water is drawn from the plant's clearwell, and more-frequent cycles cause the clearwell level to fall, dramatically lowering CT inactivation of microbes and disrupting the process control of equipment. The basin where waste is discharged becomes overfilled, forcing Operators to take a Microfloc treatment unit offline until the waste/supernatant pumps have reduced volume for acceptance.

Seasonally, the Town must switch source water withdrawals from Canobie Lake to Arlington Pond. The inorganic and organic chemistry of Arlington Pond is considerably different than Canobie Lake. Turbidity can be two times that of Canobie Lake and the color is higher. Total organic carbon and specific UV absorbance indicate that Natural Organic Matter controls coagulation, prompting Operators to add a greater dose of alum to the raw water supply. Particulate loading on the clarifiers and filters in turn causes the same treatment process problems stated previously.

Another treatment issue associated with the transfer of water from Arlington Pond is pH variability. Plant records document pH swings from the mid 6s to mid 8s. The underlying reason for pH oscillation is raw water coming in contact with the transmission pipe cement mortar lining. When the water sits idle for several hours in the pipe, the problem is exacerbated in terms of controlling coagulation.

The two projects below would lower the risk of a non-compliance event, overdraft of clearwell volume, recycle settled waste more efficiently, and restore plant design capacity. Recovering waste discharge into the basin would substantially trim the disposal costs to the Greater Lawrence Sanitary District (GLSD).

Plant Waste Discharge Management

The waste discharge project will commit Town capital to recover 80% or more of the water collected from clarifier flushes and filter wash/rinse cycles. Upwards to 13% of the total water treatment plant throughput is wasted each day and discharged to the sanitary sewer. The existing recycle pumps and tank volume are drastically undersized to manage the waste stream efficiently. When the Town draws water from Arlington Pond, working pressure generated by the raw water pumps reportedly exceeds the supernatant pump's impeller curve, resulting in little to no flow. The Town spends almost $90,000 annually to discharge the plant waste volume to GLSD. The proposed budget for engineering and constructing additional waste basin capacity, pumps, controls, etc. is $750,000.

Primary Disinfection

Downstream of the Microfloc treatment units is a serpentine clearwell that stores water for primary disinfection, filter wash supply and high lift pumping purposes. The clearwell is subject to large draws of filter wash water while trying to sustain adequate time for chlorine to be in contact with the water prior to the distribution system. Plant operations are greatly impacted by the clearwell volume deficit or level limits imposed in the controls system so the Town does not operate in violation. At times, treatment units have to sit on standby waiting for the clearwell to fill. Trying to maintain a constant level in the clearwell has caused the finished water pumps to continually ramp up and down, building line pressure and likely contributing to water main breaks. The proposed engineering and construction budget for increasing clearwell volume capacity is $700,000.

4.3 Chemical Treatment Improvements for Arlington Pond Water

Background

The Town of Salem is obligated to draw source water from Arlington Pond starting in late October through April each year. Rotation from Canobie Lake to Arlington Pond has proven to be a formidable challenge for Water Operators. Approximately 4.1 miles of 24-inch diameter cement-lined ductile iron transmission pipe connects the raw water pumping station to the treatment plant. At an average daily flow of 2.0 mgd for the low water demand period (October – April), raw water has a detention time of

over six (6) hours in the transmission pipe, assuming a plug flow hydraulic condition. Combining the extended water transit time with intermittent plant operations as tank levels reach their high shutdown more frequently in late fall through spring, water that is moderately aggressive will tend to dissolve the cement mortar, pushing the pH and alkalinity higher as witnessed by the Operations Log. The pH ranges from 6.40 to 7.20 with the treatment plant online. Start-up pH has not been monitored.

The pH variability greatly impacts coagulated floc formation and turbidity/total organic carbon/color removal. Before switching the supply over to Arlington Pond, Water Operators have implemented a protocol of back-flushing the lengthy transmission pipe to purge settled sediments and aged water. Typically, it takes several days of sustained plant operations to steady the pH entering Salem's Water Treatment Plant. Relining the ductile iron pipe with a non-corrosive, NSF Standard 61, material would be very costly.

Monitoring and Treatment Strategies

Bench-Scale Study

The Town should add an online pH analyzer at both the Arlington Pond Pump Station and internal to the treatment plant on the raw water entering the facility. Adding alkalinity to buffer the pond pH would hamper TOC removal. There are two chemical corrosion inhibitor treatment strategies that Salem could trial on a bench-scale prior to actual deployment of an additive at the Arlington Pond Pump Station. Small-scale testing would call for a cut length of small diameter (say 6-inch) ductile iron cement-lined pipe capped on each end, with water supplied into the pipe via tubing and discharged on the opposite end through a regulating valve. The approximate flow of Arlington Pond water through the pipe would be 250 to 300 mL/min for 6 hours of transit time. An NSF-approved reactive phosphate and sodium silicate chemical would be selected for the trials. Varying dosages of each chemical would be applied to assess their ability for preventing dissolution of the pipe's cement mortar lining. If the pH is found to be stable, discharged water would be collected for jar testing of the primary coagulant. A phosphate or silicate residual is likely to raise the coagulant dose requirement slightly. The time for floc formation, morphology, filterability of floc and water quality parameters (aluminum, turbidity, TOC and color) would be evaluated through the jar testing protocol. If small-scale testing proves a corrosion inhibitor to be effective strategy for Arlington Pond pH control, a chemical additive application would then be filed with NHDES. This study could be performed under a budget of $15,000.

Initial Implementation

Before committing permanent chemical facility funds into the Arlington Pond Pump Station, Salem may want to attempt a barrel feed and pump arrangement for the onset of full-scale inhibitor addition. Palletized containment, power and a 4-20 mA signal from a raw water flow meter would be necessary. Applicable Personal Protective Equipment and bottle eye wash station for handling the chemical would require purchase as well. There is adequate floor space at the pump station for storing two (2) barrels of inhibitor chemical. The Town should budget $10,000 for construction and technical support.

Permanent Facilities

Permanent chemical storage and feed facilities would include a partitioned room with containment, ventilation, heat and drench shower. An estimated project budget of $40,000 is recommended for long-term chemical storage and feed of an inhibitor.

Appendix D

Section 5, Analysis of Existing Distribution System (supplements 2008 version)

Section 5 (2013 Update)

Analysis of Existing Distribution System

Section 5 of the 2008 Master Plan presented a detailed analysis of the existing water distribution system, including water mains, pumping stations, and storage tanks.

Some aspects of that work which have not been updated for this 2013 report include the following:

- The storage volume available in the Town's three water storage tanks was considered adequate in the 2008 Master Plan. There is no need to reconsider that conclusion at this time.
- Performance of the water distribution system with respect to ISO fire flows was assessed. Several projects were identified. Since the time of the 2008 Master Plan, ISO has not conducted another fire flow survey, so there is no update of the hydraulic assessment in this 2013 report.

Other aspects of the 2008 distribution system analysis, however, need updating:

- Two potential projects to improve pumping capacity were identified in Section 5.4, one at the WTP's finished water pumps and one at the Manor Parkway Booster Station. This work has not been done to date, but preliminary design efforts have proceeded on the latter project.
- The Town has addressed a number of piping system improvements that were listed in Section 5.6 of the 2008 Master Plan, while others remain to be completed.
- Section 5.7 of the 2008 Master Plan addressed the condition of the water storage tanks. The Town has constructed some tank-related improvements since 2008, while some work related to the storage tanks remains to be addressed.

This 2013 Update addresses the current status and future needs for pumping improvements, piping system improvements, and storage tank improvements. We have elected to do this by preparing new versions of Sections 5.4, 5.6 and 5.7. We have retained those section designations below, to make it clear that these new versions are intended to supplement those particular parts of the 2008 Master Plan.

5.4 Pumping System Capacity

The raw and finished water WTP pumps do not have sufficient capacity to meet NHDES regulations, for reasons discussed in the 2008 Master Plan. Therefore, a project to address this issue is carried in Section 11 of this Update Report. As noted in the 2008 Master Plan, detailed evaluation of the existing pumps, clearwell, and available space would be needed to develop a specific project and cost.

The deficiencies of the Manor Parkway Booster Station were the subject of an August 2012 preliminary design report by Underwood Engineers of Portsmouth, NH. This report is excerpted in Appendix G. The two primary features of their recommended project are:

- Replacement of all pumps in the Manor Parkway Booster Station.
- New fire pumping station at Commercial Drive.

Underwood's recommended budget for the project was $1,614,000.

Following receipt of the August 2012 report, Salem determined to carry the engineering of part of the project in 2013, and construction of part of the project in 2014, as is listed in the current version of the Town's overall Capital Improvement Plan (CIP). Subsequently, however, it was decided not to fund the project in the 2013 budget. Because this project is needed to rectify a current deficiency affecting public safety, we have carried the project in 2014 and 2015 of this report's CIP (see Section 11), without modifying the costs as listed in the Town's current overall CIP. These costs were $115,000 for engineering and $1,100,000 for construction, which does not add up to Underwood's recommended budget. We recommend that the cost and schedule for completing the rest of the project be considered in the near future, and have mentioned this need in Section 11 of this Update Report.

5.6 Other Piping System Issues

The 2008 Water Master Plan included a list of known distribution system problems that the Town (specifically, Distribution Foreman Glenn Burton) maintained. The Town prioritized the issues into four tiers and identified the necessary corrective measures. CDM Smith provided a cost estimate for each project as part of the 2008 report. The piping issues that were addressed included:

- **Abandoning old parallel mains**
  Salem has a number of instances where old unlined cast iron pipe was kept in service, even after a newer, larger-diameter main was placed in the same street. In many cases, there are still service connections, hydrants, and/or side street mains connected to the old main instead of the newer one. Unlined cast iron mains can be sources of leakage, breakage, and impaired water quality. Their internal diameter is typically reduced by tuberculation (formation of iron hydroxide deposits), such that their hydraulic capacity may be very limited. In two cases, Salem operates bleeders (continuous waste of water) to control the water quality in these mains. Such mains are candidates to be abandoned, with their service connections, hydrants, and side-street connections switched over to newer mains.

- **Replacing other old mains**
  Salem has other old unlined cast iron pipe which is still in service, but for which there is no parallel newer main. These can be replaced with new mains to eliminate the issues described above that are associated with unlined cast iron mains.

- **Eliminating undersized mains**
  Salem has several 4-inch mains in small residential areas. Mains of this size cannot provide any significant fire flows. Improved service results from replacing these undersized mains. Typically this is done with an 8-inch main to assure proper residential fire protection, although in some cases a 6-inch main may suffice.

- **Accessibility**
  Some old Salem mains are located in easements and/or at depths that make them almost inaccessible. Water mains should be in public rights-of-way or in dedicated and accessible easements, and should be buried at proper depths, to allow for long-term maintenance. Old mains in this situation can be abandoned and replaced with new mains in proper locations at conventional depths.

- **Looping projects**
  All water systems have some dead-end mains. It is desirable, however, to minimize dead-end mains where possible. Dead-end mains can be associated with water quality deterioration. Looped mains generally improve water quality by providing better circulation, which also boosts available fire flows. Several locations in Salem appear to be candidates for looping projects which would eliminate dead-end mains.

As part of this update, CDM Smith met with Mr. Burton. We reviewed the project list and noted progress and changes. An updated Table 5-5 shows the new list of recommended projects. Of the 34 projects in the 2008 table, the Town has completed 11, and 23 remain as recommended improvements. Some of the remaining projects, although not complete, have advanced since 2008 and are pending construction funding or in design phases. A newly added Table 5-6 summarizes the projects from the 2008 list that have been completed. An updated Figure 5-2 identifies each remaining and completed project.

5.6.1 Updated Costs

CDM Smith re-evaluated the estimated construction costs for the remaining projects. This Master Plan update maintained the cost assumptions in the 2008 report which were based on 2010 dollars, but increased the unit costs for new pipe based by a percentage based on the four-year (2008-2012) change in the ENR Index (Table 5-7) to represent 2014 dollars. The cost assumptions included:

- Projects will be contracted out rather than constructed by Town staff.
- 5-foot of cover in paved roadways, with trench paving included.
- No rock or unsuitable materials.
- Restrained-joint, ductile-iron pipe to be utilized.
- New Hampshire labor rates.
- Hydrant assemblies every 500 feet, mainline or same-size sideline valves every 1,000 feet, and 15 services per 1,000 feet.
- Prices include all contractor indirect costs, and a 25% construction contingency.
- Engineering assumed to be by Town staff, thus costs not included.

Table 5-7 Updated Unit Pipe Costs

Pipe Diameter	Unit Cost
8”	$174/ft
10”	$190/ft
12”	$212/ft
16”	$271/ft

These unit costs are only intended as a general guide. Each project should be examined for site-specific factors that could require a larger budget. We also note that, for projects already included in the Town’s Capital Improvement Program, the actual CIP cost is listed in Table 5-5.

Table 5-5
DPW List of Piping System Improvements

Project No.[1]	Status	Street	Location	Problem	Required action	Budget[2]
First Tier - Highest Priority						
1-1	Recommended	North Main St	Main St to Bluff St	Unlined, redundant, blow off running	Connect 40 services to 16" main, abandon 6"	$152,000
1-4[3]	Recommended	North Policy St	WTP to North Policy St.	Inadequate discharge connections	New 16" WTP discharge to improve reliability in emergency situations	$723,000
1-5[3,4]	Privately Funded	Hampshire Rd	RR Xing to 300' into Methuen	Unlined, blow off running	Connect customers to Methuen Water Dept, abandon 6", as part of development	$107,000
Second Tier						
2-2	Designed (not funded)	Haigh Ave	at Streeter	No interconnection, poor flow, stagnation	Install <100' of 6" to connect dead ends	$17,000
2-3[3]	In Design	Pond St	Lawrence Rd to Sandhill	Unlined, poor condition, undersized	Replace existing 6" with 1,600' of new 8"	$392,000
2-4[3]	Recommended	Spicket Hill Tank	Cross-country	Flow restrictions to storage tank	Install 1,800' of 12" main from tank to Nirvana Dr. (needs hydraulic evaluation)	$496,000
2-5	In Design	South Broadway	469 S B'way to 300 Lawrence Rd	Unlined, poor condition, cross country	Connect 5- 3/4", 1- 1 1/2", 1- 2" and 1- 8" services over to existing 12" mains	$34,000
Third Tier						
3-1[3]	In design	Main St	N Policy to Sullivan Ave	Unlined, redundant	Connect 8 services to 12" main, abandon 6"	$37,000
3-2[3]	Recommended	North Policy St	St. Mary's to Veronica Ave.	Poor condition, undersized	Install 4,400' of 16" main	$1,382,000
3-3[3]	Recommended	Old Rockingham Rd	12" thru back yards	Stagnation, no access to piping through back yards, under decks, etc.	Install 5 services to main on Old Rock Rd, can couple with Catherine, Joseph, Helen problem	$25,000
3-4	Recommended	Old Rockingham Rd	At Therese, at Helen, at Joseph	No interconnection, poor flow, stagnation	Phone duct conflict, needs complicated plan	$239,000
3-5	Recommended	Howard St	Charles St to Franklin St	Unlined, poor condition, undersized, needed to replace 1922 cross-country line	Replace existing lines with est. 675' of 12" main	$101,000
3-8[3]	Recommended	MacLaughlin Ave	North Main St to Oak Ave	Unlined, poor condition, undersized	Remove and replace existing 6" with est 750 of 8"	$151,000
3-9[3]	Recommended	Point A Rd	South Policy St to Fairmont Rd	Unlined, redundant	Connect 2 services to 16" main and remove 6" from service	$10,000
Fourth Tier						
4-1	Recommended	Brady Ave	Cortland to #71 Brady Ave	Unlined, undersized	Replace with est. 3000' of 12" main	$636,000
4-2	Recommended	Old Rockingham Rd	St. Mary's to Range Rd	Poor condition, undersized	Replace with est. 3000' of 12" main	$636,000
4-4[3]	In Design	Pond St	Sand Hill to Copper Beech	Unlined, poor condition, undersized	Remove and replace existing 4" with est. 1800' of new 8"	$362,000
4-7	Recommended	Lake St	Millville to Easy	Poor condition, undersized	Remove and replace existing 6" with est 2200' of new 12" main	$466,000
4-8	Recommended	Veterans Parkway	Senior center to Freedom Dr	Dead ends, service interruptions, flows	Install est 1750' of 12" main to connect dead ends	$371,000
4-9	Recommended	Geremonty Dr	Court House to Veterans Pkwy	Dead ends, service interruptions, flows	Install est 1000' of 12" main to connect dead ends	$212,000
4-11	Recommended	Azarian Rd	to Future Rd connection	Single feed to area, dead end, flow	Require connection as part of subdivision approval of lot 135-8944 as part of future development	Privately Funded
4-12	Recommended	Stone Post Rd	Jana Connection	Cross country feed	Install est 500' of 8" to connect to Jana, remove cross-country feed from service	$87,000
4-13[3]	Recommended	Fairmont Rd	South Policy to end	Unlined, poor condition, undersized	Remove and replace existing 6" with est 250' of new 8"	$60,000
Other Water System Improvements						
U-1	Recommended	93 Rest Stop	Meredith Rd to Rest Stop	Undersized	Replace 4" main with new 8"	$86,000
U-2	Recommended	Alexander Ave and Beverly Ave	Beverly Ave to 14 Alexander Ave	Undersized	Replace 4" main with new 8"	$167,000
U-3	Recommended	Clifton Ave	Millville St to Dyer Ave	Undersized	Replace 4" main with new 8"	$178,000
U-4	Recommended	Crestwood Cir	Green Acre Dr to Marie Ave	Undersized	Replace 4" main with new 8"	$51,000
U-5	Recommended	Green Ave	Haigh Ave to Baron Ave	Undersized	Replace 4" main with new 8"	$106,000
U-6	Recommended	Hampshire Rd	State Border Into Methuen	Undersized	Replace 4" main with new 8"	$74,000
U-7	Recommended	Jennings Rd	N Main St to End	Undersized	Replace 4" main with new 8" as part of future development	$106,000
U-8	Recommended	Linwood Ave	Lawrence Rd to Eleanor St	Undersized	Replace 4" main with new 8"	$381,000
U-9	Recommended	Ansel St, Messer Ave, and Otis Ave	Baldwin St to Ansel St	Undersized	Replace 4" main with new 8"	$171,000
U-10	Recommended	Robert Ave	Dawson Ave to Highland Ave	Undersized	Replace 4" main with new 8"	$163,000
U-11	Recommended	Summer St	Millville St to Morrison Ave	Undersized	Replace 4" main with new 8"	$177,000
Other-1	Recommended	Brookdale/Cross-Country	Northeastern Blvd to Industrial Way	Connect Manor Parkway high service zone to N. Policy Street	Install New 12" Main	$770,000
Other-2	Recommended	Cross-country	Between N Broadway and Howard St	Abandon cross country pipe	Abandon 12" Main	$10,000
Other -3[3,5]	Recommended	North Policy Street	WTP to Old Rockingham Road	Install redundant line	New 16" Main	$1,300,000

1. Project numbers are consistent with the 2008 Water Master Plan report. Priorities were determined by DPW using the following factors weighted in order:
   1: effect on operating cost
   2: risk of failure and severity of impact on operations
   3: fire flows
   4: water quality
   5: overall customer benefit
2. Budget estimates provided by CDM Smith, unless otherwise noted (see Note 3)
3. Project budget from 2013-2017 CIP, provided by the Town.
4. Project will potentially be funded through private development, but currently the 2013-2017 CIP is carrying $107,000 as shown.
5. Project is mislabeled as Project 1-3 in the 2013-2017 CIP. Project 1-3 from the 2008 Water Master Plan has been completed (see Table 5-6).

Table 5-6
DPW Piping System Improvements, Completed 2008 - 2012

Project No.[1]	Street	Location	Problem	Completed Action
1-2	Main St	School St to N Main St	Unlined, redundant, blow off running	Connect 15 services to 16" main, abandon 6"
1-3	North Policy St	Pump Station Rd to St. Mary's	Poor condition, undersized	Replace with est. 300' of 16" main
1-6	St. Mary's Ln	North Policy to Old Rockingham Rd	Redundant, 4 mains connected to 1890 12", 9' deep.	Connect 12 services to new mains. Connect new 12" directly to new 16"
2-1	Spencer Ave	at Joyce Heard Ave	No interconnection, poor flow, stagnation	Install <100' of 6" to connect dead ends
2-6	Willow St	All	Unlined, poor condition, undersized	Remove and replace existing 6" with est 350' of 8"
3-6	Taylor St	Lee Joy Lane to Howard St	Needed to replace 1922 cross-country line, dead ends, improve flow, bypass Depot	Install est. 400' of 12" main
3-7	Cluff Crossing Rd	S Broadway to Lancelot Ct	Unlined, redundant	Connect exist services over to 16" main (1-3/4", 1-2", 2-6" add 3 hydrants)
4-3	Franklin St	Howard St to Millville St	Unlined, poor condition	Remove and replace est. 1100' of existing 6" with new 8"
4-5	Lawrence Rd	Senter to S Broadway	Unlined, redundant	Connect 21 3/4" services and 1 4" service to 12" main, abandon existing 6"
4-6	South Broadway	Lawrence Rd to Mass. Line	Unlined, poor condition, undersized	Remove and replace existing 6" with est. 700' of new 8" (6, 3/4" services,1, 8" service)
4-10	Geremonty Dr	Main St to Meisner Dr	Dead ends, service interruptions, flows	Install est 500' of 8" main to connect dead ends

1. Project numbers are consistent with the 2008 Water Master Plan report.

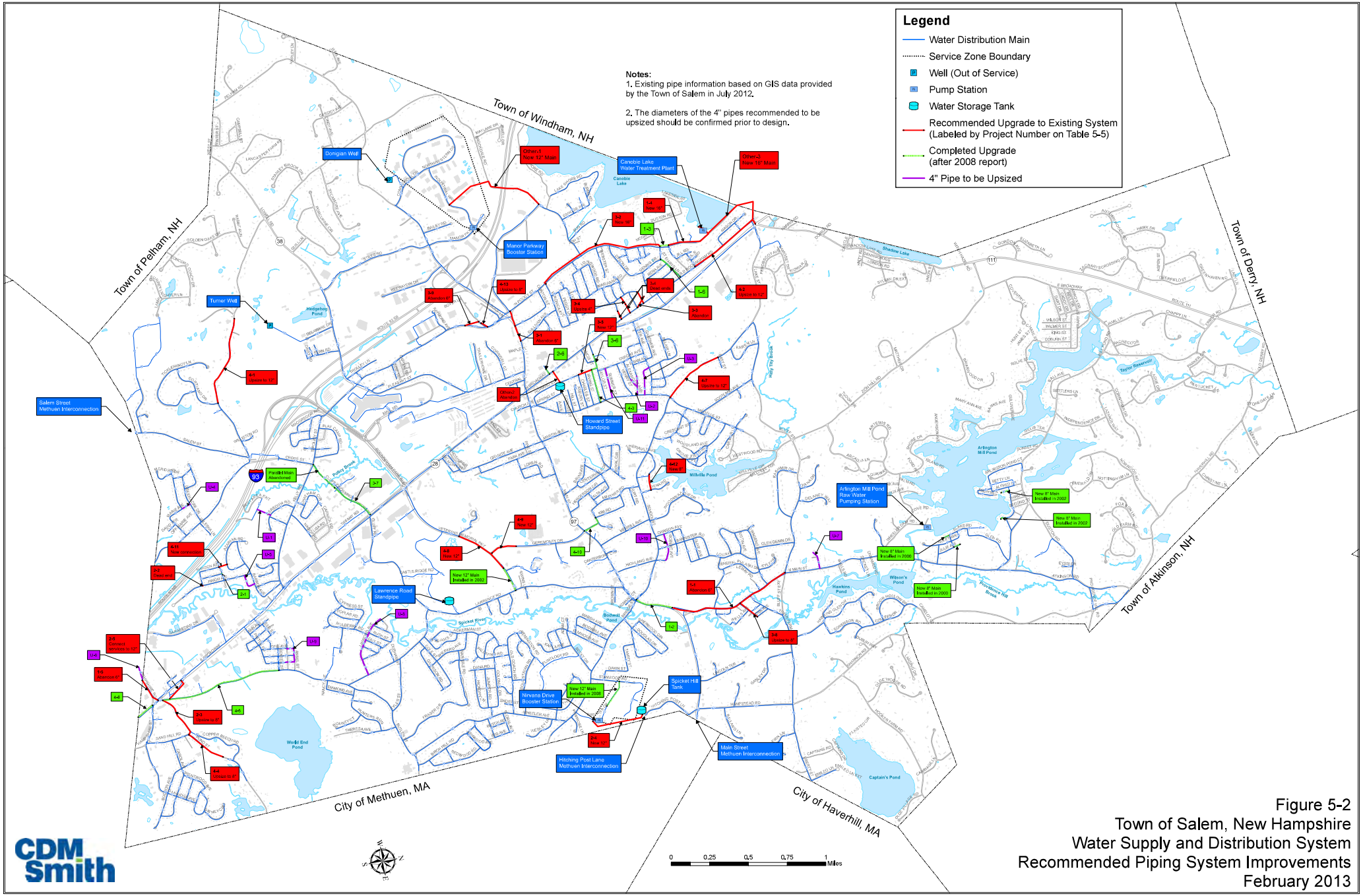


Figure 5-2
Town of Salem, New Hampshire
Water Supply and Distribution System
Recommended Piping System Improvements
February 2013

5.6.2 Additional 4-inch Main Replacement

As previously mentioned, the Town has numerous 4-inch mains in the system and many cannot provide adequate fire flow; however, each main has to be investigated on a case-by-case basis. The Town has intentionally installed some of the 4-inch mains on short dead end lines in order to minimize water age and remove the need for a fire hydrant at the end for flushing. On these lines, the Town installed 2" flushing blow offs. Table 5-5 lists areas that should be investigated for upsizing 4-inch mains. Diameters of the mains should be confirmed prior to proceeding into design phases as some may be incorrectly labeled as 4 inches. These mains are also identified on Figure 5-2.

5.7 Condition of Water Tanks

The 2008 Master Plan reviewed inspections conducted on all three water tanks in 2007. The recommendations at that time can be briefly summarized as follows:

- Howard Street Standpipe: Complete recoating, both inside and outside.
- Lawrence Road Standpipe: No immediate needs.
- Spicket Hill Tank: No immediate needs.
- Next inspections to be within five years of the 2007 inspection or of subsequent work, in accordance AWWA Standard G200 which requires "comprehensive (3-5 years) inspections", and NHDES regulations which require inspection of tank interiors at least every five years (Env-Ws 361.08).

Since 2008, the Town has performed the following work on the tanks:

- Howard Street Standpipe: In 2011, a Tideflex passive mixing system was installed inside the tank, and the tank interior was recoated. The cathodic protection system was removed and will not be replaced. The most recent interior inspection took place on April 17, 2012, by a remotely-operated vehicle (ROV), and was summarized in a report by Utility Service Co. Inc. The tank interior was generally in excellent condition, but several minor areas of corrosion were recommended for repair under the warranty clause of the recoating contract. The most significant such areas were on the mixing system brackets. The recommended repair work was completed in summer 2012. The absence of a screen or flap valve on the overflow pipe was noted in the report. No work has been performed on the tank exterior since the 2008 Master Plan.
- Lawrence Road Standpipe: In 2011, a Tideflex passive mixing system was installed inside the tank, and the tank interior received spot recoating. The most recent interior inspection took place on April 17, 2012, by a remotely-operated vehicle (ROV), and was summarized in a report by Utility Service Co. Inc. The tank inspector noted a few localized areas of corrosion on the shell, and rust on the mixing system brackets. The repair work was completed in summer 2012.
- Spicket Hill Tank: DPW indicated the tank was inspected in 2012 and was in good condition, and does not need a mixing system.

The following work is recommended, and these items are carried forward in Section 11 of this Update Report:

- Howard Street Standpipe: The previously-recommended exterior recoating should be performed as soon as possible. The current Salem overall CIP lists this project for 2015 with a budget of $450,000. The next interior inspection should be scheduled for 2017.
- Lawrence Road Standpipe: The next interior and exterior inspection should be scheduled for no later than 2017.
- Spicket Hill Tank: The next interior and exterior inspection should be scheduled for no later than 2017.

Appendix E

Section 8, Supply Source Issues (supplements 2008 version)

Section 8 (2013 Update)

Supply Source Issues

This section of the 2013 Update presents supplementary materials to Section 8 of the 2008 Master Plan. The following subjects are addressed:

- Abandonment of two former groundwater supply stations
- Other groundwater resources
- Chloramination at Methuen interconnection

8.1 Well Station Abandonment

The Town is pursuing abandonment of the former groundwater supplies, and requested that the Master Plan include a project and budget for this work.

8.1.1 Donigian Well Pumping Station

The Donigian Well Pumping Station is located off Commercial Drive in southwestern Salem.

A grassy access drive extends to the station. The station is a 20x12-foot concrete building, with slab-on-grade construction, and is currently overgrown with vegetation. The thickness of the slab is unknown. The well itself is not in the building but is reportedly in a nearby manhole. The well is reportedly a 6.5-inch diameter, 325-foot deep bedrock well with a 200-gpm, 50-hp pump.

Donigian Well Station

Electric power is no longer available at the station, but power lines once extended from Commercial Drive to the station, and the six poles are still standing. A few inactive wires are attached to some of the poles.

The station contains various mechanical piping and valves, electrical panels, and a chemical feed pump. None of this equipment has been utilized in many years. There is currently no chemical storage in the station, and the facility never had standby power.

It is not known whether either lead or asbestos is present in the station. We have assumed that the mechanical piping is coating with lead-bearing paint, and that the electrical switches and/or panels have some asbestos-containing components. There are, however, no floor tiles or ceiling panels in the station that could contain asbestos.

The following work is needed to demolish the station. The work can all be done by a general contractor except for the work noted as being done by the Licensed Well Driller, and except for dealing with any lead and asbestos in the station.

- Install siltation controls to protect wetlands adjacent to the station.
- Remove and dispose of the pump and motor through the manhole opening.
- Fill well with cement-bentonite grout, which is Portland cement with about 6% bentonite clay mixed in. This work must be done by a NH-Licensed Well Driller, who will also pull the pump and motor per the item above.
- Remove and dispose of manhole cover, frame, and the concrete itself that is above ground level. Fill with sand.
- Excavate the existing water main immediately outside the station, cut the main, and plug the downstream end with a restrained-joint cap, surrounded by a concrete thrust block. Repeat process where the access drive leaves the main road.
- Remove gate box and cover after closing the gate valve. Two valves are assumed.
- Remove and dispose of building and contents, including allowance for lead and asbestos handling as described above.
- Break up and remove concrete slab foundation. Grade the station area level.
- Remove and dispose of six electric poles.

The station may contain lead-based paint.

Any transformers that need to be removed should first be checked for hazardous materials.

Assuming that the work would be performed under a single construction contract, we recommend a budget of $75,000. This includes a construction contingency but does not include engineering. DPW has also reported that there is a possibility the station could instead be bought by a developer.

8.1.2 Turner Well Pumping Station

The Turner Well Station is located off Delaware Drive in southwestern Salem. This facility was turned over to the landowner in early 2013, and is no longer a municipal water system facility.

8.2 Other Groundwater Resources

Section 8.2 of the 2008 Master Plan briefly reviewed the 1996 and 2003 groundwater resource evaluations conducted by SEA for the Town. It did not appear likely that a high-capacity (1.0 mgd or more) groundwater source could be located.

In recent discussions, DPW has noted that there may be a possibility of smaller-capacity groundwater sources that could be of some benefit to Salem. Examples of possible interest may include:

- A small well located along the Arlington Pond raw water transfer line, whose yield could be added to the surface water being transferred. The possible improvement of overall raw water quality resulting from such an action could be reviewed.
- A small conventional well or possibly an angle well at Arlington Pond, which could be utilized to withdraw Arlington Pond water for transfer to the WTP or, possibly, to Canobie Lake.

The second option above, plus two other options, were mentioned in Section 8.3 of the 2008 Master Plan as potential means to improve the quality of water being discharged to Canobie Lake and thus to mitigate some of the concerns raised in the Town's longstanding attempt to secure permissions for such a discharge.

CDM Smith concurs that it is always possible to do additional groundwater testing to attempt to locate more resources, particularly if smaller-capacity sources would have some value. The geology of New England's unconsolidated deposits and the geology of the underlying bedrock are both highly variable over short distances. This means that it is very difficult to say with certainty that no additional groundwater resources are available.

Whether the costs of such testing efforts would be warranted depends in part upon:

- The amount of water supply to be saved by improving the efficiency of the WTP waste handling, as discussed in Section 4, and how this changes the overall supply/demand status for Salem.
- The degree to which the Arlington Pond water conditioning project proposed in Section 4 of this report mitigates the treatment process problems at the WTP.
- The degree to which the Town wishes to avoid the need to purchase Methuen water during emergencies or droughts.

We suggest that DPW consider the potential benefits of additional groundwater testing further as the upcoming projects listed in Section 4 proceed, depending upon their results.

8.3 Chloramination at Methuen Interconnection

The Town maintains the ability to purchase water from Methuen, especially at the interconnection located near the Spicket Hill tank. Methuen water is chlorinated, while Salem water is chloraminated. The Town has a degree of concern regarding potential water quality disruptions from the mixing of the two differently-treated source waters in the Salem distribution system, and plans to construct a chemical feed station at the interconnection to enhance chemical compatibility.

The station would have the ability to add chlorine and ammonium sulfate, and also to adjust pH. In March 2011, Wright-Pierce provided the Town a cost estimate for engineering and construction of this facility of $182,000.

We note for the Town's reference that Methuen has a very low residual at this location, and is looking at the possibility of booster disinfection at their nearby tank.

Appendix F

Section 11, Capital Improvement Planning (supersedes 2008 version)

Section 11 (2013 Update)

Capital Improvement Planning

This section of the 2013 Update replaces Section 11 of the 2008 Master Plan.

11.1 Introduction

This Water Master Plan update has re-evaluated many of the recommendations from the 2008 report, as discussed in the previous sections. The primary purpose of this section is to collect and summarize recommendations regarding facilities and infrastructure and include them in a single section for the Town's future reference.

This section reviews issues related to the integration of water system work with other Town efforts, such as the roadway improvements program. We offer suggestions on the prioritization of the various improvements to the existing water system that were presented in Section 5 and group the projects in 5-year phases.

11.2 Integration of Water System Work with Other Town Projects

Salem provided CDM Smith with the most recent five-year Capital Improvements Plan (2013 to 2017) and the ten-year road plan (2013 to 2022). The annual budgeting cycle and these planning documents provide opportunities for integration of the needed water system work into the Town's overall financial planning. We offer the following general remarks on this process:

- The ten-year road plan includes numerous roadway projects which will be constructed in areas that also have water system needs. Combining utility projects into a single coordinated program typically results in cost savings for the community, and should be done whenever possible. The Town has expressed a preference for constructing water system projects the year before any scheduled roadway improvements. This schedule allows time for any issues, such as settling, to be resolved prior to paving.

- The key time for coordination of projects is late spring, when the Engineering Department develops recommendations for the Town Manager. Mid-to-late spring is thus the ideal time each year for the Engineering Director, DPW Director, Utilities Manager and others to review overall capital needs associated with Public Works. The 2008 Water System Master Plan and this update provide information that can be utilized for this purpose. The Town is considering future performance of a Sewer Master Plan which, if pursued, would do the same for that utility. The needs of other utilities—such as gas, electric, and communications— should also be factored in during these mid-to-late spring reviews.

- As demonstrated in this update, after some years, a utility plan needs to be re-evaluated. Some projects will have been completed, others deferred, and issues will arise that could not have been anticipated in the original plan. In the short term, this can be done fairly simply. Issues and ideas can be noted throughout the year on hard copies or e-copies of the key maps and

tables in this document, and then reviewed as part of the annual coordination process. In the long term, Town officials may opt for formal updates. Many utilities follow a 15-year cycle for major updates of utility master plans. This cycle includes a "mini-update" at 5-year intervals, such as this update. If Salem wished to continue to follow this philosophy, then the Town should prepare another formal update of the key maps and tables in five years, and then a major update or new Master Plan in ten years.

To facilitate the coordination process, CDM Smith has reviewed the current CIP and roadway improvement plan and created Figure 11-1, which overlays the recommended water system improvements from Section 5 with the other Town improvements.

11.3 Prioritizing Improvements to the Existing Distribution System

The updated Table 5-5 presented DPW's prioritized list of improvements to the existing distribution system. As in the 2008 report, this Section 11 reprioritizes Table 5-5 based on other work scheduled in the Town.

In developing the reprioritization, we considered the following factors:

- All recommended projects in this Section are being grouped into 5-year Phases, as follows:

  Phase 1 – 2013 through 2017

  Phase 2 – 2018 through 2022

  Phase 3 – 2023 through 2027

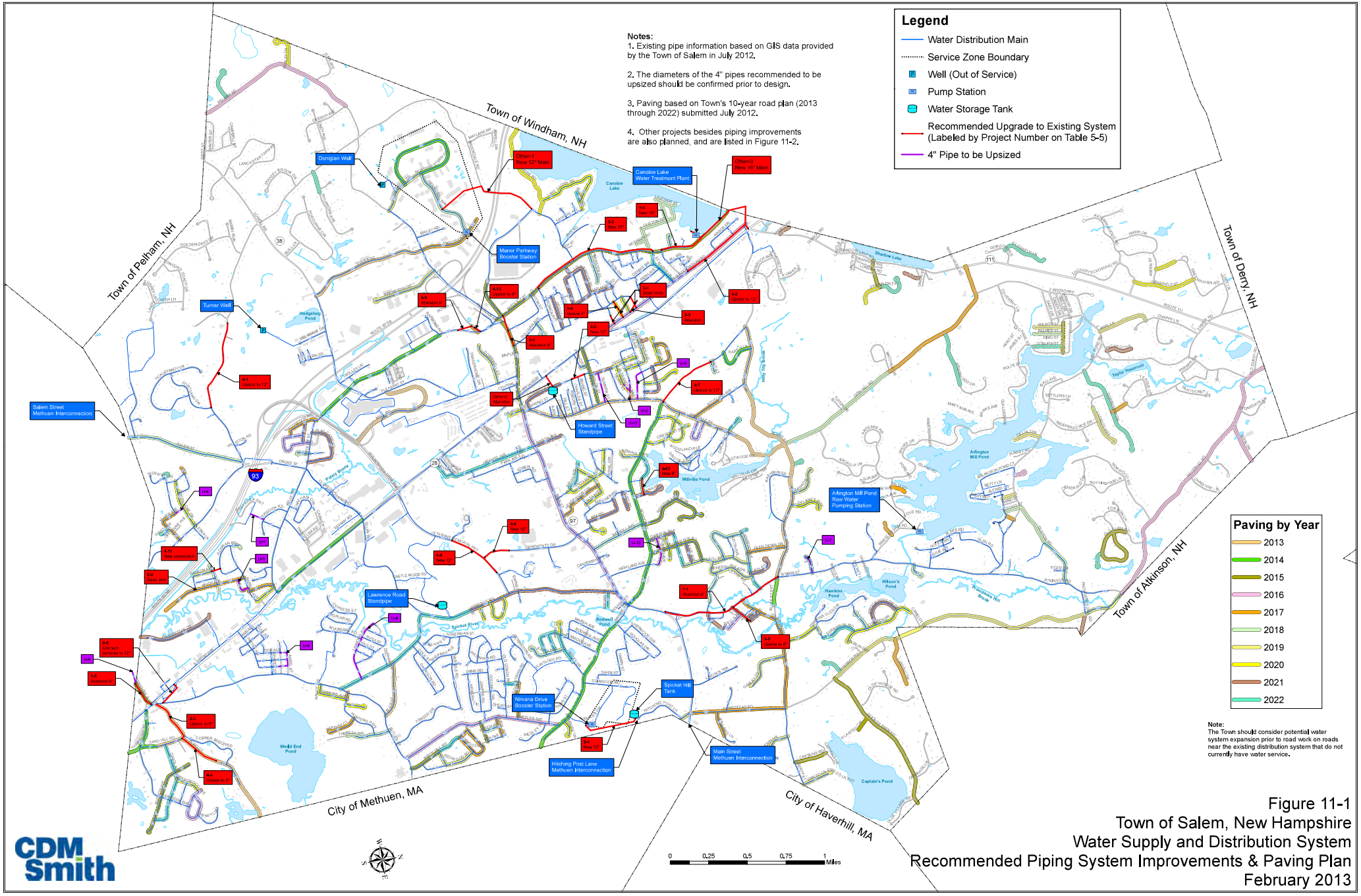
  Phase 4 – 2028 through 2032

- As shown on Figure 11-1, a number of projects on the DPW list correspond to roadway projects that are included in the Town's ten-year road plan. The roadway projects already have an assigned date, and that date was held for the purpose of this Water System Master Plan update. Such projects were slotted into the appropriate phase based on the road project's date.

- In general, water projects in the current CIP were held at their planned date; however, the planned years for the following projects should be or have been reconsidered to coordinate with intersecting road improvements:

  Project 1-4
  The CIP scheduled the installation of the new 16" main on North Policy Street from the water treatment plant to Pumping Station Road in 2013 and the road program has work scheduled in 2015. Based on discussions with DPW, this Master Plan Update schedules Project 1-4 in 2015.

  Project 3-2
  The CIP scheduled the installation of the new 16" main on North Policy Street from St. Mary's to Veronica Avenue in 2013 and the road program has work scheduled in



CDM Smith

Figure 11-1
Town of Salem, New Hampshire
Water Supply and Distribution System
Recommended Piping System Improvements & Paving Plan
February 2013

2015. This Master Plan Update schedules Project 3-2 in 2014 to better coincide with the road plan.

- Most of the projects on Table 5-5 are relatively small-scale water main improvements. Given the magnitude and nature of these projects, CDM Smith assigned all items on this list into either Phase 1 or Phase 2, thereby completely addressing the list of issues on Table 5-5 within a ten-year period.

- An attempt was made to group the projects by geographic location and estimated project cost so as to create viable, cost-effective potential construction contracts.

The resulting reprioritization of Table 5-5 is shown on Table 11-1.

11.4 Water System Capital Improvement Program

Figure 11-2 presents a one-page summary of the overall water system capital improvement program. All facility-related recommendations are listed on this summary figure, and the report section in which they are discussed is identified on the figure. The program elements are grouped into five major categories, as shown on the left-hand side of Figure 11-2.

Water Conservation and Demand Management

Section 3 of this Update Report listed a number of items for the Town's consideration. The larger-cost items are called out in Figure 11-2:

- The ongoing meter replacement program is shown is continuing through 2015, at which time all Salem customer meters will have been upgraded.

- Wright-Pierce has recommended a comprehensive water audit be completed on a 5-year cycle. This work is called out for 2017, in addition to the annual accounting of unmetered water performed by DPW.

- In accordance with current DPW planning, the Town-wide leak detection surveys are listed on a two-year frequency starting in 2014. It should be noted that DPW has also purchased and updated its own leak detection equipment to do localized leak detection with DPW forces, should a problem arise between the town-wide surveys.

Supply Sources

These projects include WTP-related projects identified in Section 4, the abandonment of the Donigian well station discussed in Section 8, the construction of chemical feed improvements on the primary interconnection with Methuen cited in Section 8, and several other items.

Storage Tanks

The poor condition of the exterior of the Howard Street standpipe warrants placing its rehabilitation as a high-priority project. The current CIP includes painting the exterior of the standpipe in 2015, so that date is held in this report. As discussed in Section 5, tank inspections should be carried out at least every five years, and the timing and nature of subsequent rehabilitation projects at all three tanks will depend upon the results of those annual inspections. We assigned the future inspections to be completed at the end of Phase 1 (2017).

Table 11-1
Reprioritized List of Water System Improvements

	Year	Project	Street	Location	Required Action	Project Cost
Phase 1	2013	2-3	Pond St	Lawrence Rd to Sandhill	Replace existing 6" with 1,600' of new 8"	$392,000
	2013	3-8	MacLaughlin Ave	North Main St to Oak Ave	Remove and replace existing 6" with est 750 of 8"	$151,000
	2013	4-4	Pond St	Sand Hill to Copper Beech	Remove and replace existing 4" with est. 1800' of new 8"	$362,000
	2014	3-1	Main St	N Policy to Sullivan Ave	Connect 8 services to 12" main, abandon 6"	$37,000
	2014	3-2	North Policy St	St. Mary's to Veronica Ave.	Install 4,400' of 16" main	$1,382,000
	2014	Other-3	North Policy Street	WTP to Old Rockingham Road	New 16" Main (voted down by BOS)	$1,300,000
	2015?	1-4	North Policy St	WTP to North Policy St	New 16" WTP discharge to improve reliability in emergency situations	$723,000
	2015	2-5	South Broadway	469 S B'way to 300 Lawrence Rd	Connect 5- 3/4", 1- 1 1/2", 1- 2" and 1- 8" services over to existing 12" mains	$34,000
	2015	3-3	Old Rockingham Rd	12" thru back yards	Install 5 services to main on Old Rock Rd, can couple with Catherine, Joseph, Helen problem	$25,000
	2015	4-2	Old Rockingham Rd	St. Mary's to Range Rd	Replace with est. 3000' of 12" main	$636,000
	2016	2-2	Haigh Ave	at Streeter	Install <100' of 6" to connect dead ends	$17,000
	2016	3-9	Point A Rd	South Policy St to Fairmont Rd	Connect 2 services to 16" main and remove 6" from service	$10,000
	2016	4-13	Fairmont Rd	South Policy to end	Remove and replace existing 6" with est 250' of new 8"	$60,000
	2016	U-4	Crestwood Cir	Green Acre Dr to Marie Ave	Replace 4" main with new 8"	$51,000
	2017	2-4	Spicket Hill Tank	Cross-country	Install 1,800' of 12" main from tank to Nirvana Drive (needs hydraulic evaluation)	$496,000
	2017	U-5	Green Ave	Haigh Ave to Baron Ave	Replace 4" main with new 8"	$106,000
					Phase 1 Subtotal:	**$5,782,000**
Phase 2	2018	1-1	North Main St	Main St to Bluff St	Connect 40 services to 16" main, abandon 6"	$152,000
	2018	Other-1	Brookdale/Cross-Country	Northeastern Blvd to Industrial Way	Install New 12" Main	$770,000
	2018	U-10	Robert Ave	Dawson Ave to Highland Ave	Replace 4" main with new 8"	$163,000
	2019	3-4	Old Rockingham Rd	At Therese, at Helen, at Joseph	Phone duct conflict, needs complicated plan	$239,000
	2019	3-5	Howard St	Charles St to Franklin St	Replace existing lines with est. 675' of 12" main	$101,000
	2019	4-1	Brady Ave	Cortland to #71 Brady Ave	Replace with est. 3000' of 12" main	$636,000
	2019	U-2	Alexander Ave and Beverly Ave	Beverly Ave to 14 Alexander Ave	Replace 4" main with new 8"	$167,000
	2019	U-3	Clifton Ave	Millville St to Dyer Ave	Replace 4" main with new 8"	$178,000
	2020	Other-2	Cross-Country	Between N Broadway and Howard St	Abandon 12" Main	$10,000
	2020	U-11	Summer St	Millville St to Morrison Ave	Replace 4" main with new 8"	$177,000
	2021	4-8	Veterans Parkway	Senior center to Freedom Dr	Install est 1750' of 12" main to connect dead ends	$371,000
	2021	4-9	Geremonty Dr	Court House to Veterans Pkwy	Install est 1000' of 12" main to connect dead ends	$212,000
	2021	4-12	Stone Post Rd	Jana Connection	Install est 500' of 8" to connect to Jana, remove cross-country feed from service	$87,000
	2021	U-1	93 Rest Stop	Meredith Rd to Rest Stop	Replace 4" main with new 8"	$86,000
	2021	U-7	Jennings Rd	N Main St to End	Replace 4" main with new 8"	$106,000
	2021	U-9	Ansel St, Messer Ave, and Otis Ave	Baldwin St to Ansel St	Replace 4" main with new 8"	$171,000
	2022	1-5	Hampshire Rd	RR Xing to 300' into Methuen	Connect customers to Methuen Water Dept, abandon 6", as part of future development	$107,000
	2022	4-7	Lake St	Millville to Easy	Remove and replace existing 6" with est 2200' of new 12" main	$466,000
	2022	4-11	Azarian Rd	to Future Rd connection	Require connection as part of future subdivision approval of lot 135-8944	Privately Funded
	2022	U-6	Hampshire Rd	State Border Into Methuen	Replace 4" main with new 8" as part of future development	$74,000
	2022	U-8	Linwood Ave	Lawrence Rd to Eleanor St	Replace 4" main with new 8"	$381,000
					Phase 2 Subtotal:	**$4,654,000**

	Report Section Reference (U=Update)	Phase 1					Phase 2	Phase 3	Phase 4
		2013	2014	2015	2016	2017	2018-2022	2023-2027	2028-2032
WATER CONSERVATION/DEMAND MANAGEMENT									
• Meter Replacement/AMR Program	3.5U	■	■	■					
• Water Audit	3.5U	■	■	■	■	Detailed	(Annual tracking with a detailed water audit report every 5 years.)		
• Leak Detection Survey	3.5U		■		■		Leak detection program every two years		
SUPPLY SOURCES									
• Abandon Donigian Well Station	8.1U		■						
• Continue Efforts with NHDES/EPA for Water Transfer	8.3	■	■						
• Surface Water Protection Plans	2.1		■						
• Consider Other Groundwater Sources (if needed)	8.2U			■					
• Chloramination at Methuen Interconnection	8.3U			■					
• Canobie Raw-water and Finished-water Pump Capacity	2.3, 5.4U		■	■					
• WTP Improvements: Plant Waste Discharge Management	4.2U		■						
• WTP Improvements: Primary Disinfection	4.2U			■					
• Chemical Treatment Improvements for Arlington Pond: Bench-Scale Study	4.3U	■							
• Chemical Treatment Improvements for Arlington Pond: Initial Implementation	4.3U		■						
• Chemical Treatment Improvements for Arlington Pond: Permanent Facilities	4.3U		■						
STORAGE TANKS									
• Howard Street Standpipe Exterior Recoating	5.7U		■						
• Howard Street Standpipe Exterior and Interior Inspection	5.7U					Inspect	(Consider need based on future inspections)		
• Lawrence Road Standpipe Exterior and Interior Inspection	5.7U					Inspect	(Consider need based on future inspections)		
• Spicket Hill Tank Exterior and Interior Inspection	5.7U					Inspect	(Consider need based on future inspections)		
DISTRIBUTION SYSTEM -- EXISTING									
• Valve Maintenance	7.3	■	■	■	■	■	(Annually)	(Annually)	(Annually)
• Hydrant Maintenance	7.4	■	■	■	■	■	(Annually)	(Annually)	(Annually)
• Manor Parkway Booster Station Upgrade	5.4U		■	■					
• New Fire Pumping Station at Commercial Drive	5.4U				■				
• Phase 1 Improvements (see Table 11-1)	5.6U, 11.3U	■	■	■	■	■			
• Phase 2 Improvements (see Table 11-1)	5.6U, 11.3U						■		
DISTRIBUTION SYSTEM -- EXPANSION									
• Phase 1 Expansion	6.4					■			
• Phase 2 Expansion	6.4						■		
• Phase 3 Expansion	6.4							■	
• Phase 4 Expansion	6.4								■

Notes:

1. See Figures 6-2 and 6-3 of 2008 report for maps showing improvements.
2. See Section 11.4 of text for discussion of the overall program.

Figure 11-2
Summary of Capital Improvements Program Planning

Existing Distribution System Improvements

Valve and hydrant maintenance programs are listed first, and should be performed on an annual basis. As noted in Section 7 of the 2008 Master Plan, once the Town has begun to implement systematic maintenance programs for valves and hydrants, it will be possible to estimate the program costs for replacements of hydrants and valves. If significant, such replacement programs can be considered as capital projects in future years. The additional ISO hydrants identified in Section 5.5.3 of the 2008 Master Plan should be included in such projects.

The projects needed to eliminate fire flow deficiencies in the Manor Parkway/Commercial Drive area are cited on Figure 11-2, and were discussed in Section 5.4 herein.

The remaining distribution system improvements from Section 11.3 above are grouped into a Phase 1 and a Phase 2 program. The specific projects and budgets are listed on Table 11-1.

Expansion of the Distribution System

The degree, nature, and timing of system expansion into North Salem or southwest Salem as described in Section 6 of the 2008 report is subject to future policy decisions by the Town. Since the direction and schedule of such efforts over the next 20 years cannot be detailed at this time, Figure 11-2 simply displays the possibility that such efforts could occur in any or all of the four phases. However, the Town should consider system expansion as it pursues its road program. Before constructing any work on roads near the distribution system that do not have water service, the Town should consider whether to coordinate the work with water system expansion.

Figure 11-2 and the tables and maps from which it is derived should be reviewed annually in the spring as part of the Town's annual budgeting and project development process.

Appendix G

Other Documents

- NHDES Administrative Order WSPCD 96-02, February 20, 1996
- NHDES Letter, January 9, 2008, Canobie Lake and Arlington Pond Water Supplies
- NHDES Letter, April 21, 2008, Management of the Salem Drinking Water Sources
- NHDES Letter, December 29, 2010, Status of Administrative Order
- "2012 Water Audit Report", August 2012, Wright-Pierce (Executive Summary only)
- "Preliminary Design of Manor Parkway Pressure Zone Improvements", August 23, 2012, Underwood Engineers (excerpt)

CC 805

State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES
6 Hazen Drive, P.O. Box 95, Concord, NH 03302-0095
603-271-3503 FAX 603-271-2867
TDD Access: Relay NH 1-800-735-2964

Town of Salem
Stephen Daly
33 Geremonty Drive
Salem, NH 03079

Re: Salem Water Department Water System
Salem, NH
EPA # 2051010

ADMINISTRATIVE ORDER
No. WSPCD 96-02

February 20, 1996

A. INTRODUCTION

This Administrative Order is issued by the Department of Environmental Services, Water Supply and Pollution Control Division, to the Town of Salem pursuant to NH RSA 485:4 and NH RSA 485:58.

B. PARTIES

1. The Department of Environmental Services, Water Supply and Pollution Control Division ("DES"), is a duly constituted administrative agency of the State of New Hampshire, having its principal offices at 6 Hazen Drive, Concord, New Hampshire.

2. The Salem Water Department is a municipally-owned water system which has a mailing address through its representative, Stephen Daly, of 33 Geremonty Drive, Salem, NH 03079. Stephen Daly is the designated representative of the Town of Salem for the purposes of water supply issues.

C. STATEMENTS OF FACT AND LAW

1. The Town of Salem is the owner of the water system which serves 6,000 service connections, and an estimated population of 18,000, in the community of Salem, NH ("Water System"). The Water System is a community water system as defined in NH RSA 485:1-a, I and NH Admin. Rule Env-Ws 301.09.

2. NH RSA 485:3 authorizes DES to adopt drinking water rules and primary drinking water standards which are necessary to protect the public health and which shall apply to all public water systems.

3. NH RSA 485:4 authorizes DES to investigate the sanitary conditions and methods pertaining to the source, treatment and distribution of all public water supplies for domestic use, and to require the application of any treatment or improvement in conditions and methods it may deem necessary to insure fitness and safety and adequate protection of the public health.

4. NH Admin. Rule Env-Ws 370.01 requires that the design of public water systems serving more than 1,000 people shall be in accordance with the practices and standards set forth in the 1992 edition of "Recommended Standards for Water Works" committee report of the Great Lakes - Upper Mississippi River Board of State Public Health and Environmental Managers.

5. Part 3.1 of the "Recommended Standards for Water Works" defines a surface water source to include all tributary streams and drainage basins, natural lakes and artificial reservoirs or impoundments above the point of water supply intake.

6. The primary source of drinking water for the Water System is Canobie Lake, located in Salem, N.H.

7. Part 3.1.1 of the "Recommended Standards for Water Works" states that the quantity of water at the source shall:

a. be adequate to meet the maximum projected water demand of the service area as shown by calculations based on the extreme drought of record;
b. provide a reasonable surplus for anticipated growth;
c. be adequate to compensate for all losses such as silting, evaporation, seepage, etc; and
d. be adequate to provide ample water for all other legal users of the source.

8. Based on the "Water System Master Plan" for Salem dated January, 1992, the dependable yield of Canobie Lake is 1.89 million gallons per day (mgd) based on a drought frequency of one in 20 years and depletion of storage of four feet.

9. During the summer and fall of 1995, the Water System routinely drew approximately 1.6 mgd from Canobie Lake. This draw resulted in a steadily declining water level in Canobie Lake and represents a serious water supply deficit.

10. The full lake (spillway) elevation of Canobie Lake is 220.0' MSL. The water supply intake is capable of withdrawing water to elevation 210.0'. The water level on January 10, 1996, was 213.4'.

11. Previous engineering studies have examined the source development options available to the Water System. The "Water System Master Plan", January, 1992, explored use of

the Turner and Donigan wells, development of new well supplies, and purchase of water from Methuen, Mass., Pennichuck Water Works, or Consumers New Hampshire Water Company as future sources to augment the Canobie Lake supply. Currently, the Water System uses the Turner well, Donigan well and water from Methuen to augment the supply from Canobie Lake. Further development of other options is needed to reduce the quantity of water drawn from Canobie Lake.

12. NH Admin. Rule Env-Ws 373.07 requires that a public water system shall not connect more consumer demand than there is source capacity to serve. The peak customer demand shall be measured by the peak day demand averaged over the last three years. The source capacity shall be measured by the cumulative safe yield capacity of each source. The safe yield of the source shall be determined by technical analysis of the source by persons demonstrating skill and experience and using conservative methodologies.

13. Based on the "Water System Master Plan" for Salem, dated January, 1992, the average daily demand and maximum daily demand are 2.13 mgd and 3.53 mgd respectively. Projected average daily demand and maximum daily demand for the year 2005 are 2.60 mgd and 4.30 mgd respectively.

D. DETERMINATION OF VIOLATIONS

1. The Water System has violated NH Admin. Rule Env-Ws 370.01 by using a source that does not provide adequate water to meet the maximum projected water demand of the service area.

2. As Owner of the Water System the Town of Salem is responsible for the violation noted herein.

E. ORDER

Based on the above findings and determinations, DES hereby orders the Town of Salem as follows:

1. Prepare a comprehensive source development and conservation plan which addresses water source options and means to reduce water demand. Submit the report to DES for review and approval by May 1, 1996. Complete a final report incorporating comments from DES no later than 30 days from the receipt of DES comments.

2. Implement the report's recommendations in accordance with a schedule identified in the report and approved by DES.

3. Beginning in March, 1996, submit reports to DES regarding quantity of water used from various sources, the water elevation of Canobie Lake, and the status of the comprehensive plan by the tenth day of each month. These reports shall continue until the recommendations of the comprehensive source development and conservation plan have been implemented.

4. Maintain a moratorium on new water connections until total source capacity exceeds maximum daily water use, and Canobie Lake is restored to elevation 217.0 (3 feet below spillway). This should not be construed as a permanent minimum elevation to be maintained at Canobie Lake. Once the water elevation exceeds 217.0', total source capacity exceeds maximum daily water use, and the Comprehensive Source Development and Conservation Plan is in effect, this administrative order shall terminate and the Comprehensive Source Development and Conservation Plan shall provide the basis for the future management of the Town's municipal water resources including Canobie Lake.

F. APPEAL

If you are aggrieved by this Order, you may appeal to the Water Supply Pollution Control Council. Such appeal must be made to the Council within 30 days of the issuance of the Order.

G. OTHER PROVISIONS

Please address all correspondence to:

Rene Pelletier, Administrator
Department of Environmental Services
Water Supply Engineering Bureau
6 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Please note that NH RSA 485:58 provides for civil and criminal penalties and administrative fines for violation of this statute.

Edward J. Schmidt, P.E., Ph.D.
Director

Robert W. Varney
Commissioner

Certified Mail No: Z 214 232 839

cc: Gretchen Rule, Esq., Enforcement Coordinator
Steven Houran, Esq., NH DOJ
US EPA, Region I
Suzanne Doucette, H.O., Town of Salem

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

January 9, 2008

Jonathan Sistare, Town Manager
Town of Salem
33 Geremonty Drive
Salem, NH 03079

COPY

Subject: **EPA ID 2051010: Salem Water Department**
Canobie Lake and Arlington Pond Water Supplies

Dear Mr. Sistare:

The purpose of this letter is to summarize our meeting on November 16, 2007, at your office and provide comments on the Draft Scope of Services to address water supply issues that was e-mailed to the Department of Environmental Services ("DES") on December 10, 2007, by SEA Consultants, Inc.

The Administrative Order dated February 20, 1996, was issued by DES to address chronically low water levels in Canobie Lake when that body of water served as the sole water supply source for the Salem Water Department. Salem has substantially resolved several items referenced in the Administrative Order except in two significant areas: 1) Drought management and 2) Water conservation. These two items are addressed below in detail.

DROUGHT MANAGEMENT

Proposed Transfer of Water from Arlington Pond to Canobie Lake

The Administrative Order required that a Comprehensive Source Development and Conservation Plan ("Plan") be prepared and implemented. The Plan completed in September 1996, outlined the means by which Salem would expand its supply capability through the use of Arlington Pond and by implementing some water conservation measures along with a drought management plan. Since 1996, the Town has made significant progress by completing the Arlington Pond intake connection. However, the town has been unable to fully implement the drought management plan as proposed, because the plan relies largely on the transfer of water from Arlington Pond to Canobie Lake to maintain an adequate quantity of water in Canobie Lake for the seasons when use of that water body is required. Implementation of the Plan has not been possible due to issues related to existing state surface water quality standards, which currently would not allow the transfer of water from Arlington Pond to Canobie Lake.

The transfer of surface water from one water body to another has been discussed by DES with the Water Quality Standards Advisory Committee ("WQSAC"), an advisory group of stakeholders assisting DES with the revision of state surface water quality standards. In the upcoming months DES will seek the input from WQSAC to assess aspects of the water quality

standards as they pertain to defining "anti-degradation"; as well as the social and economic impact analysis that would occur as part of a transfer request if it is determined that a proposed transfer of water would degrade the water quality of the receiving surface water body. Once DES formally proposes revisions to the surface water quality standards, the proposed rule revisions will be subject to public hearings and a review of the proposed regulations by a legislative committee. The legislative committee can support the rules, object to the rules but allow DES to adopt them, or prohibit DES from adopting the rules and propose legislation to change DES' rulemaking authority relative to certain aspects of the surface water quality standards.

In addition to having to comply with state surface water quality standards, the Town will need to apply for a federal NPDES permit for the transfer of surface water from one water body to another as New Hampshire does not have primacy to administer the NPDES program. It is worth noting that the EPA currently has several federal court cases pending involving the question of whether or not NPDES permits are required for surface water transfers in other states, and the outcome of the current cases and associated appeals could impact the need for an NPDES permit for Salem's proposed transfer.

Enhanced Management of the Spickett River Watershed

At our November 16th meeting, we discussed reinvigorating the effort to develop a Spickett River watershed plan involving multiple interests on the watershed. In this way, the Town may be able to expand the duration of pumping from Arlington Pond directly to the filtration plant. Past water quality monitoring has shown that, although Arlington Pond water is more "flashy" than Canobie Lake, this water has been successfully treated at the plant. Anticipated long-term plant improvements will enhance the plant's capacity to deal with rapid shifts in raw water quality.

Given the size and hydraulics of the watershed, we see real possibilities for all parties to develop cooperative agreements which protect their own interests and the environment. We are confident that a watershed plan can be developed in a manner which is consistent with statutes, regulations and legislatively deeded water rights. As the Town stated to DES, the watershed plan should not only address optimizing water management to support lake recreation, water supply needs and instream environmental needs, but also include communication and management plans for coordinating among stakeholders to manage high flows within the watershed.

DES believes it is critical that the Town pursue enhancing the management of the Spickett River Watershed to meet its water supply needs. Although the regulations for determining "degradation" to surface water quality under future surface water quality standards discussed above cannot be determined at this time, if a surface water transfer were proposed from one water body to another based on social and economic criteria in future regulations, it is unlikely such a transfer could be approved without the Town having analyzed the legal, technical and

financial feasibility of implementing enhanced management efforts in the Spickett River Watershed.

DES is willing to act as a facilitator in the development of the enhanced watershed management plan. DES' role will include identifying stakeholders, coordinating and documenting meetings, identifying designated uses of the water bodies and developing a basic data report that summarizes existing information regarding the watershed. Resources that Salem may need to contribute to the study include: additional data collection, including stream gaging, water quality sampling, watershed modeling, and further assessing instream flow needs.

WATER CONSERVATION

Although the Comprehensive Source Development and Conservation Plan outlines general goals for residential, commercial and industrial water conservation, the Town has not fully implemented a basic water conservation program. Since development of the Plan, the Town has expanded its public outreach and has imposed summer odd/even irrigation schedules. In addition, the Town continues to validate the accuracy of commercial meters and has obtained energy audit services from Energy New England. However, based on the information provided by the Town at our meeting, the Town does not have the residential metering infrastructure or the staffing required to measure unaccounted-for water in the water system. The Town also has not committed resources to maintain a water system leak detection and repair program. If the surface water quality standards/anti-degradation issues discussed above ultimately allow for the transfer of water from Arlington Pond to Canobie Lake, it is likely DES will require that the Town develop, implement and maintain an unaccounted-for water and leak detection and repair program before such transfers would be permitted to occur. Similarly, when developing an enhanced watershed management program from the Spickett River Watershed with the multiple stakeholders, DES will consider the Town's water needs within the context of the water system developing, implementing and maintaining an unaccounted-for water program and leak detection and repair program. DES' regulations for water conservation (Env-Ws 390) provide basic criteria the Town should follow when establishing an unaccounted-for water program and leak detection and repair program.

Given the Town's population density and the availability of water resources in southern New Hampshire, DES believes the Town should consider implementing more than just the basic water conservation measures described above. These measures may include:

1) Establishing water efficiency standards for new connections to the water system that require water efficient landscaping and use of water efficient fixtures and appliances;

2) Implementing a rate structure that encourages water conservation by increasing the price of a unit volume used as use exceeds certain thresholds.

3) Establishing a water fixture replacement or retrofitting program. This program could be applied to public buildings (such as schools) and private buildings. Investing in improving the efficiency of water fixtures will reduce water demand which essentially has the same effect as developing new sources of supply. Funding for this program could be through ratemaking or these improvements could be paid for as "offsets" by new customers of the water system.

It is requested that the Town review the information above and provide DES with a scope of work or update to the document which was e-mailed to DES on December 10, 2007. Please call me at 271-1168 (or by email at *Sarah.Pillsbury@des.nh.gov*) or Brandon Kernen at 271-0660 (or by email at *Brandon.Kernen@des.nh.gov*) if there are questions in the meantime.

Sincerely,

Sarah Pillsbury, Administrator
Drinking Water and Groundwater Bureau

cc: Bill Daly, Town of Salem
Rick Russell, Town of Salem
Robert Puff, Town of Salem
Tony Zuena, PE, SEA Consultants
Kirsten Ryan, SEA Consultants
Paul Currier, DES Watershed Management Bureau

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

April 21, 2008

Jonathan Sistare, Town Manager
Town of Salem
33 Geremonty Drive
Salem, NH 03079

Subject: **EPA ID 2051010: Salem Water Department**
Management of the Salem Drinking Water Sources

Dear Mr. Sistare:

I am writing to follow-up on our letter dated January 7, 2008 in which we provided our comments on the Scope of Services prepared by SEA, Inc. regarding management of the Spicket River watershed for multiple water quality and quantity goals. Since that time, we understand that the effort to raise town funds for this effort in the town budget has been unsuccessful. You have stated, however, that the town remains committed to a long-term watershed management plan which would secure the drinking water supply and protect legal and environmental interests.

We intend to initiate discussions with a broad group of stakeholders about the management plan over the next several months. In the meantime, we need to reiterate some of the concerns expressed at our November 16, 2007 meeting regarding water withdrawals. By contract with the Arlington Pond Protective Association, the town exercises unrestricted use of that body of water until April 30. After that date, and until October 10, the town can continue to pump water from Arlington Pond as long water level is not drawn below a fixed elevation. We understand the town's limitations in switching from one source to another due to adjustments required at the treatment plant as well the degradation of water quality during the warmer months of the year. Given the ongoing concerns about Canobie Lake water levels, we urge the town to maximize water withdrawals from Arlington Pond while observing limits on Spicket River flow and maintaining drinking water quality. The town should assess if there are enhancements that can be made to the surface water treatment plant that allows it to more rapidly alternate between the use of Arlington Pond and Canobie Lake so that the allowable use of Arlington Pond is more fully utilized.

At our November meeting, you also summarized the measures the town has taken regarding conservation, primarily its public outreach and imposition of summer odd/even irrigation schedules. We encourage the town to expand the conservation program in the short-term to include more restrictive irrigation management requirements. We also believe the town should conduct a system-wide leak detection and repair program within the next few months. The town needs to also begin taking steps to improve water system metering accuracy where meters of all water users connected to the system are calibrated on a regular schedule and audits of the water system are routinely implemented to ensure unaccounted for water is less than 15%. Improving the accuracy of metering and minimizing unaccounted-for water ultimately will be a requirement of any watershed management plan developed to augment the town's water supply. We also

strongly encourage the town to consider developing and implementing an inclining block water use rate structure.

We request that you provide us with a reply by June 16, 2008 regarding the town's continued effort on these issues until such time that they can be further addressed in the context of a long-term management plan. Please call me at 271-1168 (or spillsbury@des.state.nh.us) or Brandon Kernen at 271-0660 (or bkernen@des.state.nh.us) if there are questions in the meantime.

Sincerely,

Sarah Pillsbury, Administrator
Drinking Water and Groundwater Bureau

cc. Bill Daly; Rick Russell; Robert Puff, Town of Salem
Paul Currier, DES Watershed Management Bureau

1/10/11 agenda

The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

December 29, 2010

RECEIVED BY

JAN - 3 2011

TOWN MANAGER'S OFFICE
SALEM NEW HAMPSHIRE

Dr. Henry E. LaBranche
Salem Town Hall
33 Geremonty Drive
Salem, New Hampshire 03079

Subject: EPA ID 205 1010 Salem Water Department – Administrative Order WSPCD 96-02

Dear Dr. LaBranche:

The purpose of this letter is to list measures Salem's Water Department needs to take in the short-term to comply with Administrative Order 96-02.

On August 16, 2010, the Department of Environmental Services (DES) met with you and the Board of Selectmen to discuss the status of the adequacy of the supply of water for Salem's Water Department. The adequacy of supply for the water department has been an ongoing issue since the issuance of Administrative Order 96-02 in 1996 to address chronically low water levels in Canobie Lake. In 1997, Salem added a second source of water supply (Arlington Pond) to its water system. The use of this water source is restricted due to an agreement made between the Town and the Arlington Pond Protective Association. Even with the addition of Arlington Pond as a water source, the Town again experienced a water supply emergency in 2002. Salem's Water Department continues to add customers, but the Town has not made significant improvements to its water supply capacity or its ability to manage water usage. For this reason, DES has not issued a Notice of Compliance for Administrative Order 96-02.

DES understands that Salem has enhanced its interconnections with the water system in Methuen, Massachusetts. This water source provides an important emergency source of water. However, the Commonwealth of Massachusetts has previously stated to officials in New Hampshire that water from water systems in Massachusetts cannot supply water to water systems in New Hampshire unless extraordinary emergency conditions exist.

Based on the options Salem has developed over the last fourteen years to improve its water supply capacity and reduce water demand, the implementation of the following measures are necessary to avoid the issuance of amendments to the existing Administrative Order:

1) Install and Operate Accurate Water Meters for All Users in the System: Salem needs to install and maintain accurate water meters for all users in the system to determine where water is being used and whether water is being lost in the system. The meters currently installed in the water system are not calibrated and appear to be significantly under registering water use.

2) Surface Water Source Use Plan: In the near term, Salem needs to extend its use of Arlington Pond as a source of water when pond elevations exceed the thresholds specified in the agreement with the Arlington Pond Protective Association. Arlington Pond receives significantly more recharge than Canobie Lake, but Salem currently limits the use of the pond as a water supply source to only the period of October 11th through April 29th. A surface water

source use plan needs to be developed and implemented under the current watershed management scenario for Salem's two water sources. The plan should optimize the use of the two water bodies based on their recharge and storage properties.

Salem's work with the US Army Corps of Engineers to evaluate water management scenarios for the Spicket River Watershed will provide additional information to refine the surface water source use plan in the future.

3) Water Treatment Plant Efficiency: Salem needs to make improvements to the water treatment plant to reduce the amount of water wasted and discharged to the sewer system during the treatment process.

DES will evaluate the progress Salem has made on implementing the measures listed above in September 2011 and at that time determine whether amendment of the Administrative Order is warranted.

DES understands that the Water Department has made significant improvements to its water system this past summer by conducting a very successful leak detection and repair program and by terminating a continuous blow-off in one segment of the water system. These efforts will complement the work the Water Department needs to complete to achieve compliance with the Administrative Order.

DES encourages Salem to participate in discussions with other communities and water systems in southern New Hampshire about extending water from the Merrimack River to southeastern New Hampshire. This alternative source of water could diversify Salem's reliance on the Spicket River Watershed and may provide the town with cost-effective flexibility in balancing the competing interests of various stakeholders in the Spicket River Watershed.

Salem may also elect to request approval to transfer water from Arlington Pond to Canobie Lake once amendments to DES's Administrative Rules are made to allow for the consideration of this request. As currently proposed, these rules will establish a high threshold that ensures water quality degradation does not occur, water efficiency is being maximized, and that no other reasonable water supply alternatives are available.

Please contact me at 271-0660 or Brandon.Kernen@des.nh.gov.

Sincerely,

Brandon Kernen
Supervisor – Hydrology and Conservation
Drinking Water and Groundwater Bureau

cc: R. Russell, Town of Salem
Salem Board of Selectmen
S. Pillsbury, R. Skarinka, P. Susca, P. Currier, DES

2012 SALEM WATER AUDIT

SALEM, NH

AUGUST 2012

08.21.12

Prepared By:

Wright-Pierce
230 Commerce Way, Suite 302
Portsmouth, NH 03801

1.0 EXECUTIVE SUMMARY

A growing priority for many New Hampshire communities is to identify opportunities that cut annualized water system operations expenses and to preserve available water resources for future generations and economic growth. Environmental regulations are also becoming more stringent to permit new sources of supply. It is far less expensive to repair a unit volume worth of leaks in the existing distribution system than it is to design, permit, construct and maintain the same unit volume of a new water supply facility.

The 2012 Water Audit Report for Salem, NH details the procedures, approach and findings of activities Wright-Pierce staff conducted to quantify water production, consumption and losses in the Salem municipal water supply system. A water audit can be considered analogous to a financial audit where water introduced into the system and recorded consumption by meters represents revenue and losses thought of as expenses.

Tasks conducted for this audit included compiling pertinent Town water billing records, analyzing and interpreting water use data, and estimating water losses. This water audit data was used as input into the American Water Works Associations (AWWA) water audit software program to determine industry standard water use categories and their respective quantities.

The approach and methods to quantify values in conjunction with the Salem Water Audit were done so adhering to the American Water Works Association (AWWA) Manual of Water Supply Practices M36, *"Water Audits and Loss Control Programs"*. A publically available water audit software program developed by AWWA's Water Loss Control Committee was the nucleus of our water audit supplemented by records furnished by the Town. Any assumptions needed to estimate metered consumption (e.g. percentages of low, medium and high flows for residential meters) or unregistered consumption of water that are not referenced by the AWWA Manual were researched from prior case studies of other utilities serving approximately the same population.

The year of record for the 2012 Water Audit is based on information obtained from the Town for Calendar Year 2011, January 1, 2011 through December 31, 2011. A general breakdown of the Town's registered water usage, authorized non-revenue use and losses are summarized in Table 1.

Table 1: 2011 Water Audit Summary

Water Use Category	Annual Quantity	% of Total Input
Volume Supplied to System	794.1 MG	100.0 %
Metered Volume	636.5 MG	80.2 %
Unbilled Authorized Use	16.4 MG	2.0 %
Meter Inaccuracy & Apparent Losses	45.4 MG	5.7 %
Distribution System Leaks (Real Losses)	95.7 MG	12.1 %

The AWWA Water Loss Control Committee, developer of the Water Audit Software also created a formula which water systems can reference for calculating a baseline expected leak volume due to the water system's physical characteristics. This volume is known as the Unavoidable Annual Real Losses (UARL) and represents the theoretical lower limit of leakage volume that could be achieved. The UARL formula takes into account the following:

- Total length of water system mains
- Number of service connections
- Total length of customer service lines
- Average water system pressure

Based on the UARL formula, Salem could in theory reduce its annual real losses to approximately 55 million gallons per year, or 6.9% of System Input Volume. Hence, Salem could theoretically pare real losses by 41.8 MG/yr or approximately 75 gpm. A recently discovered leak estimated to be 25 gpm is scheduled for repairs. The Leak Survey performed last year pin-pointed several minor and a few substantial water main losses of water in the distribution system. Subsequent to the survey, we estimate the real losses (80 to 100 MG) were halved by Town Water Department employees repairing the leaks. The Water Treatment Plant production records confirmed the real loss estimates. Salem's customer base was relatively unchanged year (2010) over year (2011), extreme climate was not really a factor on demand patterns for the two years (2010-2011) yet water plant production decreased 86 MG over the period (881 MG vs 795 MG). At a variable production cost of $353/MG (refer to the AWWA Spreadsheet in the Appendix), the Town of Salem saved over $30,000 in operations expenses for 2011.

From our 2011 Water Audit investigation, Wright-Pierce recommends the Town of Salem engage in the following activities:

- Undertake an extensive residential and commercial meter replacement program to renew aging meters. Test, install and replace water meters in accordance with AWWA Manual M6. Consider more aggressively replacing the oldest meters to more quickly recover lost revenue. The Town has begun installing radio-read technology to reduce manpower required to physically read meters, reduce the potential for reading / billing errors, and provide real-time consumption tracking capabilities.
- Hire a qualified instrumentation technician to volumetrically calibrate the raw, finished and carbon dioxide motive water flow meters each year.
- Perform a usage audit on the water treatment plant to assess production water efficiency internal to the facility operations.
- Contract with an experienced leak survey consultant on a yearly basis until meters are sufficiently upgraded, and then bi-annually after that.
- Keep detailed records of distribution system leak repairs and estimated flow rate of repaired leaks.
- Confirm and record hydrant flush rates and total flush volumes with a pitot gauge or diffuser combination.

civil &
environmental
engineering

UNDERWOOD
engineers

1612.00

August 22, 2012

Mr. Robert E. Puff, Jr., P.E., Director of Engineering
Town of Salem, New Hampshire
33 Geremonty Drive
Salem, New Hampshire 03079

Re: ***Preliminary Design***
Manor Parkway Pressure Zone Improvements
Salem, NH

Dear Mr. Puff:

In accordance with Engineering Service Request (ESR #3) dated March 1, 2012, please accept this letter and the following attachments as the preliminary design for the referenced project:

- Preliminary Drawings (bound separately)
- Design Summary
- Opinion of Probable Cost
- Design memoranda from Underwood Engineers' sub-consultants (electrical, heating and ventilation, structural)
- Suggested letter to notify property owners of the project
- Letter by Underwood Engineers to the Town dated June 20, 2012 regarding Hydraulic Restriction Diagnostics

Background

Underwood Engineers prepared a Feasibility Study (May 18, 2011), which evaluated alternatives to improve fire flows in the existing Manor Parkway Pressure Zone and also to expand the pressure zone to address inadequate service pressures and fire flows along Brookdale Road and the Canobie Lake areas, extending to North Policy Street.

The Town has decided to proceed with preliminary design of improvements to the existing Manor Parkway Pressure Zone, but not expansion of the zone, at this time. This area is limited to the existing industrial park – Industrial Way, Northwestern Drive, and portions of Manor Parkway and Commercial Drive (Figure 1, attached).

ph 603.436.6192
fx 603.431.4733
25 Vaughan Mall
Portsmouth, NH 03801
underwoodengineers.com

Project Goals

The general goals of the project are as follows (see attached Design Summary for additional detail):

- Increase available fire flow to 3,500 gpm at 20 psi residual in all Town-owned mains in the Manor Parkway Pressure Zone, per Insurance Service Office (ISO) and Fire Department requirements.
- Reduce over-pressurization caused by existing fire pump.
- Improve fire pump controls and enable fire pump to start independently of alarm transmission from private sprinkler systems.
- Replace existing booster pumping system, which is at the end of its useful life, with a new booster pumping system sized to meet peak hour demand with the largest pump out of service.

Design Decisions

The attached Design Summary includes the result of several design modifications and decisions since the Feasibility Study was completed. Two of the decisions have particular cost and O&M impacts and are highlighted here.

Diesel Engines vs. Electric Motors

At the Town's request, Underwood Engineers compared diesel engines to electric motors as options for driving the fire pumps. Electric motors would require an engine-driven stand-by generator. The electrical service would also need to be increased above and beyond the upgrade that is required for the proposed booster pumps. Preliminarily sizing suggests a 600 kW generator with a footprint of approximately 28 ft. x 12 ft. would be required for two electric fire pumps. Locating a generator this size on the existing site is not practical. For this reason and due to the higher cost of the generator and electrical service needed to support the electric fire pump motors, this option was eliminated from further consideration, and diesel-driven fire pump engines are included in the current design.

2 Stations vs. 1 Station

Two options were considered for pumping station configuration:

- Option 1: One Station – All Pumps (Booster and Fire) at Manor Parkway
- Option 2: Two Stations – New Booster Pumps and 1 Fire Pump at Manor Parkway & 1 Fire Pump at New Station on Commercial Drive

Option 2 offers the following advantages over Option 1:

- Facilitates construction phasing. High pressure service can be maintained to the pressure zone during construction by constructing improvements to one station at a time.

- Provides greater redundancy. Each station is fed from a different water main and electrical service improving the likelihood one station will remain operational in the event of an emergency.
- Facilitates testing and maintenance. High pressure service can be maintained to the pressure zone during maintenance and repair activities and annual fire pump certification testing at one station because the other station will remain in service.
- Allows existing yard piping, floor penetrations, most interior piping and layout to be maintained at Manor Parkway station.
- Cost effective. The cost of the new station under Option 2 is more than offset by the costs of a parallel water main from Pelham Road to the Manor Parkway station, upsizing yard and interior piping, and additional building improvements required at the existing station, all of which would be required under Option 1. Underwood Engineers' opinion of probable construction cost (excluding engineering and contingency) for Option 1 is $1,215,000, compared to $1,102,000 for Option 2. The difference of $113,000 is significantly greater than the allowance of $25,000 currently assumed for costs associated with property acquisition for the new station on Commercial Drive (property, legal, cadastral, etc.). While there is some additional O&M cost associated with the second station under Option 2, it is limited to maintenance of the building (electricity, heat, plowing, etc.) and is minor compared to the scope of the project. O&M costs associated with the pumps themselves will be the same regardless of where the pumps are located.

For these reasons, Option 2 is recommended and has been advanced to the current preliminary design level, while Option 1 has been eliminated from further consideration.

Budget

A project budget of $1,614,000 is recommended, including design and construction phase engineering, construction, contingency, and allowances for project-related items outside the scope of Underwood Engineers' design (land acquisition, fiber optic cable, etc.). Additional detail is provided in the attached Opinion of Probable Cost spreadsheet. Costs are presented assuming construction in 2013.

Please note, costs associated with modifying existing private sprinkler systems, if required, are not included in the above figures.

Next Steps

We recommend the Town take the following next steps:

- Notify property owners in the pressure zone of the project, proposed change in operating pressure, and possible impact to their private sprinkler systems. A draft suggested letter for the Town's use is provided.
- Remove the spool piece and check valve on the fire pump discharge. If the spool piece is unlined, replace it with cement-lined ductile iron. While the piping is open, inspect in

both directions for evidence of tuberculation, scaling or other potential source of hydraulic restriction.

- Proceed with survey, final design, and construction of the recommended project in 2013, pending approval and appropriation of further funding.

Please call with any questions.

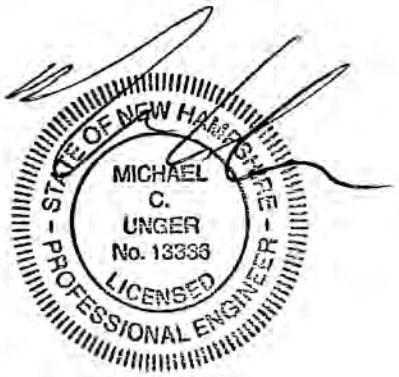
Very truly yours,

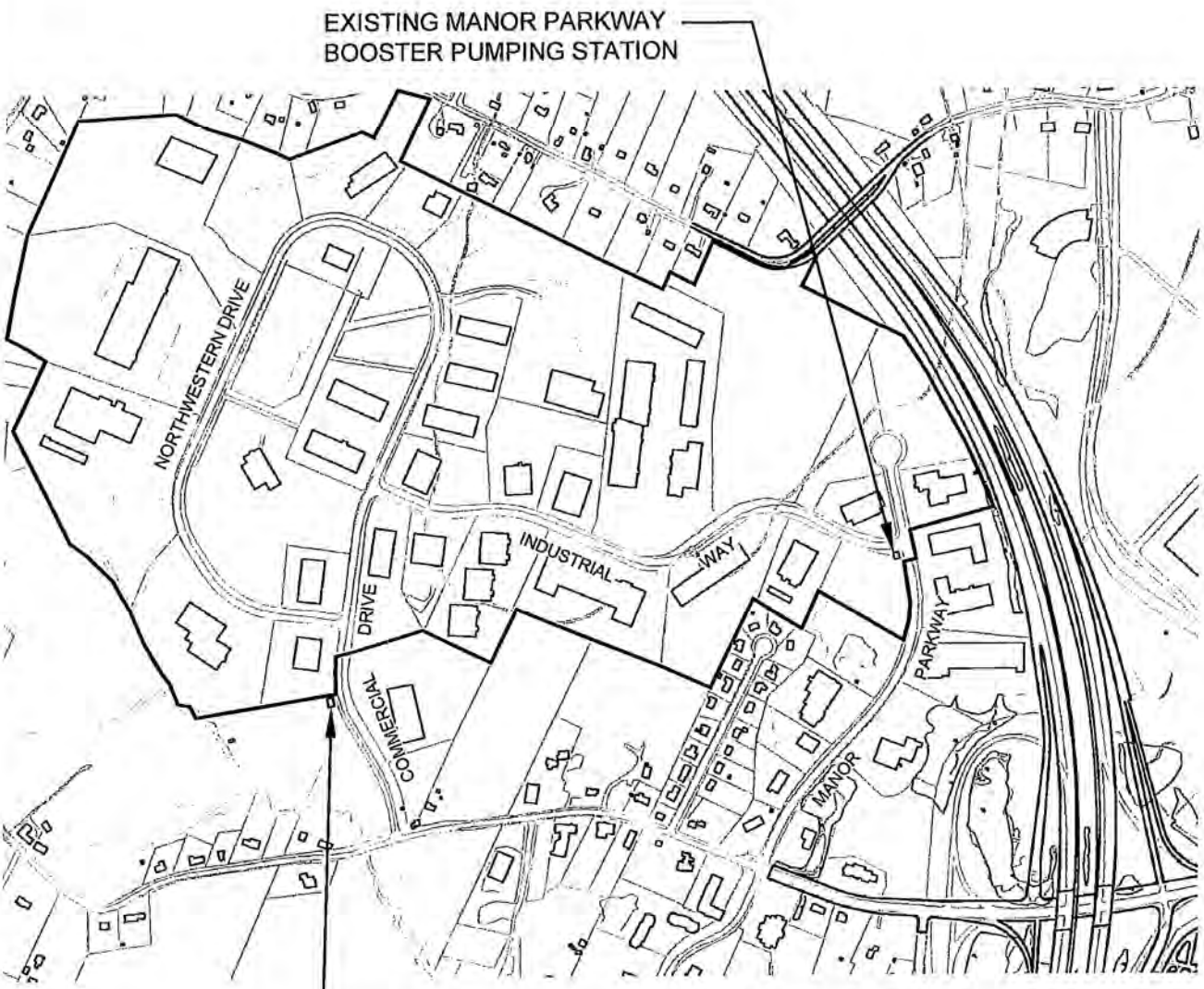
UNDERWOOD ENGINEERS, INC

Michael B. Metcalf, P.E.
Sr. Project Manager

Michael C. Unger, P.E.
Project Engineer

Encl. (6 copies)





LEGEND:

PRESSURE ZONE BOUNDARY

NOT TO SCALE

DATE		MANOR PARKWAY	FIG.
7/2012	UNDERWOOD engineers	PRESSURE ZONE BOUNDARY AND BOOSTER PUMPING STATIONS	1
PROJECT 1612	25 Vaughan Mall, Portsmouth, N.H. 03801 Tel. 603-436-6192 Fax. 603-431-4733	SALEM, NEW HAMPSHIRE	