2021

WATER SUPPLY AND WATER MAIN IMPROVEMENTS PLANNING

Holliston, Massachusetts
December 2021

2021 WATER SUPPLY AND WATER MAIN IMPROVEMENTS PLANNING

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1 INTRODUCTION

1. INTRODUCTION

BACKGROUND

The Town of Holliston is located in Middlesex County, southwest of Boston, Massachusetts east of I-495. The Town of Holliston's water system consists of five active wells that provide an average of approximately 1.0 million gallons per day (MGD) of water to its almost 15,000 residents. The water is delivered from the well supplies to the customers through approximately 90 miles of 4-inch to 16-inch water mains. There are five (5) storage tanks with a total capacity of 5.6 million gallons that are used to maintain operating pressures and to provide fire protection.

The purpose of this study is to evaluate both the water supply and water distribution system to identify necessary improvements for a 20-year planning horizon.

The first component is to evaluate the Town of Holliston's current sources of water, and identify any anticipated shortfalls in supply over a 20-year planning horizon. Permitting and constructing new water supply sources can take many years to be approved, therefore completing a planning level evaluation will identify if there are future water supply needs for the Town or if current sources remain sufficient.

The second component is to update the Town of Holliston's water main replacement program. An Asset Management (AM) program for its water distribution system was originally developed in 2010. The Town has been working to address the recommendations in that 2010 plan and requested an update to the plan. This water main replacement plan has been coordinated with a recent Sidewalk and ADA compliance report completed by Stantec along with other studies related to Complete Streets and the Town's annual paving program.

This report is designed to be a network level - planning tool and intended to provide a foundation for managing the Town's water system resources by combining technology, local knowledge, and professional engineering input.

2 HISTORICAL DATA

2. WATER SUPPLY SYSTEM HISTORICAL DATA

POPULATION

In evaluating Holliston's water requirements, both present and future populations must be accounted for. Table 1 shows historical population data from 2000 to 2020, provided by the US Census Bureau. With the exception of the years 2002, 2003, 2004, 2005, and 2010, the population of Holliston has experienced an overall upward trend since the 2000s.

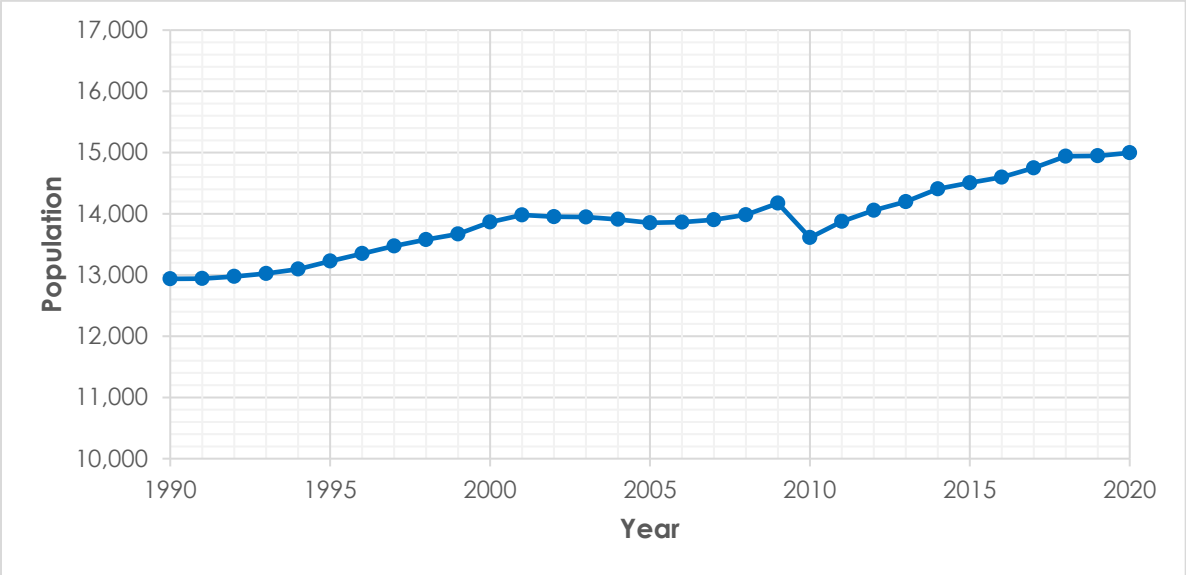
Table 1
US Census Historical Population – Town of Holliston

Year	US Census Population	Percentage Change	Year	US Census Population	Percentage Change
2000	13,864	–	2011	13,875	1.95%
2001	13,980	0.84%	2012	14,056	1.30%
2002	13,951	-0.21%	2013	14,197	1.00%
2003	13,946	-0.04%	2014	14,406	1.47%
2004	13,908	-0.27%	2015	14,506	0.69%
2005	13,852	-0.40%	2016	14,597	0.63%
2006	13,862	0.07%	2017	14,748	1.03%
2007	13,902	0.29%	2018	14,939	1.30%
2008	13,983	0.58%	2019	14,946	0.05%
2009	14,172	1.35%	2020	14,996	0.33%
2010	13,610	-3.97%			

Source: DataCommons.org

The data in Table 1 shows that the population of Holliston has gradually increased at an average rate of 0.4% from 2000 to 2020. Figure 1 shows this historical population information graphically.

Figure 1
Historical Population – Town of Holliston



WATER DEMAND

Water Use Categories

Water consumption is typically comprised of residential, commercial, and industrial demands as well as Confidently Estimated Municipal Use (CEMU) and Unaccounted-for Water (UAW). A description of demand types is provided in Table 2.

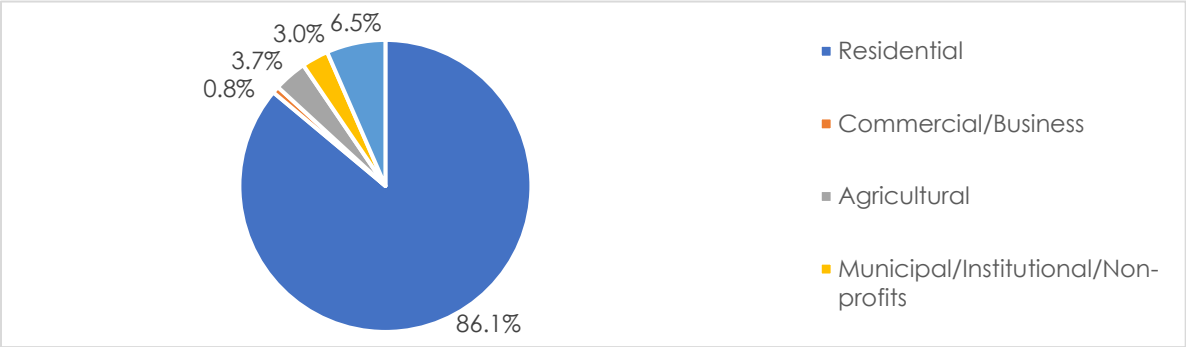
Table 2
Finished Water Use Categories

Use Category	Category Description
Residential	Water used in residences and apartments
Residential Institutions	Water used in residential establishments such as colleges
Commercial/Business	Water used in restaurants, service stations, and retail establishments
Agricultural	Water used for growing crops, raising animals, and/or running a garden center
Industrial	Water used in manufacturing and warehousing facilities
Municipal/ Institutional, Non-profits	Water used for municipal purposes, including schools, playing fields, municipal buildings, treatment plant; non-profits e.g. churches; non-residential institutions e.g. private schools
Other	Water used for purposes not included in above categories
CEMU	Water Confidently Estimated for Municipal Use (e.g. fire protection and training, hydrant/water main flushing, flow testing, bleeders/blow offs, tank overflow and drainage, sewer system flushing, street cleaning)
UAW	Unaccounted for Water - Water that includes all unmetered uses (e.g. leaks, and water main breaks, fire flows)

Metered Finished Water Use

As presented in its 2020 Annual Statistical Report (ASR), the Holliston Water Department has 4,917 service connections; of which 4,649 are residential connections, 216 are commercial/business connections, 11 are agricultural connections, 20 are municipal/institutional/nonprofits, and 21 are other connections i.e. to churches in Town. Figure 2 presents the average metered water consumption by user classification in 2020. Most of the metered water use is residential, followed by commercial/business, residential institution, municipal/institutional/non-profits, industrial, and agricultural. CEMU and UAW volumes are not metered and therefore not included in the figure.

Figure 2
Metered Water Consumption in 2020



Historical Water Usage

Table 3 and Table 4. illustrate the historical annual water usage by user class for years 2009 through 2020, and Table 5 illustrates the historical total water usage by user class as a percentage of annual water consumed for the same timeframe. Note that ASR data for the years 2011 and 2013 were not available for analysis.

Table 3
Historical Water Use – Million Gallons per Year (MGY)

Year	Residential	Commercial/ Business	Agricultural	Industrial	Municipal/Institutional/ Non-profits	Other	Total CEMU	UAW	Total
2009	248.6	25.2	0.7	–	3.4	3.9	36.6	70.3	388.7
2010	249.3	23.7	1.1	–	3.7	2.3	13.6	50.9	344.8
2012	242.6	22.3	1.0	–	3.5	2.7	5.1	48.5	325.7
2014	238.7	23.6	1.4	–	3.4	2.3	54.3	60.7	384.4
2015	246.4	24.6	0.9	–	5.4	2.8	46.1	23.9	350.1
2016	235.9	22.5	1.3	–	12.1	0.2	41.1	47.6	360.6
2017	298.6	20.0	1.1	–	7	2.1	19.7	38.4	386.9
2018	230.0	21.3	1.2	–	10.6	2.3	48.3	74.5	388.1
2019	220.0	24.0	1.3	–	10.5	1.7	77.0	30.5	365.0
2020	249.0	2.2	10.6	–	8.6	18.9	26.1	24.6	340.0
AVG	245.9	20.9	2.1	–	6.8	3.9	36.8	47.0	363.4

Table 4
Historical Water Use – Million Gallons per Year (MGD)

Year	Residential	Commercial/ Business	Agricultural	Industrial	Municipal/Institutional/ Non-profits	Other	Total CEMU	UAW	Total
2009	0.681	0.069	0.002	–	0.009	0.011	0.100	0.193	1.06
2010	0.683	0.065	0.003	–	0.010	0.006	0.037	0.140	0.94
2012	0.663	0.061	0.003	–	0.010	0.007	0.014	0.133	0.89
2014	0.654	0.065	0.004	–	0.009	0.006	0.149	0.166	1.05
2015	0.675	0.067	0.002	–	0.015	0.008	0.126	0.066	0.96
2016	0.644	0.061	0.004	–	0.033	0.001	0.112	0.130	0.99
2017	0.818	0.055	0.003	–	0.019	0.006	0.054	0.105	1.06
2018	0.630	0.058	0.003	–	0.029	0.006	0.132	0.204	1.06
2019	0.603	0.066	0.004	–	0.029	0.005	0.211	0.083	1.00
2020	0.680	0.006	0.029	–	0.023	0.052	0.071	0.067	0.93
AVG	0.673	0.057	0.006	–	0.019	0.011	0.101	0.129	0.99

Table 5
Historical Water Usage by User Class as Percent of Annual Water Produced

Year	Residential	Commercial/ Business	Agricultural	Industrial	Municipal/Institutional/ Non-profits	Other	Total CEMU	UAW	Total
2009	64.0%	6.5%	0.2%	–	0.9%	1.0%	9.4%	18.1%	100%
2010	72.3%	6.9%	0.3%	–	1.1%	0.7%	4.0%	14.8%	100%
2012	74.5%	6.8%	0.3%	–	1.1%	0.8%	1.6%	14.9%	100%
2014	62.1%	6.1%	0.4%	–	0.9%	0.6%	14.1%	15.8%	100%
2015	70.4%	7.0%	0.3%	–	1.5%	0.8%	13.2%	6.8%	100%
2016	65.4%	6.2%	0.4%	–	3.3%	0.1%	11.4%	13.2%	100%
2017	77.2%	5.2%	0.3%	–	1.8%	0.5%	5.1%	9.9%	100%
2018	59.3%	5.5%	0.3%	–	2.7%	0.6%	12.4%	19.2%	100%
2019	60.3%	6.6%	0.4%	–	2.9%	0.5%	21.1%	8.3%	100%
2020	73.2%	0.6%	3.1%	–	2.5%	5.6%	7.7%	7.2%	100%
AVG	67.9%	5.7%	0.6%	–	1.9%	1.1%	10.0%	12.8%	100%

The increase in percentage use for residential and the significant decrease in percentage use for commercial/business between 2019 and 2020 could be attributed to the COVID-19 pandemic which saw a considerable number of people confined to their residences even for work hours. The high CEMU percentage use in 2019 was mainly due hydrant/water main flushing/main construction and bleeders/blowoffs. The elevated UAW percentage use in 2018 could be due to meter malfunctions/misregistrations, service leaks, and hydrant malfunctions. It is anticipated that the percentage for each user type is likely to remain similar to its historical 10-year average for the duration of the planning period, but should be revisited if significantly large users are added to the water system.

Confidently Estimated Municipal Use and Unaccounted for Water

CEMU is the amount of water quantified by the Holliston Water department in its ASRs for purposes such as fire protection, hydrant flushing, bleeders/blow offs, source meter calibration adjustments, construction uses, and major water main breaks.

Unaccounted-for water (UAW) is often difficult to quantify. It typically consists of unmetered water usage such as leaks, water theft, or meter malfunction/misregistration. It is calculated by subtracting the sum of the total metered water usage and total CEMU from the total finished water produced and available for distribution.

UAW has averaged 12.8% over the study period, and have been lower than the 10% or less performance standard required by the Holliston Water Department's Water Management Act (WMA) registration permit for the past two years, i.e. in 2019 and 2020. Stantec assumes that the Holliston Water Department will continue to implement strategies to meet this requirement throughout the planning period.

Domestic Water Consumption

Population, zoning, and water consumption habits collectively influence the pattern of domestic (residential) water use. Since consumption is primarily dependent on the population served, domestic water consumption is often expressed in terms of gallons per capita per day (GPCD). Table 6 illustrates the daily residential consumption per capita for years 2009 through 2020.

Table 6
Historical Daily Residential Gallons per Capita Water Demand

Year	Daily Residential Water Use[1] (GPD)	Estimated Population Served[2]	Residential Gallons per Capita per Day (RGPCD)
2009	681,123	14,172	48.1
2010	683,131	13,610	50.2
2012	662,938	14,056	47.2
2014	654,038	14,406	45.4
2015	675,045	14,506	46.5
2016	644,443	14,597	44.1
2017	818,167	14,748	55.5
2018	630,137	14,939	42.2
2019	602,740	14,946	40.3
2020	680,328	14,996	45.4
AVERAGE	673,209	14,498	46.5

[1] As presented in the Holliston Water Department's past ASRs

[2] Per US Census data

Consumption rates varied from 40.3 to 55.5 residential gallons per capita per day (RGPCD) with an average of approximately 46.5 RGPCD. With the exception of year 2017, residential water use has remained fairly stable over this time period. Stantec assumes that the Town will continue its conservation efforts to stay below the RGPCD performance standard of 65 gallons for public water suppliers (PWS) permittees established by Massachusetts under the Water Management Act.

Maximum Daily Demand

The maximum day demand is the largest volume of water used over a single 24-hour period. The ratio of maximum to average daily consumption is generally higher for residential use than it is for industrial and commercial use. Consumers can easily double or triple their average daily consumption by activities such as lawn watering, car washing, and swimming pool use. The maximum day demand from 2020 was 1.57 MGD per the ASR of that year. Table 7 provides a summary of the historical maximum day demand, average day demand and maximum day to average day ratio.

Table 7
Historical Maximum and Average Day Demands

Year	Maximum Day Demand (MGD)	Average Day Demand (MGD)	Maximum Day to Average Day Ratio
2009	1.959	1.065	1.84
2010	*	0.945	–
2012	1.507	0.890	1.69
2014	1.879	1.053	1.78
2015	1.914	0.959	2.00
2016	1.605	0.985	1.63
2017	1.729	1.060	1.63
2018	1.591	1.063	1.50
2019	1.602	1.000	1.60
2020	1.461	0.929	1.57
AVERAGE	1.661	0.987	1.68

*Data not available


3
PROJECTIONS

3. PROJECTIONS

FUTURE POPULATION

Evaluation of the Town's water supply and distribution system must consider future as well as present populations. Any increase in population affects the water supply and distribution needs. The majority of the Town's population is served by the municipal water system operated by the Holliston Water Department and was assumed to be 100% for this evaluation.

The Metropolitan Area Planning Council (MAPC) uses a dynamic model to make population projections in the Greater Boston Region that are referenced by local, regional, and state agencies when establishing policies and investments to meet the needs of the region. The MAPC population projections developed for Holliston for the years 2020, 2030, and 2040 are shown in Table 8.

Table 8
MRPC Population Projection Estimate

Year	2020	2030	2040
Population Estimate	13,547	13,080	12,836

The UMass Donahue Institute (UMDI) produces population projections for Massachusetts regions and municipalities, which are referenced by planners and researchers. The UMDI population projections developed for Sterling for the years 2020, 2025, 2030, 2035, and 2040 are shown in Table 9.

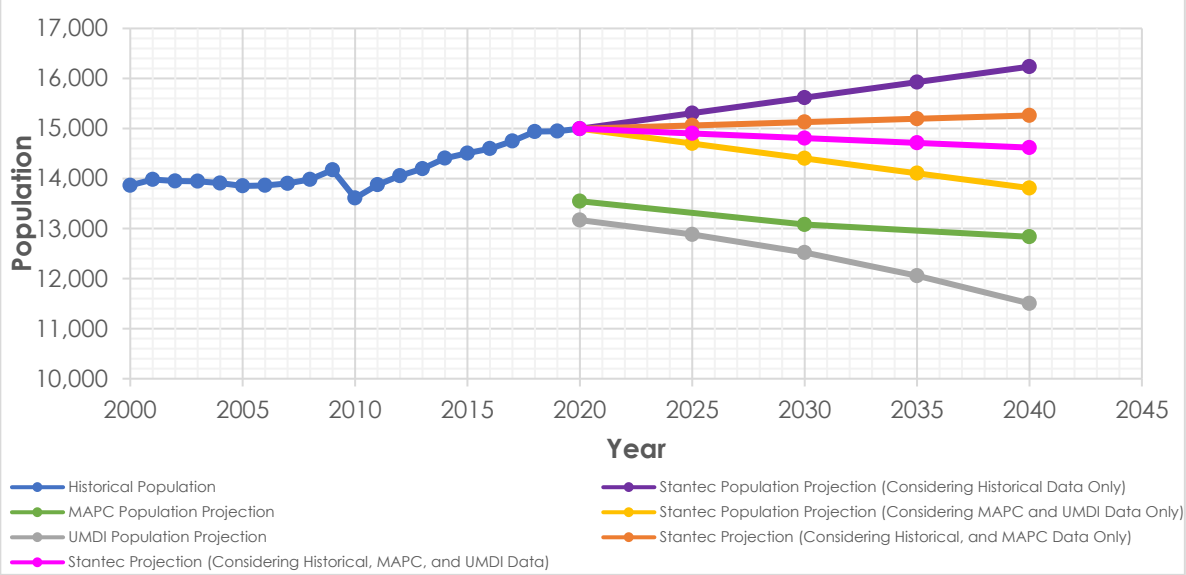
Table 9
UMDI Population Projection Estimate

Year	2020	2025	2030	2035	2040
Population Estimate	13,170	12,883	12,521	12,058	11,505

The historical, and projected data from MAPC, UMDI and Stantec are presented in Figure 3. Both the MAPC and UMDI population projection models predict a decrease in population for the Town of Holliston. Stantec first developed projections based on the historical data, and then developed projections based on the trends observed with the MAPC and UMDI data. Considering that historical population for the Town indicated a gradual increase in population while the MAPC and UMDI indicated a decrease for future years, Stantec developed two other sets of projections based on combinations of the respective trend lines associated with the historical,

MAPC and UMDI data to show what the actual growth pattern for future trends might look like.

Figure 3
Historical and Projected Population Trends



The different projection scenarios developed were reviewed with the Holliston Town Planner. Based on discussions, it was determined that the Stantec projection that considers only Historical and MAPC data best represents the Town's future population trend. Table 10 shows the population projections that serve as the basis for future water use consumption in this report.

Table 10
Stantec Population Projections

Year	Estimated Population	Percentage Change
2025	15,062	–
2030	15,128	0.44%
2035	15,195	0.44%
2040	15,261	0.44%

FUTURE WATER DEMAND

One of the objectives of this plan is to estimate future water demands, and use these estimates to determine the resiliency of the current water system supply. If inadequacies are found, a plan for system improvements will be developed.

Estimated future demands include residential, commercial, industrial, agricultural, municipal/institutional/non-profits, confidently estimated municipal use, and unaccounted-for water usage. Residential demand is dependent on changes in population. Commercial/ industrial demand depends on changes in economic development. As population and commercial/ industrial activities increase, the amount of water needed increases. By estimating the future residential demand and commercial demand and knowing the percentage of total demand represented by the unaccounted-for water, the future total demand can be calculated.

Projected water use is essential in determining the future adequacy of the supply system. The following method was used for determining future residential water demands:

1. Consumption records from 2009 through 2020 supplied by the Holliston Water Department were analyzed (see Table 3).

2. Historical residential demands were divided by the population to determine historical per capita residential demand (see Table 6).

3. Future population projections were estimated (see Table 10).

4. Average historical per capita residential demand was multiplied by the projected population for future years to calculate average domestic water demands for future planning years.

Average Daily Demand

The Average Day Demand (ADD) in 2020 was 0.929 MGD. To project future water demands, the residential water use was estimated based on historical residential gallons per capita per day multiplied by the population projections developed for 2025, 2030, 2035 and 2040 (see Table 10). The average daily demand for all other water consumption categories for the planning period was estimated based on the relationship with the residential water use for the different years, and considering the overall percentage uses for the period of 2009 through 2020. Stantec assumed that UAW will continue to remain below the UAW requirement of 10% through 2040. The projected average day demands are presented as a percent of total daily demand in Table 11, and the corresponding daily demand volumes are presented in Table 12 and Table 13.

Table 11
Projected Percentage Average Day Demand by Use Category

Year	Residential	Commercial/ Business	Agricultural	Industrial	Municipal/Institutional/ Non-profits	Other	Total CEMU	UAW*	Total
2025	70.1%	5.93%	0.61%	–	1.93%	1.15%	10.3%	10.0%	100%
2030	70.1%	5.93%	0.61%	–	1.93%	1.15%	10.3%	10.0%	100%
2035	70.1%	5.93%	0.61%	–	1.93%	1.15%	10.3%	10.0%	100%
2040	70.1%	5.93%	0.61%	–	1.93%	1.15%	10.3%	10.0%	100%
AVG	70.1%	5.93%	0.61%	–	1.93%	1.15%	10.3%	10.0%	100%

* Assumed UAW for period 2025 through 2040 remains at 10% (similar to 2019 and 2020)

Table 12
Projected Average Day Demand (MGY) by Use Category

Year	Residential	Commercial/ Business	Agricultural	Industrial	Municipal/Institutional/ Non-profits	Other	Total CEMU	UAW*	Total
2025	255.6	21.6	2.21	–	7.04	4.18	37.6	36.5	364.7
2030	256.7	21.7	2.22	–	7.07	4.20	37.8	36.6	366.3
2035	257.8	21.8	2.23	–	7.10	4.22	38.0	36.8	368.0
2040	259.6	22.0	2.25	–	7.15	4.25	38.2	37.1	370.6
AVG	257.4	21.8	2.23	–	7.09	4.21	37.9	36.7	367.4

Table 13
Projected Average Day Demand (MGD) by Use Category

Year	Residential	Commercial/ Business	Agricultural	Industrial	Municipal/Institutional/ Non-profits	Other	Total CEMU	UAW*	Total
2025	0.700	0.059	0.0061	–	0.0193	0.0115	0.103	0.100	0.999
2030	0.703	0.060	0.0061	–	0.0194	0.0115	0.104	0.100	1.004
2035	0.706	0.060	0.0061	–	0.0195	0.0116	0.104	0.101	1.008
2040	0.709	0.060	0.0061	–	0.0195	0.0116	0.104	0.101	1.012
AVG	0.705	0.060	0.0061	–	0.0194	0.0115	0.104	0.101	1.006

The projected average day demands consider all the use categories that were in play for the period 2009 through 2020, except for the use category "Industrial" since it has remained at 0 MGD during that timeframe. Water demand for the different user categories, including UAW, are projected to remain consistent in terms of overall percentage of water use over the planning period. Total water demand during the period of 2025 through 2040 is projected to be comparable to the demands that have been experienced during the period of 2009 through 2020 with a moderate increase over more recent years. UAW has been exceptionally low in recent years and for planning purposes, UAW has been projected to remain at 10% over the planning period. This results in an overall increase in water use in the near term as compared to 2020 data, with an overall decreasing trend in projected total water demand over the planning period due to decreasing population.

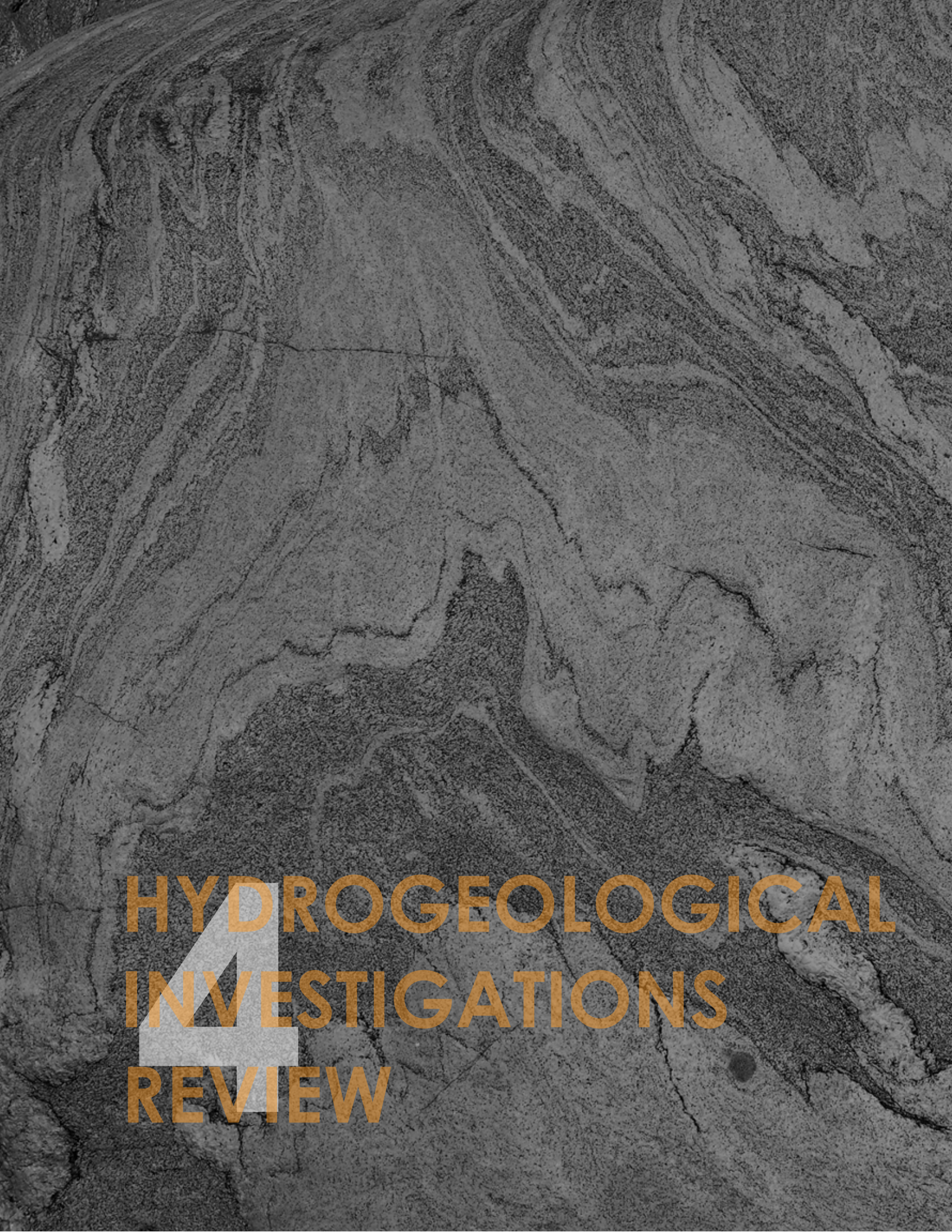
Maximum Daily Demand

The projected maximum day demands from 2025 through 2040 are presented in Table 14. These were calculated by multiplying the projected average day demand for those years with the average of the maximum day to average day ratio from the historical period of 2009 through 2020. An average day demand of 0.989 MGD was calculated for 2025, and a maximum daily demand ratio of 1.68 was selected for the 20-year planning period.

Table 14
Projected Maximum and Average Day Demands

Year	2025	2030	2035	2040
Average Day	0.989	0.999	1.004	1.008
Maximum Day (1.68*×Average Day)	1.657	1.674	1.682	1.689

*1.68 is the average of the maximum day to average day ratio from the period of 2009 through 2020.



4 HYDROGEOLOGICAL INVESTIGATIONS REVIEW

4. HYDROGEOLOGICAL INVESTIGATIONS REVIEW

In November 1997, a pumping test was conducted for Well #7 as a potential Public Water Supply source). This well source was approved in a Permit from the MADEP in 2001. Since that time, Well 8 was also constructed as a replacement well to Well 2.

In 2002, an investigation of potential locations for a new well source was conducted. The investigation led to a potential location on the southeast end of Chestnut Street, and another potential location in a valley encompassed by Hanlon Road, Marshall Street and Wilson Street. However, further investigations indicated that either locations would not be a suitable site for the new well source since the overburden and aquifers were found to be too thin for the installation of a gravel-packed well, and may contribute to low yield, and surface water infiltration and runoff into the well.

In more recent years there has not been any investigations into new source development. The following section will evaluate the need for future well source investigation.

5 WELL DATA

5. WELL DATA

PUMPING RATES

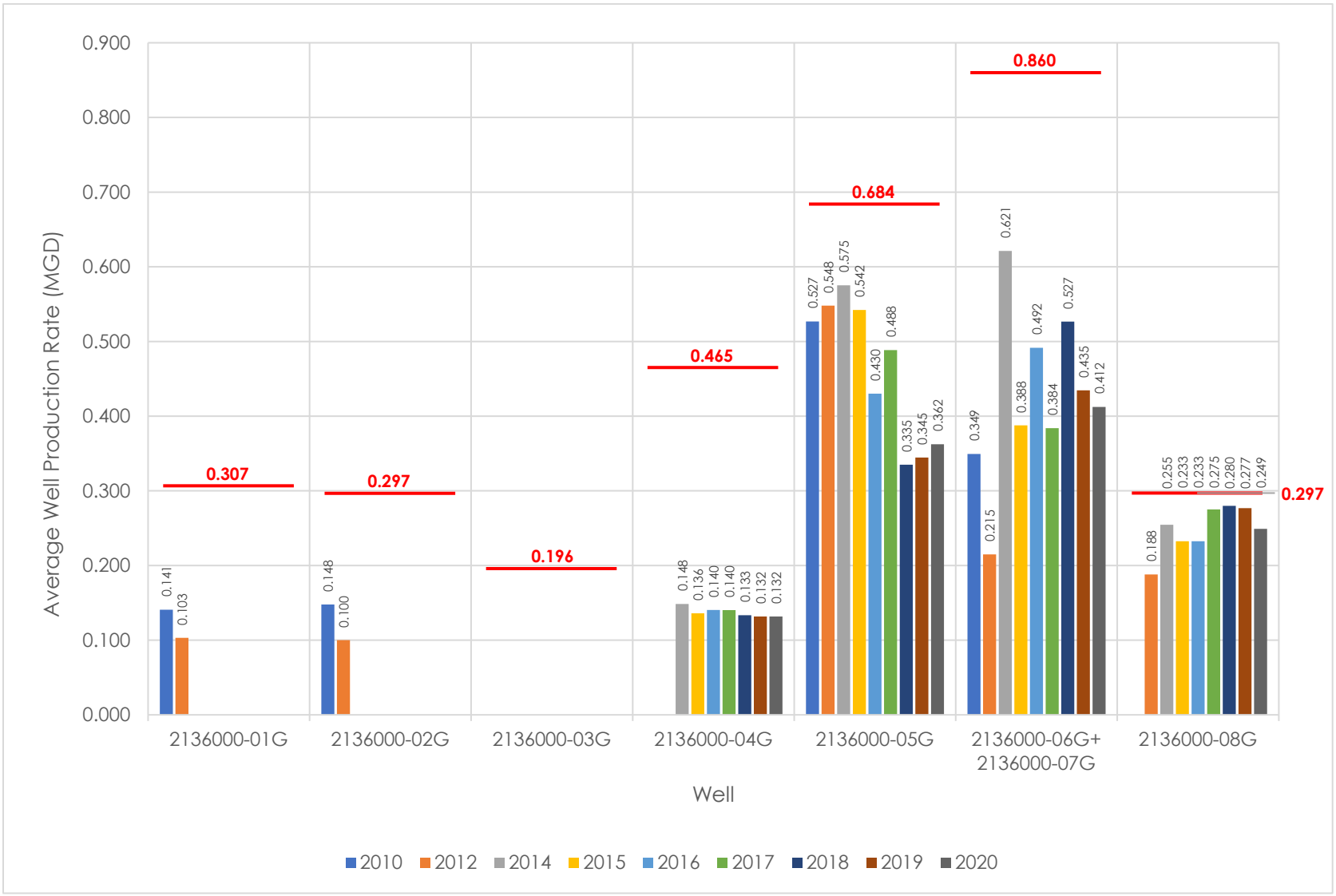
Table 15 shows the MassDEP approved pumping rate, year when the well meter was installed, year when the well meter was last calibrated, and the operational status for each groundwater source as listed in Town's ASRs. Well 2136000-03G was replaced with well 2136000-04G, and Well 03G is considered an emergency source of supply although there is no mechanical equipment in-place to allow pumping water from it. In 2012, Well 2136000-08G was connected to the water distribution system as a replacement to well 2136000-02G. In 2014, well 2136000-07G was connected to the water distribution system.

Table 15
Approved Daily Pumping Rate (MGD) for each Well

Well ID	Name	Approved Daily Pumping Rate (MGD)	Well Meter Installation Year	Last Meter Calibration Year	Operational Status
2136000-01G	*Norfolk Street #1*	*0.307*	*1960*	*2005*	*Offline*
2136000-02G	*Maple Street #2*	*0.297*	*unknown*	*unknown*	*Offline*
2136000-03G	*Washington Street #3*	*0.196*	*1950*	*1950*	*Offline*
2136000-04G	Washington Street #4	0.465	2007	2019	Online
2136000-05G	Central Street #5	0.684	2007	2019	Online
2136000-06G	Brook Street #6	0.864	1997	2019	Online
2136000-07G	Mohawk Path Well #7	0.860	2000	2019	Online
2136000-08G	Maple Street #8	0.297	2000	2019	Online

Figure 4 shows the average production rate for each well for the years 2010 through 2020 with respect to the corresponding approved daily pumping rate (MGD). Data for the years 2009, 2011, and 2013 were not available. Water supply from wells 2136000-01G and 2136000-02G ended in 2012. There was no water production from Well 2136000-03G during the timeframe investigated. The highest pumping rate occurred at wells 2136000-06G and 2136000-07G. The authorized withdrawal for these two sources is measured by the total pump rate at both sources. The next highest pumping was wells 2136000-05G, and 2136000-08G. Only wells 2136000-05G and 2136000-08G appear to be operating close to their respective approved daily pumping rate.

Figure 4
Average Well Production Rate (MGD) per Year



Depicts approved daily pumping rate (MGD) for well

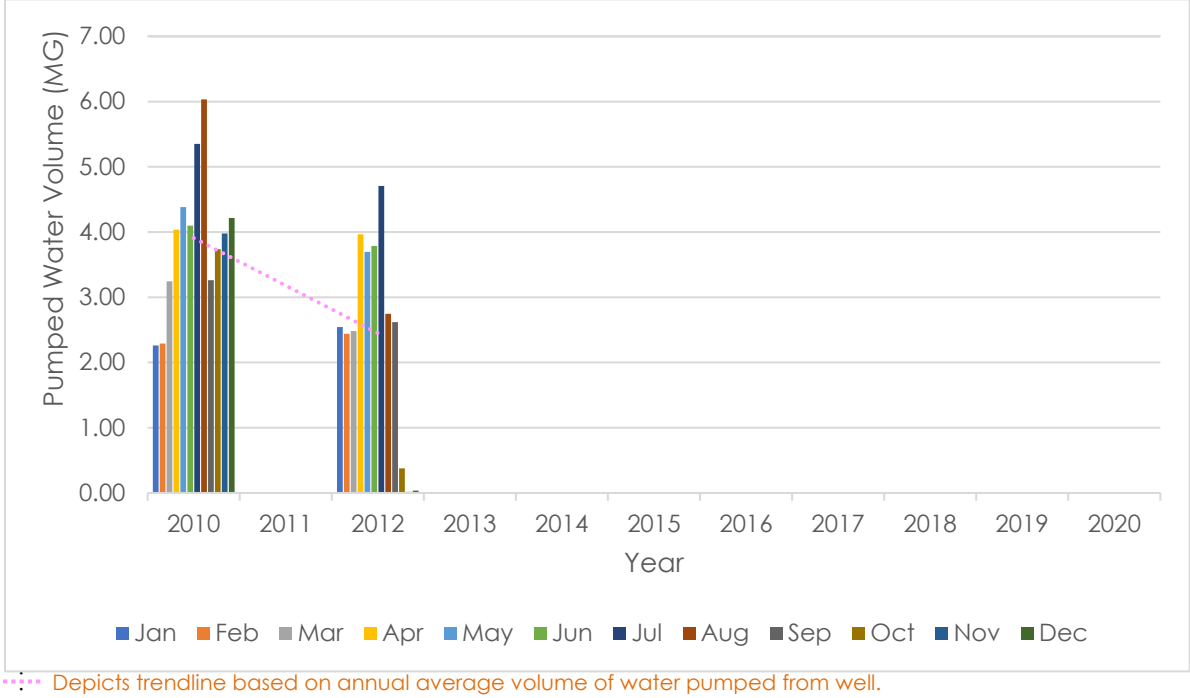
Stantec

Table 16 through Table 22 together with corresponding Figure 5 through Figure 11 show the volume pumped from each well the years 2010 through 2020. Data for the years 2009, 2011, and 2013 were not available. The amount of water pumped from wells 2136000-05G and 2136000-06G followed an overall increasing trend, while the amount of water pumped from wells 2136000-04G, 2136000-07G, and 2136000-08G followed an overall decreasing trend. There was no water production from wells 2136000-01G and 2136000-02G after 2012.

Table 16
Monthly Volume (MG) of Water Pumped from Well 2136000-01G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	2.26	2.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	2.29	2.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	3.24	2.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April	4.04	3.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	4.38	3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
June	4.10	3.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July	5.35	4.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
August	6.03	2.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September	3.26	2.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
October	3.74	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November	3.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December	4.22	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	3.91	2.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 5
Monthly Volume (MG) of Water Pumped from Well 2136000-01G



Depicts trendline based on annual average volume of water pumped from well.

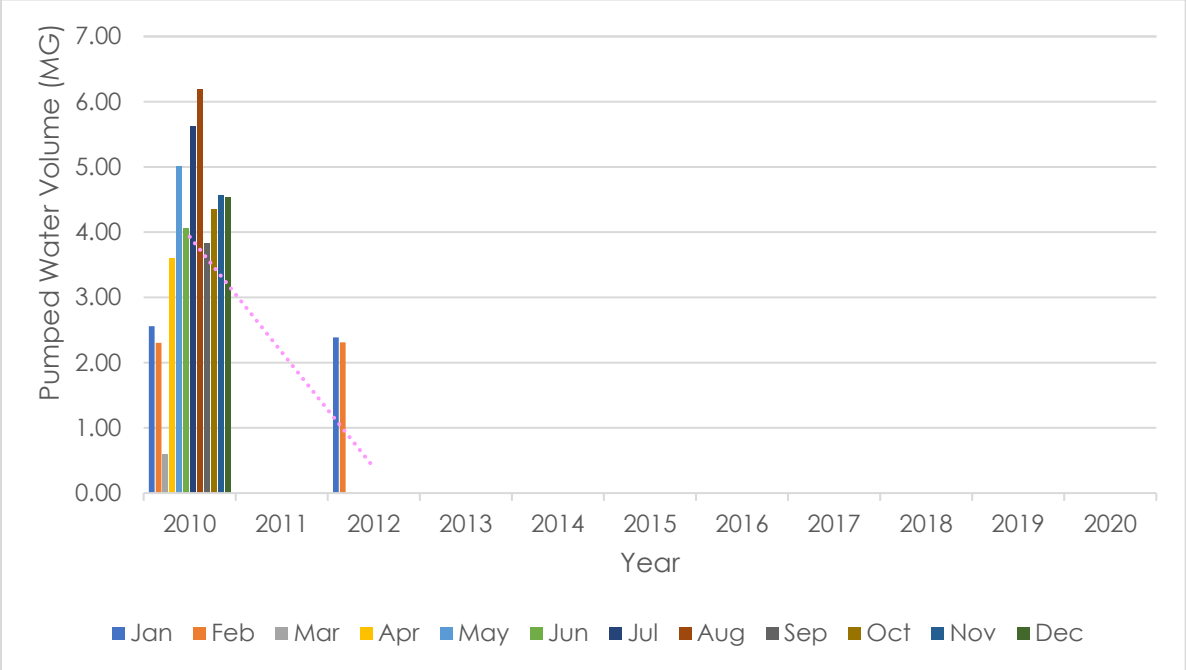
Stantec

Table 17
Monthly Volume (MG) of Water Pumped from Well 2136000-02G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	2.56	2.39	0.00	0.00	0.00	0.00	–	–	–
February	2.30	2.31	0.00	0.00	0.00	0.00	–	–	–
March	0.59	0.00	0.00	0.00	0.00	0.00	–	–	–
April	3.59	0.00	0.00	0.00	0.00	0.00	–	–	–
May	5.01	0.00	0.00	0.00	0.00	0.00	–	–	–
June	4.06	0.00	0.00	0.00	0.00	0.00	–	–	–
July	5.62	0.00	0.00	0.00	0.00	0.00	–	–	–
August	6.18	0.00	0.00	0.00	0.00	0.00	–	–	–
September	3.82	0.00	0.00	0.00	0.00	0.00	–	–	–
October	4.35	0.00	0.00	0.00	0.00	0.00	–	–	–
November	4.56	0.00	0.00	0.00	0.00	0.00	–	–	–
December	4.53	0.00	0.00	0.00	0.00	0.00	–	–	–
AVERAGE	3.93	0.39	0.00	0.00	0.00	0.00	–	–	–

"–" means well not included in the ASR of that year.

Figure 6
Monthly Volume (MG) of Water Pumped from Well 2136000-02G



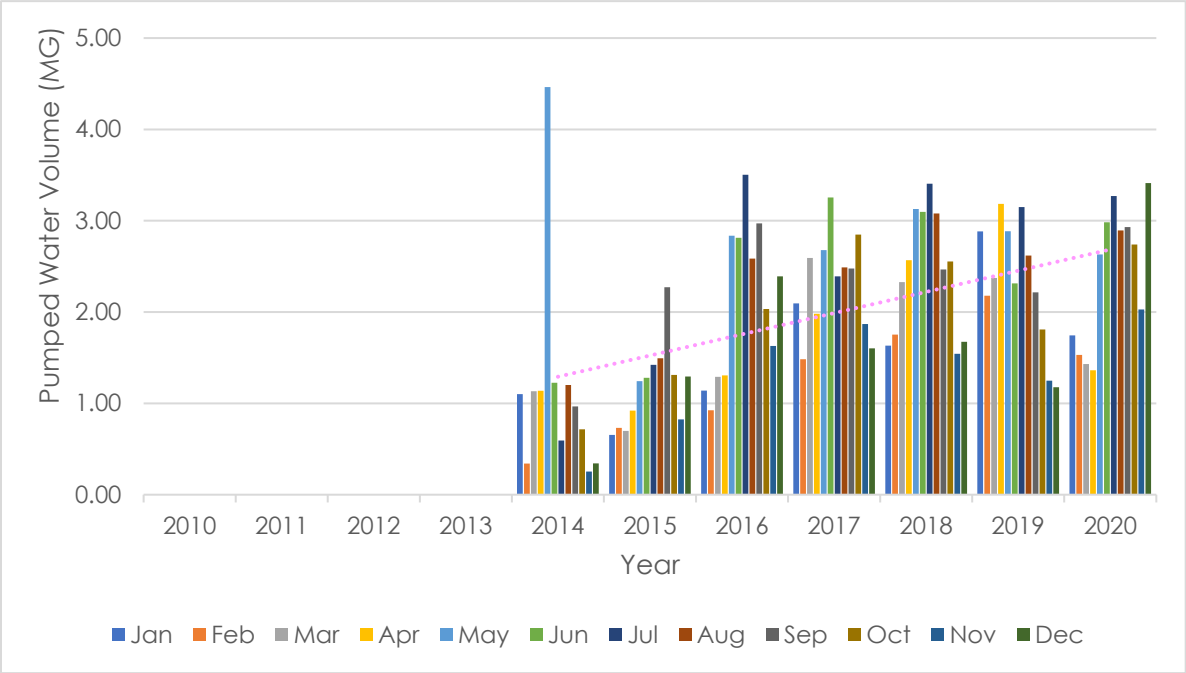
Depicts trendline based on annual average volume of water pumped from well.

Stantec

Table 18
Monthly Volume (MG) of Water Pumped from Well 2136000-04G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	0.00	0.00	1.10	0.66	1.14	2.09	1.63	2.88	1.75
February	0.00	0.00	0.34	0.73	0.93	1.48	1.75	2.18	1.53
March	0.00	0.00	1.13	0.70	1.29	2.59	2.33	2.37	1.43
April	0.00	0.00	1.14	0.92	1.31	1.98	2.57	3.19	1.36
May	0.00	0.00	4.46	1.24	2.84	2.68	3.13	2.89	2.63
June	0.00	0.00	1.23	1.28	2.81	3.25	3.10	2.31	2.98
July	0.00	0.00	0.59	1.42	3.50	2.39	3.41	3.15	3.27
August	0.00	0.00	1.20	1.49	2.59	2.49	3.08	2.62	2.89
September	0.00	0.00	0.97	2.27	2.97	2.48	2.47	2.22	2.93
October	0.00	0.00	0.72	1.31	2.03	2.85	2.55	1.81	2.74
November	0.00	0.00	0.25	0.83	1.63	1.87	1.54	1.25	2.03
December	0.00	0.00	0.34	1.29	2.39	1.60	1.68	1.18	3.41
AVERAGE	0.00	0.00	1.12	1.18	2.12	2.31	2.44	2.34	2.41

Figure 7
Monthly Volume (MG) of Water Pumped from Well 2136000-04G



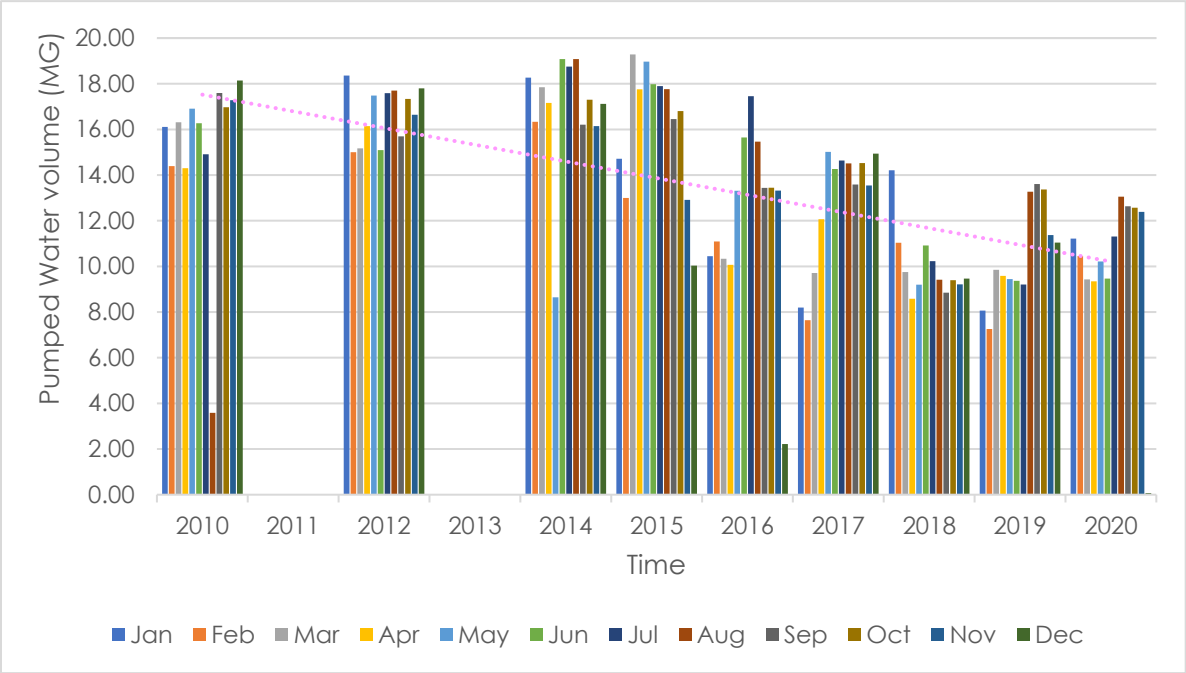
Depicts trendline based on annual average volume of water pumped from well.

Stantec

Table 19
Monthly Volume (MG) of Water Pumped from Well 2136000-05G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	16.11	18.36	18.27	14.72	10.45	8.20	14.21	8.06	11.22
February	14.39	15.00	16.33	12.99	11.09	7.65	11.03	7.26	10.45
March	16.31	15.17	17.85	19.28	10.34	9.71	9.75	9.85	9.43
April	14.30	16.14	17.16	17.75	10.07	12.06	8.58	9.59	9.34
May	16.91	17.49	8.65	18.97	13.32	15.02	9.20	9.44	10.21
June	16.27	15.09	19.08	17.98	15.65	14.27	10.92	9.37	9.47
July	14.91	17.59	18.75	17.89	17.45	14.64	10.23	9.20	11.31
August	3.59	17.70	19.08	17.77	15.46	14.51	9.42	13.27	13.05
September	17.59	15.70	16.21	16.45	13.44	13.59	8.85	13.61	12.63
October	16.97	17.34	17.30	16.80	13.45	14.52	9.39	13.37	12.57
November	17.28	16.64	16.14	12.91	13.32	13.54	9.21	11.37	12.39
December	18.14	17.80	17.12	10.03	2.22	14.94	9.47	11.04	0.06
AVERAGE	15.23	16.67	16.83	16.13	12.19	12.72	10.02	10.45	10.18

Figure 8
Monthly Volume (MG) of Water Pumped from Well 2136000-05G



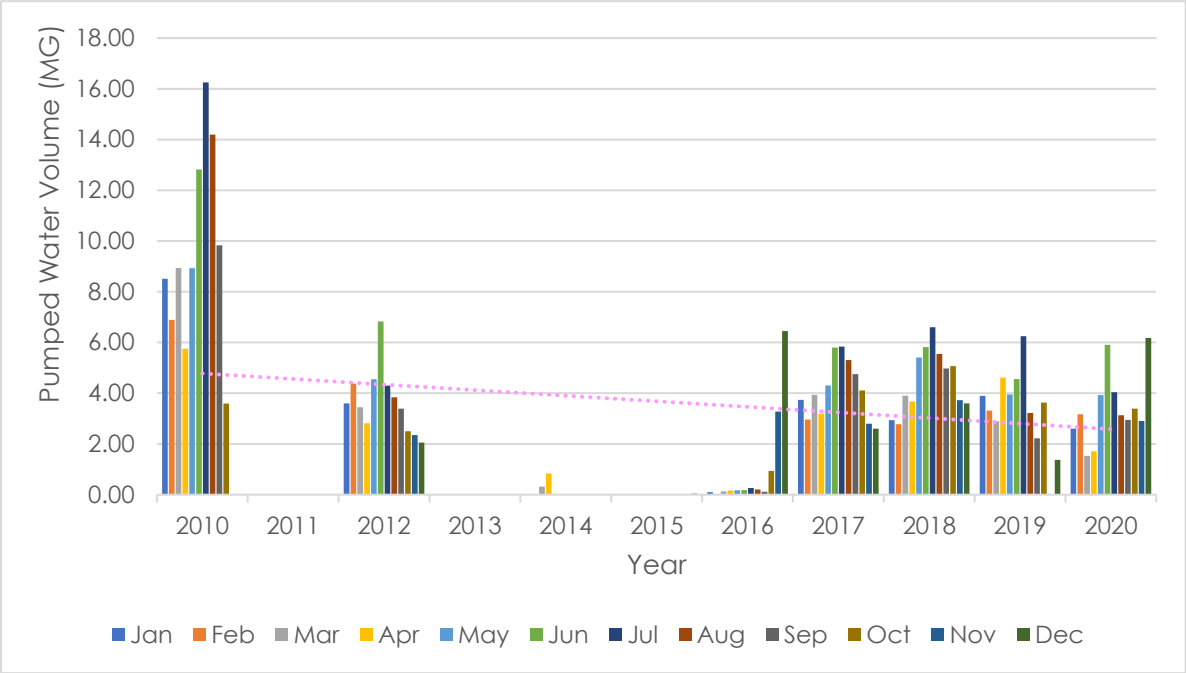
Depicts trendline based on annual average volume of water pumped from well.

Stantec

Table 20
Monthly Volume (MG) of Water Pumped from Well 2136000-06G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	8.51	3.60	0.00	0.00	0.10	3.74	2.94	3.90	2.61
February	6.89	4.38	0.00	0.00	0.00	2.96	2.78	3.31	3.17
March	8.93	3.45	0.32	0.00	0.13	3.94	3.90	2.89	1.53
April	5.75	2.82	0.84	0.00	0.16	3.20	3.68	4.62	1.72
May	8.93	4.55	0.00	0.00	0.17	4.30	5.41	3.95	3.93
June	12.82	6.83	0.00	0.00	0.18	5.80	5.82	4.56	5.91
July	16.25	4.30	0.00	0.00	0.26	5.84	6.60	6.25	4.04
August	14.20	3.84	0.00	0.00	0.21	5.31	5.55	3.22	3.13
September	9.83	3.39	0.00	0.00	0.12	4.76	4.97	2.23	2.95
October	3.59	2.50	0.00	0.00	0.94	4.11	5.07	3.63	3.39
November	0.00	2.35	0.00	0.00	3.28	2.80	3.73	0.00	2.90
December	0.00	2.05	0.00	0.04	6.45	2.60	3.60	1.37	6.18
AVERAGE	7.98	3.67	0.10	0.00	1.00	4.11	4.50	3.33	3.45

Figure 9
Monthly Volume (MG) of Water Pumped from Well 2136000-06G



Depicts trendline based on annual average volume of water pumped from well.

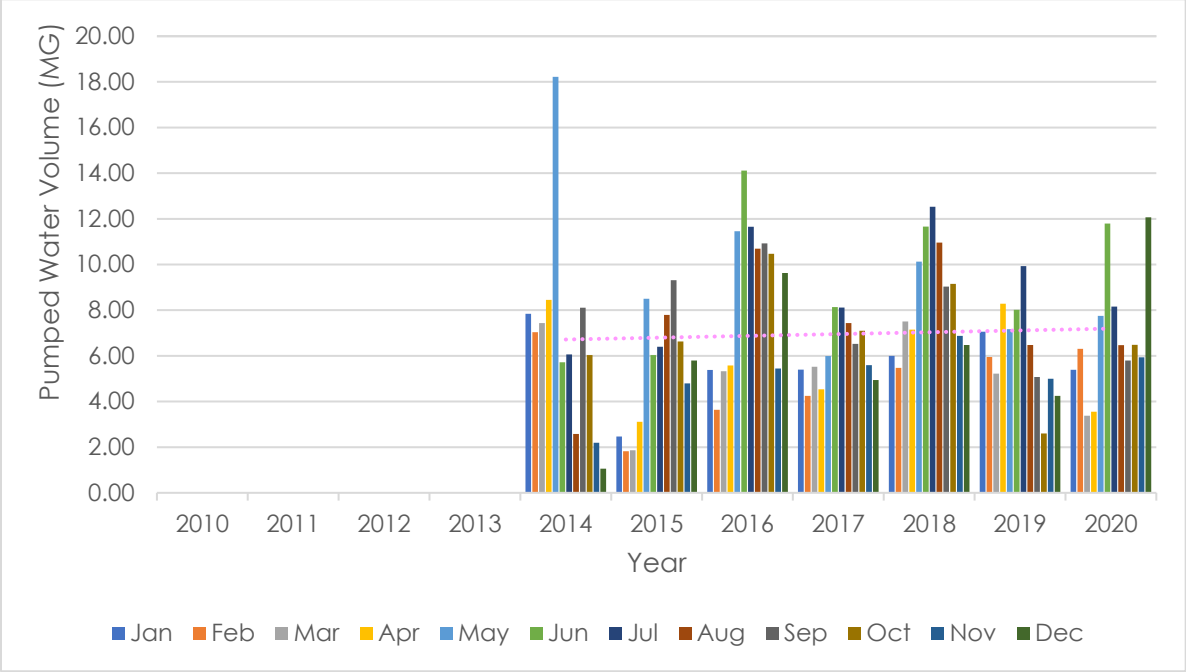
Stantec

Table 21
Monthly Volume (MG) of Water Pumped from Well 2136000-07G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	–	–	7.84	2.46	5.38	5.40	6.00	7.06	5.39
February	–	–	7.04	1.82	3.64	4.25	5.47	5.95	6.31
March	–	–	7.43	1.86	5.33	5.52	7.50	5.22	3.38
April	–	–	8.45	3.11	5.58	4.53	7.15	8.29	3.55
May	–	–	18.22	8.50	11.46	5.99	10.12	7.17	7.75
June	–	–	5.72	6.03	14.12	8.14	11.66	8.01	11.80
July	–	–	6.06	6.40	11.65	8.11	12.53	9.93	8.16
August	–	–	2.58	7.79	10.69	7.44	10.96	6.48	6.47
September	–	–	8.11	9.31	10.93	6.52	9.03	5.07	5.80
October	–	–	6.03	6.63	10.47	7.10	9.15	2.60	6.49
November	–	–	2.19	4.79	5.45	5.59	6.87	5.00	5.94
December	–	–	1.06	5.80	9.63	4.94	6.48	4.24	12.07
AVERAGE	–	–	6.73	5.38	8.69	6.13	8.58	6.25	6.92

"–" means well not included in the ASR of that year.

Figure 10
Monthly Volume (MG) of Water Pumped from Well 2136000-07G



Depicts trendline based on annual average volume of water pumped from well.

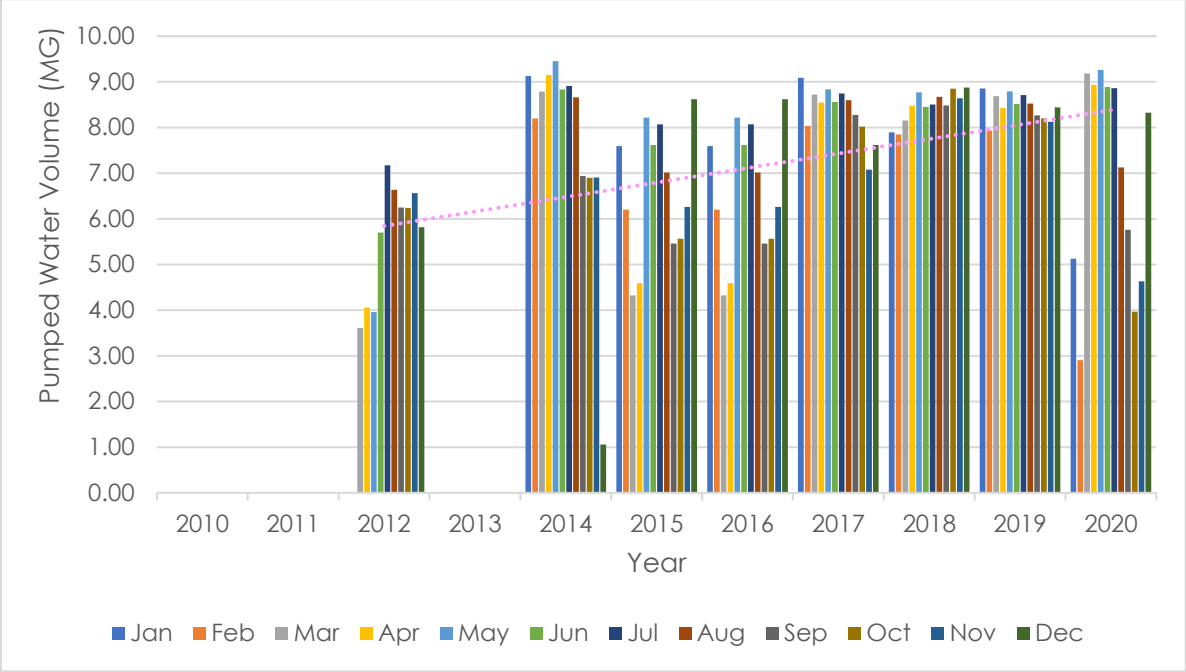
Stantec

Table 22
Monthly Volume (MG) of Water Pumped from Well 2136000-08G

Period	2010	2012	2014	2015	2016	2017	2018	2019	2020
January	–	0.00	9.13	7.59	7.59	9.09	7.89	8.85	5.13
February	–	0.00	8.20	6.20	6.20	8.04	7.85	7.94	2.90
March	–	3.61	8.79	4.32	4.32	8.72	8.15	8.69	9.18
April	–	4.06	9.15	4.59	4.59	8.55	8.48	8.43	8.94
May	–	3.96	9.45	8.22	8.22	8.84	8.77	8.79	9.26
June	–	5.70	8.83	7.62	7.62	8.56	8.45	8.52	8.89
July	–	7.17	8.91	8.07	8.07	8.75	8.50	8.71	8.86
August	–	6.64	8.66	7.02	7.02	8.60	8.67	8.53	7.13
September	–	6.25	6.94	5.46	5.46	8.28	8.48	8.27	5.76
October	–	6.24	6.90	5.57	5.57	8.02	8.85	8.20	3.97
November	–	6.56	6.91	6.26	6.26	7.08	8.64	8.13	4.63
December	–	5.82	1.06	8.62	8.62	7.62	8.88	8.44	8.33
AVERAGE	–	4.67	7.74	6.63	6.63	8.34	8.47	8.46	6.91

"–" means well not included in the ASR of that year.

Figure 11
Monthly Volume (MG) of Water Pumped from Well 2136000-08G



Depicts trendline based on annual average volume of water pumped from well.

Stantec

WMA PERMITS AND REGISTRATIONS

The Town of Holliston's Water Management Act (WMA) Registration and related permit allows for the daily average withdrawal of 1.14 MGD (i.e. annual average of 416.1 MGY) from the Charles River basin at the rates shown in Table 23. The total volume of 1.41 MGD allocated for Period Four is the maximum interim volume that may be allocated to the Town, and is reserved pending the completion of a water needs forecast by the Massachusetts Department of Conservation and Recreation for the Town.

Table 23
Maximum Authorized Raw Water Withdrawal Volumes per WMA

Five-Year Periods		Permit		Permit + Registration	
		Daily Average (MGD)	Annual Average (MGY)	Daily Average (MGD)	Annual Average (MGY)
Period One; Years 1 – 5	3/1/2010 to 2/28/2014	0	0	1.14	416.10
Period Two; Years 6 – 10	3/1/2014 to 2/29/2019	0	0	1.14	416.10
Period Three; Years 11 – 15	3/1/2019 to 2/28/2024	0	0	1.14	416.10
Period Four; Years 16 – 20	3/1/2024 to 2/28/2029	0.27	98.55	1.41	514.65

The volume allocated for Period One through Period Three includes withdrawal from the following registered withdrawal points:

Identification Code	Type	Name
2136000-01G	Groundwater	Norfolk Street #1
2136000-02G	Groundwater	Maple Street #2
2136000-04G	Groundwater	Washington Street #4
2136000-05G	Groundwater	Central Street #5
2136000-06G	Groundwater	Brook Street #6

The volume allocated for Period 4 includes an additional 0.27 MGD for Well #7 as an authorized withdrawal point:

Identification Code	Type	Name
2136000-07G	Groundwater	Well #7

Note that the approved daily pumping rate for Well #7 and Well #6 is limited to a maximum combined daily pumping rate of 0.86 MGD, which represents the previously approved pumping rate for Well #6. The limitation to this volume is due to the potential impact of withdrawals on nearby wetlands and

Dopping Brook. MassDEP will reevaluate this volume in the future after several years of monitoring.

The Town of Holliston's original WMA permit expired on February 28, 2009; however, an interim permit was issued authorizing the continued withdrawal of the previously permitted volumes for the Wells #1, 2, 4, 5, and 6. In May 2002, the Town was issued another WMA permit for the inclusion of Well #7 as an approved source with an additional permitted volume allocated solely for it.

The Permit Extension Act has extended all Water Management Registrations by four (4) years; thereby rendering the Town's current Water Management Registrations to be effective through December 31, 2021. However, per Stantec communication with MassDEP, it is possible that another extension may be granted due to the ongoing COVID-19 pandemic. MassDEP will send to suppliers the necessary forms file a renewal request for WMA Registration in advance the renewal period.

6 WATER SUPPLY RECOMMENDATIONS

6. WATER SUPPLY RECOMMENDATIONS

HYDROGEOLOGICAL INVESTIGATION OF NEW SOURCE(S)

Based on the current review, the Town of Holliston's existing groundwater sources remain adequate to meet ancitpated future demand. Hydrogeological investigation of new sources is at present not required.

It is recommended that the Town of Holliston continue being proactive with respect to its water system operational and maintenance practices especially during offseason, staffing of its well stations, and system resiliency during emergency situations. It is also recommended that the water quality at each well contine to be closely monitored especially in regard to emerging conatminants such as PFAS.

OPERATIONAL AND MAINTENANCE PRACTICES FOR EXISTING SOURCES

The following sections describe the recommended operational and maintenance practices for the existing well pumping stations on a daily, weekly, monthly, and yearly basis.

Daily or Weekly

- Check well pumping station interior and grounds for general cleanliness and condition, and for any threats to water quality.
- Check any warning lights or alarms – low water level in the well, intrusion, power outage, pump failure, etc.
- Read source water meter. Record water-production data in well house log.
- Read pump run hour meters and record data in well house log (unless automatic data storage is available).
- Check pump-cycling rate. If it runs continuously or cycles more than 6 times per hour, see pump troubleshooting.
- Check that instruments are properly calibrated.
- Check that generator is functional and on standby for a sudden power loss.

- Check well house buildings for signs of security problems – graffiti, vandalism, doors or locks damaged, entry, etc.
- Check wells source site after any adverse weather – high winds, heavy snow, ice, rains, etc.
- Check well water level if source capacity is marginal or there are drought conditions.

Monthly

- Check area for excessive vegetation or dangerous conditions – uncut grass, brush, dead trees, fire hazard, etc.
- Check well pumping station control valves for proper positions, open or closed. This information should be posted.
- Check source control system – pressure switch settings, cycling, storage tank water levels, etc.
- Check well pumping station control valves for damage or leaks.
- Check for leaks – read source meter when you expect the water usage to be zero.
- Check well pump cycling and pressure switch settings, on/off pressures, and line pressures.

Annually or Seasonally

- Check well site for water ponding, poor drainage areas, excessive vegetation, unhealthy trees, fire hazards, etc.
- Check well pumping stations conditions – corrosion, vent screens, vehicular or other damage, animal activity, etc.
- Check cold weather protection – insulation, heating system, alarm system, etc.
- Verify sanitary integrity of the sources – screened vents, no unprotected openings, electrical box sealed, etc.
- Evaluate source use designations (permanent, seasonal, emergency, or inactive).
- Exercise valves and test run emergency source wells to waste. Do not supply distribution system without water quality tests.
- Evaluate Emergency Response Plan and update as required.
- Review source related customer complaints and evaluate corrective actions and planning.
- Implement seasonal start-up or shut-down procedures.
- Review source water quality test results for trends, such as increasing iron and manganese.

Less Than Once a Year

- Measure source pump capacity in gallons per minute (GPM) to detect pump output problems (pump test to confirm pump curve).
- Evaluate general source capacity to meet water system demand with water use and production records.
- Evaluate capacity of source water to provide water of a reliable quantity and quality acceptable to customers.
- Consider television inspection of the well interior and the well screens.

7 WATER MAIN IMPROVEMENTS PLANNING

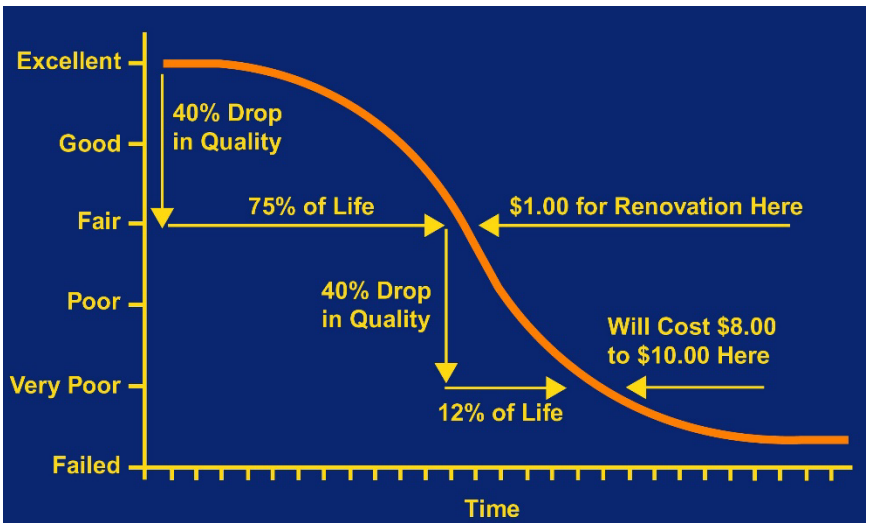
7. WATER MAIN IMPROVEMENTS PLANNING

GENERAL ASSET MANAGEMENT CONCEPTS

The development of an asset management system is a logical approach town officials use to allocate cost effective budgets. The theory of asset management is based on accurately predicting accelerated deterioration of assets. Figure 12 dramatically illustrates the key concept of making timely maintenance repairs, thereby averting the need for far more expensive structural repairs. The goal is to save money in both the short and long run by developing a program that minimizes expenditures.

The Town of Holliston initiated an asset management approach to the water distribution system assets in 2010. This report serves as an update to the previous report.

Figure 12
Typical Asset Management Deterioration Curve



The curve shows the rate at which a typical asset deteriorates over time (Figure 12). An asset deteriorates slowly through the first two-thirds of its projected life span (the portion of the graph where the curve is nearly horizontal). This level of deterioration per year increases drastically (the portion where the curve becomes nearly vertical) as the asset continues two the last third of its life span. When the asset is near the end of its projected life span, the asset levels out at a slower rate in the bottom through the worst conditions

until it reaches failure (the curve returns to near horizontal). The point where a typical asset passes middle age, before the curve drops off sharply, is considered the critical zone in the asset's life. Before this point, it is relatively inexpensive to keep an asset in good service, while after this point, it becomes much more expensive to keep the asset in good service condition.

The asset management system formalizes the asset deterioration curve process by using computer software. The procedure is to collect, organize, and maintain a complete water system database that describes a particular water system network. This data is then analyzed to identify existing deterioration levels, prioritize cost-effective repairs, and create an optimal long-term spending plan. Asset Management provides the Town with a tool to make the best use of every available dollar.

Study Approach

In 2010 Stantec completed an Asset Management Plan for the water distribution system assets. Since the development of that report the Town has been implementing an annual pipeline replacement program. This evaluation serves as an update to the previous study.

In 2010 the water system GIS data was developed using a combination of existing mapping and field data collection. Stantec conducted a Town-wide hydrant and valve inventory and assessment. Hydrants and valves were visually inspected, and the overall condition was documented in the GPS unit along with its coordinates. In addition to visual inspection, the model and manufacturing date (year) of each hydrant was also collected. All hydrant-manufactured years were then analyzed in GIS to determine the install date for a pipeline. On a single street if the majority of the hydrants were manufactured within 5 years of each other, then the earliest year was assigned as the "year installed" for the pipeline. When hydrants on a street were from a variety of years, the hydrant years were compared to the Town's existing listing of pipeline installation years and a decision was made based on the nearby pipeline age and available information.

This existing GIS data was updated to reflect the water system improvements that have been constructed over the last 10 years. Data was also collected from the Town on history of breaks, leaks, and water quality complaints. Stantec also collaborated with the Town on identifying problem areas within the water distribution system which may not be reflected in the break and water quality complaint data. Previous hydraulic studies were also reviewed to identify any pipe improvements that were recommended for hydraulic improvements.

8 WATER MAIN IMPROVEMENTS METHODOLOGY

8. WATER MAIN IMPROVEMENTS METHODOLOGY

ASSET MANAGEMENT SOFTWARE

Today's computer management technology allows consolidation of multiple data for easy and efficient building, editing, sorting, and reporting. Stantec used CarteGraph Systems, Inc. - WATERview® software for storing and analyzing Holliston's water distribution system data. The database was custom tailored to reflect Holliston's specific decision-making criteria for selecting water main repair types for available and proposed budgets.

For analyzing Holliston's water distribution system, the Pipe Condition Index (PCI) served as the primary factor in determining the water main serviceability and performance. PCI is based on pipe material, age, and the pipes' proximity to potentially elevated ground water levels and is used to quantify the overall water main condition.

Within the Holliston water distribution system there are five (5) different pipeline materials: Asbestos Cement, Cast Iron, Ductile Iron, Steel and Poly Vinyl Chloride. Regardless of material, a pipeline's proximity to high groundwater can influence the deterioration rate of the pipeline. Water main performance curves were developed for each water main material type and whether the pipe was installed in a location where high groundwater may be present. The location of high groundwater levels was assumed based on proximity to wetlands and surface water.

Pipe Condition Index (PCI)

Stantec generated a PCI for each inventoried water main in Holliston using pipe age and material data. Typically break history would also be included in generating a PCI but Holliston does not have a significant history of water main breaks. Most leaks in the system are not cause by breaks but by leaks at the service connections. Instead, the available break history provided was used as part to determine a Network Priority Rating (NPR). PCI is measured on a one hundred to zero scale, with one hundred representing a water main in excellent condition and zero describing a water main in extremely poor condition, or other words has outlived its expected service life.

Three Treatment Repair Bands

Stantec's water main management software decision matrix uses three broad category ranges to group the calculated PCI numbers into three major repair bands. An individual pipe segment will fall into a particular band based on

user-defined criteria such as material type, age, and ground water level conditions. Then each segment is assigned a repair alternative candidate with the prescribed treatment band. Table 24 presents the category ranges represented by the PCI bands.

Table 24
PCI Treatment Band Ranges

Action	PCI Band #	PCI Range	Condition	Notes
Do Nothing	1	100 – 65	Excellent to Good	Strong reliability
Monitor	2	65 – 5	Fair	Acceptable condition/performance
Replace	3	5 – 0	Failure	Outlived service life, likely in need of pipe replacement and/or inadequate fire flow protection/ criticality

- When pipes are in near perfect condition, the **Do Nothing** category (Band #1) prescribes no work. Pipes are highly dependable and have an excellent performance track record.

- The **Monitor/Maintenance** category (Band #2) is categorized for pipes in reasonably good to fair condition. This treatment band has the widest PCI range, as these pipes have plenty of remaining service life, but are subject to "monitoring of health". This treatment category would include leak detection, clean and lining cast iron pipe, inspecting external pipe conditions, pipe excavations, etc.

- The **Replace** category (Band #3) represents pipes that are near the end of their expected service life and warrants pipe replacement. Quite often, project level evaluation through test pit, field sampling, and cutting out a pipe section/coupon is done to evaluate pipe integrity prior to construction.

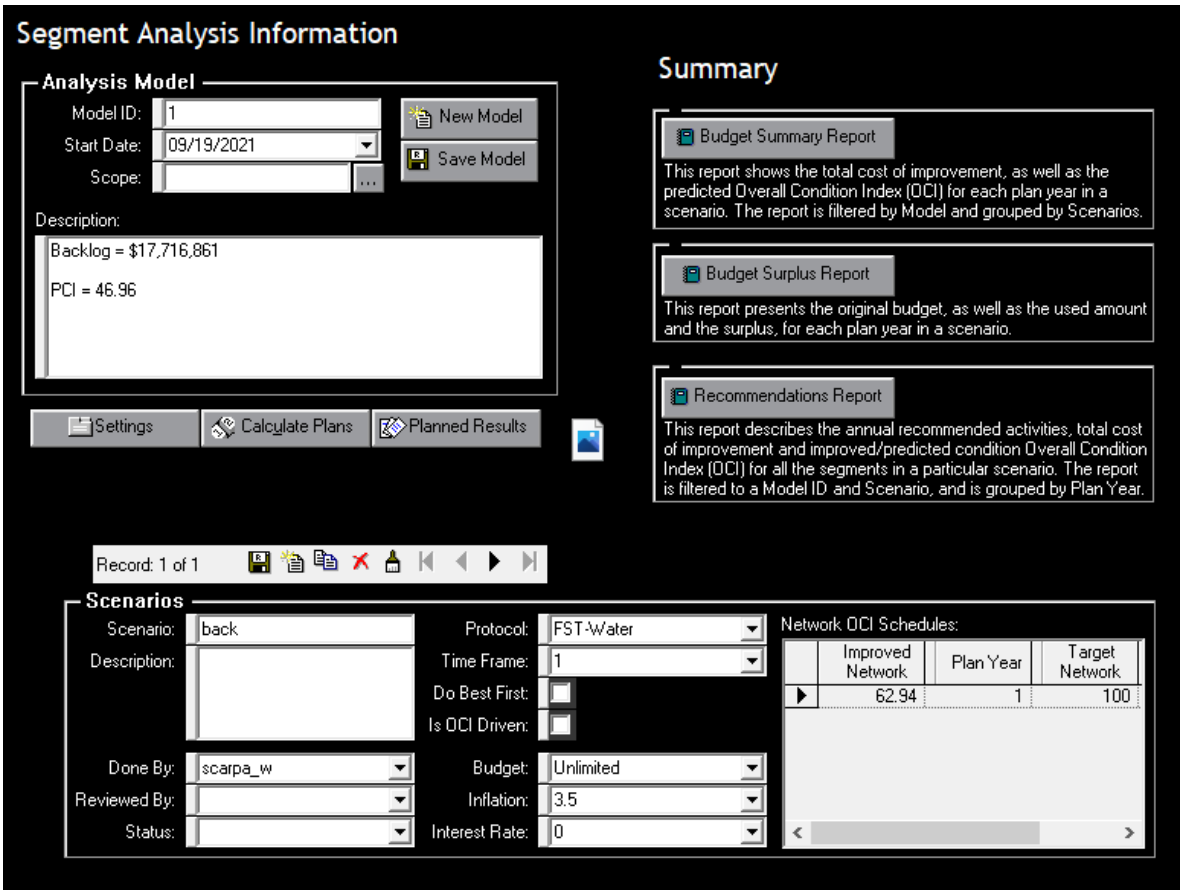
Priority Ranking and Future Projection

After all water main segment repairs are assigned, the software prioritizes needed system repairs based on the highest projected Network Priority Ranking (NPR). The NPR value uses variables representing break history, fireflow protection adequacy, complaint history, and criticality. Although water main repairs could solely be prioritized on an "oldest-first" basis, Stantec and Holliston Water Department chose to maximize its available water funds by generating an NPR that favors repairs that have outlived its service life and critical components to the water distribution system.

First a backlog scenario was run to establish the current conditions of the infrastructure then a future plan was developed. Each plan year, the software prepares a future water main condition projection, exhausts the assigned budget, and then produces an annual list of water main segments to include in the repair program. The system also takes inflation into account for the time value of money. In these cases, a 3.5% inflation rate was used. Figure 13 shows the scenario analysis model. Having explained the methodology built into the

water system asset management software, the next section describes the existing water main system conditions in Holliston.

Figure 13
Pipe Segment Analysis



9 WATER MAIN EXISTING CONDITIONS

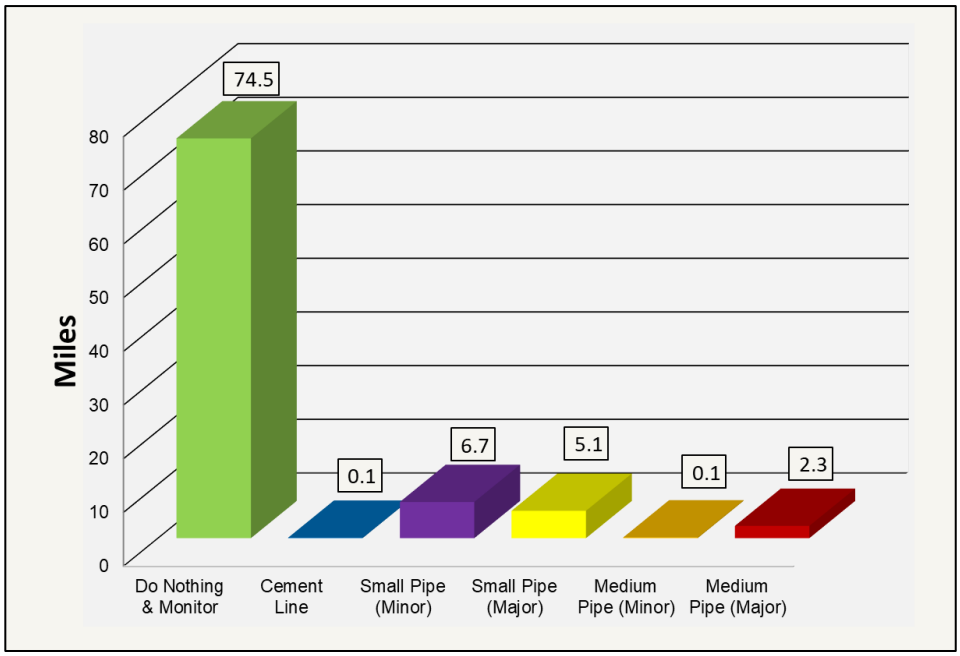
9. WATER MAIN EXISTING CONDITIONS

WATER MAIN MATERIAL AND CURRENT PCI

The Town of Holliston water distribution includes approximately 90 miles of pipe. This water distribution system is predominantly asbestos cement pipe material. The system is comprised of 61.5 miles of asbestos cement, 16.7 miles of ductile iron, 9.5 miles of poly vinyl chloride, 1.0 mile of steel, and 0.1 mile of cast iron pipe.

Stantec determined that the Town's average water main system network PCI in the Fall of 2021 was 47. This PCI average value generally represents a water main in "fair" condition. Figure 14 illustrates today's mile distribution based on the repair treatment bands. Treatment bands are broken into Do Nothing & Monitor, Cement Line, Small Pipes (8 in. diameter and less) and Medium Pipes (10-12 in. diameter) for Major and Minor roadways.

Figure 14
Town-wide Pipe Distribution in Miles by Repair Activity



Stantec

DISTRIBUTION OF PIPES BY AGE

Holliston has approximately 90 miles of piping that make up its water main distribution system. The categorization of water main pipe segments by age show that 21% (18.8 miles) of pipe was installed between the 1940s and 50s; 45% (30.2 miles) were installed between the 60s and 70s; 25% (22.5 miles) of pipes between the 80s and 90s, and 9% (8.3 miles) of pipe were installed after 2000 (Figure 15). Over one-half of the pipe distribution network is over 40 years old.

Appendix A contains the PCI values for each individual water main pipe segment.

Figure 15
Pipe Distribution in Miles by Year Installed

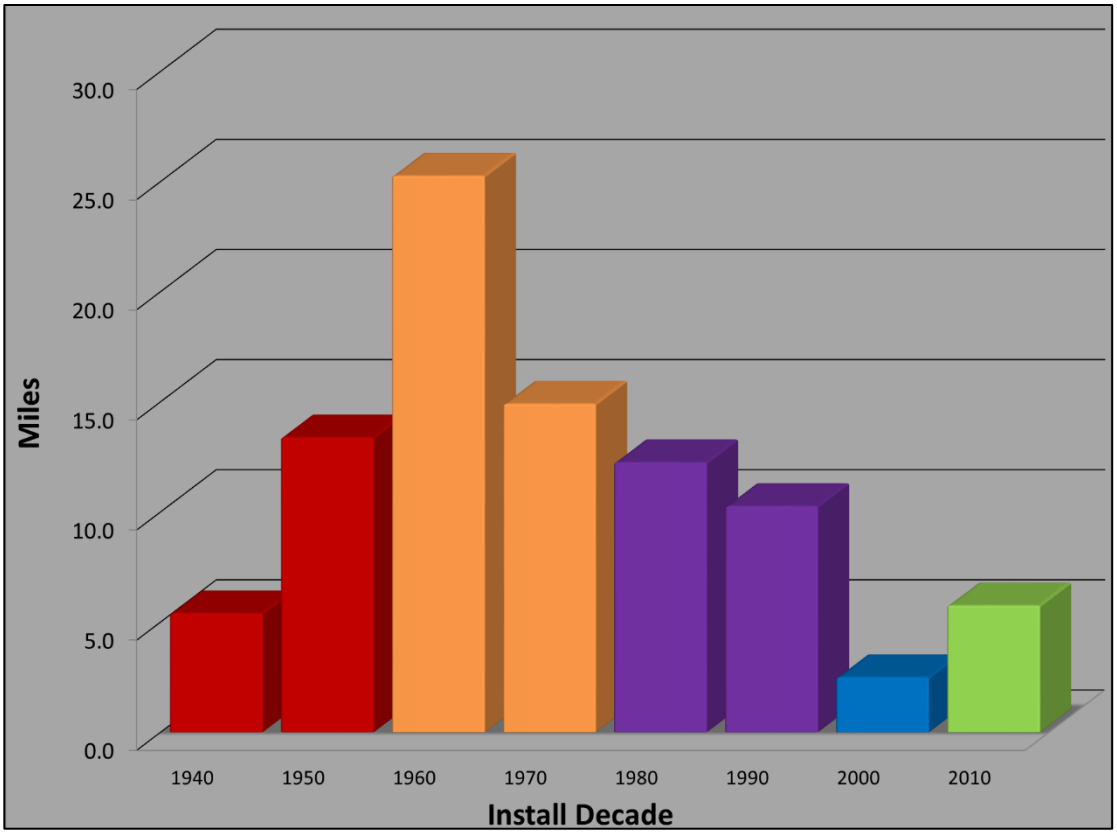


Figure 16 shows a map illustrating town-wide pipe age.

Legend

Date Installed

- 1940s
- 1950s
- 1960s
- 1980s
- 1990s
- 2000s
- 2010s

N

W E

S

Figure 16
Map of Town-wide Pipe Age

CURRENT WATER MAIN BACKLOG

Backlog is defined as the cost of repairing all the water main which are already due for replacement within one year and bringing the average PCI of those water mains to a near perfect 100. Backlog is a "snapshot" or relative measure of outstanding repair work. The backlog not only represents how far behind the Holliston water system distribution network is in terms of its present physical condition, but its cost value serves as a benchmark to measure the impact of various funding scenarios. The current backlog offers a basis for comparison to future and/or past year's backlog(s). Backlog dollars represent the cost for design engineering, water main installation and pavement trench restoration only, it does not include related repair cost for other roadway/ pavement rehabilitation improvements. The backlog is based on a replacement ranging between $200-$350 per foot depending on size and roadway location. This variance in the construction cost per foot was assigned to account for the additional existing utilities and traffic management required for more major roadways.

As of Fall 2021, Holliston's backlog of water main repair work totaled $17,716,861; an increase of over $12 million in the last 11 years. This cost estimate consists $41,301 in cement line work, $7,130,501 in small pipe replacement on minor roadways, $6,740,305 in small pipe replacement on major roadways, $174,292 in medium pipe replacement on minor roadways and $3,630,461 in medium pipe replacement on major roadways. See Figure 17.

Figure 17
Dollar Backlog of Outstanding Repairs

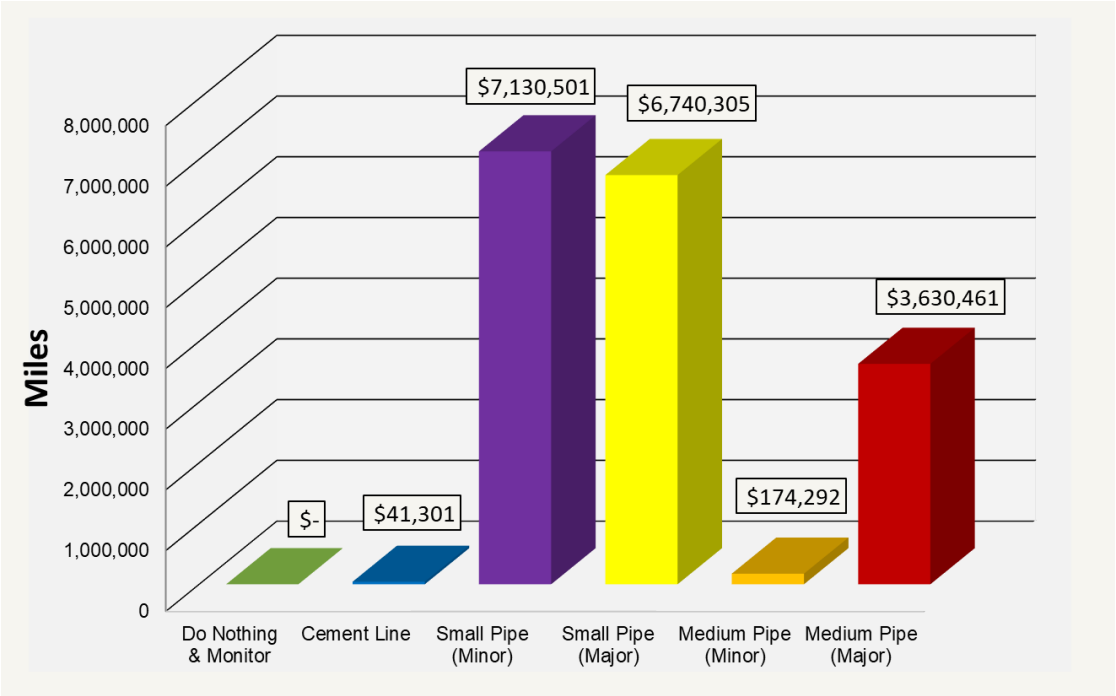


Figure 18 shows a map illustrating town-wide backlog.

Legend

Repair Type

- Do Nothing & Monitor
- Cement Line
- Small Pipe (Minor)
- Small Pipe (Major)
- Medium Pipe (Minor)
- Medium Pipe (Major)

N

W E

S

Figure 18
Map of Town-wide Backlog

10 MODEL/PLANNING PROCESS

10. MODEL/PLANNING PROCESS

BUDGET ANALYSIS

The analysis software of the asset management system is where financial determinations and projections are made. Consideration is given to the required budget and need for replacement, based on the supplied information from meetings with the Town and Stantec.

The planning process determines the most beneficial improvement plan based on the dollars available for rehabilitation or replacement and other factors. Asset management pulls together these components in its Network Priority Ranking (NPR) value in order to develop a cost-effective program. As previously stated, the NPR was configured to maximize water main funds.

Appendix A contains a backlog report of the suggested segment repairs, the associated costs, PCI, and NPR - as detailed in the Methodology section, the NPR number reflects the comparative merit of repairing one water main section over another, fire flow deficiency break history, customer complaints, and criticality. This report has been ordered alphabetically. The balance of this section explains the results of Holliston's scenario projections, and concludes with a long-term action plan based on the scenario findings.

SCENARIO FINDINGS

The following sections provide an overview of the budget/planning model results. Two budget/planning scenarios were modeled. These include: Zero Budget and Anticipated Budget Scenarios

After determining Holliston's existing backlog of work, Stantec projected the network average pipe condition index and backlog at a zero annual appropriation rate for water main replacement over the next 25-years; then anticipated appropriation rate for 25-years with a priority on repairing the highest priority pipes first.

All funding scenarios were calculated for a duration of 25-years. Focusing on higher priority projects, including the closing of loops and expansion of infrastructure the first 16 years, then prioritizing the highest ranked pipe segments.

All the scenarios accounted for the "optimum" NPR where NPR focuses on repairing the worst segments first. The dollar amounts appropriated incorporate a 3.50% annual inflation rate. **Therefore, where the annual water main program appropriation appears to remain the same, it in fact represents a net budget decrease due to the impact of inflation.**

In the scenario specific summary tables that follow, each plan begins with the same network average PCI, then shows the new network average PCI at the end of each plan period. The tables also use the same amount of outstanding repair work (backlog) at the start of each plan period, so the first plan year backlog will appear the same for each of the scenarios. The successive years document the impact of the funding plan on comparison of water main pipe network average conditions and backlog while accounting for a 3.5% inflation rate.

Zero Budget

As a baseline, a worst-case scenario was developed to show how the backlog would increase over a 25-year period, if there was no funding for water main replacements. Table 25 shows the change in backlog with no funding.

Table 25
Zero Budget – Impact on Backlog

Year	Funding	PCI Level	Backlog
Present		47.0	$17,716,861
FY 2023	$0	45.5	$18,598,747
FY 2024	$0	44.1	$19,249,329
FY 2025	$0	42.8	$23,801,317
FY 2026	$0	41.4	$24,633,840
FY 2027	$0	40.1	$26,633,841
FY 2028	$0	38.8	$28,531,578
FY 2029	$0	37.6	$43,384,144
FY 2030	$0	36.4	$47,575,021
FY 2031	$0	35.3	$49,244,341
FY 2032	$0	34.4	$54,661,225
FY 2033	$0	33.5	$61,381,337
FY 2034	$0	32.6	$67,925,882
FY 2035	$0	31.9	$74,248,804
FY 2036	$0	31.1	$80,810,641
FY 2037	$0	30.4	$84,501,430
FY 2038	$0	29.8	$87,796,829
FY 2039	$0	29.2	$98,716,363
FY 2040	$0	28.6	$103,415,915
FY 2041	$0	28.1	$111,479,835
FY 2042	$0	27.6	$118,302,818
FY 2043	$0	27.1	$123,661,594
FY 2044	$0	26.7	$128,977,117
FY 2045	$0	26.3	$134,938,943
FY 2046	$0	25.9	$141,009,813
FY 2047	$0	25.5	$148,266,402

In a 25-year period, this scenario shows that with no water main replacement funding, the network average PCI dropped more than 20 points. Further, the numbers show the repair backlog increasing by eight times to $148,000,000.

Anticipated Budget

Based on discussions with the Town of Holliston, Stantec evaluated the 25-year projection on an Anticipated Budget scenario based on an $1,300,000 funding level that the Town can secure to maintain and repair its water mains. Table 26 presents the results of this funding level.

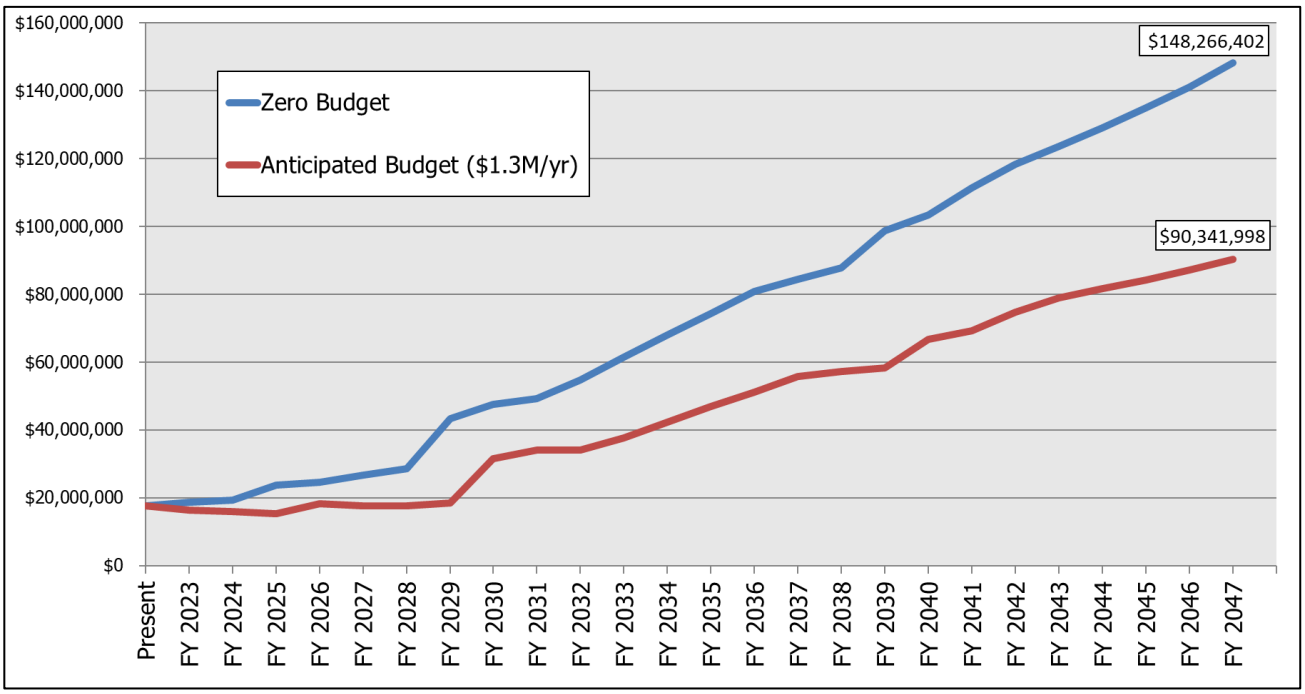
Table 26
Anticipated Budget – Impact on Backlog

Year	Funding	PCI Level	Backlog
Present		47.0	$17,716,861
FY 2023	$1,300,000	48.2	$16,417,693
FY 2024	$1,300,000	47.9	$15,954,015
FY 2025	$1,300,000	47.7	$15,214,174
FY 2026	$1,300,000	47.4	$18,340,450
FY 2027	$1,300,000	46.9	$17,699,573
FY 2028	$1,300,000	46.6	$17,625,001
FY 2029	$1,300,000	46.2	$18,451,807
FY 2030	$1,300,000	46.0	$31,582,353
FY 2031	$1,300,000	45.8	$34,072,159
FY 2032	$1,300,000	45.7	$33,955,526
FY 2033	$1,300,000	45.6	$37,575,898
FY 2034	$1,300,000	45.5	$42,358,759
FY 2035	$1,300,000	45.5	$46,935,374
FY 2036	$1,300,000	45.5	$51,216,983
FY 2037	$1,300,000	45.6	$55,674,116
FY 2038	$1,300,000	45.6	$57,200,379
FY 2039	$1,300,000	45.6	$58,241,937
FY 2040	$1,300,000	45.7	$66,807,232
FY 2041	$1,300,000	45.7	$69,146,998
FY 2042	$1,300,000	45.8	$74,665,220
FY 2043	$1,300,000	45.9	$78,958,565
FY 2044	$1,300,000	46.0	$81,596,732
FY 2045	$1,300,000	46.1	$84,128,000
FY 2046	$1,300,000	46.2	$87,218,232
FY 2047	$1,300,000	46.2	$90,341,998

The network average PCI slightly drops from a PCI of 47 down to a PCI of 46.2. While this funding level maintains the backlog through FY2029, the backlog

grows significantly to over $90,000,000 as older water mains reach the end of their service life at the end of the 25-years.

Figure 19
Summary of Water Main Funding Scenarios



11 WATER MAIN IMPROVEMENTS RECOMMENDATIONS

11. WATER MAIN IMPROVEMENTS RECOMMENDATIONS

PLAN OF ACTION

The overall water main network in the Town of Holliston is currently in fair condition. However, this study shows that future diligence will be necessary to preserve and improve town-wide water main conditions. The findings in this report illustrate anticipated funding levels are sufficient for the early years of the 25-year planning period but will be insufficient for the increase in water mains that begin coming due for replacement beginning in FY 2029.

The pipe deterioration rates included in this report are theoretical in nature. Actual pipe deterioration rates can be significantly impacted not only by high groundwater levels, which have been theoretically compensated for in this analysis through more aggressive deterioration curves for those pipe segments, but also pressure surges, pipe bedding material, corrosive soils, and electrical currents among other factors. Therefore the Town should supplement this network level tool with actual visual inspection of pipe exteriors. If a pipe segment is due for replacement based on its age, a test pit could be completed to visually inspect the exterior of the pipe to determine if any deterioration is present. Also, when excavation of a pipe segment is required for a service connection or repair, visual pipe observations should be noted since this data can assist with determining if this pipe segment will be due for replacement soon.

APPENDICES

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
10	ALDEN ROAD	AC - Asbestos Cement	6	1140	27.94	20.72	$ -	Do Nothing
100	TRAVIS ROAD	AC - Asbestos Cement	6	863	27.87	33.22	$ -	Do Nothing
101	TURNER ROAD	AC - Asbestos Cement	6	1053	30.09	5.73	$ -	Do Nothing
102	WALNUT ROAD	AC - Asbestos Cement	6	571	22.54	58.58	$ -	Do Nothing
103	WASHINGTON STREET	AC - Asbestos Cement	6	140	30.44	3.23	$ 28,047.60	Small Pipe (Minor)
104	WASHINGTON STREET	AC - Asbestos Cement	6	637	27.94	20.72	$ -	Do Nothing
105	WEBSTER DRIVE	AC - Asbestos Cement	6	612	30.02	18.22	$ -	Do Nothing
106	WILKINS ROAD	AC - Asbestos Cement	6	1434	29.66	20.72	$ -	Do Nothing
107	WINTER STREET	AC - Asbestos Cement	6	2293	26.43	96.65	$ -	Do Nothing
108	AVON STREET	AC - Asbestos Cement	6	80	30.44	3.23	$ 16,027.20	Small Pipe (Minor)
109	CENTRAL STREET	AC - Asbestos Cement	6	1024	32.62	0	$ 205,148.16	Small Pipe (Minor)
11	APPLEYARD LANE	AC - Asbestos Cement	6	1137	18.81	96.65	$ -	Do Nothing
110	WASHINGTON STREET	DI - Ductile Iron	12	191	19.6	79.15	$ -	Do Nothing
111	FRANCINE DRIVE	AC - Asbestos Cement	6	1046	25.44	38.22	$ -	Do Nothing
112	HIGHLAND STREET	PVC - Poly Vinyl Chloride	12	346	19.38	80.65	$ -	Do Nothing
113	LOWLAND STREET	AC - Asbestos Cement	12	251	24.37	45.72	$ -	Do Nothing
114	MAPLE STREET	DI - Ductile Iron	6	675	24.25	46.58	$ -	Do Nothing
115	MAPLE STREET	DI - Ductile Iron	6	63	29.01	46.58	$ -	Do Nothing
116	MAPLE STREET	DI - Ductile Iron	6	1330	25.96	46.58	$ -	Do Nothing
117	NORTH MILL STREET	DI - Ductile Iron	6	595	24.93	75.15	$ -	Do Nothing
118	OAK STREET	AC - Asbestos Cement	6	60	29.37	10.73	$ -	Do Nothing
119	PLEASANT STREET	AC - Asbestos Cement	6	692	26.52	30.72	$ -	Do Nothing
12	ASHLAND STREET	AC - Asbestos Cement	6	2428	35.48	0	$ 486,425.52	Small Pipe (Minor)
120	POND VIEW	DI - Ductile Iron	6	3111	18.53	86.65	$ -	Do Nothing
121	SCHOOL STREET	AC - Asbestos Cement	6	505	17.1	96.65	$ -	Do Nothing
122	TRACY LYN ROAD	AC - Asbestos Cement	6	1116	26.52	30.72	$ -	Do Nothing
123	TRAVIS ROAD	DI - Ductile Iron	6	983	20.67	71.65	$ -	Do Nothing
124	WASHINGTON STREET	AC - Asbestos Cement	8	76	30.44	3.23	$ 15,225.84	Small Pipe (Minor)
125	WASHINGTON STREET	DI - Ductile Iron	12	98	19.6	79.15	$ -	Do Nothing
126	WENDY LANE	DI - Ductile Iron	6	473	42.22	79.15	$ -	Do Nothing
127	GOULDING PLACE	PVC - Poly Vinyl Chloride	6	590	17.81	91.65	$ -	Do Nothing
128	BOGASTOW BOOK ROAD	AC - Asbestos Cement	6	469	22.82	56.58	$ -	Do Nothing
129	ROBIN HILL DRIVE	AC - Asbestos Cement	6	487	27.94	20.72	$ -	Do Nothing
13	AVON STREET	AC - Asbestos Cement	6	787	26.16	33.22	$ -	Do Nothing
130	ROLLING MEADOW DRIVE	PVC - Poly Vinyl Chloride	6	3458	19.38	80.65	$ -	Do Nothing
131	ROBIN HILL DRIVE	PVC - Poly Vinyl Chloride	6	1624	19.24	81.65	$ -	Do Nothing
132	EVERETT STREET	PVC - Poly Vinyl Chloride	6	663	19.31	81.15	$ -	Do Nothing
133	WHITNEY STREET	PVC - Poly Vinyl Chloride	6	397	24.15	80.65	$ -	Do Nothing
134	RALEIGH ROAD	PVC - Poly Vinyl Chloride	8	567	18.38	87.65	$ -	Do Nothing
135	PARTRIDGE WAY	PVC - Poly Vinyl Chloride	8	1105	18.38	87.65	$ -	Do Nothing
136	MANCHESTER	PVC - Poly Vinyl Chloride	8	308	18.38	87.65	$ -	Do Nothing
137	PARTRIDGE WAY	PVC - Poly Vinyl Chloride	8	600	18.38	87.65	$ -	Do Nothing
138	RALEIGH ROAD	PVC - Poly Vinyl Chloride	8	377	18.38	87.65	$ -	Do Nothing
139	ADAMS STREET	AC - Asbestos Cement	8	1873	27.59	23.22	$ -	Do Nothing
14	BAYBERRY LANE	AC - Asbestos Cement	6	982	25.8	35.72	$ -	Do Nothing
140	ANDREW LANE	AC - Asbestos Cement	8	1362	27.94	20.72	$ -	Do Nothing
141	ANNE MARIE DRIVE	AC - Asbestos Cement	8	1246	25.44	38.22	$ -	Do Nothing
142	ASHLAND STREET	AC - Asbestos Cement	8	278	30.9	0	$ 55,694.52	Small Pipe (Minor)
143	BAKER STREET	AC - Asbestos Cement	8	1111	26.52	30.72	$ -	Do Nothing
144	BOGASTOW BOOK ROAD	AC - Asbestos Cement	8	1147	24.82	54.58	$ -	Do Nothing
145	BONNEY DRIVE	AC - Asbestos Cement	8	2083	24.37	45.72	$ -	Do Nothing
146	BRIARCLIFF LANE	AC - Asbestos Cement	8	1844	21.96	62.58	$ -	Do Nothing
147	BROOK STREET	AC - Asbestos Cement	8	1095	29.14	45.72	$ -	Do Nothing
148	BULLARD STREET	AC - Asbestos Cement	8	1274	27.87	54.58	$ -	Do Nothing

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
149	BURNAP ROAD	AC - Asbestos Cement	8	1091	25.8	35.72	$ -	Do Nothing
15	BEVERLY CIRCLE	PVC - Poly Vinyl Chloride	8	417	19.1	82.65	$ -	Do Nothing
150	CARL ROAD	AC - Asbestos Cement	8	570	25.8	35.72	$ -	Do Nothing
151	CEDAR ROAD	AC - Asbestos Cement	8	462	30.44	3.23	$ 92,557.08	Small Pipe (Minor)
152	CEDAR STREET	AC - Asbestos Cement	8	2837	26.43	96.65	$ -	Do Nothing
153	CENTRAL STREET	AC - Asbestos Cement	8	3818	23.68	50.58	$ -	Do Nothing
154	CENTRAL STREET	AC - Asbestos Cement	8	1268	23.68	50.58	$ -	Do Nothing
155	CENTRAL STREET	AC - Asbestos Cement	8	2570	24.37	45.72	$ -	Do Nothing
156	CENTRAL STREET	AC - Asbestos Cement	8	641	18.86	84.29	$ -	Do Nothing
157	CHAMBERLAIN STREET	AC - Asbestos Cement	8	523	27.94	20.72	$ -	Do Nothing
158	CHARLES STREET	AC - Asbestos Cement	6	987	28.3	18.22	$ -	Do Nothing
159	CHURCH PLACE	AC - Asbestos Cement	8	285	30.44	3.23	$ 57,096.90	Small Pipe (Minor)
16	BIRCH ROAD	AC - Asbestos Cement	6	934	24.02	48.22	$ -	Do Nothing
160	CHURCH STREET	AC - Asbestos Cement	8	2431	23.68	62.58	$ -	Do Nothing
161	CONCORD STREET	AC - Asbestos Cement	8	1702	45	0	$ 426,214.84	Small Pipe (Major)
162	CURVE STREET	AC - Asbestos Cement	8	434	25.09	40.72	$ -	Do Nothing
163	DALTON ROAD	AC - Asbestos Cement	8	3507	23.39	64.58	$ -	Do Nothing
164	DAY ROAD	AC - Asbestos Cement	8	514	26.52	30.72	$ -	Do Nothing
165	DUNSTER ROAD	AC - Asbestos Cement	8	1257	25.8	35.72	$ -	Do Nothing
166	DODD DRIVE	AC - Asbestos Cement	8	1538	24.37	45.72	$ -	Do Nothing
167	ELM STREET	AC - Asbestos Cement	8	528	34.78	18.22	$ -	Do Nothing
168	EXCHANGE STREET	AC - Asbestos Cement	8	1453	21.86	96.65	$ -	Do Nothing
169	FISKE STREET	AC - Asbestos Cement	8	1158	53.52	0	$ 231,993.72	Small Pipe (Minor)
17	BIRCHWOOD DRIVE	AC - Asbestos Cement	6	1446	17.1	96.65	$ -	Do Nothing
170	FRANCINE DRIVE	AC - Asbestos Cement	8	531	25.44	38.22	$ -	Do Nothing
171	FRUIT STREET	AC - Asbestos Cement	8	449	24.73	43.22	$ -	Do Nothing
172	GORWIN DRIVE	AC - Asbestos Cement	8	1524	27.94	20.72	$ -	Do Nothing
173	GOULDING STREET	AC - Asbestos Cement	8	2299	27.94	20.72	$ -	Do Nothing
174	GRANITE STREET	AC - Asbestos Cement	8	1153	26.52	30.72	$ -	Do Nothing
175	GRETCHEN LANE	AC - Asbestos Cement	8	1045	24.02	48.22	$ -	Do Nothing
176	GROVE STREET	AC - Asbestos Cement	8	297	30.02	18.22	$ -	Do Nothing
177	GORWIN DRIVE	AC - Asbestos Cement	8	1188	26.16	33.22	$ -	Do Nothing
178	HANLON ROAD	AC - Asbestos Cement	8	1107	30.92	33.22	$ -	Do Nothing
179	HARGRAVE AVENUE	AC - Asbestos Cement	8	302	25.09	40.72	$ -	Do Nothing
18	BRADFORD JAY ROAD	AC - Asbestos Cement	6	1002	27.94	20.72	$ -	Do Nothing
180	HIGH STREET	AC - Asbestos Cement	8	2030	30.9	0	$ 508,352.60	Small Pipe (Major)
181	HIGHLAND STREET	AC - Asbestos Cement	12	1027	26.87	28.22	$ -	Do Nothing
182	IRVING PLACE	AC - Asbestos Cement	8	467	22.25	60.58	$ -	Do Nothing
183	JEFFREY AVENUE	PVC - Poly Vinyl Chloride	8	1677	19.38	80.65	$ -	Do Nothing
184	JENNINGS ROAD	AC - Asbestos Cement	8	1402	24.37	45.72	$ -	Do Nothing
185	KAREN CIRCLE	AC - Asbestos Cement	8	2251	27.94	20.72	$ -	Do Nothing
186	KATHERYN AVENUE	AC - Asbestos Cement	8	412	24.37	45.72	$ -	Do Nothing
187	LITTLE ROAD	AC - Asbestos Cement	8	357	26.16	33.22	$ -	Do Nothing
188	MARSHALL STREET	AC - Asbestos Cement	8	1894	26.16	33.22	$ -	Do Nothing
189	MARY CHRIS ROAD	AC - Asbestos Cement	8	389	25.44	38.22	$ -	Do Nothing
19	BROOK STREET	AC - Asbestos Cement	6	395	29.14	45.72	$ -	Do Nothing
190	MEADERS ROW	AC - Asbestos Cement	8	247	29.14	45.72	$ -	Do Nothing
191	MECHANIC STREET	AC - Asbestos Cement	8	1600	17.1	96.65	$ -	Do Nothing
192	MILL STREET	AC - Asbestos Cement	8	900	24.37	45.72	$ -	Do Nothing
193	NORFOLK STREET	AC - Asbestos Cement	8	1445	27.94	20.72	$ -	Do Nothing
194	NORFOLK STREET	AC - Asbestos Cement	8	325	27.94	20.72	$ -	Do Nothing
195	NORTH MILL STREET	AC - Asbestos Cement	8	496	29.85	40.72	$ -	Do Nothing
196	NORTH MILL STREET	AC - Asbestos Cement	8	372	23.68	50.58	$ -	Do Nothing
197	OAK STREET	AC - Asbestos Cement	8	1490	28.3	18.22	$ -	Do Nothing

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
198	PILGRIM DRIVE	AC - Asbestos Cement	8	1146	22.54	58.58	$ -	Do Nothing
199	PINE OAK STREET	AC - Asbestos Cement	8	339	26.87	28.22	$ -	Do Nothing
20	BYRON ROAD	PVC - Poly Vinyl Chloride	6	422	19.17	82.15	$ -	Do Nothing
200	PINECREST ROAD	AC - Asbestos Cement	8	2244	17.1	96.65	$ -	Do Nothing
201	PRENTICE STREET	AC - Asbestos Cement	8	2042	29.37	10.73	$ -	Do Nothing
202	QUEENS TERRACE	AC - Asbestos Cement	8	1097	23.68	50.58	$ -	Do Nothing
203	RICHARD ROAD	AC - Asbestos Cement	8	1881	25.44	38.22	$ -	Do Nothing
204	ROY AVENUE	AC - Asbestos Cement	8	357	26.52	30.72	$ -	Do Nothing
205	RUTHELLEN STREET	AC - Asbestos Cement	8	1771	25.44	38.22	$ -	Do Nothing
206	SCOTT DRIVE	AC - Asbestos Cement	8	405	26.52	30.72	$ -	Do Nothing
207	SHORT ROAD	AC - Asbestos Cement	8	322	25.8	35.72	$ -	Do Nothing
208	SMITHS ROW	AC - Asbestos Cement	8	219	30.44	3.23	$ 43,874.46	Small Pipe (Minor)
209	SOUTH STREET	AC - Asbestos Cement	8	3644	23.39	52.58	$ -	Do Nothing
21	CABOT ROAD	AC - Asbestos Cement	6	934	22.82	56.58	$ -	Do Nothing
210	SPRING STREET	AC - Asbestos Cement	8	592	17.1	96.65	$ -	Do Nothing
211	STONEYBROOK DRIVE	AC - Asbestos Cement	8	3125	25.39	50.58	$ -	Do Nothing
212	SUMMER STREET	AC - Asbestos Cement	8	1859	32.62	0	$ 465,530.78	Small Pipe (Major)
213	TEMI ROAD	AC - Asbestos Cement	8	702	25.8	35.72	$ -	Do Nothing
214	TURNER ROAD	AC - Asbestos Cement	8	1580	30.37	35.72	$ -	Do Nothing
215	UNDERWOOD STREET	AC - Asbestos Cement	8	1490	29.37	10.73	$ -	Do Nothing
216	UNION STREET	AC - Asbestos Cement	8	1500	18.81	96.65	$ -	Do Nothing
217	VINE STREET	AC - Asbestos Cement	8	468	22.54	58.58	$ -	Do Nothing
218	WASHINGTON STREET	AC - Asbestos Cement	8	3183	30.44	3.23	$ 797,086.86	Small Pipe (Major)
219	WASHINGTON STREET	AC - Asbestos Cement	8	841	60	0	$ 210,603.22	Small Pipe (Major)
22	CARLTON DRIVE	AC - Asbestos Cement	6	616	27.94	20.72	$ -	Do Nothing
220	WASHINGTON STREET	AC - Asbestos Cement	8	613	30.44	3.23	$ 153,507.46	Small Pipe (Major)
221	WASHINGTON STREET	AC - Asbestos Cement	8	282	30.44	3.23	$ 56,495.88	Small Pipe (Minor)
222	WATER STREET	AC - Asbestos Cement	8	1796	31.64	28.22	$ -	Do Nothing
223	WINCHESTER DRIVE	AC - Asbestos Cement	8	1151	25.11	52.58	$ -	Do Nothing
224	WINDGATE ROAD	AC - Asbestos Cement	8	2468	25.44	38.22	$ -	Do Nothing
225	WINDSOR DRIVE	AC - Asbestos Cement	8	685	21.68	64.58	$ -	Do Nothing
226	WINSTON ROAD	PVC - Poly Vinyl Chloride	8	506	20.88	82.15	$ -	Do Nothing
227	WINTER STREET	AC - Asbestos Cement	8	2155	17.1	96.65	$ -	Do Nothing
228	WINTHROP STREET	AC - Asbestos Cement	8	2306	26.09	45.72	$ -	Do Nothing
229	ELM STREET	CI - Cast Iron	8	467	32.88	24.87	$ 41,301.48	Cement Line
23	CHERYL LANE	AC - Asbestos Cement	6	1707	21.67	96.65	$ -	Do Nothing
230	BOYTON ROAD	DI - Ductile Iron	8	665	19.17	82.15	$ -	Do Nothing
231	DEER RUN ROAD	DI - Ductile Iron	8	748	18.45	87.15	$ -	Do Nothing
232	MAYFLOWER LANDING	DI - Ductile Iron	8	915	23	88.65	$ -	Do Nothing
236	ALPINE DRIVE	DI - Ductile Iron	8	953	19.17	82.15	$ -	Do Nothing
237	BALD HILL ROAD	DI - Ductile Iron	8	1502	19.14	82.32	$ -	Do Nothing
238	BOULDER ROAD	DI - Ductile Iron	8	678	18.31	88.15	$ -	Do Nothing
239	CASSANDRA LANE	DI - Ductile Iron	8	1611	18.6	86.15	$ -	Do Nothing
24	CHRISTOPHER ROAD	AC - Asbestos Cement	6	1116	26.52	30.72	$ -	Do Nothing
240	COUNTRY ROAD	DI - Ductile Iron	8	1026	19.88	77.15	$ -	Do Nothing
241	ERIN WAY	DI - Ductile Iron	8	640	19.1	82.65	$ -	Do Nothing
242	FOREST PARK DRIVE	DI - Ductile Iron	8	1324	22.79	90.15	$ -	Do Nothing
243	GREAT MEADOW ROAD	DI - Ductile Iron	8	1000	18.88	84.15	$ -	Do Nothing
244	HARNESS LANE	DI - Ductile Iron	8	371	18.6	86.15	$ -	Do Nothing
245	JOHNSON DRIVE	DI - Ductile Iron	8	421	18.53	86.65	$ -	Do Nothing
246	LONE OAK CIRCLE	DI - Ductile Iron	8	581	19.6	79.15	$ -	Do Nothing
247	MORGANS WAY	DI - Ductile Iron	8	3180	19.03	83.15	$ -	Do Nothing
248	NOEL DRIVE	DI - Ductile Iron	8	1472	18.31	88.15	$ -	Do Nothing
249	NORLAND STREET	AC - Asbestos Cement	8	2769	29.37	10.73	$ -	Do Nothing

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
25	COLD SPRINGS ROAD	AC - Asbestos Cement	6	1048	18.81	96.65	$ -	Do Nothing
250	PAUL ROAD	AC - Asbestos Cement	8	1099	27.87	33.22	$ -	Do Nothing
251	PRENTICE STREET	DI - Ductile Iron	8	869	23.72	83.65	$ -	Do Nothing
252	SABINA DRIVE	DI - Ductile Iron	8	725	18.53	86.65	$ -	Do Nothing
253	SHAW FARM ROAD	DI - Ductile Iron	8	1387	17.95	90.65	$ -	Do Nothing
254	SOUTH STREET	DI - Ductile Iron	8	808	20.1	75.65	$ -	Do Nothing
255	TEMI ROAD	AC - Asbestos Cement	8	906	26.16	33.22	$ -	Do Nothing
256	TIMBER LEDGE DRIVE	DI - Ductile Iron	8	770	18.53	86.65	$ -	Do Nothing
257	UNDERWOOD STREET	AC - Asbestos Cement	8	433	33.94	10.73	$ -	Do Nothing
258	WASHINGTON STREET	AC - Asbestos Cement	8	2873	58.1	0	$ 719,456.66	Small Pipe (Major)
259	WEDGEWOOD DRIVE	AC - Asbestos Cement	8	1633	28.66	15.72	$ -	Do Nothing
26	COLONIAL WAY	AC - Asbestos Cement	6	306	27.82	21.58	$ -	Do Nothing
260	WHISPERING LANE	DI - Ductile Iron	8	266	18.31	88.15	$ -	Do Nothing
261	WHISPERING LANE	DI - Ductile Iron	8	1926	18.53	86.65	$ -	Do Nothing
262	WHITE PINE DRIVE	DI - Ductile Iron	8	1711	19.03	83.15	$ -	Do Nothing
263	WOODS CROSSING	DI - Ductile Iron	8	1800	18.38	87.65	$ -	Do Nothing
264	OVERLOOK DRIVE	PVC - Poly Vinyl Chloride	8	2587	19.53	79.65	$ -	Do Nothing
265	ALBERTA LANE	PVC - Poly Vinyl Chloride	8	1133	18.67	85.65	$ -	Do Nothing
266	AMY LANE	PVC - Poly Vinyl Chloride	8	1195	19.03	83.15	$ -	Do Nothing
267	BEAVER BROOK DRIVE	PVC - Poly Vinyl Chloride	8	561	18.67	85.65	$ -	Do Nothing
268	FAIRVIEW STREET	PVC - Poly Vinyl Chloride	8	3331	23.15	87.65	$ -	Do Nothing
269	FISKE POND ROAD	PVC - Poly Vinyl Chloride	8	1344	24.22	80.15	$ -	Do Nothing
27	COPPER LANE	AC - Asbestos Cement	6	614	27.94	20.72	$ -	Do Nothing
270	GORWIN DRIVE	PVC - Poly Vinyl Chloride	8	565	18.38	87.65	$ -	Do Nothing
271	HILLSIDE DRIVE	PVC - Poly Vinyl Chloride	8	1880	23.43	85.65	$ -	Do Nothing
272	HOLLIS STREET	AC - Asbestos Cement	8	2812	30.9	0	$ 563,356.08	Small Pipe (Minor)
273	JOHNSON DRIVE	PVC - Poly Vinyl Chloride	8	2908	23.36	86.15	$ -	Do Nothing
274	OLD SAWMILL ROAD	PVC - Poly Vinyl Chloride	8	1918	18.67	85.65	$ -	Do Nothing
275	PAMALA DRIVE	PVC - Poly Vinyl Chloride	8	1717	21.17	80.15	$ -	Do Nothing
276	ROGERS STREET	PVC - Poly Vinyl Chloride	8	1000	24.07	81.15	$ -	Do Nothing
277	SADDLE RIDGE ROAD	PVC - Poly Vinyl Chloride	8	416	18.6	86.15	$ -	Do Nothing
278	WHITNEY STREET	PVC - Poly Vinyl Chloride	8	1535	24.15	80.65	$ -	Do Nothing
279	WILSON STREET	PVC - Poly Vinyl Chloride	8	278	22.43	92.65	$ -	Do Nothing
28	COTTAGE DRIVE	AC - Asbestos Cement	6	916	22.82	56.58	$ -	Do Nothing
280	NORFOLK STREET	ST - Steel	8	2384	22.15	73.29	$ -	Do Nothing
281	STODDARD PARK ROAD	ST - Steel	8	1043	21.15	68.29	$ -	Do Nothing
282	CHAMBERLAIN STREET	AC - Asbestos Cement	10	2150	27.94	20.72	$ -	Do Nothing
283	CHAMBERLAIN STREET	AC - Asbestos Cement	10	1561	27.94	20.72	$ -	Do Nothing
284	DODD DRIVE	AC - Asbestos Cement	10	415	26.16	33.22	$ -	Do Nothing
285	FRANKLIN STREET	AC - Asbestos Cement	10	927	23.39	52.58	$ -	Do Nothing
286	NORFOLK STREET	AC - Asbestos Cement	10	1377	25.8	35.72	$ -	Do Nothing
287	WASHINGTON STREET	AC - Asbestos Cement	10	1771	40.24	0	$ 532,203.21	Medium Pipe (Major)
288	WASHINGTON STREET	AC - Asbestos Cement	10	2304	39.78	3.23	$ 692,375.04	Medium Pipe (Major)
289	WESTFIELD DRIVE	AC - Asbestos Cement	10	1513	45.37	30.72	$ -	Do Nothing
29	CRANBERRY LANE	AC - Asbestos Cement	6	1440	26.16	33.22	$ -	Do Nothing
291	HOPPING BROOK ROAD	DI - Ductile Iron	10	3087	19.17	82.15	$ -	Do Nothing
293	CENTRAL STREET	AC - Asbestos Cement	12	1491	23.68	50.58	$ -	Do Nothing
294	CONCORD STREET	AC - Asbestos Cement	12	3761	44.54	3.23	$ 1,130,218.11	Medium Pipe (Major)
295	HIGHLAND STREET	AC - Asbestos Cement	12	1799	28.59	28.22	$ -	Do Nothing
296	LOWLAND STREET	AC - Asbestos Cement	12	2344	24.37	45.72	$ -	Do Nothing
297	WASHINGTON STREET	AC - Asbestos Cement	12	2310	32.16	3.23	$ 694,178.10	Medium Pipe (Major)
298	UNDERWOOD STREET	AC - Asbestos Cement	12	1652	29.37	10.73	$ -	Do Nothing
299	OLD LOCUST ST	DI - Ductile Iron	12	1900	23	88.65	$ -	Do Nothing
30	CYNTHIA CIRCLE	DI - Ductile Iron	6	105	19.67	90.65	$ -	Do Nothing

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
301	OLD CART PATH	DI - Ductile Iron	12	3750	18.45	87.15	$ -	Do Nothing
302	ASHLAND STREET	AC - Asbestos Cement	12	696	35.67	0	$ 174,292.32	Medium Pipe (Minor)
303	CONCORD STREET	DI - Ductile Iron	12	1921	24.07	81.15	$ -	Do Nothing
304	COURTLAND STREET	DI - Ductile Iron	12	879	23.22	87.15	$ -	Do Nothing
305	FISKE STREET	DI - Ductile Iron	12	920	18.17	89.15	$ -	Do Nothing
306	HANLON ROAD	DI - Ductile Iron	12	1178	19.17	82.15	$ -	Do Nothing
307	HIGHLAND STREET	DI - Ductile Iron	12	2863	17.95	90.65	$ -	Do Nothing
308	LINDEN STREET	DI - Ductile Iron	12	1592	22.74	89.15	$ -	Do Nothing
309	MARSHALL STREET	DI - Ductile Iron	12	2753	23.65	84.15	$ -	Do Nothing
31	DAVID STREET	AC - Asbestos Cement	6	682	26.52	30.72	$ -	Do Nothing
310	PRENTICE STREET	DI - Ductile Iron	12	2556	25	74.65	$ -	Do Nothing
311	WASHINGTON STREET	DI - Ductile Iron	12	1205	19.53	79.65	$ -	Do Nothing
312	WASHINGTON STREET	AC - Asbestos Cement	12	603	32.16	3.23	$ 181,207.53	Medium Pipe (Major)
313	WASHINGTON STREET	DI - Ductile Iron	12	3613	24.17	79.15	$ -	Do Nothing
314	WOODLAND STREET	DI - Ductile Iron	12	4400	20.95	81.65	$ -	Do Nothing
315	HIGHLAND STREET	PVC - Poly Vinyl Chloride	12	3080	19.45	80.15	$ -	Do Nothing
316	HIGHLAND STREET	PVC - Poly Vinyl Chloride	12	1274	22.72	57.29	$ -	Do Nothing
317	MARSHALL STREET	PVC - Poly Vinyl Chloride	12	2064	19.31	81.15	$ -	Do Nothing
318	WILLOWGATE RISE	PVC - Poly Vinyl Chloride	12	2700	24.1	79.65	$ -	Do Nothing
319	BEATRICE STREET	DI - Ductile Iron	16	1689	18.45	87.15	$ -	Do Nothing
32	DEAN ROAD	AC - Asbestos Cement	6	438	30.44	3.23	$ 87,748.92	Small Pipe (Minor)
320	CHURCH PLACE	DI - Ductile Iron	16	655	20.45	73.15	$ -	Do Nothing
321	ADAMS STREET	AC - Asbestos Cement	8	1389	27.59	23.22	$ -	Do Nothing
322	ADAMS STREET	AC - Asbestos Cement	8	1395	32.35	23.22	$ -	Do Nothing
323	ADAMS STREET	AC - Asbestos Cement	8	1836	27.59	23.22	$ -	Do Nothing
324	WASHINGTON STREET	AC - Asbestos Cement	8	807	55.24	0	$ 202,088.94	Small Pipe (Major)
325	WASHINGTON STREET	AC - Asbestos Cement	8	598	58.29	0	$ 149,751.16	Small Pipe (Major)
326	CONCORD STREET	DI - Ductile Iron	12	2370	19.31	81.15	$ -	Do Nothing
327	WASHINGTON STREET	AC - Asbestos Cement	8	1586	29.71	0	$ 397,166.12	Small Pipe (Major)
328	WESTFIELD DRIVE	AC - Asbestos Cement	10	2425	26.52	30.72	$ -	Do Nothing
329	WINTER STREET	AC - Asbestos Cement	8	2082	17.1	96.65	$ -	Do Nothing
33	DIXON CIRCLE	AC - Asbestos Cement	6	331	27.16	38.22	$ -	Do Nothing
330	FISKE STREET	AC - Asbestos Cement	8	1134	53.52	0	$ 227,185.56	Small Pipe (Minor)
331	FISKE STREET	AC - Asbestos Cement	8	2833	53.52	0	$ 567,563.22	Small Pipe (Minor)
332	WILLOWGATE RISE	PVC - Poly Vinyl Chloride	12	1982	19.53	79.65	$ -	Do Nothing
333	HIGHLAND STREET	AC - Asbestos Cement	12	2727	26.87	28.22	$ -	Do Nothing
334	HOLLIS STREET	AC - Asbestos Cement	8	1826	30.9	0	$ 365,820.84	Small Pipe (Minor)
335	UNDERWOOD STREET	AC - Asbestos Cement	8	2026	29.37	10.73	$ -	Do Nothing
336	GORWIN DRIVE	AC - Asbestos Cement	8	2537	29.66	20.72	$ -	Do Nothing
337	MARSHALL STREET	AC - Asbestos Cement	8	1837	26.16	33.22	$ -	Do Nothing
338	HOPPING BROOK ROAD	DI - Ductile Iron	10	2737	19.17	82.15	$ -	Do Nothing
339	OLD CART PATH	DI - Ductile Iron	12	3210	18.45	87.15	$ -	Do Nothing
34	DONNA ROAD	AC - Asbestos Cement	6	1449	30.9	0	$ 290,292.66	Small Pipe (Minor)
340	NORFOLK STREET	ST - Steel	8	2024	20.43	73.29	$ -	Do Nothing
341	MARKED TREE ROAD	AC - Asbestos Cement	6	2110	29.37	10.73	$ -	Do Nothing
342	WASHINGTON STREET	AC - Asbestos Cement	8	1633	32.62	0	$ 408,935.86	Small Pipe (Major)
343	WASHINGTON STREET	AC - Asbestos Cement	12	1332	30.44	3.23	$ 400,279.32	Medium Pipe (Major)
344	OLD CART PATH	DI - Ductile Iron	12	3513	18.45	87.15	$ -	Do Nothing
345	MARSHALL STREET	DI - Ductile Iron	12	2316	18.88	84.15	$ -	Do Nothing
346	HANLON ROAD	AC - Asbestos Cement	8	416	26.16	33.22	$ -	Do Nothing
348	GORWIN DRIVE	AC - Asbestos Cement	8	398	32.71	20.72	$ -	Do Nothing
349	GORWIN DRIVE	AC - Asbestos Cement	8	232	32.52	20.72	$ -	Do Nothing
35	DORSET ROAD	AC - Asbestos Cement	6	1326	28.3	18.22	$ -	Do Nothing
350	UNDERWOOD STREET	AC - Asbestos Cement	8	913	29.37	10.73	$ -	Do Nothing

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
351	HOWARD STREET	AC - Asbestos Cement	6	255	25.8	35.72	$ -	Do Nothing
352	HOWARD STREET	AC - Asbestos Cement	6	308	25.8	35.72	$ -	Do Nothing
353	WASHINGTON STREET	AC - Asbestos Cement	8	741	58.29	0	$ 185,561.22	Small Pipe (Major)
354	SHAW FARM ROAD	AC - Asbestos Cement	6	114	17.1	96.65	$ -	Do Nothing
355	SHAW FARM ROAD	AC - Asbestos Cement	6	444	23.57	96.65	$ -	Do Nothing
356	APPLEYARD LANE	AC - Asbestos Cement	6	274	23.57	96.65	$ -	Do Nothing
357	WATER STREET	AC - Asbestos Cement	8	486	26.87	28.22	$ -	Do Nothing
358	UNION STREET	AC - Asbestos Cement	8	637	24.37	45.72	$ -	Do Nothing
359	UNION STREET	AC - Asbestos Cement	8	459	21.86	96.65	$ -	Do Nothing
36	DUDLEY ROAD	AC - Asbestos Cement	6	412	27.94	20.72	$ -	Do Nothing
360	DAVID STREET	AC - Asbestos Cement	6	183	31.28	30.72	$ -	Do Nothing
361	PRENTICE STREET	AC - Asbestos Cement	8	423	29.37	10.73	$ -	Do Nothing
362	PINECREST ROAD	AC - Asbestos Cement	8	117	33.06	18.22	$ -	Do Nothing
363	HIGHLAND STREET	AC - Asbestos Cement	12	881	26.87	28.22	$ -	Do Nothing
364	HIGHLAND STREET	AC - Asbestos Cement	12	403	31.64	28.22	$ -	Do Nothing
365	CENTRAL STREET	AC - Asbestos Cement	8	418	20.58	84.29	$ -	Do Nothing
366	CENTRAL STREET	AC - Asbestos Cement	8	195	18.86	84.29	$ -	Do Nothing
367	MITCHELL ROAD	PVC - Poly Vinyl Chloride	6	725	19.31	81.15	$ -	Do Nothing
368	MITCHELL ROAD	PVC - Poly Vinyl Chloride	6	638	24.07	81.15	$ -	Do Nothing
369	FISKE STREET	AC - Asbestos Cement	8	1174	55.24	0	$ 235,199.16	Small Pipe (Minor)
37	EVERGREEN ROAD	AC - Asbestos Cement	6	499	25.8	35.72	$ -	Do Nothing
370	FISKE STREET	AC - Asbestos Cement	8	418	53.52	0	$ 83,742.12	Small Pipe (Minor)
371	BOGASTOW BOOK ROAD	AC - Asbestos Cement	8	227	23.11	54.58	$ -	Do Nothing
372	BOGASTOW BOOK ROAD	AC - Asbestos Cement	8	283	27.87	54.58	$ -	Do Nothing
373	MARILYN STREET	AC - Asbestos Cement	6	49	31.64	28.22	$ -	Do Nothing
374	LOWLAND STREET	AC - Asbestos Cement	12	502	24.37	45.72	$ -	Do Nothing
375	LOWLAND STREET	AC - Asbestos Cement	12	782	29.14	45.72	$ -	Do Nothing
376	CURVE STREET	AC - Asbestos Cement	8	309	29.85	40.72	$ -	Do Nothing
377	WINTER STREET	AC - Asbestos Cement	8	572	17.1	96.65	$ -	Do Nothing
378	WINTER STREET	AC - Asbestos Cement	8	195	21.86	96.65	$ -	Do Nothing
379	WINTER STREET	AC - Asbestos Cement	8	569	21.86	96.65	$ -	Do Nothing
38	FAIRLANE WAY	AC - Asbestos Cement	6	1112	29.66	20.72	$ -	Do Nothing
380	WESTFIELD DRIVE	AC - Asbestos Cement	10	713	26.52	30.72	$ -	Do Nothing
381	WESTFIELD DRIVE	AC - Asbestos Cement	10	282	31.28	30.72	$ -	Do Nothing
382	JAR BROOK ROAD	AC - Asbestos Cement	6	74	34.13	10.73	$ -	Do Nothing
383	WASHINGTON STREET	AC - Asbestos Cement	6	520	32.71	20.72	$ -	Do Nothing
384	CRANBERRY LANE	AC - Asbestos Cement	6	27	30.92	33.22	$ -	Do Nothing
385	CONCORD STREET	DI - Ductile Iron	12	1399	28.65	81.15	$ -	Do Nothing
386	TURNER ROAD	AC - Asbestos Cement	6	211	34.85	5.73	$ -	Do Nothing
387	WINTER STREET	AC - Asbestos Cement	6	453	23.57	96.65	$ -	Do Nothing
388	WINTER STREET	AC - Asbestos Cement	6	860	21.67	96.65	$ -	Do Nothing
389	DORSET ROAD	AC - Asbestos Cement	6	334	30.02	18.22	$ -	Do Nothing
39	FISHER STREET	AC - Asbestos Cement	6	792	26.52	30.72	$ -	Do Nothing
390	DORSET ROAD	AC - Asbestos Cement	6	178	34.78	18.22	$ -	Do Nothing
391	ADAM WHEELER LANE	AC - Asbestos Cement	6	591	32.71	20.72	$ -	Do Nothing
392	NORFOLK STREET	AC - Asbestos Cement	8	327	29.66	20.72	$ -	Do Nothing
393	NORFOLK STREET	AC - Asbestos Cement	8	391	32.71	20.72	$ -	Do Nothing
394	LAKE SHORE DRIVE	AC - Asbestos Cement	6	103	28.78	48.22	$ -	Do Nothing
395	SUMMER STREET	AC - Asbestos Cement	8	799	30.9	0	$ 200,085.58	Small Pipe (Major)
396	SUMMER STREET	AC - Asbestos Cement	8	335	35.67	0	$ 83,890.70	Small Pipe (Major)
397	WASHINGTON STREET	AC - Asbestos Cement	8	482	53.52	0	$ 120,702.44	Small Pipe (Major)
398	WASHINGTON STREET	AC - Asbestos Cement	8	545	53.52	0	$ 136,478.90	Small Pipe (Major)
399	WASHINGTON STREET	AC - Asbestos Cement	8	250	58.29	0	$ 62,605.00	Small Pipe (Major)
40	GREEN STREET	AC - Asbestos Cement	6	737	28.23	30.72	$ -	Do Nothing

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
400	WASHINGTON STREET	AC - Asbestos Cement	8	314	58.29	0	$ 78,631.88	Small Pipe (Major)
401	SOUTH STREET	AC - Asbestos Cement	6	582	28.16	52.58	$ -	Do Nothing
402	ADAMS STREET	AC - Asbestos Cement	8	77	32.35	23.22	$ -	Do Nothing
403	ADAMS STREET	AC - Asbestos Cement	8	873	32.35	23.22	$ -	Do Nothing
404	MARSHALL STREET	AC - Asbestos Cement	8	271	26.16	33.22	$ -	Do Nothing
405	ADAMS STREET	AC - Asbestos Cement	8	304	27.59	23.22	$ -	Do Nothing
406	GORWIN DRIVE	AC - Asbestos Cement	8	325	30.92	33.22	$ -	Do Nothing
407	ADAMS STREET	AC - Asbestos Cement	8	196	32.35	23.22	$ -	Do Nothing
408	ADAMS STREET	AC - Asbestos Cement	8	1031	27.59	23.22	$ -	Do Nothing
409	ADAMS STREET	AC - Asbestos Cement	8	100	32.35	23.22	$ -	Do Nothing
41	GREENVIEW DRIVE	AC - Asbestos Cement	6	81	28.16	52.58	$ -	Do Nothing
410	ADAMS STREET	AC - Asbestos Cement	8	1063	34.06	23.22	$ -	Do Nothing
411	GORWIN DRIVE	AC - Asbestos Cement	8	310	27.94	20.72	$ -	Do Nothing
412	GORWIN DRIVE	AC - Asbestos Cement	8	738	27.94	20.72	$ -	Do Nothing
413	OAK STREET	AC - Asbestos Cement	6	751	35.21	3.23	$ 150,455.34	Small Pipe (Minor)
414	NORTH MILL STREET	AC - Asbestos Cement	8	215	29.85	40.72	$ -	Do Nothing
415	NORTH MILL STREET	AC - Asbestos Cement	8	263	25.09	40.72	$ -	Do Nothing
416	NORTH MILL STREET	AC - Asbestos Cement	8	485	25.09	40.72	$ -	Do Nothing
417	HARGRAVE AVENUE	AC - Asbestos Cement	8	72	29.85	40.72	$ -	Do Nothing
418	MILL STREET	AC - Asbestos Cement	8	619	24.37	45.72	$ -	Do Nothing
419	MILL STREET	AC - Asbestos Cement	8	712	29.14	45.72	$ -	Do Nothing
42	GREENVIEW DRIVE	AC - Asbestos Cement	6	937	24.37	45.72	$ -	Do Nothing
420	FISKE STREET	AC - Asbestos Cement	8	267	53.52	0	$ 53,490.78	Small Pipe (Minor)
421	FISKE STREET	AC - Asbestos Cement	8	446	58.29	0	$ 89,351.64	Small Pipe (Minor)
422	FISKE STREET	AC - Asbestos Cement	8	261	58.29	0	$ 52,288.74	Small Pipe (Minor)
423	WINTER STREET	AC - Asbestos Cement	8	1027	17.1	96.65	$ -	Do Nothing
424	WINTER STREET	AC - Asbestos Cement	8	351	21.86	96.65	$ -	Do Nothing
425	WASHINGTON STREET	AC - Asbestos Cement	8	1304	55.24	0	$ 326,547.68	Small Pipe (Major)
426	WASHINGTON STREET	AC - Asbestos Cement	8	547	53.52	0	$ 136,979.74	Small Pipe (Major)
427	WASHINGTON STREET	AC - Asbestos Cement	8	956	53.52	0	$ 239,401.52	Small Pipe (Major)
428	WASHINGTON STREET	AC - Asbestos Cement	8	558	53.52	0	$ 139,734.36	Small Pipe (Major)
429	DEAN ROAD	AC - Asbestos Cement	6	313	30.44	3.23	$ 62,706.42	Small Pipe (Minor)
43	GREENVIEW DRIVE	AC - Asbestos Cement	6	371	27.94	20.72	$ -	Do Nothing
430	DEAN ROAD	AC - Asbestos Cement	6	383	35.21	3.23	$ 76,730.22	Small Pipe (Minor)
431	TRAVIS ROAD	AC - Asbestos Cement	6	179	26.16	33.22	$ -	Do Nothing
432	TRAVIS ROAD	AC - Asbestos Cement	6	300	30.92	33.22	$ -	Do Nothing
433	HOLLIS STREET	AC - Asbestos Cement	8	279	30.9	0	$ 55,894.86	Small Pipe (Minor)
434	HOLLIS STREET	AC - Asbestos Cement	8	271	37.38	0	$ 54,292.14	Small Pipe (Minor)
435	ASHLAND STREET	AC - Asbestos Cement	6	2263	37.38	0	$ 453,369.42	Small Pipe (Minor)
436	HIGHLAND STREET	DI - Ductile Iron	12	2302	17.95	90.65	$ -	Do Nothing
44	GREGORY ROAD	AC - Asbestos Cement	6	1407	27.94	20.72	$ -	Do Nothing
45	GROVE STREET	AC - Asbestos Cement	6	595	24.37	45.72	$ -	Do Nothing
46	HAMPSHIRE STREET	AC - Asbestos Cement	6	506	24.37	45.72	$ -	Do Nothing
47	HEMLOCK DRIVE	AC - Asbestos Cement	6	1877	29.66	20.72	$ -	Do Nothing
48	HERITAGE WAY	AC - Asbestos Cement	6	523	21.67	96.65	$ -	Do Nothing
49	HIGH ROCK ROAD	AC - Asbestos Cement	6	940	27.94	20.72	$ -	Do Nothing
5	WILSON STREET	PVC - Poly Vinyl Chloride	2	715	58.29	0	$ 143,243.10	Small Pipe (Minor)
50	HIGH STREET	AC - Asbestos Cement	6	2360	40.24	0	$ 590,991.20	Small Pipe (Major)
51	HOLLY LANE	AC - Asbestos Cement	6	2330	27.94	20.72	$ -	Do Nothing
52	HOWARD STREET	AC - Asbestos Cement	6	407	25.8	35.72	$ -	Do Nothing
53	INDIAN RIDGE	PVC - Poly Vinyl Chloride	6	557	18.38	87.65	$ -	Do Nothing
54	JAR BROOK ROAD	AC - Asbestos Cement	6	870	31.09	10.73	$ -	Do Nothing
55	JERROLD STREET	AC - Asbestos Cement	6	2788	29.66	20.72	$ -	Do Nothing
56	JAMES	AC - Asbestos Cement	6	993	30.9	0	$ 198,937.62	Small Pipe (Minor)

PIPE ID	STREETNAME	MATERIAL TYPE	PIPE DIAMETER (INCHES)	LENGTH (FEET)	NPR	PCI	REPAIR COST	REPAIR CATEGORY
57	LAKE SHORE DRIVE	AC - Asbestos Cement	6	1271	24.02	48.22	$ -	Do Nothing
58	LINDEN STREET	DI - Ductile Iron	12	102	21.39	66.58	$ -	Do Nothing
59	LOCUST STREET	AC - Asbestos Cement	6	2934	32.62	0	$ 587,797.56	Small Pipe (Minor)
6	WINTHROP STREET	AC - Asbestos Cement	2	240	46.38	0	$ 48,081.60	Small Pipe (Minor)
60	LOUIS STREET	AC - Asbestos Cement	6	885	25.8	35.72	$ -	Do Nothing
61	MARILYN STREET	AC - Asbestos Cement	6	1857	26.87	28.22	$ -	Do Nothing
62	MARKED TREE ROAD	AC - Asbestos Cement	6	2190	29.37	10.73	$ -	Do Nothing
63	MEADOWBROOK LANE	AC - Asbestos Cement	6	2106	30.21	38.22	$ -	Do Nothing
64	MILL STREET	AC - Asbestos Cement	6	1100	22.54	58.58	$ -	Do Nothing
65	MITCHELL ROAD	PVC - Poly Vinyl Chloride	6	660	19.31	81.15	$ -	Do Nothing
66	MORSE FARM ROAD	PVC - Poly Vinyl Chloride	6	479	19.38	80.65	$ -	Do Nothing
67	MORTON STREET	AC - Asbestos Cement	6	945	27.94	20.72	$ -	Do Nothing
68	NORFOLK STREET	AC - Asbestos Cement	6	1023	30.8	0.73	$ 204,947.82	Small Pipe (Minor)
69	NORTHWAY STREET	AC - Asbestos Cement	6	1207	29.66	20.72	$ -	Do Nothing
70	OAK STREET	AC - Asbestos Cement	6	1393	30.44	3.23	$ 279,073.62	Small Pipe (Minor)
71	OAKHURST LANE	AC - Asbestos Cement	6	538	30.9	0	$ 107,782.92	Small Pipe (Minor)
72	ORCHARD LANE	AC - Asbestos Cement	6	808	30.56	35.72	$ -	Do Nothing
73	PEARL STREET	AC - Asbestos Cement	6	1278	34.42	20.72	$ -	Do Nothing
74	PERSIS PLACE	AC - Asbestos Cement	6	234	28.3	18.22	$ -	Do Nothing
75	PETER STREET	AC - Asbestos Cement	6	529	29.49	43.22	$ -	Do Nothing
76	PINE STREET	AC - Asbestos Cement	6	457	27.16	38.22	$ -	Do Nothing
77	PLEASANT STREET	AC - Asbestos Cement	6	226	17.1	96.65	$ -	Do Nothing
78	POPE ROAD	AC - Asbestos Cement	6	1124	27.94	20.72	$ -	Do Nothing
79	PROSPECT STREET	AC - Asbestos Cement	6	3019	27.94	20.72	$ -	Do Nothing
80	PETER STREET	AC - Asbestos Cement	6	849	25.8	35.72	$ -	Do Nothing
81	QUAIL RUN	DI - Ductile Iron	6	405	18.88	84.15	$ -	Do Nothing
82	QUINCY PLACE	AC - Asbestos Cement	6	418	26.82	60.58	$ -	Do Nothing
83	RICH ROAD	AC - Asbestos Cement	6	214	30.9	0	$ 42,872.76	Small Pipe (Minor)
84	RIDGE ROAD	AC - Asbestos Cement	6	999	27.94	20.72	$ -	Do Nothing
85	ROBERT ROAD	AC - Asbestos Cement	6	2018	37.28	20.72	$ -	Do Nothing
86	ROCKLAND STREET	AC - Asbestos Cement	6	1733	30.8	0.73	$ 347,189.22	Small Pipe (Minor)
87	ROY AVENUE	AC - Asbestos Cement	6	1417	28.23	30.72	$ -	Do Nothing
88	SCHOOL STREET	AC - Asbestos Cement	6	323	17.1	96.65	$ -	Do Nothing
89	SHAW FARM ROAD	AC - Asbestos Cement	6	1191	18.81	96.65	$ -	Do Nothing
9	ADAM WHEELER LANE	AC - Asbestos Cement	6	905	29.66	20.72	$ -	Do Nothing
90	SILVER LANE	AC - Asbestos Cement	6	1014	27.87	33.22	$ -	Do Nothing
91	SKYVIEW TERRACE	AC - Asbestos Cement	6	1548	32.4	1.55	$ 310,126.32	Small Pipe (Minor)
92	SMITHURST DRIVE	AC - Asbestos Cement	6	495	27.94	20.72	$ -	Do Nothing
93	SOUTH STREET	AC - Asbestos Cement	6	720	25.11	52.58	$ -	Do Nothing
94	SPARROW LANE	AC - Asbestos Cement	6	443	28.66	15.72	$ -	Do Nothing
95	SPRUCE STREET	AC - Asbestos Cement	6	518	28.66	15.72	$ -	Do Nothing
96	STAGECOACH ROAD	AC - Asbestos Cement	6	2116	32.52	20.72	$ -	Do Nothing
97	SWEET GRASS LANE	AC - Asbestos Cement	6	959	27.94	20.72	$ -	Do Nothing
98	SMITHURST DRIVE	AC - Asbestos Cement	6	340	27.94	20.72	$ -	Do Nothing
99	TAYLOR ROAD	AC - Asbestos Cement	6	511	30.9	0	$ 102,373.74	Small Pipe (Minor)

Appendix B. Priority Project List

Project	Plan Year	Street	Install Year	Diameter (in)	Material	Length (ft)	Cost ($)
FISKE, BULLARD, CENTRAL EXPANSION & LOOP	1	CENTRAL STREET	-	8		1,450	$ 435,000
	1	FISKE STREET	1974	8	AC - Asbestos Cement	1,158	$ 347,400
	1	FISKE STREET	1974	8	AC - Asbestos Cement	418	$ 125,400
						3,026	**$ 907,800**
FISKE, BULLARD, CENTRAL EXPANSION & LOOP	2	BULLARD STREET	-	8	-	3,090	$ 927,000
						3,090	**$ 927,000**
NORFOLK STREET (coordinate w/ sidewalk work)	3	NORFOLK STREET	1975	8	ST - Steel	2,384	$ 476,800
	3	NORFOLK STREET	1975	8	ST - Steel	2,024	$ 404,800
	3	NORFOLK STREET	1966	10	AC - Asbestos Cement	1,377	$ 344,250
						5,785	**$ 1,225,850**
NORFOLK STREET (coordinate w/ sidewalk work)	4	NORFOLK STREET	1960	8	AC - Asbestos Cement	1,445	$ 289,000
	4	NORFOLK STREET	1960	8	AC - Asbestos Cement	327	$ 65,400
	4	NORFOLK STREET	1960	8	AC - Asbestos Cement	391	$ 78,200
	4	NORFOLK STREET	1952	6	AC - Asbestos Cement	1,023	$ 204,600
						3,186	**$ 637,200**
GOULDING STREET NEIGHBORHOOD (coordinate w/ sidewalk work)	5	GOULDING PLACE	2005	6	PVC - Poly Vinyl Chloride	590	$ 118,000
	5	ALDEN ROAD	1960	6	AC - Asbestos Cement	1,140	$ 228,000
	5	DUDLEY ROAD	1960	6	AC - Asbestos Cement	412	$ 82,400
	5	GREGORY ROAD	1960	6	AC - Asbestos Cement	1,407	$ 281,400
	5	GOULDING STREET	1960	8	AC - Asbestos Cement	2,299	$ 574,750
						5,848	**$ 1,284,550**
GOULDING STREET NEIGHBORHOOD (coordinate w/ sidewalk work)	6	TRACY LYN ROAD	1964	6	AC - Asbestos Cement	1,116	$ 223,200
	6	ADAM WHEELER LANE	1960	6	AC - Asbestos Cement	905	$ 181,000
	6	BRADFORD JAY ROAD	1960	6	AC - Asbestos Cement	1,002	$ 200,400
	6	HIGH ROCK ROAD	1960	6	AC - Asbestos Cement	940	$ 188,000
	6	HOLLY LANE	1960	6	AC - Asbestos Cement	2,330	$ 466,000
	6	SWEET GRASS LANE	1960	6	AC - Asbestos Cement	959	$ 191,800
	6	ADAM WHEELER LANE	1960	6	AC - Asbestos Cement	591	$ 118,200
						7,843	**$ 1,568,600**
CENTRAL STREET	7	CENTRAL STREET	1996	8	AC - Asbestos Cement	641	$ 128,200
	7	CENTRAL STREET	1996	8	AC - Asbestos Cement	418	$ 83,600
	7	CENTRAL STREET	1996	8	AC - Asbestos Cement	195	$ 39,000
	7	CENTRAL STREET	1972	8	AC - Asbestos Cement	3818	$ 763,600
	7	CENTRAL STREET	1972	12	AC - Asbestos Cement	1491	$ 372,750
	7	CENTRAL STREET	1970	8	AC - Asbestos Cement	2570	$ 514,000
	7	CENTRAL STREET	1946	6	AC - Asbestos Cement	1024	$ 204,800
						10,157	**$ 2,105,950**
CONCORD STREET	8	CONCORD STREET	1953	12	AC - Asbestos Cement	3761	$ 1,128,300
	8	CONCORD STREET	1949	8	AC - Asbestos Cement	1702	$ 425,500
						5,463	**$ 1,553,800**
WASHINGTON STREET DOUBLE WATER MAIN	9	WASHINGTON STREET	1953	8	AC - Asbestos Cement	76	$ 16,880
	9	WASHINGTON STREET	1953	8	AC - Asbestos Cement	613	$ 153,250
	9	WASHINGTON STREET	1953	12	AC - Asbestos Cement	2310	$ 693,000
	9	WASHINGTON STREET	1953	12	AC - Asbestos Cement	1332	$ 399,600
	9	WASHINGTON STREET	1900	8	AC - Asbestos Cement	1586	$ 396,500
	9	WASHINGTON STREET	1900	8	AC - Asbestos Cement	1633	$ 489,900
						7,550	**$ 2,149,130**
HOLLIS STREET	10	HOLLIS STREET	1949	8	AC - Asbestos Cement	2812	$ 562,400
	10	HOLLIS STREET	1949	8	AC - Asbestos Cement	1826	$ 365,200
	10	HOLLIS STREET	1949	8	AC - Asbestos Cement	279	$ 55,800
	10	HOLLIS STREET	1949	8	AC - Asbestos Cement	271	$ 54,200
						5,188	**$ 1,037,600**
PRENTICE STREET	11	PRENTICE STREET	-	8		3586	$ 717,200
						3,586	**$ 717,200**
CHAMBERLAIN STREET	12	CHAMBERLAIN STREET	-	8		2592	$ 518,400
						2,592	**$ 518,400**
HIGH STREET	13	WASHINGTON STREET	1953	10	AC - Asbestos Cement	2304	$ 691,200
	13	WASHINGTON STREET	1953	12	AC - Asbestos Cement	603	$ 180,900
	13	HIGH STREET	1949	6	AC - Asbestos Cement	2360	$ 590,000
	13	HIGH STREET	1949	8	AC - Asbestos Cement	2030	$ 507,500
	13	WASHINGTON STREET	1949	10	AC - Asbestos Cement	1771	$ 531,300
						9,068	**$ 2,500,900**
WOODLAND STREET	14	WOODLAND STREET	1985	12	DI - Ductile Iron	4400	$ 1,320,000
						4,400	**$ 1,320,000**
CABOT ROAD NEIGHBORHOOD	15	CABOT ROAD	1975	6	AC - Asbestos Cement	934	$ 186,800
	15	COTTAGE DRIVE	1975	6	AC - Asbestos Cement	916	$ 183,200
	15	BIRCH ROAD	1971	6	AC - Asbestos Cement	934	$ 186,800
	15	LAKE SHORE DRIVE	1971	6	AC - Asbestos Cement	1271	$ 254,200
	15	LAKE SHORE DRIVE	1971	6	AC - Asbestos Cement	103	$ 20,600
	15	CEDAR ROAD	1953	8	AC - Asbestos Cement	462	$ 92,400
						4,620	**$ 924,000**

Appendix B. Priority Project List

Project	Plan Year	Street	Install Year	Diameter (in)	Material	Length (ft)		Cost ($)
	16	WALNUT ROAD	1976	6	AC - Asbestos Cement	571	$	114,200
	16	EVERGREEN ROAD	1966	6	AC - Asbestos Cement	499	$	99,800
OAK STREET NEIGHBORHOOD	16	HEMLOCK DRIVE	1960	6	AC - Asbestos Cement	1877	$	375,400
	16	OAK STREET	1959	8	AC - Asbestos Cement	1490	$	298,000
	16	OAK STREET	1953	6	AC - Asbestos Cement	1393	$	278,600
	16	OAK STREET	1953	6	AC - Asbestos Cement	751	$	150,200
						6,581	**$**	**1,316,200**
	17	WASHINGTON STREET	1950	8	AC - Asbestos Cement	841	$	210,603
	17	WASHINGTON STREET	1950	8	AC - Asbestos Cement	598	$	149,751
WASHINGTON STREET	17	WASHINGTON STREET	1950	8	AC - Asbestos Cement	741	$	185,561
	17	WASHINGTON STREET	1950	8	AC - Asbestos Cement	1304	$	349,798
	17	WASHINGTON STREET	1950	8	AC - Asbestos Cement	547	$	151,864
	17	WASHINGTON STREET	1950	8	AC - Asbestos Cement	956	$	265,414
						4,987	**$**	**1,312,991**
	18	WASHINGTON STREET	1950	8	AC - Asbestos Cement	807	$	202,089
	18	WASHINGTON STREET	1950	8	AC - Asbestos Cement	482	$	133,818
WASHINGTON STREET	18	WASHINGTON STREET	1950	8	AC - Asbestos Cement	545	$	151,308
	18	WASHINGTON STREET	1950	8	AC - Asbestos Cement	250	$	62,605
	18	WASHINGTON STREET	1950	8	AC - Asbestos Cement	314	$	78,632
	18	WASHINGTON STREET	1950	8	AC - Asbestos Cement	558	$	154,918
						2,956	**$**	**783,369**
FISKE STREET	19	FISKE STREET	1974	8	AC - Asbestos Cement	1134	$	243,356
	19	FISKE STREET	1974	8	AC - Asbestos Cement	2833	$	607,962
	19	FISKE STREET	1974	8	AC - Asbestos Cement	267	$	55,362
	19	FISKE STREET	1974	8	AC - Asbestos Cement	446	$	89,352
	19	WASHINGTON STREET	1950	8	AC - Asbestos Cement	2873	$	744,624
						7,553	**$**	**1,740,656**
SUMMER STREET	20	FISKE STREET	1974	8	AC - Asbestos Cement	1174	$	243,429
	20	FISKE STREET	1974	8	AC - Asbestos Cement	261	$	52,289
	20	SUMMER STREET	1949	8	AC - Asbestos Cement	1859	$	465,531
	20	SUMMER STREET	1949	8	AC - Asbestos Cement	799	$	200,086
	20	SUMMER STREET	1949	8	AC - Asbestos Cement	335	$	96,269
						4,428	**$**	**1,057,603**
	21	ASHLAND STREET	1949	6	AC - Asbestos Cement	2428	$	486,426
	21	LOCUST STREET	1949	6	AC - Asbestos Cement	2934	$	587,798
ASHLAND STREET	21	ASHLAND STREET	1949	8	AC - Asbestos Cement	278	$	66,145
	21	ASHLAND STREET	1949	12	AC - Asbestos Cement	696	$	193,230
	21	ASHLAND STREET	1949	6	AC - Asbestos Cement	2263	$	453,369
						8,599	**$**	**1,786,968**
	22	BEVERLY CIRCLE	1987	8	PVC - Poly Vinyl Chloride	417	$	83,400
	22	BYRON ROAD	1986	6	PVC - Poly Vinyl Chloride	422	$	84,400
	22	MITCHELL ROAD	1984	6	PVC - Poly Vinyl Chloride	660	$	132,000
	22	MITCHELL ROAD	1984	6	PVC - Poly Vinyl Chloride	725	$	145,000
MITCHELL ROAD	22	MITCHELL ROAD	1984	6	PVC - Poly Vinyl Chloride	638	$	127,600
	22	SKYVIEW TERRACE	1952	6	AC - Asbestos Cement	1548	$	310,126
	22	DONNA ROAD	1951	6	AC - Asbestos Cement	1449	$	290,293
	22	RICH ROAD	1950	6	AC - Asbestos Cement	214	$	42,873
						6,073	**$**	**1,215,692**
	23	WASHINGTON STREET	1953	8	AC - Asbestos Cement	3183	$	797,087
ROCKLAND STREET	23	ROCKLAND STREET	1952	6	AC - Asbestos Cement	606	$	121,406
	23	ROCKLAND STREET	1952	6	AC - Asbestos Cement	1733	$	347,189
						5,522	**$**	**1,265,682**
	24	UNDERWOOD STREET	1956	8	AC - Asbestos Cement	1490	$	372,500
UNDERWOOD STREET	24	UNDERWOOD STREET	1956	8	AC - Asbestos Cement	2026	$	506,500
	24	UNDERWOOD STREET	1956	8	AC - Asbestos Cement	913	$	228,250
						4,429	**$**	**1,107,250**
	25	ANDREW LANE	1960	8	AC - Asbestos Cement	1362	$	272,400
	25	CHAMBERLAIN STREET	1960	8	AC - Asbestos Cement	523	$	104,600
CHAMBERLAIN STREET	25	CHAMBERLAIN STREET	1960	10	AC - Asbestos Cement	1561	$	390,250
	25	UNDERWOOD STREET	1956	8	AC - Asbestos Cement	433	$	108,250
	25	UNDERWOOD STREET	1956	12	AC - Asbestos Cement	1652	$	495,600
						5,531	**$**	**1,371,100**
					Total	**138,061**	**$**	**32,335,491**