

AUGUST 2021

Preliminary Engineering Report

**Town of Bristol, Vermont
Water Distribution System**

GME Project # 29-021



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TOWN OF BRISTOL, VERMONT
PRELIMINARY ENGINEERING REPORT
WATER DISTRIBUTION SYSTEM

AUGUST 2021

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SECTION I – PROJECT PLANNING

1.1 Location

The Town of Bristol water system serves the village area of Bristol, Vermont. A project location Map is included as Figure 1. The Town operates the system under a Permit to Operate issued by State of Vermont (WSID# 5002). The system currently has 437 residential connections representing approximately 1,170 residents as well as 187 commercial connections representing an estimated 800 employees. The Bristol water system is fed by a high capacity groundwater spring located off Pumphouse Road. The water treatment and distribution system in general consists of a water treatment (chlorine treatment), a pumping facility, a storage reservoir and water distribution piping network. The system provides both drinking water and water for fire fighting capabilities to the Bristol village area.

1.2 Background

Green Mountain Engineering (GME) was contracted by the Town of Bristol to conduct a Preliminary Engineering Report (PER) on the Town's aging water distribution system. The majority of the existing distribution system was installed in the early 1900's and consists of cast iron pipe with with lead joints. This piping is well beyond its useful life expectancy of 50-80 years. The lead joints used in this type of construction are notorious for degrading over time, resulting in ever increasing leakage rates. The most recent data for the Town of Bristol water system indicates overall non-revenue water loss of 55% for calendar year 2019 and 53% for calendar year 2020. While all municipal water distribution systems have some losses, those losses are typically minimal. Based on data from the American Water Works Association (AWWA), the average municipal water system in the United States has an estimated non-revenue water loss of approximately 16%.

1.3 Environmental Resources Present

GME conducted a review of existing environmental resources using the State of Vermont's Natural Resource Atlas as well as researching other relevant sources of information as identified herein. The bulk of the areas requiring water main replacement occur under existing public streets. In these and therefore there are few important environmental resources that would be impacted in these areas. There are however several segments of waterline that traverse cross country. These segments may require additional study as outlined below.

1.3.1 Wetlands

GME identified two small areas within the project area that currently contain mapped wetlands. One area of of mapped wetland adjacent to the existing Reservoir and the second is adjacent to the New Haven River. These areas are shown on the Wetlands Map included as Figure 3, Appendix A.

1.3.2 Flood Plains

The New Haven River flows along the south end of the village of Bristol. There are limited areas of the water system that are within the 100-year floodplain identified near

the stream channel. These areas are shown on the 100-year floodplain map included as Figure 4, Appendix A.

1.3.3 River Crossings

There are currently two locations within the project limits where existing water mains cross the New Haven River. These are located at South Street (bridge crossing) and Basin Street (buried).

1.3.4 Rare or Endangered Species

There were no endangered species identified within the project area. There were two locations identified within the project area that the current mapping shows contain rare plant species. The areas identified as containing rare plant species are included as Figure 5, Appendix A.

1.3.5 Deer Wintering Areas

There were no deer wintering areas identified within the project area.

1.3.6 Prime Agricultural Soils

A map showing the areas of Prime Agricultural Soils within the Bristol Villiage area is included in the supporting documentation. The majority of the Bristol villiage area is technically shown to contain "prime agricultural soils". However, the entire villiage area has been devoped over the past 200-years and no longer contains areas of agricultural importance as defined and generally recognized by the State of Vermont. A map of Prime Agricultural Soils in the area is included as Figure 6, Appendix A.

1.3.7 Public Lands

The majority of the project is located under existing public streets. Where located outside of public streets, the existing water mains are on lands otherwise owned or controlled by the Town of Bristol with one exception. There is a single water main ("Rockydale Line") that runs from the existing water storage resevoir eastward to what is known as the "Rockydale area" along Route 116. This line crosses property owned by the A. Johnson Lumber Company however an easement for this line exists.

There are State and Federal forest areas located on the south side of VT Route 116 as shown on the attached State and Federal Land Map is included as Figure 7, Appendix A. These lands are outside of the project limits and GME does not anticipate any work occuring on State or Federal lands.

1.3.8 Historic Preservation

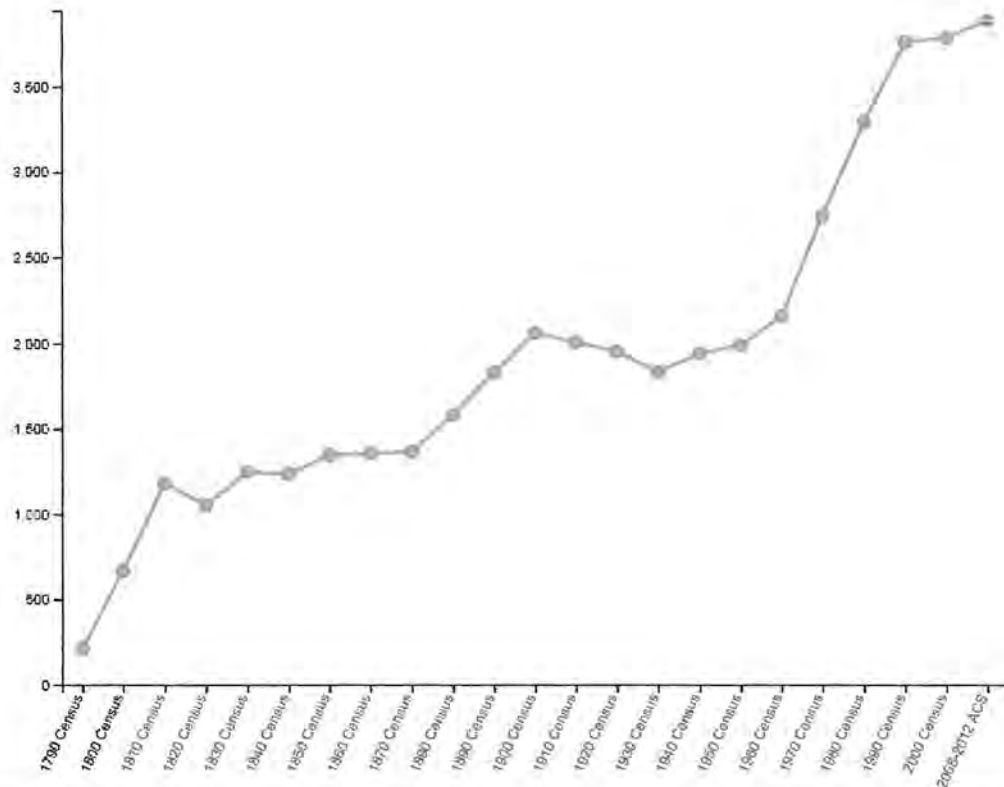
GME conducted a review of the State Historic Preservation resources available on-line for Bristol. Bristol has a "Downtown Historic District" that was officially entered on the National Register of Historic Places on March 10, 1983. The Bristol Downtown Historic District encompasses approximately sixteen (16) buildings along both sides of Main Street including the Town Hall. GME does not anticipate any impacts to the buildings within the historic district from this project.

1.4 Population Trends

The Town of Bristol’s population over the past century has been generally increasing. The last year that full census data was available was 2010. The average increase in population from 1970 until 2010 for the Town of Bristol was slightly over 1% per year. Although Vermont’s statewide populaton has in recent years stagnated, this has not been the case for towns such as Bristol that are considered “bedroom communities” for the larger Burlington metropolitan area. Bristol is well positioned for future population growth due to its proximity to Chittenden County, ample area for future housing, the expansion of broadband technology and affordable real estate. GME anticipates that a similar population growth trend of approximately 1% annually will continue into the foreseeable future.

Figure 6 – Bristol Population Trends

TOTAL POPULATION, 1790-2010



	1790	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
Bristol	211	665	1179	1051	1247	1233	1344	1355	1365	1579	1828	2061	2005	1952	1832	1939	1988	2159	2744	3293	3762	3788	3889

Source: U.S. Census Bureau – Census of Population & Housing; 2000 Summary

Data tables derived from Vermont Indicators

1.5 **Community Engagement**

The Bristol Selectboard has held numerous public meetings over the course of years regarding the age, condition and need for upgrades to the existing water distribution system. This PER will provide the Selectboard and broader community additional information necessary to justify the relatively large investments necessary to upgrade the existing distribution system. This PER, once approved, will be published on the town website (www.bristolvt.org), and bond vote hearings will be held, as necessary, to inform the public prior to each vote.

SECTION 2.0 - EXISTING FACILITIES

A map of the existing Bristol water distribution system is included as Figure 8, Appendix A. The Town of Bristol's existing water distribution infrastructure is summarized in Appendix B.

2.1 History & Condition of Existing Facilities

The bulk of the Town of Bristol's water distribution system was originally constructed in 1905, as shown in the Water Distribution Summary, Appendix B. A number of residential neighborhoods were built and the water system expanded beyond the original village core from the late 1960's through 1990. In 1995, the New Haven Spring Source was developed as the primary source for the system and the existing open reservoir was replaced. In more recent years, there has been a small amount of water distribution system replacement work done on Spring Street, North Street, South Street, West Street and Mountain View Street. The waterline under North Street between Spring Street and Main Street was replaced in 2010. The portion of West Street between Maple Street and Airport Drive was replaced in 2018. The waterline under Mountain View Street was replaced in its entirety in 2017.

2.2 Existing System Hydraulics

Water is pumped approximately 3,900-feet from a groundwater spring located on Pumphouse Road to a 632,000 gallon Aquastore® Reservoir located at 73 Mountain Terrace Road. The base elevation of the reservoir is approximately 730-feet in elevation. Water from the reservoir is fed from the reservoir via gravity to a piping distribution network which subsequently provides water for Bristol village. The water distribution network is made up of approximately 58,000 lineal feet of water main (11 miles). The system generally maintains average water pressures throughout the village between 80 and 120 psi. The lowest portion of the distribution network contains a single pressure reducing valve located on a line that feeds the Lovers Lane area.

2.3 Financial Status of Existing Facilities

The Town of Bristol Water District has been in operation for over 100-years. The water district generates approximately \$300,000 per year in annual revenues from the sale of water. At the close of the most recent fiscal year 2020 (July 1, 2019 - June 30, 2020), the Bristol Water District had a fund balance of approximately \$472,000 and a Capital Fund balance of approximately \$114,000. The Bristol Selectboard members act in the capacity of the Bristol Water Board. As a municipal entity, the Town of Bristol has the ability to apply for State and Federal funding as well as bond for the capital resources necessary to complete future upgrade projects.

2.4 Water/Energy/Waste Audits

There have been no known audits performed for the components involved with this project. Based on discussions with the Bristol Water Operator and review of the water usage records, there are no suspicions of a single major leak within the system. The high overall leakage rates for the Town of Bristol and age of the overall piping system, indicates system wide leakage.

SECTION 3.0 – NEED FOR PROJECT

3.1 Health, Sanitation and Security

Approximately 47% (roughly 27,000 lineal feet) of Bristol's water distribution piping system is approximately 116 years old. The majority of the original 1905 era piping is made of cast iron with lead joints which was the standard construction practice in the early 1900's. Life expectancy for typical cast iron (CI) pipe varies based on a number of factors however as a rule of thumb is generally between 50 and 80 years. Once distribution piping exceeds its useful life, water losses through leakage and sudden unplanned failures can be expected to increase steadily over time.

Mineral deposits such as iron generally collect on the inside of unlined cast iron piping. This build-up drastically reduces the interior pipe diameter. The net result is reduced flow capacity throughout the distribution network. This has a direct impact on fire flows and ISO fire ratings for the community which generally results in higher fire insurance rates for residents. Other impacts from an aging water distribution system includes expensive, unplanned emergency repairs, utility outages, higher pumping and treatment costs as well as the potential for the inadvertent introduction of contaminants into the water distribution system particularly when unplanned emergency repairs occur.

3.2 Aging Infrastructure

As discussed, the majority of the distribution system piping is made of cast iron with lead joints that far exceeds its useful life expectancy. Piping from this era was typically manufactured and installed with few if any of today's quality control standards. Without significant investment in new infrastructure, emergency repairs and non-revenue water losses (predominantly leakage) can be expected to increase over time. Non-revenue water losses are measured by comparing the difference between the metered volume of water pumped to the water storage reservoir and the metered volume of water sold to the end users. While all municipal water distribution systems have some non-revenue water losses, those losses are typically minimal. According to data from the American Water Works Association (AWWA), the average municipal water system in the United States has an estimated non-revenue water loss of approximately 16%. Older distribution systems that have put off needed maintenance and infrastructure replacement may have non-revenue water losses as high as 30%.

Over the past several years, Bristol has put forth considerable efforts to reduce non-revenue water losses by putting a focus on maintenance, including participation in a State funding Leakage Study that resulted in targeted repairs in various locations and was the impetus for the West Street replacement project due to the evidence of widespread leakage in that line. In addition, systematic replacement of aging fire hydrants has also been on-going. Although these efforts appear to have had a measureable impact, considering the average age of the overall water distribution system, the Town has likely reached the limitation of what they can accomplish without significant additional investment in new infrastructure.

Based on the Town of Bristol’s Annual Water Audit Reports, non-revenue water losses for the past 5 calendar years are included in Table 1 below.

Table 1
Non-Revenue Water Loss

Calendar Year	Non-Revenue Water Loss
2016	58.6
2017	59.6
2018	59.7
2019	55.1
2020	53.5

As presented, 2019, non-revenue water losses were approximately 55% and in calendar year 2020 approximately 54%. The average water losses over the past two calendar years has exceeded 45,000,000 gallons per year (123,000 gallons per day). This is an extremely high number for a relatively small water system. A number of factors can contribute to non-revenue water loss including distribution leakage, water main breaks, metering errors, hydrant flushing, etc. The primary factor in non-revenue water losses in older systems however is typically leakage. Without replacement, the Town can generally expect non-revenue water losses to continue to increase over time. An increase in small system wide leaks, valve failures and sudden piping breaks and ruptures will also likely occur. Water pumping and treatment costs and overall distribution system maintenance costs will also increase as well as scheduled and emergency repairs. The likelihood of a system-wide failure resulting in a loss of water to the entire water distribution network will also increase.

3.3 Reasonable Growth

The population of Bristol continues to slowly increase. Bristol is in the process of building its first industrial park and new businesses continue to move to the area. As discussed previously, continued slow, steady population growth as well business growth is expected well into the future. Although this is primarily an infrastructure replacement project, considerations should be made for projected residential and commercial growth as well as increased fire flow requirements. As previously discussed, Bristol is well positioned for future population growth due to its proximity to Chittenden County, ample area for future housing, the expansion of broadband technology and reasonably affordable real estate. GME would anticipate the current population growth trend of approximately 1% annually to continue.

SECTION 4 – ALTERNATIVES CONSIDERED

The primary focus of this PER is on the 1905 era cast iron piping that has exceeded its useful life. There are no viable alternatives to replacing this piping. Options exist in terms of construction materials, techniques and prioritization of the work. It is the goal of the Town of Bristol to replace all distribution piping and associated 1905 era infrastructure which has exceeded its useful life (piping, valves, hydrants, connections, etc.).

4.1 Design Criteria

The working pressure of the water distribution system in the village of Bristol is between 80 psi and 120 psi. The existing distribution network has been installed in various segments since 1905. As a result, the current network contains a variety of different pipe sizes, materials and conditions.

4.1.1 Hydraulic Analysis

GME conducted a hydraulic analysis of the existing water distribution system. The analysis was performed using WaterCAD® software and mapping of the water system from a previous study performed by GME. As the Bristol water system provides both domestic water as well as fire flow capabilities, the model was calibrated using hydrant flow test data collected by the operator during a recent ISO study and other available hydrant flow data from recent projects.

The difficulty associated with modeling the Bristol system centered around accounting for the large amount of leakage being experienced. A conservative approach was taken and the 2020 average of pumped flow was assumed as the Average Day Demand (222,792 gallons per day). Maximum Day Demand was then determined by review of the data and found to be 423,800 or approximately 1.9 times the ADD. It should be pointed out that one outlier in the data occurred on October 31, 2020. This data point was ignored in GME's analysis based on a review of the circumstances with the system operator. Flow data for 2020 is included in Appendix F. Converting this value to gallons per minute results in a Maximum Day Demand of 294 gpm. Applying the growth factor of 1% per year for a 50 year design period (1.64) for distribution systems, resulted in a base flow 483 gpm. GME believes that replacement of the existing 1905 era infrastructure will eliminate the majority of Bristol's non-revenue water losses, for purposes of the modeling however, GME has conservatively estimated only a 15% reduction in non-revenue water losses which provides for a base flow rate of 413 gpm. The assumption of higher base flow rates throughout the system provides for a more conservative approach to pipe sizing.

The purpose of modeling the system is to determine if any deficiencies exist that can be addressed when pipes are replaced to enhance fire flows throughout the system. Theoretical maximum day demand values were placed throughout the system in the calibrated model and fire flows were analyzed at seven representative locations to determine available fire flows in the system while maintaining a minimum pressure of 20 psi. As summarized, available fire flows at three of the seven locations did not meet the ISO recommended flows for the existing system.

Table 2
Non-Revenue Water Loss

Hydrant No.	Location	Available Fire Flow from Model	ISO Recommended Fire Flow	Fire flow from Model with Recommended Projects
H-20	Prince St	1383	2500	3337
H-41	Maple/Pleasant	1454	500	3098
H-75	Pine/Maple	1780	1000	2990
H-2	High School (N)	1191	2000	2643
H-15	West/Liberty	1886	500	3201
H-58	Fitch/Mountain	1818	1750	2563
H-68	North/Plank	1315	2250	2584

GMEs strategy to increase fire flows within the system included a first step of increasing all internal street pipe sizes to the minimum 8-inch pipe size. These include Elm Street, Taylor Avenue, Fitch Avenue, Crescent Street, Devino Lane (including an 8-inch connection to North Street), Mountain Street (from Mountain Terrace to Devino Lane), Munsill Avenue, Maple Street, Pine Street, Park Street, Pleasant Street and Liberty Street. Finally, the cross-country line to the Rockydale area is the original 4-inch cast iron transmission main from when the system source was a spring in Lincoln. This line has been found to require frequent repair in recent years and is a higher priority project. We recommend the pipes be upgraded to 8-inch as the streets are paved or reconstructed. It is our understanding that the next two streets to be paved are Pine Street and Munsill Avenue.

Next we looked at the original 10-inch cast iron line from the reservoir and determined that increasing this pipe to 12-inch from the reservoir to East Street and increasing the East/Main/West Street line from 10-inch to 12-inch would provide the needed fire flows. As a portion of this route was recently repaved, it is lower on the priority list in terms of recommended projects, but would result in meeting the ISO recommended flows when complete.

4.2 Recommendations for Distribution System Replacement & Prioritization

Due to the high leakage rates as well as the average age of the overall piping distribution network, the entire Bristol distribution system was evaluated as part of this PER. A replacement priority list was subsequently developed. Factors considered when evaluating replacement priorities included age, repair history, type of construction, fire flow limitations, future growth, capital cost as well as, from a practical sense, anticipated Town paving schedules.

The Bristol Water Distribution system consists of approximately 58,000 lineal feet (11 miles) of piping. Approximately 47 % of the existing water distribution piping system was installed in or around 1905. This age far exceeds the anticipated useful life of any water distribution system. Age was the principal factor used to evaluate priorities for future watermain replacement. The Bristol Water Department Operator has confirmed that areas that contain the oldest piping are seeing the greatest number of emergency repairs as

one would expect. GME would also expect that the older cast iron contains significant mineral buildup. Water distribution piping of this vintage was not constructed of materials intended to limit or stop mineral buildup that modern water distribution system piping would normally contain (cement lining for instance). Over time, mineral buildup can significantly reduce the overall pipe diameter. Mineral buildup will also increase internal pipe friction and drastically reduce the overall system fire flow capabilities. GME is recommending that every water main installed in the 1905 era be replaced. In addition, GME is recommending that a number of these water mains be replaced with larger diameter piping to increase fire flows in certain areas to meet ISO standards.

A summary of the piping segments suggested for replacement as well as the recommended future pipe sizing is included in Appendix C.

In total, approximately 33,100 lineal feet (57%) of existing water distribution system piping is recommended for replacement. Figure 8, Appendix A provides a graphical representation of the segments of the distribution system recommended for replacement.

4.3 Environmental Impacts

The State of Vermont's Environmental Resource Atlas was utilized as an initial screening tool to evaluate potential environmental impacts from this water main replacement project. As discussed in Section 1.3, potential environmental impacts identified within the project area include Wetlands, Flood Plains, River Crossings and Rare or Endangered Species. It is notable that the great majority of the project will be conducted under existing Town Streets where the few environmental issues exist. There is at least one overland water line (Rockydale) in need of replacement however where these issues will need to be surveyed and evaluated in greater detail. Due to the large scope of waterline replacement required in the Town of Bristol, GME anticipates that areas will need to be prioritized as discussed in Section 4.2 and replaced as funding becomes available. GME recommends that the potential environmental impacts for each phase of future construction be evaluated separately as part of the permitting process.

4.3.1 Wetlands

A small area of wetlands was identified adjacent to the reservoir. This was the only mapped wetland found within the project area. Figure 3, Appendix A shows the currently mapped wetlands. Future work near this area will require detailed wetland delineation. Depending on the proximity and potential impacts to the wetland area, mitigation plans may be required as part of the permitting process.

4.3.2 Flood Plains

The New Haven River is located along the southern limits of Bristol Villiage. The New Haven River in this area has a well defined channel with relatively steep sideslopes that limits potential flooding. Figure 4, Appendix A shows the approximate 100-year flood plain in this area based on FEMA mapping. All water mains proposed for replacement are outside of the mapped 100-year flood plain with one exception. The section of water main on Pumphouse Road from south Street to Lathrop's Mill is recommended for replacement and is located within the 100-year flood plain. GME recommends working with the State of Vermont Watershed Management Division during the permitting process to ensure that any concerns are addressed. Work within the 100-year flood plain may also require a local zoning permit from the Town of Bristol.

4.3.3 River Crossings

Two existing water mains in the Bristol Villiage area cross the New Haven River. One is located on South Street and the other at the end of Basin Street. Both sections of pipe were replaced in the past 25-years and therefore disturbance of these two sections is not envisioned as part of this project.

4.3.4 Rare or Endangered Species

Rare or endangered species were identified in the project area. Figure 5, Appendix A indicates the areas where rare and endangered species are currently mapped. There are two water mains scheduled for replacement that may conflict within these currently mapped areas. The first water main extends overland from the Town Reservoir easterly to Rockydale. The second water main extends from the Town Reservoir westerly to what is known as the Bingham residence. Both of these water mains cross a small section of land that is currently shown as containing rare or endangered species. Work near these areas will need additional delineation and mapping. Depending on the impacts, mitigation plans may be required as part of the permitting process.

4.4 Land Requirements

Design of each segment of water main will require consideration of existing municipal rights of way and/or associated easements in the rare instance where replacement may be located on private property. Almost all of the existing piping recommended for replacement is located under municipally owned streets or on municipally owned lands. Due to the magnitude of piping to be replaced and the intricate design details necessary for each segment, an analysis of the easement or ROW issues for each street or segment is beyond the scope of this study. This will need to be conducted segment by segment as the design for each section is completed. It is worthwhile noting that all of the water main scheduled for replacement has been in place for over 100-years. In the rare instance that it is determined that a segment of existing water main is located on private property without formal written easements, prescriptive easements certainly would exist at this point.

4.5 Future Design Considerations

The overall scope of the project in terms of recommended replacement involves 37 separate streets or segments of pipe. Evaluating the detailed design and permitting hurdles for each segment at this stage is beyond the scope of this PER. Future design considerations involved with the project should include the following:

- Land ownership, easements and existing right of ways.
- Existing utilities will need to be located and appropriate design considerations taken to avoid conflicts. There is existing storm and sanitary sewer infrastructure throughout parts of the village area. Water distribution piping requires a 10-foot minimum isolation distance from sanitary sewer lines and 5-feet from storm sewer lines. If this is not obtainable in certain areas, mitigation techniques will need to be presented as part of the design.
- An archeological evaluation of each segment will need to be conducted.
- Geotechnical information may be needed in certain areas.
- Any work along the along the Route 116 corridor and outside of the former Village limits will require a VTrans permit.
- Most segments will require a Permit to Construct.
- The detailed engineering design for each street should take into account replacement of all main line isolation valves, corporation stops as well as curb stops.
- Due to the age of many of the existing service lines, ideally each water service should be replaced in its entirety to the facility being served, not just to the curb stop. It is understood that this may not always be possible due to ownership and cost issues however the Town should work closely with the community prior to and during construction to accomplish this to the extent possible.
- In residential areas where future water mains are to be located within 10-feet of the existing Town right of way, to the extent possible research should be conducted to verify that the location of existing on-site septic systems do not encroach on the new water main.

4.6 Sustainability Considerations

This is a common municipal utility replacement project, which generally does not encompass sustainability issues.

4.7 **Opinion of Probable Cost**

GME's opinion of probable construction costs are provided in Appendix D. A summary of the total anticipated funding project funding needs including anticipated permitting, engineering as well as construction management costs are summarized in Table 3.

Table 3
Summary
Opinion of Probable Cost
Bristol Water Distribution System (2021 Dollars)

Construction Phase	Description	Opinion of Probable Construction Cost	Opinion of Probable Standard Engineering, Permitting & Construction Cost	Specialized 3rd Party Technical Services	Opinion of Total Project Cost 3
1	Pine Street	\$619,157	\$148,906	¹ \$3,000	\$772,000
2	Munsill Avenue	\$401,095	\$98,752	¹ \$3,000	\$503,000
3	Reservoir to Rockydale	\$628,453	\$151,044	^{1,2} \$10,000	\$790,000
4	Liberty Street	\$345,621	\$85,993	¹ \$3,000	\$435,000
5	Maple Street	\$480,746	\$117,072	¹ \$3,000	\$601,000
6	Mountain Street & Devino Lane	\$1,058,221	\$238,763	¹ \$3,000	\$1,300,000
7	Pleasant Street & North Street	\$892,122	\$204,034	¹ \$3,000	\$1,100,000
8	Church St., Park Place, North St.	\$521,125	\$126,359	¹ \$3,000	\$651,000
9	Reservoir to Bingham Res.	\$320,394	\$80,191	^{1,2} \$10,000	\$411,000
10	Elm Street & Taylor Ave.	\$421,473	\$103,439	¹ \$3,000	\$528,000
11	Crescent, Garfield, Fitch Ave	\$603,437	\$145,291	¹ \$3,000	\$752,000
12	West Street	\$311,163	\$78,067	¹ \$3,000	\$393,000
13	Main Street	\$307,071	\$77,126	¹ \$3,000	\$388,000
14	East Street	\$349,264	\$86,831	¹ \$3,000	\$440,000
15	Pumphouse Road	\$199,431	\$52,369	¹ \$3,000	\$255,000
Total		\$7,458,773	\$1,794,236	\$59,000	\$9,319,000

¹ Denotes anticipated costs for an Archeology Resource Evaluation

² Denotes anticipated costs for Specialized 3rd party Technical Services such was wetlands studies or threatened or endangered species evaluations.

³ Rounded to nearest \$1,000.

It should be noted that these are preliminary opinions of probable cost and that detailed opinions should be performed for each street and segment being considered for replacement once a detailed design for each street or segment is complete.

4.8 Future Funding Considerations

The Town of Bristol is facing replacement of the majority of its existing water distribution system. This is a large scale endeavour that GME anticipates will take a number of years and be conducted in multiple phases. Total costs for construction will be in the many millions of dollars. Funding on this scale will likely be the single largest hurdle facing the Town of Bristol. Funding will have a direct impact on the timing of construction and phasing. Current funding mechanisms such as Drinking Water State Revolving Fund (DWSRF) will clearly be needed. However, other funding opportunities such as large scale earmarks or direct grants via state or federal “infrastructure” funding mechanisms may very likely be required in order for a small community such as Bristol to be able to afford infrastructure replacement on this scale.

SECTION 5 - SELECTION OF AN ALTERNATIVE

5.1 Life Cycle Cost Analysis

A Life Cycle Analysis is not applicable to this type of project. However, usable life expectancy of modern waterline under normal operating conditions can be expected to exceed 75-years.

5.2 Non-Monetary Factors

As discussed, the water main piping installed in the early 1900's has to be replaced. The alternatives simply come down to construction materials and methods. The Town has historically used ductile iron pipe, but recently (West Street) have allowed the use of PVC piping which is a widely used and accepted industrywide alternative. HDPE may also be an acceptable alternative in areas where directional drilling may be a more cost effective or technically viable option to open cut construction.

SECTION 6 – PROPOSED PROJECT

6.1 Preliminary Project Design

Each segment of water main identified for replacement will require detailed engineering design. The project is a distribution system infrastructures replacement project. The recommended piping materials, size and approximate length are noted in the Recommended Replacement Priority List, Appendix C.

6.2 Tentative Project Schedule

With the large quantity of piping to be replaced, it is anticipated that construction will need to be conducted and financed in multiple phases. The anticipated project schedule is as follows:

- | | |
|---|---------------------------|
| • Submittal of Draft PER: | February 2021 |
| • Anticipated approval of PER: | August 2021 |
| • Phase 1 – Design/Permitting (Step 2) | Nov 2021 – June 2022 |
| • Phase 1 – Bidding/Construction (Step 3) | July 2022 – December 2022 |
| • Future Phases - TBD as funding is available | |

6.3 Sustainability Considerations

Not Applicable.

6.4 Permit Requirements

A preliminary list of necessary permits includes, but may not be limited to,

- Vermont Agency of Natural Resources' Drinking Water & Groundwater Protection Division
Permit-To-Construct
- VTrans 1111 Permit for work to be performed in State Highway Right of Way (Route 116)
- Vermont Agency of Natural Resources, Construction General Permit

6.5 Right of Way Considerations

Right of Way considerations are discussed under Section 4.6

6.6 Opinion of Probable Cost

The Opinion of Probable Project Costs are presented in Appendix D. These project costs should be updated annually as the project progresses and should become a basis for future annual funding requests.

6.7 Annual Operating Budget

6.7.1 Current Annual Operating Income

Table 4 summarizes the Bristol Water Department's annual operating revenues.

Bristol Water Annual Revenue	Actual FY 2019-2020 Revenue	Anticipated FY 2020-2021 Revenue	Department
	\$311,176	\$322,424	

6.7.2 Current Annual Operating Expenses

Table 5 summarizes the Bristol Water Department's annual operating expenses.

Bristol Water Annual Expenses	Actual FY 2019-2020 Expenses	Anticipated FY 2020-2021 Expenses	Department
	\$313,307	\$322,424	

6.8 Debt Repayment

Due to the scale of this project, it is anticipated that it will take a number of years to complete the entire project. The State of Vermont's Drinking Water State Revolving Loan Fund (DWSRF) is the most likely funding source for this project. DWSRF's interest rates and percent of loan forgiveness percentages vary each fiscal year. The Town of Bristol will need to determine how much piping they can afford to replace and what the forgiveness percentages and interest terms will be before debt repayment can be estimated. With total anticipated project costs approaching \$10,000,000 (2021 dollars), unless large grant funds are obtained or other outside State or Federal funding sources that do not require repayment, annual debt payments will most certainly increase the overall annual operating cost of the water Department for some time to come. As the non-revenue water losses decrease so will anticipated fixed costs for chemicals, electricity, emergency maintenance, etc.

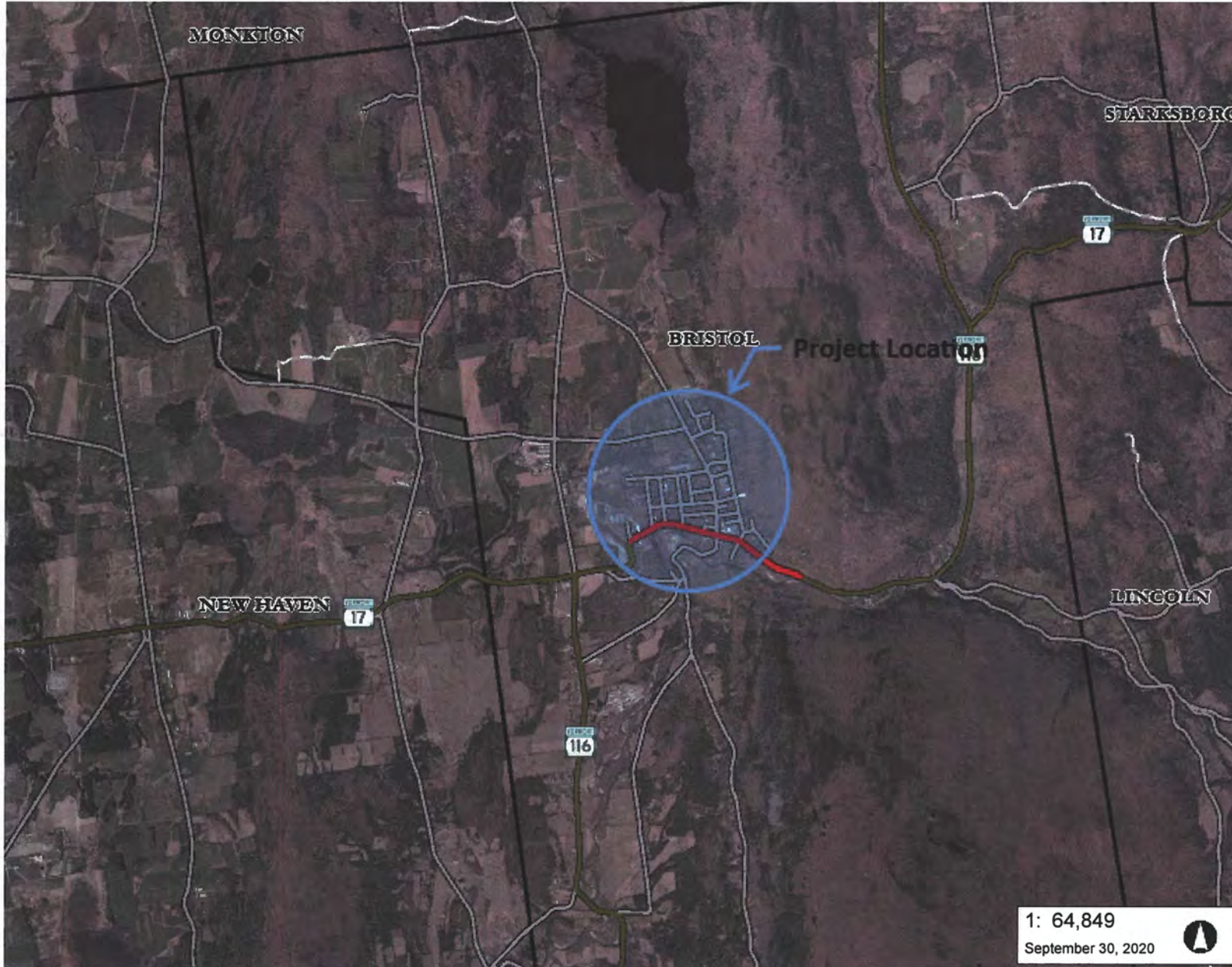
SECTION 7 – CONCLUSIONS & RECOMMENDATIONS

Table 4, Appendix B outlines the recommended and required piping in need of replacement. The reasons to move forward with the recommended project are:

1. Reduction of unbilled water losses and operating costs.
2. Increase in critical fire flows and subsequent ISO ratings.
3. Anticipated reduction in resident fire insurance rates.
4. Increase in overall distribution system reliability and a corresponding reduction in emergency service disruptions.
5. Reduction in potential for the introduction of contaminants in the distribution system.

Appendix A

- Figure 1 - Project Location Map
- Figure 2 – Project Service Area Map
- Figure 3 - Wetlands
- Figure 4 – Flood Plains
- Figure 5 - Rare or Endangered Species
- Figure 6 – Prime Agricultural Soils
- Figure 7 – State & Federal Lands
- Figure 8 - Bristol Water Distribution System Map



LEGEND

- Roads**
- Interstate
 - US Highway, 1
 - State Highway
 - Town Highway (Class 1)
 - Town Highway (Class 2,3)
 - Town Highway (Class 4)
 - State Forest Trail
 - National Forest Trail
 - Legal Trail
 - Private Road/Driveway
 - Proposed Roads
- Town Boundary

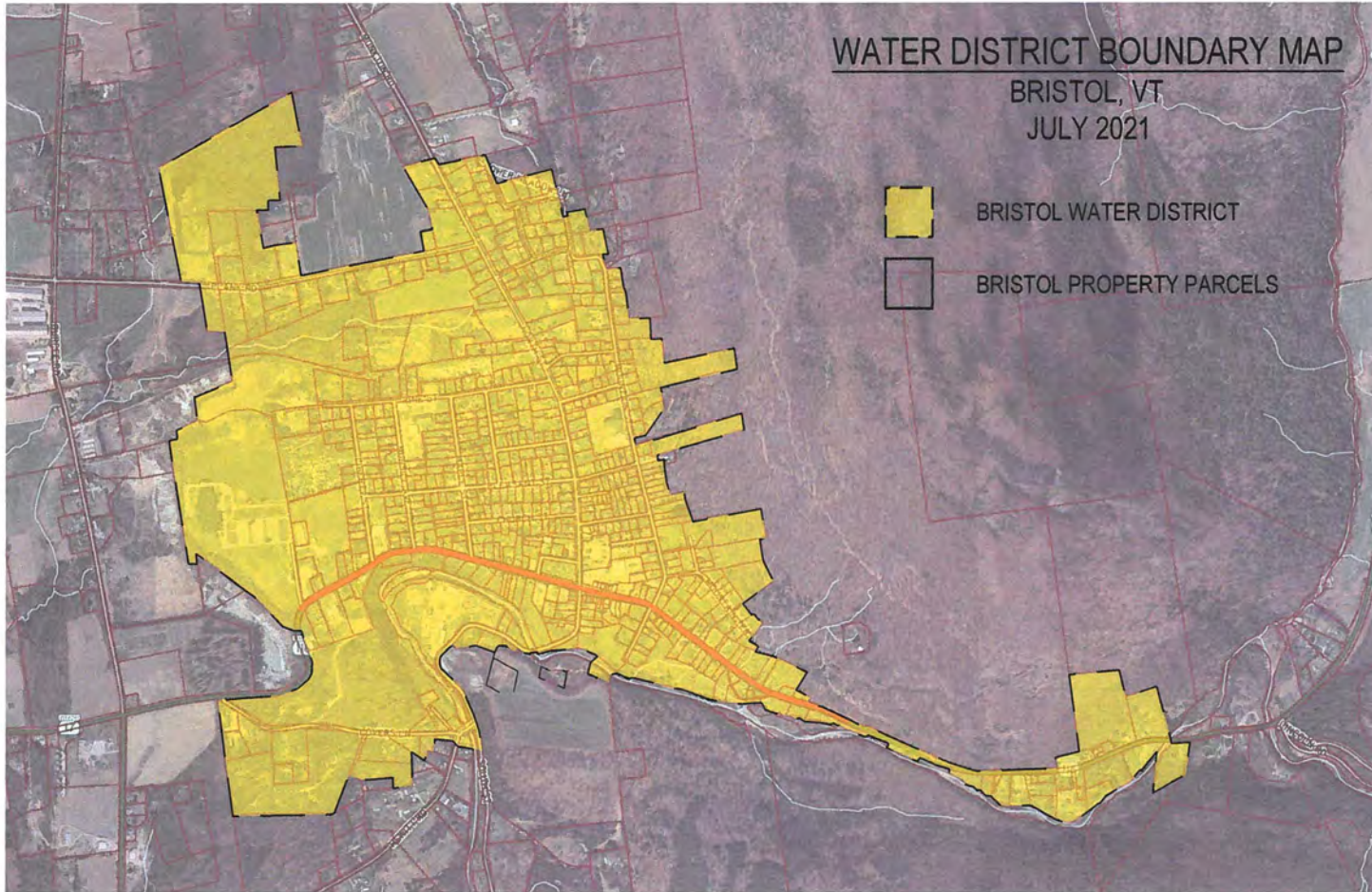
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September 30, 2020

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NOTES

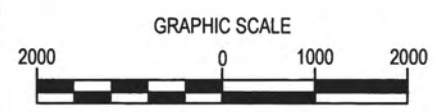
Bristol, Vermont



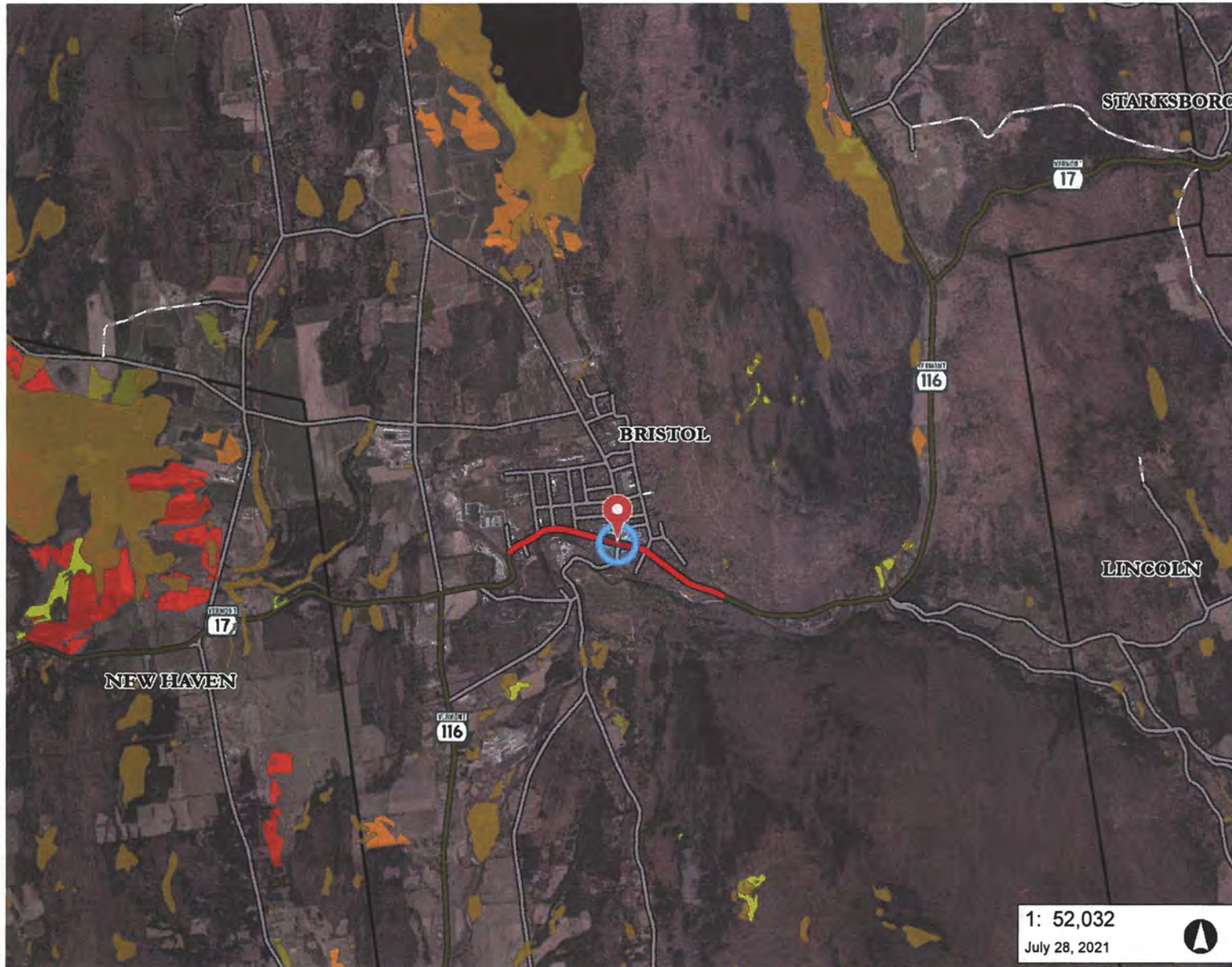
1438 SOUTH BROWNELL ROAD
 WILLISTON, VERMONT 05495
 PHONE: (802)862-5590
 FAX: (802)862-7598

GREEN MOUNTAIN ENGINEERING

CIVIL
 WATER
 WASTEWATER



DRAWING TITLE	WATER SERVICE AREA MAP		DESIGNED SP	PROJECT NO. 29-021
			DRAWN JJB	
PROJECT	BRISTOL WATER SYSTEM - PER SYSTEM MODELING		CHECKED AH	FIGURE NO. 2
			PLOT DATE 8/16/21	
CLIENT	TOWN OF BRISTOL, VERMONT		SCALE AS SHOWN	
			DATE AUG. 2021	



LEGEND

- Special Regulation Watershed
- Wetland - VSWI
 - Class 1 Wetland
 - Class 2 Wetland
 - Buffer
- Wetlands Advisory Layer
- Wetland Restoration Potential (2017)
 - 0.600000 - 1.000000
 - 1.000001 - 2.000000
 - 2.000001 - 3.000000
 - 3.000001 - 4.000000
- Roads
 - Interstate
 - US Highway; 1
 - State Highway
 - Town Highway (Class 1)
 - Town Highway (Class 2,3)
 - Town Highway (Class 4)
 - State Forest Trail
 - National Forest Trail
 - Legal Trail
 - Private Road/Driveway
 - Proposed Roads
- Stream/River
 - Stream
 - Intermittent Stream
- Town Boundary

1: 52,032
July 28, 2021

NOTES

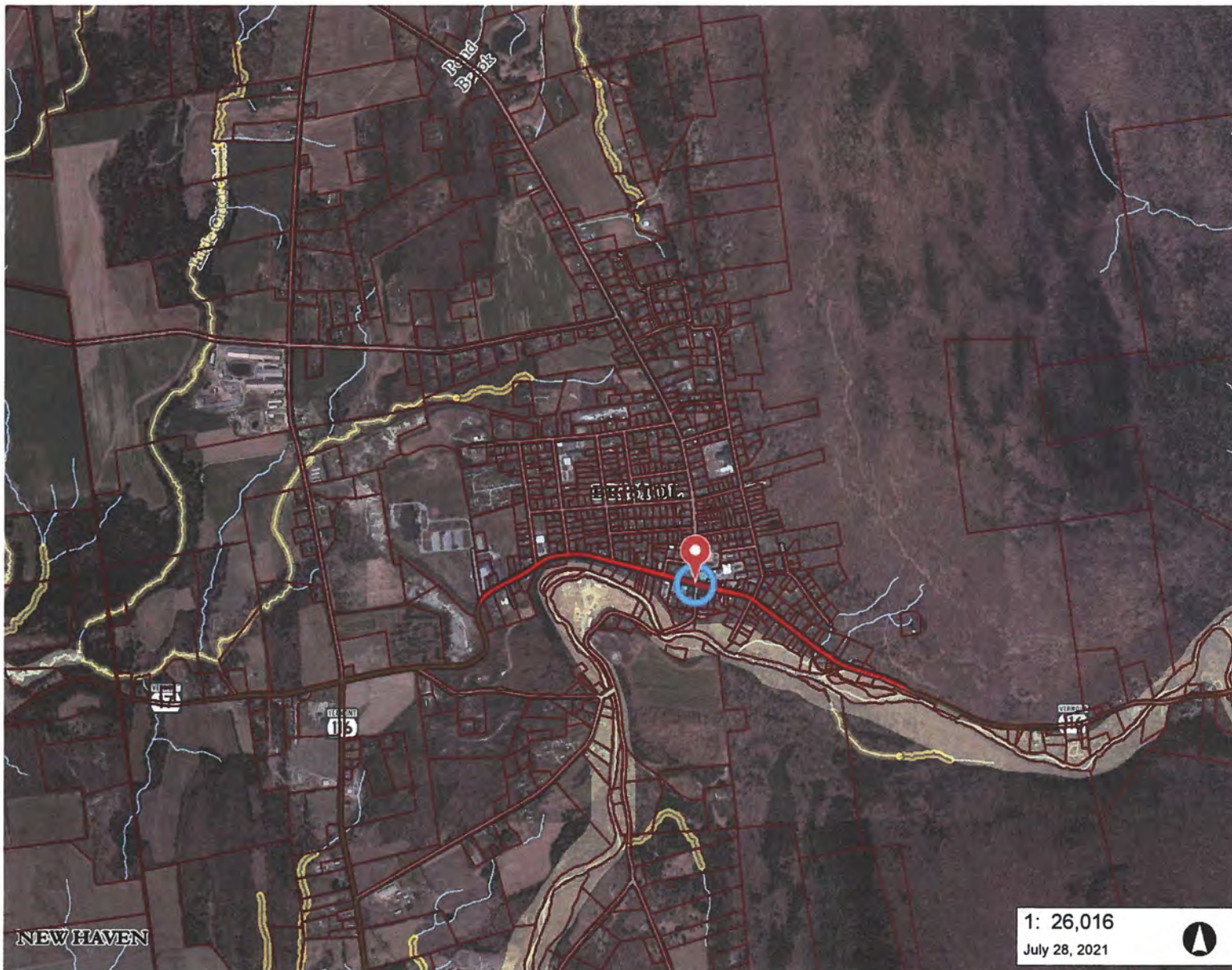
Map created using ANR's Natural Resources Atlas

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LEGEND

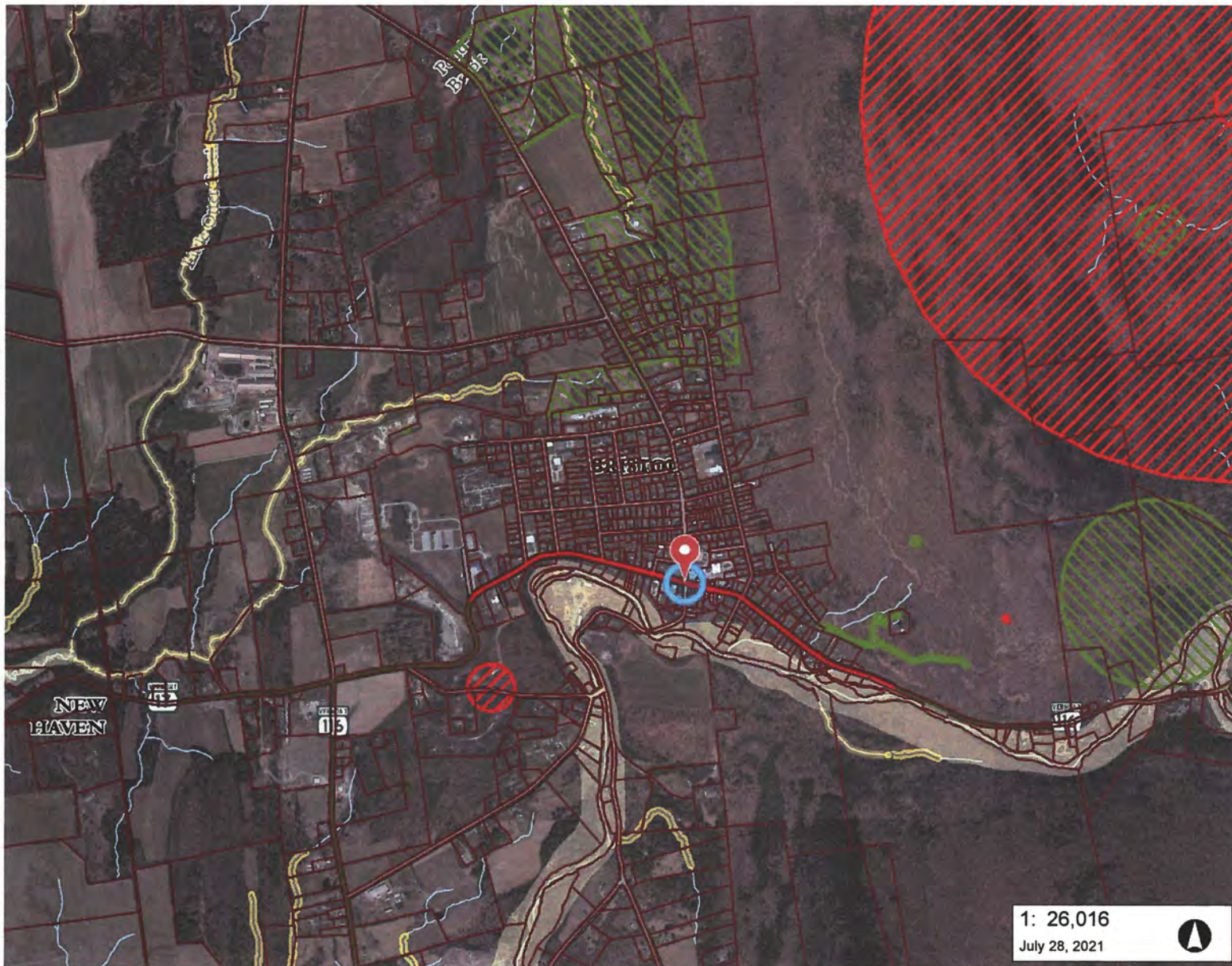
- Special Regulation Watershed
- DFIRM Panels
- DFIRM Floodways
- Flood Hazard Areas (Only FEMA)**
 - AE (1-percent annual chance flood)
 - A (1-percent annual chance floodpl.)
 - AO (1-percent annual chance zone feet)
 - 0.2-percent annual chance flood ha
- River Corridors (Aug 27, 2019)**
 - .5 - 2 sqmi.
 - .25-.5 sqmi.
- Parcels (standardized)**
- Roads**
 - Interstate
 - US Highway; 1
 - State Highway
 - Town Highway (Class 1)
 - Town Highway (Class 2,3)
 - Town Highway (Class 4)
 - State Forest Trail
 - National Forest Trail
 - Legal Trail
 - Private Road/Driveway
 - Proposed Roads
- Stream/River**
 - Stream
 - Intermittent Stream

1: 26,016
July 28, 2021

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NOTES
Map created using ANR's Natural Resources Atlas



LEGEND

- Special Regulation Watershed
- Rare Threatened Endangered
 - Threatened or Endangered
 - Rare
- DFIRM Panels
- DFIRM Floodways
- Flood Hazard Areas (Only FEM)**
 - AE (1-percent annual chance flood)
 - A (1-percent annual chance floodpl.)
 - AO (1-percent annual chance zone feet)
 - 0.2-percent annual chance flood ha
- River Corridors (Aug 27, 2019)**
 - .5 - 2 sqmi.
 - .25-.5 sqmi.
- Parcels (standardized)
- Roads**
 - Interstate
 - US Highway; 1
 - State Highway
 - Town Highway (Class 1)
 - Town Highway (Class 2,3)
 - Town Highway (Class 4)
 - State Forest Trail
 - National Forest Trail
 - Legal Trail
 - Private Road/Driveway
 - Proposed Roads

1: 26,016
July 28, 2021

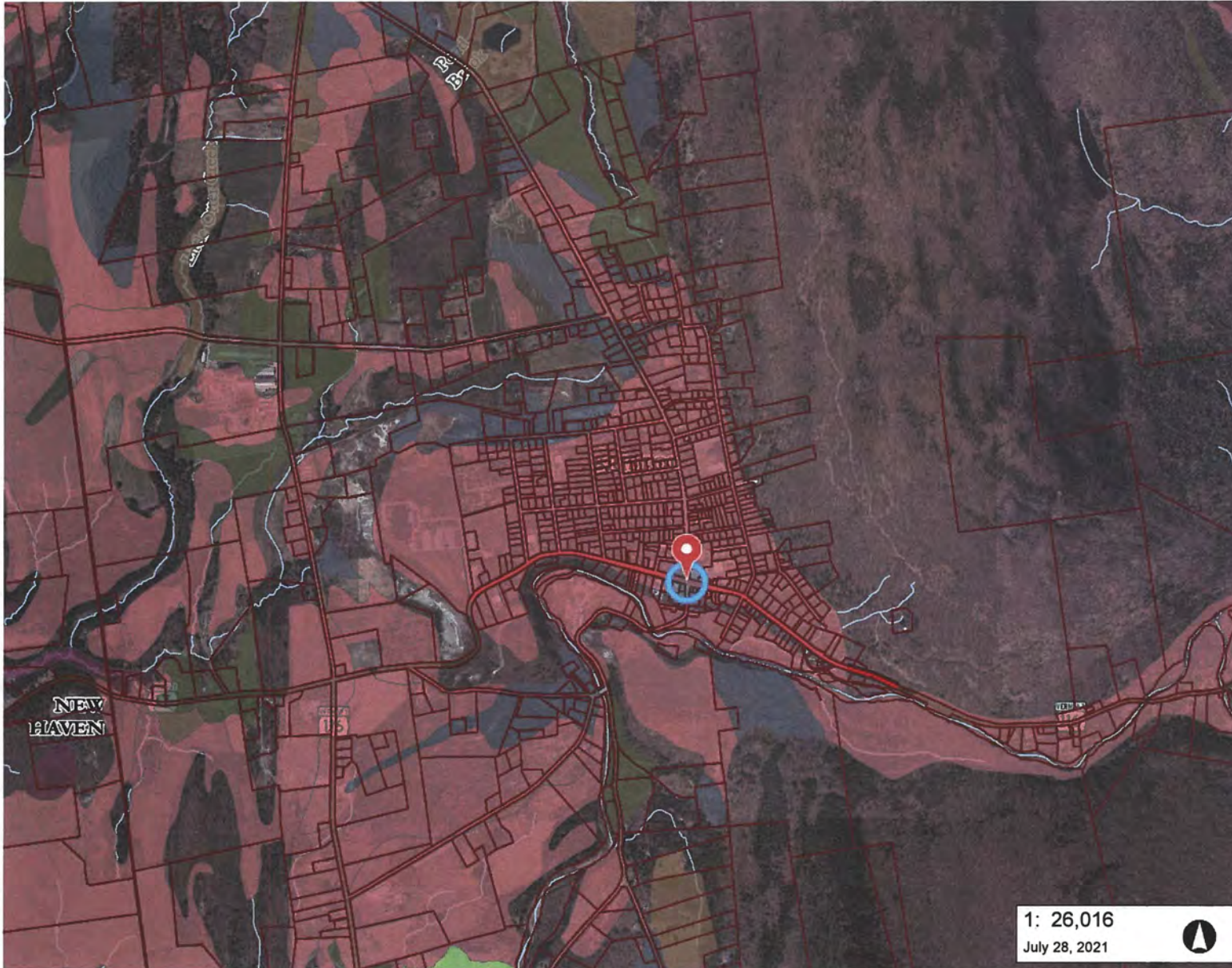


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NOTES

Map created using ANR's Natural Resources Atlas



LEGEND

- Special Regulation Watershed
- Soils - Prime Agricultural
 - Local
 - Local (b)
 - Not rated
 - Prime
 - Prime (b)
 - Prime (f)
 - Statewide
 - Statewide (a)
 - Statewide (b)
 - Statewide (c)
- Parcels (standardized)
- Roads**
 - Interstate
 - US Highway; 1
 - State Highway
 - Town Highway (Class 1)
 - Town Highway (Class 2,3)
 - Town Highway (Class 4)
 - State Forest Trail
 - National Forest Trail
 - Legal Trail
 - Private Road/Driveway
 - Proposed Roads
- Stream/River**
 - Stream
 - Intersecting Stream

1: 26,016
July 28, 2021

1,322.0 0 661.00 1,322.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 2168 Ft. 1cm = 260 Meters

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NOTES

Map created using ANR's Natural Resources Atlas



LEGEND

- Special Regulation Watershed
- State Natural Areas
- Wilderness Area (GMNF)
- Green Mountain National Forest
- Parcels (standardized)

Roads

- Interstate
- US Highway: 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River

- Stream
- Intermittent Stream

- Town Boundary

NOTES

Map created using ANR's Natural Resources Atlas

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WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 2168 Ft. 1cm = 260 Meters

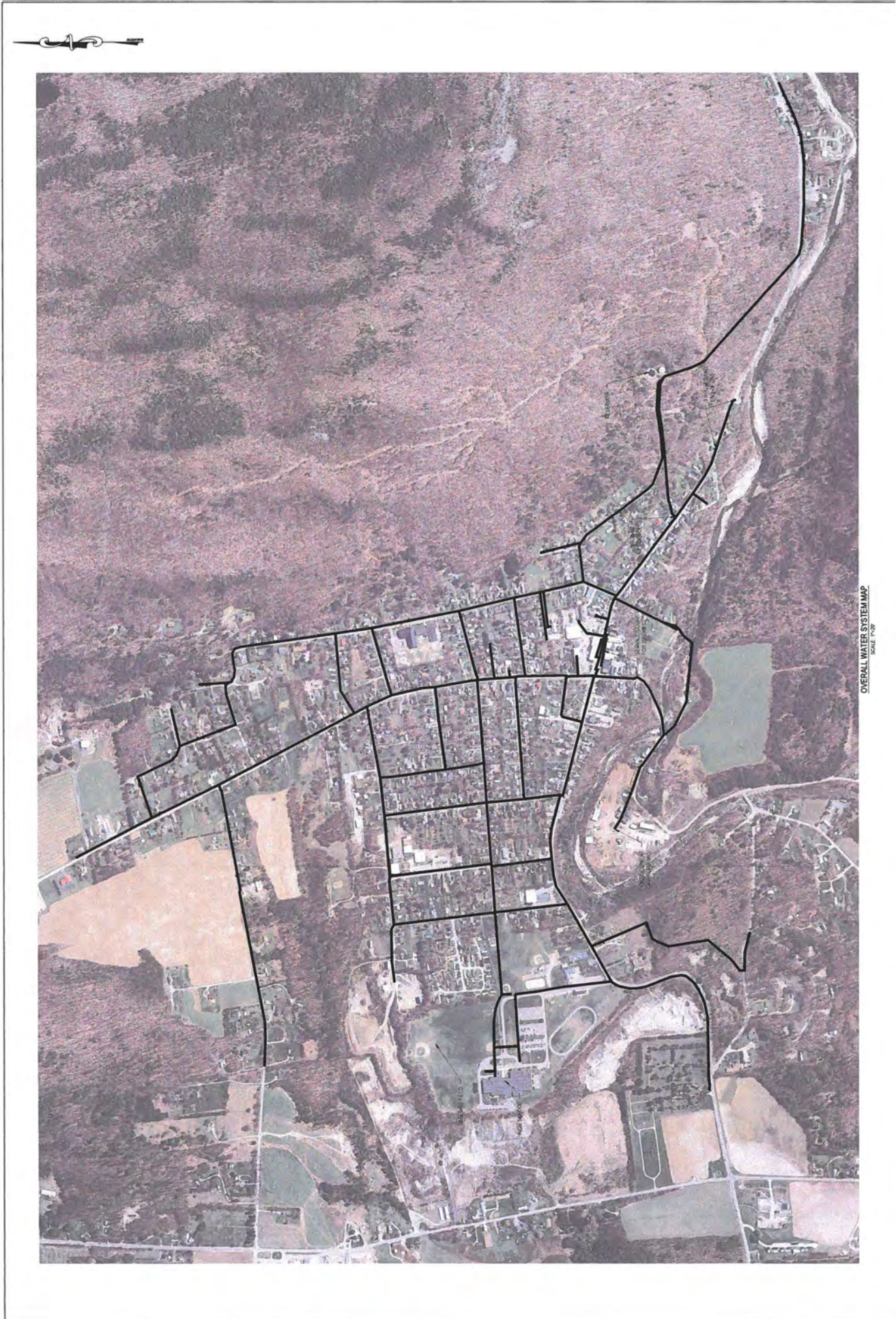
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REV	DATE	DESCRIPTION	BY

GREEN MOUNTAIN ENGINEERING
 1000 SOUTH WINDMILL ROAD
 WASHINGTON VERMONT 05682
 PHONE 802-253-3333
 FAX 802-253-7333

PROJECT NO. 20-021	
PROJECT NAME WATER DISTRIBUTION SYSTEM - PER SYSTEM MODELING	
TOWN OF BRISTOL, VERMONT	
DATE 10/20/2020	SCALE 1"=100'
PROJECTED 10/20/2020	BY [Signature]
DATE 10/20/2020	BY [Signature]
PROJECTED 10/20/2020	BY [Signature]
DATE 10/20/2020	BY [Signature]
PROJECTED 10/20/2020	BY [Signature]



Appendix B

Water Distribution System Inventory

Preliminary Engineering Report Bristol Waterline Inventory

Revised 7-21-21

Street Name	From	To Intersection	Size	Material	Length	Approximate Installation Year
Airport Dr.	West St.	Airport Dr.	8	D.I.	1068 feet	1996
Basin St.	River Crossing	North Bank to South Bank	10	D.I.	100 feet	1994
Basin St.	East St.	North bank of New Haven River	8	D.I.	772 feet	1995
Church St.	North St.	Maple St.	6	C.I.	1200 feet	1905
Crescent St.	North St.	Mountain St.	6	D.I.	840 feet	1983
Devino Lane	Mountain St	Meadow Ln.	4	D.I (?)	415 feet	1978 ?
East St.	Bingham Residence 75 East St.	3 houses east to end of line	1 ?	C.I.	1000 feet	1905
East St.	Mountain St.	Bingham Residence (75 East St.)	10	C.I.	900 feet	1905
East St.	Drake Smith Rd. Hyd Valve	next 3 houses	4	C.I.	275 feet	1905
East St.	Bingham Residence (75 East St.)	Drake Smith Rd. Hyd. Valve	6	C.I.	375 feet	1905
Elm St.	North St.	Taylor Ave.	4	C.I.	785 feet	1905
Fitch Ave.	North St.	Mountain St.	4	C.I.	690 feet	1905
Firehouse Drive	West Street	Lovers Lane	8	PVC	2600 feet	2018
Garfield St.	North St.	Mountain St.	6	C.I.	775 feet	1905
High St.	Mountain Terrace	end of line	2	Galvanized ?	400 feet	1960
Liberty St.	Pine St.	West St.	8	D.I.	1600 feet	1983
Lower Meadow Ln.	North St.	14 Lower Meadow Lane	6	D.I.	1200 feet	1978
Main St.	North St.	Prince Ln.	10	C.I.	350 feet	1905
Main St.	Prince Ln.	Mountain St.	10	C.I.	425 feet	1905
Main St.	Service "loop" for businesses		8	C.I.	622 feet	1905
Maple St.	West St.	Pine St.	6	C.I.	1760 feet	1905
Meadow Ln.	Devino Lane	Lower Meadow Ln.	6	D.I.	1600 feet	1977
Mountain Street	East St.	Mountain Terrace	8	D.I.	350	1984
Mountain Street	Mountain Terrace	Garfield	8	D.I.	670	1984
Mountain Street	Garfield	Fitch	6	C.I.	1440	1905
Mountain Street	Fitch Ave.	Crescent Street	6	C.I.	350	1905
Mountain Street	Crescent Street	Meadow Lane	4	D.I.	1420	1968
Mountain Terr.	Mountain St.	end of Mountain Terr.	12	D.I.	1290 feet	1995
Mountain View St.	Mountain St.	End of line	8	D.I.	484 feet	2016
Munsill Ave.	West St.	Pleasant St.	4	C.I.	600 feet	1905
Munsill Ave.	Pleasant St.	Pine St.	6	D.I.	990 feet	1980
North St.	West St.	Spring St.	8	D.I.	1170 feet	2010
North St.	Spring St.	Pine St.	8	C.I.	1115 feet	1905
North St.	Pine St.	Plank Rd.	8	D.I.	1640 feet	2005
North St.	Plank Rd.	Lower Meadow Ln. - X-Country	6	D.I.	740 feet	1974
North St.	Lower Meadow Ln. - X-Country	end of line	4	D.I.	840 feet	1994

Park Pl.	School St.	North St.	6	C.I.	570 feet	1905
Pine St.	last residence on street	Town Garage	2	Galvanized	270 feet	1970
Pine St.	Liberty St.	last residence on street	4	C.I.	250 feet	1905
Pine St.	Maple St.	Liberty St.	6	C.I.	970 feet	1905
Pine St.	North St.	Maple St.	8	C.I.	1080 feet	1905
Plank Rd.	North St.	Roy's Automotive	8	D.I.	1050 feet	2005
Plank Rd.	Roy's Automotive	end of line	8	D.I.	1735 feet	1997
Pleasant St.	Liberty St.	Munsill Ave.	6	C.I.	468 feet	1905
Pleasant St.	Munsill Ave.	Maple St.	6	C.I.	606 feet	1905
Pleasant St.	Maple St.	North St.	8	C.I.	1210 feet	1905
Pumphouse Rd.	South St.	End of line at Lathrop's Mill	4	C.I.	1040 feet	1905
Pumphouse Rd.	South St.	Water Facility - Pump Station	6	C.I.	400 feet	1960
School St.	West St.	Park Pl.	6	C.I.	220 feet	1905
South St.	West St.	13 South St.	8	D.I.	420 feet	2010
South St.	13 South St.	North bank of New Haven River	8	D.I.	520 feet	2014
South St.	River Crossing	North Bank to South Bank	8	D.I.	100 feet	2014
Spring St.	North St.	Mountain St.	8	D.I.	690 feet	2010
Taylor Ave.	Pleasant St.	Pine St.	6	C.I.	1020 feet	1905
West St.	Airport Dr.	Liberty St.	8	PVC	875 feet	2017
West St.	Liberty St.	Munsill Ave.	8	PVC	470 feet	2017
West St.	Munsill Ave.	Maple St.	8	PVC	650 feet	2017
West St.	Maple St.	School St.	8	C.I.	750 feet	1905
West St.	School St.	North St.	8	C.I.	470 feet	1905
	Reservoir	Bingham Residence	10	C.I.	1450 feet	1905
	Reservoir	end of Mountain Terr.	12	D.I.	1133 feet	1995
	High School	Hydrant in front of northern side of High School	4	D.I.	130 feet	1969
	Reservoir	Rockydale Dr.	4	C.I.	4300 feet	1905
	Airport Dr.	Baseball Field	6	D.I.	550 feet	1969
	Liberty St.	Airport Dr.	6	D.I.	820 feet	1969
	Western side of parking lot	Hydrant in front of southern side of High School	6	D.I.	180 feet	1969
	South bank of River	Pump House	6	D.I.	650 feet	1995
	Airport Dr.	Western side of parking lot	8	D.I.	200 feet	1996

Total 58098 feet

D.I. = Ductile Iron

C.I. = Cast iron

Appendix C

Recommended Replacement Priority List

Appendix C
Preliminary Engineering Report
Town of Bristol, Vermont
Water Main Replacement
Recommended Priority List

Revised 8-9-21

Priority Number	Street	From Intersection with ...	To Intersection with ...	Current Size	Material	Approximate length (ft)	Approximate Installation Year	Recommended Replacement Size (inches)	Comments
1	Pine St.	Liberty St.	last residence on street	4"	C.I.	250	1905	8	Beyond Useful life
-	Pine St.	Maple St.	Liberty St.	6"	C.I.	970	1905	8	Beyond Useful life
-	Pine St.	North St.	Maple St.	8"	C.I.	1080	1905	8	Beyond Useful life
2	Munsill Ave.	West St.	Pleasant St.	4"	C.I.	600	1905	8	Beyond Useful life
-	Munsill Ave.	Pleasant Street	Pine St.	6"	D.I.	990	1980	8	Hydraulic Analysis recommends increasing line size
3		Reservoir	Rockydale Dr.	4"	C.I.	4300	1905	8	Beyond Useful life
4	Liberty Street	Pine Street	West Street	8"	D.I.	1600	1983	8	Hydraulic Analysis recommends increasing line size
5	Maple St.	West St.	Pine St.	6"	C.I.	1760	1905	8	Beyond Useful life
6	Mountain Street	East St.	Mountain Terrace	8"	D.I.	350	1984	8	Hydraulic analysis recommends increasing line size
	Mountain Street	Mountain Terrace	Garfield	8"	D.I.	670	1984	8	Hydraulic Analysis recommends increasing line size
-	Mountain Street	Garfield	Fitch	6"	C.I.	1440	1905	8	Beyond Useful life
-	Mountain Street	Fitch Ave.	Crescent Street	6"	C.I.	350	1905	8	Beyond Useful life
-	Mountain Street	Crescent Street	Meadow Lane	4"	D.I.	1420	1968	8	Hydraulic analysis recommends increasing line size??
-	Devino Lane	Meadow Lane	North Street	-	-	550	N/A	8	Currently no waterline. Hyd. analysis recommends looping
7	Pleasant St.	Maple St.	North St.	8"	C.I.	1210	1905	8	Beyond Useful life
-	Pleasant St.	Munsill Ave.	Maple St.	6"	C.I.	606	1905	8	Beyond Useful life
-	Pleasant St.	Liberty St.	Munsill Ave.	6"	C.I.	468	1905	8	Beyond Useful life
	North St.	Spring St.	Pine St.	8"	C.I.	1115	1905	8	Beyond Useful life
8	Church St.	North St.	Maple St.	6"	C.I.	1200	1905	8	Beyond Useful life
-	Park Pl.	School St.	North St.	6"	C.I.	570	1905	8	Beyond Useful life
	School St.	West St.	Park Place	6"	C.I.	220	1905	8	Beyond Useful life
9	-	Reservoir	Bingham Residence	10"	C.I.	1450	1905	12	Beyond Useful life
10	Elm St.	North St.	Taylor Ave.	4"	C.I.	785	1905	8	Beyond Useful life
	Taylor Ave.	Pleasant St.	Pine St.	6"	C.I.	1020	1905	8	Beyond Useful life
11	Crescent Street	North St.	Mountain St.	6"	D.I.	840	1983	8	Hydraulic Analysis recommends increasing line size
-	Garfield Street	North St.	Mountain St.	6"	C.I.	775	1905	8	Beyond Useful life
-	Fitch Ave.	North St.	Mountain St.	4"	C.I.	690	1905	8	Beyond Useful life
12	West St.	Maple St.	School St.	8"	C.I.	750	1905	12	Beyond Useful life
-	West St.	School St.	North St.	8"	C.I.	470	1905	12	Beyond Useful life
13	Main St.	North St.	Prince Ln.	10"	C.I.	350	1905	12	Beyond Useful life
-	Main St.	Prince Ln.	Mountain St.	10"	C.I.	425	1905	12	Beyond Useful life
-	Main St.	Service Loop For Businesses		8"	C.I.	622	1905	8	Beyond Useful life
14	East St.	Mountain St.	Bingham Residence @ 75 East St.	10"	C.I.	900	1905	12	Beyond Useful life
-	East St.	Bingham Residence @ 75 East St.	Drake Smith Rd. Hyd. Valve	6"	C.I.	375	1905	12	Beyond Useful life
-	East St.	Drake Smith Hydrant Valve	Next 3 houses	4"	C.I.	275	1905	8	Beyond Useful life
-	East St.	3 Houses	End of Line	1"	C.I.	1000	1905	8	Beyond Useful life
15	Pumphouse Rd	South St.	End of Line at Lathrop's Mill	4"	C.I.	1040	1905	8	Beyond Useful life

Appendix D

Opinion of Probable Construction Cost

OPINION OF PROBABLE CONSTRUCTION COST

Pine Street (North Street to Liberty Street to Last House on Street)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020 Unit Price	2020 Total Cost	2021 Total Cost	2025 Total Cost	2030 Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	2,300	L.F.	\$95.00	\$218,500	\$220,417	\$239,583	\$264,500
3/4" Diameter Copper House Service	520	L.F.	\$50.00	\$26,000	\$26,228	\$28,509	\$31,474
1" Diameter Copper House Service	47	L.F.	\$58.50	\$2,750	\$2,774	\$3,015	\$3,328
Existing Waterline Connections	9	EA.	\$3,000.00	\$27,000	\$27,237	\$29,605	\$32,684
8" Gate Valve	8	EA.	\$2,250.00	\$18,000	\$18,158	\$19,737	\$21,789
6" Gate Valve	3	EA.	\$2,000.00	\$6,000	\$6,053	\$6,579	\$7,263
4" Gate Valve	2	EA.	\$1,800.00	\$3,600	\$3,632	\$3,947	\$4,358
3/4" Curb Stops and Boxes	26	EA.	\$250.00	\$6,500	\$6,557	\$7,127	\$7,868
3/4" Corporation Stops	26	EA.	\$350.00	\$9,100	\$9,180	\$9,978	\$11,016
1" Curb Stops and Boxes	2	EA.	\$410.00	\$820	\$827	\$899	\$993
1" Corporation Stops	2	EA.	\$410.00	\$820	\$827	\$899	\$993
Removal of Fire Hydrant	3	EA.	\$585.00	\$1,755	\$1,770	\$1,924	\$2,124
Fire Hydrant Branch Connection	4	EA.	\$5,000.00	\$20,000	\$20,175	\$21,930	\$24,211
Rigid Trench Insulation	600	S.F.	\$2.50	\$1,500	\$1,513	\$1,645	\$1,816
Class "B" Concrete	16	C.Y.	\$300.00	\$4,800	\$4,842	\$5,263	\$5,811
Miscellaneous Extra Excavation	50	C.Y.	\$30.00	\$1,500	\$1,513	\$1,645	\$1,816
Below-Grade Rock Removal (pipelines)	1	C.Y.	\$150.00	\$150	\$151	\$164	\$182
Replacement of Unsuitable Material	75	C.Y.	\$40.00	\$3,000	\$3,026	\$3,289	\$3,632
Boulder Excavation	25	C.Y.	\$60.00	\$1,500	\$1,513	\$1,645	\$1,816
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	10	Ton	\$585.00	\$5,850	\$5,901	\$6,414	\$7,082
Permanent Trench Pavement Repair	1,388	S.Y.	\$70.00	\$97,160	\$98,012	\$106,535	\$117,615
Concrete Sidewalk Replacement	0	S.F.	\$15.00	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$5,000	\$5,000	\$5,044	\$5,482	\$6,053
Site Prep and Miscellaneous (8%)	1	L.S.	\$37,144	\$37,144	\$37,470	\$40,728	\$44,964
Contingency (20%)	1	L.S.	\$100,290	\$100,290	\$101,170	\$109,967	\$121,403
Contractor's Bonds (2%)	1	L.S.	\$12,035	\$12,035	\$12,140	\$13,196	\$14,568
Subtotal				\$613,773	\$619,157	\$672,997	\$742,989
Street Repair							
Pavement Overlay	5,867	S.Y.	\$25	\$146,667	\$147,953	\$160,819	\$177,544
Contingency (20%)	1	L.S.	\$35,509	\$35,509	\$35,820	\$38,935	\$42,984
Contractor's Bonds (2%)	1	L.S.	\$4,411	\$4,411	\$4,449	\$4,836	\$5,339
Subtotal				\$186,586	\$188,223	\$204,590	\$225,867
TOTAL				\$800,359	\$807,380	\$877,587	\$968,856

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Munsill Avenue (West Street - Pine Street)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	1,590	L.F.	\$95.00	\$151,050	\$152,375	\$165,625	\$182,850
3/4" Diameter Copper House Service	380	L.F.	\$50.00	\$19,000	\$19,167	\$20,833	\$23,000
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	4	EA.	\$3,000.00	\$12,000	\$12,105	\$13,158	\$14,526
8" Gate Valve	4	EA.	\$2,250.00	\$9,000	\$9,079	\$9,868	\$10,895
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$1,800.00	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	19	EA.	\$250.00	\$4,750	\$4,792	\$5,208	\$5,750
3/4" Corporation Stops	19	EA.	\$350.00	\$6,650	\$6,708	\$7,292	\$8,050
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	3	EA.	\$585.00	\$1,755	\$1,770	\$1,924	\$2,124
Fire Hydrant Branch Connection	3	EA.	\$5,000.00	\$15,000	\$15,132	\$16,447	\$18,158
Rigid Trench Insulation	300	S.F.	\$2.50	\$750	\$757	\$822	\$908
Class "B" Concrete	13	C.Y.	\$300.00	\$3,900	\$3,934	\$4,276	\$4,721
Miscellaneous Extra Excavation	55	C.Y.	\$30.00	\$1,650	\$1,664	\$1,809	\$1,997
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	30	C.Y.	\$40.00	\$1,200	\$1,211	\$1,316	\$1,453
Boulder Excavation	30	C.Y.	\$60.00	\$1,800	\$1,816	\$1,974	\$2,179
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	5	Ton	\$585.00	\$2,925	\$2,951	\$3,207	\$3,541
Permanent Trench Pavement Repair	905	S.Y.	\$70.00	\$63,350	\$63,906	\$69,463	\$76,687
Concrete Sidewalk Replacement	0	S.F.	\$15.00	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$24,062.40	\$24,062	\$24,273	\$26,384	\$29,128
Contingency (20%)	1	L.S.	\$64,968.48	\$64,968	\$65,538	\$71,237	\$78,646
Contractor's Bonds (2%)	1	L.S.	\$7,796.22	\$7,796	\$7,865	\$8,548	\$9,438
			Subtotal	\$397,607	\$401,095	\$435,973	\$481,314
Street Repair							
Pavement Overlay	4,533	S.Y.	\$25.00	\$113,333	\$114,327	\$124,269	\$137,193
Contingency (20%)	1	L.S.	\$27,438.60	\$27,439	\$27,679	\$30,086	\$33,215
Contractor's Bonds (2%)	1	L.S.	\$3,408.16	\$3,408	\$3,438	\$3,737	\$4,126
			Subtotal	\$144,180	\$145,445	\$158,092	\$174,534
			TOTAL	\$541,787	\$546,540	\$594,065	\$655,848

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Reservoir to Rockydale Ln

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	4,300	L.F.	\$95.00	\$408,500	\$412,083	\$447,917	\$494,500
3/4" Diameter Copper House Service	340	L.F.	\$50.00	\$17,000	\$17,149	\$18,640	\$20,579
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	1	E.A.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
8" Gate Valve	1	E.A.	\$2,250.00	\$2,250	\$2,270	\$2,467	\$2,724
6" Gate Valve	0	E.A.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	0	E.A.	\$1,800.00	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	17	E.A.	\$250.00	\$4,250	\$4,287	\$4,660	\$5,145
3/4" Corporation Stops	17	E.A.	\$350.00	\$5,950	\$6,002	\$6,524	\$7,203
1" Curb Stops and Boxes	0	E.A.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	E.A.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	0	E.A.	\$585.00	\$0	\$0	\$0	\$0
Fire Hydrant Branch Connection	1	E.A.	\$5,000.00	\$5,000	\$5,044	\$5,482	\$6,053
Rigid Trench Insulation	200	S.F.	\$2.50	\$500	\$504	\$548	\$605
Class "B" Concrete	10	C.Y.	\$300.00	\$3,000	\$3,026	\$3,289	\$3,632
Miscellaneous Extra Excavation	20	C.Y.	\$30.00	\$600	\$605	\$658	\$726
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	20	C.Y.	\$40.00	\$800	\$807	\$877	\$968
Boulder Excavation	5	C.Y.	\$60.00	\$300	\$303	\$329	\$363
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	5	Ton	\$585.00	\$2,925	\$2,951	\$3,207	\$3,541
Permanent Trench Pavement Repair	160	S.Y.	\$70.00	\$11,200	\$11,298	\$12,281	\$13,558
Concrete Sidewalk Replacement	0	S.F.	\$15.00	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$37,702.00	\$37,702	\$38,033	\$41,340	\$45,639
Contingency (20%)	1	L.S.	\$101,795	\$101,795	\$102,688	\$111,618	\$123,226
Contractor's Bonds (2%)	1	L.S.	\$12,215.45	\$12,215	\$12,323	\$13,394	\$14,787
Subtotal				\$622,988	\$628,453	\$683,101	\$754,143
TOTAL				\$622,988	\$628,453	\$683,101	\$754,143

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.
2. Street improvements are not included in this estimate as this is a State highway.

OPINION OF PROBABLE CONSTRUCTION COST

Liberty St

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	1,600	L.F.	\$95.00	\$152,000	\$153,333	\$166,667	\$184,000
3/4" Diameter Copper House Service	320	L.F.	\$50.00	\$16,000	\$16,140	\$17,544	\$19,368
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	4	EA.	\$3,000.00	\$12,000	\$12,105	\$13,158	\$14,526
8" Gate Valve	4	EA.	\$2,250.00	\$9,000	\$9,079	\$9,868	\$10,895
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$1,800.00	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	16	EA.	\$250.00	\$4,000	\$4,035	\$4,386	\$4,842
3/4" Corporation Stops	16	EA.	\$350.00	\$5,600	\$5,649	\$6,140	\$6,779
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	1	EA.	\$585.00	\$585	\$590	\$641	\$708
Fire Hydrant Branch Connection	1	EA.	\$5,000.00	\$5,000	\$5,044	\$5,482	\$6,053
Rigid Trench Insulation	200	S.F.	\$2.50	\$500	\$504	\$548	\$605
Class "B" Concrete	8	C.Y.	\$300.00	\$2,400	\$2,421	\$2,632	\$2,905
Miscellaneous Extra Excavation	30	C.Y.	\$30.00	\$900	\$908	\$987	\$1,089
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	30	C.Y.	\$40.00	\$1,200	\$1,211	\$1,316	\$1,453
Boulder Excavation	30	C.Y.	\$60.00	\$1,800	\$1,816	\$1,974	\$2,179
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	5	Ton	\$585.00	\$2,925	\$2,951	\$3,207	\$3,541
Permanent Trench Pavement Repair	561	S.Y.	\$70.00	\$39,270	\$39,614	\$43,059	\$47,537
Concrete Sidewalk Replacement	0	S.F.	\$15.00	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$20,734.40	\$20,734	\$20,916	\$22,735	\$25,100
Contingency (20%)	1	L.S.	\$55,982.88	\$55,983	\$56,474	\$61,385	\$67,769
Contractor's Bonds (2%)	1	L.S.	\$6,717.95	\$6,718	\$6,777	\$7,366	\$8,132
			Subtotal	\$342,615	\$345,621	\$375,675	\$414,745
Street Repair							
Pavement Overlay	4,667	S.Y.	\$25.00	\$116,667	\$117,690	\$127,924	\$141,228
Contingency (10%)	1	L.S.	\$14,122.81	\$14,123	\$14,247	\$15,486	\$17,096
Contractor's Bonds (2%)	1	L.S.	\$3,166.48	\$3,166	\$3,194	\$3,472	\$3,833
			Subtotal	\$133,956	\$135,131	\$146,882	\$162,157
TOTAL				\$476,571	\$480,752	\$522,556	\$576,902

Notes:

i. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Maple St

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	1,760	L.F.	\$95.00	\$167,200	\$168,667	\$183,333	\$202,400
3/4" Diameter Copper House Service	540	L.F.	\$50.00	\$27,000	\$27,237	\$29,605	\$32,684
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	2	EA.	\$3,000.00	\$6,000	\$6,053	\$6,579	\$7,263
8" Gate Valve	6	EA.	\$2,250.00	\$13,500	\$13,618	\$14,803	\$16,342
6" Gate Valve	2	EA.	\$2,000.00	\$4,000	\$4,035	\$4,386	\$4,842
4" Gate Valve	0	EA.	\$1,800.00	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	27	EA.	\$250.00	\$6,750	\$6,809	\$7,401	\$8,171
3/4" Corporation Stops	27	EA.	\$350.00	\$9,450	\$9,533	\$10,362	\$11,439
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	5	EA.	\$585.00	\$2,925	\$2,951	\$3,207	\$3,541
Fire Hydrant Branch Connection	5	EA.	\$5,000.00	\$25,000	\$25,219	\$27,412	\$30,263
Rigid Trench Insulation	400	S.F.	\$2.50	\$1,000	\$1,009	\$1,096	\$1,211
Class "B" Concrete	20	C.Y.	\$300.00	\$6,000	\$6,053	\$6,579	\$7,263
Miscellaneous Extra Excavation	50	C.Y.	\$30.00	\$1,500	\$1,513	\$1,645	\$1,816
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	50	C.Y.	\$40.00	\$2,000	\$2,018	\$2,193	\$2,421
Boulder Excavation	50	C.Y.	\$60.00	\$3,000	\$3,026	\$3,289	\$3,632
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	5	Ton	\$585.00	\$2,925	\$2,951	\$3,207	\$3,541
Permanent Trench Pavement Repair	1,002	S.Y.	\$70.00	\$70,140	\$70,755	\$76,908	\$84,906
Concrete Sidewalk Replacement	408	S.F.	\$15.00	\$6,120	\$6,174	\$6,711	\$7,408
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$28,840.80	\$28,841	\$29,094	\$31,624	\$34,913
Contingency (20%)	1	L.S.	\$77,870.16	\$77,870	\$78,553	\$85,384	\$94,264
Contractor's Bonds (2%)	1	L.S.	\$9,344.42	\$9,344	\$9,426	\$10,246	\$11,312
			Subtotal	\$476,565	\$480,746	\$522,550	\$576,895
Street Repair							
Pavement Overlay	4,693	S.Y.	\$25.00	\$117,325	\$118,354	\$128,646	\$142,025
Contingency (20%)	1	L.S.	\$28,405.00	\$28,405	\$28,654	\$31,146	\$34,385
Contractor's Bonds (2%)	1	L.S.	\$3,528.20	\$3,528	\$3,559	\$3,869	\$4,271
			Subtotal	\$149,258	\$150,567	\$163,660	\$180,681
			TOTAL	\$625,824	\$631,313	\$686,210	\$757,576

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Mountain Street (Meadow Ln - Mountain Ter) and Devino Ln (Meadow Ln - North St)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
<u>WATER SYSTEM</u>							
8" Diameter D.I. Water Main	4,780	L.F.	\$95.00	\$454,100	\$458,083	\$497,917	\$549,700
3/4" Diameter Copper House Service	700	L.F.	\$50.00	\$35,000	\$35,307	\$38,377	\$42,368
1" Diameter Copper House Service	35	L.F.	\$58.50	\$2,048	\$2,065	\$2,245	\$2,479
Existing Waterline Connections	10	EA.	\$3,000.00	\$30,000	\$30,263	\$32,895	\$36,316
8" Gate Valve	10	EA.	\$2,250.00	\$22,500	\$22,697	\$24,671	\$27,237
6" Gate Valve	3	EA.	\$2,000.00	\$6,000	\$6,053	\$6,579	\$7,263
4" Gate Valve	3	EA.	\$1,800.00	\$5,400	\$5,447	\$5,921	\$6,537
3/4" Curb Stops and Boxes	39	EA.	\$250.00	\$9,750	\$9,836	\$10,691	\$11,803
3/4" Corporation Stops	39	EA.	\$350.00	\$13,650	\$13,770	\$14,967	\$16,524
1" Curb Stops and Boxes	2	EA.	\$410.00	\$820	\$827	\$899	\$993
1" Corporation Stops	2	EA.	\$410.00	\$820	\$827	\$899	\$993
Removal of Fire Hydrant	2	EA.	\$585.00	\$1,170	\$1,180	\$1,283	\$1,416
Fire Hydrant Branch Connection	8	EA.	\$5,000.00	\$40,000	\$40,351	\$43,860	\$48,421
Rigid Trench Insulation	900	S.F.	\$2.50	\$2,250	\$2,270	\$2,467	\$2,724
Class "B" Concrete	14	C.Y.	\$300.00	\$4,200	\$4,237	\$4,605	\$5,084
Miscellaneous Extra Excavation	50	C.Y.	\$30.00	\$1,500	\$1,513	\$1,645	\$1,816
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	50	C.Y.	\$40.00	\$2,000	\$2,018	\$2,193	\$2,421
Boulder Excavation	15	C.Y.	\$60.00	\$900	\$908	\$987	\$1,089
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	10	Ton	\$585.00	\$5,850	\$5,901	\$6,414	\$7,082
Permanent Trench Pavement Repair	2,000	S.Y.	\$70.00	\$140,000	\$141,228	\$153,509	\$169,474
Concrete Sidewalk Replacement	640	S.F.	\$15.00	\$9,600	\$9,684	\$10,526	\$11,621
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$63,484.60	\$63,485	\$64,041	\$69,610	\$76,850
Contingency (20%)	1	L.S.	\$171,408.42	\$171,408	\$172,912	\$187,948	\$207,494
Contractor's Bonds (2%)	1	L.S.	\$20,569.01	\$20,569	\$20,749	\$22,554	\$24,899
			Subtotal	\$1,049,020	\$1,058,221	\$1,150,241	\$1,269,866
<u>Street Repair</u>							
Pavement Overlay	12,800	S.Y.	\$25.00	\$320,000	\$322,807	\$350,877	\$387,368
Contingency (20%)	1	L.S.	\$77,473.68	\$77,474	\$78,153	\$84,949	\$93,784
Contractor's Bonds (2%)	1	L.S.	\$9,623.05	\$9,623	\$9,707	\$10,552	\$11,649
			Subtotal	\$407,097	\$410,668	\$446,378	\$492,801
			TOTAL	\$1,456,116	\$1,468,889	\$1,596,619	\$1,762,667

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Pleasant St (Liberty St - North St) and North St (Spring St to Pine St)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
<u>WATER SYSTEM</u>							
8" Diameter D.I. Water Main	3,399	L.F.	\$95.00	\$322,905	\$325,738	\$354,063	\$390,885
3/4" Diameter Copper House Service	1,150	L.F.	\$50.00	\$57,500	\$58,004	\$63,048	\$69,605
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	14	EA.	\$3,000.00	\$42,000	\$42,368	\$46,053	\$50,842
8" Gate Valve	11	EA.	\$2,250.00	\$24,750	\$24,967	\$27,138	\$29,961
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	2	EA.	\$1,800.00	\$3,600	\$3,632	\$3,947	\$4,358
3/4" Curb Stops and Boxes	50	EA.	\$250.00	\$12,500	\$12,610	\$13,706	\$15,132
3/4" Corporation Stops	50	EA.	\$350.00	\$17,500	\$17,654	\$19,189	\$21,184
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	6	EA.	\$585.00	\$3,510	\$3,541	\$3,849	\$4,249
Fire Hydrant Branch Connection	6	EA.	\$5,000.00	\$30,000	\$30,263	\$32,895	\$36,316
Rigid Trench Insulation	500	S.F.	\$2.50	\$1,250	\$1,261	\$1,371	\$1,513
Class "B" Concrete	24	C.Y.	\$300.00	\$7,200	\$7,263	\$7,895	\$8,716
Miscellaneous Extra Excavation	20	C.Y.	\$30.00	\$600	\$605	\$658	\$726
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	20	C.Y.	\$40.00	\$800	\$807	\$877	\$968
Boulder Excavation	10	C.Y.	\$60.00	\$600	\$605	\$658	\$726
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	7	Ton	\$585.00	\$4,095	\$4,131	\$4,490	\$4,957
Permanent Trench Pavement Repair	1,772	S.Y.	\$70.00	\$124,040	\$125,128	\$136,009	\$150,154
Concrete Sidewalk Replacement	710	S.F.	\$15.00	\$10,650	\$10,743	\$11,678	\$12,892
Traffic Control	1	L.S.	\$2,500	\$2,500	\$2,522	\$2,741	\$3,026
Site Prep and Miscellaneous (8%)	1	L.S.	\$53,520	\$53,520	\$53,989	\$58,684	\$64,787
Contingency (20%)	1	L.S.	\$144,504	\$144,504	\$145,772	\$158,447	\$174,926
Contractor's Bonds (2%)	1	L.S.	\$17,340	\$17,340	\$17,493	\$19,014	\$20,991
			Subtotal	\$884,364	\$892,122	\$969,698	\$1,070,546
<u>STORMWATER SYSTEM</u>							
12" HDPE Storm Pipe	300	L.F.	\$65	\$19,500	\$20,000	\$22,800	\$23,000
15" HDPE Storm Pipe	400	L.F.	\$70	\$28,000	\$28,718	\$32,738	\$33,026
18" HDPE Storm Pipe	850	L.F.	\$75	\$63,750	\$65,385	\$74,538	\$75,192
New Catch Basin	9	EA.	\$5,250	\$47,250	\$48,462	\$55,246	\$55,731
Permanent Trench Pavement Repair	383	S.Y.	\$70	\$26,810	\$27,497	\$31,347	\$31,622
Concrete Sidewalk Replacement	100	S.F.	\$15	\$1,500	\$1,538	\$1,754	\$1,769
Traffic Control	1	L.S.	\$500	\$500	\$513	\$585	\$590
Site Prep and Miscellaneous (8%)	1	L.S.	\$14,985	\$14,985	\$15,369	\$17,521	\$17,674
Contingency (20%)	1	L.S.	\$40,459	\$40,459	\$41,496	\$47,306	\$47,721
Contractor's Bonds (2%)	1	L.S.	\$4,855	\$4,855	\$4,980	\$5,677	\$5,726
			Subtotal	\$247,609	\$253,958	\$289,512	\$292,051
<u>Street Repair</u>							
Pavement Overlay	8,400	S.Y.	\$25	\$210,000	\$211,842	\$230,263	\$254,211
Contingency (20%)	1	L.S.	\$50,842	\$50,842	\$51,288	\$55,748	\$61,546
Contractor's Bonds (2%)	1	L.S.	\$6,315	\$6,315	\$6,371	\$6,924	\$7,645
			Subtotal	\$267,157	\$269,501	\$292,936	\$323,401
			TOTAL	\$1,399,131	\$1,415,581	\$1,552,145	\$1,685,999

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Pleasant St (Liberty St - North St) and North St (Spring St to Pine St)

Description	Quantity	Units	ENR 11400		ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	3,399	L.F.	\$95.00	\$322,905	\$325,738	\$354,063	\$390,885
3/4" Diameter Copper House Service	1,150	L.F.	\$50.00	\$57,500	\$58,004	\$63,048	\$69,605
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	14	EA.	\$3,000.00	\$42,000	\$42,368	\$46,053	\$50,842
8" Gate Valve	11	EA.	\$2,250.00	\$24,750	\$24,967	\$27,138	\$29,961
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	2	EA.	\$1,800.00	\$3,600	\$3,632	\$3,947	\$4,358
3/4" Curb Stops and Boxes	50	EA.	\$250.00	\$12,500	\$12,610	\$13,706	\$15,132
3/4" Corporation Stops	50	EA.	\$350.00	\$17,500	\$17,654	\$19,189	\$21,184
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	6	EA.	\$585.00	\$3,510	\$3,541	\$3,849	\$4,249
Fire Hydrant Branch Connection	6	EA.	\$5,000.00	\$30,000	\$30,263	\$32,895	\$36,316
Rigid Trench Insulation	500	S.F.	\$2.50	\$1,250	\$1,261	\$1,371	\$1,513
Class "B" Concrete	24	C.Y.	\$300.00	\$7,200	\$7,263	\$7,895	\$8,716
Miscellaneous Extra Excavation	20	C.Y.	\$30.00	\$600	\$605	\$658	\$726
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	20	C.Y.	\$40.00	\$800	\$807	\$877	\$968
Boulder Excavation	10	C.Y.	\$60.00	\$600	\$605	\$658	\$726
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	7	Ton	\$585.00	\$4,095	\$4,131	\$4,490	\$4,957
Permanent Trench Pavement Repair	1,772	S.Y.	\$70.00	\$124,040	\$125,128	\$136,009	\$150,154
Concrete Sidewalk Replacement	710	S.F.	\$15.00	\$10,650	\$10,743	\$11,678	\$12,892
Traffic Control	1	L.S.	\$2,500	\$2,500	\$2,522	\$2,741	\$3,026
Site Prep and Miscellaneous (8%)	1	L.S.	\$53,520	\$53,520	\$53,989	\$58,684	\$64,787
Contingency (20%)	1	L.S.	\$144,504	\$144,504	\$145,772	\$158,447	\$174,926
Contractor's Bonds (2%)	1	L.S.	\$17,340	\$17,340	\$17,493	\$19,014	\$20,991
			Subtotal	\$884,364	\$892,122	\$969,698	\$1,070,546
STORMWATER SYSTEM							
12" HDPE Storm Pipe	300	L.F.	\$65	\$19,500	\$20,000	\$22,800	\$23,000
15" HDPE Storm Pipe	400	L.F.	\$70	\$28,000	\$28,718	\$32,738	\$33,026
18" HDPE Storm Pipe	850	L.F.	\$75	\$63,750	\$65,385	\$74,538	\$75,192
New Catch Basin	9	EA.	\$5,250	\$47,250	\$48,462	\$55,246	\$55,731
Permanent Trench Pavement Repair	383	S.Y.	\$70	\$26,810	\$27,497	\$31,347	\$31,622
Concrete Sidewalk Replacement	100	S.F.	\$15	\$1,500	\$1,538	\$1,754	\$1,769
Traffic Control	1	L.S.	\$500	\$500	\$513	\$585	\$590
Site Prep and Miscellaneous (8%)	1	L.S.	\$14,985	\$14,985	\$15,369	\$17,521	\$17,674
Contingency (20%)	1	L.S.	\$40,459	\$40,459	\$41,496	\$47,306	\$47,721
Contractor's Bonds (2%)	1	L.S.	\$4,855	\$4,855	\$4,980	\$5,677	\$5,726
			Subtotal	\$247,609	\$253,958	\$289,512	\$292,051
Street Repair							
Pavement Overlay	8,400	S.Y.	\$25	\$210,000	\$211,842	\$230,263	\$254,211
Contingency (20%)	1	L.S.	\$50,842	\$50,842	\$51,288	\$55,748	\$61,546
Contractor's Bonds (2%)	1	L.S.	\$6,315	\$6,315	\$6,371	\$6,924	\$7,645
			Subtotal	\$267,157	\$269,501	\$292,936	\$323,401
			TOTAL	\$1,399,131	\$1,415,581	\$1,552,145	\$1,685,999

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Reservoir - East St

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
12" Diameter D.I. Water Main	1,450	L.F.	\$140.00	\$203,000	\$204,781	\$222,588	\$245,737
3/4" Diameter Copper House Service	0	L.F.	\$50.00	\$0	\$0	\$0	\$0
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	1	EA.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
12" Gate Valve	3	EA.	\$2,500.00	\$7,500	\$7,566	\$8,224	\$9,079
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$1,800.00	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	5	EA.	\$250.00	\$1,250	\$1,261	\$1,371	\$1,513
3/4" Corporation Stops	5	EA.	\$350.00	\$1,750	\$1,765	\$1,919	\$2,118
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	0	EA.	\$585.00	\$0	\$0	\$0	\$0
Fire Hydrant Branch Connection	0	EA.	\$5,000.00	\$0	\$0	\$0	\$0
Rigid Trench Insulation	200	S.F.	\$2.50	\$500	\$504	\$548	\$605
Class "B" Concrete	10	C.Y.	\$300.00	\$3,000	\$3,026	\$3,289	\$3,632
Miscellaneous Extra Excavation	25	C.Y.	\$30.00	\$750	\$757	\$822	\$908
Below-Grade Rock Removal (pipelines)	15	C.Y.	\$150.00	\$2,250	\$2,270	\$2,467	\$2,724
Replacement of Unsuitable Material	25	C.Y.	\$40.00	\$1,000	\$1,009	\$1,096	\$1,211
Boulder Excavation	2	C.Y.	\$60.00	\$120	\$121	\$132	\$145
Erosion Control	1	L.S.	\$5,000.00	\$5,000	\$5,044	\$5,482	\$6,053
Dust Control	1	Ton	\$585.00	\$293	\$295	\$321	\$354
Permanent Trench Pavement Repair	30	S.Y.	\$70.00	\$2,100	\$2,118	\$2,303	\$2,542
Concrete Sidewalk Replacement	50	S.F.	\$15.00	\$750	\$757	\$822	\$908
Clearing and Grubbing	1	L.S.	\$5,000.00	\$5,000	\$5,044	\$5,482	\$6,053
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$19,221.00	\$19,221	\$19,390	\$21,076	\$23,268
Contingency (20%)	1	L.S.	\$51,896.70	\$51,897	\$52,352	\$56,904	\$62,822
Contractor's Bonds (2%)	1	L.S.	\$6,227.60	\$6,228	\$6,282	\$6,829	\$7,539
Subtotal				\$317,608	\$320,394	\$348,254	\$384,473
TOTAL				\$317,608	\$320,394	\$348,254	\$384,473

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.
2. Street improvements are not included in this estimate as this is a State highway.

OPINION OF PROBABLE CONSTRUCTION COST

Elm St & Taylor Ave

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	1,805	L.F.	\$95.00	\$171,475	\$172,979	\$188,021	\$207,575
3/4" Diameter Copper House Service	540	L.F.	\$50.00	\$27,000	\$27,237	\$29,605	\$32,684
1" Diameter Copper House Service	0	L.F.	\$58.50	\$0	\$0	\$0	\$0
Existing Waterline Connections	4	EA.	\$3,000.00	\$12,000	\$12,105	\$13,158	\$14,526
8" Gate Valve	5	EA.	\$2,250.00	\$11,250	\$11,349	\$12,336	\$13,618
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	1	EA.	\$1,800.00	\$1,800	\$1,816	\$1,974	\$2,179
3/4" Curb Stops and Boxes	27	EA.	\$250.00	\$6,750	\$6,809	\$7,401	\$8,171
3/4" Corporation Stops	27	EA.	\$350.00	\$9,450	\$9,533	\$10,362	\$11,439
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	6	EA.	\$585.00	\$3,510	\$3,541	\$3,849	\$4,249
Fire Hydrant Branch Connection	6	EA.	\$5,000.00	\$30,000	\$30,263	\$32,895	\$36,316
Rigid Trench Insulation	200	S.F.	\$2.50	\$500	\$504	\$548	\$605
Class "B" Concrete	10	C.Y.	\$300.00	\$3,000	\$3,026	\$3,289	\$3,632
Miscellaneous Extra Excavation	10	C.Y.	\$30.00	\$300	\$303	\$329	\$363
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	10	C.Y.	\$40.00	\$400	\$404	\$439	\$484
Boulder Excavation	2	C.Y.	\$60.00	\$120	\$121	\$132	\$145
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	2	Ton	\$585.00	\$1,170	\$1,180	\$1,283	\$1,416
Permanent Trench Pavement Repair	448	S.Y.	\$70.00	\$31,337	\$31,612	\$34,360	\$37,934
Concrete Sidewalk Replacement	0	S.F.	\$15.00	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Site Prep and Miscellaneous (8%)	1	L.S.	\$25,284.93	\$25,285	\$25,507	\$27,725	\$30,608
Contingency (20%)	1	L.S.	\$68,269.32	\$68,269	\$68,868	\$74,857	\$82,642
Contractor's Bonds (2%)	1	L.S.	\$8,192.32	\$8,192	\$8,264	\$8,983	\$9,917
			Subtotal	\$417,808	\$421,473	\$458,123	\$505,768
Street Repair							
Pavement Overlay	4,933	S.Y.	\$25.00	\$123,333	\$124,415	\$135,234	\$149,298
Contingency (20%)	1	L.S.	\$29,859.65	\$29,860	\$30,122	\$32,741	\$36,146
Contractor's Bonds (2%)	1	L.S.	\$3,708.88	\$3,709	\$3,741	\$4,067	\$4,490
			Subtotal	\$156,902	\$158,278	\$172,042	\$189,934
			TOTAL	\$574,710	\$579,751	\$630,165	\$695,702

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

Crescent St & Fitch Ave & Garfield St

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020	2020	2021	2025	2030
			Unit Price	Total Cost	Total Cost	Total Cost	Total Cost
<u>WATER SYSTEM</u>							
8" Diameter D.I. Water Main	2,305	L.F.	\$95.00	\$218,975	\$220,896	\$240,104	\$265,075
3/4" Diameter Copper House Service	280	L.F.	\$50.00	\$14,000	\$14,123	\$15,351	\$16,947
1" Diameter Copper House Service	416	L.F.	\$58.50	\$24,336	\$24,549	\$26,684	\$29,459
Existing Waterline Connections	6	EA.	\$3,000.00	\$18,000	\$18,158	\$19,737	\$21,789
8" Gate Valve	6	EA.	\$2,250.00	\$13,500	\$13,618	\$14,803	\$16,342
6" Gate Valve	0	EA.	\$2,000.00	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$1,800.00	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	34	EA.	\$250.00	\$8,500	\$8,575	\$9,320	\$10,289
3/4" Corporation Stops	34	EA.	\$350.00	\$11,900	\$12,004	\$13,048	\$14,405
1" Curb Stops and Boxes	0	EA.	\$410.00	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410.00	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	4	EA.	\$585.00	\$2,340	\$2,361	\$2,566	\$2,833
Fire Hydrant Branch Connection	4	EA.	\$5,000.00	\$20,000	\$20,175	\$21,930	\$24,211
Rigid Trench Insulation	500	S.F.	\$2.50	\$1,250	\$1,261	\$1,371	\$1,513
Class "B" Concrete	11	C.Y.	\$300.00	\$3,300	\$3,329	\$3,618	\$3,995
Miscellaneous Extra Excavation	25	C.Y.	\$30.00	\$750	\$757	\$822	\$908
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150.00	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	25	C.Y.	\$40.00	\$1,000	\$1,009	\$1,096	\$1,211
Boulder Excavation	5	C.Y.	\$60.00	\$300	\$303	\$329	\$363
Erosion Control	1	L.S.	\$3,000.00	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	5	Ton	\$585.00	\$2,925	\$2,951	\$3,207	\$3,541
Permanent Trench Pavement Repair	1,320	S.Y.	\$70.00	\$92,400	\$93,211	\$101,316	\$111,853
Concrete Sidewalk Replacement	736	S.F.	\$15.00	\$11,040	\$11,137	\$12,105	\$13,364
Traffic Control	1	L.S.	\$5,000.00	\$5,000	\$5,044	\$5,482	\$6,053
Site Prep and Miscellaneous (8%)	1	L.S.	\$36,201.28	\$36,201	\$36,519	\$39,694	\$43,823
Contingency (20%)	1	L.S.	\$97,743.46	\$97,743	\$98,601	\$107,175	\$118,321
Contractor's Bonds (2%)	1	L.S.	\$11,729.21	\$11,729	\$11,832	\$12,861	\$14,199
			Subtotal	\$598,190	\$603,437	\$655,910	\$724,125
<u>Street Repair</u>							
Pavement Overlay	6,200	S.Y.	\$25.00	\$155,000	\$156,360	\$169,956	\$187,632
Contingency (20%)	1	L.S.	\$37,526.32	\$37,526	\$37,855	\$41,147	\$45,427
Contractor's Bonds (2%)	1	L.S.	\$4,661.16	\$4,661	\$4,702	\$5,111	\$5,642
			Subtotal	\$197,187	\$198,917	\$216,214	\$238,701
			TOTAL	\$795,377	\$802,354	\$872,124	\$962,825

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

OPINION OF PROBABLE CONSTRUCTION COST

West Street (Maple Street - North St)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020 Unit Price	2020 Total Cost	2021 Total Cost	2025 Total Cost	2030 Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	1,220	L.F.	\$95	\$115,900	\$116,917	\$127,083	\$140,300
3/4" Diameter Copper House Service	230	L.F.	\$50	\$11,500	\$11,601	\$12,610	\$13,921
1" Diameter Copper House Service	30	L.F.	\$59	\$1,755	\$1,770	\$1,924	\$2,124
Existing Waterline Connections	6	EA.	\$3,000	\$18,000	\$18,158	\$19,737	\$21,789
8" Gate Valve	3	EA.	\$2,250	\$6,750	\$6,809	\$7,401	\$8,171
6" Gate Valve	1	EA.	\$2,000	\$2,000	\$2,018	\$2,193	\$2,421
4" Gate Valve	1	EA.	\$1,800	\$1,800	\$1,816	\$1,974	\$2,179
3/4" Curb Stops and Boxes	11	EA.	\$250	\$2,750	\$2,774	\$3,015	\$3,329
3/4" Corporation Stops	11	EA.	\$350	\$3,850	\$3,884	\$4,221	\$4,661
1" Curb Stops and Boxes	3	EA.	\$410	\$1,230	\$1,241	\$1,349	\$1,489
1" Corporation Stops	3	EA.	\$410	\$1,230	\$1,241	\$1,349	\$1,489
Removal of Fire Hydrant	5	EA.	\$585	\$2,925	\$2,951	\$3,207	\$3,541
Fire Hydrant Branch Connection	5	EA.	\$5,000	\$25,000	\$25,219	\$27,412	\$30,263
Rigid Trench Insulation	400	S.F.	\$3	\$1,000	\$1,009	\$1,096	\$1,211
Class "B" Concrete	6	C.Y.	\$300	\$1,800	\$1,816	\$1,974	\$2,179
Miscellaneous Extra Excavation	50	C.Y.	\$30	\$1,500	\$1,513	\$1,645	\$1,816
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	50	C.Y.	\$40	\$2,000	\$2,018	\$2,193	\$2,421
Boulder Excavation	25	C.Y.	\$60	\$1,500	\$1,513	\$1,645	\$1,816
Erosion Control	1	L.S.	\$5,000	\$5,000	\$5,044	\$5,482	\$6,053
Dust Control	10	Ton	\$585	\$5,850	\$5,901	\$6,414	\$7,082
Traffic Control	1	L.S.	\$20,000	\$20,000	\$20,175	\$21,930	\$24,211
Site Prep and Miscellaneous (8%)	1	L.S.	\$18,667	\$18,667	\$18,831	\$20,468	\$22,597
Contingency (20%)	1	L.S.	\$50,401	\$50,401	\$50,844	\$55,265	\$61,012
Contractor's Bonds (2%)	1	L.S.	\$6,048	\$6,048	\$6,101	\$6,632	\$7,321
Subtotal				\$308,457	\$311,163	\$338,220	\$373,395
STORMWATER SYSTEM							
12" HDPE Storm Pipe	260	L.F.	\$65	\$16,900	\$17,048	\$18,531	\$20,458
15" HDPE Storm Pipe	800	L.F.	\$70	\$56,000	\$56,491	\$61,404	\$67,789
18" HDPE Storm Pipe	300	L.F.	\$75	\$22,500	\$22,697	\$24,671	\$27,237
New Catch Basin	16	EA.	\$5,250	\$84,000	\$84,737	\$92,105	\$101,684
Permanent Trench Pavement Repair	400	S.Y.	\$70	\$28,000	\$28,246	\$30,702	\$33,895
Concrete Sidewalk Replacement	75	S.F.	\$15	\$1,125	\$1,135	\$1,234	\$1,362
Traffic Control	1	L.S.	\$1,500	\$1,500	\$1,513	\$1,645	\$1,816
Site Prep and Miscellaneous (8%)	1	L.S.	\$16,802	\$16,802	\$16,949	\$18,423	\$20,339
Contingency (20%)	1	L.S.	\$45,365	\$45,365	\$45,763	\$49,743	\$54,916
Contractor's Bonds (2%)	1	L.S.	\$5,444	\$5,444	\$5,492	\$5,969	\$6,590
Subtotal				\$277,636	\$280,072	\$304,426	\$336,086
TOTAL				\$586,093	\$591,234	\$642,646	\$709,481

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.
2. Street improvements are not included in this estimate as this is a State highway.

OPINION OF PROBABLE CONSTRUCTION COST

Main Street (North Street - Prince Lane)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020 Unit Price	2020 Total Cost	2021 Total Cost	2025 Total Cost	2030 Total Cost
<u>WATER SYSTEM</u>							
12" Diameter D.I. Water Main	1,397	L.F.	\$125	\$174,625	\$176,157	\$191,475	\$211,388
3/4" Diameter Copper House Service	0	L.F.	\$50	\$0	\$0	\$0	\$0
1" Diameter Copper House Service	0	L.F.	\$59	\$0	\$0	\$0	\$0
Existing Waterline Connections	2	EA.	\$3,000	\$6,000	\$6,053	\$6,579	\$7,263
12" x 12" x 8" Tees	4	EA.	\$2,000	\$8,000	\$8,070	\$8,772	\$9,684
12" Gate Valve	1	EA.	\$2,500	\$2,500	\$2,522	\$2,741	\$3,026
8" Gate Valve	5	EA.	\$2,250	\$11,250	\$11,349	\$12,336	\$13,618
6" Gate Valve	0	EA.	\$2,000	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$1,800	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	0	EA.	\$250	\$0	\$0	\$0	\$0
3/4" Corporation Stops	0	EA.	\$350	\$0	\$0	\$0	\$0
1" Curb Stops and Boxes	0	EA.	\$410	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	0	EA.	\$585	\$0	\$0	\$0	\$0
Fire Hydrant Branch Connection	0	EA.	\$5,000	\$0	\$0	\$0	\$0
Rigid Trench Insulation	200	S.F.	\$3	\$500	\$504	\$548	\$605
Class "B" Concrete	20	C.Y.	\$300	\$6,000	\$6,053	\$6,579	\$7,263
Miscellaneous Extra Excavation	10	C.Y.	\$30	\$300	\$303	\$329	\$363
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	5	C.Y.	\$40	\$200	\$202	\$219	\$242
Boulder Excavation	1	C.Y.	\$60	\$60	\$61	\$66	\$73
Erosion Control	1	L.S.	\$3,000	\$3,000	\$3,026	\$3,289	\$3,632
Dust Control	2	Ton	\$585	\$1,170	\$1,180	\$1,283	\$1,416
Permanent Trench Pavement Repair	194	S.Y.	\$60	\$11,667	\$11,769	\$12,792	\$14,123
Concrete Sidewalk Replacement	0	S.F.	\$15	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$5,000	\$5,000	\$5,044	\$5,482	\$6,053
Site Prep and Miscellaneous (8%)	1	L.S.	\$18,422	\$18,422	\$18,583	\$20,199	\$22,300
Contingency (20%)	1	L.S.	\$49,739	\$49,739	\$50,175	\$54,538	\$60,210
Contractor's Bonds (2%)	1	L.S.	\$5,969	\$5,969	\$6,021	\$6,545	\$7,225
Subtotal				\$304,401	\$307,071	\$333,773	\$368,485
TOTAL				\$304,401	\$307,071	\$333,773	\$368,485

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.
2. Street improvements are not included in this estimate as this is a State highway.

OPINION OF PROBABLE CONSTRUCTION COST

East Street (Three Houses - End of Line)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020 Unit Price	2020 Total Cost	2021 Total Cost	2025 Total Cost	2030 Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	2,250	L.F.	\$80	\$180,000	\$181,579	\$197,368	\$217,895
3/4" Diameter Copper House Service	780	L.F.	\$42	\$32,760	\$33,047	\$35,921	\$39,657
1" Diameter Copper House Service	0	L.F.	\$50	\$0	\$0	\$0	\$0
Existing Waterline Connections	5	EA.	\$2,500	\$12,500	\$12,610	\$13,706	\$15,132
12" Gate Valve	2	EA.	\$1,800	\$3,600	\$3,632	\$3,947	\$4,358
8" Gate Valve	2	EA.	\$1,300	\$2,600	\$2,623	\$2,851	\$3,147
6" Gate Valve	0	EA.	\$1,050	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$800	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	26	EA.	\$200	\$5,200	\$5,246	\$5,702	\$6,295
3/4" Corporation Stops	26	EA.	\$300	\$7,800	\$7,868	\$8,553	\$9,442
1" Curb Stops and Boxes	0	EA.	\$350	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$350	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	3	EA.	\$500	\$1,500	\$1,513	\$1,645	\$1,816
Fire Hydrant Branch Connection	4	EA.	\$4,250	\$17,000	\$17,149	\$18,640	\$20,579
Rigid Trench Insulation	500	S.F.	\$2	\$1,000	\$1,009	\$1,096	\$1,211
Class "B" Concrete	40	C.Y.	\$250	\$10,000	\$10,088	\$10,965	\$12,105
Miscellaneous Extra Excavation	20	C.Y.	\$24	\$480	\$484	\$526	\$581
Below-Grade Rock Removal (pipelines)	4	C.Y.	\$125	\$500	\$504	\$548	\$605
Replacement of Unsuitable Material	1	C.Y.	\$32	\$32	\$32	\$35	\$39
Boulder Excavation	5	C.Y.	\$50	\$250	\$252	\$274	\$303
Erosion Control	1	L.S.	\$5,000	\$5,000	\$5,044	\$5,482	\$6,053
Dust Control	1	Ton	\$500	\$500	\$504	\$548	\$605
Permanent Trench Pavement Repair	0	S.Y.	\$60	\$0	\$0	\$0	\$0
Concrete Sidewalk Replacement	0	S.F.	\$8	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$5,000	\$5,000	\$5,044	\$5,482	\$6,053
Site Prep and Miscellaneous (8%)	1	L.S.	\$22,858	\$22,858	\$23,058	\$25,063	\$27,670
Contingency (10%)	1	L.S.	\$30,858	\$30,858	\$31,129	\$33,836	\$37,354
Contractor's Bonds (2%)	1	L.S.	\$6,789	\$6,789	\$6,848	\$7,444	\$8,218
Subtotal				\$346,226	\$349,264	\$379,634	\$419,116
TOTAL				\$346,226	\$349,264	\$379,634	\$419,116

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design
2. Street improvements are not included in this estimate as this is a State highway.

OPINION OF PROBABLE CONSTRUCTION COST

Pumphouse Road (South Street - Pump House)

Description	Quantity	Units	ENR 11400	ENR 11400	ENR 11500	ENR 12500	ENR 13800
			2020 Unit Price	2020 Total Cost	2021 Total Cost	2025 Total Cost	2030 Total Cost
WATER SYSTEM							
8" Diameter D.I. Water Main	1,040	L.F.	\$95	\$98,800	\$99,307	\$105,387	\$109,440
3/4" Diameter Copper House Service	0	L.F.	\$50	\$0	\$0	\$0	\$0
1" Diameter Copper House Service	0	L.F.	\$59	\$0	\$0	\$0	\$0
Existing Waterline Connections	2	EA.	\$3,000	\$6,000	\$6,031	\$6,400	\$6,646
8" Gate Valve	1	EA.	\$2,250	\$2,250	\$2,262	\$2,400	\$2,492
6" Gate Valve	0	EA.	\$2,000	\$0	\$0	\$0	\$0
4" Gate Valve	0	EA.	\$1,800	\$0	\$0	\$0	\$0
3/4" Curb Stops and Boxes	0	EA.	\$250	\$0	\$0	\$0	\$0
3/4" Corporation Stops	0	EA.	\$350	\$0	\$0	\$0	\$0
1" Curb Stops and Boxes	0	EA.	\$410	\$0	\$0	\$0	\$0
1" Corporation Stops	0	EA.	\$410	\$0	\$0	\$0	\$0
Removal of Fire Hydrant	0	EA.	\$585	\$0	\$0	\$0	\$0
Fire Hydrant Branch Connection	0	EA.	\$5,000	\$0	\$0	\$0	\$0
Rigid Trench Insulation	200	S.F.	\$3	\$500	\$503	\$533	\$554
Class "B" Concrete	10	C.Y.	\$3,000	\$30,000	\$30,154	\$32,000	\$33,231
Miscellaneous Extra Excavation	20	C.Y.	\$30	\$600	\$603	\$640	\$665
Below-Grade Rock Removal (pipelines)	0	C.Y.	\$150	\$0	\$0	\$0	\$0
Replacement of Unsuitable Material	20	C.Y.	\$40	\$800	\$804	\$853	\$886
Boulder Excavation	5	C.Y.	\$60	\$300	\$302	\$320	\$332
Erosion Control	1	L.S.	\$5,000	\$5,000	\$5,026	\$5,333	\$5,538
Dust Control	5	Ton	\$585	\$2,925	\$2,940	\$3,120	\$3,240
Permanent Trench Pavement Repair	32	S.Y.	\$60	\$1,920	\$1,930	\$2,048	\$2,127
Concrete Sidewalk Replacement	0	S.F.	\$15	\$0	\$0	\$0	\$0
Traffic Control	1	L.S.	\$1,000	\$1,000	\$1,005	\$1,067	\$1,108
Site Prep and Miscellaneous (8%)	1	L.S.	\$12,008	\$12,008	\$12,069	\$12,808	\$13,301
Contingency (20%)	1	L.S.	\$32,421	\$32,421	\$32,587	\$34,582	\$35,912
Contractor's Bonds (2%)	1	L.S.	\$3,890	\$3,890	\$3,910	\$4,150	\$4,309
Subtotal				\$198,414	\$199,431	\$211,641	\$219,781
Street Repair							
Pavement Overlay	400	S.Y.	\$25	\$10,000	\$10,051	\$10,667	\$11,077
Contingency (20%)	1	L.S.	\$2,215	\$2,215	\$2,227	\$2,363	\$2,454
Contractor's Bonds (2%)	1	L.S.	\$271	\$271	\$272	\$289	\$300
Subtotal				\$12,486	\$12,550	\$13,318	\$13,831
TOTAL				\$210,900	\$211,981	\$224,960	\$233,612

Notes:

1. The construction cost estimates are based on preliminary phase estimates only. More detailed costs shall be developed during Final Design Phase Engineering based on actual design quantities.

Appendix E

Hydraulic Analysis



FF Analysis Existing Pipe Conditions

Label	Fire Flow Iterations	Flow (Total Needed) (gpm)	Flow (Total Available) (gpm)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Pressure (Calculated Zone Lower Limit) (psi)
H-2	4	500	987	20	20	30
H-3	4	500	1084	20	20	37
H-4	4	500	1198	20	20	30
H-5	3	500	1085	20	20	34
H-9	3	500	266	20	20	59
H-10	18	500	338	20	28	20
H-11	7	500	2702	20	31	20
H-12	3	500	667	20	20	21
H-13	4	500	1249	20	20	22
H-14	4	500	1215	20	20	24
H-15	4	500	1301	20	20	25
H-16	4	500	1312	20	20	24
H-17	4	500	1934	20	20	26
H-18	4	500	2077	20	20	27
H-19	4	500	2391	20	20	25
H-20	4	500	1332	20	20	65
H-21	7	500	2888	20	31	20
H-22	7	500	3092	20	33	20
H-23	4	500	1896	20	20	38
H-24	7	500	3208	20	29	20
H-25	6	500	896	20	35	20
H-26	6	500	2046	20	35	20
H-27	6	500	1328	20	42	20
H-28	4	500	1552	20	20	24
H-29	3	500	814	20	20	21
H-30	4	500	1734	20	20	25
H-31	4	500	2190	20	20	28
H-32	4	500	2266	20	20	22
H-33	7	500	2317	20	26	20
H-34	7	500	2336	20	26	20
H-35	4	500	2048	20	20	23
H-36	4	500	1514	20	20	23
H-37	4	500	1690	20	20	27
H-38	4	500	1288	20	20	23
H-39	4	500	1299	20	20	23
H-40	4	500	1103	20	20	22
H-41	4	500	1364	20	20	24
H-42	4	500	1553	20	20	24
H-43	4	500	1786	20	20	26
H-44	4	500	2075	20	20	25
H-45	3	500	923	20	20	71

H-46	6	500	2167	20	22	20
H-47	4	500	2077	20	20	23
H-48	4	500	2145	20	20	27
H-49	4	500	2251	20	20	39
H-51	4	500	2720	20	20	25
H-52	4	500	2248	20	20	29
H-53	7	500	3167	20	23	20
H-54	7	500	3208	20	25	20
H-55	7	500	3319	20	24	20
H-56	4	500	1751	20	20	27
H-57	4	500	1711	20	20	24
H-58	4	500	1514	20	20	27
H-59	4	500	1300	20	20	23
H-60	3	500	782	20	20	21
H-61	3	500	731	20	20	21
H-62	3	500	625	20	20	42
H-63	3	500	790	20	20	21
H-64	21	500	1009	20	21	20
H-65	6	500	1660	20	22	20
H-66	4	500	1208	20	20	24
H-67	4	500	1185	20	20	23
H-68	4	500	1126	20	20	23
H-69	4	500	1124	20	20	22
H-70	3	500	795	20	20	22
H-71	21	500	1154	20	20	20
H-72	19	500	741	20	20	20
H-73	4	500	1525	20	20	24
H-74	4	500	947	20	20	23
H-75	4	500	1408	20	20	25
H-76	4	500	1246	20	20	23
H-77	4	500	1332	20	20	25
H-78	4	500	1297	20	20	24
H-79	4	500	1256	20	20	25

FF Analysis Proposed Pipe Conditions

Label	Fire Flow Iterations	Flow (Total Needed) (gpm)	Flow (Total Available) (gpm)	Pressure (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)	Pressure (Calculated Zone Lower Limit) (psi)
H-2	4	500	2643	20	20	25
H-3	4	500	1887	20	20	60
H-4	4	500	2370	20	20	47
H-5	4	500	1921	20	20	63
H-9	4	500	1675	20	20	52
H-10	6	500	2021	20	28	20
H-11	7	500	3340	20	30	20
H-12	3	500	781	20	20	21
H-13	4	500	2831	20	20	32
H-14	4	500	2608	20	20	38
H-15	7	500	3201	20	21	20
H-16	4	500	3118	20	20	23
H-17	7	500	3247	20	24	20
H-18	7	500	3263	20	25	20
H-19	7	500	3279	20	23	20
H-20	7	500	3337	20	24	20
H-21	7	500	3380	20	28	20
H-22	7	500	3423	20	37	20
H-23	4	500	2875	20	20	39
H-24	7	500	3449	20	36	20
H-25	5	500	925	20	35	20
H-26	6	500	2303	20	33	20
H-27	6	500	1406	20	42	20
H-28	4	500	1637	20	20	24
H-29	3	500	830	20	20	21
H-30	5	500	3228	20	20	22
H-31	4	500	3054	20	20	28
H-32	5	500	3110	20	20	24
H-33	5	500	3190	20	20	21
H-34	7	500	3223	20	21	20
H-35	7	500	3206	20	22	20
H-36	23	500	3214	20	20	20
H-37	4	500	2982	20	20	28
H-38	4	500	3027	20	20	26
H-39	4	500	3118	20	20	23
H-40	23	500	3197	20	20	20
H-41	5	500	3098	20	20	23
H-42	5	500	3058	20	20	24
H-43	4	500	3031	20	20	24
H-44	5	500	3039	20	20	24
H-45	3	500	978	20	20	78

H-46	5	500	3042	20	20	23
H-47	4	500	2858	20	20	30
H-48	5	500	2980	20	20	27
H-49	4	500	2541	20	20	44
H-51	4	500	3141	20	20	26
H-52	5	500	3005	20	20	28
H-53	7	500	3410	20	20	20
H-54	7	500	3435	20	22	20
H-55	7	500	3493	20	20	20
H-56	4	500	2900	20	20	27
H-57	4	500	2887	20	20	25
H-58	4	500	2563	20	20	34
H-59	4	500	2624	20	20	30
H-60	4	500	2430	20	20	33
H-61	4	500	2491	20	20	31
H-62	3	500	1075	20	20	75
H-63	3	500	982	20	20	21
H-64	4	500	1260	20	20	22
H-65	4	500	2902	20	20	23
H-66	4	500	2723	20	20	28
H-67	4	500	2673	20	20	29
H-68	4	500	2584	20	20	26
H-69	4	500	1898	20	20	26
H-70	3	500	996	20	20	22
H-71	4	500	2558	20	20	27
H-72	4	500	2357	20	20	27
H-73	5	500	3083	20	20	21
H-74	4	500	2796	20	20	33
H-75	4	500	2990	20	20	26
H-76	4	500	3029	20	20	26
H-77	4	500	2936	20	20	29
H-78	4	500	2962	20	20	28
H-79	4	500	2800	20	20	33

Appendix F

2020 Flow Data

INSURANCE SERVICES OFFICE, INC.
HYDRANT FLOW DATA SUMMARY

City BRISTOL, VT
 County ADDISON

DATE: 12/9/19

TEST	GAUGE HYDRANT LOCATION	SERVICE	FLOW HYDRANT LOCATION	STATIC	RESIDUAL	OUTLET SIZE	PITOT READING	COMMENTS
1	Shaws Parking Lot (Prince Lane)	Bristol Water District, Main Service	36 Main Street in Front of Bristol Financial	110 psi	58 psi	2.5"	38 psi	12/9/19 Duration: 5 Mins
2	Maple and Pleasant	Bristol Water District, Main Service	Maple Street in Front of Brett's House	106 psi	75 psi	2.5"	29 psi	12/9/19 Duration: 5 Mins
3	Pine and Maple	Bristol Water District, Main Service	60 Pine Street	106 psi	62 psi	2.5"	30 psi	12/9/19 Duration: 5 Mins
4	High School (North Side in Front of Mt. Abe.)	Bristol Water District, Main Service	West Side in Front of Mt. Abe	110 psi	42 psi	2.5"	38 psi	12/9/19 Duration: 5 Mins
5	West Street at Liberty	Bristol Water District, Main Service	35 Liberty Street	112 psi	50 psi	2.5"	41 psi	12/9/19 Duration: 5 Mins
6	Mountain Street near Trading Post	Bristol Water District, Main Service	26 Mountain Street	109 psi	105 psi	2.5"	90 psi	12/9/19 Duration: 5 Mins
7	North Street near Planic	Bristol Water District, Main Service	Plank Road in Front of Apartment Bldg.	110 psi	34 psi	2.5"	32 psi	12/9/19 Duration: 5 Mins
8	Fitch Ave at Mountain Street	Bristol Water District, Main Service	39 Mountain Street	91 psi	69 psi	2.5"	29 psi	12/9/19 Duration: 5 Mins
9	Rockydale near Rest.	Bristol Water District, Main Service	N/A	N/A	N/A	N/A	N/A	Only 1 working hydrant by Sargent's at the end of the Rockydale line and no other working hydrant to flow.

THE ABOVE LISTED NEEDED FIRE FLOWS ARE FOR PROPERTY INSURANCE PREMIUM CALCULATIONS ONLY AND ARE NOT INTENDED TO PREDICT THE MAXIMUM AMOUNT OF WATER REQUIRED FOR A LARGE SCALE FIRE CONDITION.
 THE AVAILABLE FLOWS ONLY INDICATE THE CONDITIONS THAT EXISTED AT THE TIME AND AT THE LOCATION WHERE TESTS WERE WITNESSED.

*Comm = Commercial; Res = Residential.

**Needed is the rate of flow for a specific duration for a full credit condition. Needed Fire Flows greater than 3,500 gpm are not considered in determining the classification of the city when using the Fire Suppression Rating Schedule.

*** (A)-Limited by available hydrants to gpm shown. Available facilities limit flow to gpm shown plus consumption for the needed duration of (B)-2 hours, (C)-3 hours or (D)-4 hours.

INSURANCE SERVICES OFFICE, INC.
HYDRANT FLOW DATA SUMMARY

Community Bristol

County Vermont (Addison)

VERMONT
 State (44)

Witnessed by: Insurance Services Office

Survey Date: Oct 31, 2013

TEST NO.	TYPE DIST.*	TEST LOCATION	SERVICE	FLOW - GPM $Q=(29.83(C(d^2)p^{-0.5}))$			PRESSURE PSI		FLOW -AT 20 PSI		REMARKS***	MODEL TYPE	FLOW TEST DATE	
				INDIVIDUAL HYDRANTS	TOTAL	STATIC	RESID.	NEEDED **	AVAIL.					
1		PRINCE LAND (GROCERY STORE PARKING LOT)	Bristol Water District, Main Service	1030	0	0	1030	110	58	2500	1400		FTPC	12/09/2019
2		MAPLE ST AT PLEASANT ST	Bristol Water District, Main Service	900	0	0	900	106	75	500	1600		FTPC	12/09/2019
3		PINE ST AND MAPLE ST	Bristol Water District, Main Service	920	0	0	920	106	75	2500	1600		FTPC	12/09/2019
3.1		PINE ST AND MAPLE ST	Bristol Water District, Main Service	920	0	0	920	106	75	1000	1600		FTPC	12/09/2019
4		AIRPORT DR (NORTH SIDE OF HIGH SCHOOL, BRANT AVE)	Bristol Water District, Main Service	1030	0	0	1030	110	42	4000	1200	(D)-(3074 gpm)	FTPC	12/09/2019
4.1		AIRPORT DR (NORTH SIDE OF HIGH SCHOOL, BRANT AVE)	Bristol Water District, Main Service	1030	0	0	1030	110	42	2000	1200		FTPC	12/09/2019
5		WEST ST AT LIBERTY ST	Bristol Water District, Main Service	1070	0	0	1070	112	50	4500	1300	(D)-(3074 gpm)	FTPC	12/09/2019
5.1		WEST ST AT LIBERTY ST	Bristol Water District, Main Service	1070	0	0	1070	112	50	500	1300		FTPC	12/09/2019
6		1ST HYD SOUTH OF MOUNTAIN VIEW ST	Bristol Water District, Main Service	1590	0	0	1590	109	104	1000	7500		FTPC	12/09/2019
7		NORTH ST AT PLANK RD	Bristol Water District, Main Service	950	0	0	950	110	34	2250	1000		FTPC	12/09/2019
8		FITCH AVE AT MOUNTAIN ST	Bristol Water District, Main Service	900	0	0	900	91	69	1750	1700		FTPC	12/09/2019
9		Rockydale near Rest	Bristol Water District, Main Service	170	0	0	170	120	50	1750	200		FTWI	03/01/1996

THE ABOVE LISTED NEEDED FIRE FLOWS ARE FOR PROPERTY INSURANCE PREMIUM CALCULATIONS ONLY AND ARE NOT INTENDED TO PREDICT THE MAXIMUM AMOUNT OF WATER REQUIRED FOR A LARGE SCALE FIRE CONDITION.

THE AVAILABLE FLOWS ONLY INDICATE THE CONDITIONS THAT EXISTED AT THE TIME AND AT THE LOCATION WHERE TESTS WERE WITNESSED.

*Comm = Commercial; Res = Residential.

**Needed is the rate of flow for a specific duration for a full credit condition. Needed Fire Flows greater than 3,500 gpm are not considered in determining the classification of the city when using the Fire Suppression Rating Schedule.

*** (A)-Limited by available hydrants to gpm shown. Available facilities limit flow to gpm shown plus consumption for the needed duration of (B)-2 hours, (C)-3 hours or (D)-4 hours.

Groundwater Systems and Systems Purchasing Water

For the Month of January 2020 WSID# 5002 Name of Water System Town of Bristol

Minimum free chlorine residual required for 4 Log viral inactivation (mg/l):

Day of Month	Water Production	Disinfection/Chlorination (Free CL, in mg/l)		Fluoride (mg/l)	pH (Only if providing corrosion control)
		Entry Point Daily Low ¹	Distribution System (When taking coliform sample)		
1	284,400	0.62			
2	155,100	0.52			
3	190,900	0.54			
4	368,300	0.64			
5	141,900	0.67			
6	187,400	0.65			
7	212,400	0.54			
8	289,800	0.49			
9	123,800	0.50	0.43/0.45		
10	266,100	0.61			
11	195,000	0.59			
12	251,400	0.69			
13	186,800	0.74			
14	285,100	0.56			
15	156,800	0.50			
16	265,800	0.58			
17	204,700	0.49			
18	361,600	0.48			
19	127,300	0.51			
20	198,200	0.47			
21	215,300	0.37			
22	256,900	0.47			
23	172,900	0.39			
24	263,000	0.41			
25	268,900	0.32			
26	156,200	0.44			
27	298,000	0.55			
28	141,600	0.70			
29	260,300	0.47			
30	279,200	0.53			
31	142,300	0.45			
Totals	6,907,400	NA	NA	NA	NA

Note: ¹ Daily low for systems with continuous monitoring. Others - during the hour of peak flow.

***Please submit this form within 10 days after the end of the month to the following address:**

Drinking Water and Groundwater Protection Division
 1 National Life Drive, Main, 2nd Floor
 Montpelier, VT 05620-3521
 Phone 802-828-1535
 Fax 1-802-828-1541

This form is available electronically at <http://www.vermontdrinkingwater.org>

Groundwater Systems and Systems Purchasing Water

For the Month of February 2020 WSID# 5002 Name of Water System Bristol Water

Minimum free chlorine residual required for 4 Log viral inactivation (mg/l):

Day of Month	Water Production (Gallons/Day)	Disinfection/Chlorination (Free CL, in mg/l)		Fluoride (mg/l)	pH (Only if providing corrosion control)
		Entry Point Daily Low	Distribution System (When taking coliform sample)		
1	256,700	0.42			
2	294,900	0.53			
3	121,600	0.45			
4	190,000	0.65	0.55/0.29		
5	232,500	0.78			
6	261,200	0.56			
7	285,800	0.92			
8	119,900	0.51			
9	300,900	0.59			
10	124,200	0.47			
11	270,200	0.48			
12	145,000	0.50			
13	269,400	0.53			
14	251,600	0.59			
15	169,300	0.37			
16	267,400	0.58			
17	193,800	0.63			
18	223,300	0.52			
19	277,100	0.67			
20	269,800	0.55			
21	123,100	0.41			
22	171,800	0.72			
23	240,900	0.69			
24	266,000	0.69			
25	196,300	0.47			
26	228,600	0.51			
27	219,800	0.63			
28	195,800	0.54			
29	264,900	0.50			
30					
31					
Totals		NA	NA	NA	NA

Note: ¹ Daily low for systems with continuous monitoring. Others - during the hour of peak flow.

***Please submit this form within 10 days after the end of the month to the following address:**

Drinking Water and Groundwater Protection Division
1 National Life Drive, Main, 2nd Floor
Montpelier, VT 05620-3521
Phone 802-828-1535
Fax 1-802-828-1541

This form is available electronically at <http://www.vcmontdrinkingwater.org>

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of March 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH if providing corrosion cor
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	2,811,452					
1	2,814,384	293,200		0.50		
2	2,815,641	125,700		0.46		
3	2,818,425	278,400		0.54		
4	2,820,831	240,600		0.65		
5	2,822,485	165,400		0.46		
6	2,824,327	184,200		0.48		
7	2,826,877	255,000		0.46		
8	2,829,733	285,600		0.61		
9	2,831,023	129,000		0.49		
10	2,833,645	262,200		0.53		
11	2,835,599	195,400		0.53	0.48/0.23	
12	2,837,819	222,000		0.47		
13	2,839,882	206,300		0.52		
14	2,842,545	266,300		0.47		
15	2,845,172	262,700		0.49		
16	2,846,798	162,600		0.21		
17	2,849,434	263,600		0.37		
18	2,851,762	232,800		0.53		
19	2,853,575	181,300		0.61		
20	2,856,771	319,600		0.54		
21	2,858,002	123,100		0.40		
22	2,860,827	282,500		0.37		
23	2,862,203	137,600		0.39		
24	2,864,871	266,800		0.50		
25	2,866,670	179,900		0.57		
26	2,869,036	236,600		0.45		
27	2,871,409	237,300		0.52		
28	2,874,674	326,500		0.50		
29	2,876,181	150,700		0.56		
30	2,878,091	191,000		0.40		
31	2,880,042	195,100		0.57		
Totals		6,859,000				

Meter Reading of last Day of reporting month	2,880,042
Meter Reading of last day of Previous Month	2,811,452
Total Production	6,859,000

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of April 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	2,880,042					
1	2,882,290	224,800		0.47		
2	2,885,106	281,600		0.43		
3	2,887,073	196,700		0.54		
4	2,889,126	205,300		0.45		
5	2,891,902	277,600		0.51		
6	2,893,347	144,500		0.52		
7	2,896,289	294,200		0.63		
8	2,897,568	127,900		0.69		
9	2,899,760	219,200		0.88		
10	2,901,811	205,100		0.47		
11	2,904,491	268,000		0.57		
12	2,905,954	146,300		0.67		
13	2,908,683	272,900		0.56		
14	2,910,399	171,600		0.71		
15	2,912,608	220,700		0.62		
16	2,913,970	136,400		0.59		
17	2,916,573	260,300		0.53		
18	2,918,083	151,000		0.38		
19	2,920,478	239,500		1.14		
20	2,921,826	134,800		0.57		
21	2,924,422	259,600		0.60		
22	2,925,790	136,800		0.61		
23	2,928,290	250,000		0.64		
24	2,929,832	154,200		0.52		
25	2,932,665	283,300		0.54		
26	2,933,811	124,600		0.58		
27	2,936,714	280,300		0.65		
28	2,937,887	117,300		0.52		
29	2,939,218	133,100		0.54		
30	2,941,848	263,000		0.49		
Totals		6,180,600				

Meter Reading of last Day of reporting month

2,941,848

Meter Reading of last day of Previous Month

2,880,042

Total Production

6,180,600

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of May 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	2,941,848					
1	2,943,474	162,600		0.46		
2	2,946,063	258,900		0.77		
3	2,948,225	216,200		0.67		
4	2,950,241	201,600		0.57		
5	2,951,654	141,300		0.81		
6	2,954,664	301,000		0.69		
7	2,956,302	163,800		0.68		
8	2,957,678	137,600		0.62		
9	2,960,274	259,600		0.57		
10	2,961,616	134,200		0.60		
11	2,964,407	279,100		0.67		
12	2,965,642	123,500		0.61		
13	2,967,192	155,000		0.52	0.42/0.41	
14	2,970,400	320,800		0.70		
15	2,972,393	199,300		0.72		
16	2,973,804	141,100		0.46		
17	2,976,001	219,700		0.73		
18	2,977,946	194,500		0.53		
19	2,979,676	173,000		0.62		
20	2,982,069	239,300		0.51		
21	2,983,992	192,300		0.59		
22	2,986,396	240,400		0.46		
23	2,989,476	308,000		0.63		
24	2,991,358	188,200		0.77		
25	2,993,815	245,700		0.50		
26	2,996,526	271,100		0.62		
27	2,999,020	249,400		0.77		
28	3,001,479	245,900		0.65		
29	3,003,812	233,300		0.54		
30	3,006,557	274,500		0.52		
31	3,008,453	189,600		0.57		
Totals	6,660,500					

Meter Reading of last Day of reporting month
Meter Reading of last day of Previous Month
Total Production

3,008,453
2,941,848
6,660,500

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of June 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 In mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,008,453					
1	3,010,751	229,800		0.59		
2	3,012,179	142,800		0.78		
3	3,014,855	267,600		0.54		
4	3,016,301	144,600		0.49		
5	3,019,069	276,800		0.65		
6	3,020,652	158,300		0.55		
7	3,023,404	275,200		0.53		
8	3,026,536	313,200		0.52		
9	3,027,767	123,100		0.62		
10	3,030,695	292,800		0.54		
11	3,031,897	120,200		0.52		
12	3,034,535	263,800		0.62		
13	3,036,530	199,500		0.53		
14	3,038,796	226,600		0.56		
15	3,040,419	162,300		0.49		
16	3,042,242	182,300		0.50		
17	3,044,946	270,400		0.43		
18	3,046,821	187,500		0.50	0.45	
19	3,049,766	294,500		0.59		
20	3,052,595	282,900		0.56		
21	3,056,287	369,200		0.55		
22	3,057,905	161,800		0.51		
23	3,061,730	382,500		0.49		
24	3,063,631	190,100		0.51	0.39	
25	3,065,098	146,700		0.46		
26	3,067,763	266,500		0.48		
27	3,069,574	181,100		0.54		
28	3,072,914	334,000		0.53		
29	3,074,881	196,700		0.53		
30	3,076,047	116,600		0.43		
Totals		6,759,400				

Meter Reading of last Day of reporting month
 Meter Reading of last day of Previous Month
 Total Production

3,076,047
3,008,453
6,759,400

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of July 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,076,047					
1	3,078,042	199,500		0.66		
2	3,080,082	204,000		0.75		
3	3,081,964	188,200		0.56		
4	3,084,931	296,700		0.68		
5	3,086,299	136,800		0.59		
6	3,088,452	215,300		0.48		
7	3,090,292	184,000		0.47		
8	3,092,790	249,800		0.41		
9	3,095,936	314,600		0.43		
10	3,097,451	151,500		0.52		
11	3,100,283	283,200		0.47		
12	3,102,910	262,700		0.49		
13	3,104,535	162,500		0.56		
14	3,105,947	141,200		0.50	0.44/0.38	
15	3,107,326	137,900		0.49		
16	3,111,564	423,800		0.50		
17	3,112,724	116,000		0.48		
18	3,114,306	158,200		0.47		
19	3,117,185	287,900		0.52		
20	3,118,740	155,500		0.46		
21	3,120,950	221,000		0.46		
22	3,123,141	219,100		0.42		
23	3,124,627	148,600		0.64		
24	3,127,699	307,200		0.59		
25	3,130,087	238,800		0.69		
26	3,132,066	197,900		0.46		
27	3,134,685	261,900		0.63		
28	3,136,540	185,500		0.50		
29	3,138,707	216,700		0.69		
30	3,141,443	273,600		0.64		
31	3,143,474	203,100		0.80		
Totals		6,742,700				

Meter Reading of last Day of reporting month

3,143,474

Meter Reading of last day of Previous Month

3,076,047

Total Production

6,742,700

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of August 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,143,474					
1	3,146,464	299,000		0.67		
2	3,148,221	175,700		0.58		
3	3,150,835	261,400		0.61		
4	3,152,814	197,900		0.51		
5	3,155,697	288,300		0.56		
6	3,157,663	196,600		0.59		
7	3,158,875	121,200		0.41		
8	3,162,033	315,800		0.58		
9	3,164,334	230,100		0.59		
10	3,166,429	209,500		0.50		
11	3,169,417	298,800		0.64		
12	3,171,026	160,900		0.56		
13	3,172,819	179,300		0.57		
14	3,175,376	255,700		0.55		
15	3,178,163	278,700		0.57		
16	3,180,431	226,800		0.68		
17	3,181,969	153,800		0.68		
18	3,184,470	250,100		0.61		
19	3,187,481	301,100		0.61		
20	3,188,759	127,800		0.54		
21	3,190,682	192,300		0.59		
22	3,193,193	251,100		0.61		
23	3,195,109	191,600		0.55		
24	3,196,705	159,600		0.54	0.61/0.07	
25	3,199,643	293,800		0.47		
26	3,202,386	274,300		0.66		
27	3,204,016	163,000		0.55		
28	3,207,025	300,900		0.61		
29	3,208,037	101,200		0.49		
30	3,210,030	199,300		0.50		
31	3,213,179	314,900		0.51		
Totals		6,970,500				

Meter Reading of last Day of reporting month

3,213,179

Meter Reading of last day of Previous Month

3,143,474

Total Production

6,970,500

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of September 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl ₂ in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,213,179					
1	3,214,441	126,200		0.40		
2	3,217,462	302,100		0.51		
3	3,218,708	124,600		0.40		
4	3,220,648	194,000		0.42		
5	3,223,539	289,100		0.63		
6	3,224,991	145,200		0.47		
7	3,226,792	180,100		0.44		
8	3,229,416	262,400		0.40		
9	3,230,979	156,300		0.46		
10	3,234,792	381,300		0.54		
11	3,237,382	259,000		0.44		
12	3,238,680	129,800		0.41		
13	3,240,237	155,700		0.50		
14	3,243,226	298,900		0.46		
15	3,244,780	155,400		0.43	0.36/0.16	
16	3,247,695	291,500		0.39		
17	3,249,355	166,000		0.50		
18	3,252,234	287,900		0.76		
19	3,255,021	278,700		0.62		
20	3,256,827	180,600		0.47		
21	3,259,962	313,500		0.56		
22	3,261,627	166,500		0.43		
23	3,264,662	303,500		0.50		
24	3,267,601	293,900		0.54		
25	3,270,435	283,400		0.53		
26	3,272,712	227,700		0.45		
27	3,276,040	332,800		0.47		
28	3,277,624	158,400		0.37		
29	3,280,471	284,700		0.46		
30	3,283,449	297,800		0.45		
Totals		7,027,000				

Meter Reading of last Day of reporting month
Meter Reading of last day of Previous Month
Total Production

3,283,449
3,213,179
7,027,000

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of October 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,283,449					
1	3,285,097	164,800		0.37		
2	3,288,665	356,800		0.63		
3	3,290,313	164,800		0.54		
4	3,293,832	351,900		0.57		
5	3,295,320	148,800		0.37		
6	3,298,361	304,100		0.54		
7	3,301,778	341,700		0.42		
8	3,303,359	158,100		0.47		
9	3,306,215	285,600		0.61		
10	3,308,827	261,200		0.42		
11	3,311,163	233,600		0.57		
12	3,314,438	327,500		0.48	0.39/0.26	
13	3,316,736	229,800		0.49		
14	3,318,659	192,300		0.51		
15	3,321,580	290,100		0.46		
16	3,323,681	212,100		0.37		
17	3,326,642	296,100		0.53		
18	3,328,520	187,800		0.54		
19	3,331,241	272,100		0.46		
20	3,333,672	243,100		0.47		
21	3,335,894	222,200		0.45		
22	3,338,816	292,200		0.48		
23	3,340,621	180,500		0.49		
24	3,343,508	288,700		0.39		
25	3,346,564	305,600		0.64		
26	3,348,056	149,200		0.58		
27	3,351,155	309,900		0.48		
28	3,354,560	340,500		0.52		
29	3,356,435	187,500		0.47		
30	3,359,991	355,600		0.69		
31	3,365,187	519,600		0.57		
Totals		8,173,800				

Meter Reading of last Day of reporting month
Meter Reading of last day of Previous Month
Total Production

3,365,187
3,283,449
8,173,800

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of November 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,365,187					
1	3,368,640	345,300		0.62		
2	3,369,852	121,200		0.63	0.52/0.38	
3	3,373,853	400,100		0.57		
4	3,378,000	414,700		0.66		
5	3,379,446	144,600		0.62		
6	3,381,926	248,000		0.56		
7	3,384,908	298,200		0.53		
8	3,387,798	289,000		0.54		
9	3,390,693	289,500		0.53		
10	3,392,803	211,000		0.55		
11	3,395,997	319,400		0.54		
12	3,397,310	131,300		0.56		
13	3,399,354	204,400		0.48		
14	3,402,492	313,800		0.59		
15	3,404,077	158,500		0.59		
16	3,405,453	137,600		0.57		
17	3,407,071	161,800		0.60		
18	3,410,272	320,100		0.58		
19	3,411,680	140,800		0.74		
20	3,414,330	265,000		0.54		
21	3,416,482	215,200		0.56		
22	3,417,814	133,200		0.51		
23	3,419,380	156,800		0.54		
24	3,421,180	180,000		0.49		
25	3,423,977	279,700		0.56		
26	3,425,538	156,100		0.48		
27	3,427,510	197,200		0.76		
28	3,430,362	285,200		0.60		
29	3,432,000	163,800		0.50		
30	3,433,645	164,500		0.57		
31						
Totals		6,845,800				

Meter Reading of last Day of reporting month
Meter Reading of last day of Previous Month
Total Production

3,433,645
3,365,187
6,845,800

VERMONT MONTHLY WATER SYSTEM OPERATIONS REPORT
for Groundwater Systems and Systems Purchasing Groundwater
WSID 5002 Bristol Town Water

For the Month of December 2020

Day of Month	Water Production		Disinfection/ Chlorination (Free Cl2 in mg/l)		Fluoride (mg/l)	PH Only if providing corrosion control
	Metered Values gals/day		Entry Point Daily Low	Distribution System (When taking coliform sample)	Entry Point	
Carry Total	3,433,645					
1	3,436,071	242,600		0.50		
2	3,437,303	123,200		0.43		
3	3,439,050	174,700		0.67		
4	3,442,011	296,100		0.50		
5	3,443,206	119,500		0.52		
6	3,445,820	261,400		0.55		
7	3,446,608	78,800		0.66		
8	3,448,884	227,600		0.54		
9	3,450,525	164,100		0.48		
10	3,452,051	152,600		0.46	0.40/0.39	
11	3,454,235	218,400		0.65		
12	3,456,581	234,600		0.55		
13	3,458,049	146,800		0.57		
14	3,460,434	238,500		0.55		
15	3,462,498	206,400		0.49		
16	3,464,188	169,000		0.47		
17	3,466,973	278,500		0.56		
18	3,468,463	149,000		0.51		
19	3,469,907	144,400		0.52		
20	3,472,821	291,400		0.57		
21	3,474,003	118,200		0.55		
22	3,475,567	156,400		0.61		
23	3,478,274	270,700		0.52		
24	3,479,610	133,600		0.61		
25	3,482,449	283,900		0.61		
26	3,483,957	150,800		0.51		
27	3,485,336	137,900		0.57		
28	3,487,078	174,200		0.65		
29	3,490,147	306,900		0.54		
30	3,491,515	136,800		0.63		
31	3,493,481	196,600		0.62		
Totals		5,983,600				

Meter Reading of last Day of reporting month	<u>3,493,481</u>
Meter Reading of last day of Previous Month	<u>3,433,645</u>
Total Production	<u>5,983,600</u>