PRELIMINARY ENGINEERING REPORT

Winooski Main Street Revitalization Project

Project No. 58011.00

PREPARED FOR

City of Winooski
27 W Allen Street
Winooski, VT 05404
802.655.6410

PREPARED BY

VHB
40 IDX Drive, Building 100
Suite 200
South Burlington, VT 05403
802.497.6100

Dufresne Group
56 Main Street
Suite 200
Springfield, VT 05156
802.674.2904

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Project Planning

1.1 Location

Two project location maps and a project base map are provided in Appendix A. As shown on these maps, the project is located along the Main Street (US 2/7) corridor in the City of Winooski. The City of Winooski is situated in Chittenden County, Vermont and borders Burlington, South Burlington, and Colchester.

The Main Street Revitalization Project is a transformational project involving a full reconstruction of the Main Street (US 2/7) corridor from the Colchester Town line south approximately 4,000 feet to the bridge over the New England Central railroad (Bridge 151). The revitalization project includes stormwater management enhancements, upgrades to existing water and wastewater infrastructure, burial of electric and telecommunication infrastructure, roadway reconstruction, and comprehensive landscape, streetscape, traffic control, and pedestrian safety enhancements.

1.2 Environmental Resources Present

1.2.1 Wetlands

No wetland resources are present within the Main Street corridor. The location of the principal stormwater outfall for the Project is located along the Winooski River, which may require retrofitting, was evaluated for wetland/water resources. No features are present near the outfall such that impacts of any kind are anticipated. A map of this outfall and nearby resources is shown in Appendix A.

1.2.2 Soils

VHB, in collaboration with S.W. Cole Engineering, performed subsurface investigations at 40 test borings along the corridor in order to identify the existing soil conditions. It was found that, underneath the asphalt and gravel fill, fine to medium graded sand with trace amounts of gravel and silt occurs at depths ranging from 2.5 to 12.5 feet. The deposit was noted to be of loose to medium relative densities. The sand layer, in most cases, is underlain by silt with equal amounts of clay and trace amounts of fine sand. This deposit was measured to be of a medium stiff to hard density. At three of the boring locations, bedrock was encountered at depths between 7.1 and 9.1 feet below the ground surface. A copy of the Explorations and Geotechnical Engineering Report can be found in Appendix C.

1.2.3 Oil and Hazardous Materials

Contaminated soils that exceed soil screening values (SSVs), including EPA regional screening levels (RSLs) for residential and industrial soils, VT screening levels (VSLs) for residential soils, and VT DEC background soil concentrations (BSCs), were identified within the Project area adjacent to known existing hazardous sites. This includes petroleum-contaminated soils (PCS)[1] adjacent to the Winooski Go-Go, Colonial Mart, Former Auto Repair/Iron Works facility, McLaughlin's Garage, and Dufresne's Service Center sites and Polychlorinated Biphenyl (PCB_-contaminated soils adjacent to the McLaughlin's Garage and Snider's Auto Center sites. A memorandum outlining the Oil and Hazardous Materials Investigation Results is provided in Appendix C. Maps of the approximate extents of the contaminated soil plumes can be found in Appendix A. The "Approximate Contamination Extents" do not define the nature and extent of contamination related to the various high-risk sites in the project area. Definition of the actual contamination extents in the project area is out-of-scope for this preliminary investigation.

Project activities that will intersect these contaminated soil volumes (CSVs) in some areas include subbase excavations/backfill, stormwater treatment installations and removal/undergrounding of utilities. Piping materials within the CSVs should be resistant to petroleum compounds and PCBs, as applicable. Underground utility spans that intersect CSVs should also be grouted to reduce the risk of creating a preferential pathway for contaminant migration. Areas where stormwater infiltration is proposed in CSVs should be further assessed utilizing the synthetic precipitation leaching procedure (SPLP) to ensure contaminants do not leach into groundwater.

1.2.4 Archaeological Resources

A field inspection performed by the University of Vermont Consulting Archaeology Program (UVM-CAP) determined that the project area does not contain any sensitive areas for pre-Contact Native American sites or historic period Euroamerican sites. A copy of UVM-CAP's Archaeological Resource Assessment can be found in Appendix C.

1.2.5 Historic Preservation

Based on an evaluation of the Project corridor by the City's consultant, VHB, for potential effects to historic resources, a recommendation that the Project will have No Adverse Effect on Historic Properties has been made. The report and its amendment (which includes stipulations for construction outside the ROW and the Archaeological Resources Assessment for the Project), is provided in Appendix C. The USDA is coordinating directly with the Vermont Division for Historic

[1] PCS includes soils that exceeded SSVs for TPH-DRO, TPH-GRO, ethylbenzene, naphthalene and 1,2,4-Trimethylbenzene

Preservation regarding this determination and to obtain the concurrence of the State Historic Preservation Officer.

1.2.6 Rare, Threatened, and Endangered Species

The Northern long-eared bat was listed in an Information for Planning and Consultation (IPaC) search of the project area, but not in the stormwater outfall area. No species of concern were listed in the project or stormwater outfall area based on a search using the Agency of Natural Resources' Natural Resource Atlas. Time of year clearing restrictions will avoid taking of any bats, and no known maternity roosts or hibernacula occur within 150 feet or 0.25 miles of the Project, respectively.

1.3 Population Trends

Research was conducted regarding population trends over the last 20 years in Winooski using historic United States Census Data. Most recent updates to the Census population estimates showed the population of Winooski as of July 1, 2016 was 7,128 people. This is an almost 2% decrease in population from April 2010 when the population was estimated to be 7,267. The population of Winooski was fairly steady through the 1990's and 2000's until 2009. Between 2009 and 2010, the population grew from 6,261 to 7,267. This 16% spike was the largest in the City's history and has since remained fairly level, with slight decreases over the last 7 years.

The median household income between 2012 and 2016 was reported to be $49,596, with 26% of Winooski residents living in poverty. The poverty line threshold is a set of values which vary by family size and family composition and is used by the Census Bureau to determine who is living in poverty. In this same time frame, approximately 15% of people living in Winooski were foreign born.

Currently, state and regional models are forecasting growth in Winooski between now and 2030. The Chittenden County Regional Planning Commission estimates that by 2030, the population of Winooski will grow approximately 8% to 7,693 people[2].

There are currently 266 residential housing units in the project area on Main Street. Using the average City household size of 2.21 people per household, the existing population is estimated at 588 people. The City does not have specific population projects but estimates that the number of units on Main Street could double as a result of the revitalization project. If the number of residential units increases by 200%, the population growth would be an additional 588 people or 8.2% of the 2016 population.

[2] *Population Forecasts*, Chittenden County Regional Planning Commission. Winooski, VT. 22 March 2017.

1.4 Community Engagement

The City of Winooski has been engaged with the Main Street Revitalization Project through every step. Various outreach activities have occurred throughout the duration of the project planning process and are described below:

- Historical community engagement on numerous scoping studies prior to the beginning of this project (e.g. 2014 Main Street Corridor Study, 2017 Transportation Master Plan).
- This project was a standing item on the Planning Commission meeting agenda beginning on November 15, 2017, which provided regular updates to the public.
- A Local Concerns Meeting was held on November 29, 2017.
- An Alternatives Open House and Presentation was held on January 10, 2018.

See Appendix B for outreach materials including meeting announcements, press releases, and meeting minutes.

2

Existing Facilities

2.1 Location Map

Two project location maps and a project base map are provided in Appendix A.

2.2 History

Water

The Winooski Water Department (WSID #5102) includes the distribution system with water mains, hydrant, valves, pressure reducing valves and water services. Water is supplied to the City by a wholesale supplier, Champlain Water District (CWD). There are no pump stations or water storage tanks within the City water system. Water storage is provided by the Colchester South tanks. The City is divided into two pressure zones, with seven pressure-reducing valves (PRVs) that create a reduced pressure zone that encompasses the area south of East Spring Street, west of Weaver Street and southwest of Brisson Court and extends to Clifford Street. The system has 1,744 connections which are all metered. The total average day demand is 0.48 MGD based on CWD metered supply data for 2013-2015.

The water distribution system was originally constructed in 1873 in conjunction with a construction project to supply the Woolen Factory on Canal Street with water from Gilbrook Pond. By 1888, the distribution system included 3 miles of cast iron (CI) mains ranging in size from 4-inch to 10-inch diameter and 400 galvanized steel water services. The 1869 Beers Atlas shows Main Street was well developed up to Stevens Street, so it is likely the Main Street water mains were among the first portions of the distribution system installed in the 1870s.

In 1973, the City connected to CWD to obtain water on a wholesale basis via a 16-inch cast iron main on upper Main Street. At the same time, PRVs were installed to create two pressure zones within the City. In the late 1970s a second 12-inch diameter ductile connection to CWD was constructed on the eastern side of the City, north of East Allen Street. Between 1977 and 1979, the majority of the original cast iron water mains were cleaned and cement lined.

The water mains on Main Street in the project area, between the railroad bridge and the Winooski/Colchester municipal boundary, include the following:

- 870 LF of 8-inch diameter CI main from Mansion Street to Spring Street
- 2,825 LF of 6-inch diameter CI main from Spring Street to the City line
- 750 LF of 16-inch diameter CI from Bellevue St. to Highland St.

There are 70 water services on Main Street, including 4-inch and 6-inch services to the elementary and high schools and a 4-inch service to 300 Main Street. The customers are not identified by type (i.e. residential, commercial, industrial). However, based on a review of individual property uses on Main Street, the number of residential units is estimated at 266 and the number of commercial units are estimated at 36. These values do not include users on side streets that contribute water to the Main Street collection mains.

One of the system's seven PRVs, PRV-3, is located within the project area on Main Street between Platt Street and East Spring Street. The PRV is a 40WR Ross Valve in a concrete manhole structure. Static pressure in the High zone ranges from 80 to 115 psi. Static pressure in the Low zone ranges from 70 to 100 psi.

Sewer

The sewer mains on Main Street were most likely installed in the 1880s, based on the materials of construction and information in the publication "The Great Falls on Onion River"[3], which describes that construction of the municipal sewer system began in 1883. The sewer mains are primarily vitrified clay tile (VC) which was the material of choice in the U.S. for many municipalities starting in the 1880s.

The existing sewer system within the project area consists of 1,975 LF of 8-inch VC pipe, 900 LF of 10-inch VC pipe and 830 LF of 12-inch VC pipe. There are 70 connections to the sewer collection system. City staff report that many of these services are Orangeburg, which is a material comprised of compressed layers of wood fiber and coal tar pitch.

Stormwater

A majority of the City's wastewater collection system was constructed prior to 1922 when the City was first incorporated. This portion of the collection system was originally constructed as a combined sewer/stormwater system, but has since been separated into two distinct systems. This separation was completed in 1974, with all wastewater flowing to the City's treatment plant at 250 West Allen Street in Winooski. The City's stormwater collection system drains to several outfalls at native wetlands, into constructed detention ponds, or directly into the Winooski River.

2.3 Condition of Existing Facilities

2.3.1 Water

The City of Winooski has been experiencing leaks on their aging water infrastructure for many years and have been documenting water main breaks and leaks since 2009. Since 2009, 19 of the 26 documented water main breaks were on the system's original CI water mains. Within the Main Street project area, breaks or leaks occurred

[3] *The Great Falls on Onion River: A History of Winooski, Vermont,* Vincent Edward Feeney. Winooski, VT. 2002.

on January 7, 2010 and on May 12, 2015. The cause of the 2010 break is unknown and the 2015 leak occurred due to a corroded galvanized service.

PRV-3 receives annual maintenance to inspect the condition of the valve and structure and address any identified issues. The valve and structure are currently in adequate condition.

The Main Street 6-inch and 8-inch diameter piping is 140 years old and beyond the typical 100 – 120-year useful life for cast iron. The remaining galvanized water services that have not been replaced are well beyond their 40-50 year expected life. These services are highly susceptible to corrosion and have not been used for water service lines since about 1960.

The Vermont Water Supply Rule requires 8-inch diameter as the minimum size of water main for providing fire protection and serving fire hydrants. The minimum pressure required during fire flow conditions is 20 psi.Typically, the limiting demand condition is fire flow demand in conjunction with maximum day demand, as these values usually are greater than peak hour demand. The future peak hour demand for the Main Street area is estimated assuming a 200% increase in the number of units in the project area and a peaking factor of 3.8. The future design average day demand is 248,000 gpd and the peak hour flow is 653 gpm. This peak hour flow is less than the fire flow demands in the project area.

Aldrich and Elliot (A&E) completed a water model of the water system in 2016 as part of the City of Winooski Water Distribution System Master Plan Update. The criteria used to identify hydraulic limitations was a minimum flow of 750 gallons per minute (gpm) at a minimum pressure of 20 psi. Ability to meet Insurance Services Office (ISO) Needed Fire Flows (NFF) was also assessed, but there are no NFFs identified by ISO for buildings in the Main Street project area that could be used to determine if there are any fire flow deficiencies on Main Street.

Computer modeling results showed the available fire flows on Main Street range from 1,456 gpm to 5,000 gpm at 20 psi. The water mains were not identified as hydraulically limiting since the available fire flows exceed 750 gpm, which is the required fire flow criteria used in the A&E report. However, the evaluation by A&E identified that the mains south of East Spring Street have low C values of 55, even though these pipes were reported as being lined in 1977.

For this PER, estimates of Needed Fire Flows were made for two new buildings at 348 Main Street and 394 Main Street which were permitted in 2016. These developments are considered by the City to represent the largest developments under the Form-Based Code. 348 Main Street is a four-story mixed-use development with commercial space on the first floor and 15 residential units. 394 Main Street is a two-story multifamily residential development with 10 units.

Using ISOfire flow calculation methods, the Needed Fire Flow for 348 Main Street was estimated as 2,250 gpm. The NFF estimated for 394 Main Street is 1,400 gpm. Based on the computer modeling results, the fire flow requirements are satisfied as the Available Fire Flows (AFF) are 5,000 gpm for 348 Main Street and 2,119 gpm for

394 Main Street. The AFF results are based on the existing system. Therefore, the AFF values will increase when the existing 6-inch diameter pipe is replaced with an 8-inch diameter main.

Besides age, the primary deficiency with the existing water piping is the undersized 6-inch diameter mains.

2.3.2 Sewer

The sewer mains within the project area are approximately 140 years old. VC pipe has an estimated useful life of 50-100 years and the life of Orangeburg pipe is 50 years, at most. The existing sewer pipes are well beyond their expected useful life.

As part of the evaluation of the current sanitary sewer pipe network within the project area, a hydraulic analysis was completed using the Autodesk Storm and Sanitary Analysis program to assess the capacity of the existing sewers. Existing flows were estimated using design flows from Chapter 1 of the Vermont Environmental Protection Rules, Wastewater System and Potable Water Supply Rules (EPR). The total estimated flow generated by the residential units, a variety of commercial uses on Main Street, and from properties on side streets that connect to the Main Street sewer is 150,120 gallons per day (gpd) as shown in **Table 1**. The peak flow, calculated using a peaking factor of 3.8, is 394 gpm.

Table 1: Estimated Existing Wastewater Design Flows

Flow Source	Estimated Flow
Main Street Residential and Commercial Flows	124,280 gpd
Weaver Street Residential and Commercial Flows	21,110 gpd
Main Street Sewer Line Infiltration	1,830 gpd
Side Streets Sewer Line Infiltration	2,200 gpd
Total Average Flow	150,120 gpd
Total Peak Flow	394 gpm

Note: Existing flows were estimated using design flows from Tables 1-3, Chapter 1 of the Vermont Environmental Protection Rules, Wastewater System and Potable Water Supply Rules (EPR).

The simulations of peak flows showed that there are no capacity limitations within the existing system. The most limited section is the 10-inch diameter pipe south of

Spring Street to Union Street which is 44% to 67% full during the simulated peak flow event.

The Vermont Department of Environmental Conservation (VTDEC) Environmental Protection Rules, Subchapter 5, Section 1-A-03, specifies minimum slopes for municipal sewer collection systems based on pipe size. These slopes are as follows:

Pipe Size (inches)	Minimum Slope (feet/100 feet)
8	0.40
10	0.28
12	0.22

The sanitary sewer mains within the project area have no areas of inadequate slopes.

2.3.3 Stormwater

Site visits and review of existing storm drainage network mapping reveal that stormwater runoff is currently collected and conveyed in conventional pipe and gutter systems. Runoff from impervious roadway and other hard surfaces flow directly into drain inlets and is piped to an outfall where it is discharged directly to the Winooski River. The water at the discharge point is neither treated, nor is the outflow controlled into the river.

Existing pipes range in size from 18 to 30-inches and are generally made of reinforced concrete pipe (RCP), corrugated metal pipe (CMP), or high-density polyethylene (HDPE). The connections from side streets and service connections vary in size between 8 and 15-inches and are usually made of PVC pipe. CMP is generally not used in new construction at this point which points to the age of the system and need for updating. In addition to the pipe system, there exists a stone culvert under Main Street between Spring Street and Platt Street. This culvert was observed by City staff in the mid-2000s and again by consultants in 2017. This culvert is of an unknown age and condition could not be determined during site visits.

Throughout the history of the storm drain network, spot improvements have been made to the infrastructure but the system is overall very outdated. These original pipes and structures make up the majority of the existing infrastructure, with conditions varying widely throughout the project area. Specifically, many of the catchbasins are 2-feet by 2-feet rectangular concrete structures with brick risers and many of these structures are showing evidence of neglect or inadequate rehabilitation and retrofitting.

2.3.4 Roadway

The major characteristics of the existing roadway network are described below:

Functional Classification:	Principal Arterial
Right of Way (ROW):	4 rods (66 feet)
Roadway Geometry:	Two 14' travel lanes with on-street parking and turn lanes at major intersections
Speed Limit:	25 mph
2016 Average Annual Daily Traffic (AADT):	13,000 – 17,000 vehicles per day
Truck Traffic:	Designated Truck Route
Pedestrian Facilities:	• Four to Five-foot sidewalks on both sides of the street • No mid-block crossings
Bicycle Facilities:	None

Other Roadway Characteristics:	• 3,840 linear feet of asphalt
	  ○ Asphalt 7-10" thick typ.
	• 240 linear feet of concrete
	  ○ Concrete 10" thick typ.
	• 46 to 50-foot curb to curb width
	• Concrete Curb
	• Utility Poles on west side of the road from Spring Street to Colchester town line:
	  ○ Poles owned by Green Mountain Power and Consolidated (formerly Fairpoint) and include telecom and electric power lines
	• Approximately 70 curb cuts for businesses and/or residences
	• Existing Underground Utilities:
	  ○ Municipal water, sewer, stormwater
	  ○ VT Gas

2.3.4.1 Safety Analysis

A review of crash data provided by the Vermont Agency of Transportation (VTrans) identified one intersection and two segments of US 7 as High Crash Locations between the years 2012 and 2016[4]. A description of these crash locations is shown in **Table 2.**

Table 2: High Crash Location Summary

Rank	Location	Mileage	AADT	Crashes	Fatalities	Injuries	PDO Crashes	Critical Rate	Actual Rate	Ratio Actual / Critical
High Crash Intersections (2012-2016)										
39	US-7- E SPRING ST, W SPRING ST.	0.430 - 0.450	17340	38	0	13	29	0.83	1.20	1.44
High Crash Segments (2012-2016)										
382	US-7	0.481 - 0.781	13636	69	0	16	54	6.68	9.24	1.38
145	US-7	0.981 - 0.270	15700	109	0	28	88	6.55	12.68	1.94

2.4 Financial Status of Any Existing Facilities

2.4.1 Revenues

Water

The City of Winooski water system receives most of its revenue through user charges. Customer water bills are based on their metered water consumption. Winooski bills on a quarterly basis with a fixed rate of $5.17 per 1,000 gallons. Based on these rates, a typical customer using 210 gpd or 19,160 gallons per quarter of water would have a total annual water bill of $396.28.

In 2017, the revenue received by the Water Fund for Water Usage Charges was $818,601.49. The Water Fund also receives income from miscellaneous fees including fire hydrant user fees, damaged water meter replacements and delinquent payment fees. The total revenues for 2017 were $896,099.69. A copy of the Fiscal Year 2019 proposed budget, which shows the revenues and expenses, is included in Appendix D. The budgeted revenue for 2018 is $840,658.69.

Sewer

The City of Winooski Wastewater Fund receives the majority of its revenue through user charges. Customer sewer bills are based on their metered water consumption. Winooski bills on a quarterly basis with a fixed rate of $6.49 per 1,000 gallons. Based on these rates, a typical customer using 210 gpd or 19,160 gallons per quarter of water would have a total annual sewer bill of $497.46.

In 2017, the revenue received by the Wastewater Fund for Sewer Service Charges was $1,012,745.17. The Wastewater Fund also receives income from Aid in Expansion fees, investment income and miscellaneous fees. The total revenue for 2017 was

[4] *High Crash Location Repot: Section and Intersections 2012-2016.* Vermont Agency of Transportation Office of Highway Safety Division, August 2017.

$1,100,271.51. A copy of the Fiscal Year 2019 proposed budget, which shows the revenues, is included in Appendix D. The budgeted revenue for 2018 is a total of $1,030,500.00.

2.4.2 Expenditures

Water

The expenditures for 2017 and 2018 are also shown in the Fiscal Year 2019 proposed budget (Appendix D). The 2018 budgeted costs are summarized as follows:

Operation and Maintenance Expenses:	$810,564.32
Capital Costs:	$80,789.22
Total 2018 Water Expenses:	$891,353.54

For 2018, the budget included a $50,694.85 draw from capital reserves.

The City contributes to a capital reserve fund when there is additional revenue and draws from the capital reserve fund as needed to balance expenses. The balance of the reserve fund was $680,544.58 at the end of 2017, which includes an operating reserve fund of $86,245.88.

Sewer and Stormwater

The expenditures for 2017, 2018 and future years are also shown in the Fiscal Year 2019 proposed budget (Appendix D). Expenses include cost for both the wastewater and stormwater departments. The 2018 budgeted costs are summarized as follows:

Wastewater Operation and Maintenance Expenses:	$576,615.46
Stormwater Operation and Maintenance Expenses:	$287,185.00
Capital Costs:	$588,495.94
Total 2018 Wastewater Expenses:	$1,165,111.40

For 2018, the budget included a $424,786.40 draw from capital reserves.

The City contributes to a capital reserve fund when there is additional revenue and draws from the capital reserve fund as needed to balance expenses. The balance of the reserve fund was $1,638,763.17 at the end of 2017, which includes an operating reserve fund of $133,781.37.

2.5 Water/Energy/Waste Audits

The City routinely performs an audit to compare CWD water supply to total City metered usage. During the period from 2013 to 2015, the average CWD supply was 484,163 gpd and the total of individual Winooski water meters was 402,679 gpd. The water losses for this period averaged 81,484 gpd. The City indicates that after quantifying some known losses, the remaining water losses are about 58,000 gpd or 12% of the supply.

3

Purpose and Need for Project

3.1 Purpose of the Project

The purpose of the Main Street Revitalization (MSR) Project is to:

- upgrade antiquated drinking water systems, sanitary sewer systems, and stormwater management and treatment practices; and
- enhance mobility and improve safety and access for all modes of transportation.

3.2 Need for the Project

The need for the MSR Project is defined by the concerns and deficiencies identified in the following areas.

3.2.1 Antiquated and Unreliable Water Supply and Sewer Systems

Most of the current water main lines in the MSR Project area are either 6-inch or 8-inch cast iron pipes that were installed over 100 years ago. These water mains have exceeded their useful life and are in need of replacement. The vulnerability of this aging infrastructure is highlighted by two water main breaks that occurred on Main Street since the City began keeping detailed records: in January 2010 and May 2015. Besides outright pipe breakages, which can cause service outages and affect traffic during reparations, system leakage is suspected to be ongoing through both partially compromised mains and galvanized service lines, which are susceptible to corrosion. System leakage results in the loss of water resources and City revenue. Based on a study completed in 2016, the Winooski Water System has approximately 12% unaccounted for water, which is above the goal of 10 percent set by the American Water Works Association.[5]

An analysis of water supply pipe roughness (*i.e.*, Hazen-Williams coefficients or "C-factors") on Main Street determined that there is either internal tuberculation, friction, or a partially closed valve(s) in the water main restricting flow in the pipe. The water main on Main Street ranks second out of five in terms of replacement priority.[6] In addition to flow restriction caused by the deterioration of the water main, its 6-inch diameter is less than the 8-inch minimum diameter for providing fire protection under the current Vermont Water Supply Rule.

[5] City of Winooski Water Distribution System Master Plan, Aldrich + Elliott, 2016

[6] Ibid.

The sanitary sewer main lines on Main Street are 10 to 12-inch vitrified clay tile sewer mains, installed approximately 140 years ago and therefore well beyond their 50 to 100-year life expectancy. Many sewer laterals tie into the main line without a manhole, increasing the likelihood of damage to the main or laterals protruding into the main and creating blockages. The video camera footage that is available for the main line indicates that it does not run straight. Additionally, separation between water lines and sewer lines throughout the MSR Project area are well below the current requirement of 10 feet.

3.2.2 Lack of Stormwater Treatment and Stormwater Pipe Separation

The existing stormwater system on Main Street consists of traditional curb and gutter collection, but lacks treatment of any kind for water quality and volume of runoff discharged. This means that stormwater runoff from the Project area is discharged to the Winooski River watershed without treatment. The contribution of pollutants from urban runoff is recognized in the City's Stormwater Management Plan (2013).

Related, the separation between stormwater and sanitary sewer pipes are below current standards, enhancing the likelihood of intermingling of the two discharges. In the early 2000's, The City found evidence of wastewater entering an antiquated stone box culvert running perpendicular to Main Street between Spring Street and Platt Street and under the sewer line. This stormwater pipe joins a network that discharges directly to the Winooski River near the intersection of Winooski Falls Way and Cascade Way. The sewer line was subsequently slip lined and the problem was resolved. However, the incident demonstrates the fragility of the material construction of the two drainage systems and the implications for downstream water quality when cross contamination occurs.

3.2.3 Deficiencies in Transportation Infrastructure

Throughout the Project corridor, sidewalk widths, crosswalk frequency and crossing distances are insufficient to accommodate current pedestrian needs. No dedicated bicycle facilities exist that support north-south movement of cyclists through Winooski. The lack of public transportation opportunities and pedestrian infrastructure explain rank in the top 40% of community challenges identified by residents in a Community Health Needs Assessment carried out by the Chittenden County Regional Planning Commission.[7] Additionally, the State has identified three High Crash Locations on Main Street that experienced over 200 crashes between 2012 and 2016. Main Street is not a designated bicycle corridor and lacks bicycle accommodations, but the 2017 Chittenden County Regional Planning Commission *Active Transportation Plan* identifies Main Street as a high-priority project corridor in its Proposed Regional Transportation Network.

[7] *Community Health Needs Assessment – Chittenden and Grand Isle Counties, Vermont.* Chittenden County Regional Planning Commission et. al, 2016.

3.2.4 Responsible Corridor Planning

The City of Winooski is the most densely populated urban area in Vermont. The Main Street corridor is identified as a "Gateway District" in Winooski's Land Use Regulations and the City has adopted Form-Based Code (FBC) Regulations for the corridor. Within this Gateway District, there are two distinct categories: Urban General Frontage and Urban Storefront Frontage. The intent of these zoning categories is to create a dense, mixed-use downtown.

The documented deterioration of the water and sanitary pipe network presents an impediment for the design and construction of FBC-compliant redevelopment projects along Main Street. While the design of new buildings can make assumptions regarding necessary utility connections, when construction is actually undertaken, experience shows that the actual means of connection often needs to be altered to account for a damaged water or sewer main or make special provisions for connecting to or replacing a section of incompetent pipe. This introduces a level of uncertainty and risk in pursuing future development, which is especially pronounced given that the Main Street corridor is actively undergoing the transition as prescribed the FBC. A dependable water and sanitary sewer network is needed in order for the envisioned revitalization of Main Street to proceed without the unanticipated costs of utility repair and the inconvenience to service and corridor traffic caused by iterative repair work or construction delays caused antiquated utilities.

4

Alternatives Considered

4.1 Description

4.1.1 Water Main Alternatives

The existing 6-inch diameter water mains on Main Street do not comply with the Vermont Water Supply Rule (WSR) requirement for minimum 8-inch diameter piping for systems providing fire protection. In addition, the 6-inch and 8-inch cast iron mains are beyond their useful life. Considering that the 6-inch mains are undersized and the mains have previously been lined, which reduced the internal diameter, rehabilitation (further reducing the internal diameter) is not an alternative. Therefore, the water mains should be replaced.

The replacement main should be 8-inch diameter to satisfy the minimum pipe size requirements of the Water Supply Rule. As described previously in Section 2, and documented in the City of Winooski June 2016 Water Distribution System Master Plan Update, the existing 6-inch and 8-inch diameter piping is of adequate size to meet minimum pressure requirements. Consequently, there is no reason to increase the water main above 8-inch diameter to resolve hydraulic deficiencies. There are also no future demand projections that justify increasing the main size above 8-inch diameter.

Since there are no sizing considerations for the water main replacement, the alternatives are limited to materials of construction and installation methods.

<u>Water Main Material Alternatives:</u>

In the water works industry, there are several alternative materials typically used for water main installation. These alternative pipe materials include:

1. Ductile Iron (DI)
2. Polyvinyl Chloride (PVC)
3. High Density Polyethylene (HDPE)

The materials have different physical characteristics and installation methods. These factors are considered when planning for a water main construction project.

However, the presence of contaminants, specifically PCBs, Total Petroleum Hydrocarbons (TPH), Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs), in the soil eliminate PVC and HDPE as viable alternatives.

Both polyvinyl chloride and polyethylene are susceptible to permeation of hydrocarbons and organic compounds. Due to the possibility that the compounds may permeate the pipe walls and adversely affect drinking water quality, PVC and HDPE are not appropriate materials for the water main replacement.

In addition, special materials are required for ductile iron water main joints to prevent permeation through the gaskets. The elastomer material in the standard plain rubber gaskets material is also susceptible to permeation. Viton gaskets are recommended as they are resistant to permeation.

There are other recommended measures to prolong the life of ductile iron pipe. In the past decade, there are more and more frequent reports of ductile iron pipe failures in "non-corrosive" soils. What was considered to be a 50 to 100-year service life material may only provide half of its expected life.

The ductile iron pipe industry has developed various methods to protect these pipes from external corrosion. The bituminous coating was the initial coating protection which has not demonstrated to provide significant protection. Other options include:

1. Wrapping the pipe in polyethylene during installation.
2. Using cathodic protection of pipelines.
3. Using a zinc coating on the exterior of the pipe. American Pipe has been supplying zinc-coated DI pipe on export orders since the early 1980s.
4. Using several or all of the options above.

All of these options add cost in an effort to retard corrosion of the iron pipe.

According to several pipe manufacturers, the zinc-coated DI pipe will extend the life well beyond conventional ductile iron pipe. This coating has been used for years in the international market and is now available in the domestic market. The zinc-coating is used as corrosion control and is coated with the typical asphalt coating to extend the life of the zinc coating. American Pipe states that this zinc coating will extends the life of the DI pipe to a century or more. Furthermore, if American Pipe's polywrap is used in conjunction with the zinc coating, American Pipe claims a service life of "hundreds of years or longer". According to pricing obtained in February 2018, the cost of adding zinc coating is about 10% more than the basic DI pipe with asphalt coating.

<u>Water Main Installation Method Alternatives:</u>

There are various installation methods available for water main construction and/or replacement, including:

1. Open Trench
2. Horizontal Directional Drilling (HDD)
3. Pipe Bursting

Horizontal directional drilling (HDD) and pipe bursting are both trenchless installations, typically completed using HDPE pipe or fusible PVC pipe. It is possible to install DI pipe with HDD or pipe bursting but it is not as common due to limitations on deflection, larger bore requirements and greater costs per linear foot.

Although the trenchless technologies would normally be expected to have cost savings compared to open trench, the savings is substantially reduced due to project-specific characteristics. First, the Main Street reconstruction project will include full road reconstruction, including removing and replacing 3 feet of subbase and pavement, which reduces the cost per foot of open trench installation. Second, the requirement to use ductile iron increases the costs for both trenchless technology alternatives.

Based on a review of cost estimates and bid tabulations for projects that included alternate pricing for installation methods and materials, the alternative of open trench installation is recommended for the water main replacement.

4.1.2 Sewer Main Alternatives

The evaluation of the existing collection system in the project area identified that the pipes are over 140 years old and beyond their useful life. The mains should be replaced or, if feasible, rehabilitated by slip lining or cured in place pipe liner methods.

In order to assess the renovation or rehabilitation alternative, we estimated the necessary hydraulic capacity of the collection system to convey wastewater contribution from the following sources:

1. Existing customers
2. Infiltration to the sewers on Main Street and side streets connected to the Main Street sewer mains
3. Potential new customers on Main Street

The existing wastewater design flow for the project area is an average of 150,120 gpd as previously presented. 124,280 gpd is attributed to the Main Street wastewater connections. As existing properties on Main Street are redeveloped under the Form-Based Code, the density is expected to increase and therefore the wastewater flows will increase. The City estimates that the number of units on Main Street could double from the current number.

Currently the wastewater flows from development on Main Street are generated from the following users:

- 266 Equivalent Residential Units (ERU's)
- 36 commercial users

The residential users currently account for 45% of the Main Street design flows.

The future distribution between residential and commercial users is unknown, as are the type of commercial users and their associated design flows. Without this information, estimates of future wastewater flows are imprecise. However, the alternative of using population projections for the City to forecast future flows is also not reliable since the project area is a very small subset of the total City population.

The future flow projection for the project area was made using the assumption that the average daily flows on Main Street will double. As summarized in **Table 3**, the future peak flow is estimated at 722 gpm.

Table 3: Future Estimated Wastewater Design Flows

Flow Source	**Estimated Flow**
Main Street Residential and Commercial Flows	248,560 gpd
Weaver Street Residential and Commercial Flows	21,110 gpd
Main Street Sewer Line Infiltration	1,920 gpd
Side Streets Sewer Line Infiltration	2,200 gpd
Total Average Flow	273,390 gpd
Total Peak Flow	722 gpm

Note: Existing flows were estimated using design flows from Tables 1-3, Chapter 1 of the Vermont Environmental Protection Rules, Wastewater System and Potable Water Supply Rules (EPR). Infiltration for Main Street sewers is based on 12-inch diameter piping replacing the existing 10-inch diameter piping.

The existing Main Street sewer mains are 8-inch diameter from the start of the collection main at the north end of Main Street to Burling Street, where the size increases to 12-inch diameter. However, south of Stevens Street the sewer main reduces to 10-inch diameter for the 800-foot section that connects to the 12-inch diameter mains on Union Street. Based on a hydraulic evaluation of the Main Street sewer network, the 10-inch mains should be increased to 12-inch diameter to prevent surcharging during the future peak flow.

With the exception of the 10-inch diameter pipes, there are no capacity deficiencies and there are no inadequate slopes within the existing Main Street collection system. Therefore, rehabilitation of most of the piping is a possible alternative to address the age deficiency.

The feasibility of rehabilitating the existing VC sewer pipes depends on the condition of the existing mains but also on the acceptability of the current location. If the existing sewer main is rehabilitated, the existing horizontal and vertical locations must be adequate to meet minimum separation requirements from the water main. These requirements are minimum separation distances of 10 feet horizontally and 18 inches vertically.

Currently, the water and sewer horizontal separation varies from a few inches to 7 feet. Therefore, if the existing sewer remains in the same location, the new water main will be required to be relocated to achieve a minimum 10 feet horizontal separation. The replacement water main should have a minimum depth of cover of 6 feet to be below frost depth. To ensure that water and sewer services crossing the mains have adequate vertical separation, the minimum depth of cover for the sewer main is about 8.5 feet, based on an 8-inch diameter water main.

Approximately 80% of the existing sewer main is not deep enough for the required vertical separation to be achieved, unless the new water main is installed with less than 6 feet of cover, with insulation. Installing new water main at less than the required depth in order to allow rehabilitation of the 130-year-old sewer is not recommended. Therefore, the sewer main should be replaced and installed at sufficient depth to achieve vertical separation from water main and services. In some areas, the sewer main will need to be lowered over 2 feet from the current location.

With replacement of the sewer main identified as the only feasible alternative, the other primary consideration for the sewer main replacement project is the location within the road right of way. Since the project includes replacement of the water main, and considering that proposed gas, telecommunication and electrical lines are all proposed to be located outside the curb line, there is considerable flexibility for locating the replacement sewer main. The primary restriction on the proposed sewer main location is the proposed water main location and design characteristics.

4.1.3 Roadway

Two alternatives were considered during the development of this project. The major differences in the alternatives were streetscape level considerations. The two alternatives are described in the following sections.

<u>Alternative 1 – Roadway Reconstruction with Bicycle Facilities on Weaver Street</u>
This alternative proposes a shift in the existing curbline to a width of 40 feet and includes 8-foot on-street parking, narrowed 12-foot travel lanes, and expanded 13-foot pedestrian and streetscape amenity space. A proposed cross-section for this alternative is shown in **Figure 1.** As shown in this cross-section, there are no proposed formal bicycle accommodations on Main Street associated with this alternative. It is proposed that shared use lane markings be used on the southbound travel lane and protected bicycle facilities be installed on the parallel road, Weaver Street, to the west of Main Street to provide a safe north-south facility for bicyclists in the area.

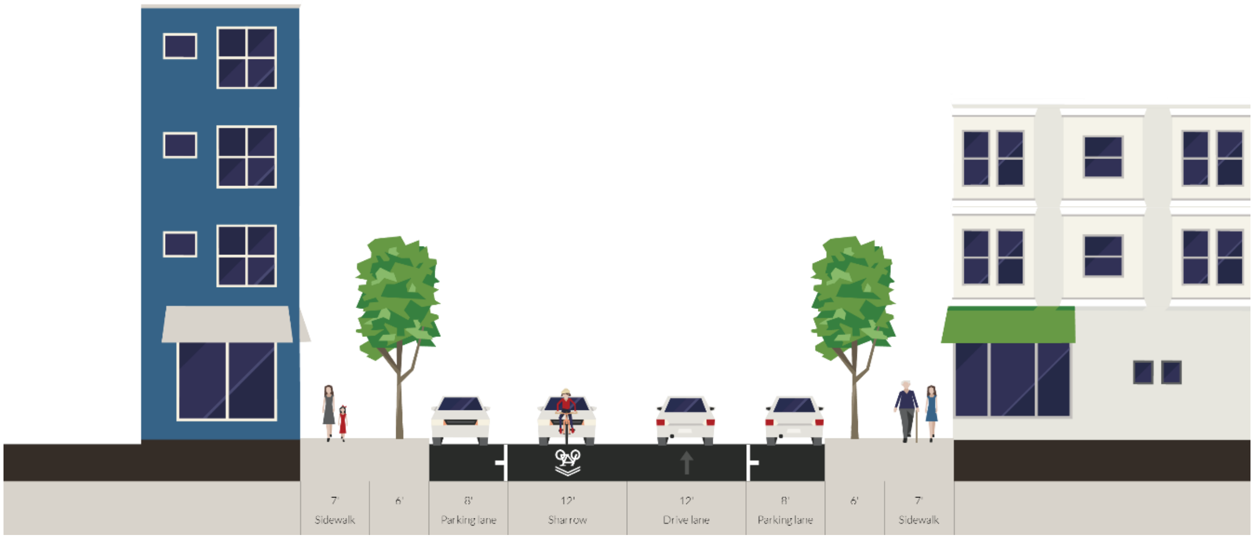


Figure 1: Roadway Alternative 1 Cross Section

Alternative 2 – Roadway Reconstruction with Bicycle Facilities on Main Street

The second roadway alternative proposed for Main Street also includes the reduction of curb lines to 40 feet and will reduce travel lane width to 11.5-feet and increase pedestrian space to 11-feet. The prominent difference is that a two-way 10-foot wide protected cycle track with a 3-foot buffer is proposed on the east side of the roadway. This facility forces parking to only be located on one side of the road and slightly narrows the pedestrian and streetscape amenity zone compared to Alternative 1. A cross-section of this alternative is shown in **Figure 2.**

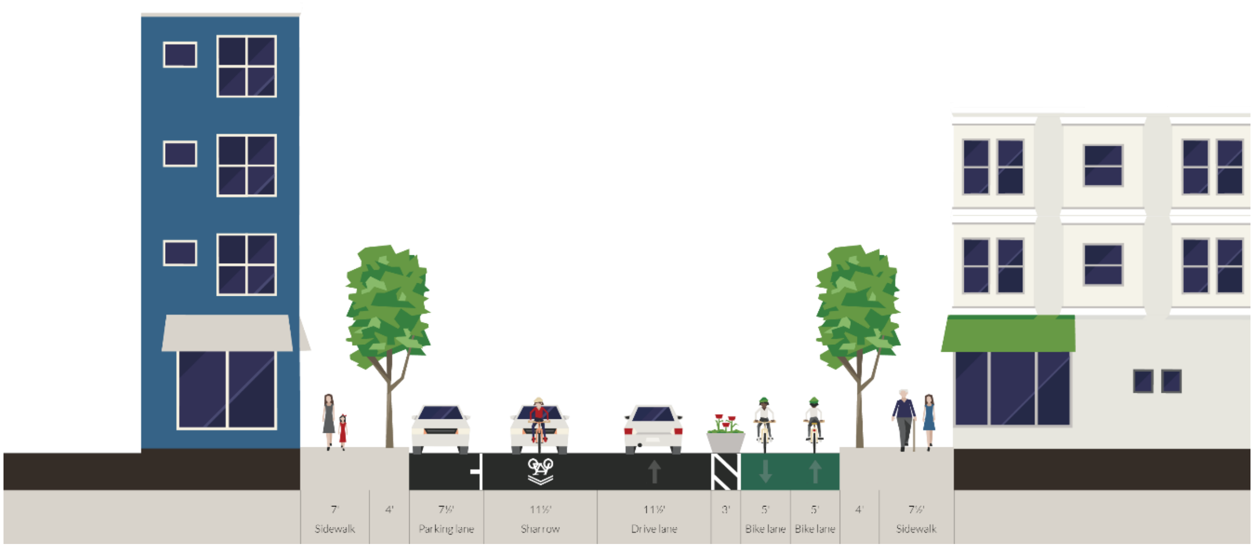


Figure 2: Roadway Alternative 2 Cross Section

The two roadway alternatives were presented to the public at a joint meeting of the Winooski Planning Commission and Public Works Commission. After gathering input from these interested parties, it was suggested that a hybrid of these two alternatives be developed as a potential preferred alternative. This alternative is described in Section 5.1.3.

4.1.4 Power Distribution

VHB has worked closely with Green Mountain Power (GMP) and Consolidated (formerly Fairpoint) to evaluate various alternatives to the current utility poles located along the length of the corridor. The following alternatives were evaluated and the preferred alternative is discussed in Chapter 5.

Alternative 1 – Undergrounding of 34kV line along Main Street

This alternative involves the relocation of the current overhead 34kV power line to an underground corridor beneath Main Street. It would be buried under the roadway and sidewalks and would provide service connections along the corridor. Vaults would be placed above ground and strategically placed in order to reduce the amount of wire needed and improve efficiency in power distribution. Because the 34kV line would serve as both distribution and transmission lines, and be located underground, the equipment associated with this Alternative is expensive. Furthermore, space is limited within the Project Limits to house the large switchgears and transformers, and configuration of the switchgears may not match the future needs of the corridor.

Alternative 2 – Relocation of 34 kV Power Lines to Weaver Street with 15kV Power on Main Street

This alternative involves the relocation of the current overhead 34kV lines to Weaver Street between West Spring Street and Tigan Street. A new 15kV underground line would be installed beneath Main Street between West Spring and Tigan Streets. The 15 kV line would be buried under the roadway and sidewalks and would provide service connections along the Main Street corridor. Vaults would be strategically placed above ground in order to reduce the amount of conductor needed and to improve efficiency in power distribution. The lines are currently mounted on poles owned by GMP and Consolidated and located in the City's Right-of-Way. The owners are responsible for the cost associated with relocating the 34kV line onto poles along Weaver Street.

Alternative 3 – Undergrounding of 34kV line along Main Street with 15kV Power on Main Street

This alternative involves the relocation of the current overhead 34kV power line to an underground corridor beneath Main Street. The power line would be buried under the roadway and sidewalks as with Alternative 1; however, it would only be a bypass transmission line. In addition to the 34kV transmission line, a 15kV distribution line would also be installed underground to provide service connections along the corridor. Vaults would be placed strategically above ground to reduce the amount of conductor needed and improve efficiency in power distribution. Because the 34kV line would be located underground, the equipment associated with this Alternative is relatively expensive (similar to Alternative 1).

4.2 Design Criteria

Table 4 provides a description of the planning and design criteria used for the development and evaluation of the alternatives for this project.

Table 4: Design Criteria

	Main Street	Standard Reference
AADT (2016)	14,000	
Functional Class	Principal Arterial	
Posted Speed Limit	25 mph	
Stopping Sight Distance	155 feet	(1)
Lane Width		(1)
Minimum	10 feet	
Existing	14 feet	
Planting Strip Width		(2)
Minimum	5-8 feet	
Existing	0-5 feet	
Sidewalk Width		(2)
Minimum	5 feet, 8-10 feet preferred	
Existing	5 feet	
Bicycle Lanes	Minimum: 4 feet	(2)
Water Main Line Size	8-inch	(3)
Sewer Main Line Size	8 - 12-inch	(4)

(1) *A Policy on Geometric Design of Highways and Streets, 6th Ed.* American Association of State Highways and Transportation Officials, Washington, DC. 2011.

(2) *Vermont Pedestrian and Bicycle Facility Planning and Design Manual,* Vermont Agency of Transportation, 2002.

(3) *Vermont Water Supply Rule,* Agency of Natural Resources Department of Environmental Conservation, 2010.

(4) *Wastewater System and Potable Water Supply Rules,* Agency of Natural Resources Department of Environmental Conservation, 2007.

4.3 Maps

Roadway alternative sections and sample conceptual plans can be found in Appendix F.

4.4 Environmental Impacts

As part of the initial phase of this project, an Environmental Report was developed for the Vermont Drinking Water and Groundwater Protection Division. A summary of this report is provided in this section and the full report can be found in Appendix C.

There are no major impacts to existing environmental resources in the area. No construction is planned to occur in a Class II or III Wetland, nor in a floodplain or Flood Hazard Area. There are no streams within the project area which will be altered in any way. The Northern Long-Eared Bat was listed in the area with one potential bat roosting tree in the project area. This will be taken into account when construction occurs and a full description of the impact to the endangered species can be found in Section 1.2.6. Wild and Scenic Recreational Rivers, as well as Public Lands are located near the project site but not within, therefore no impacts to these areas are anticipated. Overall, no adverse impacts on nearby environmental resources are expected to occur as a result of this project.

According to the Vermont Stormwater Manual, this project is considered a "Redevelopment Plus Expansion" linear transportation project. These standards require that run-off from all new impervious surfaces must be treated before being discharged. Therefore, positive impacts on stormwater discharge are anticipated due to the inclusion of on-site stormwater treatment being proposed in the form of rain gardens.

4.5 Land Requirements

The majority of Winooski Main Street Reconstruction Project is occurring within the existing Right-of-Way (ROW) but some utility work will require temporary or permanent access to currently private property. With the installation of new water, sewer, electrical, and telecommunication, service connections will need to be made to all customers which involves temporary access to their property from the main lines. Along with the service connections, the underground electrical and telecommunication lines will periodically need to daylight to transformers and vaults. These areas have been conceptually sited and are located on approximately 15 different private properties along the corridor.

In addition to the utility work occurring outside of the ROW, it is proposed to modify the radius of the curb at the northwest corner of the intersection of Main Street and Tigan Street. This shift in the curbline helps to accommodate truck turning movements while maintaining a reasonable crosswalk distance for pedestrians. When this curbline is shifted, it requires the current property owner to close their driveway on Main Street and provide access from Tigan Street instead. This can be seen on Sheet 10 of the Proposed Project Conceptual Plans in Appendix F.

4.6 Cost Estimates

Probable cost estimates were calculated using unit costs developed using VTrans cost estimating resources, research of previous projects, and construction bids containing similar materials and construction requirements. The costs related to particular project elements as well as a final cost for each alternative are shown in **Table 5**.

As noted in Section 4.1.3, a hybrid of the two Roadway Alternatives was selected as the Preferred Alternative, which is described in Section 5.1.3.

As noted in Section 4.1.4, Power Alternative 1 was dropped from consideration due to its relatively high cost and difficulty in locating and configuring large electrical equipment, and is therefore not included in Table 5. Power Alternative 2 was selected as the Preferred Alternative because of its lower cost than Alternative 3.

Table 5: Alternative Cost Estimates

	Roadway Alternative 1	**Roadway Alternative 2**	**Power Alternative 2**	**Power Alternative 3**
Materials	$10,884,500	$12,534,500	561,361	$651,238
Engineering and Design	$1,632,675	$1,800,175	$541,980	$732,011
Resident Engineering	$1,088,450	$1,253,450	N/A	N/A
Mobilization & Traffic Control	$1,587,675	$1,835,175	N/A	N/A
Contingency	$2,721,125	$3,133,500	N/A	N/A
Total [8] (Rounded)	**$18,000,000**	**$21,000,000**	**$1,300,000**	**$1,622,000**

[8] Total under Power Alternatives includes surcharges, from which the City may be exempt.

4.7 Non-Monetary Factors

The intent of this project is to improve the built environment along the Main Street corridor and, in turn, improve the quality of life surrounding this corridor. In addition to the many advantages associated with the project, there are also non-monetary disadvantages to the project. The following is a brief description of various advantages and disadvantages to the project which cannot be described by a monetary value.

Advantages

- Lowered likelihood of water or sewer main leakages
- Increased safety for cyclists and pedestrians
- Improved urban forest
- Increased community engagement with public outreach process

Disadvantages

- Project construction spans multiple construction seasons causing disruptions to daily traffic and business operations
- Increased maintenance responsibility
- Fewer on-street parking spaces

5

Proposed Project

5.1 Preliminary Project Design

5.1.1 Water and Sewer

Following a review of the existing water and sewer main conditions, an evaluation of projected peak wastewater flows, and a review of available fire flows, the recommended water and sewer improvements involves a complete replacement of piping, summarized as follows:

- Full replacement of the water distribution system on Main Street with 8-inch diameter ductile iron piping and new water services from the main to the edge of the Right-of-Way (ROW). The project will also include replacement of main line valves and fire hydrants as well as a pressure reducing valve in a concrete manhole. Due to the presence of contaminants in the soils, the ductile iron pipe will be treated with a zinc coating, installed with Viton gaskets and wrapped in polyethylene.
- Full replacement of the sewer collection system with 8-inch and 12-inch diameter SDR 35 PVC piping, new manholes and new sewer services from the main to the edge of the ROW. It is anticipated that the majority of the new sewer lines will be 1-2 feet lower than the existing sewer lines, in order to achieve required vertical separation from water mains and services. As a result, the project may include constructing additional manholes at the side street interconnection locations.

Since both water and sewer are being replaced with open trench construction, and the entire road is being reconstructed, there is more flexibility in the locations of the new water and sewer mains compared to a situation where there is an existing utility that is not be relocated.

The location of the water and sewer lines are determined based on required separation distances from each other and from other utilities. The project is planned to include gas, telecommunications and electrical lines outside of the roadway limits. Within the 40-foot roadway, measured curb to curb, the underground utilities will include water, sewer and storm drain.

The selected location of the sewer main, as shown in the Roadway Typical Section in Appendix F, is below the 3 feet wide striped separation west of the northbound bike lane. The City selected this location as it is out of the traffic zone, which facilitates maintenance operations. The water main is located west of the sewer main at a location that achieves the 10-foot minimum horizontal separation. At this location, the minimum separation of 5 feet between water main and storm drains is also achieved.

5.1.2 Stormwater

Stormwater is being managed and treated in various ways throughout the proposed project. The proposed design incorporates Green Stormwater Infrastructure as well as traditional stormwater capture methods. Roadway stormwater is proposed to be collected using traditional curb and gutter systems with periodic catch basins along the curb line connected to storm drains varying in diameter from 18 – 30 inches.

Run-off along the sidewalk and landscaped amenity belt is proposed to be treated in 12 rain gardens distributed along the corridor. Rain gardens operate on the principles of treatment and infiltration of water into well-draining soils. The rain gardens will be underlain by perforated underdrain pipes which will collect any water not infiltrated and carry it into the main roadway drainage system. These rain gardens are each 25 feet long and are located between street trees where conditions allow. The gardens were sited in areas where there are no contaminated soils and, in most cases, not adjacent to parallel on-street parking.

In addition to the rain gardens, precipitation and run-off can be treated by passing through the street tree grates into an intricate network of tree planting cells, called Silva Cells, which treat the water using engineered soils and is absorbed by the root systems of the trees.

5.1.3 Roadway

The preferred alternative after technical evaluation and public input is a variation on Alternative 1. The preferred alternative incorporates a curb to curb width of 40-feet, the expanded 13-foot pedestrian area, and an uphill protected bike lane. The inclusion of the bike lane reduces parking and creates the challenge of incorporating parking onto both sides of the street. To accomplish this, the centerline of the roadway will shift so that parking will be able to switch sides of the street. Bicyclists travelling downhill will be made more visible to drivers through the inclusion of shared use lane markings. The proposed cross-sections with parking on either side are showed in **Figure 3** and **Figure 4.**

Figure 3: Preferred Alternative with Westerly Parking

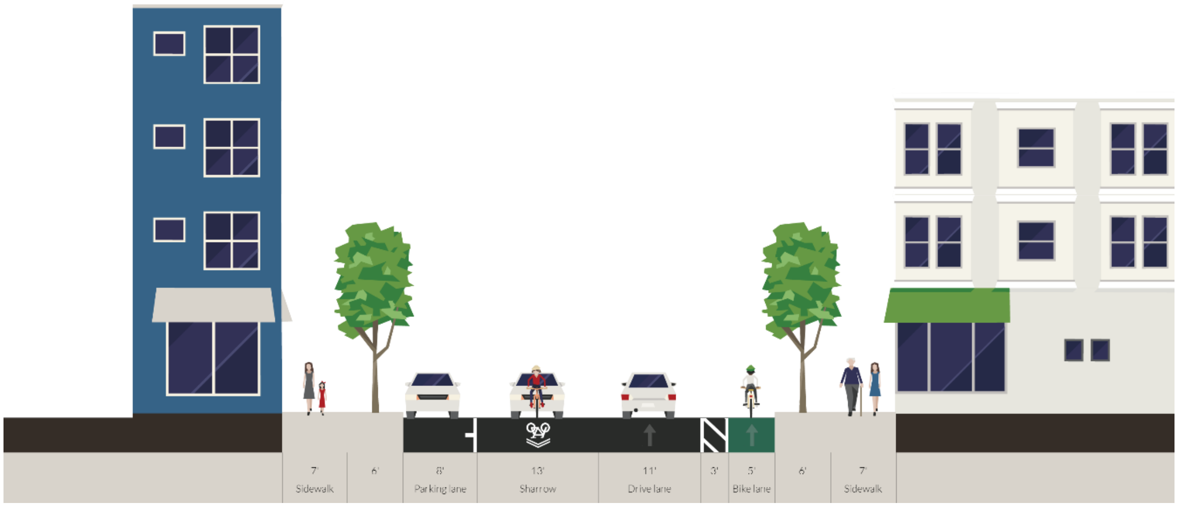
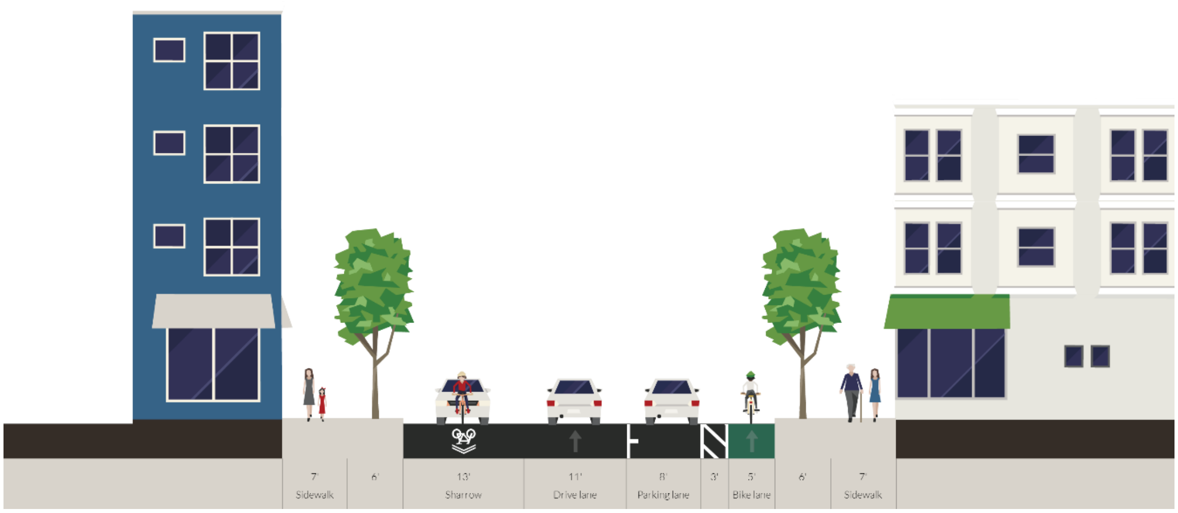


Figure 4: Preferred Alternative with Easterly Parking



5.1.4 Power Distribution

Through discussions with the project team, GMP, and the City, the preferred alternative for power distribution is Alternative 2. This alternative includes the burial of a 15kV line under Main Street with above ground vaults strategically placed along the corridor. The details of the power lines can be found in the Conceptual Plans in Appendix F.

5.2 Project Schedule

The project design and construction schedule has been approximated from an assumed construction start time of Spring 2020. The major milestones along the course of the design and construction documents are outlined below:

- Completion of Conceptual Plans and Estimates – March 2018
- Completion of NEPA Documentation – March 2018
- Completion of Preliminary Plans – November 2018
- Right of Way Acquisition/Easements – November 2018 – April 2019
- Issuance of Permits – June 2019
- Completion of Final Plans – October 2019
- Completion of Contract Plans and Bid Documents – January 2020
- Bid for Construction – February 2020
- Begin Construction – Spring 2020
- End Construction – Summer 2022

5.3 Permit Requirements

An analysis of local and state permits was conducted and the anticipated permits which will be required for this project are summarized in

Table 6**.**

Table 6: Anticipated Permit Requirements and Authorizations

Permitting Agency	Anticipated Permit Requirement
Local Permits from Town Clerk, Zoning Administrator, Planning Commission, or Public Works	Traffic Control Plan
	Excavation Permit
Vermont Department of Environmental Conservation ("DEC") Drinking Water and Groundwater Protection Division	Construction Permit - Public Drinking Water Systems
	Wastewater and Water Supply Permit
DEC Facilities Engineering Division	State-Funded Municipal Water/Sewer Extensions/Upgrades and Pollution Control Systems
	Plan Approval of PER and ER
	Final Design Approval
DEC Stormwater Program	Construction Stormwater Discharge Permit
	Operational Stormwater Discharge Permit
DEC Waste Management and Prevention Division	Corrective Action Plan (anticipated)
DEC Waste Water Management Program	Groundwater Dewatering Permit: 3-9004 (to be determined based on DEC review)

5.4 Sustainability Considerations

5.4.1 Water and Energy Efficiency

Water

As described in Section 2.3, water losses are currently estimated at 12% of the supply. Replacement of the old water mains and any remaining galvanized services lines is expected to decrease water loss through leakage and improve the efficiency of the water system.

Energy

Efficiencies in energy use were considered when determining the final design, particularly in the power distribution lines. Green Mountain Power expressed that they are proposing to use the most up to date and best technology they have in order to produce and distribute power efficiently to their users along the roadway. High efficiency transformers and power downs allow for very little power to be lost in the distribution process.

5.4.2 Green Infrastructure

This corridor is being considered for various green stormwater infrastructure. In order to create a healthy urban forest, the street trees will be grown in Silva Cells which promote larger, healthier, urban trees. These cells use infiltration from sidewalk run-off to water the trees. In addition to the Silva Cell system, rain gardens are being proposed for infiltration along the corridor. The rain gardens will be sited in areas where soils are sandy and conducive for drainage and there are no existing contaminants.

5.5 Total Project Cost Estimate

Costs for the Project have been estimated based on the Conceptual Plans, coordination with utility providers, and discussions with the City of Winooski. The estimated costs have been broken out into five categories to align with potential funding sources. The construction costs associated with the roadway between the curbline were divided amongst the categories which are eligible under Drinking and Clean Water funding sources. There are four utilities in the roadway (potable water, sanitary sewer, and two stormwater lines) so the roadway costs can be broken down into 10-foot wide segments and then allocated as 10-feet of roadway towards potable water costs, 10-feet of roadway towards sanitary sewer costs, and 20-feet of roadway towards stormwater and drainage costs. The five categories are:

- Sanitary Sewer
- Potable Water
- Stormwater/Drainage
- Sidewalks and Landscaping
- Relocation of Overhead Utilities

For each of the five overall categories, the costs have been further broken out into the various components that comprise each category. These components are:

- Construction
- Administrative and Legal
- Engineering and Permitting
- Right of Way Acquisition
- Construction Administration/Inspection

The estimated costs for Construction have been developed by computing the estimated quantities for each aspect of work, and applying unit prices to each item (largely based on VTrans' bid history database). See Appendix E for more detail regarding construction costs. The costs for Engineering and Permitting and for Construction Administration/Inspection for the work associated with stormwater, potable water, and sanitary sewer have been estimated based on the Guidance Document prepared by the Facilities Engineering Division (dated September 1, 2011). In accordance with that Guidance Document, the costs are based on the following formulas (where C = estimated cost of construction):

- Preliminary Engineering = $0.15(0.6788xC^{0.9206})$
- Final Design (incl. Permitting) = $0.30(0.6788xC^{0.9206})$

- Construction Engineering = $0.55(0.6788xC^{0.9206})$

The costs for Engineering and Permitting and for Construction Administration/Inspection for the work associated with the sidewalks and landscaping, and relocation of overhead utilities, is a straight percentage of the Construction costs. Additionally, the remaining costs have been estimated as a straight percentage of the Construction costs. The percentages used for the estimate are: Administrative and Legal (1%), Right of Way Acquisition (1%), Engineering and Permitting (12%), and Construction Observation/Inspection (10%).

The estimated costs for the project are summarized in **Table 7**.

Table 7: Estimated Project Cost Summary

	Construction	Administrative & Legal	Engineering & Permitting	Right of Way Acquisition	Construction Engineering	Contingency	Short Term Interest	Total Cost*
Sanitary Sewer	$1,425,000	$14,250	$142,000	$14,250	$173,000	$142,500	$4,000	$1,950,000
Potable Water	$1,550,000	$15,500	$153,000	$15,500	$187,000	$155,000	$4,300	$2,100,000
Stormwater / Drainage	$3,200,000	$32,000	$298,000	$32,000	$364,000	$320,000	$8,900	$4,300,000
Sidewalks, Streetscapes & Landscaping	$5,525,000	$55,250	$663,000	$55,250	$552,500	$552,500	$15,200	$7,450,000
Relocation of Overhead Utilities	$4,650,000	$46,500	$558,000	$46,500	$465,000	$697,500	$12,700	$6,500,000
Total*	$16,350,000	$200,000	$1,850,000	$200,000	$1,750,000	$1,900,000	$45,000	$22,300,000

*Rounded to the nearest $50,000

5.6 Annual Operating Budget

The current and projected annual operating budgets for the Water Department and the Wastewater Department are shown in **Table** 8Error! Reference source not found. and **Table 9**. As shown, the Fiscal Year 2019 budgeted revenue and expenses for the Water Department are $850,250. For the Wastewater Department (which includes the stormwater system) the revenues and expenses budget for 2019 are $1,050,500.

The projected operating budgets include the following items that increase future expenses:

- Operation and Maintenance costs increasing at 3% annually.
- Additional expenditures for City replacement and reconstruction projects
- Debt repayment associated with the Main Street reconstruction project.

The proposed capital improvements are not anticipated to result in significant additional operating costs, therefore the annual operating costs are anticipated to increase similar to the rate of inflation, at about 3% per year.

The costs for the City's replacement and reconstruction projects is based on the values in the City's Capital Plan.

The cost for debt repayment is based on the total project costs presented previously and proposed financing, as outlined in the following section

5.6.1 Debt Repayments

Funding alternatives utility projects include:

- Municipal Bond Bank
- Drinking Water and Clean Water State Revolving Funds (DWSRF/CWSRF) programs
- United States Department of Agriculture Rural Development (RD) Water and Environmental Programs and Community Facilities grant/loan programs.

The concepts and customer costs outlined in this section represent our interpretation of these different program requirements and should not be considered a guarantee of a grant/loan offer. The City intends to apply for funding through RD, therefore the proposed financing presented herein is based on RD financing.

The United States Department of Agriculture (USDA) administers a Water & Waste Disposal Loan and Grant program for small communities (population fewer than 10,000 people) to complete infrastructure improvement projects for drinking water, sanitary sewer, storm sewer, and solid waste collection. USDA also has a Community Facilities Direct Loan & Grant Program to develop community facilities for communities with population less than 20,000 people.

For the water and wastewater program, funds are disbursed to community projects based on a priority basis, which is determined by RD during the application process. Grant and loan eligibility criteria is determined by a comparison of the community Median Household Income (MHI) compared to the State MHI.

RD uses MHI data from the 2010 American Community Survey, which lists the City MHI as $43,660 and the State MHI as $55,307. The ratio of the City and State MHIs is 79%. Since the City MHI is under 80% of the State MHI ratio, the City could qualify for a grant of up to 75% of the project costs.

To qualify for the maximum 75% grant, the project would need to alleviate a health or sanitary problem. For projects that do not address a health or sanitary problem, grant awards are more commonly 25% to 45% of the project costs for systems, with user rates for a typical residential household (210 gpd consumption) in the range of 1-1.5% of the MHI.

A rate that is 1-1.5% of the City MHI would be $437 to $655 per year. The current rates are $396/yr for water and $497/yr for sewer. The average of the water and sewer rates is about $450/yr which indicates a grant award is feasible for the City.

The low interest federally subsidized loans available through RD loan funding have interest rates that vary based on the household income of the community. The loan term for the sewer projects is limited to 30 years and the loan term for water projects is limited to 40 years.

The three categories of loans available are as follows with rates effective until March 31, 2018:

- Market Rate: 3.5% interest rate if the Median Household Income (MHI) equals or exceeds the current State non-metropolitan MHI.
- Intermediate Rate: 2.75% interest rate if the service area MHI is below the State MHI.
- Poverty Rate: 2.125% interest rate if the service area MHI is less than 80% of the State MHI and the project is needed to meet health or sanitary standards.

The Village MHI is 79% of the State MHI ratio, therefore the project should qualify for the poverty interest rate.

The cost for debt repayment assumes a 30% grant from Rural Development and a 70% loan at an interest rate of 3.125% (as suggested by Rural Development for finance calculation purposes). As shown in **Table** 8, the cost for repayment of a loan for the water improvements is about $64,900 per year. A user rate increase of 7.6% above the current rate is required to fund this additional expense.

As shown in **Table 9**, the cost for repayment of a loan for the wastewater and stormwater improvements is about $226,800 per year. A user rate increase of 21.6% above the current rate is required to fund this additional expense.

These calculated user rate increases for water and wastewater do not account for additional revenue from new users (allocation fees and user fees), or debt relief through additional contributions from reserves. Furthermore, the City would likely increase rates incrementally in the years preceding construction, thereby building additional reserves that would be used to pay down debt. A range of total user rate increases is presented in **Table 8** and **Table 9**. The analyses in **Table** 8 and **Table 9** are not based an official funding determination. The rate and revenue projections should be finalized once a funding offer is received.

Table 8: Water Rate and Revenue Projections

	ACTUAL	BUDGET	PROPOSED BUDGET		
EXPENSE ITEM	**2017**	**2018**	**2019**	**2020**	**2021**
O&M Costs	$699,550	$810,564	$774, 293	$796,807	$820,711
Capital Costs:					
Equipment Purchase	$4,256	$11,200	$1,360		
Replacements	$0	$6,000	$6,000	$6,000	$7,000
Reconstruction Projects	$0	$0	$0		
Debt Service	$0	$49,431	$50,317	$51,233	$27,387
Debt Interest	$13,092	$14,158	$11,282	$10,815	$9,051
Depreciation Expense	$114,229	$0	$0		
Amortization Expenses	$16,421	$0	$0		
Loss of Asset Disposition	$13,362	$0	$0		
Annual Cost New Debt					$64,887
Capital reserve contribution	$35,190	-$50,695	$6,998	-$14,605	-$13,900
Total Expenses	$896,100	$840,659	$850,250	$850,250	$905,172
Revenue	$896,100	$840,659	$850,250	$850,250	$850,250
Additional Revenue required for Main St. water project					$54,922
% Rate Increase for Main St. project					5-8 %

Notes:

1. *Values for 2017-2019 are from the Winooski Water Fund - FY19 Proposed.*
2. *O&M Costs are inflated at 3% per year. The inflation requires a draw from capital reserves if revenues are not increased.*
3. *Capital costs are based on the City's budget and with future capital projects per the Capital Plan limited to control expenses equal to the existing revenue raised by current rates.*
4. *Cost of New Debt is based on a total project cost of $2,100,000, a 70% RD loan with a 2.125% interest rate and a term of 40 years, and a 30% grant.*
5. *A range of rate increases is shown because this table does not account for future allocation fees and user fees from new users, or additional contributions of reserve funds to pay down debt service. Furthermore, the City would plan to increase rates incrementally leading up to year 2021, thereby building reserves which can in turn be used to reduce debt load.*

Table 9: Wastewater and Stormwater Rate and Revenue Projections

	ACTUAL	BUDGET	PROPOSED BUDGET		
EXPENSE ITEM	**2017**	**2018**	**2019**	**2020**	**2021**
O&M Costs					
Wastewater O&M	$552,736	$579,615	$623,178	$641,515	$660,760
Stormwater O&M	$215,791	$287,185	$306,028	$315,904	$325,382
Capital Costs:					
Future WW/SW capital projects				$9,911	$100,991
Plant Improvements	$2,558	$279,000	$127,500		
Equipment Purchase	$5,781	$31,200	$4,250		
Vehicle Purchase			$12,240		
Reconstruction Projects		$170,000	$173,400		
Aeration Bond					
Clarifier Bond		$60,000	$60,000	$60,000	
Depreciation Expense	$301,197				
Debt Principal			$38,186	$15,040	$15,040
Debt Interest and Service	$7,052	$48,296	$8,385	$7,630	$7,148
Annual Cost New Debt					$198,717
Capital Reserve Contribution	$169,025	-$424,796	-$302,667	-$24,293	
Total Expenses	$1,254,141	$1,030,500	$1,050,500	$1,050,000	$1,308,037

Revenue	$1,100,272	$1,030,500	$1,050,500	$1,050,500	$1,050,500
Additional Revenue (Required for Main St. Sewer and Storm Drains)					$266,831
% Rate Increase for Main St. project					12-22%

Notes:
1. Values for 2017-2019 are from the Winooski wastewater and stormwater budget.
2. O&M Costs are inflated at 3% per year.
3. Capital costs are based on the City's budget and with future capital projects per the Capital Plan limited to control expenses equal to the existing revenue raised by current rates.
4. Cost of New Debt is based on a total project cost of $6,250,000, a RD loan for 70% with a 2.125% interest rate and a term of 30 years, and a 30% grant.
5. A range of rate increases is shown because this table does not account for future allocation fees and user fees from new users, or additional contributions of reserve funds to pay down debt service. Furthermore, the City would plan to increase rates incrementally leading up to year 2021, thereby building reserves which can in turn be used to reduce debt load.

The project costs that are not eligible for funding under the Water & Waste Disposal Loan and Grant program may be funded under the Rural Development Community Facilities Direct Loan & Grant Program, as well as through Commercial Lenders. The Community Facilities program offers grants ranging from 15% to 75% of the total project cost, with a maximum grant of $50,000. Based on preliminary discussions with Rural Development, it appears grant funds may not be available for this project but low interest loan funds could be available for the sidewalks, streetscapes, and landscaping.

At the time of issuing this report, the City assumes it will not own the underground infrastructure that would replace the relocated overhead utilities. Therefore, this infrastructure would not be eligible for funding through a Community Facilities Direct Loan. Instead, the City would finance this work through Commercial Lenders.

It should be noted that these financing calculations assume that the City would be responsible for full cost of undergrounding utilities (estimated to be about $6,500,000). Other Vermont municipalities have undergone similar projects with costs of undergrounding utilities shared by the utility owner. The details of cost sharing of undergrounding utilities on this project would be determined during the Final Design and ROW Acquisition Phase.

The cost for debt repayment of a Communities Facilities Direct Loan from Rural Development assumes an interest rate of 3.5% and a term of 30 years. The cost for debt repayment of a Commercial Loan assumes an interest rate of 4.0% and a term of 10 years. As shown in **Table 10**, the cost for repayment of the Community Facilities loan is about $424,300 per year, and the cost for repayment of the Commercial Loan is about $801,400 per year. This debt repayment represents an increase of 18.3% above the current General Fund budget. For a property owner with a home worth $225,000 this represents an increase of approximately $420 per year. The actual rate increase would be lower, as the City expects to generate new forms of revenue through a local options tax on meals, hotels and services, future retirement of existing debt service, and future growth of the grand list. A range of rate increases is indicated in **Table 10**.

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Table 10: City General Fund Effects

	ACTUAL	BUDGET	PROPOSED BUDGET		
EXPENSE ITEM	**2017**	**2018**	**2019**	**2020**	**2021**
Total Expense	$6,049,213	$6,269,886	$6,697,989	$6,700,000	$6,700,000
Annual Cost of New Debt (CF)					$424,319
Annual Cost of New Debt (Commercial)					$801,391
Total Expenses	$6,049,213	$0	$0	$0	$758,480

Total Revenue	$6,672,317	$6,269,775	$6,697,989	$6,700,000	$6,700,000
Additional Revenue (Required for Main St. Streetscape and Utilities Project)					$758,480
% increase					4-12%

Notes:
1. Values for 2017-2019 are from the Winooski General Fund Budget. Values for 2020 and 2021 are assumed.
2. Costs of New Debt is based on a $13,950,000 RD loan with 3.5% interest rate and a term of 30 years.
3. Costs of New Debt (Commercial) is based on a $6,500,000 Commercial loan with a 4.0% interest rate and a term of 10 years.
4. A range of rate increases is show because this table does not account for future sources of new revenue into the General Fund, such as from adoption of a local options tax on meals, hotels and services, future retirement of debt service, and future grand list growth

The analyses in Tables 8-10 are not based an official funding determination. The rate and revenue projections should be finalized once a funding offer is received.

5.7 Potential Construction Problems

Including weather-related delays, there are other circumstances that could arise during construction, particularly in a downtown setting, that would result in additional cost and delay to the project. One such scenario is the presence of previously unidentified underground utilities. Given the complexity of the underground infrastructure improvements, the existence of any unknown underground facilities would likely result in the delay of construction and additional cost to redesign around the anomaly.

Other such scenarios that could add delay and cost to the project include:

- Presence of previously unidentified contaminated soils. Additional testing and management of contaminated soils would add cost and delay to the construction project.

- Traffic management costs. Additional traffic control measures may be necessary during construction to maintain certain traffic demands along the project corridor. These could include, but not be limited to, additional flagging operations and uniformed traffic officers, additional message boards and signs, and temporary construction for detour routes.

- Cost escalation. Increases in material costs, such as steel, fuel and asphalt, would result in a larger construction cost.

- Unforeseen complications in retaining utility services (water, sewer, power, gas, telecommunications) during construction. Short interruptions of some services may be inevitable, but unexpected interruptions can force the City and contractors to address the issue, thereby potentially delaying construction.