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**Chapin Spencer**
Director of Public Works

# Memorandum

TO: Board of Finance

FROM: Chapin Spencer, Director of Public Works
Megan Moir, Assistant Director - Water Resources

DATE: September 5, 2018

RE: **Proposal for a Resilient City** -- Reinvesting in Burlington's Wastewater & Stormwater Infrastructure -- Phase II of Burlington's Sustainable Infrastructure Plan

Burlington has been undergoing a period of substantial revinestment across assets that are vital to keeping Burlington a great place to live, work and recreate. Major progress has been made in repaving streets, rebuilding sidewalks, renovating the Bike Path, and rehabilitating water mains since 2016 when the City Council approved the 10 Year Capital Plan and voters approved two bonds funding the initial years of the capital plan. While reinvestments in our community's wastewater and stormwater systems had been understood to be a future second phase of the Sustainable Infrastructure Plan, this year's multiple system failures at our Main Wastewater Treatment Plant and the public's growing calls for improved stormwater management and green infrastructure have accelerated the development of this proposal. It is time to build on past progress to further reduce Burlington's impact on our waterways and Lake Champlain. Burlingtonians deserve and expect infrastructure that performs to modern standards. We are bringing forward the next phase of Burlington's Sustainable Infrastructure Plan to reinvest in the City's wastewater and stormwater systems in order to achieve those goals.

## Background

Burlington's first wastewater treatment plant (WWTP) was constructed on the waterfront in 1953. North Plant was constructed in 1961 and East Plant in 1963. As was typical of older cities, much of Burlington had only one pipe to carry both sanitary waste and stormwater flow away from the buildings and streets. Anytime the volume in the combined sewer system exceeded the capacity of the wastewater treatment plant (or in some cases the local pipe network) a mixture of stormwater and untreated sewage would discharge to water bodies around Burlington. This was to protect the WWTPs and also to prevent the sewer system backing up into people's homes, but it obviously had

water quality impacts. To this day, there are approximately 860 communities across the United States, like Burlington, that still have combined sewer systems (http://bit.ly/EPAcsos).

Since the construction of Burlington's three WWTPs in the 1950's and 1960's, each generation of Burlingtonians has left a legacy of water protection through major upgrades to the City's wastewater and stormwater management systems. In the 1970's, all three WWTPs were upgraded for additional flow capacity and treatment improvements. In the 1990's, wastewater and stormwater collection systems were separated in the New North End and sections of the Old North End and a wet weather treatment system was added to the Main WWTP. **The time is now for the current generation to make our investment.**

Up until the 1990s, as Burlington grew there were on-shore sewage discharges into the Lake during most rainstorms, and frequent beach closures (http://bit.ly/BacT1990). Burlington voted for a $52 million bond to upgrade the WWTPs to improve phosphorus removal, increase hydraulic capacity, and most importantly to greatly reduce the locations, frequency and volume of untreated CSOs. The number of CSO points decreased from 12 to 5. Additionally, an estimated 170 million gallons of annual wet weather flow was being treated and disinfected at the Main WWTP's wet weather process after 1994 instead of being discharged into Lake Champlain, the Winooski River and Englesby Brook as untreated and undisinfected combined sewer overflows.

Since the 1994 upgrades, the three WWTPs have generally operated in a reliable fashion. Through the 1994 upgrades and subsequent investments since then, the frequency of untreated CSOs in Burlington has declined over time (see Appendix A). In 2016, the Legislature passed Act 86 which mandated more and quicker public communications after CSOs and permit exceedances at WWTPs. As stewards of the lake and public health, DPW Water Resources staff support this transparency. We were one of the first municipalities in the State to install monitoring equipment that provides accurate flow data for our incident reports when CSOs occur.

The additional public notification required by Act 86 and the multiple permit violations at Main WWTP this season have heightened the public's awareness and concern. Main WWTP experienced permit violations resulting from a valve failure, a computer system failure and biological disruptions from high strength industrial waste. These events all occurred during high flow episodes (storm events) and resulted in incomplete disinfection of the sewage component contained within the combined sewer/stormwater flows (while somewhat variable, sewage typically constitutes approximately 5-10% of the total volume of flow during storm events). This resulted in higher than allowable bacteria levels being discharged via the outfall pipe (2600' offshore). Beaches were closed for 48 hours following these events in accordance with Act 86. In addition, there have also been six days with intense storm events causing untreated collection system Combined Sewer Overflows, primarily into the Pine Barge Canal, but also into the Intervale Wetland and the Winooski River on at least one occasion.

With public feedback urging the City to do more to steward our water resources, the Mayor's call to put a reinvestment plan together this fall, and our own commitment to water quality, we have

accelerated the wastewater and stormwater capital planning work that was already underway. As the City Council reviewed in our FY'18 and FY'19 budget presentations, we called out our wastewater and stormwater capital planning and alerted Councilor to significant upcoming reinvestment needs that would necessitate a second phase of the Sustainable Infrastructure Plan. The potable water distribution system was included in Phase I because relining water mains always requires excavations in the roadways and we needed to ensure the water mains were repaired prior to repaving the streets to avoid expensive rework and impact to residents. Relining the wastewater and stormwater lines can happen using existing manholes and therefore does not damage the roadway surface -- providing us with more flexibility on when this work is done.

## Historical Context

DPW staff has put together a water quality history document that provides additional background on the City's wastewater and stormwater management over time. This document can be viewed here: https://www.burlingtonvt.gov/DPW/Water-Quality-History.

## Proposal for a Resilient City -- Wastewater Improvements

Overall, Phase II of the Sustainable Infrastructure Plan proposes approximately $20M of investments into existing Wastewater infrastructure including the City's wastewater treatment plants, pump stations, collection system and pollution prevention programs. The various components of the investment are detailed below and are summarized in Appendix B.

**WWTP Disinfection Upgrades** -- The disinfection systems provide chemical treatment to ensure bacteria levels in the plant's effluent remain low. While we have replaced significant disinfection equipment since the 1994 upgrade (including all disinfection pumps and pump drive controllers at Main WWTP), critical pieces of equipment that are original to the upgrade 24 years ago remain in service. Three different failures in our plants' disinfection systems led to discharges that exceeded permit limits this season:

- April 16 - valve failure at Main WWTP
- July 10 - programmable logic control (PLC) failure at Main WWTP
- August 24 - feed line blockage at North WWTP

The 2017 Dubois & King Wastewater 10 Year Capital Plan identified the need to upgrade key components of the disinfection systems in FY'21. After the July 10 PLC failure, DPW Water Resources engaged two outside teams to refine and detail the recommendations so implementation could be expedited:

- Hallam ICS provided cost estimates on rehabilitating Main Plant's overall SCADA/PLC control system since the larger system is also original to the plant and in need of upgrades and we want to make sure that our upgrade of the disinfection PLC is compatible with a future global PLC upgrade.

- Dubois & King refined their rehabilitation recommendations of Main Plant's other disinfection system's equipment (pumps, drives, valves, feed lines, etc.) and evaluated the disinfection systems at North and East WWTPs as well.

For the capital upgrades, full redundancy, automatic run sequences, and PLC failure alarms will be mandatory functionality. The upgrades are projected to cost $1,438,000 and are itemized in Appendix C.

**Other WWTP Upgrades** -- The City's three WWTPs are complex industrial facilities with multiple chemical, biological and mechanical processes. The disinfection system described above is just one of many essential systems that must all function together to discharge the high-quality effluent Burlingtonians demand. As mentioned in the introduction, our plants have been upgraded once a generation since they were constructed in the 1950's. It has been 24 years since the last comprehensive upgrade. DPW Water Resources had proactively prepared for the next major re-investment by completing the Wastewater 10 Year Capital Plan in 2017 and providing forecasts of upcoming capital expenditures at the FY'18 and FY'19 City Council budget presentations. Despite this proactive work, recent failures of the plants' aging equipment has caused three permit violations at our WWTPs (described above) and resulted in beach closures, and an erosion of the public trust in our stewardship of Burlington's water resources. As a result of these incidents, DPW Water Resources is proposing to accelerate our reinvestment efforts and timelines. Dubois & King was re-engaged in July to refine a number of the 10 Year Capital Plan estimates. Additionally, Water Resources Engineers and Managers reviewed and supplemented the capital projects list based on recent failures and issues. The 28 upgrades across the three WWTPs, including final design, construction oversight and construction inflation costs where appropriate, are projected to cost $11,403,000 and are itemized in Appendix C.

**Pump Stations** -- Pump stations push wastewater towards the City treatment plants from low areas of the system where wastewater cannot reach the plant using gravity alone. Most of the City's sewer system is gravity-fed, but there are 25 areas that are lower than the main gravity system and must drain to a pump station which then pumps the wastewater up to the gravity-based network. Some of the current pump stations are over 50 years old and reinvestment in them has been minimal over the past decades. In past years, pump station failures have led to discharge of wastewater into adjacent water bodies and surfacing onto roadways and private property, and such events are likely to increase in future years without proactive investment. Engineering firm Dubois & King conducted an assessment of the pump stations in in 2016-2017 to determine their deficiencies and likelihood of failure. Staff then evaluated the consequence of failure for each pump station to determine the overall prioritization. Phase II of the Sustainable Infrastructure Plan proposes to make substantial repairs to 10 highest risk pump stations and one leachate pump station which collects leachate from the City's old Manhattan Landfill and pumps it to Main Plant. These investments will improve the reliability of the pump stations and reduce the risk of wastewater from the collection system flowing into water bodies, streets etc. The upgrades to these 11 pump stations are projected to cost $2,595,000 and are itemized in Appendix D.

**WW Collection System Rehabilitation** -- The Wastewater collection system collects sewage that comes from customers' private sewer laterals and carries it to the City's three municipal wastewater treatment plants. There are 46.5 miles of sanitary sewer pipes (wastewater only) and 46.6 miles of combined sewer pipes (wastewater and stormwater). While we do not have a comprehensive age inventory on our sewer collection system, many sewers are over 100 years old. Some of the oldest 'pipes' are constructed of brick and after intense storm events we find bricks among the screenings at the Main WWTP -- indicating that these combined sewers are falling apart. Failures in the collection system have led to discharge of wastewater into adjacent water bodies, sinkholes, backflow into adjacent buildings, and surfacing onto roadways and private property. In 2017, DPW Water Resources began a systematic assessment of the collection system and to date 20% of the system has been inspected by independent firms. Based on these inspections, past failure locations, and other proposed capital projects in the City's rights-of-way, staff has prioritized the list. Phase II of the Sustainable Infrastructure Plan proposes to reline or replace 6.7 miles of the highest priority sections (pipes marked as needing short term rehabilitation in the map in Appendix E) in the collection system at a projected cost of $3,360,000.

**Pre-Capital Investment Planning Studies** -- There are two upcoming Wastewater capital investments that are not included in this Phase II proposal and require additional planning work to determine the optimal design solution.

- Sludge Dewatering -- The Main WWTP has presses that dewater the residual sludge -- the solid byproduct of the various treatment processes at the plant. Currently, sludge from all three plants is brought to the press room at Main WWTP where it is partially dewatered and then trucked to upstate New York where it is neutralized with lime and land applied. We seek to evaluate other options for multiple reasons: the presses at Main WWTP are nearing the end of their life; there are other emerging process and re-use options for Burlington's sludge; a number of Burlington businesses are generating significant organic waste that might make a digester feasible; and the current hauling and disposal costs (~$750,000) are significant and could fund other solutions.
- East Plant Process Evaluation -- Due to the characteristics of the influent at the East Plant, there may be benefits to modifying the existing process to a sequenced batch reactor (SBR) process. Before reinvesting in certain systems at East Plant, we seek to complete a third party evaluation of the process alternatives. It is important to note that the capital upgrades in this current proposal are for elements of East Plant that would remain even if the Plant were converted to a different type of treatment plant.

Phase II of the Sustainable Infrastructure Plan proposes to dedicate $180,000 to completing these two planning studies which are itemized at the bottom of Appendix C.

**Industrial Wastewater Program** -- Over the past 4 years, the organic content of the influent at Main WWTP has increased (see figure 1 below), which is due to increased high strength waste from commercial customers that handle or produce organic matter -- mainly beverage and food industries. The variable and high strength waste can disrupt the biological process of a WWTP, and this is what occurred at Main WWTP on June 2 & 4 when the plant's discharge exceeded permit limits. Breweries and cideries have been assessed a high-strength waste (BOD) surcharge since

2013 to cover the additional costs of processing their high-strength waste, but given the increasing BOD trends overall and the continued increase in brewery/cidery flow, in late 2016 Burlington Water Resources began to develop a more robust pre-treatment and pollution prevention program that would reduce the strength of the influent received at our WWTPs. The June 2 & 4 incidents demonstrated the urgency of this work, and since then we have contracted with Hoyle, Tanner & Associates to assist us with program development and have procured flow monitors and sampling equipment to initially install at the largest producers. Phase II of the Sustainable Infrastructure Plan proposes investing $425,000 to accelerate the program development and implementation, and potentially provide pass through loans (up to $250K) to commercial customers for their development of pre-treatment or side-streaming systems. The City values the vibrant beverage and food production industries and this program would give us the tools to partner with these producers in a way that allows them to flourish while ensuring the protection of the City's water resources.

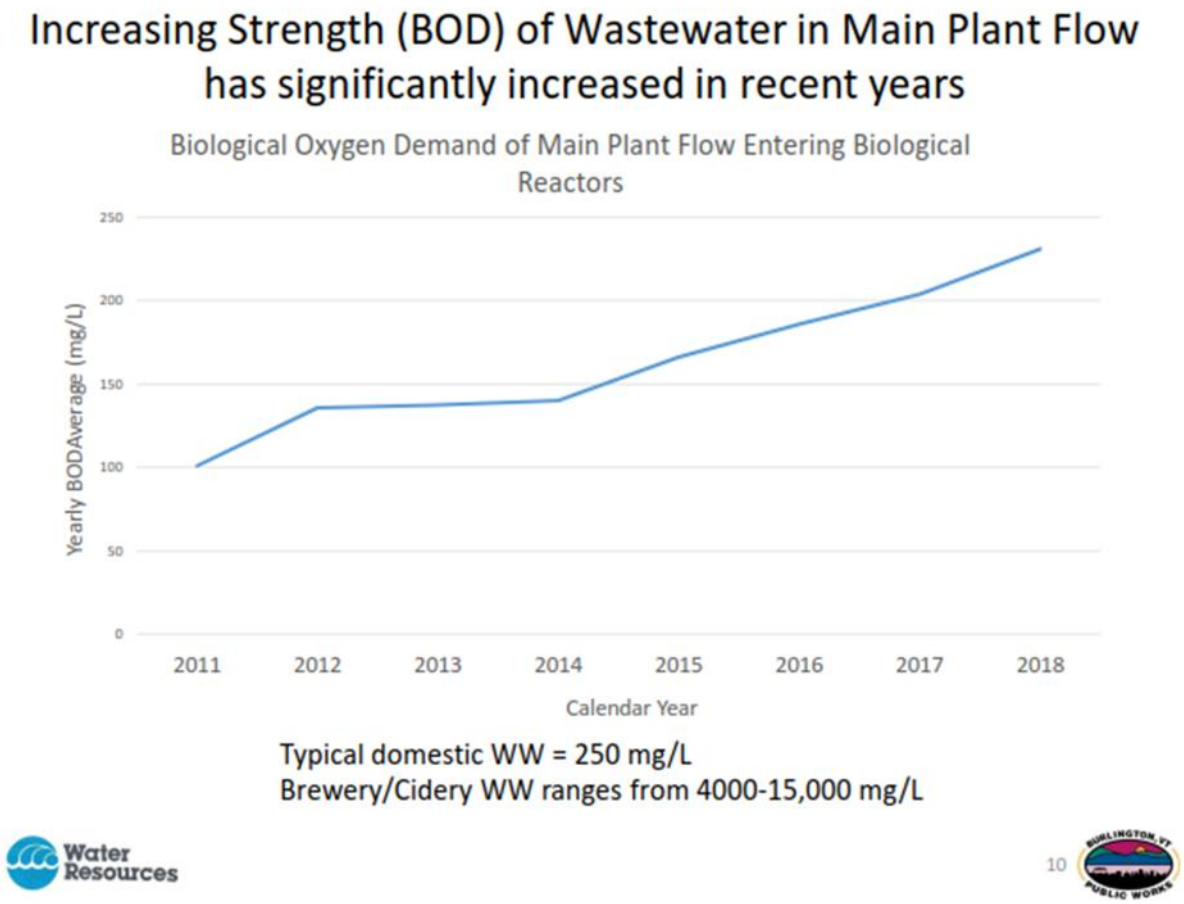



Figure 1: Increasing trend in strength (BOD) at Main WWTP

## Proposal for a Resilient City -- Stormwater Improvements

Phase II of the Sustainable Infrastructure Plan proposes approximately $10M of improvements to the City's stormwater infrastructure including construction of a diverse array of new green

infrastructure, repair of existing failing stormwater outfalls and rehabilitation of stormwater pipes. The various components of the investment are described below and are detailed in Appendix B.

**Stormwater Outfalls** -- Stormwater outfalls are the points where the separate storm system discharges stormwater into the City's watersheds. There are 101 outfalls in the City that are in various states of repair. Failing outfalls erode public and private property, undermine buildings and roads, and release sediment and nutrients into water bodies during storm events. 11 of the City's 101 outfalls have failed and have high risk of impact. Phase II of the Sustainable Infrastructure Plan proposes to invest $2.3M to repair the top 5 outfalls as detailed in Appendix F.

**Stormwater Collection System Rehabilitation** -- The separate stormwater collection system transports stormwater from catch basins to outfalls. The City has approximately 53.1 miles of separate stormwater pipes and 3,200 catch basins. Failures in the collection system undermine roadways and utilities, create sinkholes, and release sediment and nutrients into water bodies. A GIS based risk analysis, using estimates of likelihood of failure based on pipe material (with corrugated metal pipe having a very high likelihood) and recent collapse history and consequences of failure (with a focus on recently paved streets or streets that are soon to be paved, heavy traffic volume streets etc), identified approximately 6.3 miles of the stormwater collection system in need of relining or replacement at a cost of $3.1M. The high-risk pipes are identified in Appendix I.

**Wet Weather Mitigation on Combined Sewer System** -- The City has approximately 46.6 miles of combined sewer and stormwater collection system. Most of Burlington's combined sewer system connects to our Main Wastewater Treatment Plant. During intense storm events, the amount of stormwater entering the system can exceed the pipes' hydraulic capacity in the collection system causing combined sewer overflows (CSOs) at one or more of the City's 5 remaining overflow points. These high flows can also exacerbate any process or equipment challenges at the main WWTP. Strategies to reduce the quantity and the intensity of stormwater flows in the combined collection system include: rain gardens, soil cells for street trees, stormwater ponds, subsurface infiltration and detention tanks, pervious pavement and pavers, downspout disconnection, etc. Where possible, Burlington prefers implementation of green wet-weather infrastructure to maximize benefits to the community, since green infrastructure not only manages stormwater runoff, but also adds more green space, shading, pedestrian/biking accommodations, and property value improvements than typical "grey" infrastructure (storage tanks). Phase II of the Sustainable Infrastructure Plan proposes to invest $3.3M in combined sewer stormwater reductions, with an emphasis on green infrastructure including:

- Supplementing TIF funding to install extensive green infrastructure on rehabilitated downtown streets consistent with the City's adopted Great Streets Standards
- Implementing other combined sewer reduction efforts in the Main WWTP sewershed, with focused reductions above the Pine Street CSO point

The potential combined sewer mitigation projects are listed in Appendix G. Additionally, because mitigating CSO frequency at the Pine Street Barge Canal CSO outfall is challenging due to soil/geologic conditions in the sewershed, approximately $500,000 in additional funding is set

aside to explore the installation of a remote disinfection station at this CSO location to address potential bacteria concerns downstream in the near term.

**Separate Stormwater Management** -- Heightened State regulation will require parcels over 3 acres to complete an engineering feasibility analysis to reduce stormwater impacts in the short term and implement retrofits in the medium-term (3-5 years). The City has a number of parcels over three acres, many of them parks, and we need to be proactive to ensure we develop designs that will provide the greatest return on investment. Phase II of the Sustainable Infrastructure Plan proposes to invest an initial $315,000 towards addressing this upcoming regulatory requirement that will further protect Burlington's waterways. The specific parcels are detailed in Appendix H. Additional funds will be necessary beyond 2023 once the permits are in place and the new regulatory requirements are clear.

## Proposal for a Resilient City -- Overall WW & SW Improvements

**Asset Management** -- A robust asset management program is critical to ensuring the maximum lifespan of each City asset and to improving our capital funding need forecasting ability. Capital upgrades are expensive and can be minimized and anticipated through preventive maintenance and scheduled assessments. In the public sector, it is often easier to secure funding for periodic capital upgrades than ongoing preventative maintenance; this lack of regular maintenance can lead to premature failure of public assets and an expensive cycle of borrowing to fix broken systems. A good asset management program can deliver the lowest cost of ownership of an asset over time while also providing real-time data and metrics so policy makers can make the best decisions possible. As a component of the Sustainable Infrastructure Plan, DPW has been leading an effort to develop a formal asset management program so that we can derive the greatest long-term value from our capital investments. The department has commissioned at third party report that is nearing completion and is expected to include recommendations for enhancing DPW's current asset management systems and abilities which vary considerably across asset classes. Phase II of the Sustainable Infrastructure Plan includes $346,000 for to acquiring and implementing a Computerized Maintenance Management System (CMMS) as a critical component of the City's asset management efforts if the Council approves moving forward with enhanced asset management after reviewing the report.

**Staff Capacity** -- Implementing $20M of wastewater improvements identified above will require project management resources. Existing Water Resources staff capacity is already stretched tackling a number of other areas of deferred investments and attention while also maintaining our 24/7 operations. Other areas of increased attention include:

- Managing expanded Water capital projects from November 2016 voter-approved bond
- Implementing meter-to-cash improvements following billing errors discovered in 2017 and 2018
- Managing the first-in-the-State Integrated Planning process while negotiating updated wastewater and stormwater permits

- Coordinating Water Plant operations around Burlington Harbor Marina construction
- Reviewing and coordinating with numerous large construction projects (CityPlace Burlington, Cambrian Rise, 85 North Avenue, Great Streets)

The complexity of Water Resources' regulatory and operational landscape has increased significantly over the last decade. To position the division for long-term success, DPW leadership is proposing a third-party organizational assessment that would provide structural and staffing recommendations. We will be seeking Board of Finance approval for this contract amendment at this upcoming Board of Finance meeting. While these specific recommendations won't be complete for the next 3-4 months, Phase II of the Sustainable Infrastructure Plan proposes a placeholder of 1.25 FTEs for engineering / project management support to manage the $30M of capital and programmatic projects.

## Requesting Authorization to Borrow

**Proposal** -- In summary, we are seeking authorization to finance up to $30M to reinvest in the City's wastewater and stormwater systems as detailed in this memo and the appendices. The recommendations have come from the 2017 10-Year Capital Plan completed by Dubois & King, first hand knowledge of Water Resources managers and engineers, and supplemental review by multiple consulting firms. Based on the secured rate mitigation strategies detailed below, we have been able to reduce the impact on ratepayers by approximately 40% -- and additional means of mitigating the impact are being vigorously pursued which is likely to further reduce the impact of the proposed bonding.

**Rate Mitigation Strategies** -- Below are the many strategies we are, or will be, pursuing to reduce the impact on our ratepayers.

- Secured
    - <u>Utilize Clean Water State Revolving Fund (SRF) Loans.</u> Borrowing from the State Revolving Fund has a number of advantages. The interest rate/admin fee is only 2% compared to 3.9% or more for municipal bonds. In addition, there is a deferred pay back on planning, design and construction expenses until 1 year after construction is completed. The interest savings, if the full $30M is borrowed, would likely exceed $8M over the life of the loan.
    - <u>Re-allocate existing Water Resources revenues to offset some debt service costs.</u> Through careful financial oversight, DPW management has been able to methodically increase the capital funding in the annual wastewater and stormwater budgets over the last several years. By dedicating a portion of the budgeted capital funds (what we call "PayGo Capital") to debt service, we can accelerate reinvestments into these utilities while minimizing bond-driven rate increases. By reallocating an estimated annual $237,000 in currently budgeted wastewater PayGo Capital and an estimated $285,000 in currently budgeted stormwater PayGo Capital approximately 30% of the new bonding will be paid for by existing revenues.

- Unsecured
    - Pursue State grants/loan forgiveness subsidy
    - Determine whether TIF-funded projects have sufficient TIF funding to cover stormwater improvements without this Water Resources bonding
    - Evaluate alternative strategies to current PILOT paradigm
    - Explore having the General Fund pay the stormwater fees for the impervious surface within the City's rights-of-way
    - Consider additional fees for service from users of services (fire services to buildings, project review, connection fees)
    - Explore minimizing rate increases for residential and low-income users through alternative rate structures or affordability programs

**Additional Needed Investments** -- While this Proposal for a Resilient City is a broad package of wastewater and stormwater upgrades, it must be acknowledged that this is not all inclusive -- and additional water resource-related capital investments will likely be needed in the future including:

- Potential sequenced batch reactor installation at East WWTP
- Dewatering and/or digester upgrade at Main WWTP
- Additional stormwater retrofits on 3+ acre municipal parcels as required by future permit conditions
- Additional phosphorus reduction strategies at our WWTPs and in our stormwater system that are currently being evaluated as part of our integrated water quality planning effort and as required by future permit conditions
- Potable water infrastructure upgrades

## What Residents & Businesses Can Do

CIty government alone cannot fully address our community's wastewater and stormwater challenges. There are many steps property owners, residents and business can take to help.

- **Stop private property stormwater from entering the municipal sewer:** Property owners can substantially reduce flows into the combined sewer by disconnecting downspouts and basement drains from the combined sewer. DPW Water Resources has worked with partners such as the CCRPC and Lake Champlain International to provide community resources such as Rethink Runoff (http://rethinkrunoff.org/) and Blue certification program https://www.burlingtonvt.gov/DPW/BlueBTV).
- **Install water saving devices:** Low-flow showerheads, faucets and toilets both reduce water usage and reduce wastewater flows -- which also saves ratepayers money.
- **Scoop your pet's poop:** Dog poop is a major contributor to stormwater pollution and bacteria in our waterways. Rain and melting snow flows across yards, dog parks, down trails, etc. on its way to creeks via our streets and storm drains. Dog poop contains bacteria and is high in nitrogen and phosphorus (nutrients that negatively affect our waters). Picking up a pet's poop is a simple step we can take take to reduce stormwater pollution.

- **Learn more about Burlington's water quality journey:** DPW Water Resources has put together an online resource providing a history of wastewater and stormwater investments. Read it here: https://www.burlingtonvt.gov/DPW/Water-Quality-History

Thank you for your consideration of this request.

# APPENDIX A

## Frequency of CSO events

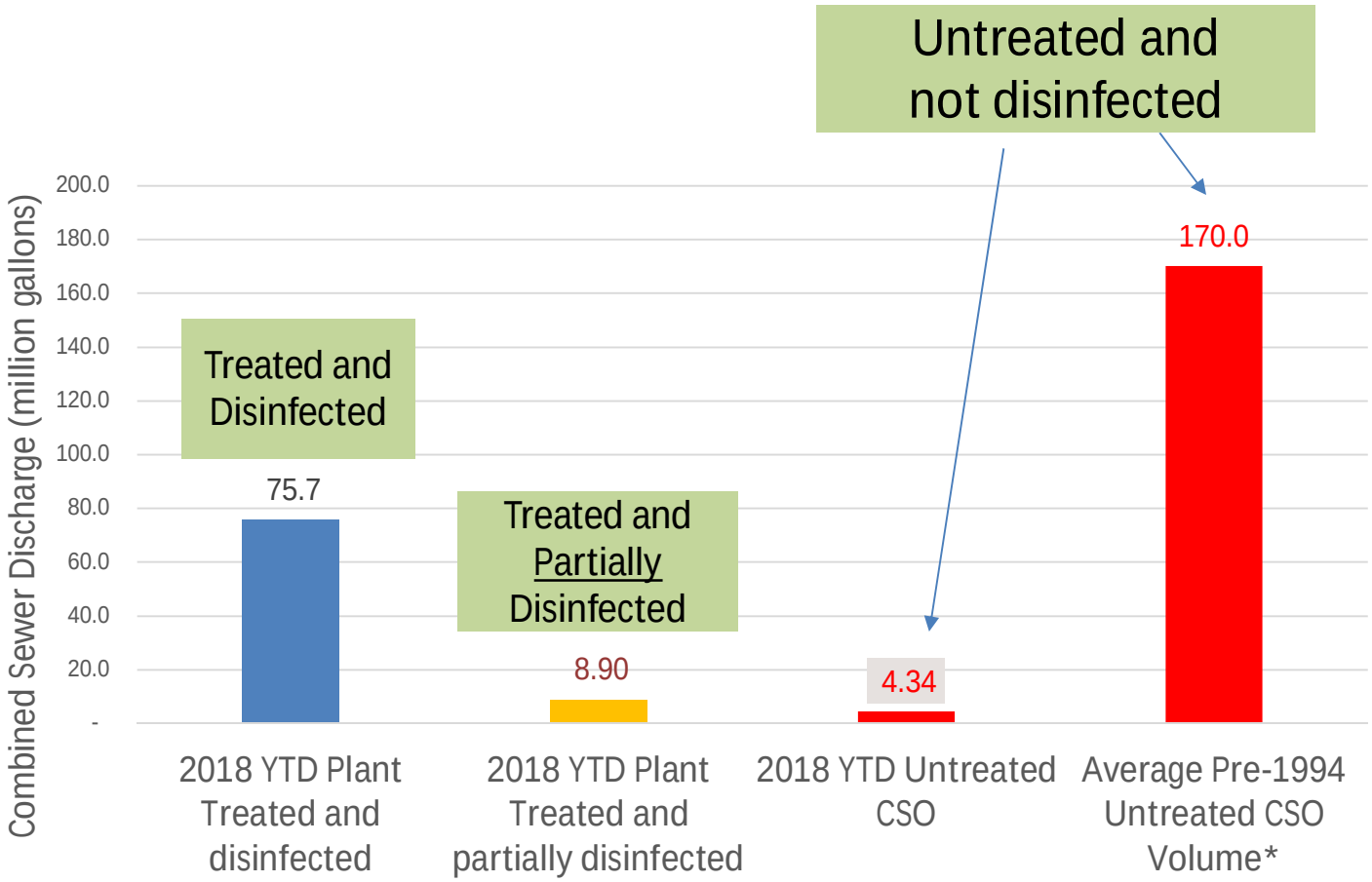
| Year | N. Champlain | Park | Gazo | Colchester | Pine Street | Notes |
|---|---|---|---|---|---|---|
| 2005 | 3 | 12 | 1 | UNK | UNK | |
| 2006 | 1 | 11 | 3 | UNK | UNK | |
| 2007 | 3 | 8 | 2 | UNK | UNK | |
| 2008 | 2 | 13 | ? | UNK | UNK | |
| 2009 | 4 | 8-9 | ? | UNK | UNK | |
| 2010 | 0 | 5 | ? | 2 | UNK | Colchester Ave CSO discovered through mapping/outfall visits |
| 2011 | 1 | 9 | 1 | 3 | UNK | Gazo, North Champlain and Park frequency and Volume reduced by ARRA projects 2010-2012 |
| 2012 | 1 | 6 | 1 | 9 | UNK | |
| 2013 | 4 | 6 | 2 | 10 - 13 | UNK | Wet year |
| 2014 | 0 | 1 | 1 | 2 | UNK | Colchester CSO improved through pipe cleaning downstream |
| 2015 | 0 | 3 | 1 | 0 | 8 | Pine Street Discovered through mapping |
| 2016 | 0 | 1 | 0 | 0 | 5 | |
| 2017 | 0 | 1 | 1 | 0 | 8 | |
| 2018 YTD | 1 | 1 | 2 | 0 | 6 | Late 2017 conducted significant cleaning of downstream section |

Note: Frequency data do not show decreases in duration or volume, particularly for Park and Gazo; nor adjust for the impact of wet/intense rainfall years such as 2011 and 2013.

UNK = Previously unidentified CSO point, no data available
? = data not easily available, still researching
Range provided when unclear or multiple events on one day
* Gazo discharged for 55 seconds on 6/18/18

# Main Wastewater Plant

## Comparison of Combined Sewer Discharges Pre 1994 to 2018 Through 8/26/18




*Pre-1994 estimate is based on average annual combined sewer wet weather flows treated by Vortex between 2001 and 2017. See https://www.burlingtonvt.gov/DPW/Water-Quality-History.

# APPENDIX B

| | Construction Cost (with ~20-25% contingency generally) | Design & Oversight (15-25% of construction cost ) | Total |
|---|---|---|---|
| *Disinfection and SCADA/PLC upgrade* | | | |
| Main Plant Disinfection upgrade | $ 480,000 | $ 111,000 | $ 590,000 |
| Main Plant SCADA/PLC upgrade (global upgrade) | -- | -- | $ 350,000 |
| North Plant Disinfection System Upgrade | $ 173,000 | $ 40,000 | $ 213,000 |
| East Plant Disinfection System Upgrade | $ 173,000 | $ 40,000 | $ 213,000 |
| North & East SCADA/PLC improvements | $ 60,000 | $ 12,000 | $ 72,000 |
| Disinfection and SCADA/PLC upgrades (Main, East and North) | $ 1,236,000 | $ 203,000 | $ 1,438,000 |
| Other WW Plant (Main, East and North) Capital Needed in next 5 years | $ 8,793,000 | $ 1,384,000 | $ 11,403,000 |
| Proposed WW Planning Studies in Next 5 years to make decision for next Bond (East Plant suitability, dewatering) | | $ 180,000 | $ 180,000 |
| Pump Stations (10 Highest Need) | $ 2,017,000 | $ 578,000 | $ 2,595,000 |
| Collection System Planning/Assessment (current planning loan) | | $ 900,000 | $ 900,000 |
| Collection System (Sewer Rehab) WW (35,485 lf = 6.72 mi) | $ 1,558,000 | $ 400,000 | $ 2,154,000 |
| Collection System (Sewer Rehab) WW Subtotal (35,485 lf = 6.72 mi) | $ 1,558,000 | $ 1,300,000 | $ 3,360,000 |
| Asset Management CMMS (50% share with SW) | $ 113,000 | $ 60,000 | $ 173,000 |
| Industrial Wastewater Program development | | $ 175,000 | $ 175,000 |
| Industrial Wastewater Pass through loans | $ 250,000 | | $ 250,000 |
| Industrial WW Subtotal | $ 250,000 | $ 175,000 | $ 425,000 |
| City Project Management Staff (0.625 FTE x 4 years) | | $ 282,000 | $ 282,000 |
| | | Wastewater Total Request | $ 19,856,000 |

| | Construction Cost (with ~20-25% contingency generally) | Design & Oversight (15-25% of construction cost ) | Total |
|---|---|---|---|
| Stormwater Outfalls (top 5 of 11 high risk outfalls) | $ 1,880,000 | $ 470,000 | $ 2,350,000 |
| SW Collection System Planning/Assessment (current planning loan) | | $ 100,000 | $ 100,000 |
| SW Collection System | $ 2,913,831 | $ 145,692 | $ 3,060,000 |
| SW Collection System (33,381 linear feet = 6.3 miles) | $ 2,913,831 | $ 245,692 | $ 3,160,000 |
| <u>Stormwater and Wet Weather Management</u> | | | |
| *Wet-Weather Mitigation* | | | |
| Combined Sewer Runoff Reduction (Pine Barge Canal as priority, with other projects throughout Main Plants) | $ 1,460,000 | $ 212,000 | $ 1,672,000 |
| Pine Street CSO disinfection Station | $ 400,000 | $ 100,000 | $ 500,000 |
| Wet Weather (CSS) Mitigation and Disinfection | $ 1,860,000 | $ 312,000 | $ 2,172,000 |
| Great Streets (if assume SW covers $125k of $250k/block) | | | *$ 1,500,000* |
| City Hall Park (if assume that SW may have to cover $150K of $300k) | | | *$ 150,000* |
| Great Streets and City Hall Park SW (if assume SW pays 1/2) | | | $ 1,650,000 |
| *Separate Stormwater Management* | | | |
| 3 acre permit obligation (City parcels) EFAs | | $ 65,000 | $ 65,000 |
| Regulatory Req'd Separate Stormwater Retrofits (between 2020-2024) | $ 150,000 | $ 100,000 | $ 250,000 |
| Separate SW Regulatory Obligations | $ 150,000 | $ 165,000 | $ 315,000 |
| Asset Management CMMS (50% share with SW) | $ 113,000 | $ 60,000 | $ 173,000 |
| City Project Management Staff (0.625 FTE x 4 years) | | $ 282,000 | $ 282,000 |
| | | Stormwater Total Request | $ 10,102,000 |

| | |
|---|---|
| TOTAL | $ 29,958,000 |

APPENDIX C

# Wastewater Plant Improvements

| Equipment | Description | Facility | D and K 2016 report | Estimate | Revised Consultant Estimate (2018) | Construction Total (with contingency) | ENR (inflation) adjustment as necessary | Design + Mgt 15% to 25% depending on size and complexity) based on non adjusted construction total | SUBTOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Main Plant Disinfection System Upgrade (does not include PLC) | This system controls the ability to disinfect wastewater and is require to protect public health. | Main | | | X | $ 479,375.00 | | $ 110,256.25 | $ 590,000 |
| Main SCADA/PLC wholesale upgrade | This system acts as the central nervous system of the facility. Without this automation, there is more possibility for error. | Main | | | X | --- | -- | ---> | $ 350,000 |
| North Plant Disinfection System Upgrade | This system controls the ability to disinfect wastewater and is require to protect public health. | North | | | X | $ 172,750.00 | | $ 39,732.50 | $ 213,000 |
| East Plant Disinfection System Upgrade | This system controls the ability to disinfect wastewater and is require to protect public health. | East | | | X | $ 172,750.00 | | $ 39,732.50 | $ 213,000 |
| North and East PLC Upgrade/optimization | This system acts as the central nervous system of the facility. Without this automation, there is more possibility for | North, East | | X | | $ 60,000 | | $ 12,000 | $ 72,000 |
| Total Disinfection and PLC/SCADA | | | | | | | | | $ 1,438,000 |
| | | | | | | | | | |
| East plant outfall | Pipe that transports wastewater effluent to the Winooski | East | Fy20 | | | $ 180,000 | $ 30,600 | $ 45,000 | $ 256,000 |
| North Influent Pump Controller | This controls the heart of the facility. Without it, North plant is not able to treat wastewater. | North | FY17 | X | | $ 18,000 | | $ 3,600 | $ 22,000 |
| North/East Fire system replacement | Fire protection. North failed last fire inspection. East likely to fail | North, East | | X | | $ 60,000 | | | $ 60,000 |
| Upgraded Blower (Hybrid) | This is central to the biological process. This equipment will provide better control of the process, redundancy and electrical efficiency | Main | | | | $ 210,000 | | $ 31,500 | $ 242,000 |

# Wastewater Plant Improvements

| Equipment | Description | Facility | D and K 2016 report | Estimate | Revised Consultant Estimate (2018) | Construction Total (with contingency) | ENR (inflation) adjustment as necessary | Design + Mgt 15% to 25% depending on size and complexity) based on non adjusted construction total | SUBTOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Dialers & Rain gauges | This allows for notification of problems at the facilities and better data on localized rain storms | North, East | | X | | $ 12,000 | | | $ 12,000 |
| Electrical component study and upgrade (Including Arc flash assessment) Find critical components that we need to have a backup on the shelf, or that needs to be replaced. i.e. foul sewer breakers. | This allows us to discover which components are failing and/or obsolete, to better manage risk and safety. | All | | X | | $ 240,000 | | $ 48,000 | $ 288,000 |
| EMG Building Improvements | To management and maintain our building envelopes. | All | | X | | $ 300,000 | | $ 60,000 | $ 360,000 |
| Back Up Blower | This is central to the biological process. This equipment will provide better control of the process, redundancy and electrical efficiency. But mostly for the redundancy. | Main | | X | | $ 90,000 | | $ 13,500 | $ 104,000 |
| Main Plant Main Bar Rack (4 ft) | This equipment screens out debris from the influent, and is imperative for treatment and protection of equipment further down the line. | Main | FY21 | | X | $ 363,576 | $ 61,808 | $ 72,715 | $ 499,000 |
| North and East Bar Racks | This equipment screens out debris from the influent, and is imperative for treatment and protection of equipment further down the line. | North, East | FY23, 20 | | X | $ 603,576 | $ 102,608 | $ 120,715 | $ 827,000 |
| Grit | | | | | | $ - | | | $ - |
| Classifiers | This equipment screens out grit and course material from the influent, and is imperative for treatment and protection equipment from wear. | North, East | | | X | $ 243,696 | | $ 48,739 | $ 293,000 |
| Trolley drive upgrades | | North, East | | X | | $ 36,000 | $ 6,120 | $ 5,400 | $ 48,000 |
| Controls | | North, East | FY17,18 | | | $ 120,000 | $ 20,400 | $ 18,000 | $ 159,000 |
| Complete replacement | | Main | FY22 | | X | $ 441,665 | $ 75,083 | $ 88,333 | $ 606,000 |
| Main Inf. Ferric Storage | Ferric is used in phosphorus control. It is a nasty chemical, and this will change our current temporary storage, to a safe and permanent installation. | Main | | X | | $ 42,000 | | $ 4,200 | $ 47,000 |

# Wastewater Plant Improvements

| Equipment | Description | Facility | D and K 2016 report | Estimate | Revised Consultant Estimate (2018) | Construction Total (with contingency) | ENR (inflation) adjustment as necessary | Design + Mgt 15% to 25% depending on size and complexity) based on non adjusted construction total | SUBTOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Rehab gates that do not work | The gates are used in various processes for flow control, maintenance and staff safety. | All | | X | | $ 480,000 | $ 81,600 | $ 72,000 | $ 634,000 |
| CSO pump controller and level sensor | This controls the ability to process wet weather events | Main | FY19,26 | X | | $ 36,000 | | $ 7,200 | $ 44,000 |
| Rehab Rodney Hunt controller, panel, solenoids and gas cylinders | This controls various gates at main plant, including the relief gate for CSO treatment. | Main | FY18,26 | X | | $ 60,000 | | $ 12,000 | $ 72,000 |
| Gas Detection systems | This is a safety system to protect staff from dangerous gasses. | All | | X | | $ 24,000 | | $ 4,800 | $ 29,000 |
| Aeration Membranes of all Plants | This is part of the biological process to deliver oxygen to the bacteria so that they can treated the wastewater. | All | FY23, 19, 19 | X | | $ 132,000 | $ 22,440 | $ 26,400 | $ 181,000 |
| North and East Piston Pump Replacement (Primary Sludge pump) | These pumps provide the ability to transfer waste solids to storage for residuals management. | North, East | | X | | $ 96,000 | | | $ 96,000 |
| Yard Hydrant Replacement All plants | Yard hydrants are used to clean and maintain equipment and tanks. | All | FY19 | X | | $ 120,000 | | | $ 120,000 |
| Godwin Pump | This piece of equipment is a trailer mounted pump which can be used as a backup pump station in an emergency. | All | | X | | $ 78,000 | | | $ 78,000 |
| Main Plant Primaries (Has to happen) | Primaries are a part of the process in which you settle out as much of the organic material as possible. They reduce the need for more expensive secondary processing. | Main | FY20 | | X | $ 1,092,050 | $ 185,649 | $ 198,582 | $ 1,477,000 |
| Main Plant CSO Bar Rack (12ft) | This equipment screens out debris from the wet weather influent system, which is a major component of the wet weather treatment process. | Main | | | X | $ 1,074,000 | $ 182,580 | $ 214,800 | $ 1,472,000 |

# Wastewater Plant Improvements

| Equipment | Description | Facility | D and K 2016 report | Estimate | Revised Consultant Estimate (2018) | Construction Total (with contingency) | ENR (inflation) adjustment as necessary | Design + Mgt 15% to 25% depending on size and complexity) based on non adjusted construction total | SUBTOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Clarifiers (Primary or Secondaries) High Priority and/or East Plant redesign # | Primaries are a part of the process in which you settle out as much of the organic material as possible. They reduce the need for more expensive secondary processing. Secondaries are important for settling out biologically treated solids leaving a clean, polished effluent. | Any | FY24 | | | $ 2,400,000 | $ 408,000 | $ 240,000 | $ 3,048,000 |
| On-Shore Relief Box Culvert | This is the culvert used to discharge off shore in the case of hydraulic overload for the wet weather system. The lab building sits on top of this structure. | Main | | X | | $ 240,000 | $ 40,800 | $ 48,000 | $ 329,000 |
| Total | | | | | | $ 8,792,563 | $ 1,217,687 | $ 1,383,485 | $ 11,403,000 |

STUDIES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Dewatering Decision (Brewery option) Final Study* | | Main, All | | X | | | | $ 120,000 | $ 120,000 |
| *Engineering evaluation of East Plant, which may include recommendations for alternative treatment strategies* | | East | | | | $ - | | $ 60,000 | $ 60,000 |
| | | | | | | | | Total Studies | $ 180,000 |

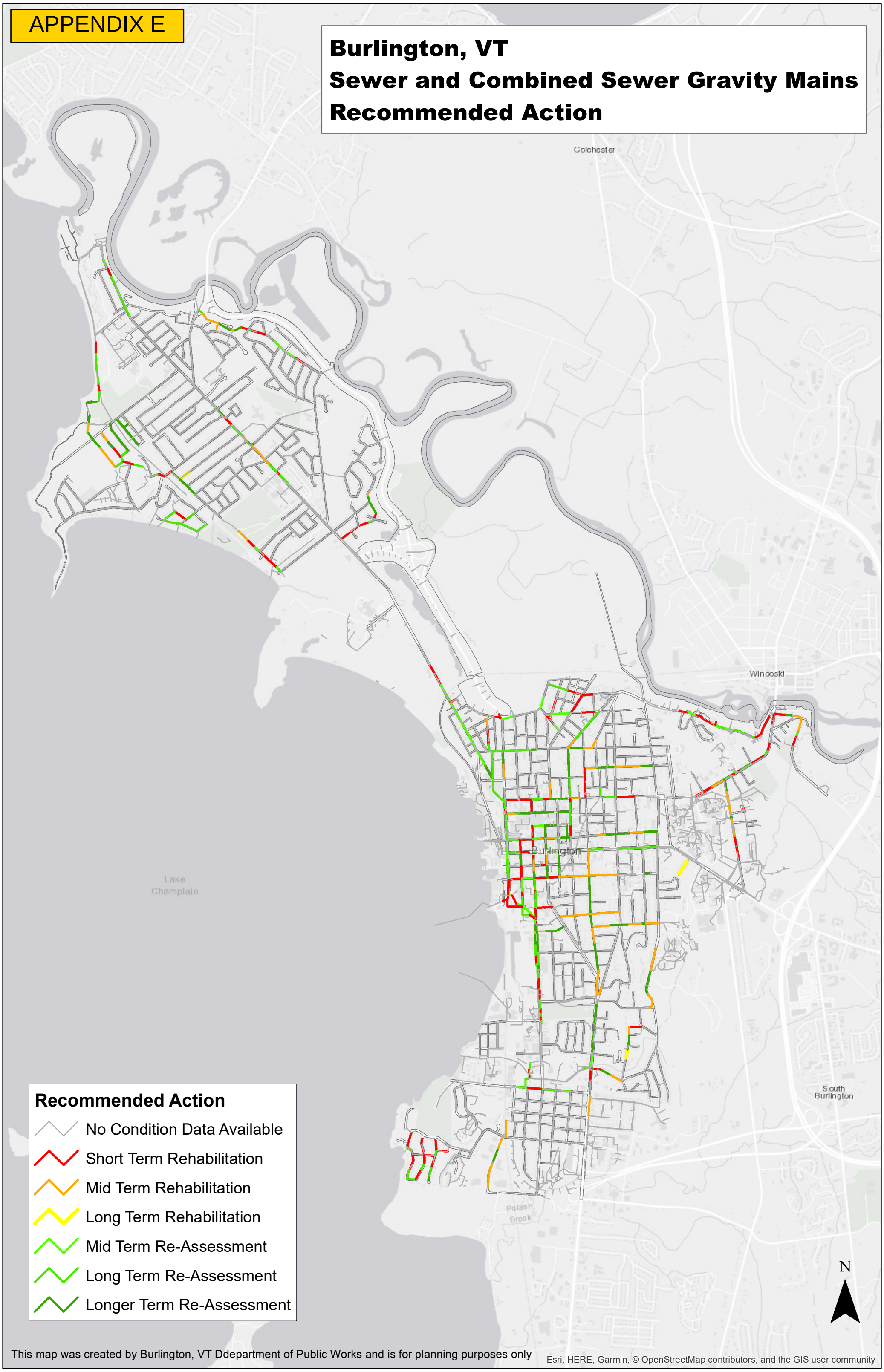
# APPENDIX D

WASTEWATER PUMP STATION IMPROVEMENTS

| Pump Station | Dry Pit or Submercible | Capital Planning D&K Year | D&K recomnmendation | Risk Totals | AEW Rank based on D&K Upgrades | FM Size/Material | Waterway Impacted by Spill? | Construction Total | Design and Oversight (30%) | Subtotal |
|---|---|---|---|---|---|---|---|---|---|---|
| Fletcher Place | S | 2018 & 2020 | VV metal and failing, valves, piping & pumps original. Controls showing safety issues | 32 | 1 | 4" Steel | Yes, would have to go over an embankment | $ 120,394 | $ 42,138 | $ 162,532.10 |
| Crescent Beach | D | 2018 | WW old brick, DW failiing, original valves, pumps and piping. Controls require entry to DW - Requiring a complete replacement of system | 29 | 2 | 4" UNK | Yes but would have to be a large spill | $ 270,369 | $ 94,629 | $ 364,997.54 |
| Queen City | D | 2023 | WW & DW both in poor condition, valves & pumps original and should be replaced. Controls OK but may need to be relocated to surface | 27 | 3 | 4" Cast | Yes but would only be from a FM or gravity break since the WW is 25ft deep | $ 192,809 | $ 67,483 | $ 260,292.35 |
| South Cove | D | 2019 | WW & DW both in poor condition, valves & piping original, pumps recently replaced but aren't submersible. Panel ok but structure is poor & needs replacement | 26 | 4 | 4" PVC (relined 2018) | Yes directly on private beach | $ 139,799 | $ 48,929 | $ 188,727.98 |
| Flynn Avenue | D | 2020 | DW metal and failing, valves, piping & pumps original. Controls showing minor seal fitting issues, controls to be moved above ground | 26 | 5 | Half 6" HDPE Half 6" Cast | Yes direct access to beach | $ 242,238 | $ 84,783 | $ 327,020.96 |
| Water Plant | S | N/A | WW & VV both deteriorating, valves showing heavy corrosion, pumps ok but capacity could be issue, junction boxes are code violations C1 D1, seal fittings needed on conduits, controls OK | 26 | 6 | 4" Ductile | Yes direct access to storm CB's that discharge to lake | $ 196,998 | $ 68,949 | $ 265,947.44 |
| Upper Beach | S | 2022 & 2024 | Hatch to be replaced, WW steel insert questionable but unknown, valves & piping original but pumps recently replaced. Controls old but ok | 23 | 7 | 4" AC | No, but does have high public impact | $ 171,668 | $ 60,084 | $ 231,751.13 |
| Proctor Place | D | 2024 | WW & DW both in poor condition, valves & pumps original and should be replaced. Controls OK | 21 | 8 | 6" Cast | Yes direct access to storm CB's that discharge to lake | $ 316,350 | $ 110,723 | $ 427,072.50 |
| Van Patten | S | 2020 | WW hatch poor, valve vault not sealed & submerged with GW, valves, pumps & pipes original, VFD's good, need covers | 20 | 9 | 4" PVC | Yes, but over an embankment into intervale | $ 67,522 | inhouse | $ 67,522.00 |
| Chase Street | S | 2020 | Plug valves original, checks recently changed, pumps need to be replaced, panels & conduits showing corrosion | 19 | 10 | 4" Cast | Yes, CB's with direct discharge into Winooski River | $ 108,529 | inhouse | $ 108,528.50 |
| Intervale Landfill | S | 2026 | Might not be the best use of our capital bond this time around | 0 | 25 | | N/A | $ 100,000 | inhouse | $ 100,000.00 |
| Mission Control | N/A | | Need to upgrade telemetry for improved staff efficiency and alarming | | | | | $ 90,000 | inhouse | $ 90,000.00 |
| | | | | | | | | $ 2,016,674 | $ 577,718 | $ 2,594,392 |

APPENDIX E

# Burlington, VT
# Sewer and Combined Sewer Gravity Mains
# Recommended Action




This map was created by Burlington, VT Ddepartment of Public Works and is for planning purposes only

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APPENDIX F

# High Risk Stormwater Outfall Repair

| Location | Estimated Construction Cost (includes 25% cont) | Design & Oversight (25%) | Total Estimate |
|---|---|---|---|
| Manhattan Drive | $725,000.00 | $181,250.00 | $906,250.00 |
| 505 Riverside Avenue | $600,000.00 | $150,000.00 | $750,000.00 |
| Northeast of Riverside Plant | $179,906.25 | $44,976.56 | $224,882.81 |
| North Avenue @ 127, just north of on ramp | $245,000.00 | $61,250.00 | $306,250.00 |
| Burlington High School | $40,000.00 | $10,000.00 | $50,000.00 |
| Ethan Allen Park, near Moore Drive | $600,000.00 | $150,000.00 | $750,000.00 |
| Englesby Brook @ Pine Street | $100,000.00 | $25,000.00 | $125,000.00 |
| Riverside Avenue, near Salmon Hole Park | $60,000.00 | $15,000.00 | $75,000.00 |
| Upper Little Eagle Bay | $72,500.00 | $18,125.00 | $90,625.00 |
| Leddy Park | $120,000.00 | $30,000.00 | $150,000.00 |
| Just west of Riverside | $62,631.25 | $15,657.81 | $78,289.06 |
| | | | |
| Total construction with 10% additional contigency ----> | $3,085,541.25 | $701,259.38 | $3,786,800.63 |
| Total construction for top 5, with 5% additional contigency on construction and design | $1,879,401.56 | $469,850.39 | $2,349,251.95 |

# APPENDIX G

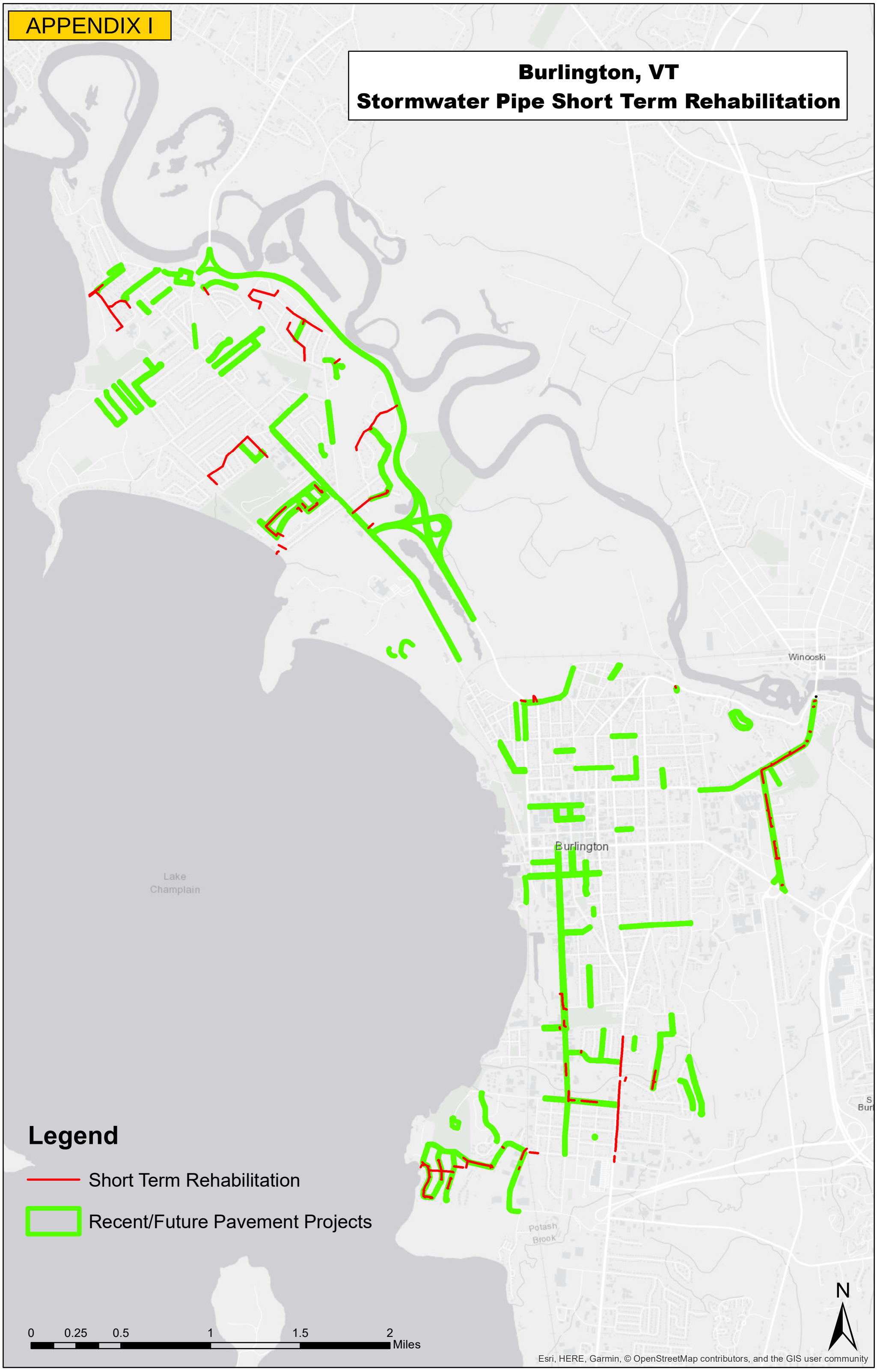
## Combined Sewer Retrofit Opportunities

| Project Currently Proposed | Acres of Impervious | Construction with contingency (25%) | Design/oversight | Watershed |
|---|---|---|---|---|
| Allen Street (below CSO) | 1.13 | $105,937.50 | $10,593.75 | Main Plant |
| Cedar Street @ Rose Street | 0.5 | $62,500.00 | $6,250.00 | Main Plant |
| Cedar Street @ LaFountain | 0.62 | $77,500.00 | $7,750.00 | Main Plant |
| North Prospect - North to Pearl | 5.62 | $395,156.25 | $39,515.63 | Main Plant |
| Cedar @ North Champlain? | 2.75 | $193,359.38 | $19,335.94 | Main Plant |
| Rose Street (above CSO) | 1.61 | $150,937.50 | $15,093.75 | Main Plant |
| Front/Summer | 0.44 | $55,000.00 | $5,500.00 | Main Plant |
| Hyde Street (near North Street) | 0.31 | $38,750.00 | $3,875.00 | Main Plant |
| Main Plant and/or Manhattan CSOs | | $1,079,140.63 | $107,914.06 | |
| | | | | |
| Fairmount Street | 1.02 | $127,500.00 | $25,500.00 | Main Plant - Above CSO |
| South Prospect (3 locations total) | 3.19 | $299,062.50 | $59,812.50 | Main Plant - Above CSO |
| Glen Road @ South Street | 0.53 | $66,250.00 | $13,250.00 | Main Plant - Above CSO |
| South Street | 0.92 | $115,000.00 | $23,000.00 | Main Plant - Above CSO |
| Prospect Parkway (2 sites) | 0.99 | $123,750.00 | $24,750.00 | Main Plant - Above CSO |
| Chestnut Terrace | 0.26 | $32,500.00 | $6,500.00 | Main Plant - Above CSO |
| Pine Street Barge Canal CSO | | $764,062.50 | $152,812.50 | |
| | | | | |
| | | | | |
| Charlotte Street - bumpouts or subsurface or tank | 1.1 | $103,125.00 | $20,625.00 | Main Plant |
| | | | | |
| | 20.99 | $1,946,328.13 | $281,351.56 | |
| 75% of total possible opportunities, knowing that we want to wait until Integrated Plan is done to pick best bang for buck projects | 12.6 | $ 1,459,746.09 | $ 211,013.67 | |
| GREAT STREETS | | | | |
| St. Paul | | | | |
| Other 12 blocks | | $1,500,000.00 | estimated cost is $250K per block, use $150K (60%) | |
| City Hall Park | | $150,000.00 | Estimated cost is $300K for CHP, assume 50% | |
| | Total Great Streets/Downtown | $1,650,000.00 | | |

APPENDIX H

Basis for Separate Stormwater Management 2019-2022 Budget #

| 3-Acre Site Compliance | Details / Notes | EFA Cost | Final Engineering & oversight | Construction Cost (Imp. * $75000) |
|---|---|---|---|---|
| Alexis Drive Subdivision | 3.1 acres total (1.55 acres required) | $5,000.00 | $29,062.50 | $145,312.50 |
| Grey Meadows Subdivision | 3.87 acres total (1.94 required) | $5,000.00 | $36,375.00 | $181,875.00 |
| Lori Lane Subdivision | 3.1 acres total (1.55 acres required) | $5,000.00 | $29,062.50 | $145,312.50 |
| Van Patten Parkway Subdivision | 9.3 acres total (4.65 acres required) | $5,000.00 | $87,187.50 | $435,937.50 |
| Riverwatch | Co-permittee - EFA only | $5,000.00 | | unknown |
| Ledgewood | Co-permittee - EFA only | $5,000.00 | | unknown |
| Strathmore | Co-permittee - EFA only | $5,000.00 | | unknown |
| Other City 3-Acre sites | 38.06 acres impervious, across 10 sites, (outside of the CSS) | $50,000.00 | $300,000.00 | $1,427,250 |
| | | | | |
| | Subtotals | $85,000.00 | $482,000 | *$2,335,688* |
| Assume need to do remaiing EFAs (some being done in FY19) and some design by 2023, with some limited capital implementation of separate stormwater improvements. There should be grant funds available for non regulatory retrofits. USE | | $65,000.00 | $100,000.00 | $150,000 |

APPENDIX I

# Burlington, VT
# Stormwater Pipe Short Term Rehabilitation