FINAL REPORT

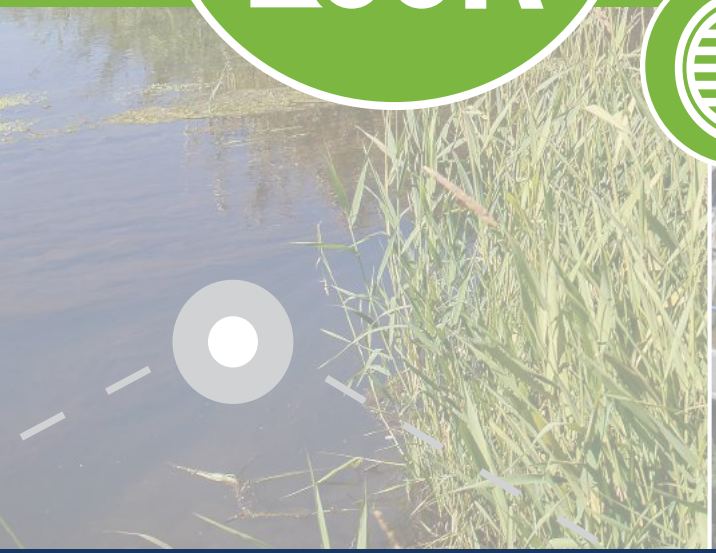
plan FOR 200K

ENGINEERING & REGIONAL UTILITIES | **MASTER PLANS**

DRAINAGE | CITY SEWER | CITY WATER

June 2018



ABBOTSFORD

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EXECUTIVE SUMMARY

In 2015, City of Abbotsford Council approved a Strategic Plan, including four cornerstones with an overarching goal/vision for the City to be the "Hub of the Fraser Valley".

The first step in achieving that vision was the adoption of Abbotsford's Official Community Plan (OCP) in June 2016, which provides a vision and a framework for how Abbotsford will grow to a population of 200,000.

To support the development of a growing and thriving City, it is essential to plan for infrastructure to be in place. The OCP recognized that there will be master plans that require development or updating, including the following three engineering master plans:

- Drainage Master Plan
- City Sewer Master Plan
- City Water Master Plan

These three plans are among the many projects initiated under the Plan 200K initiative to implement the City's OCP.

These three Master Plans were commissioned in April 2017, with completion dates of June 2018. Over the project period, work can be represented in four stages as follows:

- Stage 1 – Background Review and Data Assessment
- Stage 2 – Analysis and Evaluation
- Stage 3 – Draft Plan
- Stage 4 – Final Plan

They are compiled under a single cover as the three plans present many similarities as mostly underground infrastructure. The capital programs within each plan are designed to be phaseable, affordable, resilient, sustainable, incremental, flexible, and grantable.

A system and condition overview was presented in the Stage 1 Report, as well as the issues and opportunities for each area. In Stage 1, a number of common themes across the three areas such as infrastructure upgrades, climate change, and resiliency to natural events and specific issues such as flooding, erosion, sediment deposition, odour and corrosion, system optimization, agricultural use, fire protection, and asset renewal, among others, were identified. Guiding principles and assumptions for each area were also presented in Stage 1.

In Stage 2, staff and consultants reviewed, analysed, and evaluated the issues and opportunities presented in Stage 1, in detail, in order to optimize the individual systems and identify and prioritize the upgrades that would align with the City's strategic objectives as well as support the growth outlined in the OCP.

Stage 3 focused on preparing a draft of the Master Plans with findings from previous stages, as well as feedback received from the public. Final priorities, project cost estimates and timing were identified and used to define the material in the Stage 3 - Draft Master Plans for all three areas. The Draft Master Plans were presented for public feedback to all stakeholders including Council, residents and business owners in Spring 2018.

Stage 4 final report compiles all findings and feedback from previous stages for the three Master Plans, and is now presented to Council for consideration and adoption. This report serves as a high level summary of the technical analyses completed by City's consultants for the three Master Plans. Technical reports for the Drainage Master Plan, City Sewer Master Plan, and City Water Master Plan will be made available on the City's website.

1.0 INTRODUCTION

1.1 2015-2018 COUNCIL STRATEGIC PLAN (CSP)

In 2015, the City of Abbotsford approved a Council Strategic Plan, including four cornerstones with an overarching goal/vision for the City to be the Hub of the Fraser Valley. To date, the City of Abbotsford continues to work toward this vision, which sees Abbotsford as a preferred destination for businesses and residents.

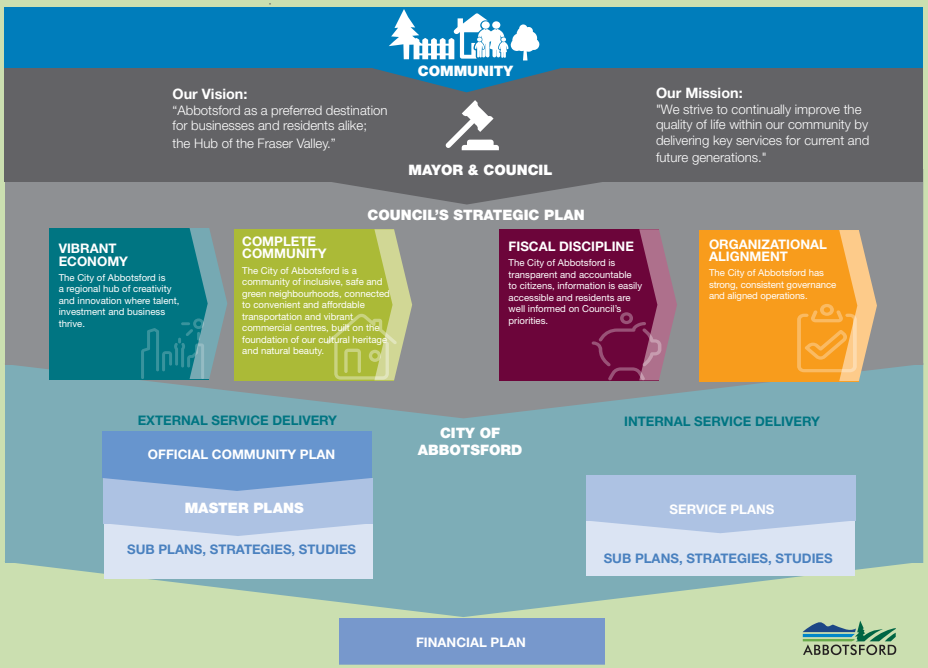
As the Hub of the Fraser Valley, the City of Abbotsford will be the regional center for communities in the Fraser Valley. Abbotsford will be home to regionally centralized services and agencies including health care, courts, transportation, the university, airport, Provincial and Federal government, entertainment and cultural facilities, and commerce.

To achieve this vision, four Cornerstones were created in 2015 to support and focus the work of Council and the City:

- Vibrant Economy
- Complete Community
- Fiscal Discipline
- Organizational Alignment

Council Strategic Plan (CSP)

The Strategic Plan aligns all municipal planning decisions and guides departmental business planning and budgeting efforts.



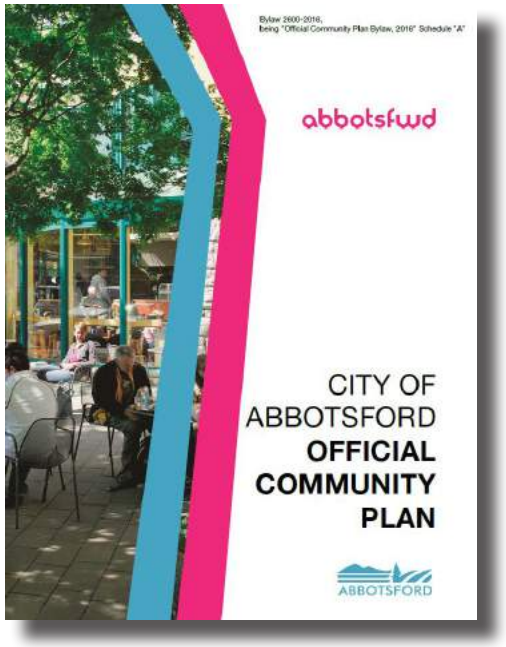
1.2 ABBOTSFORWARD

Abbotsforward is the update of the City of Abbotsford's Official Community Plan (OCP). Along with updated land use regulations, the new OCP includes a vision, several 'big picture' items and a comprehensive list of policies.

The OCP vision paints a powerful picture of what Abbotsford will be like at 200,000 residents, while setting the stage for future and continuing growth and improvement beyond this plan. It embodies the values, priorities, and aspirations of the community, and charts the course for development and implementation of policies.

These directions are diverse, providing guidance for land use, urban design, housing, transportation, infrastructure, jobs, open space, arts and culture, heritage, climate change and energy conservation, natural areas, and agriculture.

Policy directions are organized around 7 Big Ideas for the future of Abbotsford that comprise the most essential and transformative ingredients of this plan. The new OCP was adopted by City Council in 2016.



OCP - 7 Big Ideas

1.3 PLAN 200K

The City of Abbotsford is growing. Abbotsford's Official Community Plan (OCP), adopted in June 2016, provides a vision and a framework for how Abbotsford will grow to a population of 200,000. The City is undertaking a comprehensive review and update to its existing Master Plans and Studies to ensure all of our future operations, development, infrastructure, services, amenities and programs align with the vision set out in our new OCP. To ensure all updates were aligned and relevant across all City departments they were all pulled together under one project name, Plan 200K. Departments now have an opportunity to work alongside each other and contribute to the development of nearly 20 plans (see diagram below). The alignment between departments will ensure implementation is focused, planned, efficient, and coordinated.

plan FOR 200K

BUILDING THE HUB OF THE FRASER VALLEY

1.4 CITY UTILITIES MASTER PLAN PROCESS

As the population of Abbotsford grows to 200,000 people, the City is working to ensure our drainage, water and wastewater services, systems and infrastructure meet the needs of a growing population.

The purpose of these Master Plans (Drainage, City Wastewater (Sewer) and City Water) is to develop a comprehensive plan as the basis for efficiently developing new infrastructure, and completing necessary upgrades to existing infrastructure to support the City's growth. These plans outline existing conditions and future upgrades, support the needs of preparing future City Financial Plans and Development Cost Charge (DCC) programs, and provide adoptable management policies and criteria to assist in management of future development and enhance our environment. This is also an opportunity to review the best practices of other municipalities to support our infrastructure improvement works. The capital programs within each plan are designed to be phaseable, affordable, resilient, sustainable, incremental, flexible and grantable.

The City Utilities Master Plans were completed through a four stage process, as follows:

Stage 1: Background Review and Data Assessment

Stage 1 of the plans included a review of each system and its current state, a highlight of key issues and opportunities for further review in later stages, and summarizes the guiding principles and assumptions made for each plan.

Stage 2: Analysis and Evaluation

Stage 2 of the plans focused on exploring and analyzing options for how our utilities services and infrastructure will grow to meet the needs of a growing population

Stage 3: Draft Plan

Stage 3 focused on preparing a draft of the Master Plans with findings from the previous stages and feedback received.

Stage 4: Final Plan

This Stage 4 – Final report compiles all findings and feedback from previous stages for the three Master Plans, and is now presented to Council for consideration and approval.

ABBOTSFORD

ENGINEERING & REGIONAL UTILITIES

DRAINAGE MASTER PLAN

FINAL REPORT

June 2018

2.0 DRAINAGE MASTER PLAN

2.1 BACKGROUND

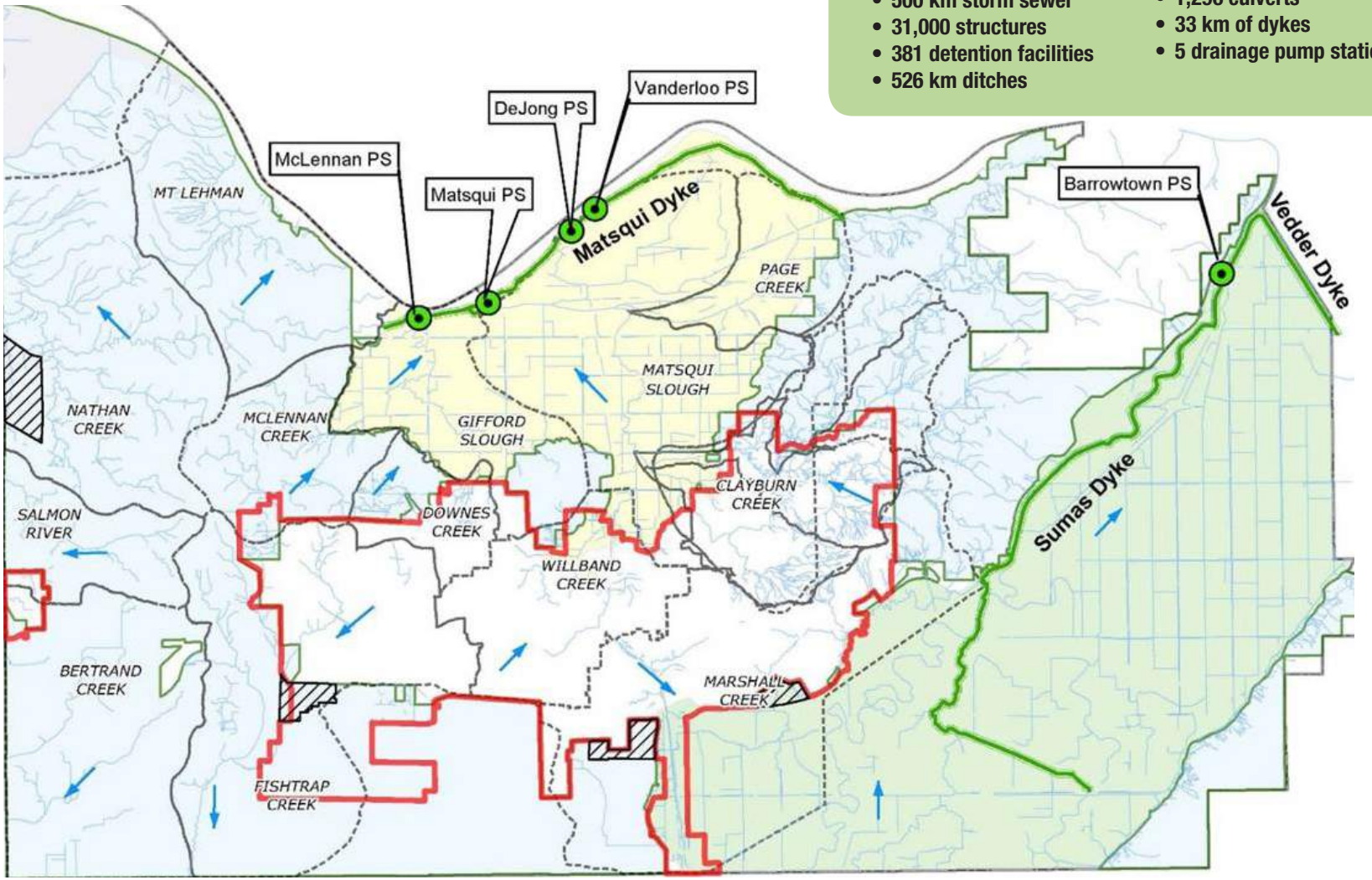
The purpose of this project is to develop a comprehensive Drainage Master Plan as the basis for developing new infrastructure, and completing necessary upgrades to existing infrastructure to support the City's growth. This plan supports the needs of preparing future City Financial Plans and Development Cost Charge (DCC) programs. It provides adoptable stormwater management policies and criteria to assist in management of future development and enhances our environment. This study has also reviewed the best practices of Stormwater fees and charges implemented in other municipalities to support the drainage infrastructure improvement works. A proposed long term capital program has now been developed with costs, timing and priorities.

2.2 OVERVIEW

Abbotsford has several hundred kilometres of creeks and streams, over 10 large drainage catchment areas (Marshall Creek, Downes Creek, Clayburn Creek, Willband Creek, Fishtrap Creek, Nathan Creek, etc.), three floodplains in Sumas Prairie, Matsqui Prairie and Glen Valley, approximately 500 km of storm sewer pipes, 33 km of dykes (along the Fraser River, Vedder River, and Sumas River), and five drainage pump stations. Ultimately, the various catchments within Abbotsford drain to the Fraser River, west to Township of Langley, or south to the United States.

Figure 2-1 Drainage System

- Over 10 watersheds
- 500 km storm sewer
- 31,000 structures
- 381 detention facilities
- 526 km ditches
- 173 km creeks
- 1,296 culverts
- 33 km of dykes
- 5 drainage pump stations



System Condition

Approximately 94% of storm mains are less than 50 years old. The average age is approximately 27 years, while an expected life span is 75 years.

Over 60% of storm mains were inspected through the City's Closed Circuit TV (CCTV) program, where robotic cameras are sent through the sewer system to assess its condition. Approximately 0.2% of the pipes are in critical condition and have been included in the emergency repair program.

The age of the three large pump stations are in the range of 32 to 44 years old, with an expected life span of 20 years for mechanical, instrumental, and electrical components, and 50 years life span for structural components. Upgrade programs have begun to replace some of the components.

The average age of the City's detention facilities is approximately 12 years old, and the useful life is 75 years. A multi-year inspection program for underground concrete detention facilities was initiated in 2009.

A comprehensive Drainage Master Plan is needed to develop new infrastructure and complete necessary upgrades to existing infrastructure to support the City's growth, in addition to supporting the needs of future Financial Plans and Development Cost Charge (DCC) programs.

This is the first Master Plan developed for the drainage system. It compiles and validates projects from studies that were completed, including Integrated Stormwater Management Plans (ISMPs) for Clayburn Creek, Marshall Creek and Downes Creek, as well as erosion, sedimentation, detention, pump station studies, and other

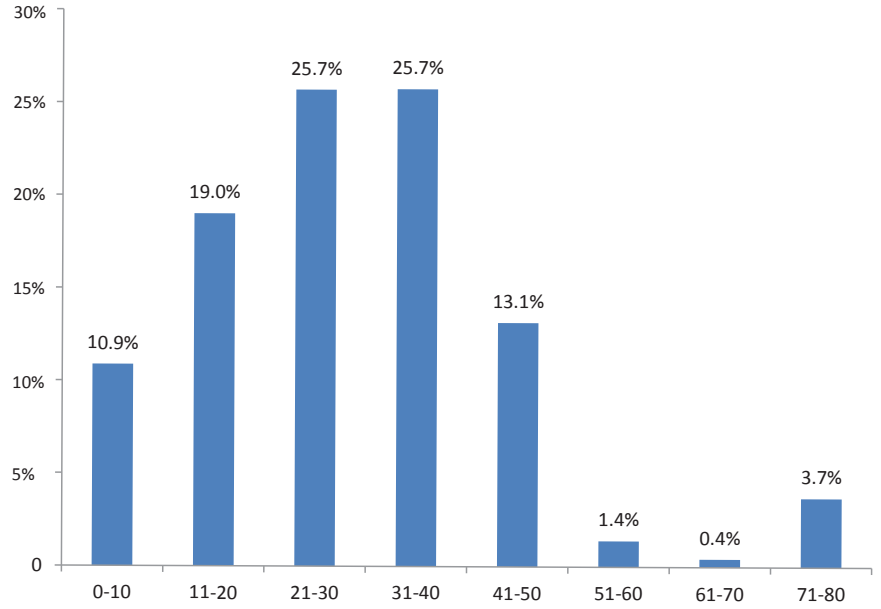


Figure 2-2 – Storm mains by physical age

drainage studies. Watersheds and areas that have been previously studied are referred to as "Studied Areas". Watersheds and areas that have not been previously studied are referred to as "Unstudied Areas".

The Master Plan recommends adoptable stormwater management policies and criteria to assist in managing future development and enhancing the environment. By reviewing the best practices of stormwater programs implemented in other municipalities, Abbotsford's Drainage Master Plan supports the drainage infrastructure improvement works.

Mitigation strategies are now developed to address each issue and opportunity. Improvement options and future studies were prioritized with cost estimates, and categorized into short term (0-5 years), medium term (6-10 years), and long term (11-25 years) plans.

2.3 GUIDING PRINCIPLES AND ASSUMPTIONS

Guiding Principles

The following Federal and Provincial guidelines and regulations and municipal bylaws are key guiding principles for the Drainage Master Plan:

- Federal Department of Fisheries and Oceans (DFO);
- Urban Stormwater Guidelines;
- Best Management Practices (BMPs) for the Protection of Fish and Fish Habitat;
- Provincial Water Sustainability Act;
- City of Abbotsford Streamside Protection Bylaw;
- City of Abbotsford Consolidated Development Bylaw;
- City of Abbotsford Storm Water Source Control Bylaw for CICP Industrial Lands; and
- ARDSA: Agricultural and Rural Development Subsidiary Agreement.

These principles guide the Master Plan process; however, the Master Plan also reviews and makes recommendations to update bylaws to guide future developments, based on best practices.

Flood and erosion protection criteria are developed to guide drainage system design to safely convey both major storm and minor storm events. The drainage system in the Matsqui and Sumas floodplains is assessed based on agricultural drainage criteria as per Agricultural and Rural Development Subsidiary Agreement (ARSDA).

BMPs (bio-swales, rain gardens, absorbent soil, pervious pavers, green roof, etc.) are applied to new development and redevelopment to manage stormwater effectively and responsibly.

Environmental and aquifer protection is achieved by meeting volume reduction, detention, and water quality treatment targets using the above onsite BMPs and regional facilities.

Assumptions

A Climate Change Factor of 10% is applied to this Master Plan, per consultant's recommendation and report of climate change projections for Metro Vancouver published by Metro Vancouver in 2016.

The dyke design crest elevation of Matsqui Dyke and Vedder Dyke is based on a 1 in 500 year design event per latest study reports published by the Fraser Basin Council. Sumas Dyke crest elevation is based on 200-year return period flood.

The rural upland area will be included in a future study due to limited land use change and development pressure.

2.4 ISSUES AND OPPORTUNITIES

2.4.1 Flooding

Matsqui and Sumas floodplains experience localized flooding affecting Clayburn Village, local roads and lowland agricultural areas. Localized flooding was also reported in the rural upland area during heavy rainfalls.

A total of 25 localized flooding areas were identified within the study area by City staff, the consultant, in previous studies, and through public consultations in Stage 1 of the Drainage Master Plan. The known key flooding areas include:

- Clayburn Village/Clayburn Road;
- Angus Campbell Road;
- Burgess Avenue at Mt. Lehman Road;
- Pepin Brook near Bradner Road (Bertrand Creek Watershed);
- Howes Creek tributary near Ranch Avenue; (Bertrand Creek Watershed); and
- Downes Creek tributary lowland near Gladwin Road and Townshipline Road Crossing.

Recommendations

Improvement options have been identified and prioritized to deal with the localized flooding issues. The following examples show improvements in one of the most frequently flooded areas in the lowland of Clayburn Creek by Clayburn Village:

- Matsqui Slough improvement downstream of Clayburn Road for 600 m;
- Clayburn Creek channel deepening in Clayburn Village;
- Installation of flood boxes, flap gates, and pumps in Clayburn Village; and
- Clayburn Creek berm construction

The recommended mitigation measures include:

- Upgrades of Clayburn Creek;
- Culvert upgrades in Sumas Prairie; and
- Future studies in unstudied areas (Willband Creek, Fishtrap Creek, rural upland areas, etc.)

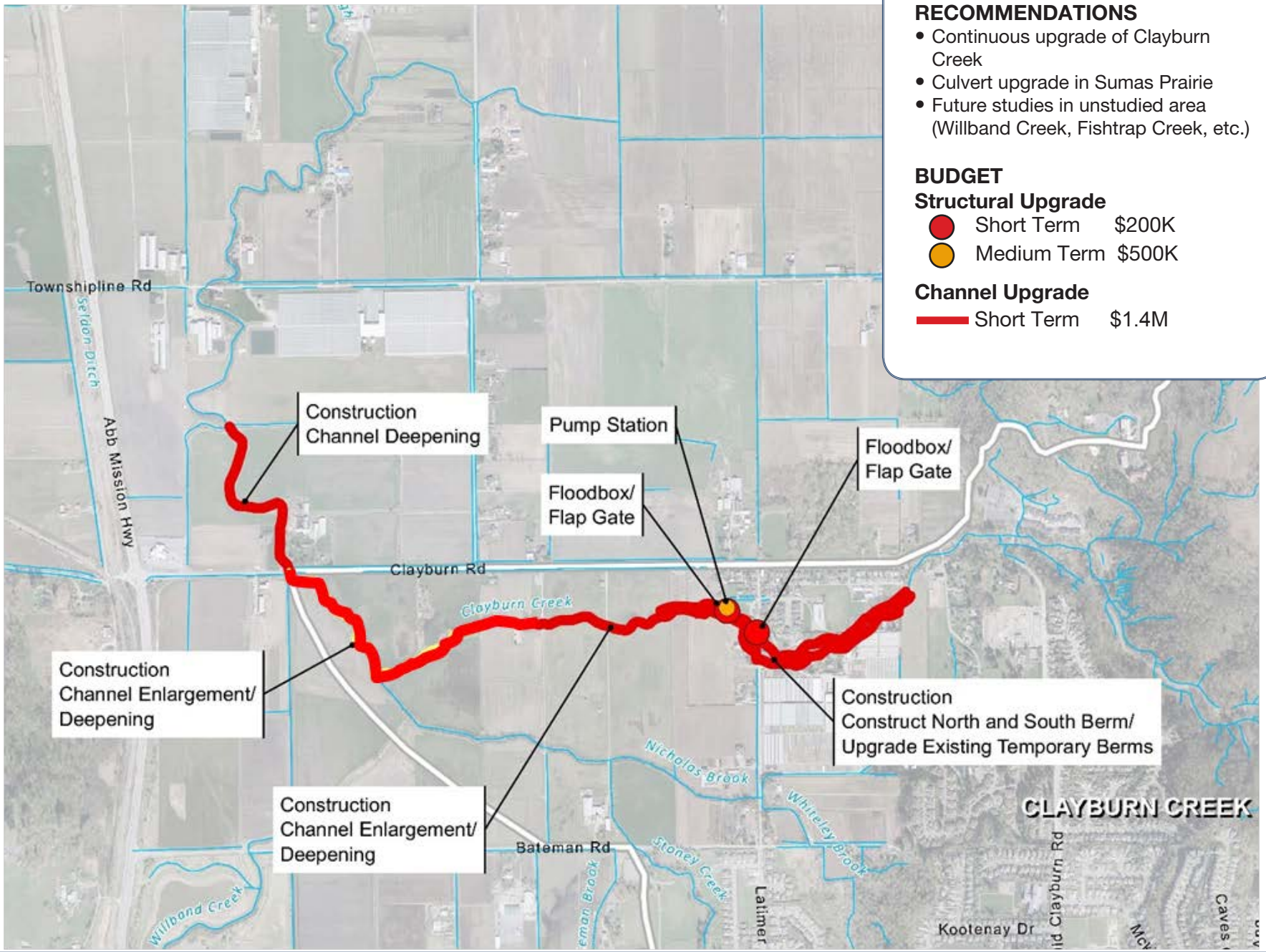
Budget

The estimated cost of structural upgrades (flood boxes, flap gates, and pump stations) is approximately $0.7M, and channel improvement (deepening, widening and sediment traps) is approximately $1.4M.

Structural Upgrade	
Short Term	$200K
Medium Term	$500K
Channel Upgrade	
Short Term	$1.4M

Other issues such as the Nooksack overflow flooding, is a longer term issue which must be addressed by senior levels of government in Canada and the United States.

Figure 2-3 – Localized flooding – Clayburn Creek Example



2.4.2 Erosion and Sediment Deposition

Active stream bank erosion along creek ravines has been observed, together with instabilities of steep ravine slopes, such as Clayburn Creek and Horn Creek. Erosion arcs have formed along the banks of the Fraser River.

Sediment aggradation in lower reaches of channels is an ongoing natural process and reduces the flow conveyance capacity of the channel.

There are approximately 37 erosion and 14 sediment deposition sites of concern within Clayburn Creek, Horn Creek, Boa Brook, Gill Creek, Downes Creek, Prairie Street and Marshall (Lonzo) Creek, etc. The largest erosion issue is along the banks of the Fraser River near the tip of Matsqui Prairie. The City has received $10M in funding to address this issue.

Recommendations

The recommended mitigation measures include:

- Bank stabilization;
- Channel improvement;
- Sediment trap enlargement;
- Modification of existing detention facilities for erosion management;
- Construction of detention facility for erosion management; and
- Stormwater flow diversion.

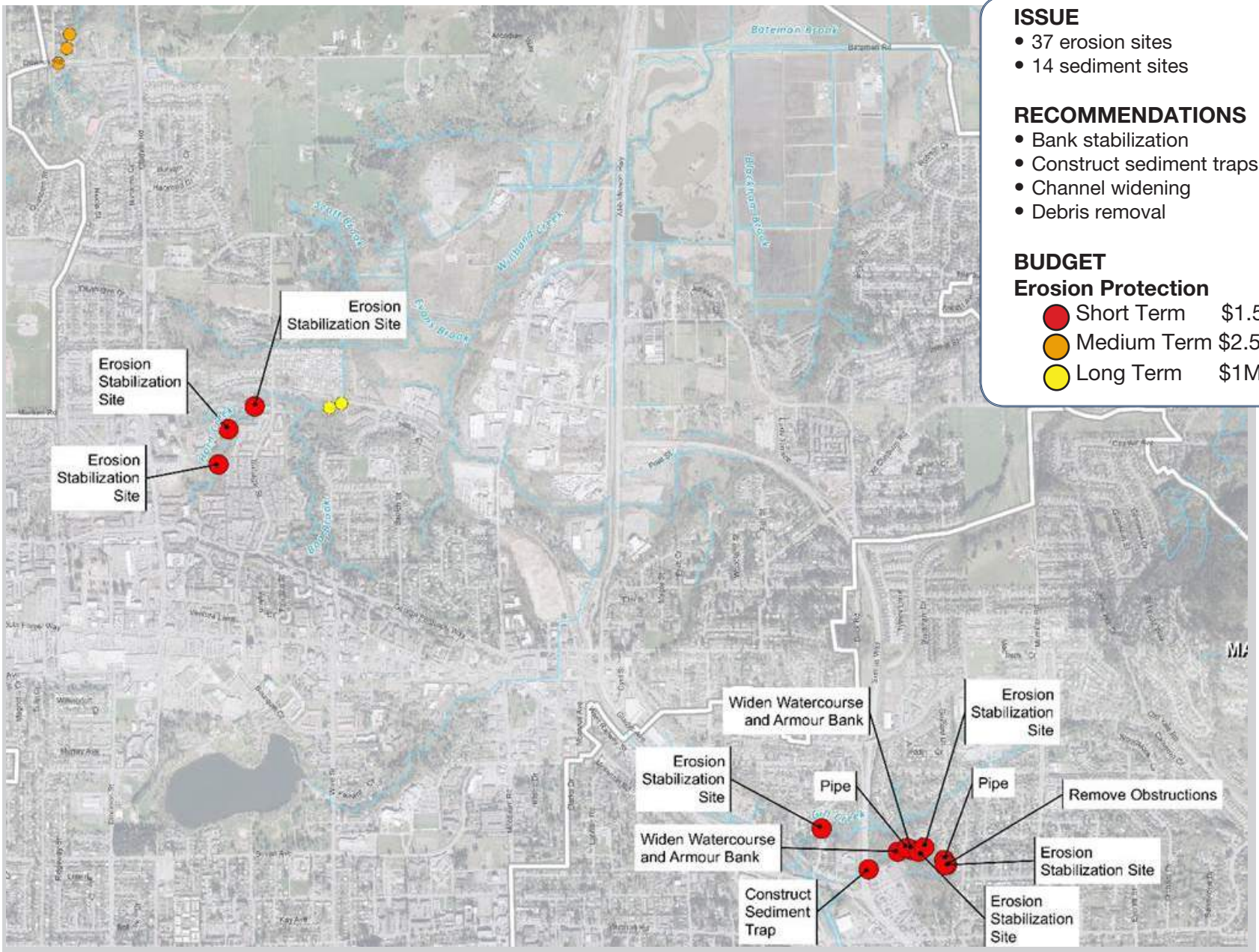
Budget

The recommended mitigation measures include:

Short Term	$1.5M
Medium Term	$2.5M
Long Term	$1M

The estimated total cost is $5M over 25 years.

Figure 2-4 – Erosion and Sediment Deposition – Horn Creek and Marshall Creek Example



2.4.3 System and Pump Station (PS) Capacity

Drainage pump stations and conveyance systems in some areas are under capacity due to changes in land use. There are approximately 170 sections of storm mains, 42 culverts and one bridge with capacity issues that need to be improved. Most of the upgrades are within the watersheds of Marshall Creek and Clayburn Creek, such as:

- Marshall Creek storm sewer upgrade;
- Stoney Creek storm sewer and culvert upgrade;
- Gill Creek culvert upgrade;
- Riverside Road culvert upgrade;
- McCallum Road storm sewer and culvert upgrade;
- Storm sewer upgrade on King Road, east of Kempley Court;
- Sumas Way culvert upgrade;
- Culvert upgrade at Vye Road on Saar Creek;
- Culvert upgrade at Old Yale Road on Arnold Slough;
- Straiton Road bridge upgrade; and
- Barrowtown Pump Station upgrade.

Recommendations

The recommended improvements include storm sewer and culvert replacement, and creating detention upstream of systems with capacity issues.

Budget

The estimated cost for conveyance system improvements and the Barrowtown Pump Station upgrade is approximately $44.5M in the next 25 years.

Conveyance upgrade

Short Term	$9.5M
Medium Term	$9.0M
Long Term	$24M

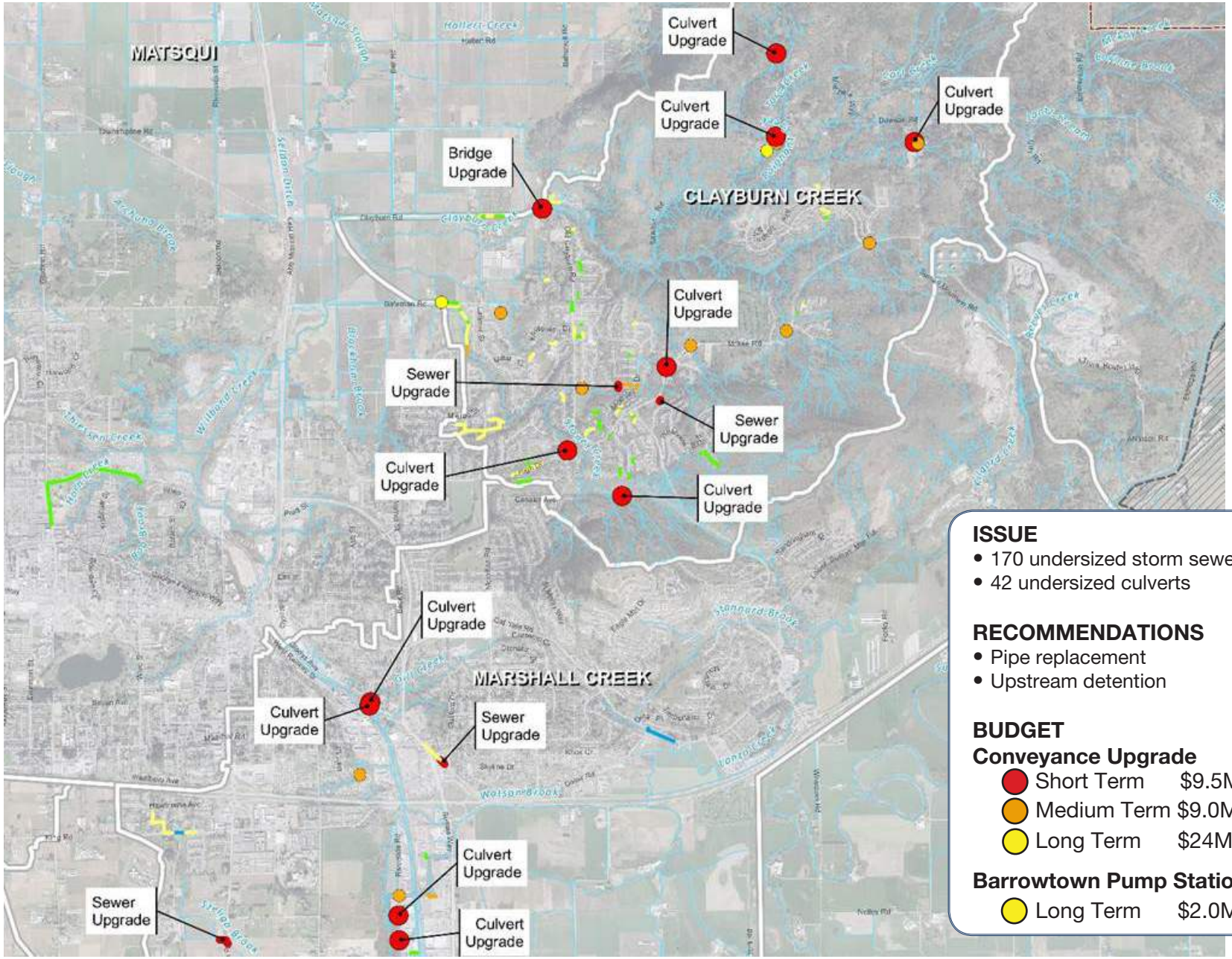
Barrowtown Pump Station

Long Term	$2M

Upon completion of the Willband Creek ISMP and Fishtrap Creek ISMP and Phase 2 drainage studies for Matsqui Prairie and Sumas Prairie, additional conveyance works may be identified.

Phase 2 of the Matsqui Prairie Drainage Study will investigate improvement options at Matsqui Slough and McLennan Pump Stations to meet the 10-year 2-day flooding duration criteria. Phase 2 Sumas Prairie Drainage Study and a cost and benefit analysis for Barrowtown Pump Station will explore capacity upgrade options.

Figure 2-5 – System Capacity – Clayburn Creek and Marshall Creek Example



2.4.4 Runoff Volume and Water Quality Control

There is very little runoff volume and water quality control in some of the older neighbourhoods. Approximately 57% of the urban drainage area is on well-draining soils, which provides opportunities to infiltrate runoff back into the ground to replenish the aquifer and provide base flow for creeks and streams. It will also reduce runoff volume downstream to slow down the erosion process and reduce the chance of flooding.

A total of 35 existing detention facility improvement opportunities were identified in the Master Plan. The improvement options include:

- modifying flow control structures/orifices;
- adjusting detention pond inlet and outlet;
- enlarging detention ponds; and
- redistributing flows among existing detention facilities.

There are opportunities to expand the current City In the Country Plan (CICP) lands Stormwater Source Control Bylaw to City-wide to promote infiltration and water quality enhancement, as well as opportunities to update bylaws to include climate change impact and fish friendly infrastructure to guide future development/redevelopment and capital improvement projects.

Through collaboration with other departments such as Parks, Recreation & Culture, opportunities could be explored around drainage infrastructure to enhance service levels to the public where possible. Examples include trails along dykes, right-of-ways, and park spaces in detention facilities. Opportunities for construction of three new detention facilities were identified on parks land within the Downes Creek watershed and around Gill Creek. Further review with the Parks, Recreation, and Culture Department will identify opportunities of community detention / infiltration facilities in other areas.

Recommendations

The recommended volume control strategies include:

- Modification of 35 existing detention facilities;
- 3 new detention ponds; and
- review community detention opportunities.

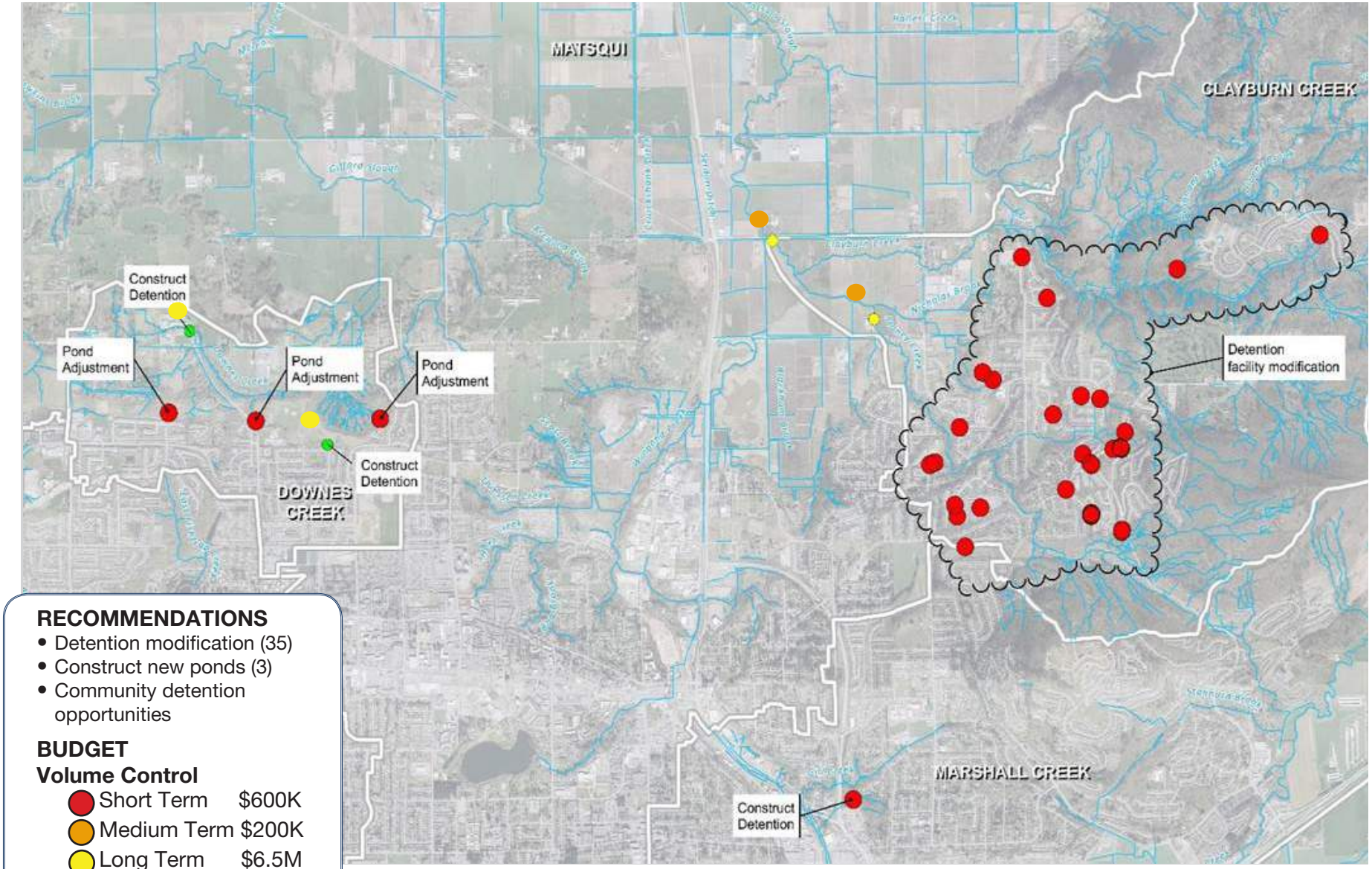
Budget

The total capital cost for volume control measures is estimated at $7M.

Short Term	$600K
Medium Term	$200K
Long Term	$6.5M

Stormwater quality control measures will be included as part of the recommended City-wide Stormwater Source Control Bylaw.

Figure 2-6 – Runoff Volume and Water Quality Control – Downes Creek and Clayburn Creek Example



RECOMMENDATIONS

- Detention modification (35)
- Construct new ponds (3)
- Community detention opportunities

BUDGET

Volume Control

Short Term	$600K
Medium Term	$200K
Long Term	$6.5M

2.4.5 Low Dyke Crests, Climate Change and Resiliency

The Master Plan conducted a high level review to identify the vulnerability of the City's drainage system (including dykes and pump stations) to severe storms and seismic events. Currently, the three Abbotsford dykes were not designed to meet the latest requirement for sea level rise, climate change and seismic standards. In addition, no backup power system is in place in the existing five pump stations (i.e. Barrowtown, Matsqui Slough, McLennan Creek, DeJong, and Vanderloo).

Climate change causes more extreme rainfall events with increased intensity, leading to an increase in peak flows, which challenges the existing drainage and dyke systems. A climate change factor of 10% has been applied to the rainfall intensity and analysis in this Master Plan to review and identify any associated impacts. Climate change impact will need to be addressed in the City Development Bylaw update.

The predicted sea level rise will result in the need to raise the City's dykes. Consideration of resiliency for pump stations and dykes includes severe storms and seismic events, such as the 2017 winter ice storm that the City responded to.

Recommendations

To account for the factors of sea level rise, climate change and seismic standards, the three dykes need to be raised by 0.6-1.6m to meet the latest requirements of design criteria and seismic upgrades. In addition, it is recommended that a future study be conducted to review backup generators in all five drainage pump stations and to develop a program to prioritize resiliency options, and a separate study be completed to review seismic upgrades for the City's dykes and pump stations.

Budget

The estimated cost for dyke improvement is approximately $415M. Costs distributed within the 25 year timeframe is $345 M, and $70 M between year 2044 and 2050.

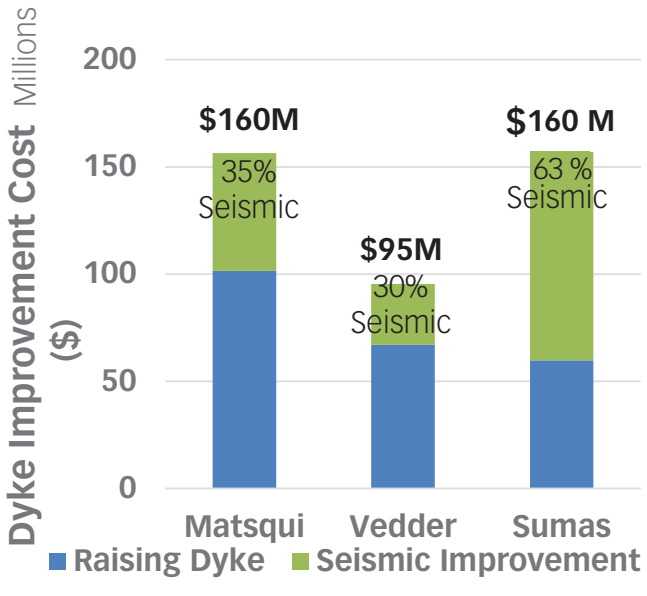
6-15 years	$240 M
16-25 years	$105 M
26-32 years	$70 M

The estimated costs also include replacement of pump stations and floodboxes as part of the dyke structure due to raising the dykes to meet the new standards. Fish friendly considerations will be included when pump stations are replaced. The City will be looking for 100% funding from senior governments for dyke improvements.

Figure 2-7 – Dyke raise requirement and improvement costs

Dyke Raise Required (m)	
Matsqui Dyke (1:500-yr)	1.0 – 1.4
Sumas Dyke (1:200-yr)	0.6 – 1.0
Vedder Dyke (1:500-yr)	1.4 - 1.6

- Climate change factor: 10%
- Sea level rise: 1 m
- Seismic: Provincial "high-consequence" performance criteria



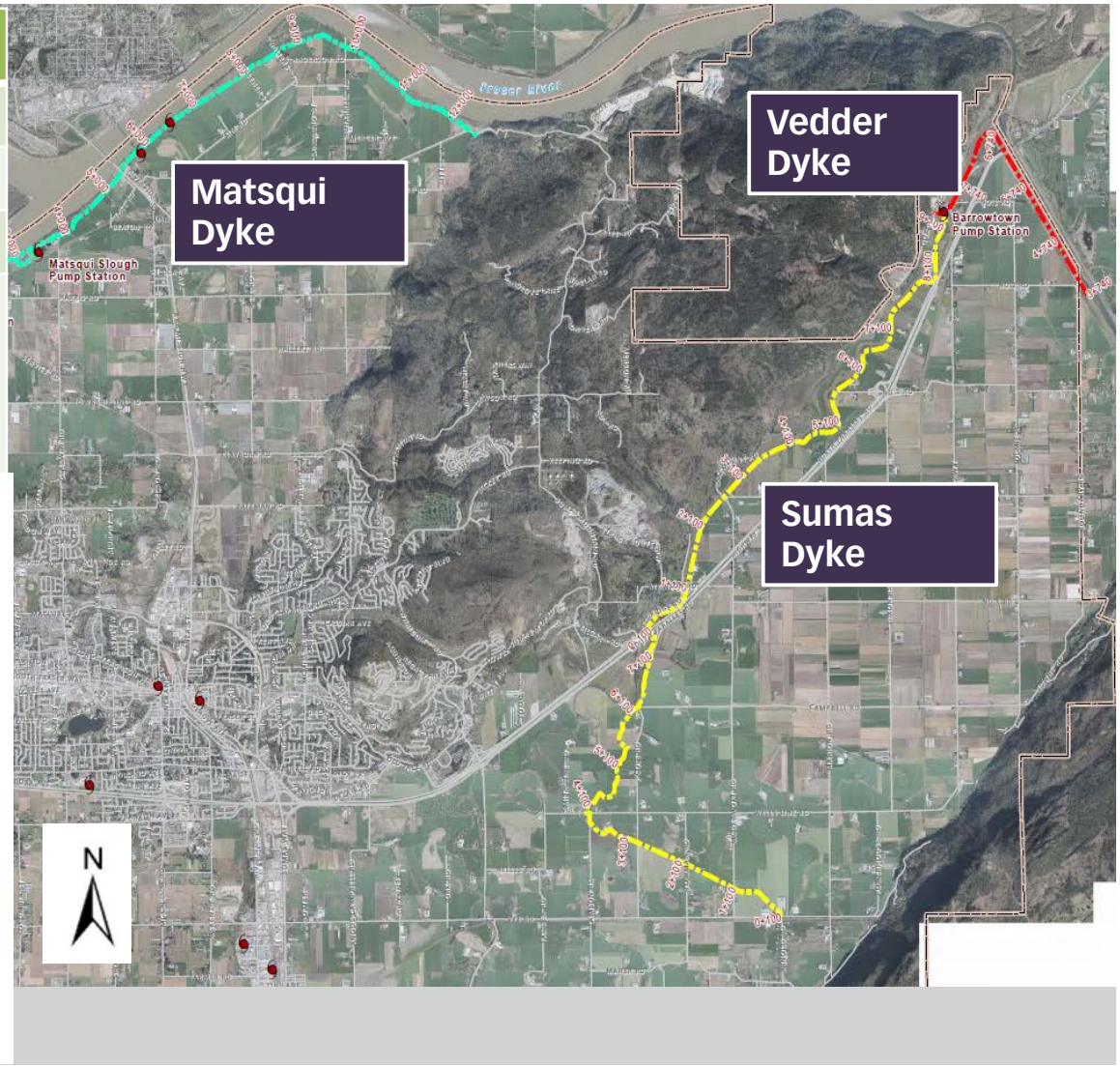
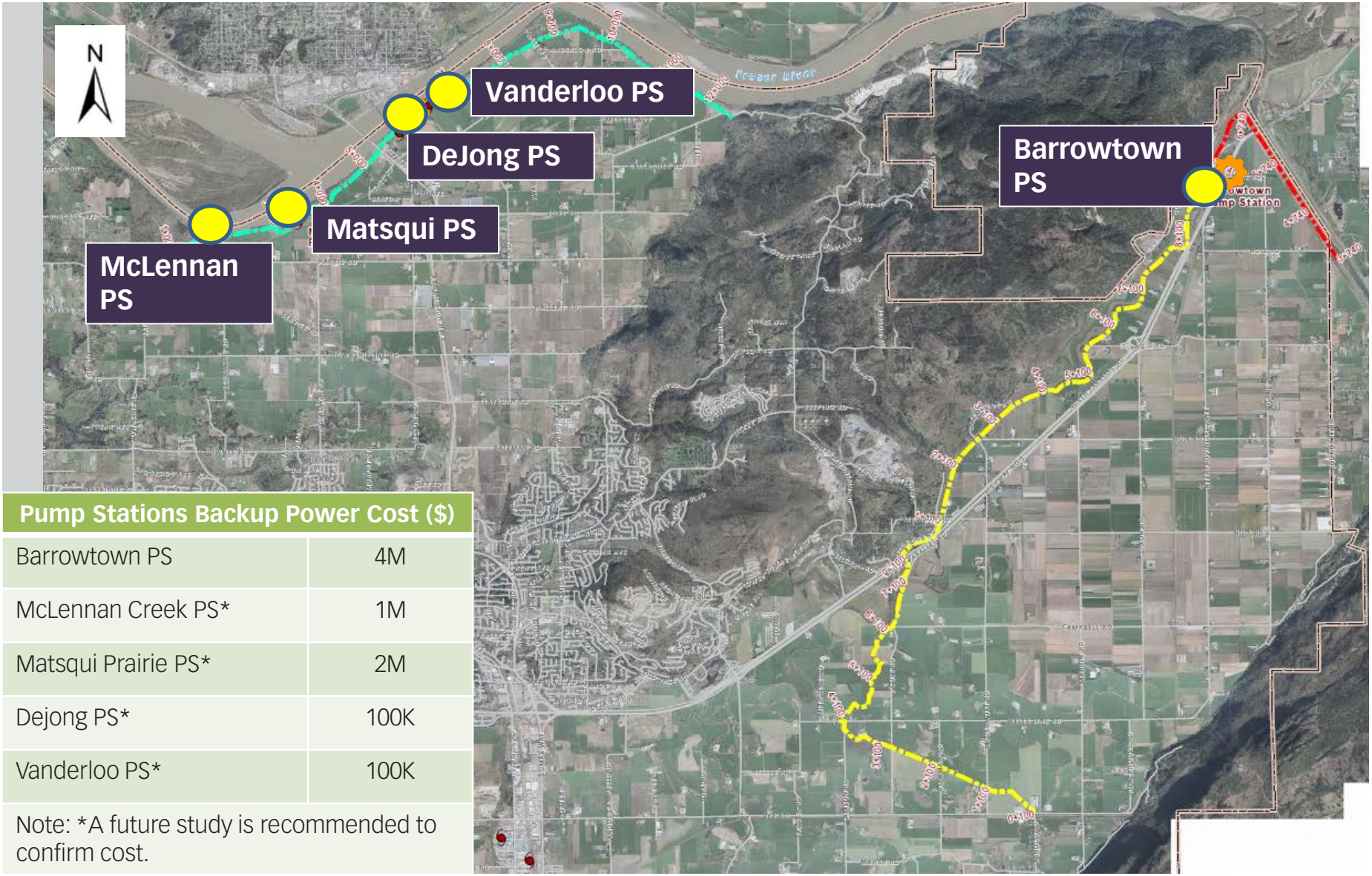


Figure 2-8 – Pump station resiliency and costs



Pump Stations Backup Power Cost ($)	
Barrowtown PS	4M
McLennan Creek PS*	1M
Matsqui Prairie PS*	2M
Dejong PS*	100K
Vanderloo PS*	100K

Note: *A future study is recommended to confirm cost.

2.4.6 Bylaw and Policy Updates

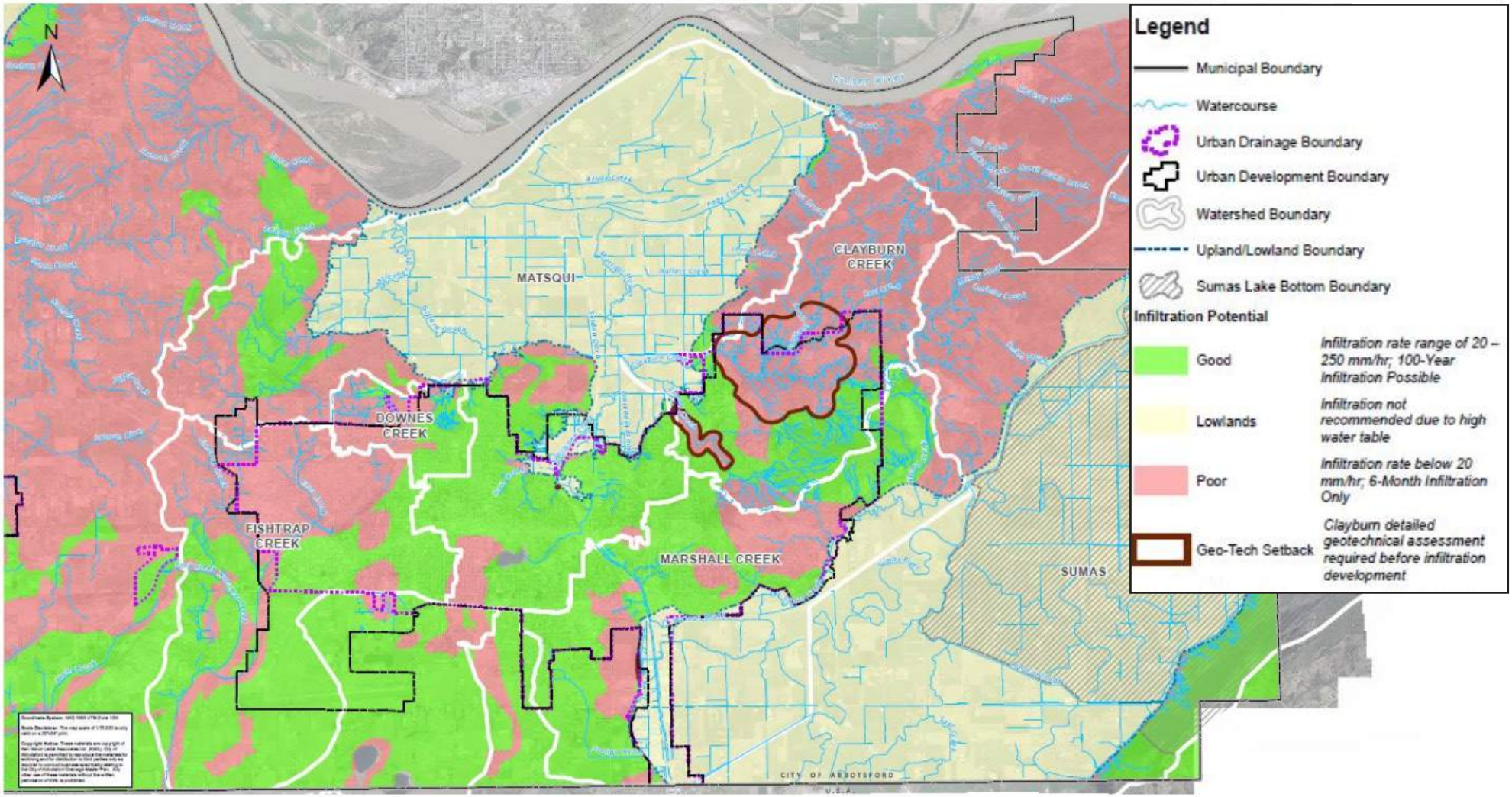
As discussed in Section 2.4.4, to further protect the aquifer and the environment, there are opportunities to expand the current CICP lands Stormwater Source Control Bylaw to City-wide to promote infiltration and water quality enhancement, and to include climate change impact and fish friendly infrastructure to guide future development /redevelopment and capital improvement projects.

Recommendations

The recommendations are to:

- Expand the current CICP lands Stormwater Source Control Bylaw to City-wide to promote infiltration and water quality enhancement, and make it enforceable for new developments and re-developments;
- Incorporate a climate change adaptation strategy and fish friendly infrastructure requirement to the Development Bylaw;
- Inform other bylaws from drainage perspectives, such as Erosion and Sediment Control Bylaw, Streamside Protection Bylaw, and Tree Protection Bylaw; and
- Consult infiltration opportunities mapping to determine volume reduction target for devleopment applications.

Figure 2-9 – Infiltration Opportunity



2.4.7 Stormwater Fees and Charges

The City has various service levels and different fees and charges for different areas. Users within the Urban Development Boundary, Sumas Prairie and Matsqui Prairie are paying drainage fees according to different rate structures through property tax to fund drainage improvement and maintenance programs. Users in the Rural Upland Area are not paying any fee for drainage servicing, and the services are limited to maintaining roadside ditches and replacing major culverts under roads in emergency situations. Current services such as ditch/culvert maintenance in the Rural Upland Areas are being funded by everyone through general revenue taxation.

Recommendations

Best practices for drainage fees and charges in the United States and Canada were reviewed. Examples in other municipalities in BC include:

- based on property size, type, and other indicators;
- flat rates;
- variable rates: impervious area calculation, street frontage, incentives; and parcel tax.

The review identified two commonly used fee structures, including a flat rate and a variable rate.

A future feasibility study on the Stormwater Fees and Charges is recommended to investigate, analyze, and recommend an appropriate rate structure and implementation strategy that is suitable for the City of Abbotsford.

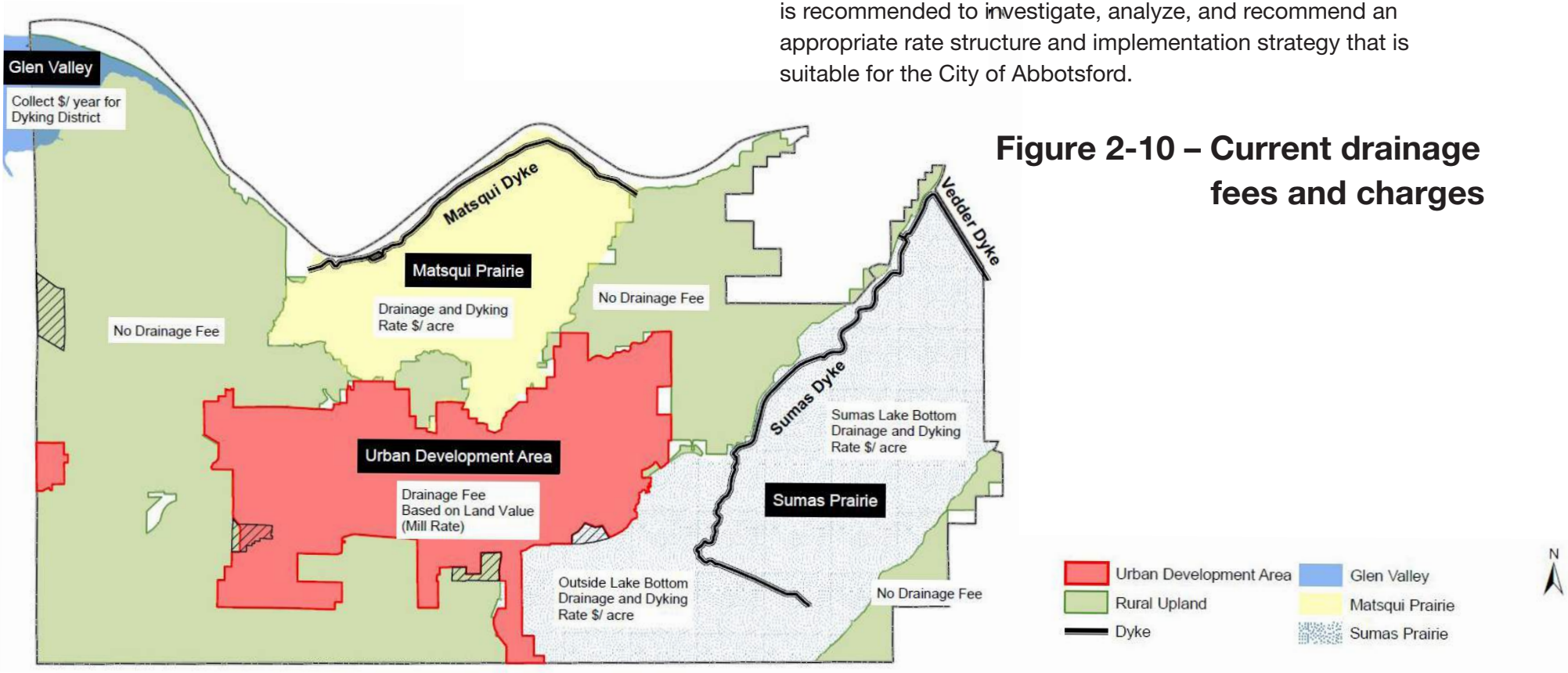


Figure 2-10 – Current drainage fees and charges

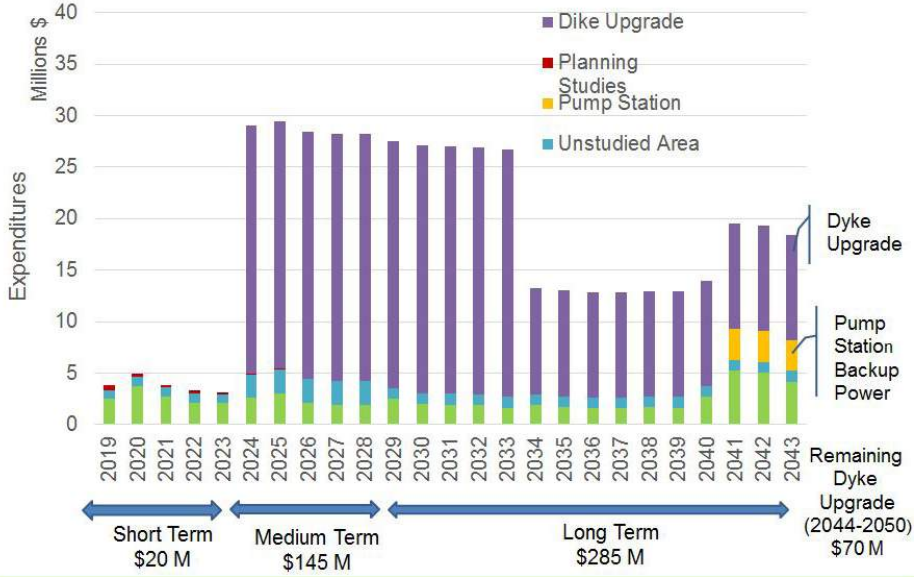
2.5 PROPOSED CAPITAL EXPENDITURES

The proposed drainage capital projects are prioritized into short term to long term horizons in the next 25 years. The total proposed capital expenditure is $450M for the next 25 years, which includes the following:

- proposed capital improvements recommended by completed studies;
- proposed capital improvements in the unstudied areas (to be confirmed by future studies);
- pump station backup generators;
- dyke improvements; and
- future studies.

The capital expenditures for the last three years are higher because they include the lower priority projects such as pump station upgrades, new detention ponds and storm diversion construction. The largest portion of the program is dyke improvement, which is estimated at $415M, including $70M to be spent after 2043.

Figure 2-11 – Proposed Drainage capital expenditures



The dyke improvement cost can be represented in two phases:

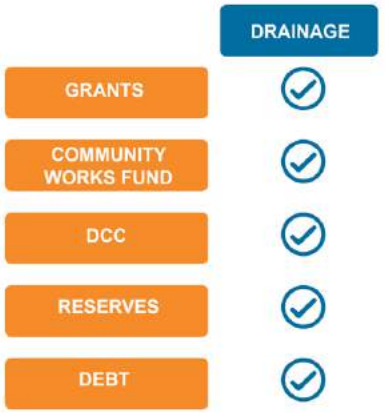
Phase 1 (2024 to 2033) - Each dyke will be raised by 0.5 m and fully seismically upgraded. The estimated cost is $240M, not including other construction components such as utilities, seepage, access and roads, turnouts, rail crossings, drainage, bank protection, land acquisition and pump stations; and

Phase 2 (2034 to 2050) - The rest of the required dyke improvement will be performed in this phase. The estimated cost is $175M for the geometric portion of dyke raising and other construction components including utilities, seepage, access and roads, turnouts, rail crossings, drainage, bank protection, land acquisition and pump stations.

The phasing program for the dykes is approximate and to be further reviewed. Major projects are to proceed with funding from senior levels of government. The City will be looking for 100% funding from senior governments for dyke improvements.

Without dyke cost, the total capital expenditures are $105M for year 1-25, with an average annual cost is approximately $4M. Highlights of the proposed 25-year Drainage Capital Program include:

- long term affordable plan;
- costs are distributed over time; and
- major projects are to proceed with significant funding.



ABBOTSFORD

ENGINEERING & REGIONAL UTILITIES

CITY SEWER MASTER PLAN

FINAL REPORT

June 2018

3.1 BACKGROUND

The wastewater system generally flows from south to north to the Joint Abbotsford Mission Environmental System (JAMES) wastewater treatment plant. The JAMES plant is located on the south side of the Fraser River. The system includes 33 pump stations, and approximately 560 km of sewer mains, ranging in size from 50 mm to 1,800 mm diameter.

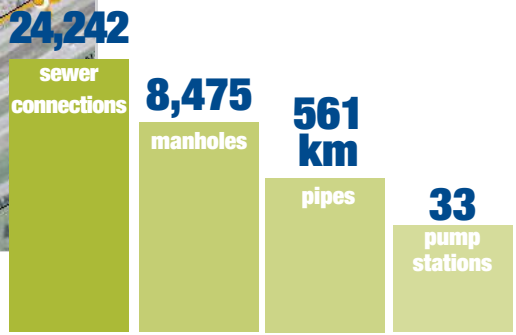
The City Sewer Master Plan has analysed the impact on the sewer collection system and identified infrastructure improvement as the residential population grows to 200,000 people as well as supporting industrial, commercial, and institutional (ICI) growth. A long term capital program has now been developed with costs, timing and priorities.

3.2 OVERVIEW

In Abbotsford, the wastewater collection system flows from south to north to the Joint Abbotsford Mission Environmental System (JAMES) wastewater treatment plant. The JAMES plant is located on the south side of the Fraser River. The collection system includes approximately 560 km of sewer mains, ranging in size from 50 mm diameter to 1,800 mm diameter; 33 pump stations; and 8,475 manholes. There are approximately 24,300 sewer connections to properties and businesses. The collection system services 132,000 people in Abbotsford, including Matsqui and Sumas First Nations. City of Sumas, Washington (USA) is also serviced to the City's sewer system under a servicing agreement.

Figure 3-1 – Example of sewer collection system

City sewer infrastructure by the **numbers**



Some of the key trunk sewers in the collection system are:

- JAMES Trunk Sewer
- North Clearbrook Trunk Sewer (NCTS)
- South Clearbrook Trunk Sewer (SCTS)
- Highway 11 Trunk Sewer
- Straiton Siphon Sewer
- Huntingdon Trunk Sewer

City Sewer Collection System and Service Area Map

Figure 3-2 shows the City's sewer collection system. The Sewer Service Area largely follows the Urban Development Boundary. However, there are some exceptions:

- Matsqui First Nations and Sumas First Nations. Both of the First Nations lands are serviced under separate servicing agreements;
- Certain schools (e.g. Upper Sumas Elementary School, Aberdeen Elementary School) are serviced to the City's sewer system due to public health reasons;
- Certain rural areas of the City (e.g. Mt. Lehman subdivision, Matsqui subdivision) are serviced to the City's sewer system due to public health reasons; and
- Certain properties are connected to the City's sewer system under previous Council policy to service rural properties.

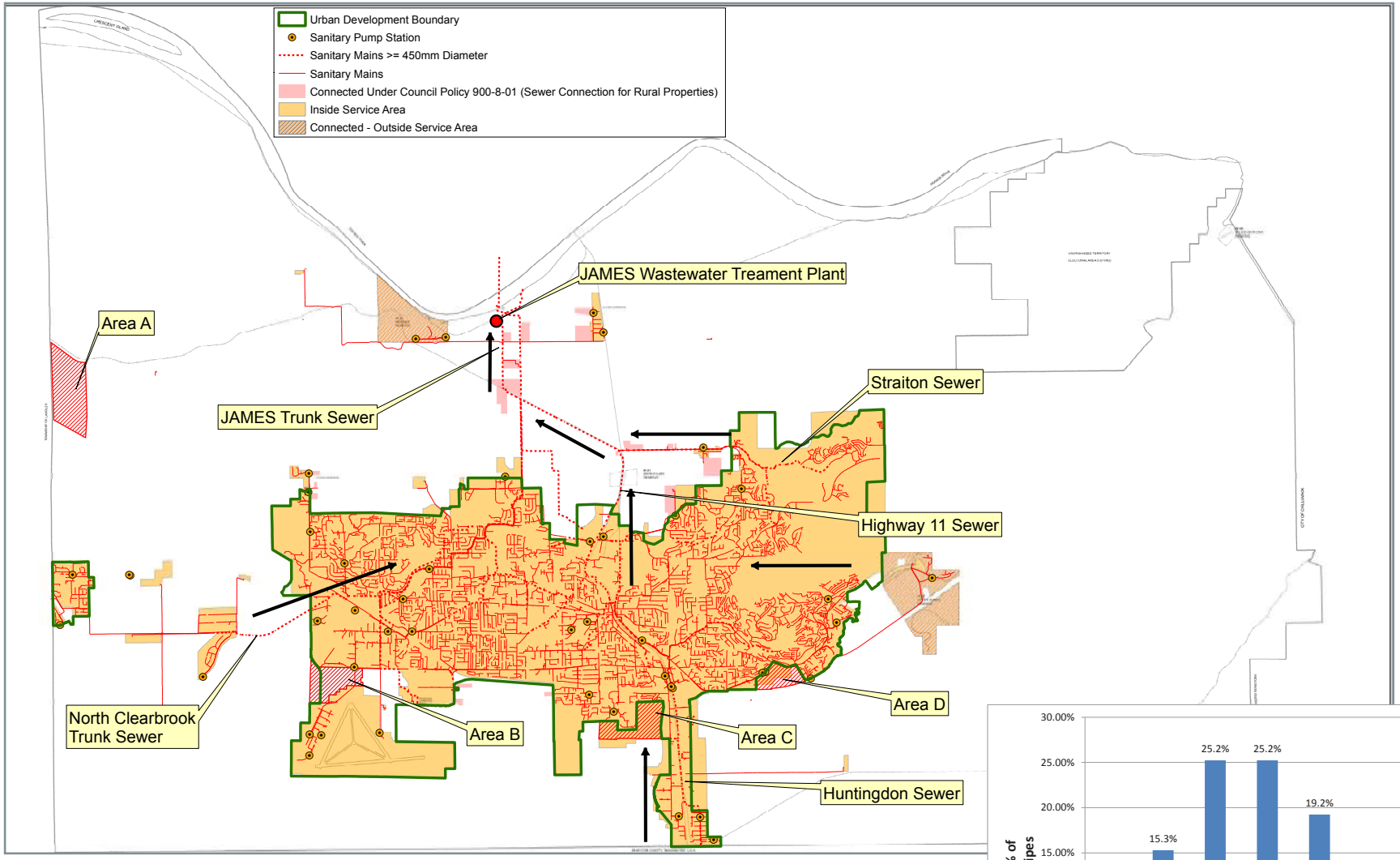
System Condition

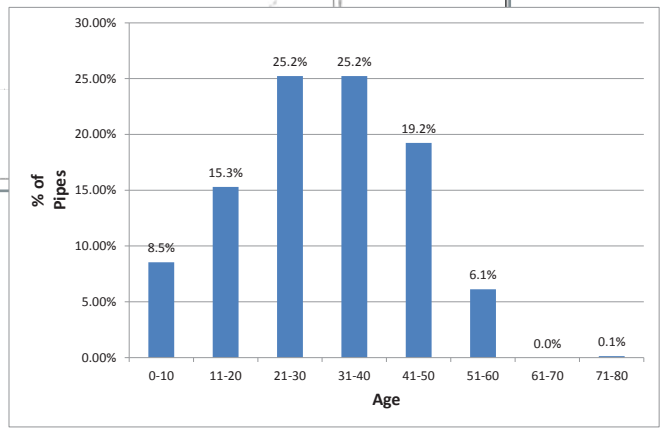
Approximately 80% of the sewer mains have been CCTV inspected. Out of the inspected pipes, 94% are in good condition, 4% of the pipes are approaching critical condition in terms of deterioration and 2% of the pipes are in critical condition. The City has a yearly sewer rehabilitation program through which the critical pipes are rehabilitated back to good condition extending their service life.

The City also monitors sanitary flows through flow monitoring stations. The flow monitoring data provides valuable information on per capita sewer usage and infiltration and inflows.

The average age of the sewer mains in the City's collection system is 30 years. Approximately 50% of the pipes are between 20 and 40 years old. The average useful life of the pipes is 75 years. The City's sewer mains are relatively young; however, the useful life decreases for asbestos cement and concrete pipes due to corrosion from sewer gases.

Figure 3-2 – Sewer collection system and sewer mains by physical age





A comprehensive Wastewater (sewer) Master Plan is needed to analyze the impact on the sewer collection system, develop new infrastructure, and complete necessary upgrades to existing infrastructure to support the residential population growth as well as industrial, commercial, and institutional (ICI) growth. Abbotsford's Sewer Master Plan is a comprehensive guiding document outlining sewer infrastructure improvement with costs, timing and priorities to support future growth.

Mitigation strategies address each issue and opportunity. Improvement options and future studies were prioritized with cost estimates, in a range of short term (0-5 years), medium term (6-10 years), and long term (11-25 years) plans.

3.3 GUIDING PRINCIPLES AND ASSUMPTIONS

Guiding Principles

The three key guiding principles of the City Sewer Master Plan are Municipal Wastewater Regulations, the Sewer Regulations Bylaw and the Development Bylaw.

Abbotsford has a separate sanitary and storm sewer system; although, a certain amount of Infiltration & Inflow (groundwater and rain runoff) will enter the sanitary sewer system through manholes and pipes. The sanitary sewer system has to be designed for sanitary flows plus 1 in 5 year return period storm flows without causing an overflow.

The bylaws guide the Master Plan process, and results from the Master Plan process feed back for bylaw improvements and revisions. If there are any health concerns raised by the Province in residential areas with on-site wastewater treatment, the City will consider servicing those areas subject to available capacity.

Assumptions

The key assumption for the City Sewer Master Plan is that the existing Sewer Service Boundary (SSB) which largely follows the Urban Development Boundary (UDB) willl remain unchanged. The residential growth and industrial, commercial and institutional (ICI) growth will follow the OCP projections.

As per the Sewer Regulations Bylaw, lands outside the SSB (ALR lands, Area H and other) will not be serviced. Lands outside the SSB will remain on private on site treatment (e.g. septic tank). The exceptions are Special Study Areas A, B, C and D identified in the OCP. The special study areas are currently outside the SSB but servicing these areas have been considered in the Master Plan.

3.4 ISSUES AND OPPORTUNITIES

3.4.1 Dry Industry vs. Wet Industry

Dry industry refers to industrial operations that have low impact on water and sewer. Wet industry refers to industrial operations that have high impact on water and sewer. For example, a warehouse or a logistics operation is considered a dry industry type development, whereas a food processing plant is considered a wet industry type development. For reference, there are approximately 25 mostly agricultural related processing industries in Abbotsford. Approximately 15% of the total sewer flows recieved at the JAMES wastewater treatment plant come from these wet processing industries.

The impacts on infrastructure from dry versus wet industries are quite different. For analysis and evaluation purposes, sewer discharge from businesses and industries are typically represented as population equivalency per hectare (PPH). A review of available sewer flow monitoring data and Advanced Metering Infrastructure (AMI) water use data showed that sewer discharge from dry industrial developments is in the range of 20 to 25 PPH. In comparison, a small to mid-range food processor, which has higher discharge, is in the range of 80 to 90 PPH.

Figure 3-3 illustrates urban sewer boundary (orange shaded) and special areas (hatched). Currently, all industrial uses, both dry and wet, are grouped under general industrial zones, as shown in purple shading on the map. The strategy applied in the Master Plan is to allow for a mix of wet and dry industrial use, including Special Study Areas A and B. An average density of 50 PPH is used for the purpose of infrastructure sizing.

As there is no specific zoning for processing industries, any agricultural processor can develop or re-purpose a property in any industrial zone. If too many processing industries develop in one particular area, it may cause significant capacity issues on the collection system.

Recommendations

The City Sewer Master Plan recommends that a study be undertaken to evaluate and develop options for accommodating wet industries. Some of the options to be considered in the study are:

- creating special zoning for wet industries;
- introducing changes to Wastewater Discharge Permits; and
- applying restrictive covenants on the property title etc.

The ideal location to develop a wet industry is near trunk sewers with available capacity, such as the South Clearbrook trunk sewer and Highway 11/Industrial Avenue trunk sewer.

The City Sewer Master Plan identifies that servicing Special Study Area A and B will require significant new infrastructure and will bring projects such as North Clearbrook Trunk Sewer (NCTS) upgrades forward by 5 to 10 years (from long term to medium term). However, the capital program has the flexibility to include, defer or remove Special Areas A and B, and associated Capital Projects Budget.

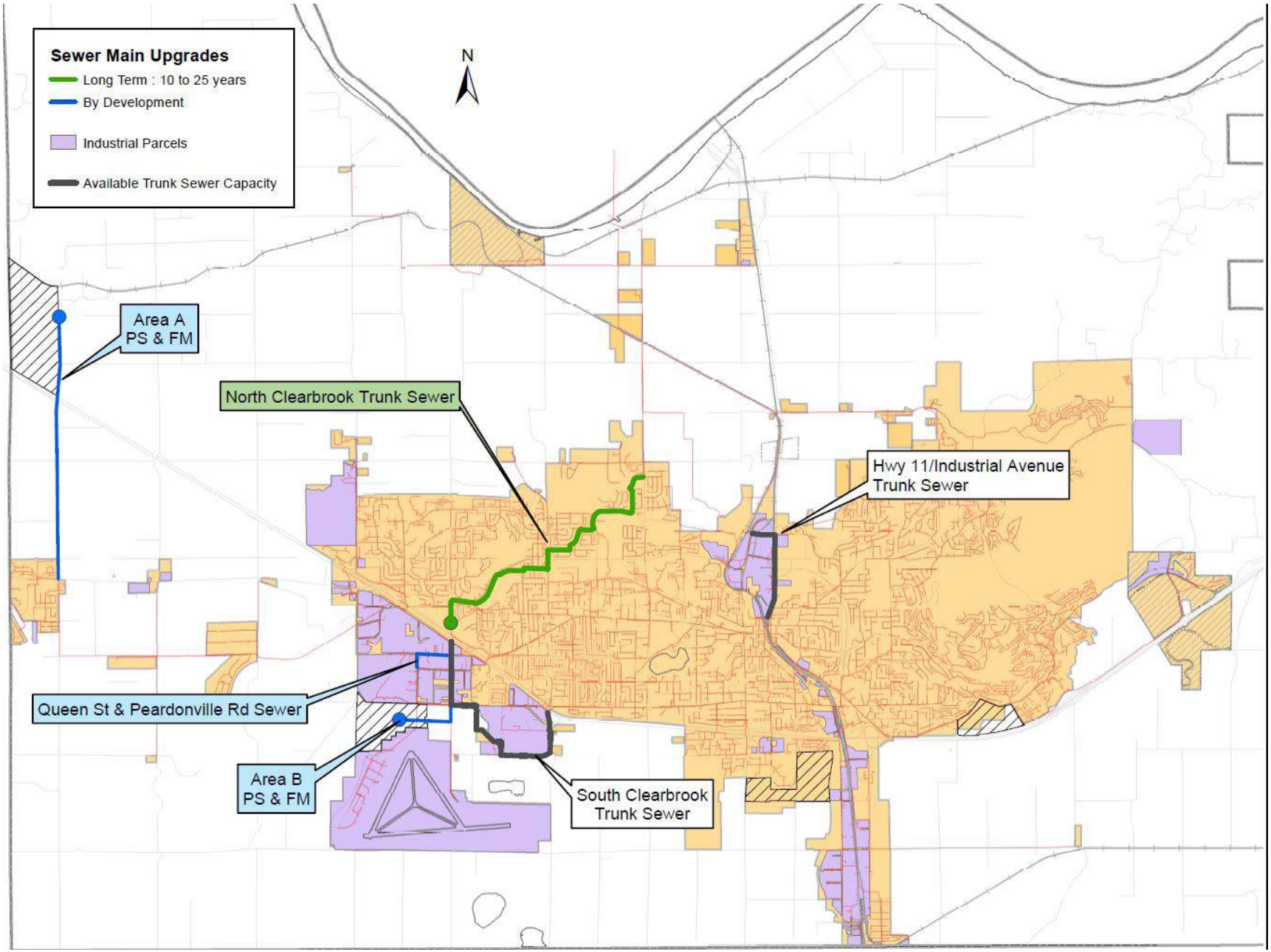
Budget

The City Sewer Master Plan identifies the following budget for accommodating industrial growth:

Wet Industry vs. Dry Industry study:	$100K (Capital costs)
NCTS upgrades:	$10M (Long Term Capital costs)

A case-by-case analysis will be required if large process industries such as a brewery/dairy/poultry industrial developments were to develop in any of the industrial areas.

Figure 3-3 – Dry industry vs wet industry – sewer improvements



3.4.2 Infrastructure Upgrades

Sewer main upgrades, facility upgrades (i.e. pump stations and siphon chambers), and odour and corrosion control are some of the major capital expenditures anticipated in the next 25 years. As the City grows to a population of 200,000 people, these projects will be needed. The Master Plan has reviewed project timing and has identified capital upgrades.

Recommendations

The Master Plan has developed short term, medium term and long term projects. These projects are required to accommodate the residential and ICI growth as identified in the 2016 OCP. The key upgrades and projects are identified below. For illustrative purposes, only the major ones are shown in Figure 3-4. A cost summary for the capital projects is presented under Section 3.9.

Short term projects

- South of Highway 1 sewer upgrade;
- Wheel Avenue sewer upgrade;
- Sumas Way sewer upgrade; and
- Queen Street pump station upgrade.

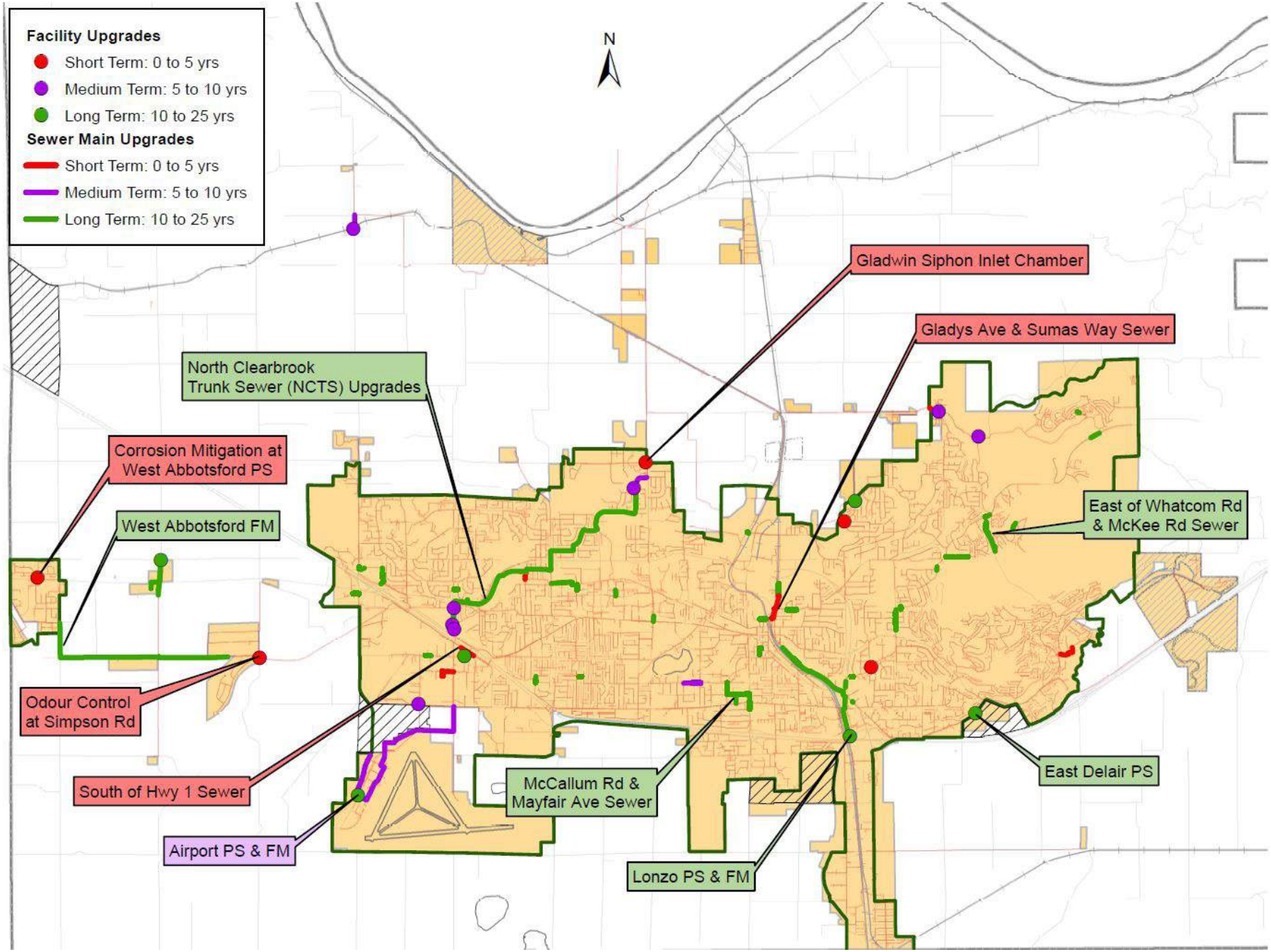
Medium term projects

- Gladys Avenue sewer upgrade;
- Airport pump station & forcemain upgrade; and
- Queen Street & Peardonville Road sewer upgrade.

Long term projects

- Lonzo pump station & forcemain upgrade;
- East Delair pump station upgrade;
- Peardonville pump station upgrade;
- Bateman pump station upgrade;
- East of Whatcom Road & McKee Road sewer upgrade; and
- McCallum Road & Mayfair Avenue sewer upgrade.

Figure 3-4 – System infrastructure upgrades



3.4.3 System Optimization

Historically, per capita sewer discharge was in the range of 350 L/capita/day. Due to the City's AMI program, on-going water conservation measures, and building code changes, per capita water usage and sewer discharge have dropped to 225 L/capita/day.

In addition, the City's Closed Circuit TV (CCTV) and sewer rehabilitation program has returned critical pipes to good condition, extending their service life, which leads to reduced Inflow and Infiltration (I&I). The combination of lower sewer discharge and reduced I&I have freed up additional capacity in the sewer system, and in some cases have deferred future upgrade requirements.

Due to the above, the Master Plan is able to optimize the capacity of the sewer system and identify or defer upgrades, as necessary. While deferring projects, the Master Plan has included industry standard safety factors in utilizing the additional capacity of the sewer system as a result of the decrease in per capita sewer discharge.

Recommendations

The Master Plan is recommending that the City continues to invest in water efficiency measures and I&I monitoring. One of the key projects that has been deferred beyond 25 years is JAMES trunk sewer upgrades (capital costs - $10M), as shown in Figure 3-5.

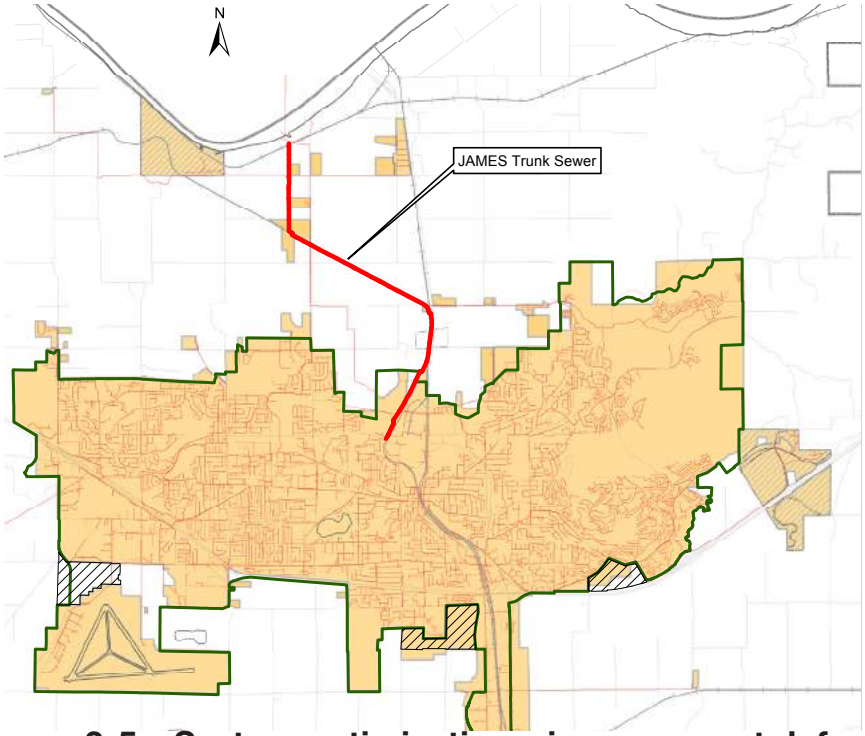


Figure 3-5 – System optimization – improvement deferral

3.4.4 Sewer Odour and Corrosion

Long forcemains (FM) and non-laminar sewage flow may cause odours, hydrogen sulphide (sewer gases) and corrosion. Sewer gases are naturally present in the sewer and are released into the atmosphere due to turbulence. The Master Plan has identified locations experiencing sewer odour, with a plan to address the issue as discussed below. Sewer gases lead to corrosion of concrete pipes and manholes. Both NCTS and JAMES trunk sewer are concrete pipes; therefore, mitigating corrosion is a key issue to be addressed in the Master Plan.

Recommendations: Sewer Odour

Two current locations have been identified having sewer odour issues:

- Near the Sun Valley subdivision on Simpson Road, west of Ross Road; and
- Gladwin Road and Downes Road.

The Simpson Road location is immediately downstream of the forcemain discharge from Lefeuvre pump station servicing West Abbotsford. The sewage tends to stay in the forcemain for a long time and odours are released once it discharges into the gravity sewer system. Some of the odour mitigating strategies identified in the Master Plan are pH adjustment and installation of an air-trap in the collection system to trap the sewer odour from reaching the residents homes.

Sewer gases are emitted at Gladwin Road and Downes Road when the gravity sewer transitions into a siphon system. The solution for this, as identified in the Master Plan, is extracting and treating the sewer gases with a carbon scrubber.

With lower per capita sewer usage, it is anticipated that a few more sites in the City will have odour issues in the future. Three additional sites have been allowed for in the future.

Recommendations: Corrosion

Typically, excessive sewer gases lead to corrosion of concrete pipes and manholes. Strategies for odour control, as discussed previously, treatment of sewage, and extraction and treatment of sewer gases using a carbon scrubber, will also mitigate pipe and manhole corrosion. Sewer rehabilitation, such as lining the sewer, is one of the other strategies identified in the Master Plan.

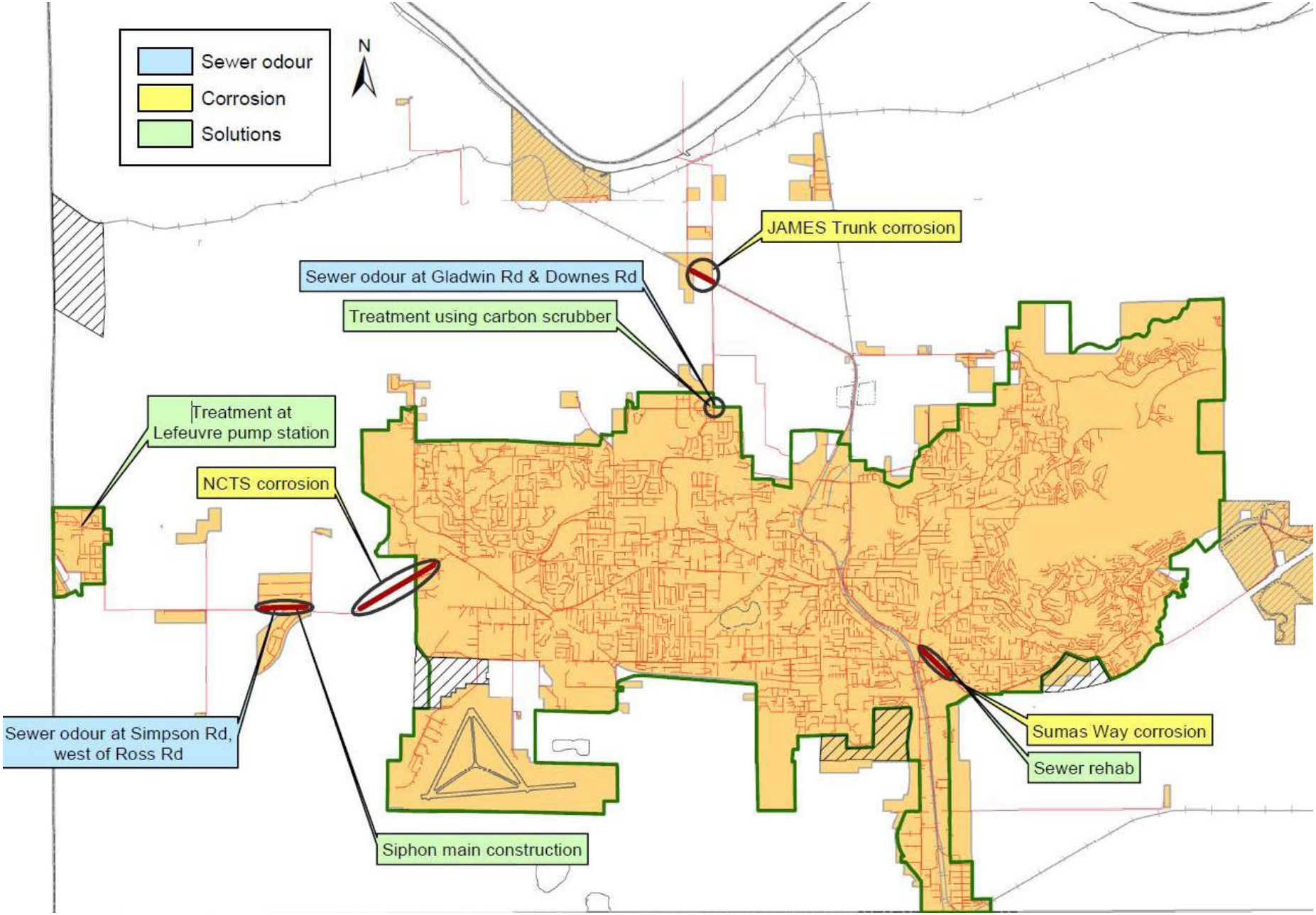
In general, the Master Plan recommends that odour and corrosion, when possible, be prevented at the source of origin. If prevention cannot be done at the source of origin, extracting and treating sewer gases and odour at problem locations is an alternative solution.

Budget

The Master Plan identifies the following budget for odour and corrosion control, and in general for sewer rehabilitation or replacement:

- Treatment at source of origin/sewer gas extraction and treatment at problem locations: $600K for each site (5 sites in total over 25 years)
- Sewer rehabilitation: $800K per year

Figure 3-6 – Sewer odour and corrosion – issue and solution



3.4.5 Sewers in Right-of-Ways

Upgrades of sewer mains in right-of-ways (ROW), especially in side and rear yards, are challenging due to neighbourhood densification. The City has challenges accessing these sewers in the right-of-ways for maintenance purposes. It is understood that in some cases, installing sewer mains in right-of-ways is unavoidable due to topography.

Recommendations

The Master Plan has identified sewer mains in ROW that need to be upgraded. The green lines in Figure 3-7 indicate various areas within the urban area where the sewers in ROW are in need of upgrading in the long term.

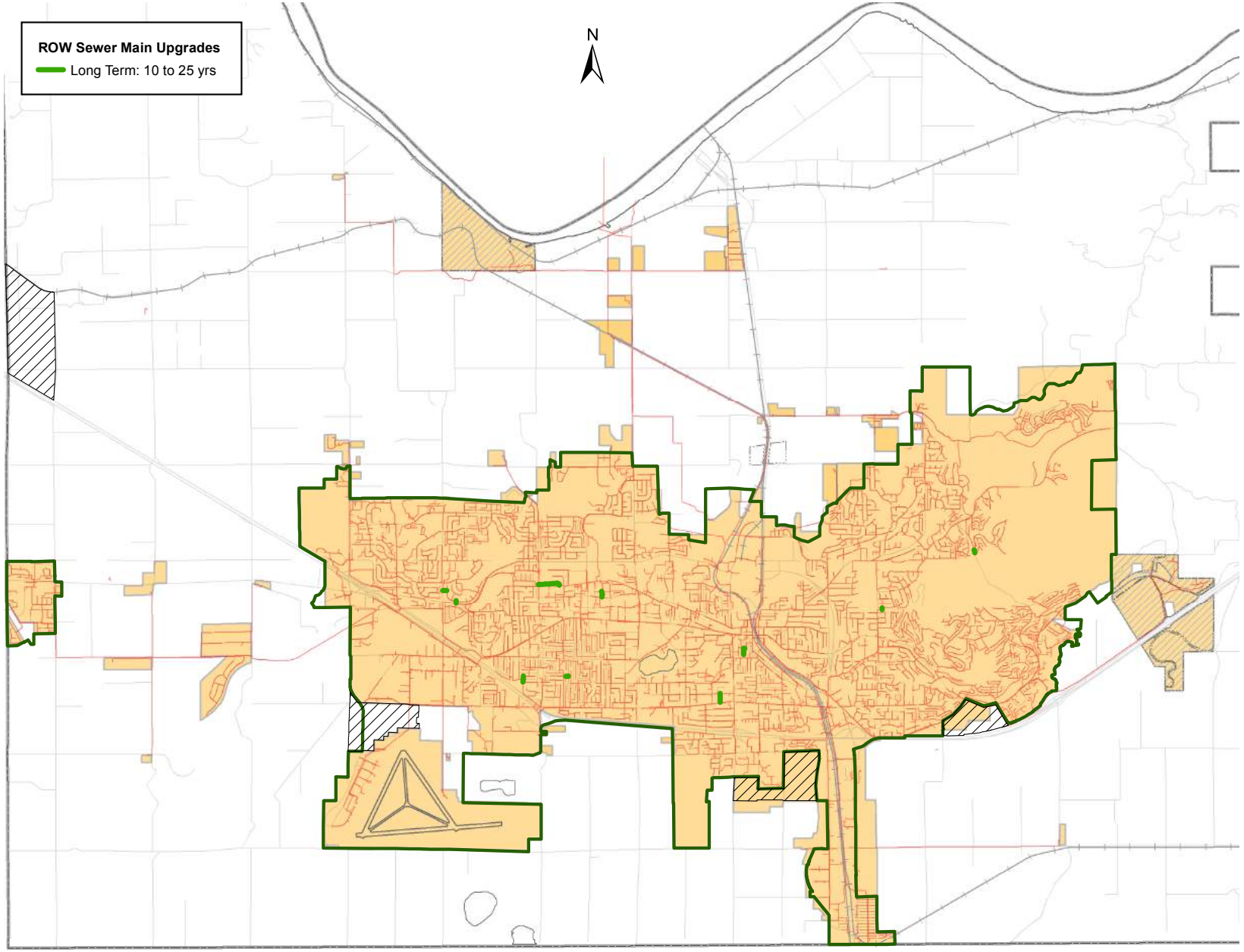
The Master Plan is recommending:

- When possible, sewer mains be installed in the roadway;
- Wider ROW be considered. Access to the ROW should also be considered while installing sewer mains at the rear of the property. This requires an update to the Development Bylaw; and
- Inaccessible sewer mains be abandoned and sewers in roadways be relocated at redevelopment stage.

Budget

The total capital cost of upgrading sewers in right-of-ways is approximately $2M.

Figure 3-7 – Sewer Right-of-Way main upgrades



3.4.6 Climate Change and Sewer Overflows

Although Abbotsford has separate stormwater and sanitary sewer systems, some stormwater finds its way into the sanitary system. In certain catchments, this can make up to 50-70% of the peak sanitary sewer flow.

Due to the increasing frequency of short but intense storms, the impact of climate change on the sewer system was reviewed in the Master Plan.

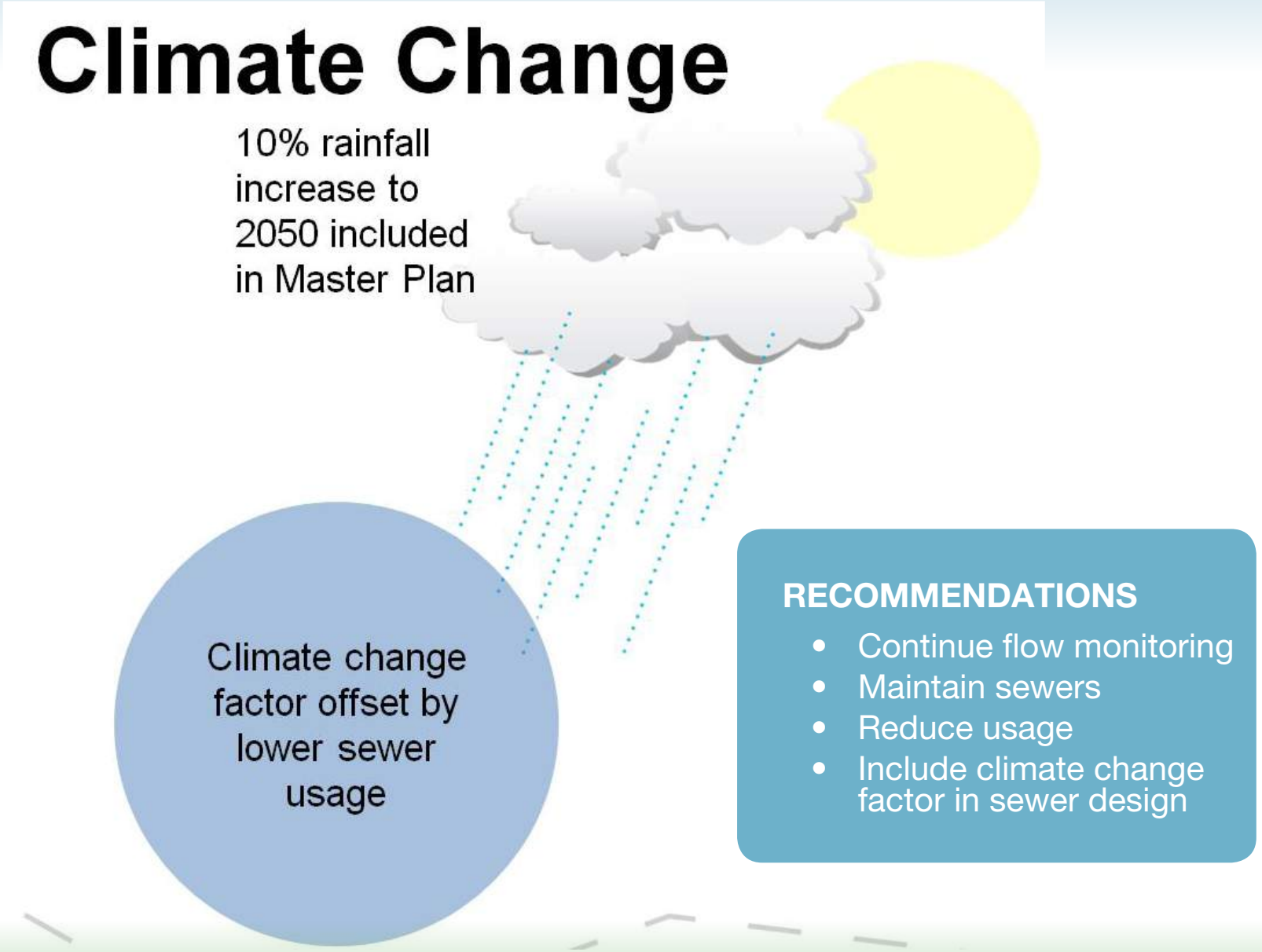
Recommendations

A climate change factor of 10% rainfall increase to year 2050 is included in the Master Plan for infrastructure analysis and sizing. All new infrastructure will be sized to incorporate this climate change factor. The effect of the climate change factor on existing infrastructure is slightly offset by residents and businesses with lower water usage and lower sewer discharge due to water conservation and the implementation of the AMI program.

The Master Plan is recommending:

- The City continue flow monitoring to further validate the 10% rainfall increase factor;
- The City maintain sewers to prevent I&I;
- Continue to reduce sewer usage through water conservation measures; and
- Consider climate change factor in new sewer design.

Figure 3-8 – Climate change and recommendations



3.4.7 Resiliency

The City sewer collection system has 33 sanitary pump stations, of which 23 stations have permanent stand-by generators and 10 stations do not have generators. During the 2017 ice storm event, City staff managed to run the stations by deploying portable generators during the power outage. There is a need to increase the system resiliency.

In addition, there is a need to evaluate the vulnerability of the sewer system due to seismic events.

Recommendations

The Master Plan identifies reviewing permanent back-up generators for the remaining 10 pump stations as part of the pump station upgrades.

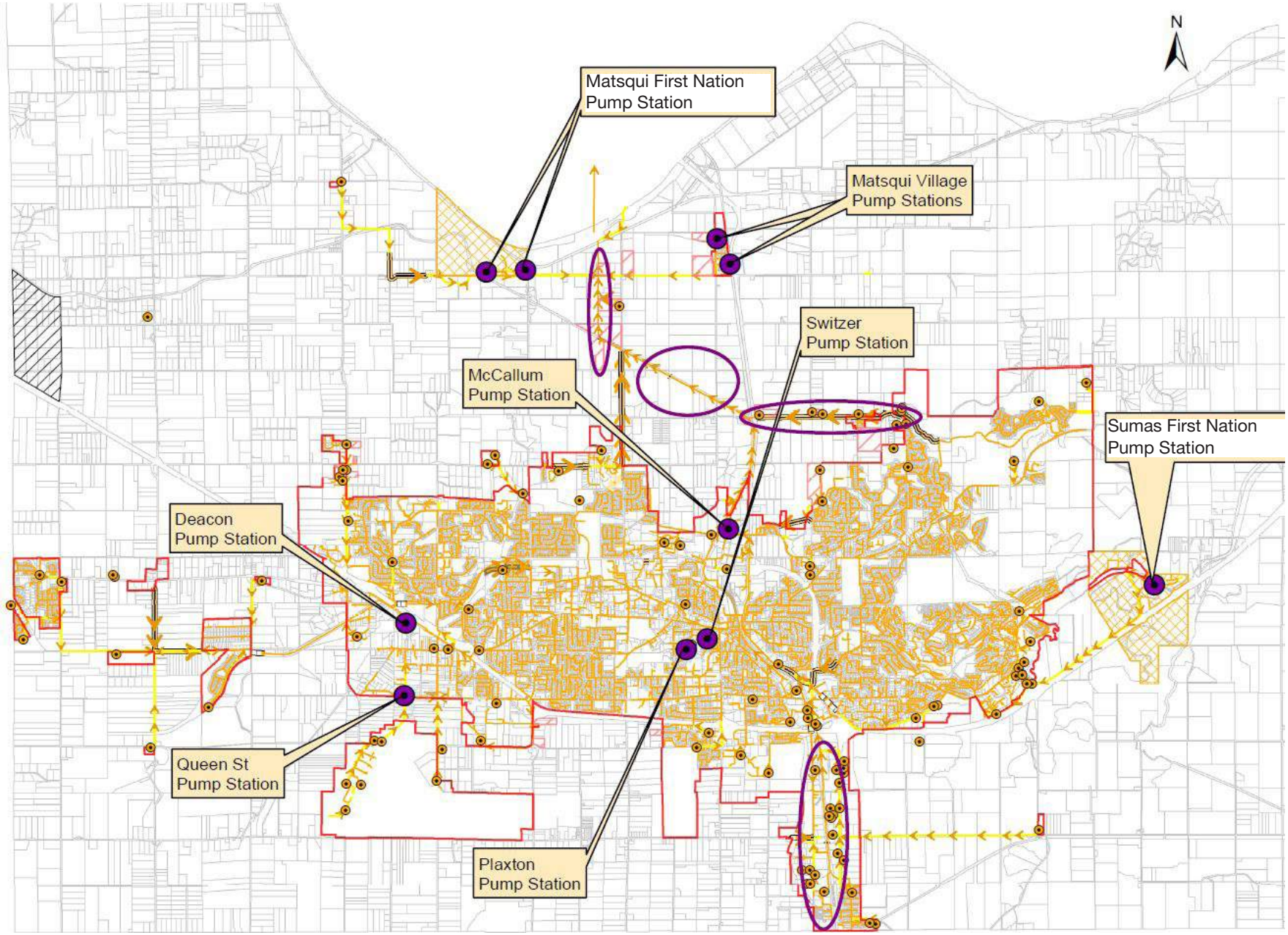
The Master Plan also identifies a separate study to review seismic upgrades for our major trunk sewers and pumping systems. Figure 3-9 shows some of the major trunk sewers that could be affected due to liquefaction in a major seismic event.

Budget

The Master Plan identifies the following budget:

- Back-up generator as part of pump station upgrades: $350K per year
- Seismic resiliency study: $200K

Figure 3-9 – Resiliency



3.5 PROPOSED CAPITAL EXPENDITURES

The total capital expenditure is approximately $65M for the next 25 years, which includes the following:

- Pump systems
- Gravity systems
- Planning and Studies

Short Term Projects ($10M) - 2019 and 2023

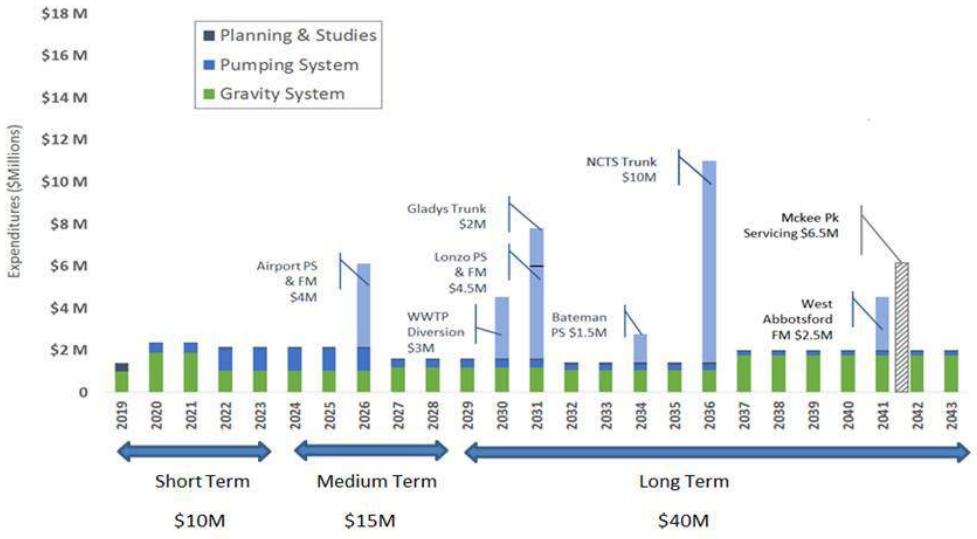
Major capital projects, as identified separately in Figure 3-10 below, are not anticipated in the next five years.

Medium Term Projects ($15M) - 2024 to 2028

Some of the major capital projects identified in the medium term are:

- Upgrades to Airport pump station and forcemain $4M
- Odour and corrosion control for Straiton siphon $600K

Figure 3-10 – Proposed City Sewer capital expenditures



Long Term Projects ($40M) - 2029 to 2043

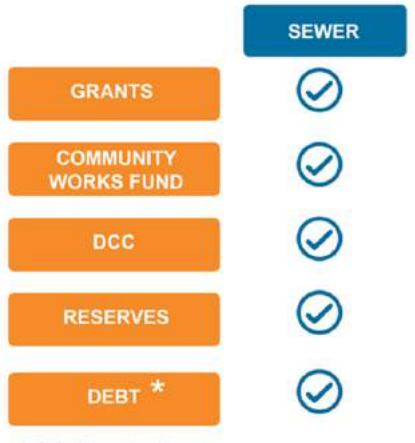
Some of the major capital projects identified in the long term are:

- Gladys trunk sewer upgrade $2M
- Lonzo PS & FM upgrade $4.5M
- West Abbotsford FM replacement $2.5M
- New WWTP JAMES trunk diversion $3M
- Bateman pump station upgrade $1.5M
  (may need to be brought forward to medium term depending on the timing of Special Study Area A and/or Area B)

McKee Peak servicing costs are identified to be in the range of $6.5M. They are not part of capital costs, rather, the servicing costs are private costs.

Highlights of the proposed 25-year City Sewer Capital Program include:

- Long term affordable plan;
- Costs distributed over time; and
- Grants will be sought after for major projects within the Capital Program.



ENGINEERING & REGIONAL UTILITIES

CITY WATER MASTER PLAN

FINAL REPORT

June 2018

4.1 BACKGROUND

Water is supplied to the City's distribution system from the Abbotsford Mission Water & Sewer Commission (AMWSC). Sources of water include Cannell Lake (UV), Norrish Creek (slow sand filtration and membrane plant) and 19 groundwater wells in the community.

The City provides potable water to approximately 132,000 people in Abbotsford including Matsqui First Nations.

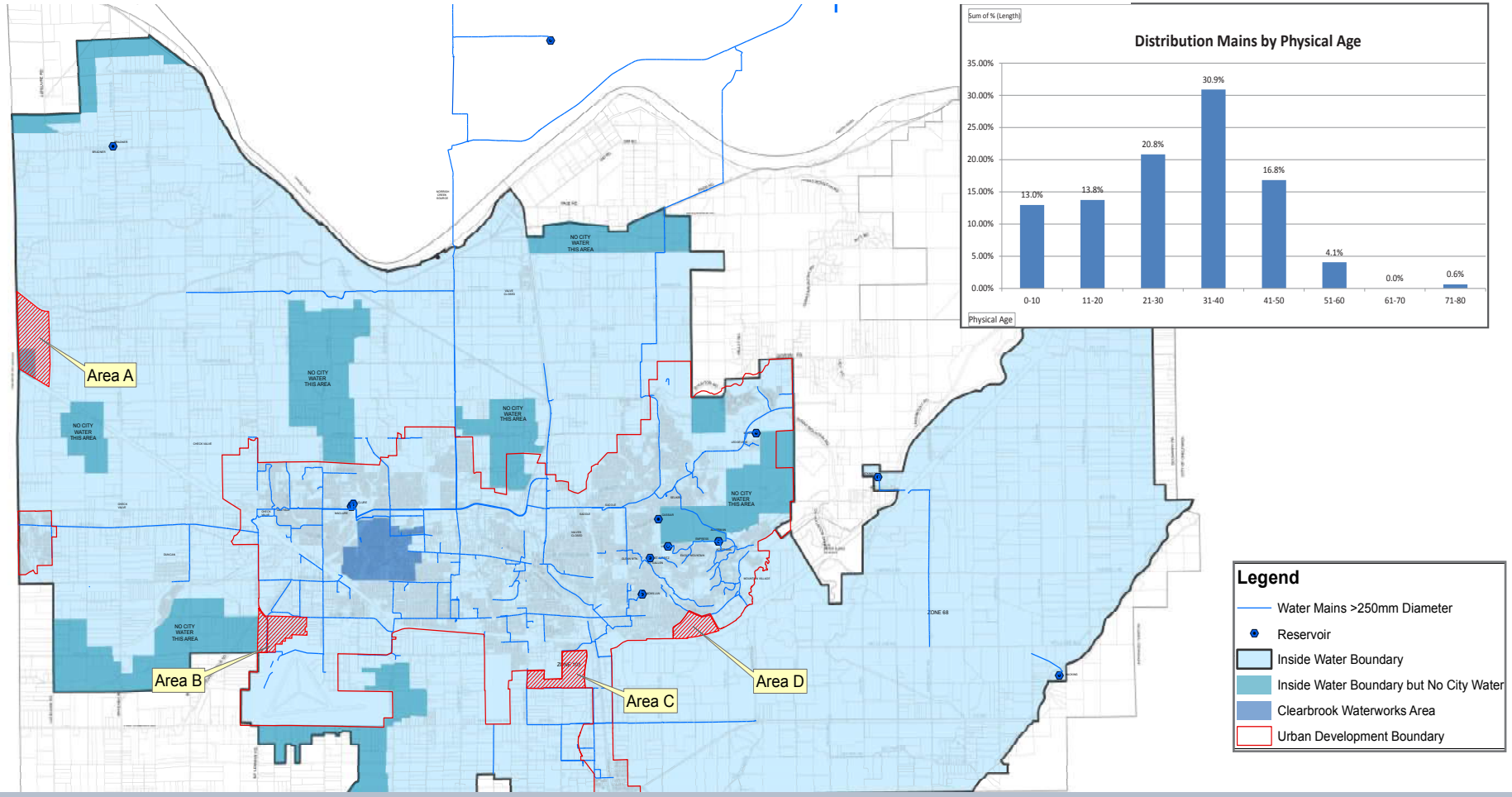
The City Water Master Plan has identified the impact on the water distribution system as the population grows to 200,000 people as well as supporting industrial, commercial, institutional (ICI) and agricultural growth. A proposed long term capital program has been developed with costs, timing and priorities.

4.2 OVERVIEW

The City provides municipal water to approximately 132,000 people. The system receives its water from Norrish Creek, Cannell Lake, and various groundwater wells in the City. The water is distributed through approximately 910 km of pipe. The system also includes 10 reservoirs, 12 pump stations, and 23 PRV stations.

Figure 4-1 shows the City water system with water mains that are 250mm (10 inches or larger). The water boundary includes properties that may be serviced by City water. The red boundary is the Urban Development Boundary. Properties that are not serviced with City water (but within the water boundary) are indentified with the darker blue. These properties have the ability obtain City water; however they would be required to go through the Local Area Improvement process. Finally, the darkest blue area at the centre of the Urban Development Boundary shows the area that is serviced by the Clearbrook Water Works District.

Figure 4-1 – Water distribution and water mains by physical age



System Condition

The average age of water main in the City of Abbotsford's distribution system is 29 years old. The approximate useful life of the water main is 75 years. This shows that Abbotsford water mains are relatively young and have over half of their remaining life left.

Demand Projections

Figure 4-2 shows the historical and future Maximum Day Demands (MDD) in mega litres per day. MDD is the peak water demand in the year that occurs on any single day. Historically, the demands peaked in 2006 and 2007. A strong effort in water conservation and the introduction of Advanced Metering Infrastructure (AMI) system and bi-monthly billing reduced the MDD by approximately 30%. Future MDD is calculated based on current demands including conservation efforts into the future and projected based on population, industrial, commercial, institutional and agricultural growth.

A comprehensive Water Master Plan is needed to analyze the impact on the water distribution system, develop new infrastructure, and complete necessary upgrades to existing infrastructure to support the residential population growth as well as industrial, commercial, institutional (ICI), and agricultural growth. Abbotsford's Water Master Plan is a comprehensive guiding document outlining water infrastructure improvement with costs, timing and priorities to support future growth.

Mitigation strategies were developed to address each issue and opportunity. Improvement options and future studies were prioritized with cost estimates, in a range of short term (0-5 years), medium term (6-10 years), and long term (11-25 years) plans.

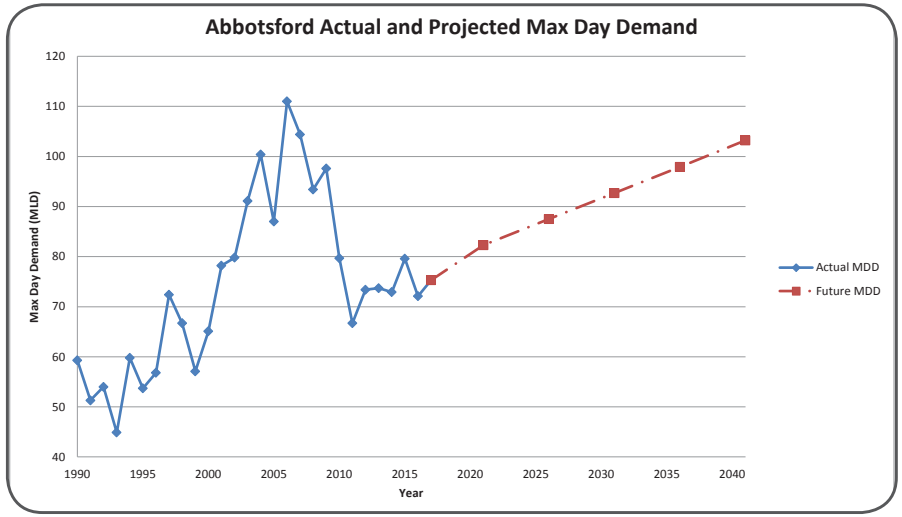


Figure 4-2 – Abbotsford Actual and Projected Max Day Demand

4.3 GUIDING PRINCIPLES AND ASSUMPTIONS

Guiding Principles

The guiding principles of the City Water Master Plan are the Canadian Drinking Water Guidelines, the Drinking Water Protection Act and Regulation, the Water Regulation Bylaw and the Development Bylaw. The bylaws guide the Master Plan process and results from the Master Plan process provide feedback for bylaw improvements and revisions.

Assumptions

The key assumptions for the City Water Master Plan are:

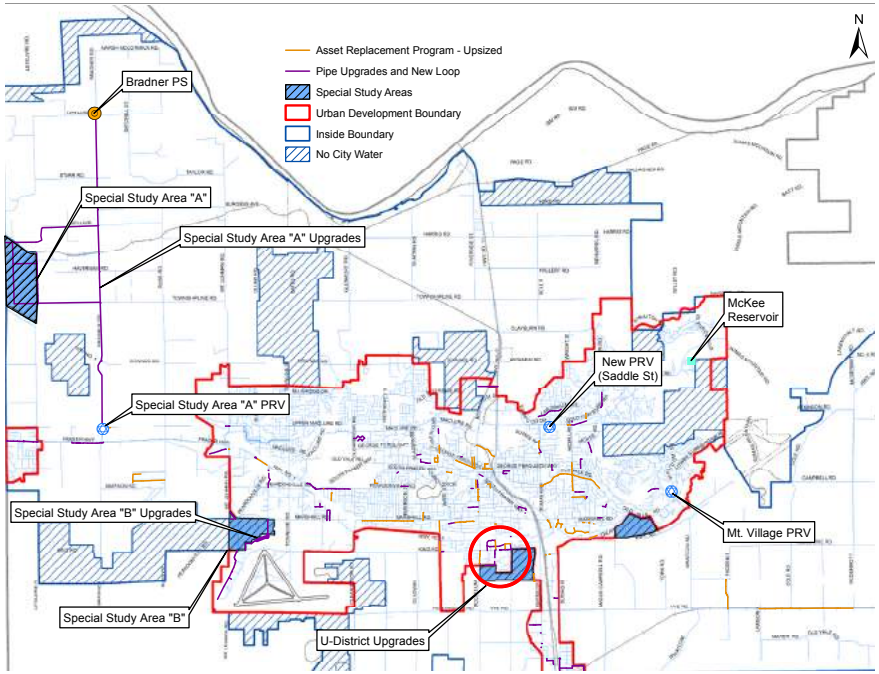
- That the services outside of the Urban Development boundary will remain limited to one service at a maximum size of 25mm (1inch) as per the current Water Regulations Bylaw;
- The existing Water Boundary will remain the same;
- The residential growth and industrial, commercial and institutional (ICI) growth will follow the OCP projections; and
- Urban fire flows will follow the Fire Underwriters Survey (FUS) in the rural area, fire flows will be what is available.

4.4 ISSUES AND OPPORTUNITIES

4.4.1 Infrastructure Upgrades and Asset Renewal

As the City grows to 200,000 people there will be need to upgrade infrastructure to meet these demands. The Master Plan looks at what infrastructure improvements are required to support the population growth to 200,000. The Master Plan has identified both linear upgrades (i.e. water main) and non-linear upgrades including, pump stations; reservoirs; and pressure reducing valve (PRV) stations.

Figure 4-3 – Infrastructure upgrades and asset renewal



Recommendations: Non-linear Upgrades

Some of the key upgrades and projects are identified below. They are also shown in Figure 4-3.

- Bradner Pump Station;
- Mt. Village PRV;
- New PRV (at Saddle Street and Old Clayburn Road);
- New PRV (at Bradner Road and Maclure Road for Special Study Area “A”); and
- McKee Reservoir (To be reviewed as part of the McKee Neighbourhood Plan).

It is also recommended that a study be undertaken to develop a condition assessment program for the City’s non-linear infrastructure so that the infrastructure can be properly maintained.

Recommendations: Linear Upgrades

There are approximately 80 km of Asbestos Cement (AC) water main remaining to be replaced. The majority of these mains are within the Urban Development Area and do not meet today’s minimum pipe size requirements. These AC water mains will be replaced and strategically upsized to strengthen and improve capacity of the system. As part of the system analysis to determine future upgrades, AC water mains were reviewed first to determine if upsizing these mains can improve the system in such a way to meet future needs. After these mains were reviewed, additional water mains were identified as needing to be upgraded or installed to meet the future water needs of the City.

Approximately 45 km of AC water main will be replaced with same size pipe or one size larger to meet current standards to ensure fire flow requirements are met. These pipes will be classified as “Linear Asset Renewal”, and are not required for future growth. There are approximately 6 km of water main that can be abandoned after services are transferred to an existing pipe that is already installed on the same road.

Approximately 19 km of the AC water mains can be replaced with a larger size pipe to meet future demands on the water system. These pipes will be classified as “Linear Asset Renewal – Upsized”. These pipes are required to be larger for future growth and to meet the minimum fire flow requirements.

Approximately 15 km of new or upgraded pipes have also been identified. These pipes will be classified as “New Pipe/Pipe Upgrades”. These pipes are required for future growth and to meet the minimum fire flow requirements.

Other new projects (timing depends on development) include:

- Special Study Area “A” PRV station and water main upgrades
- Special Study Area "B” water main upgrades
- “U” District Neighborhood Improvements

Budget

The Master Plan identifies the following budgets for asset renewal and capacity upgrades:

• Non-linear condition assessment program development	$250K
• Non-linear asset renewal	$1.0M to $1.5M per year
• Linear asset renewal budget	$2.0M per year
• Linear asset renewal - Upsized	$1.0M to $1.5M per year
• New pipe/pipe upgrades	$1.4M per year for approximately 15 years
• Non-linear improvement budget	$2.0M (Excludes McKee Reservoir)

4.4.2 Agricultural Water Use

The current water system, outside of the Urban Development Boundary, was originally designed and intended for domestic and light agricultural use. With the increase of commercialization of the agricultural industry (i.e. greenhouses, larger poultry and dairy farms), the water system may be challenged to meet future water demands.

The current Water Regulation Bylaw restricts rural properties to a maximum water connection size of 25mm. It also does not allow water to be used for open field irrigation. This appears to be an effective method to limit water demands in rural areas. Without these restrictions remaining in place, major infrastructure improvements would be required for the rural area.

The Master Plan allows for a 75% growth over the 25 years in the Agricultural sector to support the City's AgRefresh initiative and allow for impacts of climate change; however, the Water Regulation Bylaw is still applicable to minimize major system upgrades.

The Agricultural industry has been successful using water detention, re-use, re-circulations, ditch irrigation, wells and design of buildings to limit water use, and is encouraged to continue with these best practices.

Recommendation

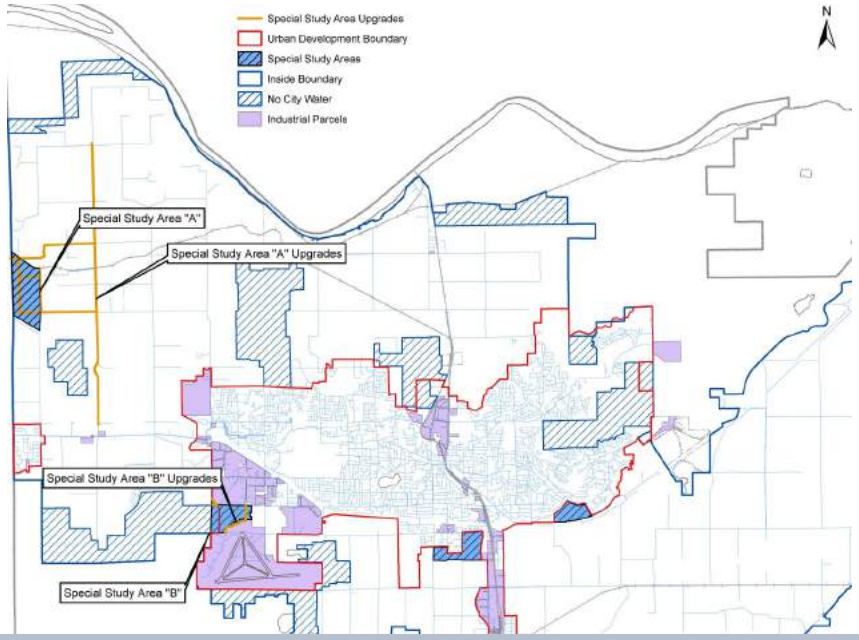
It is recommended that no changes be made to the current bylaw.

4.4.3 Dry Industry vs. Wet Industry

Issues and Opportunities

Dry industry refers to industrial operations that have low impact on water and sewer. Wet industry refers to industrial operations that have high impact on water and sewer. For example, a warehouse or a logistics operation is considered a dry industry type development, whereas a food processing plant is considered a wet industry type development. For reference, there are approximately 25 mostly agricultural related processing industries in Abbotsford.

The impact on infrastructure from dry versus wet industries is quite different. For analysis and evaluation purposes, water usage from businesses and industries is typically represented as population equivalency per hectare (PPH). A review of available sewer flow monitoring data and Advanced Metering Infrastructure (AMI) water use data showed that water usage from dry industrial developments, such as warehousing, transport and logistics, is typically in the range of 20-25 PPH. A small to mid-range food processor, which has higher usage, is in the range of 80 to 90 PPH.



Currently, all industrial uses, both dry and wet are grouped under general industrial zones, as shown in the purple shading in Figure 4-4. Similar to the Sewer Master Plan, the Strategy applied in this Master Plan is to allow for a mix of wet and dry industrial use, including Special Study Areas “A” and “B”. An average density of 50 PPH was used.

As there is no specific zoning for processing industries, an agricultural processor can develop or re-purpose a property in any industrial zone. If too many processing industries develop in one particular area, it may cause significant capacity issues on the water distribution system.

Recommendations

If a large wet industrial development is proposed, a site specific water study should be initiated to determine the effects on the local water system to determine if the existing infrastructure can support the development if any offsite improvements are required.

The inclusion of Special Study Areas “A” and “B” requires significant new infrastructure to service growth. These areas were studied separately and the required improvements can be removed or added to the Master Plan.

Budget

The Master Plan identifies the following budget for accommodating industrial growth:

- Area “A” servicing costs - $25M (private costs);
- Area “B” servicing costs - $2M (private costs).

Figure 4-4 – Dry industry vs wet industry – water improvements

4.4.4 Fire Protection

As the City grows it is important to ensure that there is adequate water for firefighting. The Master Plan has reviewed existing and future firefighting abilities and made recommendations for reservoir or pipe upgrades to ensure that there is adequate water for firefighting to support future growth.

Recommendations

It is recommended that the proposed minimum fire flow requirement, as identified below, be adopted in next Development Bylaw update. This recommendation supports the Fire Master Plan as it ensures there is adequate water to fight fires.

Existing and Proposed Minimum Fire Flow Requirements		
Land Use	Current Bylaw	Proposed
Single Detached/ Duplex Residential	75 L/s	75 L/s
Ground Oriented (Townhouses)	120 L/s	150 L/s
Midrise (Apartments)	167 L/s	175 L/s
Institutional	167 L/s	200 L/s
Commercial / Mixed Use	167 L/s	200 L/s
Industrial	167 L/s	220 L/s

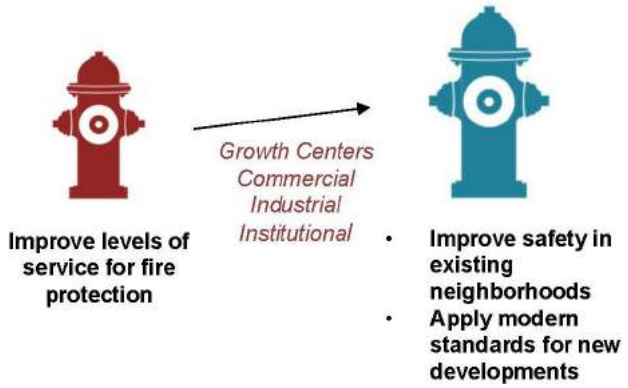


Figure 4-5 – Existing and proposed minimum fire flow requirements

4.4.5 System Optimization

The Master Plan has reviewed the current operation of the water distribution system and made recommendations for improvements to optimize the current system. These improvements will allow the City to optimize the existing infrastructure and improve the system.

The modelling analysis indicates that improvements can be made to the existing system operation to optimize the system in lieu of infrastructure upgrades. These improvements include pressure zone boundary realignments and changing set points on PRV stations, pump stations and/or reservoirs. These improvements are incorporated into the Master Plan.

Recommendations

Originally it was noted that McKinley PRV, Clayburn Village PRV, and Sandon PRV were deficient and required upgrading; however, upon further review it was determined that McKinley and Clayburn Village PRV's fed pressure zones that are fully built out and no further development is anticipated in these areas. These PRV stations do not require upgrades at this time. Rather than upgrading Sandon PRV, it is recommended that the set points be reviewed in the station to ensure that the larger PRV is used for higher flows. An additional improvement identified to the water system is the realignment of the Pressure Zones 123 and 103. Historically, these two pressure zones were the division of the water systems between the District of Abbotsford and District of Matsqui. The boundary of these pressure zones follows McCallum Road from Highway 1 north to South Fraser Way.

Currently the City maintains and operates two water mains, one on each side of the road for portions of McCallum Road from Marshall Road to South Fraser Way. These water mains are undersized to support future developments along McCallum Road. Rather than replacing both water mains with larger pipes, it is proposed that a single pipe be installed to replace both mains and that the pressure boundary between Zones 123 and 103 be realigned. Figure 4-6 shows the proposed pressure boundary realignment. The pressure boundary realignment will result in a pressure increase in the City's system by approximately 30 psi for the areas that used to be serviced in Pressure Zone 103 which will be adjusted to Pressure Zone 123.

Budget

The budget for these projects is included in the "Asset Replacement – Upsized" Program.

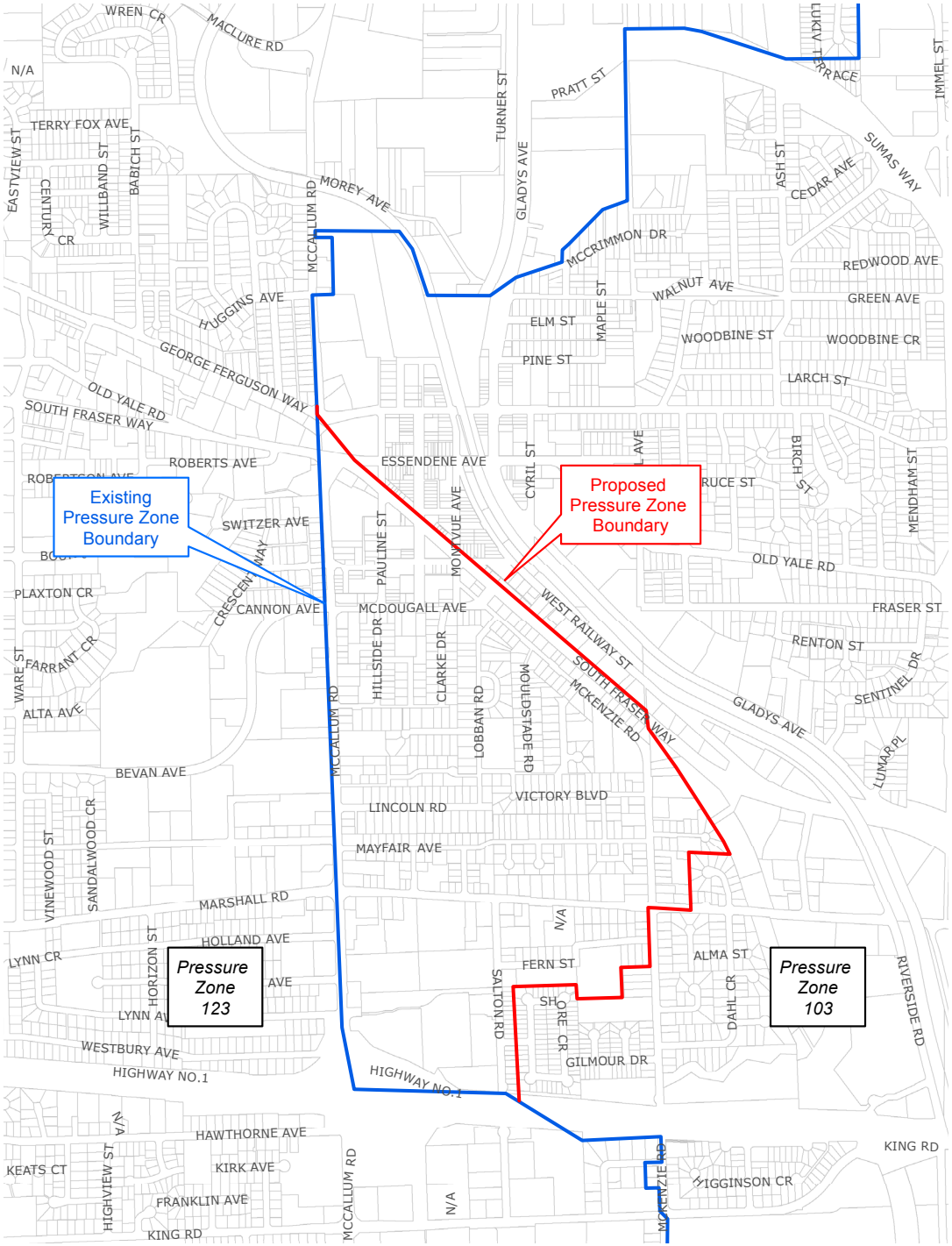


Figure 4-6 – Existing and proposed Pressure zone boundary

4.4.6 Resiliency

There is a need to evaluate the vulnerability of the water system due to seismic and severe storm events.

A large portion of our water system is gravity fed, does not require pumping, and can operate without power. Currently only one out of twelve pump stations require a standby generator (i.e. Bradner Pump Station). PRV stations operate mechanically and do not require backup power to operate.

Recommendations

In 2006, the City conducted a Lifeline Study of the water system. It is recommended that this study be updated and include the following items:

- Develop seismic construction standards for critical water mains;
- Determine requirements for seismic valves at reservoirs; and
- Determine post disaster readiness of the pump and PRV stations.

Budget

The Master Plan identifies the following budget:

Include Back-up generator as part of the Bradner Pump Station Upgrade	Included in station upgrade budget
Update 2006 Lifeline Study	$250K
Resiliency Upgrades (if required*)	$5.0M

**The $5.0M budget for resiliency upgrades is for projects identified from the Lifeline Study and is only required if needed.*

4.5 PROPOSED CAPITAL EXPENDITURES

The total capital expenditure is approximately $125M for the next 25 years, which includes the following:

- Non linear upgrades;
- Non linear asset renewal;
- Linear asset renewal
  (Pipes that need to be replaced with the same size);
- Linear asset renewal – Upsized
  (Pipes that need to be replaced but need to be upsized for growth);
- New pipe/pipe upgrades
  (Pipes that required to be upgraded for or installed for growth); and
- Studies; and
- Seismic upgrades (if required).

Short Term Projects ($30M) - 2019 and 2023

Non linear upgrades (PRV and Pump Station upgrades)

- Bradner Pump Station;
- Mt. Village PRV upgrades;
- New Saddle PRV Linear asset renewal;
- Linear asset renewal – Upsized;
- New pipe/pipe upgrades; and
- Seismic upgrades (if required).

Medium Term Projects ($30M) - 2024 to 2028

- Non linear asset renewal;
- Linear asset renewal;
- Linear asset renewal;
- New pipe/pipe upgrades; and
- Seismic upgrades (if required)

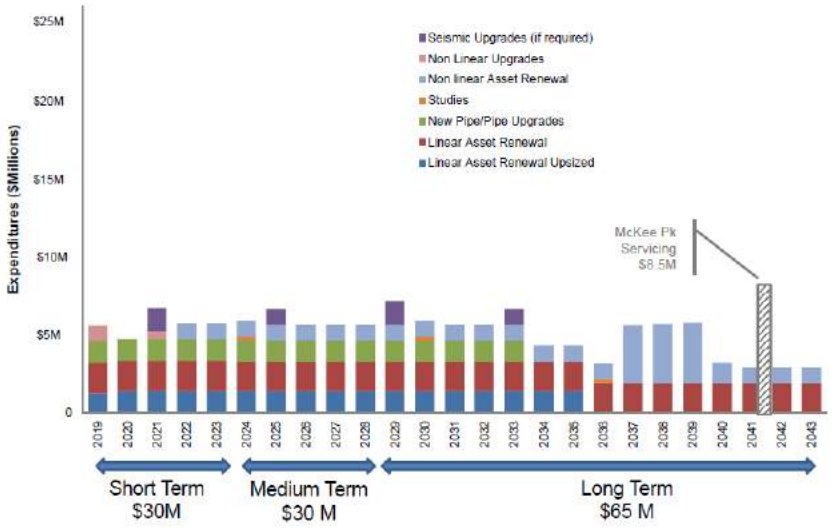
Long Term Projects ($65M) - 2029 to 2043

- Non linear asset renewal;
- Linear asset renewal;
- Linear asset renewal - Upsized;
- New pipe/pipe ugrades; and
- Seismic upgrades (if required).

McKee Peak servicing costs are identified to be in the range of $8.5M; however, the McKee Area Neighborhood Plan is currently being studied and the infrastructure needs and funding strategy will be updated with the Neighborhood Plan.

The overall 25-year plan includes asset renewal and upgrades to service growth. The proposed annual average spending is in line with the historical yearly spending average. The proposed capital expenditure program is approximately $5.2M per year and the ten year average spending is approximately $5.6M per year.

Figure 4-7 – Proposed City Water capital expenditures



5.0 PUBLIC ENGAGEMENT

The following summarizes the engagement strategy undertaken through the four stages for all three City Utilities Master Plans:

Stages	Council (Executive Committee)	Committees	Public Engagement
STAGE 1 Background and Data Assessment	Oct 2, 2017	Council Committee (May 25, 2017) ADDIAC (Dec 13, 2017) DAC (Jan 4, 2018)	• Taste of Abby • Canada Day • Berry Beat • Farmer's Market • Seven Oaks Mall • Recreation Centres (MRC/ARC) • Kalgidhar Park and Temple visit • Chamber of Commerce • Urban Development Institute
STAGE 2 Analysis and Evaluation	Feb 19, 2018	ADDIAC (Feb 14, 2018) DAC (Mar 1, 2018)	• UDistrict • MCA • Clearbrook library • High Street • Seven Oaks Mall
STAGE 3 Draft Plan	May 7, 2018	DAC (May 3, 2018) ADDIAC (May 9, 2018)	• Earth Day • Clearbrook library • Farmers Markets • UFV

Approximately 1,400 people have been engaged through the development of the Engineering Utilities Master Plans.

In addition to the above, the City has initiated the Plan 200K website for all City projects under this umbrella, including the Drainage, City Sewer and City Water Master Plans. Updates on the plans have been provided to the public via the website.

7.0 CONCLUSION

The result of this 14 month process is a comprehensive multi-faceted plan for the City of Abbotsford drainage, sewer and water utilities that includes priorities, project cost estimates and timelines for efficiently developing new infrastructure, and completing necessary upgrades to existing infrastructure to support the City's growth. This plan outlines existing conditions and future upgrades, supports the needs of preparing future City financial plans and Development Cost Charge (DCC) programs and provides adoptable management policies and criteria to manage future development and enhance our environment. Capital programs are designed to be phaseable, affordable, resilient, sustainable, incremental, flexible and grantable.

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