Regional Municipality of Wood Buffalo

Wastewater Master Plan

Strategy Report Summary

September 2014

Associated Engineering

GLOBAL PERSPECTIVE.
LOCAL FOCUS.

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INTRODUCTION

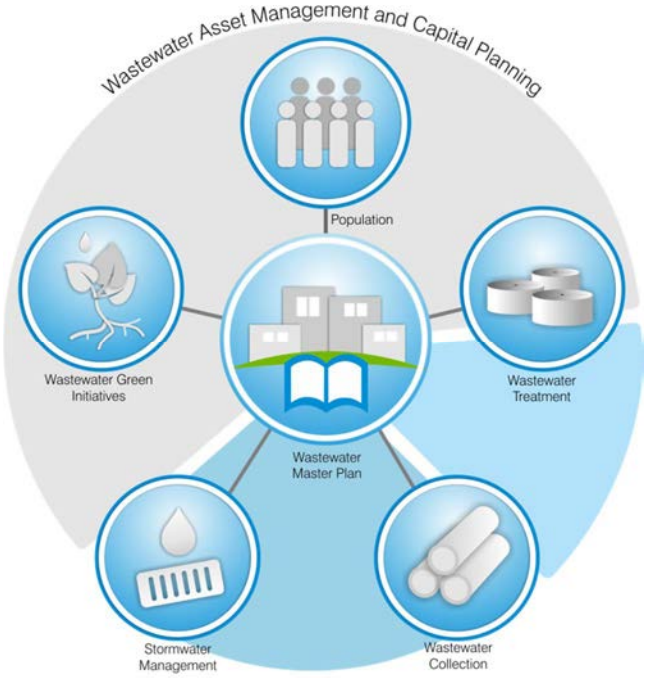
In 2009, the Regional Municipality of Wood Buffalo (the Municipality) completed a Wastewater Collection Master Plan. The plan identified major upgrades to the wastewater collection system that were needed to accommodate significant growth in the region. Most of the critical upgrades identified in this plan have been completed to date. With the critical collection upgrades completed, the Municipality identified the need to develop a strategic plan for all wastewater infrastructure to address future growth of the community. This line of thought initiated the development of the Wastewater Master Plan (WWMP).

Master planning of all infrastructure is vital to support and strategize long-term growth for any community. Evolution of the WWMP is a consistent, proactive step by the Municipality to ensure proper planning of infrastructure that will encourage growth and a continued high level of service to the Municipal residents.

The WWMP is a strategic planning document that evaluates five technical elements of the Municipality's wastewater system, including: population, treatment, collection, stormwater, and green initiatives. Wastewater Asset Management and Capital Planning is an overarching element that ties all the technical elements together.

To critically evaluate all elements of the WWMP, 26 technical memoranda (TMs) were completed. These TMs were discussed with six Municipal departments, during six collaborative workshops held between March, 2013 and March, 2014. More details of the topics covered are summarized in *Figure 1*.

The intent of this WWMP Implementation Strategy Report is to assemble the 26 separate topics and evaluations and provide an overview of the steps needed to continually



provide a high-level of wastewater service to the residents. An overall summary that the Municipality can use to plan wastewater infrastructure work over years to come is included in this document. It is important to note that the WWMP is a living document that must be re-assessed regularly, as growth trends constantly evolve.

The main objectives of each WWMP element are described below.

Population projections review the historical growth trends and future development potential of the urban development sub-region (UDSR) This analysis is critical to determine wastewater infrastructure needs to support continual Municipal growth.

Wastewater Treatment evaluates three wastewater treatment components: inputs, treatment, and outputs. The objective of the review is to evaluate the efficiency of the current system to meet the treatment goals and environmental considerations of the outputs, as well as to evaluate future treatment needs of the Municipality.

Wastewater Collection assesses the existing system, using a hydraulic model. This method highlights the problem areas, within the Municipality that need to be upgraded, and examines all sanitary pipes and lift stations. Collection system needs for future development areas are also summarized.

Stormwater Management reviews existing strategies for stormwater and snow management. This element also evaluates flood protection for current and future development of the Municipality.

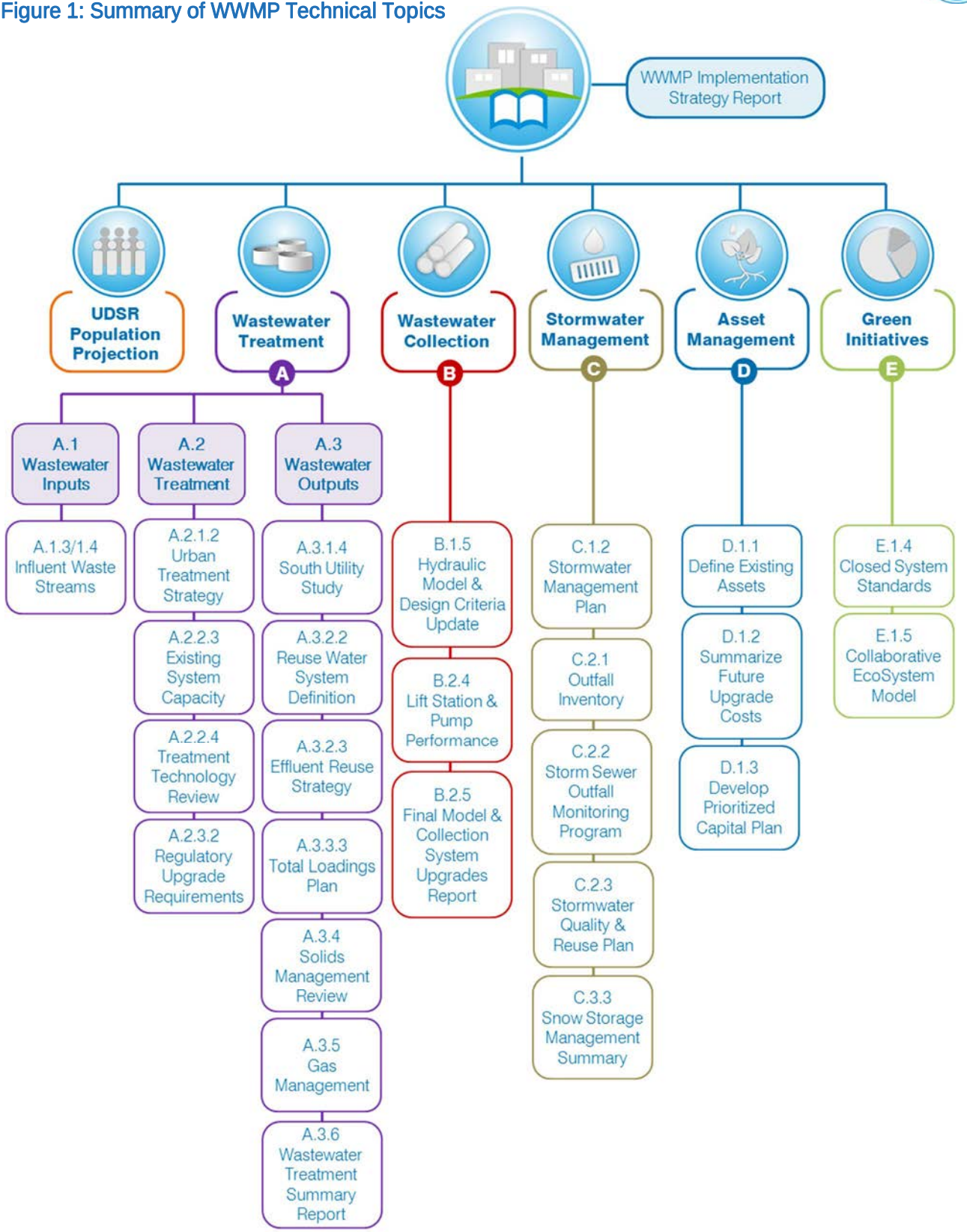
The Municipality has placed a strong emphasis on bringing green initiatives to the community. Wastewater is a valuable resource that requires careful consideration with respect to concepts for green initiatives. Wastewater Green Initiatives were reviewed as the final technical element of the WWMP. These measures are geared towards helping to reduce the environmental footprint of the Municipality and local industry.

To assist the Municipality with capital planning of the wastewater infrastructure, the recommendations generated from the five technical WWMP elements are assembled to create a Wastewater Asset Management and Capital Plan. The intent of this plan is to provide the Municipality with a platform for priority-based decisions regarding implementation of the recommended wastewater upgrades and new infrastructure. The Wastewater Asset Management and Capital Plan is an overarching element that ties all the technical elements of the WWMP together.

Each of the five technical elements was evaluated in the WWMP to determine the future wastewater infrastructure needs of the Municipality based on the following main drivers:

Each element highlights key capital project recommendations and the associated main drivers associated with the project.

Figure 1: Summary of WWMP Technical Topics



POPULATION PROJECTION

Overview

Population projections are vital in developing any Infrastructure Master Plan. They are fundamental to assessing the capacity of existing wastewater infrastructure and for planning future residential and commercial/ industrial needs. To accurately project infrastructure needs, it is important to have clear understanding of the future growth areas and populations within the region.

The population projection element of the WWMP identifies the following:

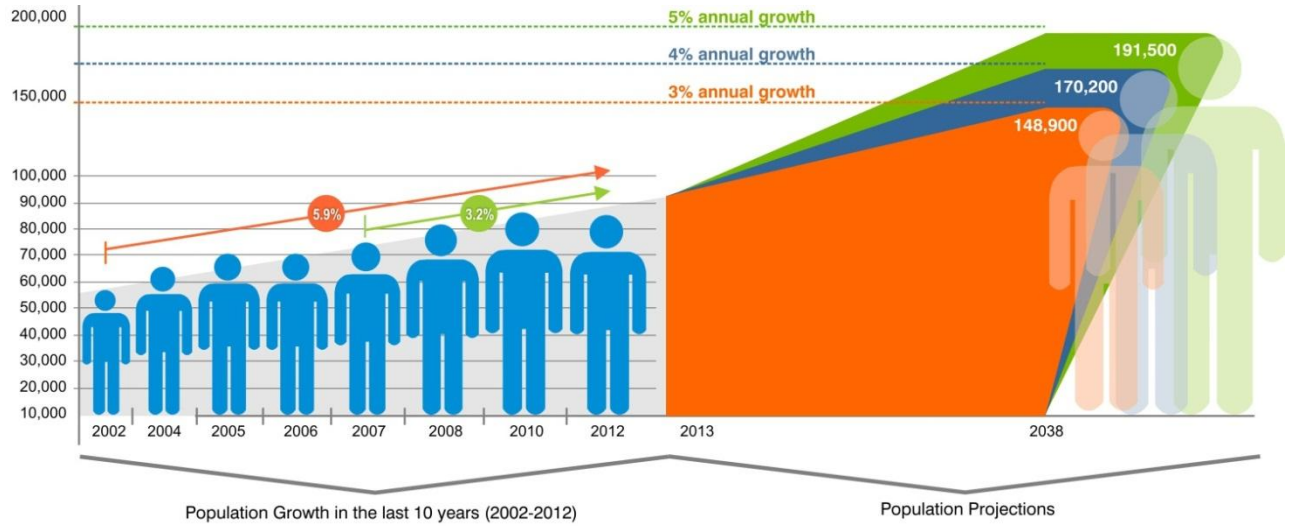
- future growth areas;
- infill of existing developments;
- ultimate population projections for full development of the growth areas;
- annual population growth rates; and
- 25-year population projections.

The ultimate service area for the Municipality is defined by the UDSR. *Figure 2* highlights the UDSR boundary as well as the existing and future development areas in the region. The map also highlights north (yellow) and south (pink) catchment areas that correlate with the wastewater collection and treatment infrastructure planning assessments that were carried out as part of the wastewater treatment element.

Findings

Population projections are difficult to determine in the Municipality as the oil sands industrial developments have a significant impact on the population growth in the region. The population chart below highlights 10 years of historical municipal census data for the Municipality. The 5- and 10-year linear annual growth rates for the UDSR are 3.2% and 5.9%, respectively.

The time frame during which the Municipality will reach the ultimate population is unknown. Typically, municipalities plan to implement infrastructure that will satisfy 25-year projections for development areas. This may result in full development of some areas and only partial development of others. The 25-year population of the Municipality is difficult to estimate due to many uncertainties related to economic growth of the region.



To accommodate the large fluctuations in population growth that are anticipated, a scale of growth categories was developed: low (3.0% growth), medium (4.0% growth), and high (5.0% growth). The population chart above highlights these growth ranges.

The ultimate population of the UDSR is based on full development of all the areas highlighted in *Figure 2*. The populations for new-development areas were estimated by applying population-per-hectare values:

- **Residential Population**: 50 people/hectare of developable land; and
- **Commercial/Industrial:** 37 people/hectare of developable land.

Municipal and federal census data report the residential population only. For infrastructure planning, it is important to evaluate the residential and commercial/industrial populations, which are referred to collectively as an equivalent population. It is important to include the commercial/industrial populations because these contribute to water demands and wastewater loadings during periods of operation.

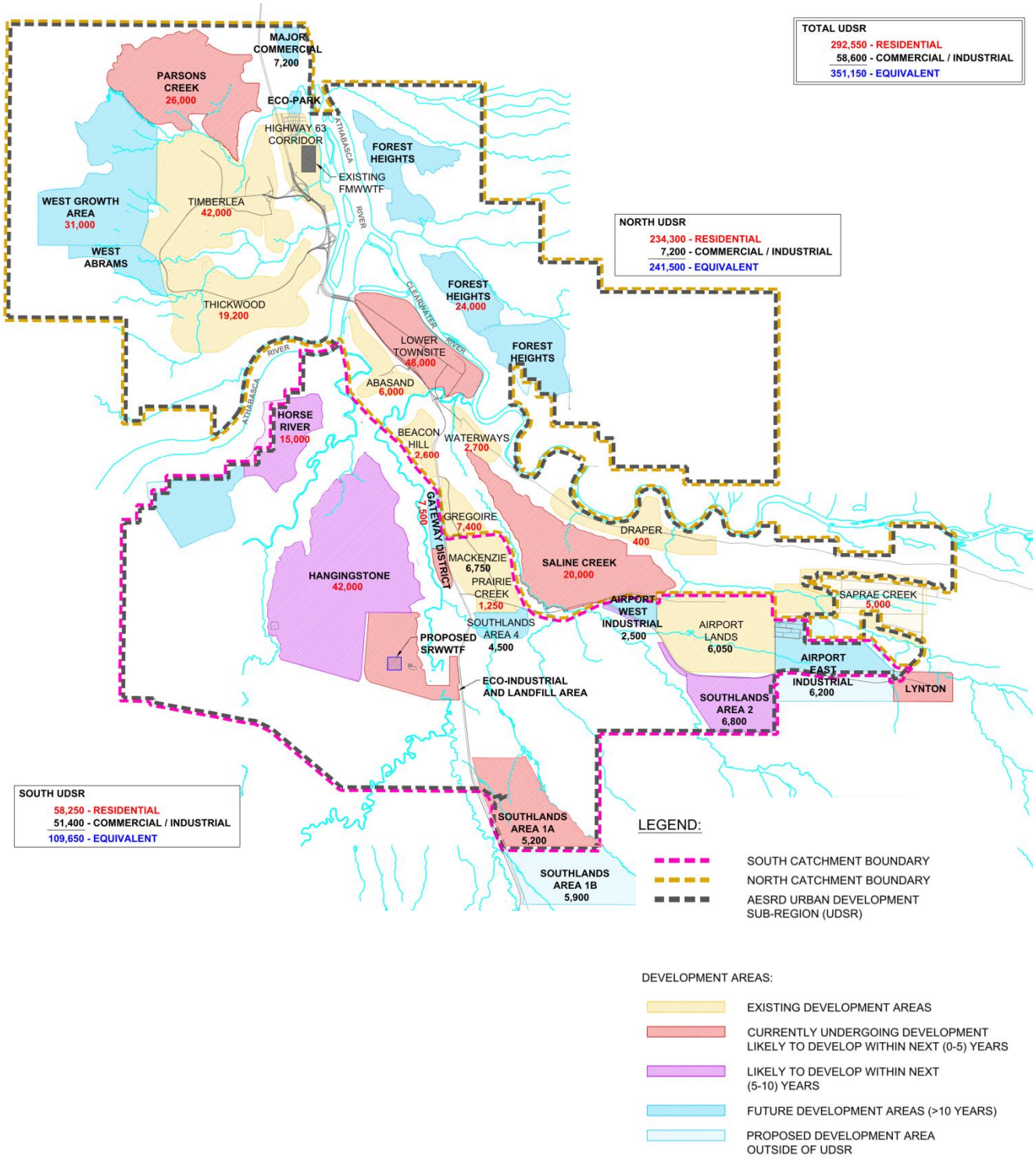
Figure 2 identifies the development areas, the ultimate populations of these areas, and whether each area is residential or commercial/industrial. The ultimate (>25 years) UDSR residential and equivalent populations for the Municipality are estimated to be 292,550 (191,500 by 2038) and 351,150, respectively. The 2013 equivalent population of the UDSR was estimated to be 85,100.

To predict growth for each of the north and south catchments, the projected timeframes for development were estimated based on discussions held during the workshops with the Municipality. *Figure 2* highlights the timeframes for areas to develop.

Recommendations

The Municipality agreed to adopt the population projection estimates during the November, 2013 workshop. It is recommended for the Municipality refer to these population projections regularly to assist with high-level project planning of infrastructure.

Figure 2: UDSR Population Projection



WASTEWATER TREATMENT

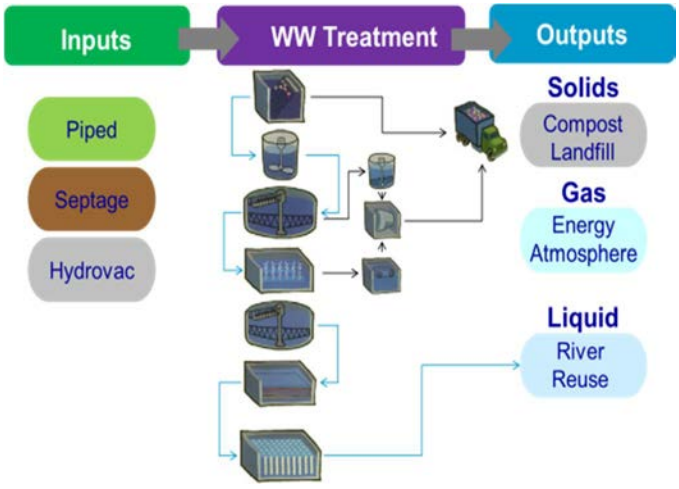
Overview

Wastewater treatment works to remove various types of biological and chemical wastes present in wastewater. The existing Fort McMurray Wastewater Treatment Facility (WWTF) was commissioned in 2010. The treatment facility currently manages three main wastewater categories:

- Piped wastewater;
- Hauled wastewater (septage); and
- Hydro-vac type wastes (mud pit wastes).

The treated effluent from the existing facility discharges to the Athabasca River. Solid residuals from the existing facility are currently hauled to the solid waste landfill.

The wastewater treatment element evaluates the Municipality's existing and future wastewater treatment needs to satisfy the growth of the Municipality and regulatory effluent quality standards. This element is divided into 3 components to align with the major system components in a wastewater treatment system.



Wastewater inputs define the current and future influent waste stream flows and loads in Fort McMurray to determine the impact they may have on the treatment system. The technical memorandum completed for wastewater inputs includes:

- TM A.1.3/A.1.4 Influent Waste Streams.

Wastewater treatment evaluates the overall wastewater strategy for the Municipality, existing facility capacity to treat the current and projected flows and loads, redundancy needs, future infrastructure needs, and regulatory requirements. The technical memoranda completed for wastewater treatment include:

- TM A.2.1.2 Wastewater Treatment Strategy
- TM A.2.2.3 Existing System Capacity
- TM A.2.2.4 Treatment Technology Review
- TM A.2.3.2 Regulatory Upgrade Requirements.

Wastewater outputs include solids, gases, and treated effluent. This component reviews solid and gas sources, and develops management plans for reuse and recycle opportunities to turn waste into energy. This component also evaluates the total loadings of treated effluent and stormwater discharges on the Athabasca River watershed. The technical memoranda completed for wastewater outputs include:

- TM A.3.1.4 South Utility Study
- TM A.3.2.2 Reuse Water System
- TM A.3.2.3 Reuse Water Strategy
- TM A.3.3.2 Total Loadings Plan
- TM A.3.4 Solids Management Review
- TM A.3.5 Foul Air Management.

Findings

The existing wastewater treatment system has some apparent short comings relevant to the wastewater input loadings, existing infrastructure capacity, consistent effluent quality, and wastewater output management. Following are the key findings:

- The wastewater inputs at the Fort McMurray WWTF are changing to include direct treatment of hauled septage. It is estimated that this will increase loads on the facility to be much greater than 2014.
- The Municipality currently manages hydro-vac waste through a mud pit and drying areas. This does not constitute a sustainable solution due to capacity restrictions.
- The existing Operating Approval for wastewater treatment outlines more stringent effluent limits for 2015. The Municipality may need to implement effluent filtration to consistently meet these new limits.
- Several of the major existing WWTF processes are at risk of having insufficient capacity when one of the components is offline due to inadequate redundancy.
- Full build-out of the Fort McMurray WWTF is necessary to ensure consistent performance in compliance with the facility's Approval with increasing demand.
- New development in the Municipality is predominantly focused south of the Athabasca River. To manage future development the Municipality currently favours constructing a second, South WWTF.
- To manage solid wastewater outputs a number of management approaches may be considered as replacements or enhancements to the current composting process, including:
  - gasification with municipal solid wastes;
  - anaerobic digestion with energy and nutrient recovery; and
  - combinations of these technologies.
- Preliminary total loadings estimates for the Municipality including treated wastewater effluent, stormwater, and snowmelt discharges reveal no apparent concerns regarding impacts to Athabasca River water quality.

Recommendations

Figure 3 shows the recommended upgrades to the existing Fort McMurray WWTF.

The timeline below summarizes the key recommendations and anticipated capital expenditures for the Municipality's WWTF.

Summary of Key Wastewater Treatment Recommendations and Associated Costs

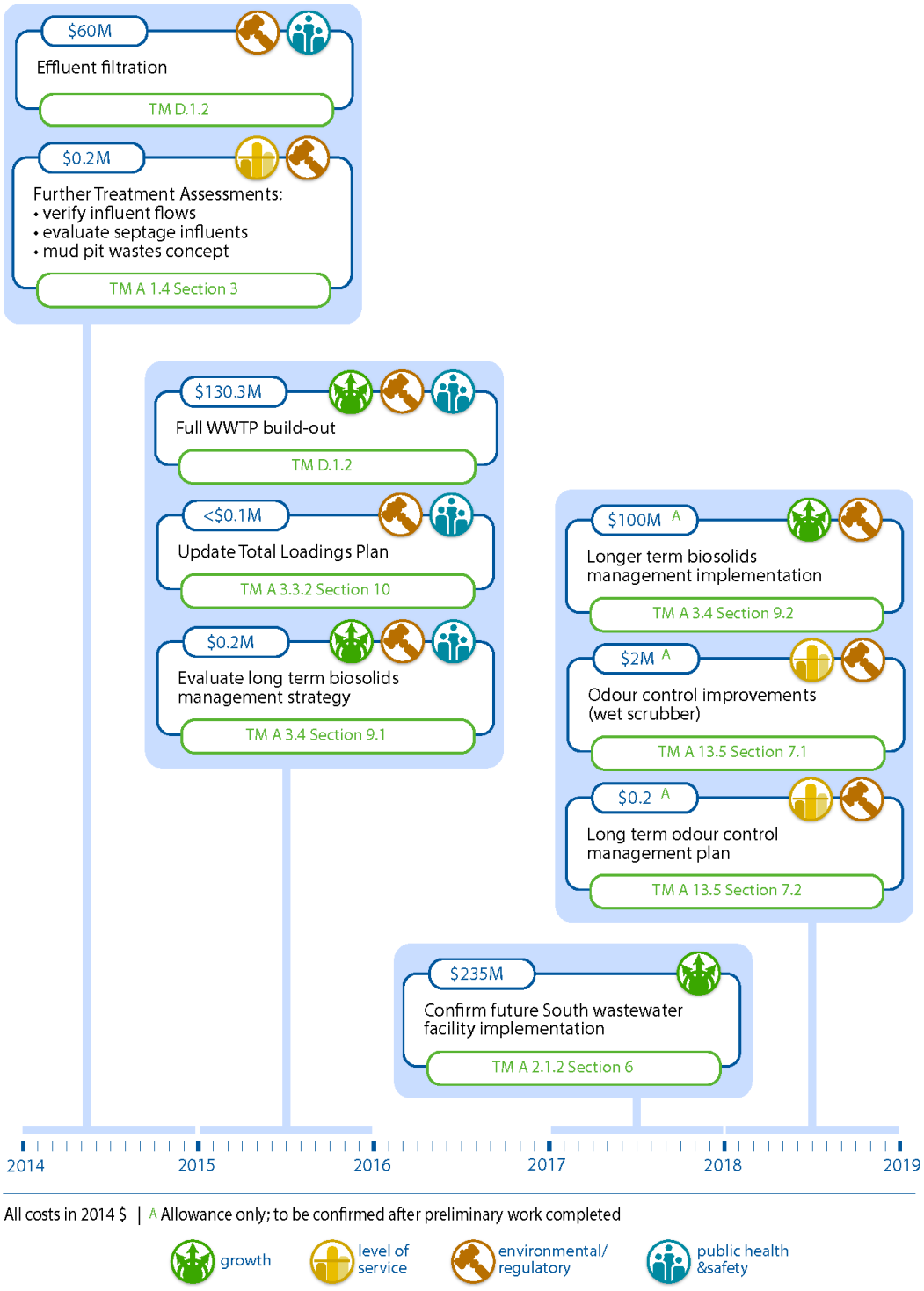
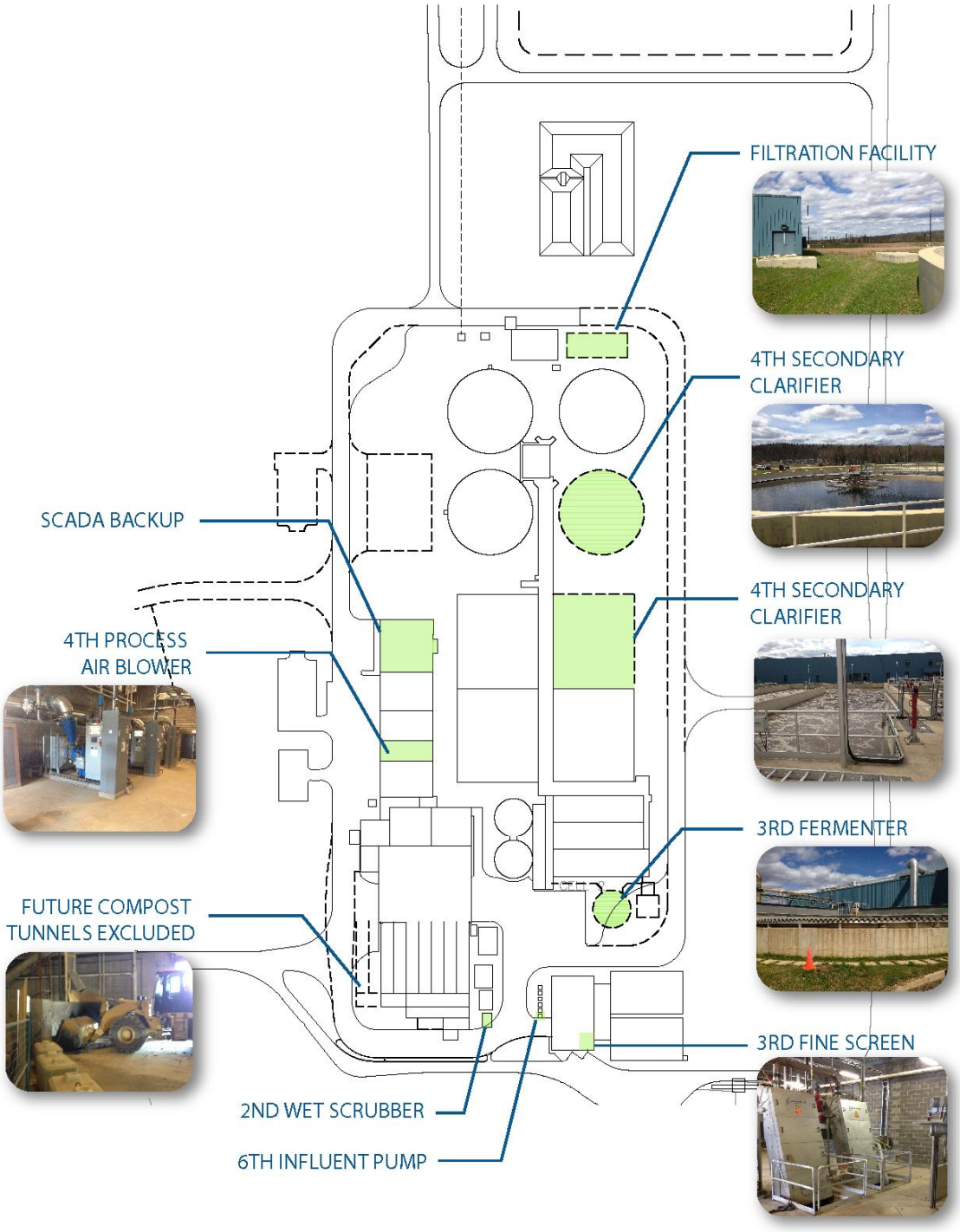


Figure 3: Fort McMurray Wastewater Treatment Facility Upgrade Requirements



WASTEWATER (SANITARY) COLLECTION SYSTEM

Overview

The municipal wastewater collection system comprises the pipes, lift stations, and force mains that are required to convey wastewater (sewage) from houses and businesses to wastewater treatment facilities. The Municipality has made extensive upgrades to its wastewater collection system since 2009, and all based on limited data available in 2009.

This element of the WWMP identifies additional upgrading required to prevent backup into house basements. It also identifies the system expansion requirements needed to service future development areas. These tasks were accomplished based on additional flow data collected over 3 years (2011-2013) and more detailed analysis. This element is evaluated in three technical memoranda:

TM B.1.5 Hydraulic Model and Design Criteria Update updates the computer model to present conditions and reviews the design criteria for wastewater collection systems;

Flow and rainfall monitoring data collected over 3 years as noted in three annual reports; more detailed assessment of flooding and options in Timberlea, and inflow/infiltration rates in Mackenzie (reported separately in 2011/2012).

TM B.2.4 Lift Station & Pump Performance inspects each of the existing pump stations for capacity, structural integrity and electrical conditions.

TM B.2.5 Final Model & Upgrade Report involves computer modelling to identify capacity restrictions and bottlenecks, to assess upgrade options, and to identify system extensions required to service future development areas.

Findings

Portions of the Municipality's existing sewer system are overloaded. Backup into house basements can occur during rainfall events in the older residential neighbourhoods of Timberlea and Thickwood, where weeping tiles were connected to the sanitary sewer system. Residents have expressed a heightened awareness and reduced tolerance of basement flooding following recent storm events resulting in flood complaints.

Several issues have led to this situation:

- Lot and roof runoff draining to house weeping tiles;
- Deterioration of lot grades over time; and
- Poorly-graded rear-yard utility lots in Mackenzie.

As well, infill intensification, and re-development will further increase the demands on the existing collection system, particularly in the Lower Townsite.

Future developments will require new wastewater collection systems that will drain to the north and proposed south treatment facility. Most of the new developments will drain to the proposed South Wastewater Treatment Facility.

Pumping is required due to the topography of the Fort McMurray area, which is broken up into discrete parcels by the region's river systems, and the pump stations and force mains may need to be constructed by the Municipality to facilitate development.

Recommendations

Figure 4 shows the upgrades to the existing system that are required immediately to prevent basement flooding in existing neighbourhoods. The map also shows other future upgrades required to accommodate infill, intensification, and re-development. In addition to these enhancements, an Inflow/Infiltration Reduction Program will help to reduce flows and free up system capacity.

Figure 5 shows the pipes and lift stations that will be required to service the future growth areas.

The timeline provides a summary of the anticipated capital expenditures in the wastewater collection system. Details are provided in the referenced TMs. Note that all cost estimates are based on high-level analysis; they are only approximate and are likely to change with more detailed analysis.

Figure 4: Existing Sanitary System Upgrade Requirements

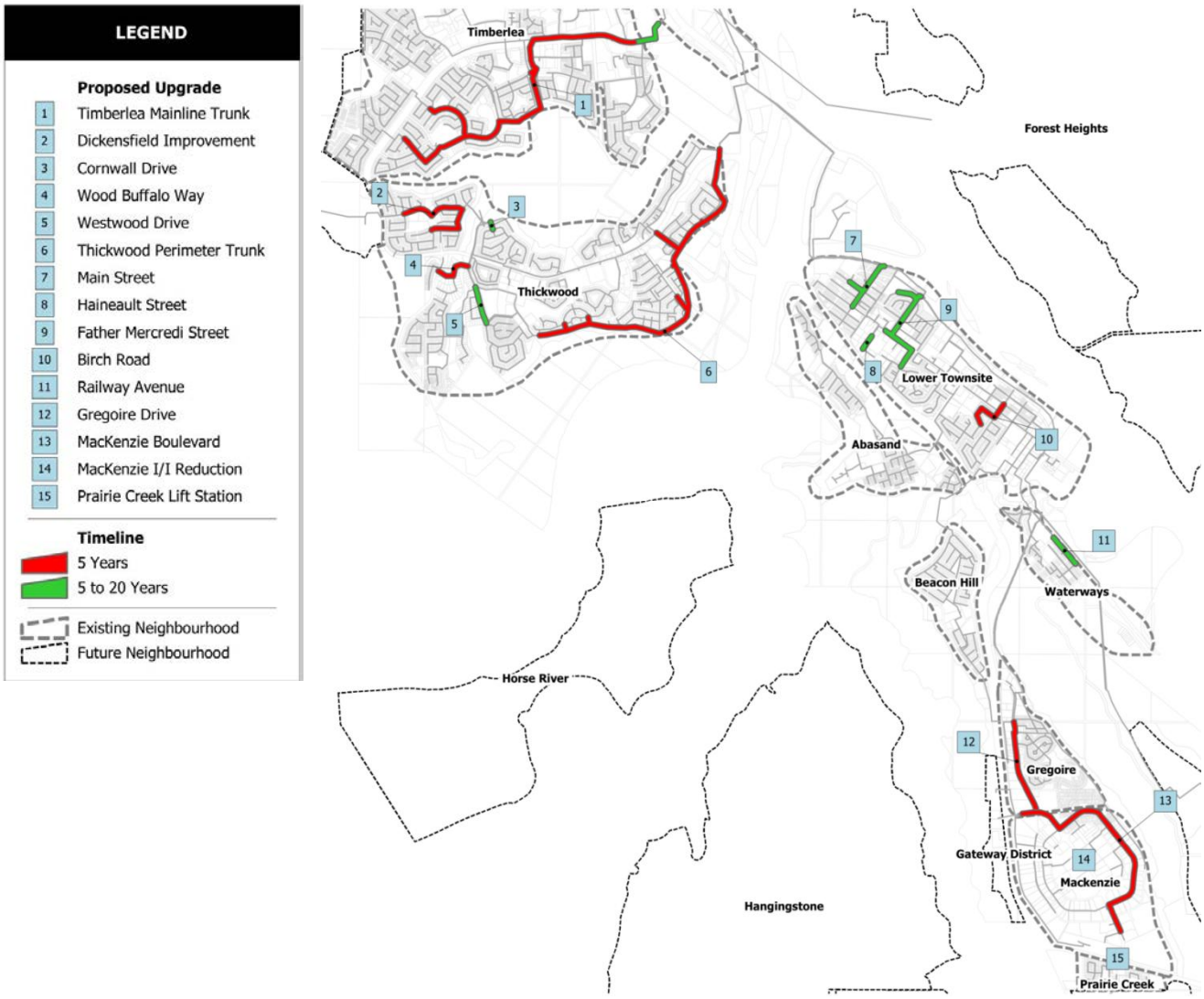
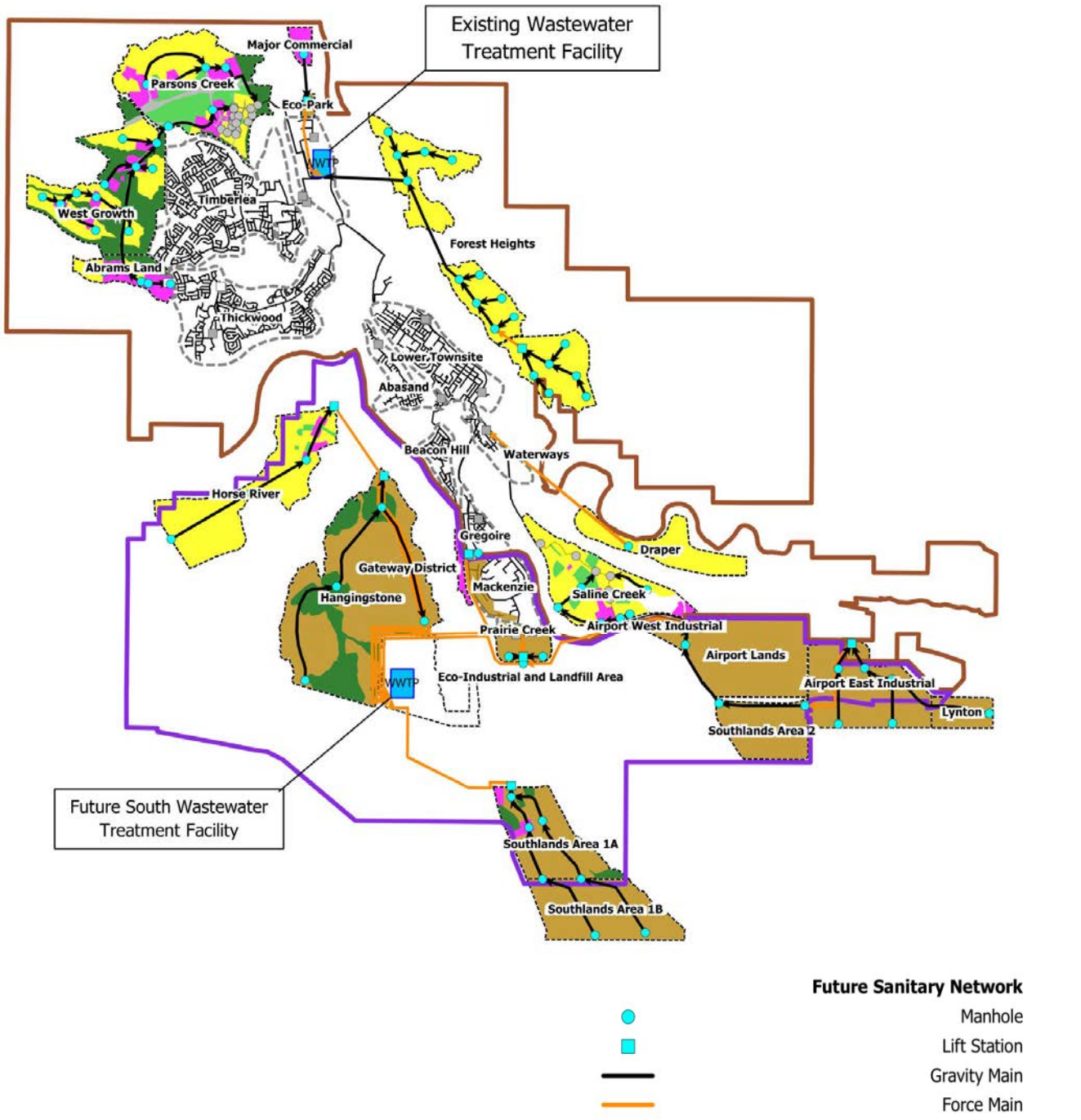
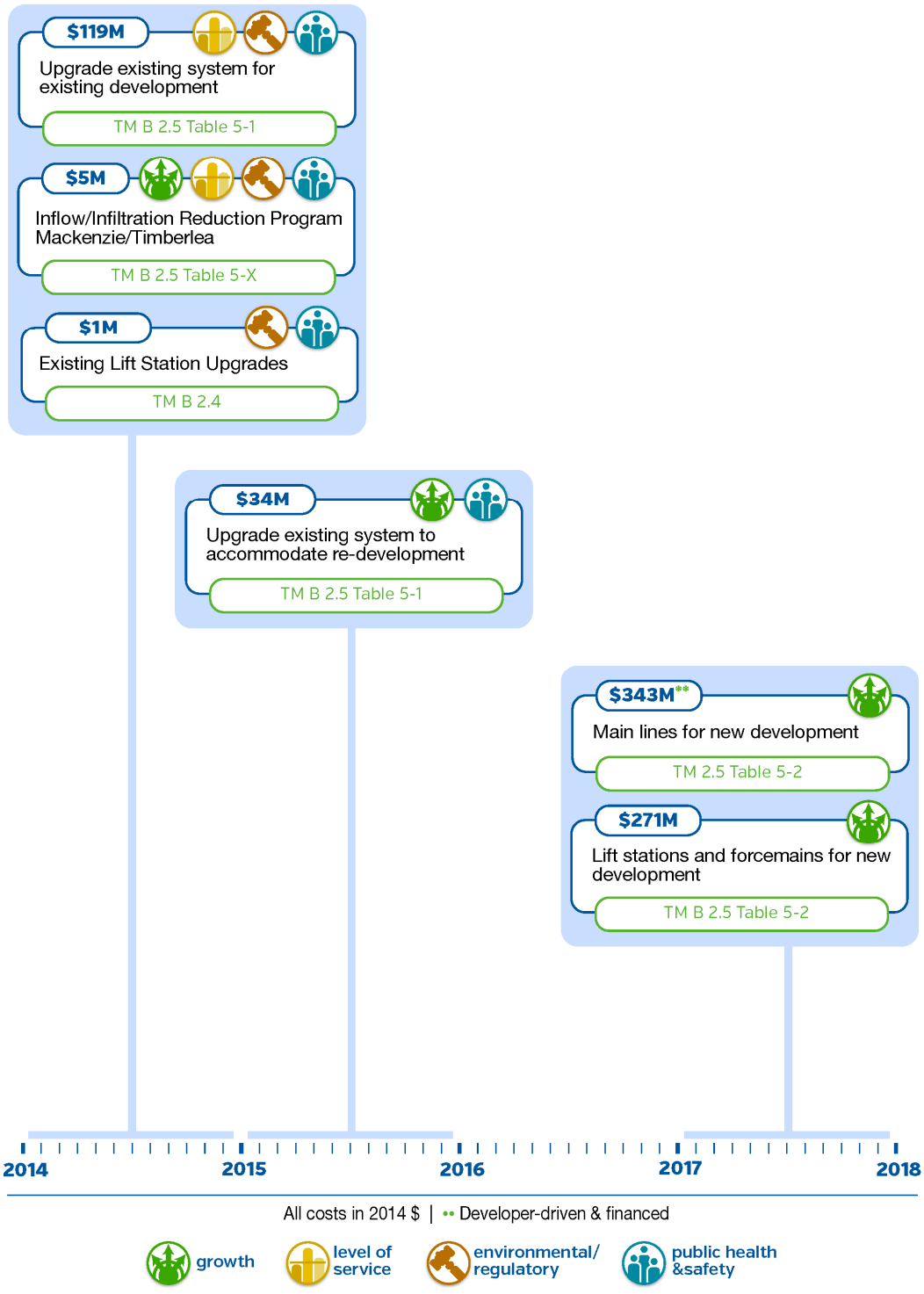


Figure 5: Future Sanitary System Expansion Requirements



Summary of Anticipated Capital Expenditures for the Wastewater Collection System



STORMWATER MANAGEMENT

Overview

The Municipality's stormwater management system is a network of pipes and ponds designed to drain the developed area, prevent flooding of private property, and minimize ponding on streets to degrees that would block traffic.

The stormwater management element examines the collection system capacity, snow storage, and water quality issues before discharging into the watershed. Water quality monitoring is necessary to meet the regulatory standards for water that is discharged to the natural environment.

This is the first time the Municipality has developed an overall stormwater management master plan. This element involves the following tasks and TMs:

TM C.1.2 Stormwater Management Plan provides detailed computer modelling of the pipes and pond to determine their capacities, identify any bottlenecks and flood-risk areas, and identify upgrade requirements.

TM C.2.1 Outfall Inventory identifies all storm sewer outfalls to regional stream courses, and notes their condition and any rehabilitation requirements.

TM C.2.2 Storm Sewer Outfall Monitoring Plan outlines a stormwater runoff monitoring program to be conducted on representative outfalls that have been specifically selected for data collection.

TM C.2.3 Stormwater Quality and Re-use Plan provides a framework for implementing and identifying opportunities to re-use stormwater runoff for the Municipality.

TM C.3.3 Snow Storage Management Plan Summary Document reviews the long-term strategy for municipal snow removal and storage.

TM C.3.4 Lower Townsite Storm Pumping Plan presents a concept plan for stormwater pumping during ice jam conditions.

Typical stormwater drainage system showing pipes and ponding areas

Findings

In older areas, the system was designed to a lower standard than is required today, so these areas do not meet all the Municipality's current design criteria for drainage and flood control during major events. Following are the key issues:

- Significant street ponding creates safety hazards and blocks traffic (215 locations).
- Ponded water spills over curbs and creates significant risk of flooding private property at a few locations.
- Outfall pipes in Thickwood, Beacon Hill, and Mackenzie are severely overloaded and could spill overbank, eroding the bank and damaging infrastructure or private property. Overloaded pipes also back up into upstream sewer systems and cause upstream flooding.
- Repairs are needed to 38 outfall structures to deal with structural or safety issues ranging from channel cleaning to replacement of the structure or conduit.
- Storm sewers along Highway 63 in Mackenzie are overloaded and badly in need of repair and maintenance.
- High-value business and commercial properties in the Lower Townsite tend to be flat-graded and are at risk of flooding if street ponding exceeds top of curb (a higher design standard should be considered for these areas in future).
- Existing stormwater ponds perform well, but some odour problems have been reported.
- During ice jam conditions in the Athabasca River, drainage in the Lower Townsite is impeded and pumping of local runoff will be required to prevent flooding of low-lying areas. A rain event, in combination of an ice jam, makes this condition more severe.

Most future new development areas will drain independently of each other to the various stream courses because the regional network of creeks and rivers break the development area into discrete development cells.

Stormwater management (ponds) will be required in all future development areas to control runoff rates and improve water quality. Large portions of these areas are poorly drained and may not be suitable for development.

Sinkhole at base of slope on Beacon Hill storm sewer outfall line

Snowmelt management is considered to be part of the overall stormwater management master plan.

Snow storage sites at Father Mercredi Street and Waterways have been closed and re-developed. As part of the snow management plan, the Municipality is looking to develop two permanent snow reclamation facilities, one at the Municipal Landfill (which will service the south side of the Athabasca River) and one on the north side of the river. The Municipality will continue to use its existing snow storage site (Dickensfield, on the north side of the river) until a new facility is developed.

The new snow reclamation facilities will be an integral part of an ECO industrial park, and will use waste heat from a solid waste gasifier. Snowmelt can be treated and, ultimately, reclaimed for re-use opportunities

Recommendations

The stormwater management master plan recommends completing upgrades where:

- there is risk of flooding private property;
- overbank spills could erode the bank and damage infrastructure or private property; or
- ponding on the street exceeds tolerable depth limits (0.3 m on collector and arterial streets and 0.5 m on local streets).

In many instances, flooding and drainage issues can be reduced by adding catch basins at minimal cost. At other locations, especially in Thickwood, storm pipes are also overloaded and need to be replaced with larger pipes.

Three dry ponds are proposed in Thickwood to minimize the cost of the required upgrades. Two of these would be located on the Fort McMurray Christian School grounds and Thickwood Heights School grounds, and the third would be in Helen Pocholko Park.

The dry ponds would be constructed in landscaped areas and would operate only in the most severe storm conditions. Under normal conditions, they would be dry and could be used for play fields and other park activities. Such dry ponds would require approval from the school board and the general community, and a public involvement process would be needed if these were to be considered.

Figure 6 shows the system upgrades that are required immediately to address these concerns**.** *Figure 7* shows the general locations of pipes and ponds that will be needed to service the future growth areas.

Several outfalls are in poor condition or have safety concerns requiring immediate attention (replacing or installing gates, flap gates, locks and hand rails). These have been identified to the Municipality for immediate action. Other outfall repairs are detailed in the TM C.2.1.

Five outfalls have been selected for monitoring water quality starting in 2014, representing represented residential, industrial, commercial and mixed use areas.

Twelve stormwater pumping stations with portable pumps are required in the Lower Townsite to handle runoff during a severe ice jam event that will back up the storm drainage system. Access chambers and piping will be installed to facilitate pumps being connected and put into operation quickly. Portable pumps will be kept on standby and transported on-site when required.

Construction of a Snow Reclamation Facility involves two initial stages: Phase 1a and Phase 1b. Phase 1a consists of a melting pad and a meltwater treatment facility to remove sand and silt. This phase of the facility will operate for the first few years, after which a decision will be made regarding expansion as Phase 1b. The municipality should start with the detailed design of Phase 1a.

The timeline below provides a summary of the anticipated capital expenditures for the stormwater management system. Details are provided in the referenced TMs.

Note that all cost estimates are based on high-level analysis; they are only approximate and are likely to change with more detailed analysis. The future costs of pipes and ponds have not been estimated, as these will be the responsibility of the various developments and may change with more detailed planning.

Prior to establishing the capital budget for implementation of improvements, the Municipality should undertake further concept planning to better define the required upgrades and scope of work.

Figure 6: Existing Stormwater Management System Upgrade Requirements

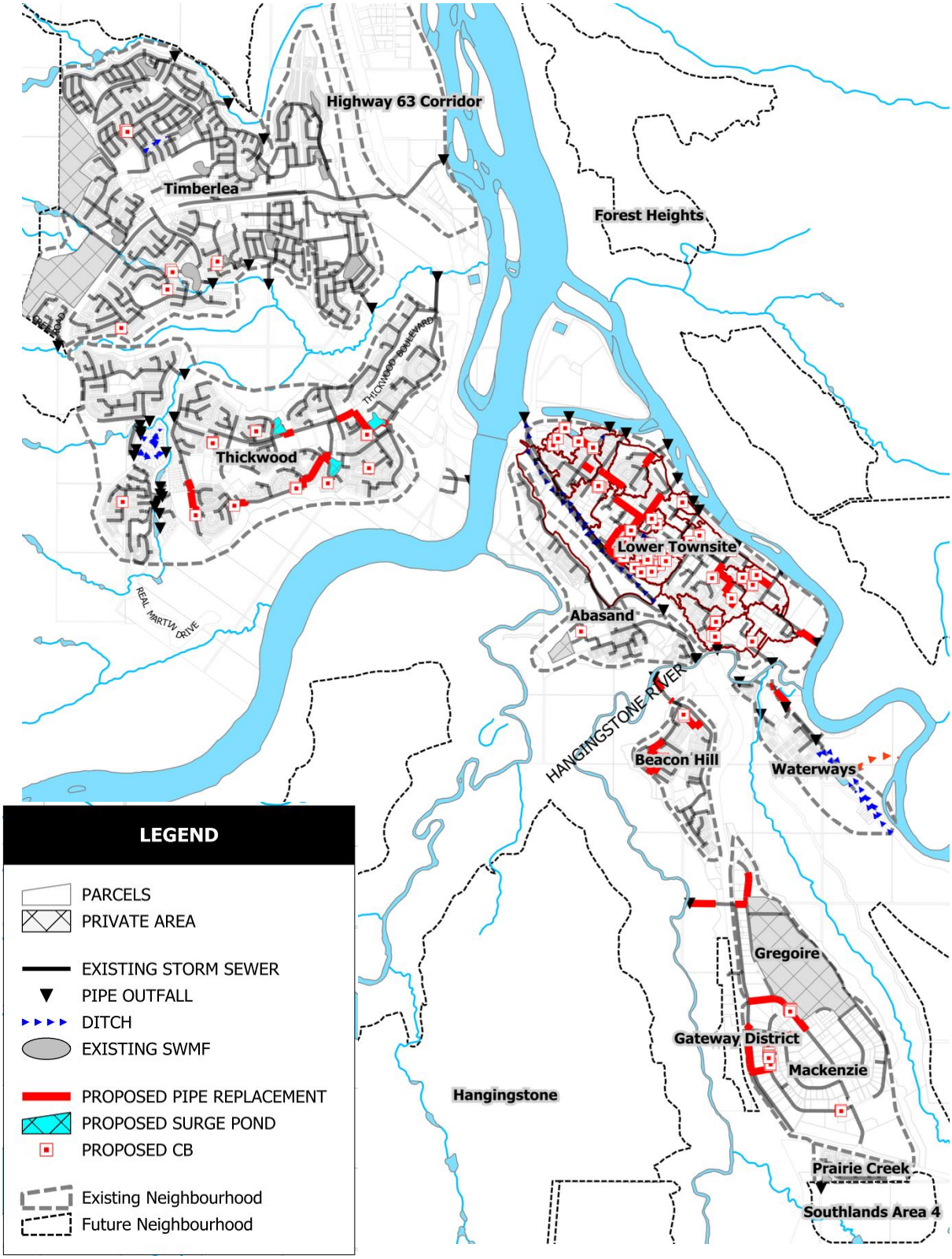
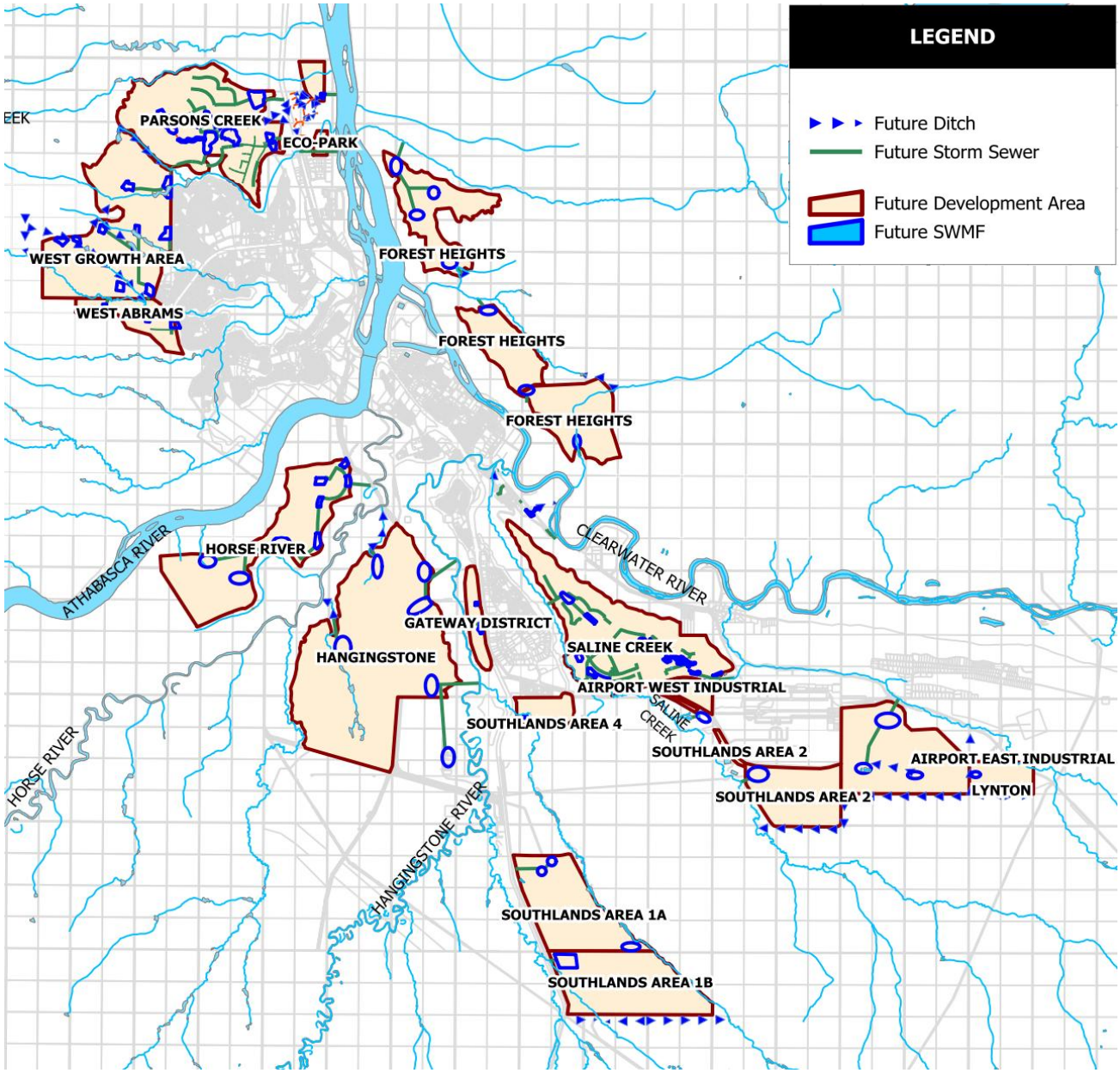
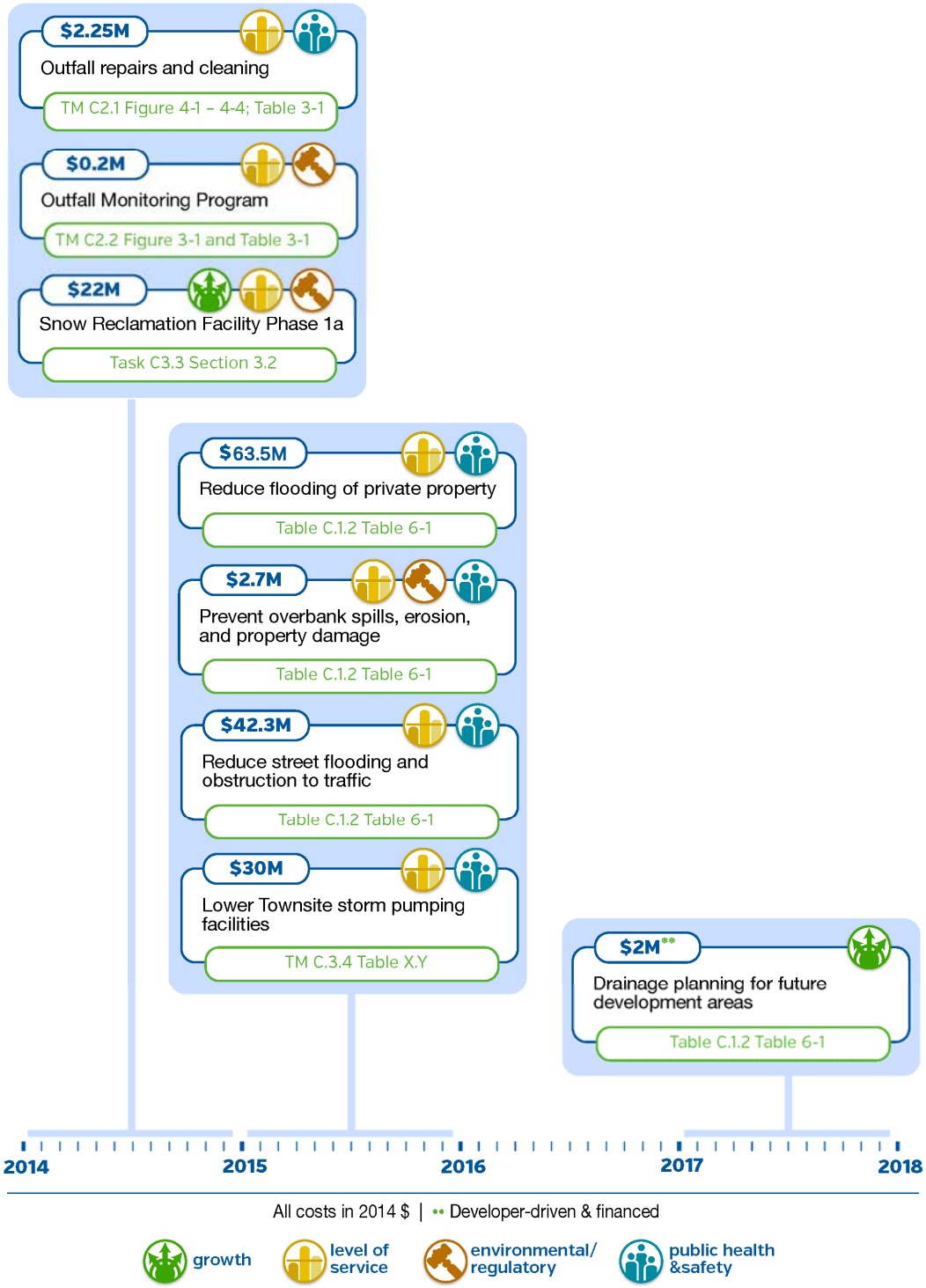


Figure 7: Future Stormwater Management System Expansion Plan



Summary of Anticipated Capital Expenditures for the Stormwater Management Collection System



ASSET MANAGEMENT AND CAPITAL PLAN

Overview

The Asset Management element provides the Municipality a compiled summary of recommended system upgrades and basis for prioritization of future capital projects for future integration into comprehensive Asset Management system. The Municipality currently maintains asset information in multiple systems specific to various department needs and skillsets. This collection of engineering analysis and future capital plan needs is an important step in development of an Asset Management system, as wastewater and stormwater system data is managed by the Engineering Department in a Geographic Information System (or mapping system) and the Finance Department with in the Municipal Tangible Capital Database (Citywide) system. Ultimately, Asset Management requires the engineering, finance and maintenance systems to be coordinated to enable informed decision making.

Compilation and summarization of the available data was achieved through the following TMs:

TM D.1.1 Define Existing Assets provides a summary of the existing treatment, sanitary sewer, stormwater and snow storage assets currently recorded within the Municipal Tangible Capital Database.

TM D.1.2 Future Upgrade Costs provides a summary of the recommended upgrades of the treatment, sanitary sewer, stormwater and snow storage assets identified through other elements of the study.

TM D.1.3 Prioritized Capital Plan provides a practical prioritized capital plan to the required upgrades.

This will to provide the Municipality a platform for priority based decisions and flexibility based on operation and development pressures to implement the plan given changing financial resource allocations.

Findings

- The current Engineering and Financial databases are in the order of 90% in alignment.
- The Municipal infrastructure age shows three defined growth periods prior to 1963, between 1973 and1983, and 2000 to current day. Further condition assessment is required to better define condition based risks.
- Based on data in the Citywide database, the 2013 book value for wastewater and stormwater assets is approximately $580M, with and estimated end-of-life replacement costs of $1.5B.
- Technical assessments of the system elements has defined various system improvements based on public safety, regulatory compliance, level-of-service and growth needs, which define the critical needs in the next five years. Please see *Figure 3 on page 11 for a* summary of prioritized existing system improvements.
- Growth demands will require extensive investment of Municipal and Developer contributed assets over the long term in the order of total values of $ 600M and $ 700M respectively.

Recommendations

- Work to implement a single asset tracking and management system.
- Develop inspection plan based on asset age to generate condition information and addition information to prioritize system re-investment.
- Determine an appropriate annual reinvestment value focused on condition based renewal.
- The Municipality will want to focus the direction of future development to avoid excessive Municipal investment in capital assets in numerous growth areas.
  The table below provides two staging scenarios for development of new Municipal assets to facilitate growth:
  1) Scenario 1 – Hangingstone Prioritized
  2) Scenario 2 – Hangingstone Deferred.

Development Horizon	Wastewater Capital	
	Scenario 1	Scenario 2
0 - 5 yrs	341	85
5 - 10 yrs	114	21
10 + yrs	50	400

GREEN INITIATIVES

Overview

The Municipality has a vision and is committed to a sustainable community. The organization has been resourceful in envisioning opportunities, and has the drive to search them out. This element focuses specifically on wastewater and drainage green initiatives related to the following:

TM C.2.3 Stormwater Quality and Re-use Plan discusses opportunities for re-use of stormwater runoff as an alternate water resource for outdoor applications, such as irrigation, washing and fire protection.

TM E.1.4 Closed Systems Standards focuses on greywater re-use in the contexts of landscape irrigation, toilet/urinals flushing in Municipal buildings, and exploring opportunities for wider implementation in private buildings; and

TM E.1.5 Collaborative Ecological Model provides an overview of all green initiatives discussed in the WWMP, and discusses how these initiatives would fit into the overall intention.

The Municipality has already initiated an internal workshop to discuss green initiatives within the Collaborative Ecosystem Model. The main objectives of this element are to identify opportunities, challenges, and issues associated with these initiatives. This element in intended to provide guidance, assist the Municipality with future planning, and determine further actions required to pursue these initiatives.

Findings

There are several opportunities to implement green initiatives within the Municipality; however, there are inherent challenges that need to be considered, including:

- Lack of regulatory support or guidance;
- Lack of a public education program regarding available and new technology;
- Public complacency about the current system, and distrust of new technology;
- Lack of urgency to conserve low relative cost resources;
- Improper application of technology;
- Concern about high capital cost, with no consideration of life-cycle cost;

A key challenge to implement green initiatives for stormwater and greywater re-use is lack of a provincial and federal regulatory framework to guide Municipal implementation. Currently, projects are evaluated on a case-by-case basis. This is true for greywater re-use in buildings in Alberta; however, the Alberta government recognizes the demands and is working towards harmonized regulation with other jurisdictions.

By recognizing the challenges and issues noted above, the Municipality can show leadership and commitment to the environment and the community.

Recommendations

The intent of the recommendations in the Green Initiatives section of the WWMP is to guide and help the municipality demonstrate leadership, communicate with multi-level stakeholders, engage the public, and elevate the *status quo*.

The recommendations for implementing these initiatives are as follows:

- Establish a task force or champion(s) who will be committed to lead the development, implementation, and maintenance of green initiatives within the Municipality;
- Initiate discussion and planning through collaborative workshops that would include multi-level stakeholders to establish clear directive and priorities
- Work to achieve buy-in and build consensus within the community and among its leaders;
- Educate and build awareness in processes that engage the public on resource conservation;
- Collaborate with industry to promote mutually beneficial initiatives
- Demonstrate competency and leadership through collaborative pilot projects;
- Develop incentive programs to promote the use of alternative water or energy sources;
- Initiate conversation with regulatory agencies to advocate for changes to regulations, standards and guidelines that will allow region-wide implementation;
- Develop a performance matrix to monitor progress;
- Identify potential risks and establish a risk management process.

The risk management process related to green initiatives recognizes that an ever-changing environment can impact project outcomes. Various parameters that factor into risk are:

- Population
- Technology
- Stakeholders
- Costs (e.g. technology, labour force, raw material)
- Regulatory regime and requirements
- Land use
- Local government.

The risks can be rated from high to low probability of occurrence based on potential for financial, environmental, and/or social disruption or damage. Once rated, mitigation measures can be established to reduce or eliminate risks, while recognizing that some cannot be mitigated.