APPENDIX A

Final Report

Regina and Region Water and Wastewater Study

August 2014

Submitted to

REGINA
Infinite Horizons

Submitted by

CH2MHILL®

WBG101512133911CGY

This project is in collaboration with*:*

West	
RM of Pense	
Grand Coulee	**Grand Coulee**
Pense	
Belle Plaine	**Belle Plaine**
East	
RM of Edenwold	
Edenwold	
Balgonie	
Pilot Butte	
White City	

North	
RM of Lumsden	RM of Lumsden No. 189
Lumsden	Town of Lumsden
Craven	Village of Craven
Other	
Sakimay F.N. (E20-17-20W2) (Four Horse Developments)	FOUR HORSE DEVELOPMENTS LTD
SaskWater	SaskWater
Water Security Agency	Water Security Agency

Final Report

Regina and Region Water and Wastewater Study

Prepared for

City of Regina, Planning & Development

August 8th, 2014

CH2MHILL®

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Calgary AB
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Canada

Certification

This report was prepared under the direction of a professional engineer registered in the Province of Saskatchewan. It is intended solely for use of the individual, company, government, or the other entity for which it was prepared, and for the purposes within the limitations stated in the report.

Barry Williamson, P.Eng.
Technical Review

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Project Manager

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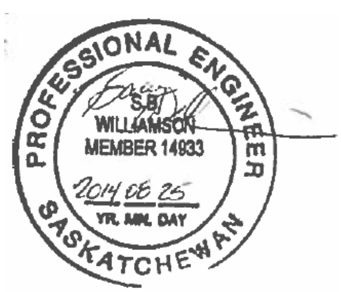
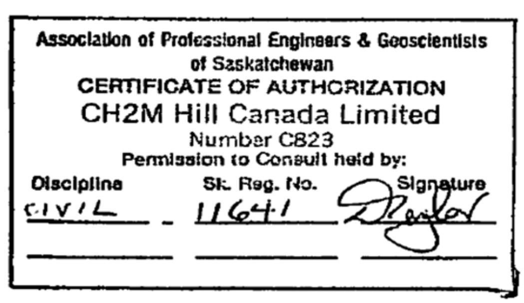
<tr><td>
</td><td>
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SECTION 1

Executive Summary

1.1 Overview

The City of Regina and the surrounding Census Metropolitan Area (CMA) is anticipating high growth over the coming 30 years. In order to absorb this growth in population, all communities need to have appropriate infrastructure in place, including water and wastewater servicing. This study identified that a number of regional engineering options are viable. In addition and equally importantly, this study is another step forward in fostering productive regional collaboration initiatives; however, much more work is required to take the engineering options developed through the political cycles and onward through to operational solutions. As indicated by several regional stakeholders, some options are time sensitive due to local servicing issues and decisions need to be made in 2014.

For the short to medium term (up to the year 2025), water infrastructure exists to accommodate the growing population and is generally in “fair to good” condition. Moving into the long term, however, water servicing becomes a significant problem for communities to the East of the City of Regina, as high population growth rates result in the water allocation limits from the Zehner Aquifer being reached within the next 10 to 15 years. Given the continued high population growth rate, an alternative regional water source will be required for the East communities to accommodate increasing demands. A regional water supply from Buffalo Pound through the City of Regina was considered and is seen by stakeholders as an appealing option, potentially with the inclusion of a regional water grid system to utilize recent local investment. The cost of an East Regional Water Pipeline connecting the City of Regina and Buffalo Pound with Pilot Butte, White City, Emerald Park, other RM of Edenwold communities, Sakimay, and Balgonie is estimated to cost $30 million[1] in initial capital, with operating costs ranging from $80,000 to $350,000 across 30 years. While water servicing is not an immediate concern, the stakeholders affected should make use of this extra time to fully investigate the option and to be ready for servicing issues when they arise. Water conservation is an activity that the region as a whole should embrace, both to postpone the likely required water infrastructure investments and also to ease the pressure on the already stretched wastewater systems servicing the stakeholders.

Generally, the wastewater infrastructure in the region is in “fair to poor” condition. Wastewater servicing is a challenge for most stakeholders across the region, as many local lagoons are at or nearly at capacity. For communities in the East particularly, hydraulic capacity is a particular issue over winter months as frozen creeks mean they are required to store treated effluent over winter months. A number of servicing options were considered, including an East Regional Wastewater Pipeline connecting the City of Regina with Pilot Butte, White City, Emerald Park, other RM of Edenwold communities, Sakimay, and Balgonie. The cost of this option is estimated to be $70 million in initial capital, with operating costs ranging from $400 thousand to $800 thousand across 30 years. In this case, City of Regina conveyance upgrades will likely be required to transport wastewater to the City’s existing West Wastewater Treatment Plant (WWTP), these could incur costs that would need shared with regional partners and further investigation is required with complex engineering models necessary. Thus, the alternative (or an addition in the future) is an East Regional WWTP capable of processing flows of 19.5 megalitres per day serving a population of approximately 50,000. This alternative is estimated to be $115 million in initial capital, with operating costs ranging from $1 million to $2 million up to the year 2043. For the Town of Lumsden in the North, a North Regional Wastewater Pipeline was also considered as an alternative to a new Local WWTP, and the cost was estimated to be $30 million in initial capital, with operating costs ranging from $170,000 to $280,000 across 30 years. Some

[1] Please note that all cost estimates and pricing included in the Executive Summary are Class 5 estimates in the range of minus 50 percent to plus 100 percent.

stakeholders in the North and East regions are facing particularly time-pressing wastewater servicing challenges and are seeking agreement on solutions to progress in 2014, and to be fully operational within the coming years. Grand Coulee also needs to move forward with a solution in the short term; however, from a regional perspective, the Grand Coulee solution could be as simple as a 3.5-kilometre pipeline with the nearby Global Transportation Hub (GTH) and corresponding pump station upgrades.

As indicated by several stakeholders, timing will be critical for a number of communities facing wastewater servicing challenges. If the potential regional solutions cannot be agreed upon promptly, then these stakeholders will have little choice but to move ahead with local options. The final stakeholder presentation in May 2014 presented the results of the study and identified opportunities for future regional collaboration.

1.1.1 Regina and Region Water and Wastewater Study

The Regina and Region Water and Wastewater Study (RRWWS) aimed to establish an understanding of the region's short- and long-term challenges and opportunities regarding water and wastewater infrastructure and associated services. With growth in Southern Saskatchewan at an all-time high, municipalities are faced with considerable challenges in managing the changes in demand, dealing with ageing infrastructure, and maintaining current levels of service to the existing user base. While each of the municipalities within the region is actively seeking to provide the best possible local solution within its current constraints, there may be opportunities for the coordinated development and sharing of infrastructure and resources to overcome servicing challenges. This study aims to identify such possibilities for regional collaboration, to open these up for further discussion, to help promote partnerships, and to work towards collaboration and cooperation where this might be in the best interest of delivering sustainable service for future generations within the Region.

On March 28th 2013[2], the Government of Saskatchewan issued an amendment to the *Planning and Development Act* of 2007, "…designed to give the Minister of Government Relations the ability to create regional planning authorities to ensure continued economic growth within the province." While this study was planned and initiated before the amendments to the Act, the efforts of this study align very well with the regional aspirations indicated by the Province. It also demonstrates that the regional stakeholders are willing to volunteer for this regional effort, as opposed to gaining their participation through intervention by the province.

1.1.2 Building Relationships

A significant objective for the study was to "build bridges" and improve stakeholder relationships, particularly between the City of Regina and regional stakeholders.

Through the delivery of the project, collectively CH2M HILL combined with the City of Regina and the regional stakeholders have met these objectives and progressed regional thinking in the census metropolitan area for potential water and wastewater solutions:

- Relationships have been built: some barriers have been addressed, and overall trust and openness has improved.
- All parties have a much better understanding of one another: communities are talking to each other more about their difficulties. Regional stakeholders have a better understanding of one another's water and wastewater servicing outlook and challenges and, in some cases, have recognized shared challenges and opportunities.
- Regional opportunities are being discussed, with an eye to solving stakeholder challenges at lower costs and with better solutions. Various engineering options have been identified and evaluated.

[2] http://www.gov.sk.ca/news?newsId=8c253880-cc68-4ccb-9190-ce8a5a2478c6

1.1.3 Stakeholder Scope

The scope of the study includes municipalities in the CMA and covers the stakeholders listed in Table 1-1. A total of 14 different community stakeholders were involved in the study, along with three other regional organizations.

Table 1-1
Stakeholders

Moose Jaw-Regina Corridor	White-Butte Area	Others
• City of Regina • RM of Pense • Village of Grand Coulee • Town of Pense • Town of Belle Plaine	• City of Regina • RM of Edenwold (including Emerald Park) • Village of Edenwold • Town of Balgonie • Town of Pilot Butte • Town of White City • WCRM158 Wastewater Management Authority	• Sakimay First Nation (E20-17-20W2) • RM of Lumsden • Town of Lumsden • Village of Craven • SaskWater • Water Security Agency (WSA) • Ministry of Environment (merged with the WSA)

Notes:
RM – Rural Municipality

The RM of Sherwood is a significant stakeholder in the study area; however, they have not been available to participate in the study at this stage. The RM of Sherwood falls within both the White-Butte Area and the Moose Jaw-Regina Corridor. Based on the understanding gained over the course of the study, new communities within the RM of Sherwood to the east of the City of Regina will likely face significant pressures on gaining water servicing, given the already stretched water allocations.

1.1.4 Wastewater Infrastructure

Generally the wastewater infrastructure in the region is in "fair to poor" status. While investment was focused on water infrastructure, much of the investment required to maintain the wastewater infrastructure was deferred. This is not uncommon across Canada, and now numerous municipalities are facing problems with aging wastewater infrastructure.

Many communities (including White City, RM of Edenwold [Emerald Park], Village of Edenwold, Balgonie, Lumsden, Grand Coulee, and Pense) have reached the hydraulic capacity of their wastewater systems or are facing engineering challenges, and these communities require solutions to be in place in the near future. With planned or approved development in their communities already progressing, a number of them are facing overflow risks. Some stakeholders in the North and East regions are facing particularly time-pressing wastewater servicing challenges and are looking to agree upon solutions to progress in 2014, and to be fully operational within the coming years. Grand Coulee also needs to move forward with a solution in the short term. For communities in the East particularly, hydraulic capacity is a particular issue over winter months as provincial regulations only allow discharge from April 1 to October 31 without special authorization.

There are real opportunities for three regional wastewater solutions in the area:

i) North Wastewater Regional Pipeline – from the Town of Lumsden to the City of Regina's existing WWTP.

ii) East Wastewater Regional Pipeline – from Balgonie, Pilot Butte, White City, Emerald Park, other nearby RM of Edenwold communities and Sakimay First Nation land, to the east side of the City of Regina. Upgrading of City of Regina conveyance would be required to transport the wastewater to the existing facility in the northwest of the City. Alternatively or in the future, an East Regional WWTP could be constructed.

iii) West Wastewater Connection from Grand Coulee to the GTH – enabling a connection from Grand Coulee to the City of Regina's existing West WWTP through the GTH. In this case, upgrades to the City of Regina's Pump Station in the GTH would likely be required.

These opportunities are time-sensitive due to the nature of the challenge and the pending growth in the related communities. In order to defer the required investment and create minor additional capacity in the systems, various interim options were also reviewed that may be appropriate for the affected stakeholders.

More detail on these opportunities are provided in this report. A summary of the two significant wastewater pipelines is provided below along with an overview of the wastewater servicing challenges for the City of Regina.

1.1.5 North Regional Wastewater Pipeline, Connecting Lumsden with the City of Regina

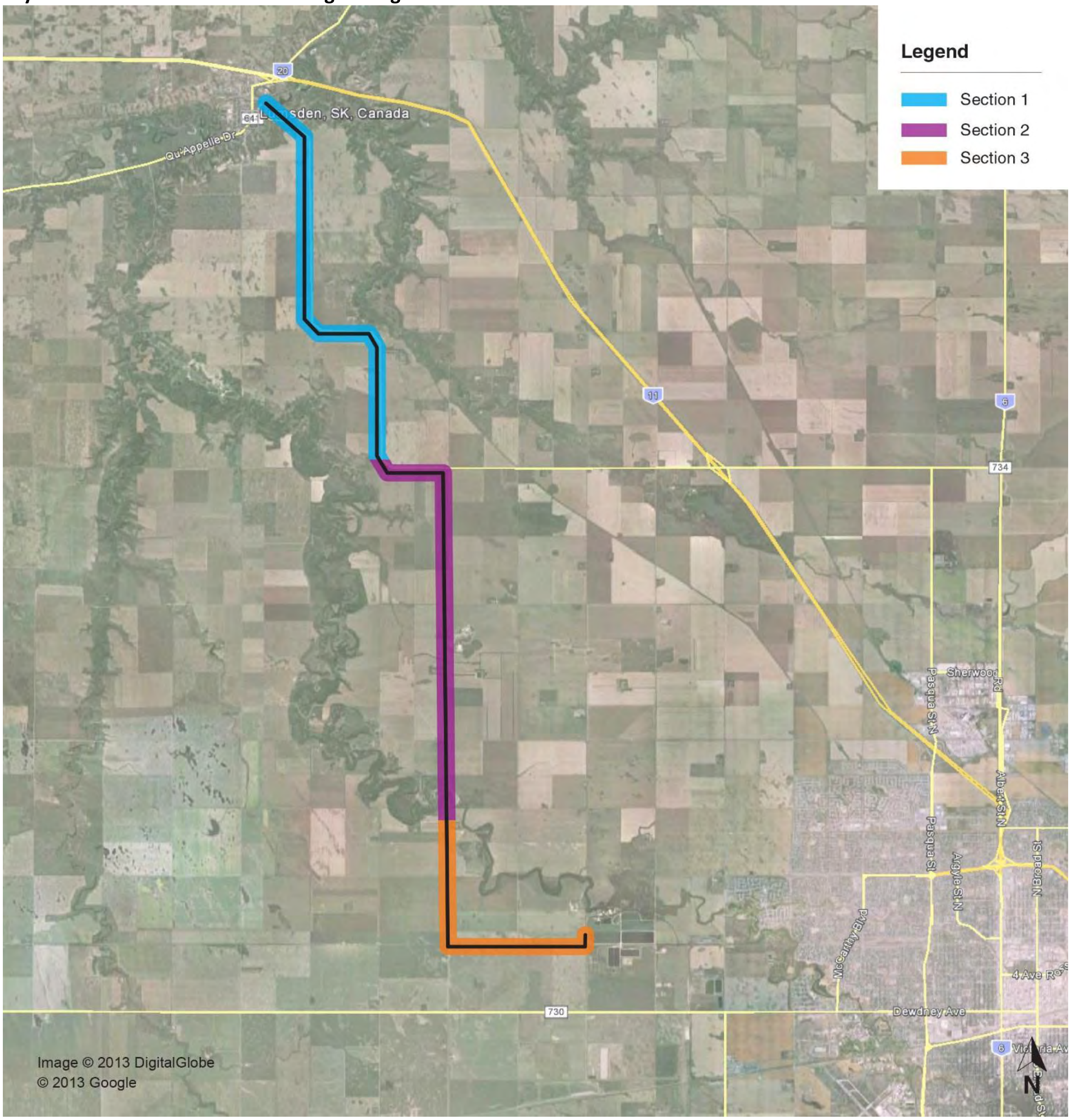
Wastewater servicing is currently a significant issue for the Town of Lumsden, with short-term environmental risks resulting in a halt on growth. As indicated by Lumsden, they will need to decide in 2014 which servicing route, regional or local, they would like to pursue. Concept and predesign work is already underway for a local WWTP. Challenges are potentially equally important for communities around Last Mountain Lake; however, that locality is outside of the study area scope. The RM of Lumsden and Craven are in a satisfactory position for wastewater servicing into the medium term.

The conceptual design for the North Regional Wastewater Pipeline suggests that a suitable route could follow the road adjacent to this country club. The RM of Sherwood expressed interest in connecting to this regional pipeline to service wastewater in the new development (and potentially to connect to the Sherwood Forest Country Club). This would reduce the costs associated with building and maintaining the regional pipeline, as they could be shared among the Town of Lumsden, the RM of Sherwood, and any other new large communities arising within either the RM of Sherwood or the RM of Lumsden in the future.

The North Regional Wastewater Pipeline would be an approximately 30 km long forcemain that would convey wastewater from the Town of Lumsden to the City of Regina's existing WWTP. Figure 5-13 shows a potential layout of the forcemain in aerial view. This project involves installation of 400-mm-diameter PVC DR 18 pipe laid along the side of the highway; installation of a short section of pipe under the railway; installation of a short section of pipe under a creek (by trenchless installation); installation of air release valves, drains, and isolation valves; construction of a pump station; and restoration of existing facilities affected by construction.

The North Regional Wastewater Pipeline was estimated to cost $30 million in initial capital, with operating costs ranging from $170,000 to $280,000 across 30 years.

Figure 5-13
Layout of the Potential Lumsden Regina Regional North Wastewater Forcemain



Note: Figure duplicated from Section 5

1.1.6 City of Regina Wastewater Servicing: Challenges in the Southeast

Currently, the City is in the process of developing a P3-based procurement approach for the WWTP. This approach will see the current WWTP upgraded by the end of 2016, as well as removing the operational requirements of the WWTP from the City for a 30-year period. From the information contained in the P3 documents that are available to the public, it appears that the operation, maintenance, and service of the current and future networks (along with the McCarthy Boulevard Pumping Station [MBPS] and a possible new Septage Receiving Facility) may remain under the control of the City of Regina.

The current collection system for the City of Regina will require only minor upgrades to serve a population of 235,000 people as defined in Stage 1 of the City's 2004 *Long Term Residential Growth Study* (LTRGS).

The Northwest Sector is the most receptive to development and requires the least amount of upgrade works, due to available capacity within the system. The Northeast Sector was not designed to accommodate any future development beyond the boundaries of the existing system. Expansion of the existing detention facility at the Creeks Lift Station in the Southeast Sector was envisioned to accommodate additional development to Stage 1 in the Southeast, but has not yet been constructed. Detention storage has already been constructed at Harbour Landing to accommodate Stage 1 development in the Southwest.

Once the population of the City reaches the population defined in Stage 1 of the LTRGS (that is, a population of 235,000), the collection system will require further investment to sustain growth into Stages 2 and 3 of the LTRGS. Based on current projections, the City is due to reach this population around the year 2020[3], at which point wastewater infrastructure upgrades will be required, particularly in the Southeast. As a result, the City of Regina is actively assessing wastewater servicing options, including regional collaborations that would solve not only the City's pending wastewater challenges but also those of regional neighbours.

1.1.7 East Region and Regina Wastewater Servicing, including Consideration of an East Regional Wastewater Treatment Plant

The CH2M HILL team has developed Cost Estimates for certain options and collected other existing information where appropriate. Table 1-2 provides an overview of the East Wastewater Servicing options. In dealing with the options it is important to remember that although the regional options are more expensive, the costs would likely be split between the users. Cost Sharing is explored in this report to give communities an indication of the split if cost sharing was based on population use in a regional model. The overall solution in this region will likely require a combination or a variation of the below options.

Table 1-2
Overview of Capital and Operation and Maintenance/Replacement Cost Options for East Wastewater Servicing
Costs at 2014 prices and exclude GST and PST. Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement presented costs are the first and last full years in the 30-year lifecycle. Calculated numbers were rounded to the nearest significant figure.

Option Available	Initial Capital Cost	Operation & Maintenance plus Replacement	± Variance	Construction Year	Notes / Source
East Regional Wastewater Pipeline	$70 million	$400,000 - $800,000	- 50% + 100%	2015 Operational 2017	CH2M HILL Cost Estimate, December 2013
East Regional Wastewater Treatment Plant	$115 million	$1 million - $2 million	- 50% + 100%	2023 Operational 2024	CH2M HILL Cost Estimate, February 2014
Local Wastewater Treatment Plant for WCRM158 White City and Emerald Park	$12-21 million (excluding effluent pipeline)	$350,000 - $500,000	TBC	2015	Proposed cost from RFP December 2013 and initial engineering work in 2014

[3] Please note that this timing excludes any loads on the system from the addition of wastewater flows from East Region communities.

Table 1-2
Overview of Capital and Operation and Maintenance/Replacement Cost Options for East Wastewater Servicing
Costs at 2014 prices and exclude GST and PST. Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement presented costs are the first and last full years in the 30-year lifecycle. Calculated numbers were rounded to the nearest significant figure.

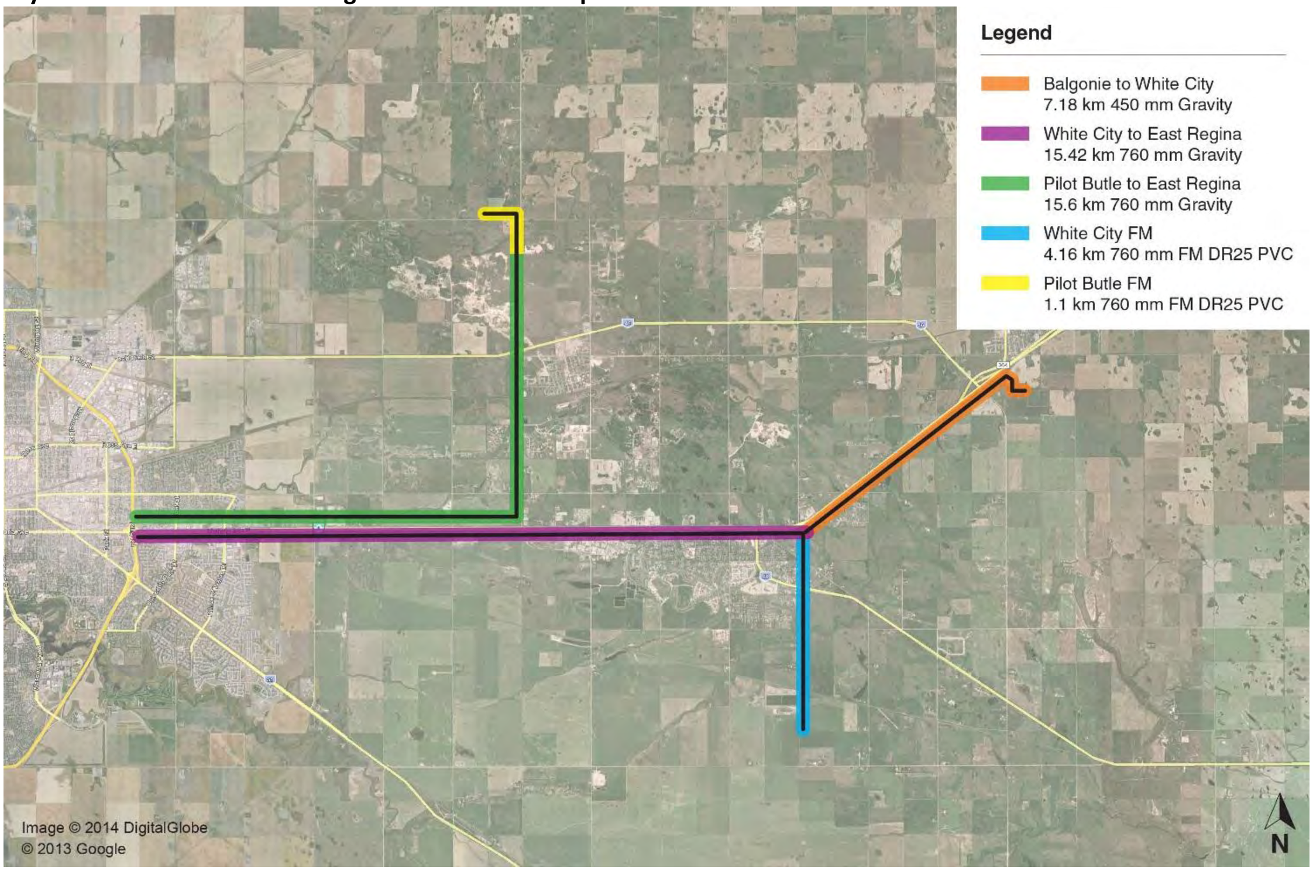
Option Available	Initial Capital Cost	Operation & Maintenance plus Replacement	± Variance	Construction Year	Notes / Source
Local Lagoon Upgrades for Balgonie and Pilot Butte	$750 thousand to $2 million per site	Minimal	Not Applicable	As required Within next 5 years	High level CH2M HILL estimate and verbal estimate from local firm

The Wastewater Management Authority Inc. (WCRM158)[4] was created between White City and the RM of Edenwold (particularly Emerald Park) to oversee and work to resolve wastewater servicing challenges for these two communities. In addition to supporting this study to investigate potential regional options, WCRM158 pursuing the predesign and cost estimate for a Local Wastewater Treatment Plant themselves through an RFP which was awarded in December 2013. The main driver behind progressing these routes in parallel was to ensure the communities would be able to have one solution operational as soon as possible in order to accommodate the short term growth.

The predominant regional servicing solution is to build a regional wastewater pipeline in the East, collecting wastewater from the communities Pilot Butte, White City, Emerald Park, other RM of Edenwold communities, Sakimay First Nation, and Balgonie, and transporting it to the east boundary of the City of Regina. Notably, most of this pipeline brings flows downhill, allowing for gravity mains to be used and resulting in a significant annual O&M saving over uphill options. Because a regional pipeline to collect wastewater will be required, no matter what its final destination (the existing West WWTP or a new East WWTP), this option was considered in isolation. City of Regina conveyance upgrades will likely be required to transport wastewater to the City's West WWTP whether in the short or long term, and these could incur costs. Further investigation is required with complex engineering models necessary and discussions to be held around regional partners contributing to this infrastructure. An overview of the East Regional Wastewater Pipeline is presented in Figure 5-20.

[4] Refer to http://www.rmedenwold.ca/assets/File/WCRM158.pdf for more information.

Figure 5-20
Layout of the Potential East Regional Wastewater Pipelines



All related data Copyright Google and Digital Globe 2013.

Note: Figure duplicated from Section 5

The City of Regina's wastewater collection system was assessed by AECOM in 2012[5] and, in general, it appears that the collection system capacity is taxed in terms of peak flow (based on the 1 in 25 year stormwater event). An observation is that all wastewater flows are routed through a single large pump station, the McCarthy Boulevard Pump Station (MBPS). Based on the importance of this pump station, it is assumed there are several layers of redundancy (such as back-up power and redundant pumps); however, the pump station may still be vulnerable to events such as a fire emergency. Several options for upgrading various sewer trunks in each City sector (Northeast, Southeast, Southwest, and Northwest) were presented in separate studies. Some of those options may have potential to form part of a solution for bringing sewer water through Regina to Regina's WWTP from the East Region communities.

Since there is an immediate need to provide capacity for the communities to the east, and because there appears to be relatively immediately available capacity within the City of Regina in the design of the retention facility meant to service the Creeks development, a potential short term solution exists: building out the retention facility and connecting the East regional flows to it. In order to lessen the effect the incoming peak flows would have, it is suggested that the existing regional lagoons (or some of them) could be used as buffer storage, prior to strategically pumping the flows to the retention facility. This concept would deliver the East regional flows to the Creeks retention facility overnight and during non-peak hours during the day. Further investigation is required with complex engineering models necessary to understand flows across the region along with regional lagoons, City of Regina conveyance, and treatment plant

5 AECOM. 2012. *City of Regina, Citywide Wastewater Collection System Assessment - Final Report*. Prepared for the City of Regina.

capacity. As a side note, Regina's existing WWTP would benefit from any treatment the existing east regional lagoons might provide for as long as they may be operational. As growth occurs in the City and the regional communities, the stakeholders would then have the option to consider long term options if required: for example, a new regional WWTP located in the east could be connected.

This demonstrates a phased approach to infrastructure investment alongside the phased growth in the City and region. The addition of a regional wastewater pipeline would solve regional servicing challenging while utilizing the City's existing conveyance investments and while also providing additional population to fund future upgrades and expansions. In the longer term, if growth continues to be high and City conveyance capacities are being reached, then a new regional WWTP located in the east could be considered.

Following a review of the effluent quality requirements by CH2M HILL engineers, it was suggested that a Biological Nutrient Removal (BNR) WWTP would be a sufficient solution for the aforementioned East Regional WWTP.[6] The BNR configuration would be equipped with tertiary filtration, ultraviolet (UV) disinfection, and Anaerobic Sludge Digestion. In terms of location, no specific location was identified at this stage in the study. Engineers worked with the design brief of a location somewhere on the East side of the City of Regina. As a result, any transportation of treated effluent from the treatment process has not been included in this estimate.

Timing will be a significant challenge. White City and Emerald Park are currently facing wastewater servicing challenges and are facing growth restrictions as a result. These communities are seeking resolution as soon as possible, so that wastewater regulatory obligations are met and growth is not disrupted. While regional options are viable from an engineering perspective, they will take longer to implement. As a result, interim options were investigated that would 'buy time' for stakeholders with immediate challenges, prior to a regional solution being operational. The duration of this interim solution would be dependent on the timeframe to negotiate and construct the pipeline. Engineering and construction can be accelerated, but the duration is mainly dependent on politics between stakeholders involved and their ability to agree upon the other aspects of the pipeline and future treatment options, including governance and rate setting approaches.

1.1.8 Water Infrastructure

The local water infrastructure in the region is generally in a "fair to good" condition. Over the past decades, communities have been investing in their water infrastructure to ensure communities have safe potable water supplies.

In the North, minor-to-moderate infrastructure upgrades will be required between 2025 and 2035 to continue meeting water demands up to 2040. In the West, only minor infrastructure upgrades will be required in the future, as all of the municipalities purchase treated water from the Buffalo Pound Supply Line (BPSL). Relative to the North and West, higher growth is expected in the communities to the east of Regina. In the East, high growth is anticipated in the next 25 years, requiring minor-to-moderate infrastructure upgrades between 2025 and 2035 to continue meeting water demands up to 2040.

With the high growth anticipated to the east of Regina in the next 25 years, higher water allocations will be required to meet increasing water demands. East Region municipalities are currently reliant on groundwater from the Zehner Aquifer; however, the total usable supply capacity of the Zehner Aquifer has already been allocated to the existing users. New developments will need to obtain water from existing users or will require an alternative water source, such as treated water from the BPSL. New communities within these RMs are likely to face significant pressures on obtaining additional water servicing, given the already stretched allocations. If growth in the East continues to be high, as desired by the municipalities, the total allocation limit for the Zehner Aquifer will be reached in the next 10 to 15 years. Thus, a regional solution

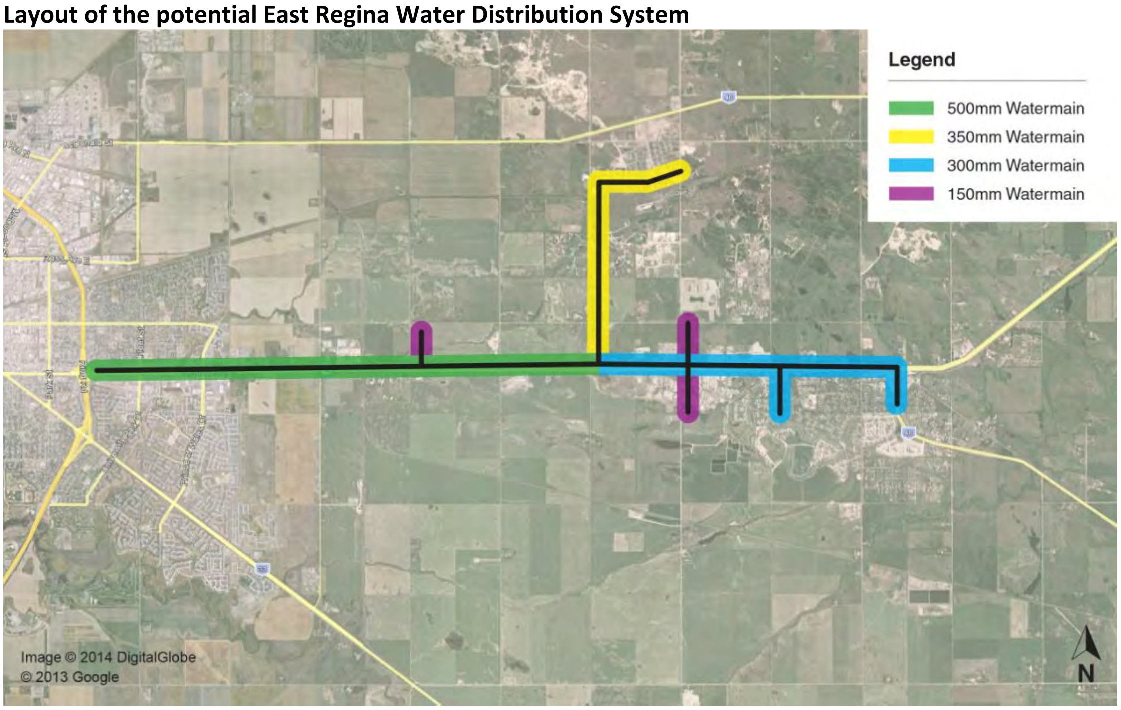
[6] These effluent quality requirements are detailed in the WCRM158 Wastewater Management Authority Inc Request for Proposal (RFP) package released in October 2013, including the Downstream Use and Impact Study (AECOM, 2013).

will be required to continue servicing the municipalities and developments in the East into the long-term (that is, until the year 2040).

As part of the RRWWS, feasible options were explored for overcoming the water demand challenges in the East. The potential solutions explored include the development of (i) East Regina Regional Pipeline; (ii) an East Regina Regional Water Grid System; and (iii) the implementation of water conservation and water re-use measures to reduce current and future water demands in each community. The overall solution in this region will likely require a combination or a variation of these options. For example, the water conservation measures would marginally reduce demands and would postpone the point at which allocation limits would be reached; however, once allocation limits are reached, a regional watermain would still need to be constructed to supply the demand.

The cost of an East Regional Water Pipeline connecting the City of Regina and Buffalo Pound with Pilot Butte, White City, Emerald Park, other RM of Edenwold communities, Sakimay First Nation, and Balgonie is estimated to be $29 million in initial capital, with operating costs ranging from $76,000 to $338,000 across 30 years. Figure 6-11 below shows the layout of the proposed water distribution system.

Figure 6-11
Layout of the potential East Regina Water Distribution System



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Although the water servicing challenges are not as pressing as the wastewater servicing challenges, the region should take these challenges seriously and use the available time to develop an optimum solution for all stakeholders. Notably, implementing water conservation and water re-use measures in the short term would not only postpone the water servicing challenges but would also benefit wastewater servicing by reducing influent wastewater flows. This would be of immediate benefit to the communities in the East who are currently experiencing significant wastewater servicing challenges.

SECTION 2

Study Background and Overview

2.1 Overview of Region and Communities

The City of Regina is the second largest city in Saskatchewan and is located in the southern portion of the province within the Rural Municipality (RM) of Sherwood. Southern Saskatchewan is experiencing a period of growth along with other prairie cities in Canada. Potash, a key ingredient in fertilizer, is a major economy for the region, and Saskatchewan is believed to have the largest deposits of the mineral in the world.

Surrounding the City of Regina are a number of rural communities of varying sizes and cultures. To the west are the bedroom communities of the Village of Grand Coulee, and the Towns of Pense and Belle Plaine, along with other smaller communities within the RM of Pense. A further 77 kilometres (km) west of Regina is the City of Moose Jaw. To the north are the Town of Lumsden and the Village of Craven within the RM of Lumsden. To the east are larger regional communities: the Towns of White City, Pilot Butte, and Balgonie. These sit within the RM of Edenwold, within which there are also other sizable communities including Emerald Park. Further to the northeast of the city is the small community of the Village of Edenwold, still located within the RM of Edenwold. A number of communities also exist adjacent to the City of Regina's city limits within the RM of Sherwood. No major communities exist in the nearby area south of the City of Regina aside from developments within the RM of Sherwood.

A scaled map of southern Saskatchewan is presented in Figure 2-1, along with the more detailed map of the Census Metropolitan Area in Figure 2-2. The Census Metropolitan Area represents the area that has grown around the City of Regina through benefiting and working with commerce, trade, and services in the area.

More information on each of the communities is detailed in Section 3 and 4.

Figure 2-1
Wider Southern Saskatchewan Area Illustrating the Provincial Context of the City of Regina and Regional Communities

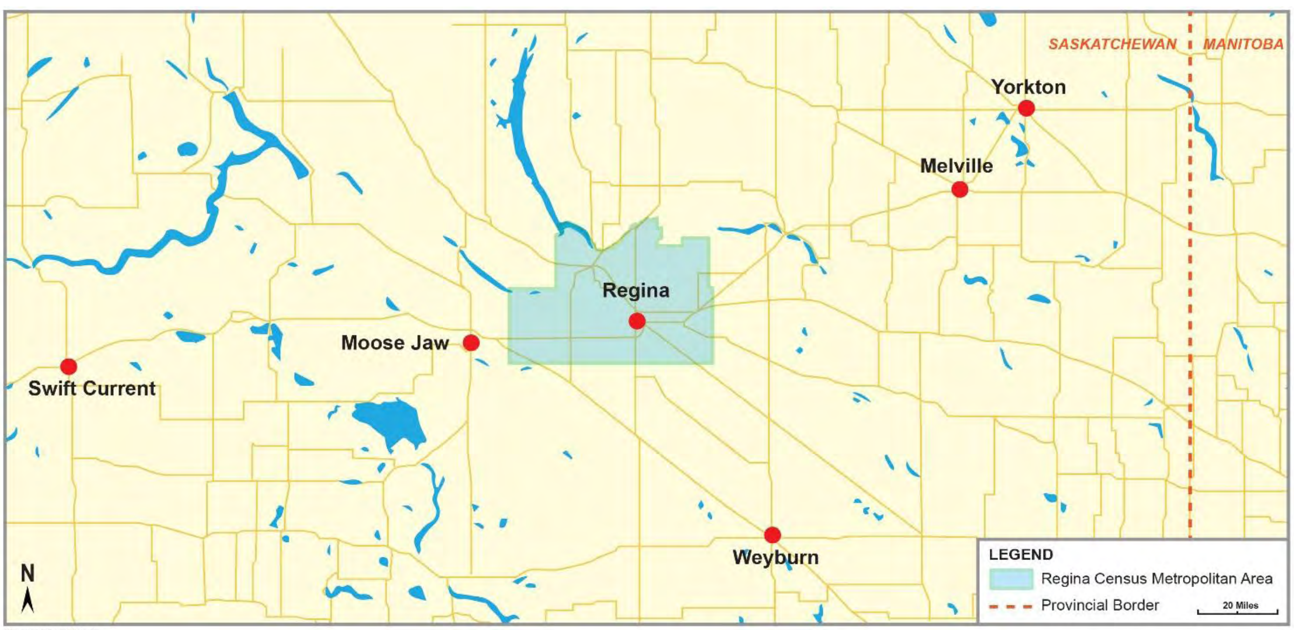
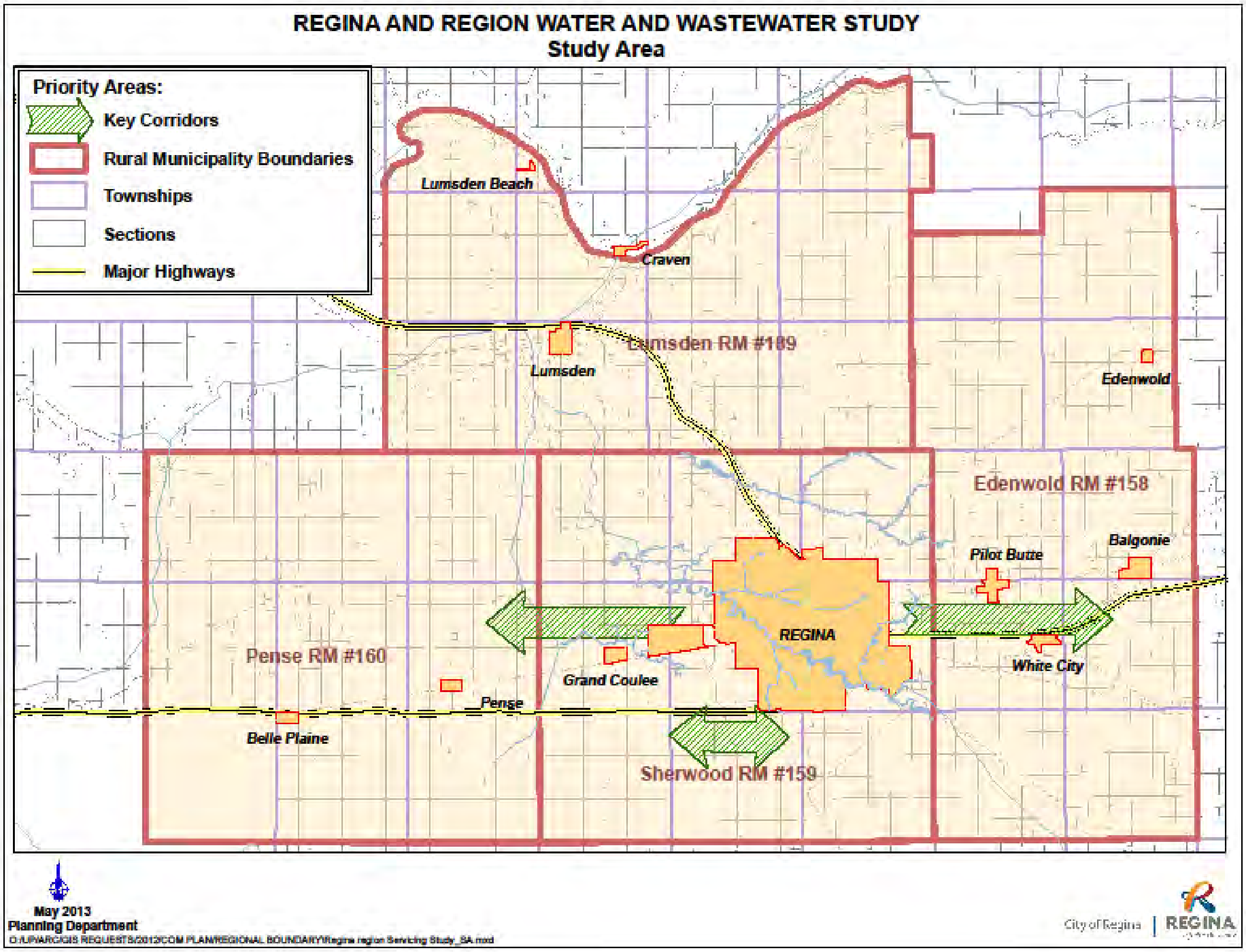


Figure 2-2
The Census Metropolitan Area surrounding the City of Regina and the scope of stakeholders for the Regina and Region Water and Wastewater Study



All related data Copyright Google and Digital Globe 2013.

2.2 Regina and Region Water and Wastewater Study Overview

The Regina and Region Water and Wastewater Study (RRWWS) aimed to establish an understanding of the region's short and long term challenges and opportunities regarding water and wastewater infrastructure and associated services. With growth in Southern Saskatchewan at an all-time high, municipalities are faced with considerable challenges in managing the changes in demand, dealing with ageing infrastructure, and maintaining current levels of service to the existing user base. While each of the municipalities within the region are actively seeking to provide the best possible local solution within their current constraints, there may be opportunities for the coordinated development and sharing of infrastructure and resources to overcome servicing challenges. This study aims to identify such possibilities for regional collaboration, to open these up for further discussion, to help promote partnership, and to work towards collaboration and cooperation where this might be in the best interest of delivering sustainable service for future generations within the Region.

On March 28th 2013[7], the Government of Saskatchewan issued an amendment to the *Planning and Development Act* of 2007, "…designed to give the Minister of Government Relations the ability to create regional planning authorities to ensure continued economic growth within the province." While this study was planned and initiated before the amendments to the Act, the efforts of this study align very well with regional aspirations indicated by the Province. It also demonstrates that the regional stakeholders are willing to volunteer for this regional effort, as opposed to gaining their participation through intervention by the province.

2.2.1 Study Objectives

During the project kickoff meeting (held at the City of Regina Town Hall on March 19, 2013), the CH2M HILL Canada Limited (CH2M HILL) and City of Regina (City) project team agreed upon the scope, objectives, and approach for the Regina and Region Water and Wastewater Study.

The following objectives were agreed upon for the study:

1. Identify opportunities to coordinate the provision of water and wastewater services across the region.
2. "Build bridges" and improve stakeholder relationships, particularly between the City of Regina and regional stakeholders.
3. Focus on engineering to discuss what is possible and feasible, avoiding political complications that could cloud the investigation of appropriate options.

While the City was the primary client for this project and its sole financer, CH2M HILL's team members were not directed to focus effort on the City's interest, but instead they were directed to look for optimum regional solutions. For example, if an attractive regional solution was to connect two regional communities, excluding the City from the solution, CH2M HILL was to pursue the investigation of that option. CH2M HILL has remained neutral and unbiased in its investigation and evaluation of the options. The study has been led by members of the CH2M HILL Asset Management team who maintained this neutral and unbiased approach.

It is hoped that, moving forward, regional opportunities can be led and funded more cooperatively through regional boards while maintaining a strong lead to ensure regional progress is made quickly to meet regional demands.

Many examples of regional collaboration already exist within the region:

- Buffalo Pound Water Treatment Plant
- White City and RM of Edenwold – Wastewater Lagoons
- Pilot Butte and Balgonie – Water Pipeline and Supply
- White Butte Regional Planning Committee
- Moose Jaw-Regina Industrial Corridor Stakeholder Committee

All of this represents a good start for the region, and this study was not tasked to change or divert from the good progress already made. Instead, the study was intended to build on these existing efforts and to provide the region with a focused review of water and wastewater over a larger area.

[7] http://www.gov.sk.ca/news?newsId=8c253880-cc68-4ccb-9190-ce8a5a2478c6

2.2.2 Study Outcomes

Through the delivery of the project, collectively CH2M HILL combined with the City of Regina and the regional stakeholders have met these objectives and progressed regional thinking in the census metropolitan area for potential water and wastewater solutions:

- Relationships have been built: some barriers have been addressed, and overall trust and openness has improved.
- All parties have a much better understanding of one another: communities are talking to each other more about their difficulties. Regional stakeholders have a better understanding of one another's water and wastewater servicing outlook and challenges.
- Regional opportunities are being discussed, with an eye to solving stakeholder challenges at lower costs and with better solutions. Various engineering options have been identified and evaluated, including the following:
  - Pre-design of options along with Capital and Operations & Maintenance costs (including replacement)
  - North Regional Wastewater Pipeline: active discussions underway with Lumsden
  - East Regional Wastewater Pipeline: a real solution option for the region, but a time-sensitive one
  - East Regional Wastewater Treatment Plant
  - West Regional Wastewater Pipeline: small population bodies make a pipeline less financially viable, but a connection between Grand Coulee and the GTH is feasible
  - East Regional Watermain / Supply Network: if aggressive growth is realized, potential solution options will be limited

2.2.3 Study Approach and Timeline

In order to meet the objectives, the following approach and timeline was developed.

Phase 1 of the study focused on the following:

i) Establishing the current state of the water and wastewater infrastructure

ii) Defining the service challenges that municipalities are facing now and in the short term

iii) Identifying any opportunities that exist for regional partnerships between neighbours to address the short-term challenges

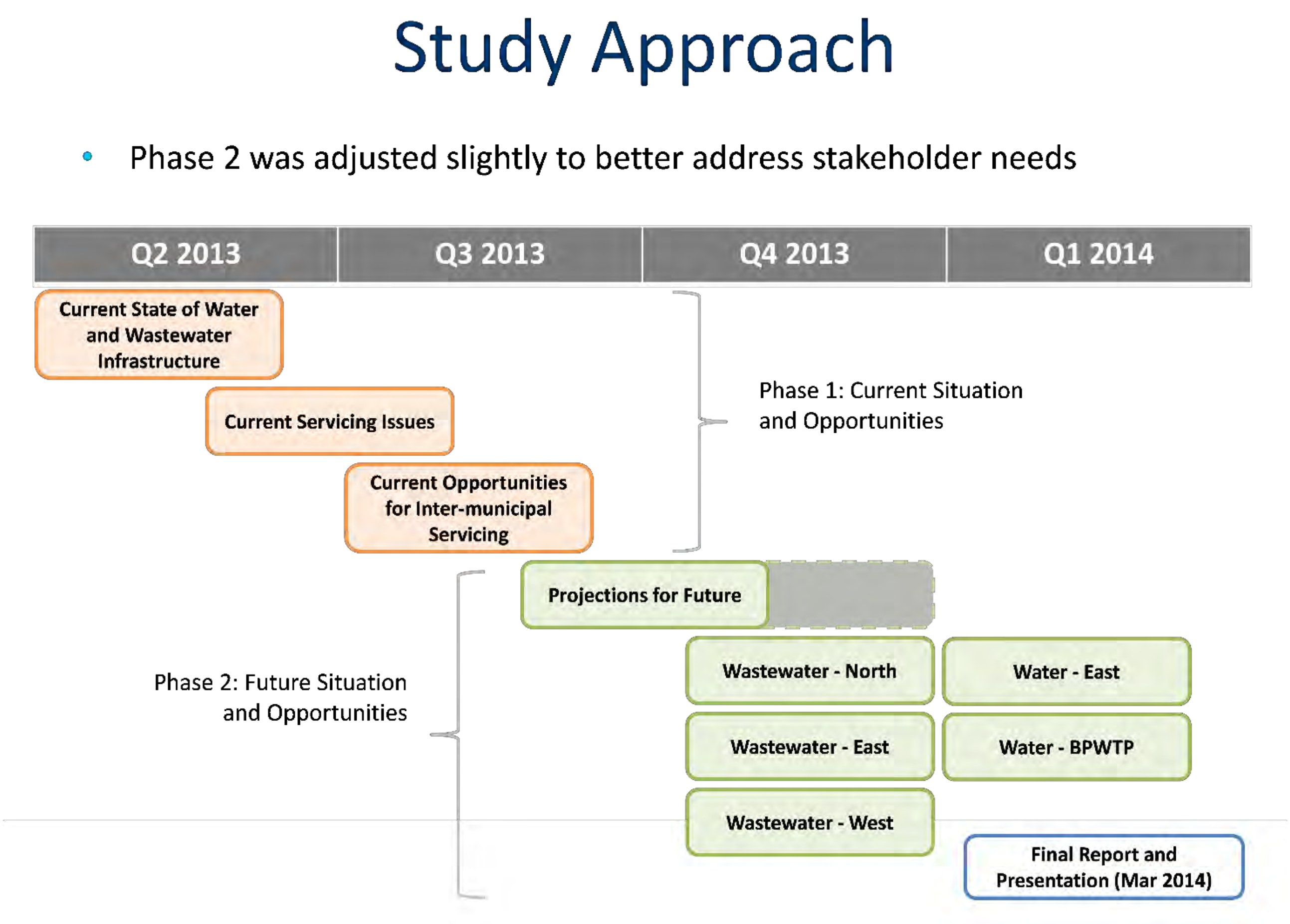
Phase 2 of the study focused on the following:

i) Establishing a view of the expected servicing needs out to 2040

ii) Defining what future service challenges may exist

iii) Identifying any opportunities for future collaborations across the region to address these long-term challenges

Figure 2-3
Regina and Region Water and Wastewater Study Revised Project Approach
The approach was revised towards the end of Phase 1 as it become clear that a detailed investigation into wastewater across the study area was required.



The timeline and approach in Figure 2-3 represent the actual approach that was delivered by the project team. The actual approach varied only slightly from the original approach outlined at the start of the study. Towards the end of Phase 1, it was obvious that wastewater was a significant issue for many stakeholders in the region and far more pressing issue than was water. Given the nature of the wastewater challenges faced by the communities, namely capacity, it was most appropriate to investigate permanent solutions as a priority and to look for interim options, as opposed to investing time on short-term or quick-win options. The project was extended by 2 months to accommodate some of the challenges faced over the course of the project.

2.2.4 Stakeholder Scope and Engagement

A total of 14 different community stakeholders were involved in the study, plus three other regional organizations. Historically, issues between stakeholders, particularly between the City and regional communities, had caused a breakdown in relations; thus, at the outset of the project, there was a need to re-establish higher levels of trust and communication. Per the objectives above, working together across the region and building relationships was an important step forward through the study.

The scope of the study includes municipalities in the Census Metropolitan Area (CMA) and covers the stakeholders listed in Table 2-1. Information documents and invitations to participate in the study were issued to the stakeholders in April 2013. An example invitation letter is included in Appendix D.

Table 2-1
Stakeholders

Moose Jaw-Regina Corridor	White-Butte Area	Others
• City of Regina • RM of Pense • Village of Grand Coulee • Town of Pense • Town of Belle Plaine	• City of Regina • RM of Edenwold (including Emerald Park) • Village of Edenwold • Town of Balgonie • Town of Pilot Butte • Town of White City • WCRM158 Wastewater Management Authority	• Sakimay First Nation (E20-17-20W2) • RM of Lumsden • Town of Lumsden • Village of Craven • SaskWater • Water Security Agency (WSA) • Ministry of Environment (merged with the WSA)

Notes:
RM – Rural Municipality

The RM of Sherwood is a significant stakeholder in the study area; however, they have not been available to participate in the study at this stage. The RM of Sherwood falls within both the White-Butte Area and Moose Jaw-Regina Corridor.

The City of Moose Jaw was not included in the scope of the study mainly due to the geographical distance between the cities, 77 km. While Moose Jaw is the other significant stakeholder to the Buffalo Pound Water Treatment Plant, it was decided that the necessary input would be available from the Buffalo Pound team. This allowed CH2M HILL to maintain a tighter scope and keep the project on schedule: given the initial stages of this study and its conceptual nature, this situation was agreed to be suitable by the City of Regina. As the regional agenda moves forward, particularly on water servicing and Buffalo Pound Water Treatment Plant, it is suggested that the City of Moose Jaw become more involved.

Various communication channels and methods were used to engage the stakeholders throughout the study, including the following:

- Group Workshops with Stakeholders (both with all stakeholders together and also split by West and East groups)
  - White-Butte Planning Committee, Study Introduction — May 15, 2013
  - Regina-Moose Jaw Industrial Corridor Committee, Study Introduction — May 9, 2013
  - Group Working Session, Overview of Challenges — July 17, 2013
  - Group Working Session, Options and SWOT Review — October 30, 2013
  - West Working Session, Wastewater Servicing Review — December 12, 2013
  - East Working Session, Wastewater Servicing Review — December 12, 2013
  - East Follow-Up Working Session, Wastewater and Water Review — February 5, 2014
- Final Stakeholder Presentation, RRWWS Overview and Next Steps — May 28, 2014
- One-on-One Meetings with Stakeholders (both with and without the City of Regina)
- One-to-One Telephone Calls
- Formal Invitational Letters by Post
- Individual and Group Emails

A list of attendees at each of the working sessions listed above is provided in Appendix E. Table 2-2 identifies the main points of contact at each stakeholder. Many other people from the stakeholders were involved, the below only indicates the primary points of contact, Appendix E will give an indication of who else was involved from the stakeholders.

Table 2-2
Points of Contact within the Stakeholder Organizations

Municipalities	Primary Point of Contact	Secondary Point of Contact (if applicable)
Regina	Kevin Syrnick	
Balgonie	Valerie Hubbard	
Pilot Butte	Laurie Rudolph	
White City	Shauna Bzdel	Ron Hinton (Contract Manager)
Edenwold	Christine Galbraith	
RM of Edenwold	Kim McIvor	Ron Hinton (Contract Manager)
Lumsden	Darcie Cooper	Ron Hinton (Contract Manager)
RM of Lumsden	Darcie Cooper	
Grand Coulee	Tobi Duck	
Pense	Jennifer Lendvay	
RM of Pense	Carolynn Meadows	Kathy Ripplinger
Craven	Wendy Dunn	
Belle Plaine	Ed Siemens	Jeffrey Halliday (Genivar Engineering) Tim Cheesman (Regional Consultant)
Sakimay Land	Linda Falstead	
Water Security Agency (WSA)	Ryan Evans (Wastewater) Jeff Hovdebo (Water)	
SaskWater	Nish Prasad	
RM of Sherwood	Rachel Kunz	Rod Benroth (Manager of Public Works)

Notes:
RM – Rural Municipality

SECTION 3

Population Data and Projections

This section details the population projections and growth assumptions for stakeholders of the RRWWS. The population is projected to the year 2040, representing growth in the long term. These population projections will be used as a basis for establishing future water demands and wastewater generation rates for each community. These projections have been used to understand where regional challenges exist and for much of the engineering pre-design work in scoping potential future solutions to the servicing challenges.

The City of Regina is anticipating rapid growth over the next 25-plus years, through the development of built or approved neighborhoods, further intensification, and greenfield development; the City is projecting to reach a population of 309,740 by 2041. Additionally, rapid growth is also anticipated to occur to the east of Regina over the next 25 years, as the communities of Pilot Butte, White City, Balgonie, and Emerald Park continue to expand and as new residential and commercial developments are constructed in the RM of Edenwold. In 2040, the cumulative population in the East is projected to be just over 35,000 residents.

Relative to the growth occurring in the East, growth to the north and west of the City is anticipated to occur more slowly, with projected populations of approximately 3,600 and 2,750, respectively, in 2040. Further analysis has been completed to determine the impact of projected growth and demands on existing and planned infrastructure and water allocations for each community: this is detailed in the Final Report and Servicing Solution memos.

3.1 Population Data Sources

Historical population data are available through the census, collected every 5 years by Statistics Canada. Covered health population data are also available from Saskatchewan Health; however, these data do not equate directly to the census data, since the health data count only persons who are registered for provincial health coverage (and not every person who may have been a resident in each municipality). The covered health population data can sometimes be inflated during non-renewal years, since individuals are added to the population, but not removed when they leave the municipality. Additionally, in cases where the correspondence address is different from the residence address, the covered population may be distributed inaccurately (for example, if a person resides in a rural municipality, but picks up their mail in a village, town, or city). Thus, only census data were used as a basis for population projections.

Population projection estimates were validated by stakeholders several times over the course of the study. It is important to note that these projections are a snapshot in time and that they may change. During the relatively short time frame of the study, a number of stakeholders did revise their population projections – partly due to a timely renewal of their Official Community Plans. Others adjusted numbers when they realized the high cost of infrastructure associated with growth or resulting from updated insight into the wishes of their existing citizens.

Limited information was available from the RM of Edenwold and the RM of Sherwood. As a result, population data from these communities should be reviewed and refined in future stages of regional work.

3.2 Historical Population Trends

The existing population data obtained from Census Canada are summarized in Table 3-1 and Table 3-2. It should be noted that the 2006 census figures were updated to reflect the 2011 geographic boundaries.

Table 3-1
Existing Population Data for the Municipalities Located within the Study Area

Municipalities	Census 1996	Census 2001	Census 2006[1]	Census 2011
Regina	180,400	178,225	179,282	193,100
RM of Sherwood	1,052	1,054	1,039	929
Balgonie	1,132	1,239	1,384	1,625
Pilot Butte	1,481	1,850	1,872	1,848
White City	907	1,101	1,113	1,894
Edenwold	198	226	242	238
RM of Edenwold	2,724	2,917	3,606	4,167
Lumsden	1,530	1,596	1,523	1,631
RM of Lumsden	1,376	1,631	1,612	1,733
Grand Coulee	336	366	435	571
Pense	534	533	507	532
RM of Pense	536	494	490	471
Craven	278	264	274	234
Belle Plaine	64	70	64	66

Notes:
[1]2006 Census figures based on 2011 boundaries
RM – Rural Municipality

Table 3-2 summarizes the average annual growth rate calculated for each municipality over the preceding 15-, 10-, and 5-year periods. White City, Balgonie, and the RM of Edenwold appear to have the highest growth rates. White City is anticipating a future population of 6,200 in the year 2035, if all the lands within the City of Regina boundary are developed. This would require a yearly growth rate of approximately 5 percent between 2011 and 2035. The City of Regina, Lumsden, and the RM of Lumsden have moderate-to-high growth rates. The City of Regina is anticipating a future population of 300,000 in 2040. This would require a yearly growth rate of approximately 1.5 percent between 2011 and 2040. In comparison, the growth rate of Belle Plaine's population has been low over the last 15 years. Additionally, over the last 5 years, the populations in Pilot Butte, Edenwold, Craven, the RM of Pense, and the RM of Sherwood have all declined.

Table 3-2
Average Annual Growth Rates for the Municipalities Located within the Study Area

Municipalities	Average Annual Growth Rate Last 15 Years	Average Annual Growth Rate Last 10 Years	Average Annual Growth Rate Last 5 Years	Growth
Regina	0.45 %	0.80 %	1.50 %	Moderate - High
RM of Sherwood	(0.83 %)	(1.25 %)	(2.21 %)	Decline
Balgonie	2.44 %	2.75 %	3.26 %	High
Pilot Butte	1.49 %	(0.01 %)	(0.26 %)	Decline Recently
White City	5.03 %	5.57 %	11.22 %	High

Table 3-2
Average Annual Growth Rates for the Municipalities Located within the Study Area

Municipalities	Average Annual Growth Rate Last 15 Years	Average Annual Growth Rate Last 10 Years	Average Annual Growth Rate Last 5 Years	Growth
Edenwold	1.23 %	0.52 %	(0.33 %)	Moderate - Decline
RM of Edenwold	2.87 %	3.63 %	2.93 %	High
Lumsden	0.43 %	0.22 %	1.38 %	Moderate - High
RM of Lumsden	1.55 %	0.61 %	1.46 %	Moderate - High
Grand Coulee	3.60 %	4.55 %	5.59 %	High
Pense	(0.03 %)	(0.02 %)	0.97 %	Decline - Moderate
RM of Pense	(0.86 %)	(0.48 %)	(0.79 %)	Decline
Craven	(1.14 %)	(1.20 %)	(3.11 %)	Decline
Belle Plaine	0.21 %	(0.59 %)	0.62 %	Low

Notes:
RM – Rural Municipality

3.3 Land Use

3.3.1 Summary of Existing Land Use: City of Regina

3.3.1.1 Southwest Sector

The southwest sector is bounded by Courtney Street on the west; Highway 1 on the south; and Dewdney Avenue, Wascana Creek, and Wascana Centre on the north and east. The Regina International Airport is located in the top left corner of the sector. Four existing communities are included in the southwest sector: Albert Park, Hillsdale, Lakeview, and Whitmore Park. The predominant dwelling type in the existing southwest sector is the single detached house; some multi-family dwellings are present in the southern portion of this sector. The majority of the commercial land use in the sector occurs along Albert Street, including the Golden Mile Shopping Centre.

3.3.1.2 Southeast Sector

The southeast sector is bounded by the future bypass route along the eastern and southern edges of the sector; the Canadian Pacific Railway (CPR) mainline to the north; and the Ring Road to the west (with the exception of the Glen Elm and Boothill communities located to the west of the Ring Road). Three existing communities are included in the southeast sector: Arcola East, Dewdney East, and Boothill. The predominant dwelling type in the existing southeast sector is the single detached house; some multi-family dwellings are scattered throughout the sector. The majority of the commercial land use occurs along East Victoria Avenue, including the Victoria Square Shopping Centre.

3.3.1.3 Northwest Sector

The northwest sector encompasses the area north of Dewdney Avenue from Pinkie Road on the west, to Lewvan Drive and the portion north of the CNR mainline from Lewvan Drive to Winnipeg Street. The sector contains 13 different communities. Of these, 10 are considered “mature communities” that are fully built and aging: Sherwood McCarthy, Argyle Park/Englewood, Uplands, Normanview, Normanview West, Regent Park, Rosemont/Mount Royal, Dieppe, Coronation Park, and Northeast. The other three communities, Twin Lakes, Walsh Acres, and Prairie View, are considered “growth communities” and are still developing. The predominant dwelling type in the existing northwest sector is the single detached house; some multi-family dwellings are scattered throughout the sector. The majority of the commercial land use in the sector occurs in the following three areas: (i) along Albert Street, including the Avon Shopping Centre and the Northgate Mall; (ii) along Rochdale Boulevard, at the intersection of Rochdale Boulevard and Pasqua Street; and (iii) at the intersection of 9th Avenue North and McCarthy Boulevard.

3.3.1.4 Northeast Sector

A land use plan for the Northeast Sector is not included in the OCP. In the *Northeast Serviceability Study* (AECOM, 2012) prepared for the City, AECOM developed a land use plan for the Northeast Sector which is shown in Appendix F. The existing land use is a mix of commercial and industrial use. The Consumers Cooperative Refineries Ltd., a petroleum manufacturing plant, occupies approximately 230 hectares of land in the north. The City's landfill and snow disposal sites are located in the top right corner of the northeast sector.

3.3.1.5 West Industrial Lands

The West Industrial Lands were annexed into the City in 2009 to accommodate the development of the global transportation hub (GTH) and to provide additional lands for industrial development. The West Industrial Lands encompass 1,300 hectares, extending 4 miles west from Courtney Street, bounded by Dewdney Avenue to the north and the CPR main line to the south, except for Section 28-17-20-W2M, which extends north of Dewdney Avenue (Appendix F).

The new intermodal terminal and logistics park complex occupies the west half of the Plan Area, and heavy industrial and manufacturing land uses will be supported within the western half of Section 20-17-20-W2M. Existing agricultural use in the Plan Area will continue until the land is transitioned to a non-agricultural use or rezoned. Currently, the major tenants in the West Industrial Lands include CPR's intermodal facility, Loblaw's distribution and warehouse facility, the Yanke Group, the Emterra Group, and Consolidated Fastfrate's trucking terminals. The first phase of the intermodal facility was completed in January 2013. Loblaws completed Phases I, II, and III of its development in 2011 and 2012.

3.3.1.6 East Regina Industrial Lands

The East Regina Industrial Lands are located in the northeast area of Regina, east of the Ross Industrial Park and north of the Glencairn neighbourhood (Appendix F). Currently, these Lands are used for agricultural purposes, and the Saskatchewan Power Corporation electrical substation is located on the west side. In the East Regina Industrial Lands Secondary Plan (included in Regina's new Official Community Plan under Part B) (City of Regina, 2014), the Lands have been divided into five key sub-areas for future development:

- Light Industrial and Business District
- Mixed Industrial and Business District
- Rail Service District
- An interconnected open space system
- Commercial Service District

3.3.2 Summary of Existing Land Use in Region: Urban Rural Fringe

3.3.2.1 Rural Municipality of Sherwood

The RM of Sherwood (No. 159) encompasses the City of Regina. It includes a wide variety of industries, from farming to manufacturing to tourism. The Sherwood Industrial Park includes several agricultural manufacturers (for example, Brandt, Sakundiak, and Kramer and Degelman), agricultural dealerships, construction contractors, trucking firms, and hazardous waste disposal services. A map showing the existing and future distribution of land use is provided in Appendix F. Land use is primary agricultural, with some areas set aside for residential growth near the City and areas planned for commercial and industrial growth in the urban-rural fringe.

3.3.3 Summary of Existing Land Use in Region: West

3.3.3.1 Grand Coulee

The Village of Grand Coulee is located approximately 10 km west of Regina, north of the Trans-Canada Highway. It is located within the rural municipality of Sherwood. Land use in Grand Coulee is primarily residential (single dwellings), with some commercial and light industrial use. A map showing the distribution of land use is provided in Appendix F.

3.3.3.2 Pense

The Town of Pense is centrally located in the Regina-Moose Jaw Corridor (that is, along Highway 1), approximately 20 km east of Regina. Land use in Pense is primarily residential, with some commercial and industrial use. Condos are currently being developed south of Front Street and in the northeast corner. Future development areas are located in the southeast corner of the town and to the west. A map showing the distribution of land use is provided in Appendix F.

3.3.3.3 Rural Municipality of Pense

The RM of Pense (No. 160) is located between the City of Regina and the City of Moose Jaw along the Trans-Canada Highway. It contains the Villages of Pense and Belle Plaine. It also contains the Hamlets of Stony Beach and Keystown. Residential development in the RM is currently not a priority, as agriculture is the primary industry. Other industries include the following: Terra Grain Fuels, Alpine Plant Foods, Mosaic Potash, Yara, and Canadian Salt, and all of these are located in an industrial park north of Belle Plaine. The Buffalo Pound Provincial Park is located in the top left corner of the RM. A map showing the distribution of land use is provided in Appendix F.

3.3.3.4 Belle Plaine

The Village of Belle Plaine is located on Highway 1, 21 km east of Moose Jaw in south central Saskatchewan. It is located within the RM of Pense. Land use in Belle Plaine is primarily residential with some industrial and commercial development along Highway 1. Future growth areas have been planned for mixed commercial and residential use; however, at present, it is anticipated that the land will be used for mainly residential development (that is, a senior citizens' home). A land use map was not provided by the Village.

3.3.4 Summary of Existing Land Use in Region: North

3.3.4.1 Lumsden

The Village of Lumsden is located in the Qu'Appelle Valley, 17 km northwest of Regina at the junction of Highways 11 and 20. It is located within the RM of Lumsden. Land use in Lumsden is primarily residential, with some industrial and commercial use as well. A map showing the distribution of land use is provided in Appendix F. Approximately 88 hectares are set aside for future residential developments.

3.3.4.2 Rural Municipality of Lumsden

The RM of Lumsden (No. 189) borders north of the RM of Sherwood, and has Highways 11 and 6 passing through it. It is primarily a farming area with increasing residential property. The RM of Lumsden contains the Towns of Lumsden and Regina Beach, and the Villages of Craven, Lumsden Beach, and Buena Vista. Additionally, it also contains the Deer Valley Development located in the Qu'Appelle Valley, south of Lumsden. The Deer Valley Development is a mixed-use residential / recreational subdivision. A map showing the distribution of land use is provided in Appendix F.

3.3.4.3 Craven

The Town of Craven is located approximately 34 km northwest of Regina along Highways 20 and 99. Land use is primarily residential with some commercial use (that is, four commercial properties, approximately 6 percent). Currently, there are only three to four lots left in the Town for construction. More land will need to be annexed into the Town if it is to grow further. A land use map was not provided by the Town.

3.3.5 Summary of Existing Land Use in Region: East

3.3.5.1 Balgonie

The Town of Balgonie is located approximately 24 km east of Regina, north of the Trans-Canada Highway. It is located within the RM of Edenwold. The official community plan for the Town is still being developed. Land use in Balgonie is primarily residential with some commercial use along the Trans-Canada Highway. A land use map for the town was not available at the time of this report's preparation.

3.3.5.2 Pilot Butte

The Town of Pilot Butte is located approximately 11 km east of Regina, just south of Highway 46. It is located within the RM of Edenwold. Land use is primarily residential (mainly single family dwellings), with some commercial, institutional, and industrial use. A map showing the distribution of land use is provided in Appendix F. Approximately 319 hectares have been set aside as urban reserve for future development.

3.3.5.3 White City

The Town of White City is located approximately 10 km east of Regina, south of the Trans-Canada Highway. It is located within the RM of Edenwold. Land use is primarily residential with some commercial and industrial use. Currently, all of the lots are single family units. The largest business in White City is Dumur Industries, a company that manufactures steel products. A map showing the distribution of land use is provided in Appendix F. Approximately 93 hectares have been set aside for future urban development. White City is currently in the process of developing several residential areas: McKenzie Point, Fairway, Emerald Creek, Bower West, and the Garden of Eden Estates. In addition to the area shown in the land use map, two quarter sections (NW and NE 11-17-18 W2) recently have been annexed into White City and rezoned for the future development of the Clear Vistas residential area. Currently, no further industrial development is planned for the future.

3.3.5.4 Edenwold

The Village of Edenwold is located approximately 30 km northeast of Regina on Highway 364. It is located within the RM of Edenwold. Land use in Edenwold is primarily residential with some commercial use. A map showing the distribution of land use is provided in Appendix F. Approximately 1 hectare is set aside for future urban development.

3.3.5.5 Rural Municipality of Edenwold

The RM of Edenwold (No. 158) is situated 3.2 km east of Regina and is intersected by the Trans-Canada Highway. The RM contains the Towns of White City, Balgonie, and Pilot Butte and the Village of Edenwold. It is characterized by a low density rural population distribution, except in the community of Emerald Park and the Country Residential Development areas. There are approximately 1,448 dwellings in the municipality. Rural residential development is expected to continue growing. The RM also includes a wide range of agricultural, recreational (that is, golf courses and campground), industrial, and commercial development. Industrial and commercial activities are located throughout the RM with expansive activity in the Great Plains Industrial Park, located adjacent to the Emerald Park residential development. Commercial development is concentrated along the Trans-Canada Highway and Highway 46. A map showing the distribution of land use is provided in Appendix F.

3.3.6 Sakimay First Nation Lands

The Sakimay First Nation owns three areas of land close to Regina: two quarter sections of land west of the City near the GTH, five quarter sections of land southeast of the City, and one section of land east of the City on Highway 1.

The west lands are bounded by Pinkie Road to the east, the CPR spur line to the west, the CPR mainline to the south, and Dewdney Avenue to the north (Appendix F). The lands comprise the eastern half of section 20-17-20-W2. The surrounding land use includes the City's wastewater treatment plant and industrial use to the north; Brandt Industries to the east; CPR lines and agricultural lands to the south; and the GTH to the west.

The west lands are located outside of the jurisdictions of the RM of Sherwood and the City of Regina. Currently, all of the land is unpopulated and undeveloped. The Sakimay First Nation would like to lease these lands for industrial and commercial land uses. The west lands encompass approximately 104 hectares of land that can be developed.

The Sakimay lands southeast of the City are located in section 35 (35-16-19-W2) and the southwest corner of section 2 (SW-2-17-19-W2) (Appendix F). The Sakimay First Nation owns these lands; however, they are not registered under "reserve status" at the moment. Development of these lands is still at the conceptual stage.

The Sakimay lands east of the City are reserved lands. They are located in the northwest corner of section 19 (NW 19-17-18-W2), encompassing approximately 146 hectares (Appendix F). The Sakimay First Nation is considering developing these lands for mixed uses: commercial and residential.

3.4 Population Projections

Population projections for each municipality were estimated based on historical average annual growth rates (AAGRs) calculated for the 15-year period spanning the 1996 and 2011 censuses. Additionally, community growth aspirations were also considered.

For communities experiencing a population decline, minimal growth rates were estimated. Low, moderate, and/or high growth scenario projections were developed separately for each municipality.

3.4.1 City of Regina

Long-term population projections were developed for the City in the working paper entitled "Population, Employment and Economic Analysis of Regina" prepared for City of Regina Planning and Sustainability Department by Derek Murray Consulting and Associates (DMC, 2010). Population projections were made under three sets of economic growth scenarios: high, moderate, and low economic growth. The growth scenarios corresponded to AAGRs of 0.33 percent, 1.12 percent, and 1.74 percent, respectively. The projected populations for the years of 2020, 2025, 2030, and 2035 are shown in Table 3-3.

Table 3-3
City of Regina – Estimated Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Average Annual Growth Rate (%)	Projected Population			
		2020	2025	2030	2035
Low Growth	0.33 % (varies each year)	207,216	209,381	210,453	210,425
Medium Growth	1.12 % (varies each year)	225,513	237,094	247,778	257,950
High Growth	1.74 % (varies each year)	240,450	261,837	282,371	302,621

Growth forecasts were updated and extended using 2011 Census data (Table 3-4). Based on the recent forecasts, the City is currently planning for the accommodation of approximately 300,000 persons by the year 2040. This would require an AAGR of approximately 1.5 percent, which is slightly lower than the rate selected under the high growth scenario in the 2010 report.

Table 3-4
City of Regina – Estimated Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Average Annual Growth Rate (%)	Projected Population						
		2011	2016	2021	2026	2031	2036	2041
Medium - to - Hig h Growth	1.5 % (varies each year)	198,377	219,892	239,421	257,917	275,879	292,887	309,740

Through the development of built or approved neighbourhoods, a population of 235,000 can be reached. This would require further residential development in the southwest (that is, Harbour Landing), in the southeast (that is, Greens on Gardiner and the Creeks), and in the northwest (that is, Skyview, Maple Ridge, Hawkstone, Fairways West, and Prairie View). Further intensification and greenfield development is required to reach 300,000. This includes a new neighbourhood in the southeast with 8,500 residents, two new neighbourhoods in the northwest with a total of 29,000 residents (that is, Coopertown – 21,500 residents and another – 7,500 residents), and a new mixed use neighbourhood on the west side (7,500 residents). This brings the population up to 280,000; the other 20,000 residents will live in the City Centre (10,000) and other parts of the City (10,000) where housing has been increased via intensification.

3.4.2 West Population Projections

3.4.2.1 Population Projections Summary - West

Figure 3-1 shows the cumulative population projections for the existing communities to the west of Regina from 2011 to 2040, assuming the high growth scenario in all communities. Currently the cumulative population is approximately 1,700 residents. In 2040, the cumulative population is projected to be approximately 2,750 residents. This results in an AAGR of approximately 1.8 percent in the West. Relative to the East, growth in the West is anticipated to be slow over the next 25 years, with the majority of the growth occurring in Grand Coulee.

Figure 3-1
West Region - Cumulative Population Projections from 2011 to 2040, assuming High Growth Scenarios

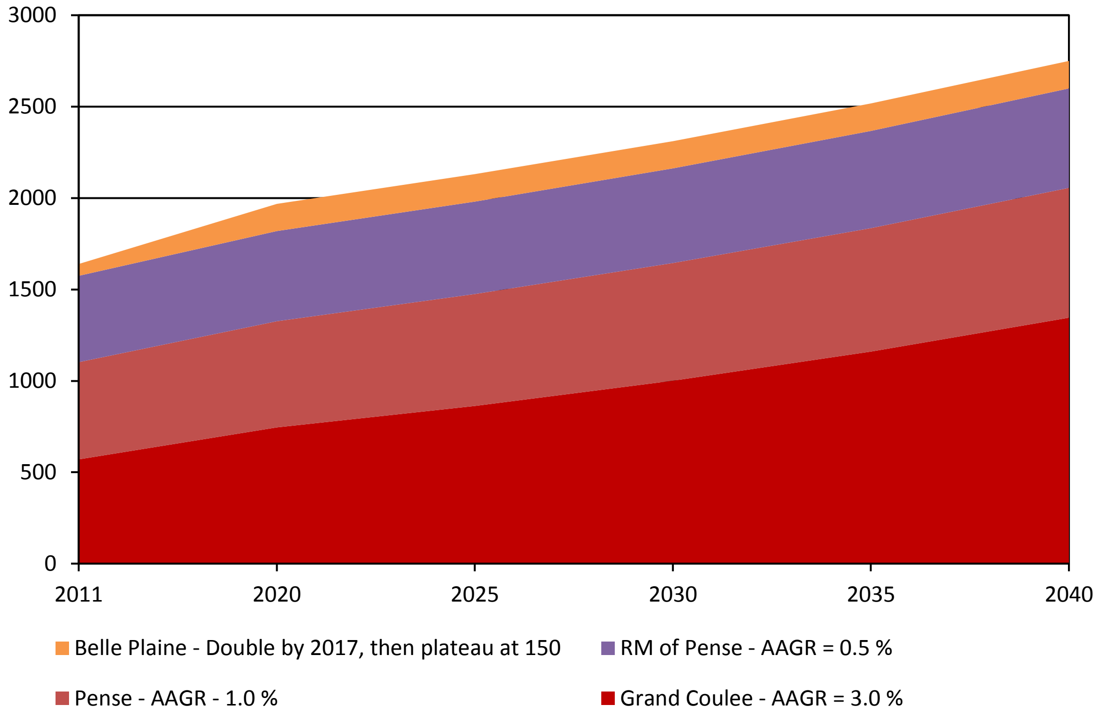


Table 3-5
West Region - Cumulative Population Projections from 2013 to 2040 (data), assuming High Growth Scenarios

Town/Municipality	AAGR (%)	2011	2020	2025	2030	2035	2040
Grand Coulee	**3.0 %**	571	745	864	1,001	1,161	1,346
Pense	**1.0 %**	532	582	612	643	675	710
RM of Pense	**0.5 %**	471	493	505	518	531	544
Belle Plaine	**4.3 %**	66	150	150	150	150	150
Total		1,640	1,969	2,130	2,312	2,517	2,750

Notes:
AAGR – Average Annual Growth Rate
RM – Rural Municipality

3.4.2.2 Grand Coulee

Over the 15-year period from 1996 - 2011, the AAGR for Grand Coulee was estimated to be approximately 3.6 percent. This is less than the AAGR of 5.6 percent calculated over the most recent 5-year period (2006 to 2011). The village anticipates an AAGR of 3.0 percent up to a population of 2,000 (that is, the population will plateau at this point). The projected populations for the years of 2020, 2025, 2030, 2035 and 2040 are shown in Table 3-6.

Table 3-6
Grand Coulee - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	3.0 %	745	864	1,001	1,161	1,346

3.4.2.3 Pense

Over the 15-year period from 1996 to 2011, the population for Pense has remained steady. However, in the past, from 2001 to 2006, the town's population decreased from 533 to 507 and then increased back to 532 by 2011. The AAGR for the more recent 5-year period from 2006 to 2011 was approximately 1 percent. Thus, a low (0.5 percent) and moderate (1 percent) growth rate scenario were selected for Pense. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-7.

Table 3-7
Pense - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Low Growth	0.5 %	556	570	585	600	615
Moderate Growth	1.0 %	582	612	643	675	710

3.4.2.4 Rural Municipality of Pense

Over the period spanning from 1996 to 2011, the population in the RM of Pense has been declining. There are two hamlets that are currently serviced by a pipeline tapping off of the Buffalo Pound Supply Line: Keystown and Stony Beach. The rest of the residents are serviced via private wells. The current number of service connections in Keystown and Stony Beach are seven and 13, respectively. Assuming three residents per household, this results in populations of 21 and 39 residents for Keystown and Stony Beach.

Low growth is expected for the RM and also in the hamlets, due to the existing infrastructure (that is, age and lack of infrastructure), availability of lots, and location. Thus, a low growth rate of 0.5 percent was selected for projecting the future populations. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-8. Under the low growth scenario, the RM population will increase by approximately 70 residents by 2040.

Table 3-8
Rural Municipality of Pense - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
RM - Low Growth	0.5 %	493	505	518	531	544
Stony Beach - Low Growth	0.5 %	41	42	43	44	45
Keystown - Low Growth	0.5 %	22	23	23	24	24

Notes:
RM – Rural Municipality

3.4.2.5 Belle Plaine

Over the period spanning from 1996 to 2011, the population in Belle Plaine has remained relatively steady. In response to additional industrial development occurring close to the Village of Belle Plaine, the current population is expected to double in the next 4 years and will plateau at a population of 150. Thus, a population of 150 was assumed for 2020 and kept constant through 2020 to 2040. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-9.

Table 3-9
Belle Plaine - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
High/Desired Growth	6.5 % (Higher in near-term)	150	150	150	150	150

3.4.3 North Population Projections

3.4.3.1 Population Projections Summary - North

Figure 3-2 shows the cumulative population projections for the existing communities to the north of Regina from 2011 to 2040, assuming the high growth scenario in all communities. Currently, the cumulative population is slightly over 3,600 residents. In 2040, the cumulative population is projected to be approximately 6,300 residents. This results in an average annual growth rate of approximately 1.9 percent in the North. Relative to the East, growth in the North is anticipated to be slow over the next 25 years, with the majority of the growth occurring in Lumsden and the RM of Lumsden.

Figure 3-2
North Region - Cumulative Population Projections from 2011 to 2040, assuming High Growth Scenarios

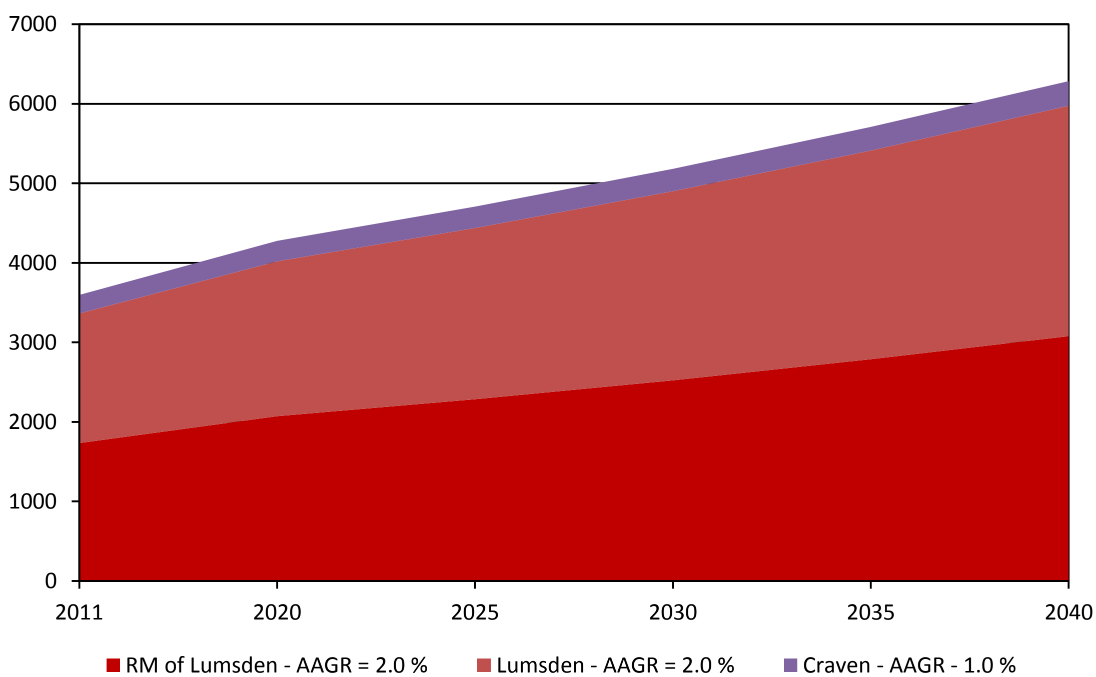


Table 3-10
North Region - Cumulative Population Projections from 2013 to 2040 (data), assuming High Growth Scenarios

Town/Municipality	AAGR (%)	2011	2020	2025	2030	2035	2040
Lumsden	**2.0 %**	1631	1949	2152	2376	2623	2896
RM of Lumsden	**2.0 %**	1733	2071	2287	2525	2787	3078
Craven	**1.0 %**	234	256	269	283	297	312
Total		3598	4276	4708	5183	5708	6286

Notes:
AAGR – Average Annual Growth Rate
RM – Rural Municipality

3.4.3.2 Craven

Over the period spanning 1996 to 2006, the population in Craven has remained relatively steady. In the recent years, from 2006 to 2011, the population declined from 274 to 234. For the purpose of predicting future water and wastewater capacity requirements, average annual growth rates of 0.5 percent (low) and 1 percent (moderate) will be assumed for Craven. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-11.

Table 3-11
Craven - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Low Growth	0.5 %	245	251	257	264	270
Moderate Growth	1.0 %	256	269	283	297	312

3.4.3.3 Lumsden

Over the period spanning from 1996 to 2006, the population in Lumsden has remained relatively steady. In the recent years, from 2006 to 2011, the population has increased from 1,523 to 1,631, with an average annual growth rate of approximately 1.4 percent. The town anticipates an AAGR of approximately 2 percent for the future. Thus, moderate (1.4 percent) and high (2 percent) growth rate scenarios were selected for Lumsden. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-12.

Table 3-12
Lumsden - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	1.4 %	1,848	1,981	2,124	2,277	2,441
High Growth	2.0 %	1,949	2,152	2,376	2,623	2,896

3.4.3.4 Rural Municipality of Lumsden

The RM of Lumsden anticipates a growth rate of 1.5 to 2 percent for the long term. This is in line with the AAGR of 1.5 percent observed over the last 5 year census period (2006 to 2011). Thus, moderate (1.5 percent), and high (2 percent) growth rate scenarios were selected for the RM of Lumsden. The projected populations (including Deer Valley and the subdivisions mentioned previously) for the years of 2020, 2025, 2030, 2035 and 2040 are shown in Table 3-13.

Minerva Ridge

Minerva Ridge is a new development approximately 2 km southwest of Lumsden, along the Qu'Appelle Drive. The residents in the development receive treated water from the Town of Lumsden. Phase I of the development is underway and includes 17 lots; 13 of the lots have already been sold, and there are currently six houses which are occupied (according to the Town of Lumsden). Phase II of the development will include another eight lots. The development will likely be full by 2020.

Assuming that there are three people per lot, the current population of Minerva Ridge is approximately 18 residents and will increase to approximately 41 residents when it is complete.

Additionally, one other water supply user (VanEverdink) outside of Minerva Ridge is serviced with treated water. Thus, this would bring the current population up to 21 and the future population up to 44.

Dodd's Subdivision

The Town of Lumsden supplies raw water to the Dodd's Subdivision. The subdivision contracts out to run their own treatment system. The Dodd's Subdivision currently contains nine houses, resulting in an approximate population of 27, assuming three residents per home. No information on the future growth of the development has been provided.

Table 3-13
Rural Municipality of Lumsden - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	1.5 %	1,981	2,135	2,300	2,477	2,669
High Growth	2.0 %	2,071	2,287	2,525	2,787	3,078

Deer Valley Golf and Estates

Deer Valley is a residential golf community located in the Qu'Appelle Valley (RM of Lumsden), approximately 6 km south of the Town of Lumsden. The town supplies raw water to the community, which they treat for potable water. The currently size of the community is approximately 240 residents (based on 80 houses, with three residents per home). Information on the future plans for the development was not provided. Growth rates of 1.5 percent (moderate growth) and 2 percent (high growth) were assumed for the community since it is located within the RM of Lumsden. The projected populations for the years of 2020, 2025, 2030, 2035 and 2040 are shown in Table 3-14.

Table 3-14
Deer Valley Golf and Estates - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	1.5 %	266	287	309	333	359
High Growth	2.0 %	276	304	336	371	410

3.4.4 East Population Projections

3.4.4.1 Summary Projections – East

Figure 3-3 shows the cumulative population projections for the existing communities and planned developments to the east of Regina from 2013 to 2040, assuming the high growth scenario in all communities. Communities to the east of Regina include Pilot Butte, White City, Balgonie, RM of Edenwold, and Sakimay First Nation. Currently, the cumulative population is approximately 12,000 residents. In 2040, the cumulative population is projected to be just over 35,000 residents. This results in an AAGR of approximately 4.1 percent in the East. In summary, growth in the East is anticipated to be high over the next 25 years.

The population from the Village of Edenwold has not been included in this graph, as the community is being considered separately for regional servicing. Population projections for the Village of Edenwold are detailed later in this report.

Population projections were not available from the RM of Sherwood at the time of the study; as such, the numbers for communities within this RM have not been included.

Figure 3-3
East Region - Cumulative Population Projections from 2013 to 2040, assuming High Growth Scenarios

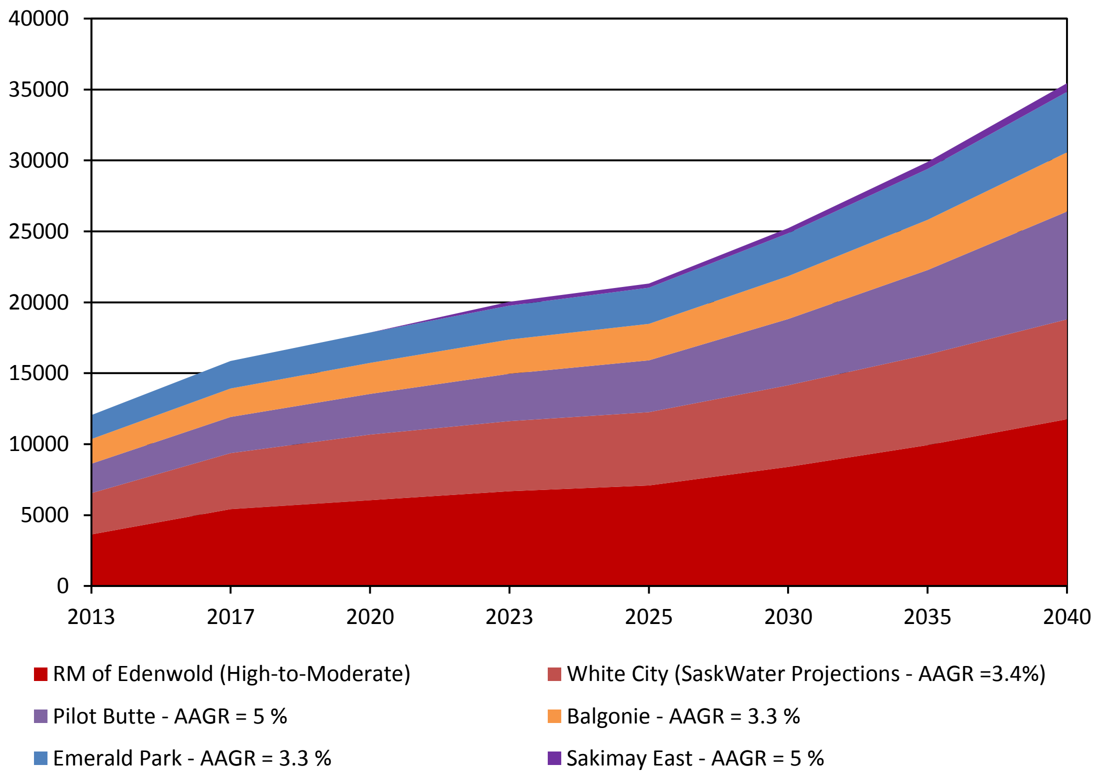


Table 3-15
East Region - Cumulative Population Projections from 2013 to 2040 (data), assuming High Growth Scenarios

Town/Municipality	AAGR (%)	2013	2017	2020	2023	2025	2030	2035	2040
White City	**3.4 %**	2,895	3,937	4,631	4,950	5,163	5,757	6,381	7,045
Balgonie	**3.3 %**	1,748	2,005	2,176	2,407	2,560	3,011	3,542	4,166
Pilot Butte	**5.0 %**	2,074	2,550	2,867	3,342	3,659	4,670	5,960	7,607
Emerald Park	**3.5 %**	1,683	1,958	2,141	2,382	2,543	3,020	3,587	4,261

Table 3-15
East Region - Cumulative Population Projections from 2013 to 2040 (data), assuming High Growth Scenarios

Town/Municipality	AAGR (%)	2013	2017	2020	2023	2025	2030	2035	2040
RM of Edenwold	**16 % to 3.4 %**	3,647	5,423	6,051	6,679	7,097	8,397	9,934	11,753
Sakimay East	**5.0 %**	-	-	-	272	300	383	488	623
Total		12,046	15,872	17,866	20,032	21,322	25,238	29,893	35,455

Notes:
AAGR – Average Annual Growth Rate
RM – Rural Municipality

3.4.4.2 White City

Over the 15-year period from 1996 to 2011, the AAGR for White City was estimated to be approximately 5 percent. White City is anticipating a future population of 6,200 in the year 2035, if all the lands within the City boundary are developed. Future population projections for White City were provided by SaskWater. Projections for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-16.

Table 3-16
White City – Estimated Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Average Annual Growth Rate (%)	2013 Estimate	Projected Population				
			2020	2025	2030	2035	2040
SaskWater Projections	3.4 %	2,895	4,631	5,163	5,757	6,381	7,045

Clear Vistas Development

Phase 1 of the Clear Vistas Community is currently being developed. The subdivision will accommodate approximately 100 lots in 2013. The population of the subdivision can be estimated assuming an average size of 3.1 persons per household. Thus, the total population by the end of 2013 is estimated to be 310 people. In the future, the Clear Vistas Community is planning on expanding to 2,000 lots and adding a commercial centre. Assuming the average size of 3.1-plus persons per household, it was estimated that the future population of the subdivision will be 6,000 to 7,500 residents.

Two quarter sections (NW and NE 11-17-18 W2) have been recently annexed into White City and rezoned for the future development of the Clear Vistas residential area. Further residential growth in White City will occur in the Clear Vistas Development. Thus, population projections for Clear Vistas have been assumed to be factored into the projection developed for White City.

3.4.4.3 Pilot Butte

Over the 15-year period from 1996 to 2011, the population for the Town of Pilot Butte has increased at an AAGR of 1.5 percent. High growth was observed from 1996 to 2001, when the Town's population increased from 1,481 to 1,850 (that is, 4.6 percent annual average growth). From 2001 to 2011, the population has remained relatively steady. The Town is expecting the current boundaries to be developed in by 2040, which would amount to a total population of approximately 8,000. To reach this target, the Town's population would need to grow at an AAGR of approximately 5 percent. Based on recent growth trends, this is likely a high growth rate estimate. Thus, moderate (1.5 percent) and high (5 percent) growth rate scenarios were selected for Pilot Butte. Projected populations for the years of 2020, 2025, 2030, 2035, 2040 are shown in Table 3-17.

Table 3-17
Pilot Butte - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	1.5 %	2,113	2,276	2,452	2,642	2,846
High/Desired Growth	5 %	2,867	3,659	4,670	5,960	7,607

3.4.4.4 Balgonie

Over the 15-year period from 1996 to 2011, the AAGR for Balgonie was estimated to be approximately 2.4 percent. This is slightly less than the AAGR of 3.3 percent calculated over the most recent 5-year period (2006 to 2011). Thus, moderate (2.4 percent) and high (3.3 percent) growth rate scenarios were selected for Balgonie. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-18.

Table 3-18
Balgonie - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	2.4 %	2,012	2,265	2,550	2,871	3,233
High Growth	3.3 %	2,176	2,560	3,011	3,542	4,166

3.4.4.5 Edenwold

For the Village of Edenwold, over the 15-year period from 1996 to 2011, the AAGR was estimated to be approximately 1.2 percent. However, in recent years (2006 to 2011), the population has actually declined. The OCP anticipates a future population of 300 in 2025. To reach this target, the Village's population would need to grow at an AAGR of approximately 1.6 percent, resulting in a population of 377 in 2040. Thus, low (0.5 percent) and moderate-to-high (1.6 percent) growth rate scenarios were selected for Edenwold. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-19.

Table 3-19
Edenwold - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Low Growth	0.5 %	249	255	262	268	275
Moderate - to - High Growth	1.6 %	275	297	322	348	377

3.4.4.6 Rural Municipality of Edenwold

Rural Municipality of Edenwold (not including Emerald Park)

Limited information and review time was available from the RM of Edenwold. As a result, population data from these communities should be reviewed and refined in future stages of regional work.

The 2011 census population for the RM of Edenwold (including Emerald Park) was reported to be 4,167. This is significantly higher than the 2011 population reported by the Saskatchewan Ministry of Health (2,688). However, no recent population information has been provided by the RM of Edenwold for Emerald Park, so it is not possible to determine which estimate is more accurate.

The population for the RM of Edenwold, not including the residents of Emerald Park, was determined to be 1,426 in 2008 in the Saskatchewan Watershed Authority *Regina East Ground Water Demand Study* (SWA, 2009). This was based on subtracting the 2008 population for Emerald Park from the 2008 Saskatchewan Ministry of Health covered population. Thus, a population of 1,426 was used as a basis for establishing population projections.

In the *Regina East Ground Water Demand Study* (SWA, 2009), a population of 5,426 was projected for 2017 (based on 1,291 new lots by 2017, multiplied by 3.1 residents per lot equals 4,000 new residents), if all of the planned developments (for example, Stone Pointe Estates, Mission Pointe Estates, North Ridge, and Cindercrete) are filled. More recently, in the Centralized Wastewater Servicing Study, the future populations of several proposed residential and commercial developments were indicated for the RM of Edenwold (Table 3-20).

Table 3-20
Proposed Developments in the Rural Municipality of Edenwold

Development	Type	Population/Equivalent Population
Carson’s Energy	Residential	90
Cindercrete	Residential	2,408
Mission Pointe	Residential	106
Stone Pointe	Residential	222
Spruce Creek	Residential	792
Carson’s Energy	Commercial	1,625
Cindercrete	Commercial	3,230
Great Plains Industrial Park	Commercial	1,300
Total Population for Proposed Developments		9,773

Based on this information, two growth rates were selected for the RM of Edenwold. A high growth rate of 16 percent was selected to reach a future population of 5,420 by 2017; a lower growth rate of 3.4 percent was selected from 2020 to 2040 to reach a future population of approximately 11,750 (assuming that all developments are filled by 2040 and a growth rate of 1.1 percent for existing population). The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-21.

Table 3-21
Rural Municipality of Edenwold (not including Emerald Park) - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
High-to-Moderate Growth	16 % to 3.4 %	5,999	7,097	8,397	9,934	11,753

Emerald Park

No information has been provided by the RM of Edenwold on Emerald Park. The population for Emerald Park was reported as 1,417 in 2008 by SaskWater. An annual average growth rate of 3 percent was used in the *Wastewater Consolidation Feasibility Study* (UMA, 2007) and in the *Regina East Ground Water Demand Study* (SWA, 2009). A slightly higher growth rate of 3.5 percent was used in the *Wastewater Treatment Facility Conceptual Study* (AE, 2009). Thus, a moderate (3.0 percent) and high (3.5 percent) growth rate scenario were selected for Emerald Park. The projected populations for the years of 2020, 2025, 2030, 2035, and 2040 are shown in Table 3-22.

Table 3-22
Emerald Park - Average Annual Growth Rates and Projected Populations

Growth Scenario	Estimated Growth Rate (%)	Projected Population				
		2020	2025	2030	2035	2040
Moderate Growth	3.0 %	2,020	2,342	2,715	3,148	3,649
High Growth	3.5 %	2,141	2,543	3,020	3,587	4,261

SECTION 4

Current State of Infrastructure and Challenges

4.1 Current State of Infrastructure in the Region

This section establishes the current state of the water and wastewater infrastructure. It sets out a baseline to allow stakeholders to understand where the region stands. From this common understanding, the region can move forward in terms of better understanding its service challenges and can seek opportunities for regional collaboration to address some of these challenges. Discussions have taken place with stakeholders at an individual level on existing infrastructure and challenges to be faced. One of the underlying objectives of this study was to open communication channels across the region and to encourage communities to talk more with one another about water and wastewater: this document provides a starting point for further engagement.

In delivering this section, numerous studies and reports were collected from the consulted stakeholders. In particular the following data sources proved most useful for each municipal stakeholder:

- Waterworks System Assessment
- Official Community Plan (OCP)
- Operating Permits and Compliance Reports

4.1.1 Water Infrastructure

The local water infrastructure in the region is generally in a “fair to good” status. Over the past decades, communities have invested in their water infrastructure to ensure that communities have safe potable water supplies.

Buffalo Pound Water Treatment Plant (BPWTP) has been considered separately as a regional asset for the purposes of this report. Sections 4.1.4 and 6 discuss the current state of BPWTP and future changes in significant detail respectively.

Some communities in the RM of Pense have reached the capacity of their water systems. Should they wish to grow, then expansions to their water systems will be required.

One community, Balgonie, is currently experiencing significant problems with its water source resulting in its wells being closed. A solution has been developed through regional collaboration between Pilot Butte and Balgonie: an 11-km pipeline is being built from the Pilot Butte Water Treatment Plant to Balgonie; Pilot Butte will sell its water on a charge per volume used basis to Balgonie.

4.1.2 Wastewater Infrastructure

Generally the wastewater infrastructure in the region is in “fair to poor” status. While investment was focused on water infrastructure, much of the investment required to maintain the wastewater infrastructure was deferred. This is not uncommon across Canada, and now many communities are facing problems with aging wastewater infrastructure.

Many communities (including White City, RM of Edenwold [Emerald Park], Village of Edenwold, Balgonie, Lumsden, and Pense) have reached the capacity of their wastewater systems or are facing engineering challenges, and they require solutions to be in place in the coming years. With planned or approved development in their communities already progressing, a number of them are facing overflow risks.

4.1.3 Overview of Infrastructure in the Region

During the initial stages of the study, a basic understanding of the infrastructure across the region was developed. The summary table from this initial investigation is presented in Table 4-1, and the details behind this summary table are included in Appendix G. The following simple rating scale was used to categorize the stakeholder's infrastructure:

Good (Green) - No capacity issues; capacity available for future growth; water quality good; wastewater compliant with permit; condition good.

Fair (Amber) - Capacity of infrastructure is approaching limits; not enough capacity available for the future; infrastructure approaching end of useful life.

Poor (Red) - Infrastructure cannot support current demands and/or needs immediate upgrades/replacement; and/or poor water quality; and/or wastewater compliance with permit at risk.

As Table 4-1 highlights, water infrastructure across the region is generally in Fair to Good condition, whereas wastewater infrastructure is far more concerning.

Table 4-1
Current State of Infrastructure Summary Table

	Water Infrastructure	Notes	Wastewater Infrastructure	Notes
City of Regina	Green	Adequate water supply currently from BPWTP	**Red**	Significant upgrades required to existing collection system
RM of Sherwood	-	Not Available	-	Not Available
Balgonie	Amber / Green	Wells unusable, but new pipeline constructed for potable water from Pilot Butte	**Green**	Current lagoons have some capacity in the short term
Pilot Butte	Green	Recently invested in water treatment infrastructure	**Green**	Current lagoons have some capacity in the short term
White City	Amber	Going through upgrades with SaskWater, mainly on raw water supply	**Red**	Current lagoons at capacity and growth has been halted
Village of Edenwold	Amber	Raw water surface source unreliable	**Red**	Current lagoons at capacity and growth has been halted
RM of Edenwold	-	Not Available	**Red**	Current lagoons at capacity and growth has been halted
Lumsden	Green	Recently invested in water infrastructure	**Red**	Current lagoons at capacity and growth has been halted
RM of Lumsden	Green	Some downstream treatment sites (Dodd's) may be experiencing local challenges	**Green**	Septage infrastructure owned, maintained, and operated by private individuals
Craven	Amber	Capacity is ok, but wells are approaching end of life and need upgrading	**Amber**	Distribution system is aging; lagoons are in good condition
Grand Coulee	Green	Adequate water supply currently	**Red**	Current lagoons are nearing capacity
Pense	Green	Adequate water supply currently	**Red**	Current lagoons are facing effluent drainage challenges

Table 4-1
Current State of Infrastructure Summary Table

	Water Infrastructure	Notes	Wastewater Infrastructure	Notes
RM of Pense	Amber	Water connections to BPWTP Supply Line, but pressure/age/condition are challenges; looking to connect Stony Beach to Alpine Foods supply line; no additional development is permitted in the hamlets due to water servicing capacity	**Green**	Septage infrastructure is owned, maintained and operated by private individuals
Belle Plaine	Green	Adequate water supply currently	**Green**	Lagoons in good condition with spare unused cell
Sakimay	-	No developments as yet; infrastructure not required	**-**	No developments as yet; infrastructure not required

Notes:
BPWTP – Buffalo Pound Water Treatment Plant
RM – Rural Municipality
WWTP – wastewater treatment plant

4.1.4 Buffalo Pound Water Treatment Plant

The BPWTP is managed and operated by a stand-alone non-profit organization. The City of Regina and the City of Moose Jaw are significant stakeholders in the organization. The majority of the treated water is sent to Regina via the eastbound supply line, which has a number of smaller lines tapped into it. The remainder of the treated water is sent to Moose Jaw via a south-bound supply line.

4.1.4.1 Water Source

Source water for the BPWTP comes from Buffalo Pound Lake, a shallow reservoir located in the Qu'Appelle Valley northwest of the City (approximately 50 km). While Buffalo Pound Lake is relatively free from industrial and municipal discharges, it contains high levels of algae due to high nutrient levels and shallow conditions.

The quantity of source water available for use from Buffalo Pound Lake is not a concern, as the withdrawal license currently permits 338 megalitres per day (ML/d) of water to be treated by the BPWTP, which is over three times the current average withdrawal rate.

4.1.4.2 Water Treatment

Water is drawn from Buffalo Pound Lake, chlorinated, and then pumped to the BPWTP, which is located 3 km south of the lake. At the BPWTP, the water is treated with cascade de-aeration, coagulation, flocculation, clarification, multimedia filtration, and granular activated carbon (GAC) contactors (seasonally). The filtered water is then chlorinated and discharged into the clearwells from which it is pumped to the City of Regina and the City of Moose Jaw. Process water is discharged to wastewater lagoons and treated. Spent carbon is regenerated onsite in the Carbon Regeneration Building.

The rated capacity of the BPWTP is 205 ML/d; however, it is expandable to 275 ML/d. Based on the existing formal agreement, the City of Regina's share of the treatment capacity is approximately 149 ML/d (73 percent). This would amount to approximately 200 ML/d, if the plant's capacity is expanded to 275 ML/d. As of 2013, the City is currently using approximately 76 ML/d of treated water on average, with a maximum demand of approximately 140 ML/d (139.1 ML/d in July 2007).

The capacities of each component included in the raw water conveyance and treatment systems were assessed during the 2005 and 2010 Waterworks System Assessments. A summary of firm and nominal capacities listed for each component in the 2010 *Buffalo Pound Water Treatment Plant Waterworks System Assessment* (AECOM, 2010) is provided in Table 4-2.

Table 4-2
Existing Capacity of the Raw Water Intake, Pumping, Conveyance, and Treatment Processes

Component/Process	Description	Firm Capacity	Nominal Capacity
Raw Water Intake	Two intakes: 1,372 mm and 1,650 mm. Capacity based on 0.15 m/s maximum velocity at intake opening.	140 ML/d	295 ML/d
Raw Water Screening	Three 1.8-m-wide travelling screens. Each 120 ML/d.	240 ML/d	360 ML/d
Low Lift Pumping	Pump A – 1,000 hp, 1968, 55 ML/d Pump B – 300 hp, 1995, 14 ML/d Pump C – 1,550 hp, 1976, 85 ML/d Pump D – 450 hp, 1995, 21 ML/d Pump E – 600 hp, 1958, 27 ML/d Pump F – 1,750 hp, 1989, 100 ML/d Pump G – 1,750 hp, 1989, 100 ML/d	300 ML/d	400 ML/d
Pre-chlorination	Three Chlorinators. Two at 900 kg/d, one at 450 kg/d. Dose at 6 mg/L. Average dose approximately 5.0 mg/L.	225 ML/d	375 ML/d
Raw Water Transmission Line	Two 3,000-m-long pipes having diameters of 1,050 mm and 1,350 mm. Both pipes merge into a single 1,650-mm-diameter pipe approximately 60 m. Firm capacity is set to maintain <2.5 m/s velocity in the aerator feed piping where restrictions occur. A transient analysis performed in 2005 by AECOM indicates that the new pipeline is capable of conveying 280 ML/d.	240 ML/d	280 ML/d.
Treatment Processes			
BPWTP - Overall	Designed to have a treatment capacity of 205 ML/d and is expandable to 275 ML/d.	205 ML/d	
De-aeration Cascades	Two cascades, ten steps each. Nominal capacity based on an application rate of 6,200 m^3/m/d. Significant overflow noted above 105 ML/d, aeration efficiency potentially reduced.	105 ML/d	210 ML/d
Rapid Mixer	Two trains, one mixer per train, G is approx. 1,000 s^{-1}, 10 seconds retention. Two blades, 125 rpm.	150 ML/d	300 ML/d
Flocculators	Two trains, four flocculators per train, G is variable from 15 to 115 s^{-1}, 1,200 second retention time (20 minutes), 4 paddles, 2.75 to 11 rpm.	125 ML/d	250 ML/d
Clarifiers	Four circular, each 256 m^2. Two rectangular, each 539 m^2. Loading rates are 3.6 m/hr at <5°C in winter and 4.9 m/hr at >15°C in summer.	135 ML/d Winter 182 ML/d Summer	184 ML/d Winter 247 ML/d Summer
Dual Media Filters	12 filters, each 11.3 m long, 6.1 m wide and 2.4 m deep. 12 m/h loading rate.	215 ML/d	240 ML/d
Screw Pumps	Two units, each 140 ML/d (updated with experience)	140 ML/d	280 ML/d

Table 4-2
Existing Capacity of the Raw Water Intake, Pumping, Conveyance, and Treatment Processes

Component/Process	Description	Firm Capacity	Nominal Capacity
GAC Contactors	12 units, each 13.6 m by 4.7 m by 5.5 m. 3,000 mm minimum GAC depth, effective size of 0.8 to 1.0 mm, uniformity < 2.1, 12.2 m/h, empty bed contact time 15 minutes.	205 ML/d	225 ML/d
Wastewater Lagoons	Six cells, total capacity 19,600 m^3	60 ML/d	75 ML/d
Chemical Feed			
Alum Feed	Five diaphragm metering pumps. Capacity based on four pumps operating to provide a dose of 100 mg/L. Approximately 14 days of alum storage.	935 ML/d	> 935 ML/d
Powdered Activated Carbon Feed	Dose of 20 mg/L. Two peristaltic Watson-Marlow chemical feed pumps.		2,070 ML/d
Polymer Feed	Four pumps (two for filter aid). All operational. Not currently used.		220 ML/d
Soda Ash Feed	Not in service.		

Notes:
m – metre(s)
m^2 – square metres
m^3 – cubic metres
m/s – metres per second
m/h – metres per hour
mg/L – milligrams per litre
ML/d – megalitres per day
mm – millimetre(s)
GAC – granular activated carbon
hp – horsepower
kg/d – kilograms per day
rpm – revolutions per minute

4.1.4.3 Raw and Treated Water Quality

There are several raw water parameters that exceed the Saskatchewan Drinking Water Quality Standards and Objectives (SDWQSO): these include iron, manganese, turbidity, colour, and total and fecal coliforms. Raw water turbidity and colour can be high during the late winter to early spring periods; however, they are greatest in the summer when high algae counts are observed.

For all of the contaminants monitored, treated water levels fall below the SDWQSO. A review of treated water data from 2000 to 2010 was presented in the *Buffalo Pound Water Treatment Plant Waterworks System Assessment* (AECOM, 2010). More recent treated water data from 2011 is presented in

Table 4-3, alongside the SDWQSO.

Table 4-3
Treated Water Quality at the Buffalo Pound Water Treatment Plant – 2011

Parameter	Treated Water Quality – 2011			Saskatchewan Water Regulations (SDWQSO)
	Average	Minimum	Maximum	
Background Colonies - Total Coliform (No/100 mL)	< DL	< DL	1	<200
Fecal Coliform (No/100 mL)	-	-	-	0
Total Coliform (No/100 mL)	< DL	< DL	< DL	0
pH	7.00	6.69	7.23	6.5 to 9.0
Calcium (mg/L)	47	37	57	N/A[a]
Magnesium (mg/L)	24	17	29	200
Chloride (mg/L)	25.6	19.7	29.8	250
Sulphate (mg/L)	217	154	253	500
Sodium (mg/L)	71	47	85	300
Total Hardness (mg/L as $CaCO_3$)	215	162	262	800
Nitrate as NO_3:N (mg/L)	0.11	< DL[b]	0.24	10
Alkalinity (mg/L as $CaCO_3$)	121	79	170	500
Iron - Dissolved (mg/L)	< DL	< DL	< DL	0.3
Manganese - Dissolved (mg/L)	< DL	< DL	0.01	0.05
Aluminum - Dissolved (µg/L)	16	6	36	100
Total Organic Carbon (mg/L)	2.8	<0.5	4.6	N/A
TTHM - Clearwell (µg/L)	53	1	107	100[c]
Turbidity - Clearwell (NTU)	0.07	0.05	0.10	0.2/0.3/1.0[d]
Colour (Pt/Co)	< DL	< DL	< DL	15

Notes:
[a] N/A = Non-applicable
[b] DL = Detection Level
[c] Based on annual average of four seasonal samples
[d] Depends on raw water turbidity
SDWQSO – Saskatchewan Drinking Water Quality Standards and Objectives
mg/L – milligrams per litre
µg/L – micrograms per litre
NTU – Nephelometric Turbidity Unit
Pt/Co - Platinum-Cobalt
TTHM – Total Trihalomethanes

Age of Infrastructure

Table 4-4 summaries the age of the infrastructure present at BPWTP.

Table 4-4
Age of Water Conveyance, Treatment, Storage, and Distribution Infrastructure – BPWTP

Component/Process	Age	Description/Comment
Raw Water Intake	62 years (1951)	First Intake; 1,350-mm-diameter
	12 years (2001)	Second Intake; 1,650-mm-diameter
Low Lift Pumping	Pump A – 45 years (1968) Pump B – 18 years (1995) Pump C – 37 years (1976) Pump D – 18 years (1995) Pump E – 55 years (1958) Pump F – 24 years (1989) Pump G – 24 years (1989)	Pump A and E have been well maintained; however, 2011 Code and Condition Assessment recommended replacement/elimination due to age.
Pre-chlorination	24 years (Year Constructed: 1989)	Has been modified since
Raw Water Transmission Line	62 years (1951); sections replaced in 1968 and 1969	1050-mm-diameter pipeline; 3,000 m long
	12 years (2000)	1350-mm-diameter pipeline; 3,000 m long
BPWTP – Expansion/Upgrades		
BPWTP – Original WTP	1955 commissioned 1952 construction started	Original WTP consisted of two clarifiers and four sand filters (27 ML/d)
BPWTP – Expansion	1958, first expansion	Doubled capacity to 56 ML/d by adding more clarifiers and filters
BPWTP – Upgrades	1966 -1970	Increased capacity to 135 ML/d through upgrades in clarification, filtration, and pumping
	1985	Upgrades for Granular Activated Carbon (GAC)
BPWTP – Expansion	1989	Increased capacity to 170 ML/d
Treatment Processes		
De-aeration	24 years (1989)	
Flash Mixing	24 years (1989)	
Four Stage Flocculation	24 years (1989)	Mixers are nearing the end of their service life
Circular Clarifiers - Internals	Replaced between 1991 – 2002	Tube Settlers and Internals
Dual Media Filters	59 years (1955)	4 filters; Miller underdrains
	56 years (1958)	4 filters; Miller underdrains
	24 years (1989)	4 filters; Leopold underdrains
Screw Pumps	29 years (1985)	Redundancy not available. Failure limits T & O treatment capacity. Spare parts are available.
GAC Contactors	29 years (1985)	Eight vessels
	24 years (1989)	Four more vessels added
Chemical Feed		

Table 4-4
Age of Water Conveyance, Treatment, Storage, and Distribution Infrastructure – BPWTP

Component/Process	Age	Description/Comment
Alum Feed	3 pumps ~ 8 years old 2 pumps > 10 years old	Five diaphragm metering pumps. Three pumps were updated in 2005.
Powdered Activated Carbon Feed	Storage silos & Solution tank > 50 years old Peristaltic Pumps > 10 years old	Existing make-up system is approaching end of the intended service life Two peristaltic Watson-Marlow chemical feed pumps
Polymer Feed	Four pumps (two for filter aid). All operational. Not currently used.	
Soda Ash Feed	Not in service. New and unused.	
Potable Water Supply		
High Lift Pumping	Pump A – 56 years (1958) Pump B – 7 years (2007) Pump C – 25 years (1989) Pump D – 10 years (2004) Pump E – 25 years (1989) Pump F – 25 years (1989)	Replacement of pumps exceeding 30 years in age was recommended in the 2011 Code and Condition Assessment. Pumps C, D, E, and F were refurbished in 2007 Pumps C and F's motors were replaced in 1989
Buffalo Pound Supply Pipeline		
1050-mm steel line	9 years (2005-2007)	Swabbing capabilities
900-mm steel line	64 years (1950)	Swabbing capabilities, age unconfirmed

Notes:
BPWTP – Buffalo Pound Water Treatment Plant
m – metre(s)
ML/d – megalitres per day
mm – millimetre(s)
GAC – granular activated carbon
T&O – taste and odour

Capacity Deficits and Issues

The following capacity deficits/issues have been identified for the BPWTP in the draft report *Buffalo Pound Water Treatment Plant Upgrades Project Status Summary Technical Memorandum* (AECOM, 2013):

- **Taste and Odour:** The existing GAC system was designed to treat Taste and Odour (T&O) during the summer months when there is algae growth in the lake. Recently, T&O events have been occurring regularly outside of the normal summer months. The GAC media has a finite sorptive capacity; once this capacity has been exhausted, the GAC contactors must be taken offline and regenerated, which is labour intensive and costly. To minimize the need for regeneration, powdered activated carbon (PAC) is typically applied during the early months of the year to treat T&O, and the GAC contactors are reserved for the summer months. T&O upgrades have been recommended at the BPWTP to eliminate the need for seasonal changes in operation and to provide a more consistent finished water with low T&O.

- **Wastewater Lagoons:** The design capacity of the wastewater lagoons at the BPWTP has been reached. At the present time, all process wastes are discharged to the lagoons, which causes solids and hydraulic overloading, resulting in sub-optimal performance.
- **Screw Lift Pumps:** The Archimedes screw lift pumps, which transport water to the GAC contactors, each have a maximum capacity of 140 ML/d. Both pumps are required to meet demands during the summer months. If one of the pumps should go offline, the GAC treatment capacity is limited to 140 ML/d. This is less than the BPWTP's current rated capacity of 205 ML/d. There is no bypass route for this part of the process.
- **Clearwell Storage**: Currently there is 10.51 ML of storage available at the BPWTP; however, the active storage volume is limited to 4.75 ML, as operational issues with the high lift pumps occur when the clearwell is below half-full. The active storage volume required to provide water for in-plant use, balancing, and surge capacity has been estimated to be approximately 10 ML (AECOM, 2010). Thus, currently the storage facilities at the WTP do not provide adequate buffering.

Planned Improvements

The following upgrades were identified as required upgrades at the BPWTP in the draft report *Buffalo Pound Water Treatment Plant Upgrades Project Status Summary Technical Memorandum* (AECOM, 2013):

- **Taste and Odour:** A pilot study was completed in 2013 which tested two different options to be considered to improve T & O removal:
  - (i) construction of four additional GAC contactors such that the GAC process could be operated year round and would also require the construction of a second GAC regeneration facility
  - (ii) the construction of an ozonation upstream of the existing GAC contactors for T & O treatment and enhanced organics removal. Those facilities are scheduled for completion after 2020.
- **Ultraviolet Disinfection:** To achieve a 4-log removal of *Cryptosporidium*, the City has approved and completed the preliminary design of the UV facilities. Construction is scheduled to be completed in 2016.
- **Wastewater Lagoons:** Upgrades to the existing lagoons with underdrain systems has been recommended to allow for a higher solids loading. Construction is scheduled for a future date to be determined.
- **Screw Lift Pumps:** The addition of a third Archimedes screw lift pump is required to provide redundancy for the two existing pumps. It will be installed with the construction of the UV facilities by 2016.
- **Clearwell Storage:** Upon review, modifications can be done to the filter and contactor clearwells to enhance the hydraulic capacity of the clearwell which can be done by 2016 without the need of significant improvements.
- **Upgrade of Primary Filters:** Replacement of the filter media and underdrains is required, as well as the addition of filter air scour to enhance backwash. This work is planned for a future date not yet determined.

4.1.5 City of Regina

4.1.5.1 Water Infrastructure

Water Supply

The BPWTP provides all of the annual water needs for the City; however, well water is also available for backup purposes. Well water undergoes chlorination prior to use. There are currently eight active wells; four wells draw water from the Regina Aquifer and the other four wells draw water from Boggy Creek. The current combined maximum day flow for Boggy Creek wells is estimated at 188 litres per second (L/s)

(16,242 cubic metres per day [m^3/day]); for the Regina Aquifer wells, it is estimated at 272 L/s (23,500 m^3/day). The total capacity of the City's groundwater system is 460 L/s (39,742 m^3/day).

4.1.5.2 Storage and Distribution

Components of the treated water conveyance, storage, and distribution system include the following: the supply pipelines, five storage reservoirs, three pumping stations, eight wells, the distribution system, and service connections.

Treated water from the BPWTP is pumped to the City's Northwest Reservoir through 56 km of supply lines. The supply line was twinned in 2005 to increase capacity and improve reliability. Five storage reservoirs are present throughout the City to store water for domestic use and fire protection; the combined storage capacity for all five reservoirs is approximately 2 days at the current average day demand. Three pumping stations (that is, North, Farrell, and Ross) are located within the City to provide adequate system pressure; the Ross pumping station is not used.

Although annual water needs are provided by the BPWTP, eight wells are available in the City for back-up purposes. Well water can be transported through pipelines into the storage reservoirs. The distribution system consists of over 1,070 km of pipelines with diameters ranging from 1,067 mm for the trunk mains, to 100 mm for the distribution mains. Additionally, over 6,000 valves are available for isolation during maintenance and repair.

The capacities of each component included in the treated water conveyance, storage, and distribution system were assessed during the 2010 waterworks system assessment. A summary of firm and nominal capacities listed for each component in the *City of Regina Waterworks Systems Assessment* (KGS, 2010) is provided in Table 4-5.

Table 4-5
Existing Capacity of the Treated Water Conveyance, Storage, and Distribution Systems

Component/Process	Description/Comments	Capacity	
Potable Water Supply		Max. Capacity	Active Capacity
Storage at BPWTP (Clearwell + Pumpwell)	Baffled underground concrete structure	10.51 ML	4.75 ML
Buffalo Pound Supply Pumping	Pump A; split case centrifugal; primarily used for pigging; Upper Pump Room	45 ML/d	-
	Pump B; split case centrifugal, installed in 2007; used in Winter; Upper Pump Room	55 ML/d (@ 60 kPa)	-
	Pump D; split case centrifugal, major duty pump; Lower Pump Room	110 ML/d	-
	Pump C; vertical turbine; used 50 % of time; High Lift Station	80 ML/d	-
	Pump E; used in the summer; High Lift Station	145 ML/d	-
	Pump F; High Lift Station	165 ML/d	-
To Regina	Based on upgraded pumping	165 ML/d	-
Buffalo Pound Supply Pipeline	Based on twinning the pipeline	225 ML/d	-
Reservoirs	Description/Comments	Total Capacity	Net Usable Capacity

Table 4-5
Existing Capacity of the Treated Water Conveyance, Storage, and Distribution Systems

Component/Process	Description/Comments	Capacity	
Potable Water Supply		Max. Capacity	Active Capacity
Northwest Reservoir	Primary Reservoir; used to meet typical demands. The net usable capacity does not include 7.3 ML of storage below the LSL.	45.4 ML	38.2 ML
Pasqua North Reservoir	Primary Reservoir; used to meet typical demands. The net usable capacity does not include 2.6 ML of storage below the LSL.	22.7 ML	20.1 ML
Albert Street Reservoir	Primary Reservoir; used to meet typical demands	45.4 ML	43.9 ML
4th Avenue Reservoir	Secondary Reservoir; used during peak usage	45.4 ML	36.5 ML
Tor Hill Reservoir	Secondary Reservoir; used during peak usage	22.7 ML	21.6 ML
Total		181.6 ML	160.3 ML
Pumping Stations		Capacity	
North Pumping Station	Capacities were referenced from Report No. 4 of the Long Term Water Utility Study Update	333 ML/d or 243 ML/d during transfer to Farrell Pumping Station	
Farrell Pumping Station	-	118 ML/d	
Ross Pumping Station	Not presently in use.	Approximately 40 ML/d	
Distribution System			
Watermains	> 900 km; range from 100 mm to 1,050 mm diameter	-	
Valves	> 6,000	-	
Hydrants	~5,000	-	
Wells		Capacity	
Well Capacity	Based on eight active wells	39 ML/d	
Pumps Capacity	Based on active wells only	39 ML/d	
Allocation	From Saskatchewan Watershed Authority for the Regina and Zehner Aquifers	2,250 ML/year	

Notes:
BPWTP – Buffalo Pound Water Treatment Plant
ML – megalitre(s)
ML/d – megalitres per day
kPa – kilopascal(s)
mm – millimetre(s)

4.1.5.3 Raw and Treated Water Quality

In addition to the water testing performed at the BPTWP, tests are undertaken at various points within the City's water supply and distribution system. Drinking Water and Compliance Reports were reviewed from 2008 to 2012.

The Water Regulations require that a total chlorine residual of not less than 0.5 mg/L or a free residual of not less than 0.1 mg/L be maintained in the distribution system. While the treated water levels of total chlorine in the distribution system have dropped below the minimum limit of 0.5 mg/L on several occasions (for example, 2011 Range: 0.31 to 1.36 mg/L), the free chlorine residual is typically in compliance with the limit of 0.1 mg/L. In 2012, the free chlorine residual dropped below the minimum limit of 0.1 mg/L in the City's distribution system. Table 4-6 summaries the chlorine residual data for 2008 to 2012.

Table 4-6
Total and Free Chlorine Residuals Summary – City of Regina Distribution System

	Free Chlorine Residual (mg/L)		Total Chlorine Residual (mg/L)	
Year	**Range**	**ALL < 0.1 mg/L**	**Range**	**ALL <0.5 mg/L**
2008	0.13 – 1.03	Y	0.43 – 1.16	N
2009	0.14 – 1.14	Y	0.25 – 1.43	N
2010	0.21 – 1.22	Y	0.34 – 1.31	N
2011	0.1 – 0.99	Y	0.31 – 1.36	N
2012	0.02 - 1.10	N	0.04 - 1.64	N

Notes:
mg/L – milligrams per litre
Y – yes
N - no

The Water Regulations also require that zero total coliform bacteria are present in the distribution system. However, some of the samples obtained in 2008, 2010, and 2011 tested positive for total coliform. Table 4-7 provides the number of positive sample collected in 2008 to 2012.

Table 4-7
Total Coliform Bacteria Summary – City of Regina Distribution System

Year	Number of Samples Tested Positive for Total Coliform Bacteria	Total Number of Samples Collected
2008	1	781
2009	0	780
2010	10	790
2011	1	819
2012	0	804

Age of Infrastructure

Table 4-8 summaries the age of the infrastructure present in the City's water distribution system.

Table 4-8
Age of Water Conveyance, Treatment, Storage, and Distribution Infrastructure – City of Regina

Component/Process	Age	Description/Comment
Reservoirs		
Northwest Reservoir	34 years (1979)	
Pasqua North Reservoir	43 years (1970)	

Table 4-8
Age of Water Conveyance, Treatment, Storage, and Distribution Infrastructure – City of Regina

Component/Process	Age	Description/Comment
Albert Street Reservoir	82 years (1931)	Structural roof upgrade in 2011
4th Avenue Reservoir	66 years (1947)	Upgraded in 1993
Tor Hill Reservoir	94 years (1919)	Upgraded in 1992
Pumping Stations		
North Pumping Station	Pump 1 - 50 years (1963) Pump 2 - 50 years (1963) Pump 3 - 50 years (1963) Pump 4 - 50 years (1963) Pump 5 - 41 years (1972) Pump 6 - 22 years (1991)	
Farrell Pumping Station	Pump 1 - 45 years (1968) Pump 2 - 52 years (1961) Pump 3 - 52 years (1961) Pump 4 - 20 years (1993)	
Ross Pumping Station	Pump 1 - 28 years (1985) Pump 2 - 28 years (1985) Pump 3 - 28 years (1985)	

Reservoir/Pumping Station Supply Mains		
Northwest Reservoir to North Pumping Station	34 years (1979)	1200 mm
Pasqua North Reservoir to North Pumping Station – 900 mm	43 years (1970)	900 mm
Pasqua North Reservoir to North Pumping Station – 750 mm	43 years (1970)	750 mm
Albert St. Reservoir to Farrell Pumping Station	1965 - 1980	914 mm
North Pumping Station to Farrell Pumping Station/Albert St. Reservoir	> 50 years old	914 mm; mains have likely never been cleaned
Tor Hill Reservoir to 4th Avenue Reservoir – Reach 1	32 years (1981)	610 mm; supply capacity limited due to size, length and available gravity head
Tor Hill Reservoir to 4th Avenue Reservoir – Reach 2	32 years (1981)	610 mm
Tor Hill Reservoir to 4th Avenue Reservoir – Reach 3	19 years (1994)	750 mm
4th Avenue Reservoir to Farrell Pumping Station – Reach 1	54 years (1959)	760 mm
4th Avenue Reservoir to Farrell Pumping Station – Reach 2	54 years (1959)	760 mm

Notes:
mm – millimetre(s)

Current Conveyance and Distribution System Capacity Deficits and Recommended Improvements:

Serviceability studies completed for the City were reviewed to identify capacity deficits in the distribution system. System deficits/issues and recommended improvements are summarized below for different areas of the City:

- **Northeast and Northwest Zones:** AECOM completed a pressure zone study in 2009 for the City of Regina (AECOM, 2009) and found that the City's distribution system is currently unable to satisfy pressure requirements in the northwest and northeast areas of the City. Three pressure zones will be required to service the northwest and northeast areas, including the Ross Industrial Park (northeast).

  To address the pressure and fire flow issues in the northwest area of the City, it was recommended that the City construct a new pump station adjacent to the Northwest Reservoir; the City completed this, and the North Pressure Zone and Booster Station was added in 2013. The construction costs for the new pump station, corresponding with a future Regina population of 300,000, were estimated to be approximately $19.3 million (not including engineering fees). Ross Avenue Pump Station could be investigated as a temporary solution for the northeast. In the long term, it was recommended that the City construct a new reservoir and pump station, if development east and north of the Ross Industrial Park continues. Following commissioning, the Ross Avenue Pump Station and 4th avenue Tor Hill Reservoir System could be decommissioned. The construction costs for the new pump station, and reservoir corresponding with a future Regina population of 300,000, were estimated to be approximately $23.5 million (not including engineering fees).

- **Southeast:** A serviceability study for the southeast quadrant of the City was completed by AECOM in 2012 (AECOM, 2012a) to review the distribution system performance under existing and future land use. Since the City is currently implementing a second pressure zone in the northwest area of the City, the Second Pressure Zone Implementation model was used as a starting point for the analysis conducted in this study. A number of system deficiencies were identified with respect to meeting pressure, for maximum day and peak hour demand conditions.

  Under the existing conditions, multiple nodes in the southeast quadrant of the City have low fire flows under the maximum day demand scenario. Low pressure (less than 270 kPa) occurs in several different areas under the peak hourly demand (PHD) scenario including the Parkridge subdivision, Ross Industrial Park, and the development north of Highway 1, east of the existing City limits. The existing key watermains appear to be sized correctly, as no pipes exceeded the design velocity criteria during the PHD scenario. All three pumping facilities (that is, North, Farrell, and Second Pressure Zone) were shown to have spare pumping capacity under the existing PHD flow rates. To improve the existing system and allow for further development in the southeast, three different alternatives were proposed. All alternatives involved the addition of a new pumping station(s), reservoir(s), and feedermains. This work is under review by the City of Regina.

- **Southwest:** A serviceability study for the southwest quadrant of the City was conducted by AECOM in 2012 (AECOM, 2012b) to review the distribution system performance under existing and future land use. Since the City is currently implementing a second pressure zone in the northwest area of the City, the Second Pressure Zone Implementation model was used as a starting point for the analysis conducted in this study. Additionally, a baseline population of 235,000 was used. To provide services to the future communities west of the Harbour Landing subdivision, two 600-mm-diameter stubs are available at the ends of Parliament Avenue and Gordon Road near Campbell Street. The mains will be extended west and north, connecting into the GTH water supply line. The Second Pressure Zone is nearing completion.

  Under the baseline conditions, many nodes in the Ross Industrial Park, Parkridge subdivision, and eastern extremities had low pressures in the PHD scenario. To counteract this, an eastern pressure zone will be required in the future, extending south of the CPR mainline to Wascana Creek and east of the Ring Road. This work is under review by the City of Regina.

- **Intermodal Facility:** A serviceability study was conducted by AECOM in 2008 (AECOM, 2008*)* for lands extending beyond the western City limits. The development area was set aside for the Intermodal Facility (IMF), the Loblaws Facility, and other industrial land use. Previously, little water infrastructure existed in the vicinity of the development, and the capacity of the infrastructure was limited. The short-term plan for servicing involved the installation of a 600-mm-diameter feed line, connected to the 857-mm-diameter inner feeder main loop located at Lewvan Drive. This feed line was installed recently. The 600-mm main runs west on 13th Avenue to Courtney Street, north on Courtney Street to Dewdney Avenue, west on Dewdney Avenue to the IMF access road, and south on the access road to provide domestic and fire flows to the IMF site and Loblaw's local distribution systems.

  In the medium term plan (up to 2035), the water distribution system will be upgraded to accommodate an additional domestic maximum day flow capacity of 106.2 L/s. This will involve the addition of a number of 300-mm waterline loops and connections. This work is under review by the City of Regina.

Operating Expenditures and Revenues

The total annual operating expenditures and revenues for the City's water, wastewater, and drainage systems are shown in Table 4-9. The portion of the total amount that belongs to the water system alone is shown in brackets.

Table 4-9
Annual Operating Expenditures and Revenue for Regina – Water, Wastewater, and Drainage
The portion of the total amount that belongs to the water system alone is shown in brackets.

Year	Operating Expenditures ($k)	Operating Revenue ($k)	Other Revenue (grants, interest, etc.) ($k)
2008	48,621.80 (15,129.60)	64,965.80 (33,594.60)	302.90
2009	51,225.70 (10,184.90)	69,877.50 (35,691.60)	1,351.00
2010	54,449.40 (10,629.40)	74,483.50 (37,499.20)	3,758.30
2011	57,217.70 (11,480.90)	84,335.90 (42,672.60)	4,379.30
2012	52,108.40 (24,774.80)	97,887.50 (47,923.60)	4,062.90

4.1.5.4 Wastewater Infrastructure

During the course of discussions, the City made available a number of reports that reviewed the overall capacity of the existing network and wastewater treatment plant (WWTP). Currently, the City is in the process of developing a P3-based procurement approach for the WWTP. This will see the current WWTP upgraded by the end 2016, and this will remove the operational requirements of the WWTP from the City for a 30-year period. From the information contained in the P3 documents that are available to the public, the operation, maintenance and service of the current and future networks along with the McCarthy Boulevard Pumping Station (MBPS) and a possible new Septage Receiving Facility may remain under the control of the City of Regina.

Collection and Type of Treatment

The City of Regina Collection system consists of 830 km of sewer including seven main trunks, as follows:

- South Trunk – serves primarily the southwest and is interconnected with the Wascana Trunk
- Wascana/Broadway Trunk – serves the south central areas
- Wascana/15th Avenue Trunk – serves the southeast
- 7th Avenue Trunk – serves the north central areas

- McCarthy Trunk – serves the north central and northeast areas
- Northwest/Rochdale Trunk – serves the northwest

In addition, there are also 26 lift stations, of which the largest is MBPS. All of the trunks converge at the MBPS, which conveys all of the wastewater collected within the City to the WWTP via two 1,050-mm-diameter (42-inch-diameter) forcemains.

Table 4-10
List of Lift Stations Identified through Information Submitted to CH2M HILL during the Study

a.	14th and York Lift	b.	Elliot Street Lift	c.	Maple Ridge Pump	d.	SIAST
e.	Albert Park Pump	f.	Garnet Street Lift	g.	Molson's	h.	SE Sector Pump
i.	Arens Road Lift	j.	Glencairn Subdivision Pump	k.	Mount Royal Lift	l.	The Creeks
m.	Correctional Centre	n.	Harbour Landing	o.	Parkway Subdivision Lift (Hillsdale)	p.	University of Regina
q.	Dieppe Lift	r.	Kent Street	s.	RCMP	t.	Walker Street Lift
u.	Edward Street Lift	v.	Lakeview South Pump	w.	Ritter	x.	Wascana Parkway
y.	West Hill Park Pump	z.	McCarthy Boulevard Pumping Station				

Notes:
SIAST – Saskatchewan Institute of Applied Science and Technology
RCMP – Royal Canadian Mounted Police

Existing Capacity of Collection and Treatment Systems

The current collection system for the City of Regina will require only minor upgrades to serve a population of 235,000 people as defined in Stage 1 of the 2004 *Long Term Residential Growth Study* (LTRGS) (City of Regina, 2004).

The Northwest Sector is the most receptive to development and requires the least amount of upgrade works due to available capacity within the system. The Northeast Sector was not designed to accommodate any future development beyond the boundaries of the existing system. Expansion of the existing detention facility at the Creeks Lift Station in the Southeast Sector was envisioned to accommodate additional development to Stage 1 in the Southeast, but has not yet been constructed. Detention storage has already been constructed at Harbour Landing to accommodate Stage 1 development in the Southwest.

Once the population of the City reaches the population defined in Stage 1 of LTRGS (that is, a population of 235,000), the collection system will then require further investment to sustain growth into Stages 2 and 3 of the LTRGS.

Residential flow accounts for approximately 60 to 65 percent of current flow, with the remaining 35 to 45 percent being trade or industrial flow.

Known Collection Issues

From research and reviewing previous reports as supplied by the City, it is evident that some areas are highlighted as problem areas: these are mainly due to them being low-lying and having shallow inverts of the sewer (less than 1.83 m), as these factors increase the risk of basement flooding during a 1-in-25-years storm event.

Known Effluent Quality Issues (as they relate to current license and pending changes)

As previously mentioned, the current WWTP is due for upgrade under a P3 project to ensure that it is compliant with the upcoming discharge regulation changes. In the meantime, however, the UV disinfection system is being upgraded.

Effluent Disposal Method

Currently, the effluent is a continuous discharge to Wascana Creek, and this will continue for the proposed P3 WWTP.

Age of Infrastructure

At present, the City estimates that 12 percent of existing sewer infrastructure is greater than 90 years old, and that 28 percent is in excess of 70 years old and is reaching the end of its design life. As the City develops and expands, the sewer network is being extended and upgraded to meet these needs. Also, as and when the sewers are being upgraded or relined, stormwater routes are being removed to separate the combined system where appropriate. The current WWTP is over 50 years old; however, as previously mentioned, this facility is due for an upgrade in the very near future.

Planned Improvements

- Improvement expenditure, from the 2012 Water and Sewer Utility Budget, is approximately $23 million for 2012 and $10 million for 2013.
- The City has a continual sewer rehabilitation program, and work is carried out in conjunction with the roadway program or as needed.
- Improvement work is carried out when a developer is installing new networks to service their land holdings.
- The WWTP is in the submission stage of the P3 process, with construction to be completed at the end of 2016 to achieve the new discharge standards required for the license.
- Upgrade of the odour equipment for MBPS was released for tender in 2013.

Number of Users on Collection System versus Truck Haul

The City has a Septage Receiving Station at the WWTP which is used by a limited number of users within the City. The majority of use is from the neighbouring RM of Sherwood, by commercial/industrial users, and by a limited number of other regional users.

4.1.6 West Communities

4.1.6.1 Grand Coulee

Water Infrastructure

Water Source

Treated surface water is delivered to Grand Coulee through the SaskWater Transmission System from Buffalo Pound East. A 150-mm-diameter, 6-km pipeline is tapped off of the supply line between the BPWTP and the City to transport the water to the Village of Grand Coulee. The 150-mm-diameter supply line was commissioned in 1999 to replace the original 75-mm-diameter supply line. There is no redundancy in the water supply line.

Water Treatment

Treated water is supplied by the BPWTP; however, booster chlorination is provided at the existing distribution system pump house in the Village of Grand Coulee. Additionally, a second chlorination location was installed in 2011 at the new reservoir to provide flexibility for disinfection.

Storage and Distribution

The existing subsurface storage reservoir is located beneath the Village's water treatment plant (WTP). It was constructed in 1980 and expanded in 1986 to an effective volume of 201 m^3. In 2009, the Village decided to expand its storage reservoir further to provide 2 days of storage at the average day demand for the future population. To serve the future population of 1,200 (year 2025), based on a per capita usage of 385 litres (L) per day, an additional storage volume of 723 m^3 was required. The Village completed the construction of the second reservoir in 2011, understood to be an above ground fiberglass tank. The combined capacity of both storage reservoirs is approximately 924 m^3. Water from the new reservoir is transferred by gravity to the original storage reservoir through a 250 mm line and then pumped to the community residents.

There are three distribution pumps: two electric-driven duty pumps and one engine-driven pump used for emergency/standby. The electric-driven pumps are 10 horsepower (hp) Grundfos vertical multistage centrifugal with a capacity of 35.9 cubic metres per hour (m^3/h) (158 US gallons per minute) each. The engine-driven pump is an Aurora 4-stage vertical turbine pump with a capacity of 37.9 L/s (at 45.7 m of total dynamic head [TDH]). The electric-driven pumps were installed in 2010, and the engine-driven pump was installed in 1980. The pumps are located in a building above the original reservoir.

The distribution system consists of underground piping ranging in size from 32 to 50 mm in diameter polyethylene (PE) and 150-mm-diameter polyvinyl chloride (PVC) mains. The PE mains were installed in 1966, and the PVC mains were installed in 1984, 1994, 2003, and 2004.

Raw and Treated Water Quality

There are no issues with the received water, as it is supplied by the BPWTP. Based on a review of historical data from 2006 to 2011, there are no issues with the treated water distributed to the residents. A minimum of 0.1 mg/L of free chlorine residual or 0.5 mg/L total chlorine residual is required at all times throughout the distribution system. The free chlorine residual does not drop below 0.1 mg/L. Also, all of the bacteriological results from 2009 to 2011 have been negative, and the average trihalomethane (THM) concentrations measured in the distribution system have been below the interim maximum acceptable concentration (IMAC) of 100 micrograms per litre (µg/L).

Planned Improvements

The Village may need to add in a booster station for the 150-mm-diameter supply line in the future. Currently the village is receiving approximately 436 m^3/d (80 gallons per minute [gpm]) from the line. The Village are planning on replacing the engine driven emergency/standby pump in 2020, after the end of its remaining service life.

Wastewater Infrastructure

The collection network at Grand Coulee is made up of gravity sewers and two pumping stations with forcemains. Half of the sewer network is being upgraded to a gravity system, so this section is new. The gravity section of the sewer network appears to perform satisfactorily. However, the current collection system is nearing capacity. Lift Station #1 is 13 years old, is nearing design capacity, and cannot handle peak wet weather flows during rain events. Lift Station #2 is currently being decommissioned, and it is being converted to a gravity network. All the users of the wastewater facilities are connected to the collection system.

The treatment system is made up of two lagoons. The lagoon system was upgraded in 2002. The wastewater from the collection system comes into the lagoons and subsequent to the treatment, the effluent is discharged into a neighbouring marsh/wetland. There are no quality issues noted with the treatment system: the latest available online Ministry of Environment inspection report, dated August 2012, shows the treatment system to be in compliance. However, the current system is nearing its capacity.

The City has hired an external consultant to assess the existing situation and determine potential options. Some of the alternatives being explored are upgrading the existing lagoon system, pumping to the future GTH, pumping to Regina, or installing a packaged WWTP.

4.1.6.2 Pense

Water Infrastructure

Water Source

The Town of Pense uses treated water from the BPWTP supply line as its water source. This water flows to the Town through a 7.4-km-long, 150-mm-diameter asbestos concrete water supply main (installed in 1964) to the Town's pump house. The Town owns the supply line from Vault (NW 33-17-22-W2M) to the pump house/water storage reservoirs. The capacity of the supply line is 11.4 L/s (985 m^3/d), which exceeds the projected peak day demand (that is, 4.48 L/s) for year 2030. Since there is only one supply line, there is no redundancy.

Water Treatment

As the Town receives treated and disinfected water from the BPWTP to Regina water supply line, there is no water treatment within the Town. However, a sodium hypochlorite (12 percent) chemical feed pump was installed in 2006 to boost residual chlorine levels within the distribution system when required. Sodium hypochlorite is injected into the water before it enters the storage reservoir.

Storage and Distribution

The Town pumphouse contains the equipment necessary to supply and distribute treated water to residents. The pumphouse was originally constructed in 1964 and was expanded in 2006. Two storage reservoirs exist: a reinforced concrete storage reservoir with a storage volume of 47 m^3 (constructed in 1964), and a new reservoir with a storage volume of 560.3 m^3 (added in 2006). The total storage capacity is 607 m^3.

The average day demand within the Town of Pense was estimated to be approximately 175 m^3/d (~345 litres per capita per day) in the *Town of Pense Waterworks Assessment Round 2* (EPEC, 2011). The peak day demand was estimated to be approximately 4.05 L/s, and the peak hour demand was estimated to be 8.37 L/s. At the average day demand, the storage reservoirs provide approximately 3.5 days of storage, which surpasses the storage requirement for fire protection. The existing storage capacity should be sufficient for a future average day flow of up to 303 m^3/d.

There are two existing VLS 10-hp distribution pumps at the pumping station that were installed in 2006. Each pump has a capacity of 13.87 L/s at 376 kPa, which exceeds the peak hour demand of 8.37 L/s reported in the 2011 WSA. There is also a natural gas fired, engine-driven engine standby pump with a capacity of 56.78 L/s at 448 kPa. A coin-operated truck fill station is connected to the distribution header at the pumping station. The truck fill facility was reconstructed in 2006.

The water distribution system was originally installed in 1964. It contains a combination of 150-mm-diameter asbestos concrete and PVC pipe watermains. The distribution system typically operates at 380 kPa. The water pressure in the distribution system has been satisfactory since the distribution pumps were replaced in 2006. The system is flushed annually.

Raw and Treated Water Quality

The treated water quality has consistently complied with the SDWQSO.

Capacity Deficits and Issues

The following capacity deficits/issues were reported in the 2011 *Town of Pense Waterworks System Assessment Round 2* (EPEC, 2011):

- **Water Supply:** There is no redundancy in the supply line.

- **Water Pressure:** There are five service connections to farms that branch off of the water supply line. The farmers are not receiving adequate pressure from the supply line.

Planned Improvements

A new water pumping station will be required for the new block in the northeast area of the Town where condos are being developed.

The most recent waterworks system assessment (EPEC, 2011) indicated that a computer distribution analysis should be conducted to identify the characteristics of the distribution system, to predict chlorine residual concentrations, and to determine distribution flows and pressure adequacy.

Wastewater Infrastructure

The collection system, for the Town of Pense, is made up of gravity sewers and a pumping station. Neighbouring towns of Stoney and Keystown flow into the gravity sewer collection system. The current sewer network seems to have sufficient capacity. There appear to be no collection issues at present, but areas of the sewer network have been identified as requiring upgrade or maintenance work. The pumping station had issues in 2011, and these are being investigated for potential upgrade. There is also a new pumping station required for new condo blocks that are being constructed. All the users of the wastewater facilities at the town are connected to the collection system.

Treatment is in the form of two lagoons in series. Treated effluent from the lagoon is discharged periodically into a drainage ditch downstream. There appear to be no effluent quality issues with the treatment system, as the latest inspection report (dated July 2012) from the Ministry of Environment shows the treatment system to be in compliance.

The lagoons are reported to have operational drainage issues, the nature of which was not understood within this study, and early investigation by the community and their engineer has been unable to find a solution. This is affecting the overall wastewater capacity of the town. A temporary solution is being implemented in the form of pumping between the cells to get additional capacity. However this needs to be addressed to provide a long-term solution and to support growth of the community.

4.1.6.3 Rural Municipality of Pense

Water Infrastructure

Water Source and Distribution

The RM of Pense supplies water to the Hamlets of Stony Beach and Keystown. The Hamlets are located a few km northwest of the Town of Pense. Stony Beach is located in Section NW 30-17-23-W2, and Keystown is located in Section SW 36-17-23-W2. Both Hamlets are supplied with water from the BPWTP supply line.

The supply line to Stony Beach consists of a 1.75-km-long, 75-mm-diameter PVC pipe and 550 m of 50-mm-diameter PVC pipe running through the Hamlet that was installed in the late 1970s. There are 13 service connections. The treated water is supplied directly to the residents by gravity; the system has no pumping, no rechlorination system, and no storage facilities. System pressure is approximately 30 to 40 pounds per square inch (psi).

The supply line to Keystown consists of a 3.0-km-long, 65-mm-diameter pipe. The distribution system was installed in the mid-1980s. There are 7 service connections. The treated water is supplied directly to the residents by gravity; the system has no pumping, no rechlorination system, and no storage facilities. There are six service connections. As mentioned, system pressure is approximately 30 to 40 psi. A Booster Station at Keystown, operated by the City of Regina, was previously used to push the water further down the supply line to the City; however, this station has now been decommissioned.

A number of locations on each system may have cistern systems that are still in use.

Water Demand

In the *2006 RM of Pense Waterworks System Assessment* (KGS, 2006), the average day demand for Stony Beach and Keystown were estimated to be between 5 and 7 m^3/day and 5 and 6 m^3/day, respectively, and the maximum day demands were estimated to be 21 m^3/day and 18 m^3/day, respectively. The populations residing in Stony Beach and Keystown in 2002 were reported to be 25 and 17, respectively.

Water consumption data was reviewed for 2012 as well. In Stony Beach, the total water consumption for 2012 was 625 m^3. This results in an average day demand of 1.7 m^3/d, which is far lower than the demand observed in 2006. In Keystown, the total water consumption for 2012 was 1,760 m^3. This results in an average day demand of 4.8 m^3/d, which is close to the demand observed in 2006.

Treated Water Quality

There are no issues with the received water, as it is supplied by the BPWTP and meets all of the current Saskatchewan Water Quality Standards.

Occasionally, low chlorine residuals (less than 0.1 mg/L) have been observed in the distribution systems. These events typically occur during the winter months. However, in 2012, around 44 percent of the samples taken in Stony Beach had inadequate free chlorine residuals present; this amounts to 11 samples out of 25.

THM concentrations in water samples from Stony Beach have been below the regulated limit of 100 µg/L. In 2010, the THM concentration in a water sample taken from the Keystown distribution system was reported to be 136 µg/L, exceeding the regulated limit of 100 µg/L; however, only one sample was obtained during the whole year. In 2009, the requirement for sampling THMs was deleted from the Permit to Operate a Waterworks.

Capacity Deficits/Issues

There is no reservoir to provide treated water storage, in the event that the BPWTP Supply Line is shut down. The RM of Pense does not want to add storage to either system, since they serve small populations.

Chlorine residuals in the Hamlet distribution systems are occasionally less than the minimum concentrations required by the Saskatchewan Ministry of Environment. Rechlorination facilities do not exist to boost the chlorine residual in the distribution systems.

Pressure in the distribution system is typically 30 to 40 psi. While this is satisfactory at present, it may not be sufficient in the future. Currently, no additional development has been allowed for either the Stony Beach or Keystown communities.

Planned Improvements

The *2006 RM of Pense Waterworks System Assessment* completed by KGS Group identified several recommendations to improve the water systems in the Hamlets of Stony Beach and Keystown (KGS, 2006):

- **Water Quality:** Installation of hydrants on all dead end lines and flushing twice per year when low chlorine residuals are noticed, to remove stagnant water from the lines
- **Health Concern:** Installation of backflow prevention devices (that is, double-check valves) on all service lines to prevent backflow events from occurring due to periodic shutdowns of the City of Regina's pipeline and other factors

Alpine Plant Foods, a liquid fertilizer manufacturing facility located south of Stony Beach, is planning to install a new water line. The RM of Pense has been in discussions with this industrial user to tap into this new line. Such an action would allow Stony Beach more room for growth in the future and would potentially eliminate low chlorine residuals and pressure issues. An agreement and Bylaw is in place concerning tapping into the Alpine Plant Foods Waterline (January, 2011). The water is being supplied by the City of Regina/BPWTP. It is understood the pressure will be similar to what is available now, even though it is a larger waterline; as a result, water users have been advised to install a personal pressure system.

Wastewater Infrastructure

The wastewater system in the RM of Pense is mainly made up of septage tanks, and it is assumed that trucking of this septage to Regina is occurring by haulers. Capacity is dependent on local storage tanks and the haulage / septage contract. Hauling is managed by the private haulage companies. Farmers are permitted to deposit septage in their own fields. In addition, capacity would be an issue if restrictions or limits are imposed by the septage receiving station.

4.1.6.4 Belle Plaine

Water Infrastructure

Water Source

The Village of Belle Plaine receives pressurized treated water from the BPWTP via a supply main to the Village's water storage reservoir. The 75-mm-diameter supply line entering Belle Plaine is branched off of a 150-mm-diameter line that is shared with the Villages of Drinkwater and Briercrest, and the BPD Water Society Corp. Line. The supply line is approximately 20 years old. The capacity of the existing 75-mm supply line exceeds the future water requirements.

Water Treatment

The treated water is chlorinated prior to distribution.

Water Storage and Distribution

The Village's water distribution system is not sized for fire protection; thus, only 1 day of storage at the average day demand is required. The existing water storage reservoir has a volume of 107.73 m^3, which exceeds the present (20 m^3) and future (60 m^3) storage requirements determined in the capacity evaluation (EPEC, 2009). The Village population has not changed significantly since the capacity evaluation was completed.

The treated water is pumped from the storage reservoir to the distribution system via two end suction pumps which each have a capacity of 3.97 L/s at 394 kPa. The existing pumping capacity exceed both the current (1.0 L/s) and future (3.13 L/s) peak hourly demands.

The existing distribution system consists of a 150-mm-diameter watermain on Main Street, running from south of the pump house to north of Assiniboia Avenue, and a 100-mm-diameter watermain on Assiniboia Avenue running from Bison Street to Prospect Street. The remaining streets and avenues are serviced by 50-mm-diameter lines.

Raw and Treated Water Quality

There are no issues with the received water, as it is supplied by the BPWTP and meets all of the current Saskatchewan Water Quality Standards.

Capacity Deficits/Issues

Currently, the water system has enough capacity; however, if development in the Village proceeds as planned, it may require additional capacity in the future.

Planned Improvements

No improvements are planned for the Village's water system in the near term, as the existing capacity and storage volume appear to be adequate to handle both the current and future populations.

Wastewater Infrastructure

The current wastewater system at the Town of Belle Plaine is designed for a capacity of approximately 800 people. Currently, all users of the wastewater facilities are connected to the collection system. The collection network at present is made up of a low pressure system and individual tanks which are emptied once a year. The age of the collection system is unknown. The overall capacity of the system is four times the current demand. However, storm events and subsequent high flow volumes can cause problems for the lagoon system downstream. No known collection issues exist at present; however, as the town expands and develops, it will require another sewage line and potentially a pump station.

The lagoon system was constructed in 2006/2007 and is 7 years old. The treatment system is made up of two lagoons. After treatment, the effluent is discharged intermittently into a marsh/wetland downstream. The treatment system appears to be working as designed. The last available online Ministry of Environment inspection report dated May 2013 showed that the treatment system needed the sewage dumping location to be moved to the primary cell. Remedial works should have been completed by August 2013.

4.1.7 North Communities

4.1.7.1 Lumsden

Water Infrastructure

Water Source

Raw water for the Town of Lumsden is supplied by two wells. Well No. 4 and Well No. 5 serve as the main source of water supply to the WTP. Well No. 4 is located in Section SE 11-19-21 W 2nd, and Well No. 5 is located in Section SW 12-19-21 W 2nd, approximately 8 km southeast of Lumsden. Well No. 4 was constructed in 1991 and has a maximum capacity of 22.7 L/s at 48.77 m TDH; the pump currently draws 22.5 L/s. Well No. 5 was constructed in 2007 and has a maximum capacity of 37.9 L/s. Together, Wells No. 4 and 5 supply water to the Deer Valley Golf and Estates, Dodd's Reservoir, and the Town of Lumsden. The supply line from Wells No. 4 and 5 to the WTP was constructed in 1991. It consists of a 7.97-km-long, 200-mm-diameter, class 150 PVC pipe.

A third well (that is, Well No. 3), located 1.5 km east of Lumsden in Section NW 34-19-21 W 2nd, is used as a back-up source. Well No. 3 was constructed in 1981 and has a maximum capacity of 18.7 L/s at 86.9 m TDH. The well is licensed for up to 129,000 m^3 annually. When required, water from this well is chlorinated at the pumphouse and fed directly to the Town's storage reservoirs without passing through the WTP. The supply line from Well No. 3 to the reservoirs was constructed in 1981. It consists of a 1.5-km-long, 150-mm-diameter, class 150 asbestos cement pipe.

The Town of Lumsden also operates a potable water filling station which is open to RM residents for their use.

Water Treatment

Well water is pumped to the WTP. The WTP was constructed in 2004 and is located south of the Town on a hill. Treatment includes oxidation, greensand filtration, and chlorination. An oxidation detention tank (272 m^3) is located underneath the WTP to provide detention time for the oxidation of iron and manganese. Potassium permanganate is injected into the raw water supply line upstream of the oxidation tank. The diaphragm metering pump has a rated capacity of 32 litres per hour (L/h). Sodium hypochlorite is also injected into the raw water supply line upstream of the oxidation tank. The diaphragm metering pump has a rated capacity of 6.6 L/h.

Two vertical turbine filter supply pumps lift water from the oxidation tank to the greensand filters (two filters) for the removal of suspended solids and oxidized iron. The filters each have a maximum capacity of 23 L/s. The filter supply pumps each have a rated capacity 35 L/s at 12.2 m TDH. Thus, the WTP has a total capacity of 3,974 m^3/d, when both greensand filters are in operation; otherwise the firm capacity is 1,987 m^3/d.

Chlorine is also fed into the treated water line as sodium hypochlorite, prior to the onsite water storage reservoirs, to provide a final disinfection prior to the distribution system.

The WTP was designed to serve a population of 3,300; the current population is approximately 2,000 residents. In the 2011 *Town of Lumsden Waterworks System Assessment* (KGS, 2011), the flow demands were estimated for a population of 1,717:

- Average Day Demand = 604.7 m^3/d
- Maximum Day Demand = 1210 m^3/d
- Peak Hourly Flow = 1,575 L/min (2,268 m^3/d)

Storage and Distribution

Treated water is supplied to the residents of Lumsden through two supply lines. A 600-mm line services the new residential development located on top of the hill adjacent to the WTP (that is, the upper zone). A 1,200-L pressure tank is used to provide 32 to 50 psi system pressure to the eight residences located on top of the hill and for in-plant use.

The remaining water flows by gravity to the existing external reservoirs through a 750-m treated water supply line. The Town of Lumsden has four treated water storage reservoirs. Reservoirs No. 1 and No. 2 are located on the edge of the Town's limits, downhill from the WTP. Reservoir No. 1 was constructed in 1962 and is capable of holding 455 m^3. Reservoir No. 2 was constructed in 1978 and is capable of holding 682 m^3. Water from these two reservoirs is gravity fed to the lower zone.

Reservoirs No. 1A and No. 1B (that is, clearwells) are located underneath the WTP and were constructed in 2004. Reservoir No. 1A is capable of holding 350 m^3, and Reservoir No. 1B is capable of holding 325 m^3. Water from these two reservoirs is used to supply the upper zone and lower zone. A 1.5-hp distribution pump, rated at 3.8 L/s at 6.6 m TDH, is used to supply the water to the upper zone. A new submersible 7.5-hp distribution pump was installed recently. These pumps are used to feed the upper zone.

The total storage capacity for the Town is 1,812 m^3. Based on the average day flow of 604.7 m^3/d (reported in the 2011 WSA), there are approximately 3 days of storage available, which surpasses the storage requirement for fire protection. The existing storage capacity should be sufficient for a future average day flow of up to 906 m^3/d.

The distribution system was initially constructed in 1962 of asbestos cement piping. It was expanded in the 1980s and again in the 2000s. Since 1980, all of the piping installed or replaced has been class 150, PVC pipe. The watermains generally consist of a combination of 100-mm-, 150-mm-, and 200-mm-diameter, asbestos cement, PE, and PVC pipes. The pressure in the system is maintained between 30 and 50 psi. The total length of pipe in the distribution system is approximately 12,800 m.

Raw and Treated Water Quality

Raw water for the Town of Lumsden contains elevated levels of iron (0.9 to 1.5 mg/L, 2008 to 2009) and manganese (0.64 to 0.74 mg/L, 2008 to 2009), which exceed the aesthetic objectives of less than or equal to 0.3 mg/L and less than or equal to 0.05 mg/L, respectively. The concentrations of sulphate (392 to 424 mg/L, 2008 to 2009), total dissolved solids (TDS) (1,210 to 1,238 mg/L, 2008 to 2009), and arsenic (22 µg/L, 2007) are also quite high. The arsenic concentration measured in Well No. 5 is slightly lower than the maximum acceptable concentration of 25 µg/L. Iron, manganese, and arsenic levels are reduced during treatment with oxidation and greensand filtration.

Based on a review of the 2008 to 2012 *Drinking Water Quality and Compliance Annual Notice to Consumers* (WSA, 2008; WSA, 2009; WSA, 2010; WSA, 2011; WSA, 2012), the treated water in the Town of Lumsden appears to be in compliance at the WTP and in the distribution system. Drinking water contaminants do not exceed the maximum acceptable concentrations outlined in the provincial and federal guidelines. Aesthetic objectives for alkalinity, chloride, hardness, magnesium, sodium, sulfate, and TDS were also met. Adequate free chlorine residuals are provided throughout the distribution system. THM levels are not monitored currently, as the water source is not considered “ground water under the influence of surface water” and thus, does not require THM sampling and analysis.

Capacity Deficits

No capacity deficits were identified for the Town of Lumsden’s water system.

Potential Upgrades/Improvements

The 2011 *Town of Lumsden Waterworks System Assessment* completed by KGS Group identified several recommendations for future work to improve the water system (KGS, 2011):

- Conduct a study of the groundwater to determine the influence of surface water (GUDI study) on the existing Well No. 5. This is still to be completed. A similar study was recently conducted on Well No. 4.
- It was noted in the assessment that, if Well No. 3 is used to supply water in the event of an emergency, the water system may not meet the contact time (CT) requirement for disinfection. The water from Well No. 3 may need to be directed to the storage reservoirs, prior to the distribution system. Thus, it was recommended that the town conduct a study to research the chlorine CT in case of using backup Well No. 3. Since the KGS Group study and recommendation, the Town feels that this emergency option would prove challenging and would require boil water advisories.

Wastewater Infrastructure

The collection system at the Town of Lumsden is comprised of gravity sewers, a pumping station, and forcemains. There are no issues with the collection system at this point. The pump stations have excess capacity in them. They have been constructed recently or have been upgraded in the past few years. There are no improvements foreseen for the collection system for Lumsden.

The treatment system for Lumsden is in the form of two lagoons, located on the northwest side of the city. Wastewater from the Town is treated at these lagoons and then discharged into a neighbouring creek. There are no known treatment quality issues, as the latest online report from Ministry of Environment inspection (dated September 2012) shows the treatment system to be in compliance. There have been recent upgrades to the treatment system with the addition of aeration to help treat the effluent and lower the biochemical oxygen demand (BOD) leaving the system. However, even with the latest upgrades, the lagoons have reached their hydraulic capacity and as a result influent flows, and in turn growth within the town, are restricted.

The Lumsden infrastructure ranges in age from 1960s to current day. Lumsden is investigating the possible construction of a new WWTP with a discharge to the creek. This WWTP will also take wastewater from the Town’s landfill and potentially from future growth in the RM of Lumsden. The new planned WWTP also requires a Level-3 Operator, of which there are less than 25 across Saskatchewan. Lumsden may struggle to recruit and retain a Level-3 operator. There will be four operators at Lumsden shortly, including junior staff, to aid in succession planning. Older studies investigated pumping wastewater to Regina, but the costs were considered to be prohibitive at that time.

4.1.7.2 Rural Municipality of Lumsden

Water Infrastructure

The Town of Lumsden supplies raw water to the Deer Valley Golf and Estates and the Dodd’s subdivision. Raw water is purchased from the Town of Lumsden (Wells No. 4 and 5) and treated prior to use. These communities own and operate water treatment facilities for their residents. The new Minerva Ridge subdivision receives potable water from the Town of Lumsden. The RM does not operate any water systems.

Table 4-11
Approximate Subdivision Populations as Advised by the RM of Lumsden, October 2013

	House # Estimate	Population Estimate*	Type of Water Supply from the Town of Lumsden
Deer Valley (excluding Golf Course)	80	240	Raw Water
Dodd's Subdivision	9	27	Raw Water
Minerva Ridge (excluding VanEverdink)	7	21	Potable Water

Notes:
*Population estimate based on three people per house

Other RM of Lumsden communities not listed above rely on private wells or other pipelines in the area.

Wastewater Infrastructure

Wastewater within the RM of Lumsden is managed privately by individual septic systems which are pumped out when required. The pumping discharge is typically transported to a facility at Regina Beach. As such, there is currently no wastewater dependency from the RM of Lumsden communities on the Town of Lumsden. This may change in the future, as developers have expressed interest in connecting new nearby communities to the Town's infrastructure.

4.1.7.3 Craven

Water Infrastructure

Water Source

The Village of Craven obtains raw water from two wells which draw from the Qu'Appelle River watershed. The wells are located approximately 1.5 km east of the Village along Highway 99. The water from the wells is mixed in approximately equal proportions in a common pipe to the WTP and reservoir. Both wellheads are open and susceptible to contamination from groundwater seepage. A summary of each well is provided in Table 4-12:

Table 4-12
Summary of Water Supply Wells in Craven

Well	Description	Installation Year	Service Life
Well No. 1	150-mm-diameter PVC casing, depth of 20 m. Located 20 m east of Highway. Submersible pump – 3.7-kW electric motor	1978	25 to 30 years (will require replacing soon)
Well No. 2	150-mm-diameter PVC casing, depth of 20 m. Located 9 m east of highway adjacent to ditch. Submersible pump – 3.7-kW electric motor	1979	25 to 30 years (will require replacing soon)

Notes:
mm – millimetre(s)
m – metre(s)
PVC – polyvinyl chloride
kW – kilowatt(s)

Well water is pumped to the WTP through a 1,500-m-long, high density polyethylene (HDPE), raw water supply main (constructed in 1979) that is 75 mm in diameter. The pipeline has been performing well, and replacement in the near term is not anticipated. The total capacity of the raw water pumps is 200 gpm (greater than 1,000 m^3/d).

Water Treatment

The Village of Craven treats its groundwater with chlorine for disinfection. Sodium hypochlorite is injected into the raw water supply line. The sodium hypochlorite metering pump was purchased in 2004 and has a rated capacity of 1.89 L/h; an identical spare pump also exists at the WTP. The chlorinated water is then stored in an elevated reservoir to provide contact time for disinfection. The average day demand is 91 m^3/d, and the maximum day demand is 205 m^3/d.

The WTP was constructed in 1980 and is around 33 years old. The building and equipment are in fair-to-good condition; replacement in the near term is not anticipated.

Water Storage and Distribution

Storage is provided in an underground concrete storage reservoir located on the valley wall north of the Village. The storage reservoir was constructed in 1981, with an effective total storage volume of 222 m^3. At the current average day demand of 91 m^3/d, the reservoir provides slightly more than 2 days of storage, which meets the minimum storage requirements for fire protection. The reservoir consists of five compartments: the Raw Well, Finished Well, Dry Well, Reservoir No. 1, and Reservoir No. 2. Up to 75 gpm (greater than 400 m^3/d) of water can flow into the reservoir by gravity. It was mentioned in the *2006 Waterworks System Assessment* that the pipe configuration at the time was susceptible to short-circuiting (Stantec, 2006).

Treated water is conveyed by distribution pumps, and then flows by gravity to residents via a network of distribution mains and service connections. The WTP contains two electric-driven distribution pumps in a duty and standby arrangement. The main duty pump is a 2.2-kilowatt (kW) centrifugal end suction pump that was installed in 2005. The stand-by pump is a 2.2-kW multi-stage end suction pump that was upgraded in 2005. The distribution pump capacity is 75 gpm (greater than 400 m^3/d).

Most of the Village is served by gravity flow from the reservoir to the distribution mains; however, a separate distribution system exists for a subdivision located on the east side of the Village. Treated water is conveyed to the subdivision on the east side of the village by two electric-driven distribution pumps and two hydropneumatic tanks. The distribution pumps are arranged in a duty and standby configuration. The main duty pump is a 2.2-kW centrifugal end suction pump that was installed in 2005. The stand-by pump is a 2.2-kW multi-stage end suction pump that was upgraded in 2005. There are also two 600 mm by 900 mm hydropneumatic tanks.

The distribution system was first constructed in 1962 and was expanded in the 1980s. Some of the town is fed off of the hydrants lines added in 1980s; however, most residents rely on the old system. No maps or records of the distribution system currently exist. The distribution mains along Tenant Street are conventional 150-mm-diameter PVC mains installed in 1981, complete with main valves, fire hydrants, and 25-mm-diameter service connections. The rest of the Village is serviced with a mix of 32- to 50-mm-diameter PE watermains and 25-mm service connections. The smaller diameter mains and service connections were installed in the 1970s to replace the original galvanized metal piping.

Raw and Treated Water Quality

In the *2006 Waterworks System Assessment* (Stantec, 2006), all of the raw and treated water parameters were below the SDWQSO. Currently, there are no known raw water quality issues; however, both wellheads are open and susceptible to contamination from groundwater seepage. It has been recommended that improvements be made to the wellheads.

In terms of the treated water, the free and total chlorine residual concentrations in the distribution system are above the regulated values of 0.1 mg/L and 0.5 mg/L, respectively. There have been no positive results reported for total coliform, and turbidity levels in the distribution system have been below 1 NTU.

Capacity Deficits/ Issues

No capacity deficits or issues were identified for the water system in Craven. The population has declined since 2006, and the Village does not expect an increase of more than 50 residents by the year 2040.

Planned Improvements

To protect the raw water supply, it was recommended in the *2006 Waterworks System Assessment* that improvements be made to the wellheads to prevent contamination via seepage (Stantec, 2006).

The wells have reached the end of their typical service life of 25 to 30 years and will require replacement.

At present, there are no planned upgrades for the raw water supply or the WTP. Craven plans to replace the aging distribution pump.

Wastewater Infrastructure

The collection system at the Town of Craven is made up of holding tanks which pump into a pressurized sewer system. The sewer then runs to a small duplex lift station (approximately 70 years old) which pumps sewage 1.2 km (0.75 miles) to a holding tank west of Craven. A second duplex pumping station, with higher capacity, then pumps the sewage out of the valley and to a lagoon 4 km (2.5 miles) away. The collection system is due for upgrading, as the pumps in the second pump station were due for replacement in 2013. Currently, all users of the wastewater facilities are connected to the collection system. Current sewer infrastructure dates from the mid-1960s, and the pumping stations date back to the 1940s.

The treatment system comprises of a typical lagoon system. The lagoon system is currently operating at 75 percent capacity. No issues have been reported for the treatment system, as the Ministry of Environment inspection report (dated September 2012) shows the lagoon system to be in compliance but also shows that remedial works are required at the pumping stations, as noted above.

4.1.8 East Communities

4.1.8.1 Balgonie

Water Infrastructure

Water Source

The Town of Balgonie is currently using groundwater as its water source via three wells. Wells 1 and 2 produce 300 to 410 m^3/day (55 to 75 gpm), while Well 3 produces 490 to 760 m^3/day (90 to 140 gpm). Untreated well water is transferred for treatment through a 100-mm line (Wells 1 and 2) and a 150-mm line (Well 3).

The wells will be shut down soon, and treated water will be supplied to the town through a pipeline from Pilot Butte.

Water Treatment

The well water is chlorinated prior to storage and distribution.

Storage and Distribution

The Town of Balgonie uses two holding tanks with a combined storage volume of around 1,390 m^3. Chlorinated water is pumped from the holding tanks to the distribution system. The distribution system was first installed in 1960. There are approximately 585 water service connections in the town.

Raw and Treated Water Quality

The Town's well water supply has a high concentration of selenium. As chlorination is the only treatment process, the distributed water has consistently exceeded SDWQSO guidelines. All remaining parameters have been within the regulatory values.

Planned Improvements

The Town has entered into an agreement with the Town of Pilot Butte which allows it to purchase treated water. The Town of Balgonie is constructing a chlorination building, a new reservoir, and the pipeline and pumps to transfer water from the Town of Pilot Butte. The new reservoir will have a capacity of 2,000 m^3, and construction of the new pipeline will start in the summer of 2013. The estimated completion date for all of the upgrades is March 31, 2014.

Wastewater Infrastructure

The wastewater collection system for Town of Balgonie consists of a gravity sewer system. The gravity sewers collect the Town's wastewater into two lift stations. The lagoon located on the outskirts of Balgonie then receives wastewater from these two lift stations. As part of periodical maintenance, the Town conducts cleaning of the gravity sewers each year. The current collection system is in good condition with no collection issues known at present. One notable capacity issue was recorded in 2011 during the floods, when Balgonie had to discharge to Wascana Creek.

The current lagoon system at Balgonie provides sufficient capacity for the current population. The lagoons have a capacity of 180 days. Periodically, the effluent water is used by local farms for irrigation, which increases the capacity of the lagoons from 180 days to 220 days. However, to support future growth in the Town, an upgrade of the wastewater system would be needed. There is an existing, old and unused lagoon that could be refurbished and put into service to increase the capacity. There are no effluent quality issues reported with the latest online Ministry of Environment inspection (dated September 2012) that shows the overall system to be compliant. There is, however, a requirement for a licensed operator per regulations.

4.1.8.2 Pilot Butte

Only approximate information was available from Pilot Butte during the initial data collection phase of the study.

Water Infrastructure

Water Source

The Town of Pilot Butte uses groundwater from the Zehner Aquifer as its water source. The existing raw water supply wells (two wells) for Pilot Butte can each provide 37.8 L/s, resulting in a peak supply capacity of 75.6 L/s or 6,532 m^3/d. In the future, Pilot Butte plans to install a third well, which can provide 37.8 L/s and which will increase the peak supply capacity to 113.4 L/s or 9,798 m^3/d.

Water Treatment

The WTP was put into service in 2013. The Town uses membrane filtration for water treatment, specifically nanofiltration and reverse osmosis. The WTP consists of four membrane trains, with a total treatment capacity of 65 L/s (5,616 m^3/d).

Storage and Distribution

Treated water from the WTP is sent to a storage reservoir with a 3,369 m^3 (890,000 US gallon) capacity. Water in the storage reservoir is pumped to the distribution system. The Contract A watermains have been installed in the distribution system, and Contract B is underway; service connections and water meters are still being installed.

During the summer of 2013, a pipeline was constructed between Pilot Butte and Balgonie. Balgonie will purchase treated water from Pilot Butte for its water needs. Under the current agreement, Pilot Butte will provide treated water to Balgonie to serve the current population and also a future population of up to 3,200 residents (maximum consumption of 54,000,000 gallons or 250 ML per year).

Raw and Treated Water Quality

At the present, there are no issues with the raw water or treated water quality.

Capacity Deficits/Planned Improvements

No capacity deficits or planned improvements at the present, as the WTP, storage reservoir, and distribution system are brand new. The WTP was constructed to support a population numbering up to 8,000, which is approximately four times the current population.

Wastewater Infrastructure

Wastewater collection system is via the traditional gravity sewers. Pumping stations then convey the collected wastewater to Pilot Butte's lagoons located to the north of the community. A new pumping station was recently completed by Pilot Butte to handle the pumping demands. There are no issues noted in the collection system at present.

Wastewater treatment is accomplished by a lagoon system. These were constructed in 2005 and have been designed for a larger future population. Currently, the lagoons are loaded to 65 percent of their hydraulic capacity. The treatment system is working as designed, with no effluent quality issues recorded. The last inspection report by the Ministry of Environment (generated in September 2012), shows the parameters to be in regulatory compliance, with no changes needed in the wastewater treatment system.

Due to the present good condition of the existing wastewater infrastructure, no improvements are planned in the recent future. Currently, the Town's lagoon system does not accept sewage hauled from sources external to Pilot Butte. However, if the Town starts to accept sewage from neighbouring communities, the extra capacity may be depleted quickly.

4.1.8.3 White City

Water Infrastructure

Water Source

Source water for the Town of White City comes from two groundwater wells owned by SaskWater. The wells draw water from the Zehner Aquifer located northwest of the Town. Currently, only one well is used at any given time to supply water at a flow rate of around 1,309 m^3/d (200 International gallons per minute [igpm]). In the future, both wells can be used at the same time to provide a maximum flow rate of 5,236 m^3/d (800 igpm). The raw water supply line currently has a capacity of 1,898 m^3/d (290 igpm).

Water Treatment

Water for the residents of White City is treated at a typical ground WTP owned and operated by SaskWater. The water is treated using several different processes, including the oxidation of iron, manganese, and other minerals via aeration; followed by sedimentation, filtration, and disinfection.

The annual volume of water produced at the WTP in 2011 was 204,187 m^3, which results in an average day flow of 560 m^3/d. The WTP currently has a rated capacity of approximately 980 m^3/d (150 igpm).

Water Storage and Distribution

Currently, the treated water storage reservoir has a capacity of approximately 1,000 $m^{3;}$ the original storage reservoir in White City was for designed to allow for 2 days' storage at 583 m^3/d. White City owns the water distribution system. The pipes were installed in the 1990s.

Capacity Deficits

The current water demand for White City exceeds the rated capacity of the WTP. An overland connection is currently being used to supply excess water to Emerald Park; however, there are serious capacity issues during the summer, and the current system does not provide for the recommended fire flows.

Planned Upgrades to Water System

To address the capacity deficit, several upgrades have been planned for the raw water supply line and WTP. The raw water supply line capacity is one of the major restrictions limiting growth. SaskWater is currently working on twinning a portion of the raw water pipeline between Emerald Park and the WTP to increase its capacity from 1,898 m^3/d to 2,619 m^3/d (400 igpm) in 2013/2014. In 2016, SaskWater plans to twin the second half of the supply system to increase capacity to 5,236 m^3/d (800 igpm) and to allow both well sites to run at the same time.

In the first phase of expansion, the WTP will be expanded to service a peak day demand of 4,419 m^3/d (675 igpm) by the end of 2014. In the second phase of the expansion, the WTP will be expanded to service a peak day demand of 6,546 m^3/d (1,000 igpm); this will occur when it is required. The water distribution pumps will also need to be upgraded to handle a higher capacity. Regarding treated water storage, White City is planning on expanding the storage reservoir capacity to 2,500 m^3 by 2014. At this time, an additional capacity increase will be required, and an increase of 1,500 m^3 is anticipated. This will increase total capacity to 4,000 m^3.

Wastewater Infrastructure

All residents of White City are connected to the wastewater collection system via gravity sewers. White City's collection system also includes six pumping stations located at various places within the community per the terrain elevations and collection zones. There also is a pumping station that pumps wastewater from Emerald Park to White City's lagoons. Currently, there is a joint wastewater authority that manages the wastewater for both White City and the neighbouring community of Emerald Park. White City upgraded a significant proportion of its gravity pipes as part of improvements done in 2006.

The treatment of the wastewater from White City (and Emerald Park) is in the form of lagoons: an existing primary lagoon, and a secondary lagoon in the southeast of the community. Per the data mentioned in the permit, this system has a capacity of 210 days. The treated effluent is drained periodically and is used for irrigation. The effluent is monitored closely, and there are no known quality issues with the treatment system. The latest available report from Ministry of Environment showed the treatment system to be in compliance with regulations, and no remedial works were recommended or required.

The current treatment system is at capacity, so potential new flows or loads will be a concern. The joint wastewater authority is looking at upgrading the treatment system in three phases. The first phase, which was recently completed in 2012/2013, included construction of a gravity main, lift stations, and forcemains to take wastewater from Emerald Park to the White City treatment lagoons. The second phase would include construction of new storage cells and remediation of the existing lagoons at White City. In the third phase, plans are to construct a mechanical treatment system. However, this would require skilled staff to operate the future treatment plant. It is proposed to discharge the effluent to a creek, which will require the effluent to be treated to a higher standard. This plant expansion is an expensive option and White City are very interested in the outputs from this regional project.

4.1.8.4 Village of Edenwold

Water Infrastructure

SaskWater owns and operates the raw water supply system and the water treatment system for the Village of Edenwold. The Village of Edenwold owns and operates the distribution system.

Water Source

Raw water for the Village of Edenwold is obtained from two ponds located at the southeast corner of the Village, south of Highway 364. The ponds are fed by surface runoff from adjacent agricultural cropland. The ponds have a total storage volume of 61,000 m^3. The current capacity can sustain 2 years of water supply; however, during drought years, water supply issues can arise. A contingency plan for raw water supply during the drought years has not yet been developed by SaskWater.

Two windmills were installed in the first pond in 2007 to help improve water quality through surface aeration. More recently, in fall 2012, an aeration system was installed in the ponds in an effort to improve the source water quality. The intake pipe is located in dugout No. 1. An intake screen is installed to prevent objects and organisms larger than 2.5 mm from entering the pipe.

The raw water is pumped to the pump house using a 5-hp end suction pump, and is transported through a 70-m-long, 50-mm-diameter pipe. The pump house is located on the shore of the dugout and was constructed in 1962. A pressure tank in the pump house maintains the pressure in the raw water line at approximately 60 psi. Potassium permanganate is injected into the intake pipe entering the pump house to oxidize organic matter and manganese and to control T&O and colour.

Water is transported to the WTP through a 1.6-km-long, 50-mm-diameter raw water supply pipe. There is no raw water storage reservoir at the pump house or at the WTP.

Water Treatment

The WTP was constructed in 1982. The treatment processes consist of coagulation, flocculation, sedimentation (with tube settlers), and multi-media filtration for turbidity and pathogen removal. A GAC contactor is used to treat T&O, and chlorination is used for disinfection. The design capacity of the WTP is 262 m^3/d (182 L/min), significantly higher than the average day demand reported in the 2011 Waterworks System Assessment (45.5 m^3/d). The current average day demand reported by the Village of Edenwold is approximately 60 m^3/d.

The tube settlers in the sedimentation tank were replaced in 2005 to prolong the detention time. The existing sedimentation tank has more than enough capacity to provide the adequate retention time for the foreseeable future. Settled water is fed to a 14,500-L transfer chamber and then flows to two dual media filters. The sand/anthracite media was replaced in 2005. The total capacity for the two filters is 262 m^3/d, which is more than enough for the existing and future flow rates. The filtered water is then polished through a GAC filter, which was completely replaced in 2005. The total capacity of the GAC filter is 262 m^3/d, which is more than enough for the existing and future flow rates. The water is then disinfected using sodium hypochlorite. Adequate disinfection is provided to inactivate viruses, Giardia, and Cryptosporidium.

The capacities for the existing treatment processes and chemical feed systems of the Edenwold WTP are summarized in Table 4-13.

Table 4-13
Existing Capacity of the Treatment Processes and Chemical Feed Systems

Component/Process	Description	Capacity	Comments
Flocculation Tank	Two stage flocculation tank. Divided into two chambers during the 2005 upgrades.	6,912 L	Detention time of 125 minutes at the Peak Flow Rate of 55 L/min; adequate
Sedimentation Tank	2.4 x 1.5 m surface area; tube settlers were replaced in 2005.	-	Surface loading rate at Peak Flow Rate of 55 L/min is 0.92 m/h, which is less than the design overflow rate; more than enough capacity for existing and future flows.

Table 4-13
Existing Capacity of the Treatment Processes and Chemical Feed Systems

Component/Process	Description	Capacity	Comments
Transfer Chamber	Transfer chamber between sedimentation and filtration	14,500 L	-
Transfer Chamber Pumps	One duty, one backup pump; 0.75 hp	-	-
Filtration	Two dual media pressure filters; 1,220 mm in diameter. Media was replaced in 2005.	182 L/min (total)	Capacity is sufficient to treat existing and future flows.
Granular Activated Carbon Filter	Completely replaced in 2005. Diameter = 1.83 m; Height = 1.5 m.	182 L/min	Capacity is sufficient to treat existing and future flows.
Chemical Feed Systems			
Potassium Permaganate	Added to raw water supply line. ALLODOS GRUNDFOS	0.52 L/h	-
ClearPac Plus	Added prior to flocculators. ALLODOS GRUNDFOS	2.64 L/h	-
Praestal	Added to second flocculator. ALLODOS GRUNDFOS	2.64 L/h	-
Sodium Hypochlorite	Added prior to reservoir. ALLODOS GRUNDFOS	0.52 L/h	Currently sufficient for disinfection; secondary disinfectant may be required in future to meet more stringent requirements.

Notes:
L – litre(s)
L/min – litres per minute
L/h – litres per hour
m – metre(s)
hp - horsepower

Storage and Distribution

Finished water is delivered to two underground storage reservoirs via a 150-mm-diameter PVC pipe. The main storage reservoir has a capacity of 84.24 m^3 and is located beneath the WTP. The second reservoir has a storage capacity of 37.24 m^3 and is located in another building, adjacent to the WTP. Both storage reservoirs were constructed in 1982. The total storage capacity is 121.5 m^3, which is at the recommended capacity (that is, twice the average day demand) for fire protection. The storage capacity will need to be increased in the future to ensure that it remains sufficient.

The pumping station in the WTP is owned by the Village of Edenwold. It consists of three pumps: one duty (259 m^3/d) and two standby (389 m^3/d each) end suction centrifugal pumps. The total flow capacity of the distribution pumps is 1,037 m^3/d, more than adequate to meet the existing and future flows. The pumps are in good condition, and no major upgrades are expected.

The distribution system was installed in 1968 and is owned by the village; SaskWater is in charge of operating the distribution system. The distribution system consists of 50-mm-diameter asbestos pipe with four watermains leaving the WTP to service the community. The total length of watermain is estimated to be 3,600 m.

Raw and Treated Water Quality

The raw water is known to be high in TDS, hardness, organics, manganese, colour, and turbidity. Algae growth has also been an issue over the years and is a major factor in the high organic carbon concentrations observed.

Treated water quality data was reviewed during preparation of the *2011 Waterworks System Assessment* for 2004 to 2010. Most of the regulated parameters were within the acceptable limits outlined in the federal and provincial treated water guidelines. However, TDS, an aesthetic objective, occasionally exceeded the recommended objective of 500 mg/L outlined in the *Guidelines for Canadian Drinking Water Quality* (Health Canada, 2012). Additionally, approximately one third of the time, manganese levels (sampled after the GAC filter) exceeded the aesthetic objective of 0.05 mg/L. High manganese levels can cause discoloured water, laundry, and plumbing fixtures and can also increase turbidity levels in the distribution system. The turbidity level in the distribution system will occasionally exceed 1 NTU, and a maximum value of 5.52 NTU was reported in 2009. The high turbidity levels can likely be attributed to manganese sediment in the reservoir. To address this issue, the *2011 Waterworks System Assessment* recommended that a study be completed to optimize the removal of manganese during treatment (Pinter, 2011).

In 2011, THM levels in the treated water exceeded the federal and provincial limit of 100 µg/L due to high run-off and deteriorating water quality. In the past, the replacement of the GAC media served to rectify this situation; however, it now appears that carbon replacement alone is not sufficient to lower THM levels. SaskWater is currently investigating improvements to the WTP processes. In fall 2012, an aeration system was installed at the dugout in an effort to improve the source water, and SaskWater will be monitoring the effectiveness of this system before deciding if further measures are necessary.

Capacity Deficits

The following capacity deficits/issues were reported in the *2011 Waterworks System Assessment* prepared by Pinter & Associates Ltd (Pinter, 2011):

- **Raw Water Supply:** In the past, the raw water supply has run dry during drought years. An alternative water supply needs to be identified for the Village of Edenwold.
- **Water Quality:** The existing treated water can occasionally contain elevated levels of manganese and THMs. THM levels have exceeded the provincial/federal regulations, on occasion.
- **Disinfection:** In the future, the WTP may require an additional secondary disinfection process to meet more stringent disinfection requirements.
- **Distribution System:** The Village residents would like more pressure for their appliances; however, SaskWater keeps the pressure low to prevent bursting as the lines are old.

Planned Improvements

No planned improvements have been mentioned. The Village is still in the process of developing the OCP. Water and wastewater improvement will be included in the plan.

Wastewater Infrastructure

The Village of Edenwold is a community located 18 km from its closest neighbor, the Town of Balgonie. Its collection infrastructure dates back to the 1960s, and is composed of gravity pipes, a pumping station, and forcemains that convey wastewater to the community's lagoon system. It is understood that the lagoon system is operated by SaskWater. The aging gravity sewer collection system is being replaced or upgraded one street or alley at a time. Electrical upgrades are also in progress for the existing pumping stations.

The treatment system serving the community is in the form of a lagoon system. The treatment system, similar to the collection system, is dated and there are instances of near-term maintenance required. Also, there are indications of the lagoon berm starting to sag with possible seepage. Repairs to the lagoon berm are planned, and the valve arrangement at the lagoon is being replaced. The treated effluent is being discharged to a neighbouring marsh. The Ministry of Environment inspection report (dated July 2012) showed that the lagoon is in compliance, but that remedial works are required as noted previously.

At present, this treatment system is on par with its capacity. Because this situation is restricting growth in the community, an immediate remedy is required to alleviate this issue.

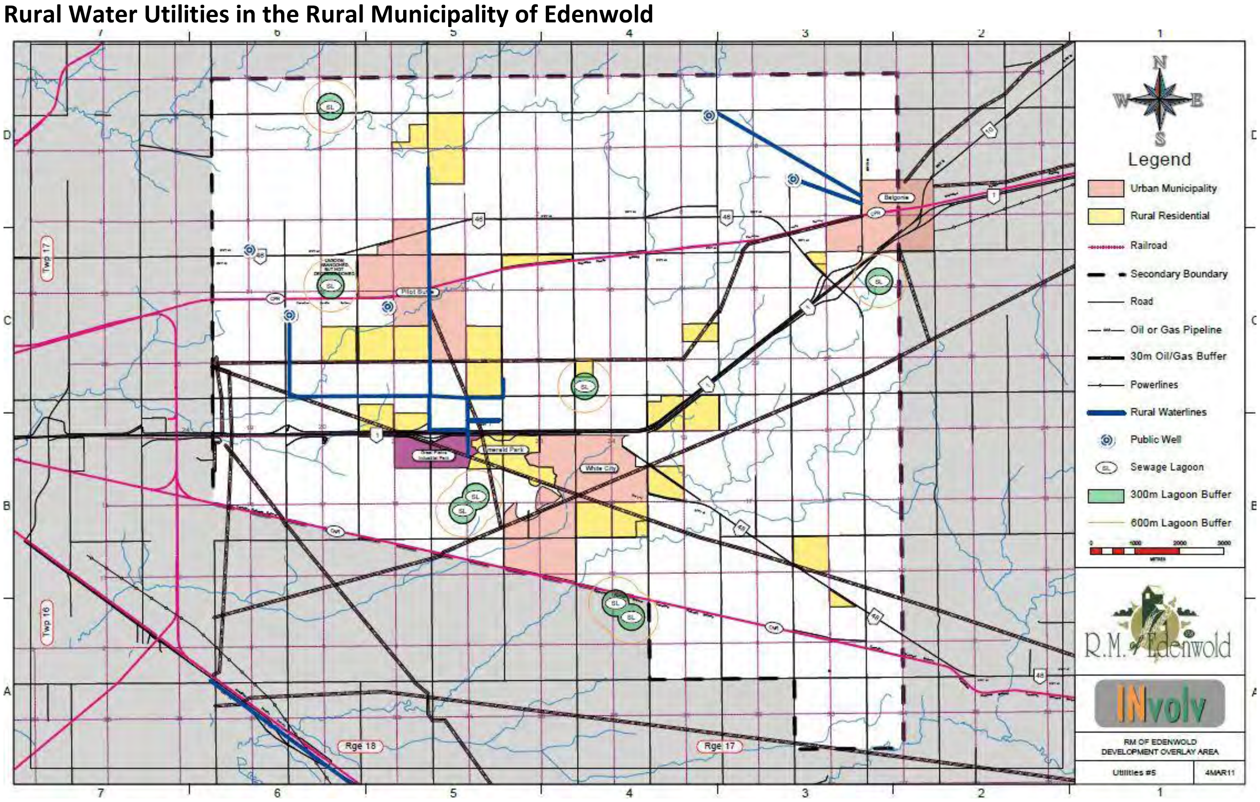
4.1.8.5 Rural Municipality of Edenwold

Water Servicing

Rural residential, commercial, and industrial residents of the RM of Edenwold are serviced by the rural water lines and public wells shown in Figure 4-1. Five public wells exist in the secondary boundary.

No additional information was provided on the water system for the RM.

Figure 4-1
Rural Water Utilities in the Rural Municipality of Edenwold



Wastewater Servicing

Limited information was available from the RM of Edenwold at the early stage of the study, due to the appointment of a new City Administrator. Part of the RM has individual systems in the form of basic treatment coupled with either irrigation or septage tanks.

The community of Emerald Park, which currently constitutes a large part of the RM of Edenwold's population, has formed a joint wastewater authority, the WCRM158 Wastewater Management Authority Inc., with White City to manage its wastewater. Please refer to Section 4.1.8.3 for details.

However, other communities in the RM (such as Clear Vistas) are part of the master plan and will be constructed in the near future, thus causing wastewater conveyance and treatment demands to increase. A more substantial solution will be required than that which is currently available.

4.1.9 Others

4.1.9.1 Sakimay First Nation Lands

The Sakimay First Nation Lands are currently unpopulated and undeveloped. A serviceability plan was outlined for the west lands in the *Sakimay First Nation Lands Concept Plan* (Stantec, 2011).

The proposed water system would branch off of the existing 600-mm watermain which runs along the south side of Dewdney Avenue to the GTH. Three connections would be provided to accommodate looping of the major system: two connections would tap into the existing 600-mm water line, and a third connection would tap into a future line to the west of the GTH to reinforce the system.

The future water demand for the west Sakimay Lands was estimated using a per capita consumption of 225 litres per day (L/d) and an equivalent residential population of 25 persons per hectare for Dry Industrial Use. This results in a water demand of 0.585 ML/d for the area of 104 hectares.

The serviceability plan also discussed the possibility of connecting the lands and development to the sewer network of the GTH. The GTH wastewater is currently collected and pumped to Regina's WWTP.

The lands to the east and southeast could also be connected to existing sewer networks that transfer wastewater to Regina's WWTP in theory. Currently, we are aware that these networks are in the early stages of conceptual design.

In relation to the lands to the east, the development company is about to approach the City of Regina to discuss service arrangements, and they are also in discussions with Pilot Butte. Currently, there is a study in progress with MXD Development Strategists Ltd. which is exploring all the options available; this study should be available in July 2014.

4.1.9.2 SaskWater

The following information was provided by SaskWater to the CH2M HILL team on May 14, 2013.

SaskWater provides water to the following communities in the study area:

1. Village of Grand Coulee

   The Village of Grand Coulee receives potable water service via a pipeline connected to the City of Regina transmission pipeline, which runs from BPWTP to the City of Regina.

2. Town of White City

   The Town of White City receives potable water from a conventional ground WTP owned by SaskWater within the municipality. Source water is ground water provided from the SaskWater wells out of the Zhener Aquifer, northwest of the Town.

3. Village of Edenwold

   The Village of Edenwold receives potable water from a conventional ground WTP owned by SaskWater within the municipality. Source water is a dugout east of the Village. (Added by CH2M HILL; it is understood that SaskWater also operates the Village of Edenwold's wastewater lagoons.)

4. Village of Disley

   The Village of Disley receives water from the Saskwater Potable Water Supply System - North. Water is purchased by SaskWater from the BPWTP, and a SaskWater pipeline provides water north of Buffalo Pound Lake to the Disley/Bethune area. (Note: Disley was out of scope for this study.)

There are no SaskWater-owned wastewater facilities within the study area.

SaskWater provides potable and non-water potable water service to the following customers in the Belle Plaine corridor: Mosaic-Belle Plaine, Yara, Terra Grain, and Canada Salt. The potable water is purchased from the BPWTP and supplied via SaskWater pipeline to Tara and Canada Salt. SaskWater owns and operates the intake, pump station, and pipelines that provide non-potable water to Mosaic, Yara, and Terra Grain. A map showing SaskWater's non-potable pipelines, potable pipelines, and pump stations (as well as the main City of Regina transmissions line) is provided in Figure 4-2, Figure 4-3, and Figure 4-4.

Regarding planned upgrades and new infrastructure within the study area, the following is noted:

i) SaskWater has planned upgrades for the Town of White City. These include a new pipeline from the source water supply to the WTP, reservoir expansion, and upgrades to the WTP.

ii) SaskWater is also in the conceptual design stage of a regional non-potable water supply in the Belle Plaine corridor.

Figure 4-2
SaskWater Non-Potable Water Supply Lines in the Buffalo Pound Area

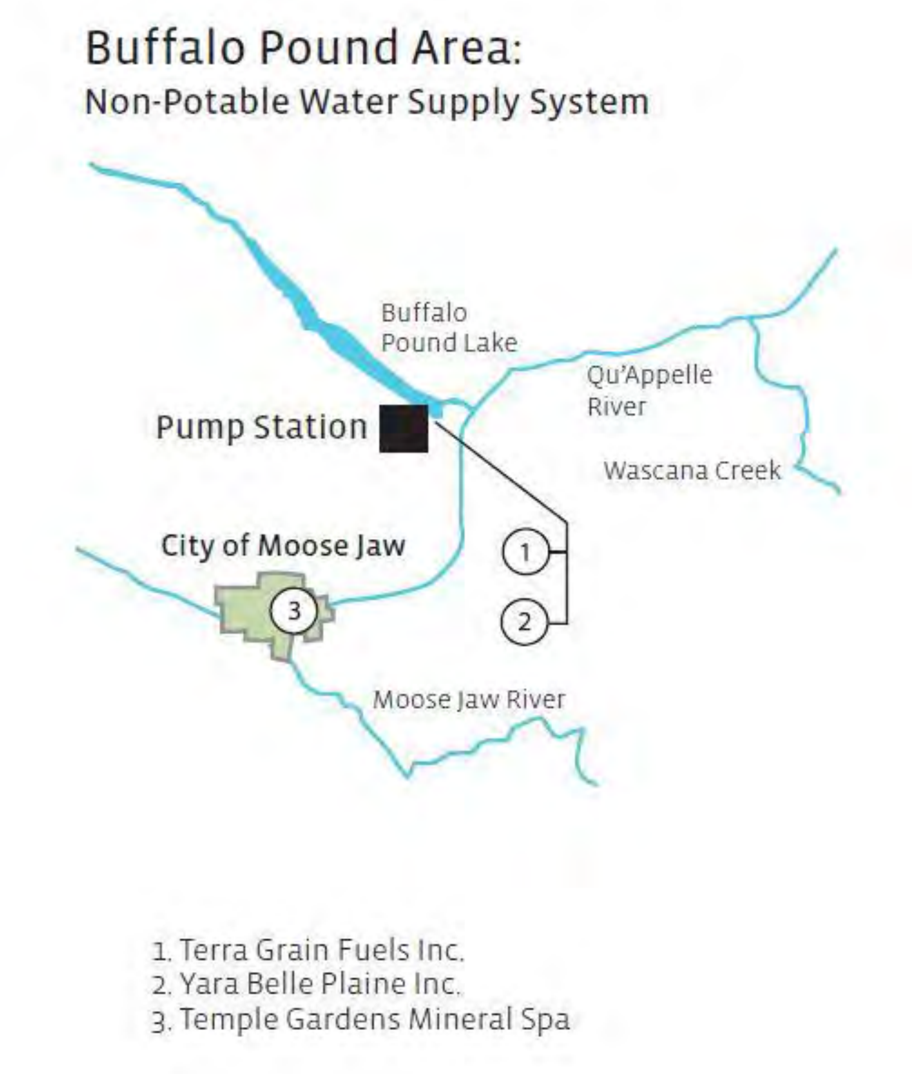


Figure 4-3
SaskWater Water Supply Lines in the Buffalo Pound Area

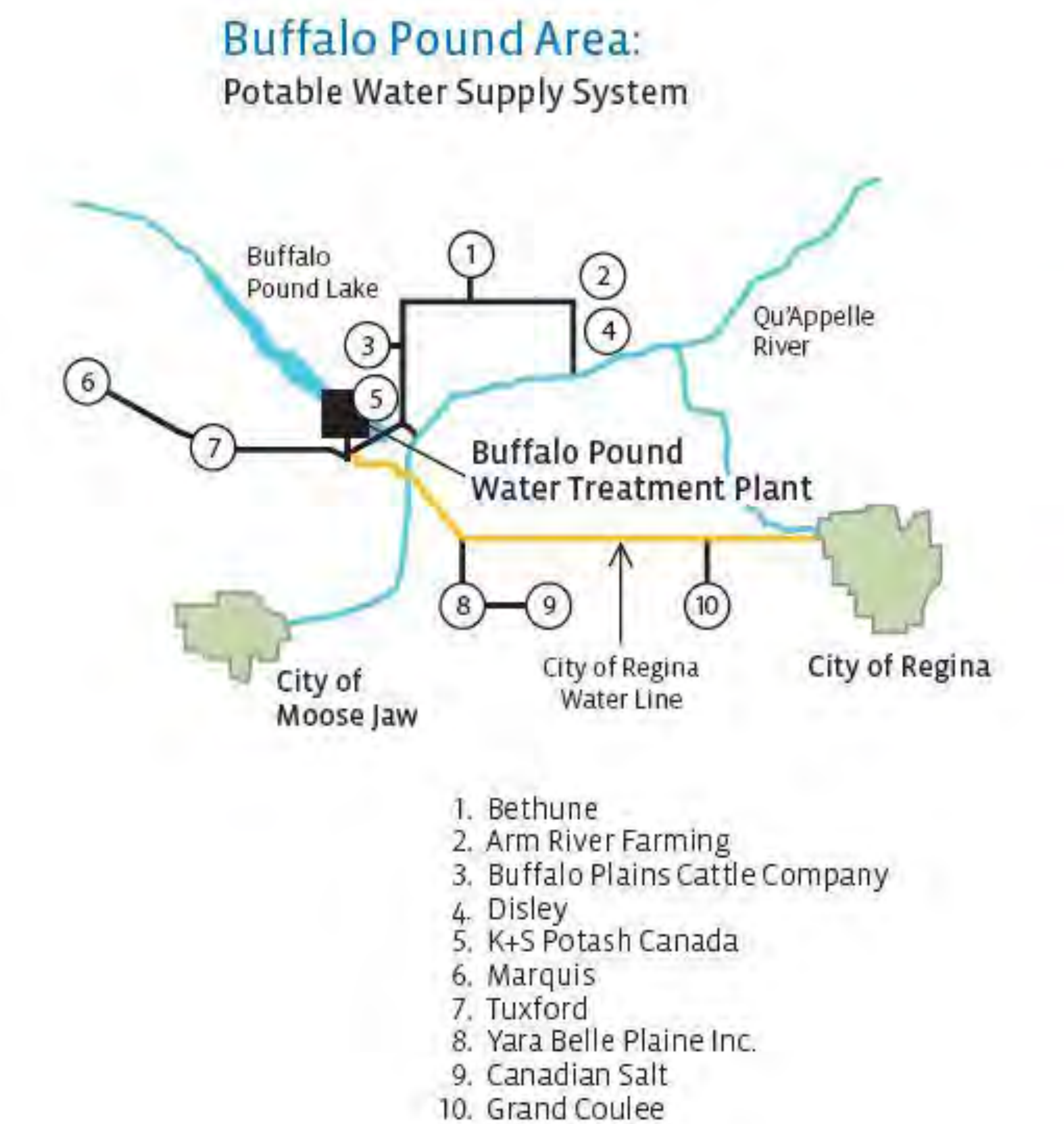
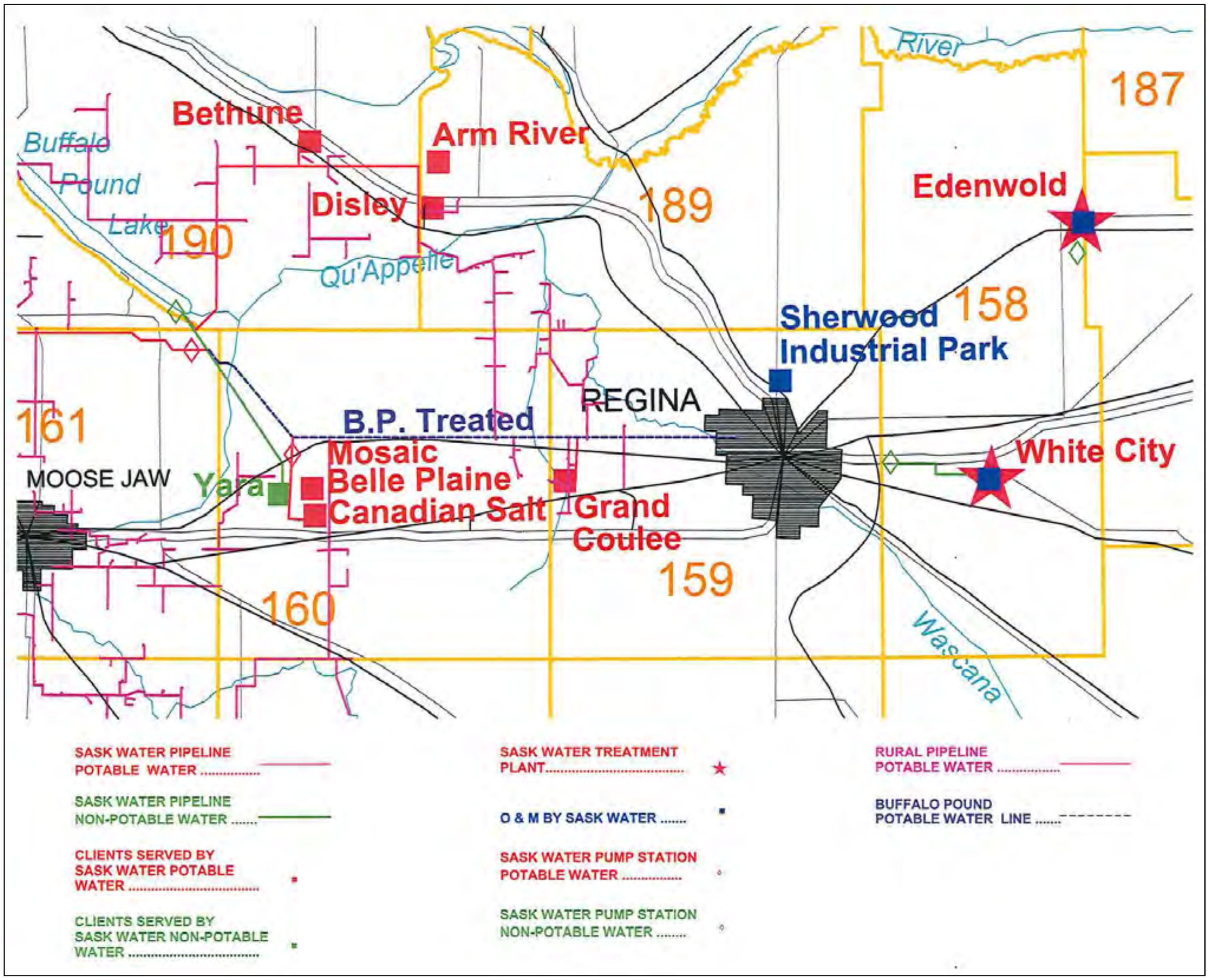


Figure 4-4
Overview of SaskWater's Infrastructure in the Regina Census Metropolitan Area
Map showing SaskWater's non-potable pipelines, potable pipelines, and pump stations, as well as the main City of Regina transmissions line. The PDF original is available from the project team with layers added for easy viewing.



4.2 Current Servicing Challenges in the Region

All challenges raised in this section were indicated by the stakeholders themselves through the various engagement points in the study. In terms of current servicing challenges in the region for the present day and immediate future, wastewater for the region is a significant servicing challenge. The water supply is adequate for most stakeholders; although some are facing challenges (namely the RM of Pense), they are working towards plans to resolve these challenges themselves. For many stakeholders, wastewater servicing is currently a servicing challenge, as lagoons are at or about to reach hydaulic capacity. These servicing challenges are further compounded by high growth rates for many communities, accelerating the pressure the wastewater systems face.

4.2.1 Regional Servicing Issues

4.2.1.1 West Region Wastewater

Currently as indicated by the stakeholders, this is an issue for Pense due to drainage issues, and a growth affecting issue for Grand Coulee in the near future. Options for wastewater solutions need to be identified and evaluated, and they could include the following: Belle Plaine has additional lagoon capacity; and the City of Regina, along with the GTH, are potentially viable regional servicing options.

4.2.1.2 North Region Wastewater

Currently as indicated by the stakeholders, this is a significant issue for Lumsden, with short-term environmental risks resulting in reduced or halted growth. Concept and predesign work is already underway for a local WWTP. Challenges are potentially equally significant for communities around Last Mountain Lake. The RM of Lumsden and Craven are in satisfactory positions for wastewater into the short term.

4.2.1.3 East Region Wastewater

While Pilot Butte and Balgonie feel they are comfortable in the immediate short term regarding wastewater servicing, other municipalities are facing challenges. The City of Regina, moving into the medium term, will require additional wastewater capacity in the East to meet growth plans. The White City and Emerald Park communities indicated they are pressed for time to design a solution to meet their immediate local wastewater servicing challenges. These factors mean that there is a real opportunity for a larger regional wastewater solution in the East that could service the East Region into the future.

4.2.1.4 Other Regional Issues

Planning and Design

Municipalities indicated they are finding it challenging to plan for and design infrastructure with limited statistical information and unguaranteed population forecasts. These challenges and a partial solution include the following:

- "Gambling on growth data" is a concern for stakeholders who are faced with major infrastructure investment decisions based on projected growth data which, for some, could be based on uncertain assumptions.
- Municipalities are unsure of how far into the future design specification should be taken; the risks of miscalculating are high and can result in costly unused infrastructure.
- A Regional Plan would help to mitigate investment risks and would provide necessary information for municipalities' use in local planning.

Resourcing Skilled Staff

Levels of operational resourcing are sufficient in the near term; however, as the workforce retires in the coming years and more staff are required for an increased asset base, with new technical skills and certifications required, municipalities are nervous about resourcing in the short to medium term. This is a concern for both water and wastewater.

- Succession planning is challenging: local knowledge is being lost as the aging workforce is retiring; knowledge and document management is lacking; and junior staff are difficult to attract and retain.
- Level-2 to Level-3 operators are required: as municipalities are moving towards owning and operating mechanical treatment facilities (particularly wastewater in the short term), they require operators with specific training and experience. Such operators are hard to find, recruit, and retain.
- Training costs are challenging: it can be expensive to bring people up to the required service level.
- Operational backup can be an issue: during staff holidays, sickness, and operationally challenging periods, some municipalities can find resourcing a challenge due to a lack of backup staff.
- Engineering / Project Management: it can be challenging for small municipalities to afford and manage the design and delivery of capital projects with external consultants.

Growth

Projected growth in Southern Saskatchewan is at an all-time high. Many municipalities surrounding Regina are working towards attracting people to their communities and growing; however, with growth comes a number of related challenges:

- Land developers are buying plots in communities and taking responsibility for setting up services to the plots (including water, sewer, gas, electricity); unfortunately, some developers are doing this cheaply and quickly with minimal quality control. As a result, a number of plots potentially have poor utilities services.
- Some municipalities have been resisting growth applications as a result of their concerns about servicing issues and other challenges; however, these stakeholders are also being pressured to simultaneously maintain growth in developing areas.
- Policies on development are defined by each municipality. When residents or developers feel that they are not receiving their expected services, they can launch appeals against the municipalities to have decisions overturned. Such appeals can be time consuming and expensive for the municipalities.

Funding and Budgeting

Money is a challenging topic for all organizations dealing with infrastructure, and the municipalities in the Study Area are feeling related challenges:

- Many of the municipalities require Provincial or Federal funding to invest in large capital projects. Such funding tends to favour regionally collaborative solutions to benefit larger audiences.
- Many municipalities are finding it challenging to understand the true cost of growth, infrastructure, and operations; as a result, they are finding it difficult to balance costs.
- Many municipalities are struggling to balance expenditure and utility rates revenue; work should be done to better understand this position across the region.

City of Regina Municipal Water Surcharge

Currently, water users outside the City of Regina limits are charged a 75 percent surcharge in addition to the standard water rates paid by properties within the City limits. This surcharge framework is currently under review by the City.

Regulation and Legislation

A very important part of managing utilities operations is working cooperatively with the regulatory bodies. For municipalities, it can be challenging to satisfy all of the regulatory requirements; however, satisfying these requirement is very necessary, for the benefit of the entire region in both short and long terms.

- Some stakeholders felt that regulations were a "moving target" (which results in these stakeholders having to over-spec designs in an effort to protect themselves from variations in regulations).
- Some municipalities are approaching their water allocation limits, and/or are unsure of the additional capacity available in the raw water supply to support growth. The Water Security Agency is scheduled to conduct a review of water allocations in 2020.
- Land Spreading Regulations for farms in particular, spreading liquid organic waste over soil is part of standard operations; however, the RMs are finding this practice somewhat challenging to manage. SaskEnvironment informed the study that a Code dealing with this issue is in progress.
- Utilities in Canada have to meet both Federal and Provincial requirements to maintain operating licenses for both water and wastewater. The Federal regulations are high level and apply across Canada, while Provincial regulations apply only within the province and are more specific. In Saskatchewan, the

Provincial regulations are imposed by the Water Security Agency, and this group also imposes the Federal regulations. As the Federal regulations are a higher level, the Provincial regulations align with them; however, they go into more detail and specifics about how the Utilities need to operate within the Province. The strictness of Provincial regulations varies across Canada.

Water

Generally, the region as a whole has adequate water supply and infrastructure for the short term. To deal with long term growth, more investment and regional planning will be required, particularly around water allocation, aquifer abstraction, and sustainability.

4.2.2 Local Servicing Issues

4.2.2.1 City of Regina

As agreed with the City of Regina, generally speaking in the short term, the water system is robust and able to meet the City's demands with minimal servicing issues. The wastewater system is currently struggling to meet demands; however, the planned WWTP upgrade will alleviate servicing issues into the medium and long term.

- City of Regina, East – Water will become more challenging as the East sectors develop, but this can be addressed with the addition of a third pressure zone in the network. Wastewater service in these sectors presents challenges for the City in the short to medium term, and solutions need to be identified and evaluated. In particular, significant industrial development is planned for the Northeast, and more residential development is planned for the Southeast, both of which will require water and wastewater upgrades.
- City of Regina, West – Wastewater treatment infrastructure is aging; however, the major upgrading of the existing WWTP in the West will resolve these wastewater issues. Currently, there are no servicing issues in the West regarding the water supply, following the recent addition of a second pressure zone in the North. However, further development in the Southwest could result in low pressures in the East sector of the City; thus, an eastern pressure zone (that is, a third pressure zone) will be required in the future.
- City of Regina, Downtown – Water and wastewater challenges exist in the downtown core in terms of transfer capacities, due to policies of densification in the downtown areas.

4.2.2.2 West Local Servicing Issues

Grand Coulee

As indicated by Grand Coulee, Wastewater is becoming a challenge, as the lagoons are approaching capacity and new lots under construction will risk taking the service to the point of exceeding capacity. Lagoons are in a location that is significantly restricting land use and growth, making the need for an updated wastewater plan more urgent should the community wish to pursue further growth. Stantec has been hired to assess capacity and develop potential local solutions. No current servicing issues were identified with the water supply.

Rural Municipality of Pense

Wastewater is managed by individuals and Public Health, which helps individuals to get septage tanks and organizes septage haulers. As explained by the RM of Pense, Water is a concern for the Hamlet of Stony Beach within the RM; Stony Beach is currently experiencing problems with line balancing, but discussions are underway with Alpine Plant Foods Corp. to take supply from its line which would also provide room for growth. Water supply for Keystown is not a concern in the short term. No additional development is permitted in the hamlets due to water servicing capacity.

Pense

As indicated by the Town of Pense, Wastewater is an issue for the Town. The lagoons are reported to have operational drainage issues, the nature of which was not understood within this study, and early investigation by the community and their engineer has been unable to find a solution. Hydraulic capacity is becoming an issue as a result, and wastewater is currently being pumped between cells to extend space. Drainage is also an issue for the community due to the relatively flat land area. The water supply is satisfactory, as the community has spare supply and several days storage for the short term requirements of the community; however, five service connections which branch off the supply line to farms have been found to have low pressure.

Belle Plaine

As explained by Belle Plaine, they have no servicing issues with the wastewater system, since they are currently using one of the recently constructed two lagoons. Likewise, there are no current servicing issues with the water supply in the short term. Drainage, however, is an issue for this community.

4.2.2.3 North Local Servicing Issues

Lumsden and the Rural Municipality of Lumsden

As explained by the Town of Lumsden, Wastewater is a significant issue for the Town. The lagoons are overloaded hydraulically, and a solution is required immediately.

- A concept study and preliminary design for the WWTP are completed; however, creating a link to the City of Regina was ruled out due to operational charges.
- The new planned WWTP requires a Level-3 Operator, of which there are less than 25 across Saskatchewan. Lumsden is concerned about recruiting and retainaing a Level-3 operator. However, there will be four lower level operators at Lumsden shortly, including junior staff, which will aid the community in its succession planning and resource challenges.
- Wastewater within the RM of Lumsden is managed privately by individual septic systems which are pumped out when required. The pumping discharge is typically transported to a facility at Regina Beach.
- No current servicing issues were identified with the water supply: the RM supplies water to other communities, and a limited spare supply is available within the short term.

Craven

As explained by the Village of Craven, they have operational challenges, mainly concerning their aging pipe networks resulting in main breaks and a lack of related documentation. No current servicing issues were identified with the water system, although the wells are at the end of their life cycles and need to be refurbished. No current servicing issues were identified with the wastewater system: lift stations are being upgraded, and the lagoons have spare capacity both in the short term and long term. If the community decided to grow, additional land next to the current lagoons could be acquired.

4.2.2.4 East Local Servicing Issues

As explained by several communities in the East, wastewater hydraulic capacity is an becoming an issue and this also limits solution options as over winter months the frozen creeks mean they are required to store treated effluent until the spring.

White City and Emerald Park (Rural Municipality of Edenwold)

As explained by these communities; water problems are major at the moment, but they are being dealt with immediately through support from SaskWater. These communities also highlighted wastewater challenges are significant, and options need to be identified and evaluated as a priority.

- Wastewater – As explained by the WCRM158 Wastewater Management Authority representing these communities, there is an urgent need to make a decision in 2014 on a wastewater treatment solution in order to meet development and growth schedules. The area has numerous environmental challenges concerning discharges to the lake and/or management of biosolids. Regarding design, the communities are unsure of the treatment process to use, the scale of design, and in the components of the scope of work. Resourcing skilled staff raises challenges both in training and in ensuring backup for the complex operation of a treatment plant.
- Water – Treatment services have been sold to SaskWater, and White City owns the distribution services. The current water demand exceeds the rated capacity of the treated supply, and additional water is being pumped overland from Emerald Park. Immediate work is underway to increase the raw water supply, and further work will be done to upgrade the WTP and distribution network.

Rural Municipality of Edenwold

Limited information was available from the RM of Edenwold however it was understood that Emerald Park (within the RM) is having wastewater and water supply challenges. However, they are working with White City to resolve these challenges, these action outlined above. The Clear Vistas master planned community is due to be built in the coming years, and it will require significant servicing. Servicing solutions are still being developed.

Village of Edenwold

This small community is situated a relatively long distance (19 km) from its nearest neighbour, the Town of Balgonie. As explained by the Village of Edenwold, they facing challenges on both sides: water supply and wastewater treatment are both operating at capacity. There is a physical constraint on land use which is halting development and infrastructure improvement.

Balgonie

As explained by the Town of Balgonie, wastewater for the Town is currently satisfactory for the short term, with some weather- and time-of-year-dependent capacity in the lagoons. During severe weather, the community may have to discharge to Wascana Creek: for example, this was done during the 2011 floods. However, more wastewater hydraulic capacity is required to support growth; For instance, there is an old lagoon that could be refurbished. Water was a significant issue for this community after discovering selenium in the wells. Wells are in the process of being sealed, and a pipeline was constructed in 2013 to allow water to be purchased from Pilot Butte, which has resolved the current water servicing issues.

Pilot Butte

As indicated by Pilot Butte, pesponding to service requests from neighbouring Balgonie has increased the investment required from Pilot Butte and will result in an accelerated use of their additional capacity and water allocation. In the short term, the community has marginal additional capacity over and above what it requires for water. The community is in a satisfactory position for wastewater in the short term but in the near future will need to assess servicing options as their lagoons start to reach their hydraulic capacity.

4.2.2.5 Sakimay First Nation

All three land pockets in the study area require water and wastewater servicing; however, it is not immediately obvious how best to service them. More work needs done to identify and evaluate different options.

4.2.3 Other Issues and Points Raised

- Stakeholders agree that this study is valuable, but the timing is challenging for a number of stakeholders who need to make decisions as soon as possible to address some of their current service issues. Postponing decisions for the outcome of this study and delaying investment may create further difficulties for these stakeholders.

- It was noted that regional collaboration efforts can be led by any party; in the case of this study, the City of Regina intended to kick-start the effort and to help in building momentum throughout the life of this effort.
- "Who benefits from growth?" The increased population and infrastructure spending means increased provincial sales tax (PST) revenues for the Province. As a result, it may be worthwhile to ask whether the Province might be able to help in funding some of the infrastructure investments.
- Costly infrastructure investment decisions can be challenged or questioned by other stakeholders.
- Cost / Benefit sharing agreements will need to be discussed in detail with any regional collaboration activity and partnership.
- The scope of the study had to limit the study area. Moose Jaw and other communities were not included at this stage in order to contain the deliverables and to ensure progress in the short term was made. Once further progress is made, the scope of the initiatives can be expanded.
- The RM of Sherwood is a significant stakeholder in the study area; however they were unable to participate in the study within the short term.
- Further north of Lumsden is Last Mountain Lake, which has a number of cabin communities surrounding the lake. These communities exist under a variety of RMs which are not covered in the study area (for example, the RM of McKillop). Accordingly, the state of the water and wastewater supply in this area is not understood; however, with rapid growth, these communities could also be facing servicing challenges.
- Storm water drainage challenges are faced by almost all municipalities in the study area however these issues are out of the scope of the study.

4.2.4 Other Points Considered

4.2.4.1 Emergency Planning

Other regions embarking on Regional Collaboration have supported each other in Emergency Planning, including discussions on sharing emergency resource and staff. The majority of stakeholders felt that their plans were satisfactory and that further collaboration work was not required at this stage.

4.2.4.2 Sustainability

Many stakeholders were concerned about the long-term sustainability of the Region's use of resources:

- Water – aquifer activity is currently based on a 100-year historical trend (which does not account for global warming); source water protection is in place for both ground and surface water; and the next review of water allocations is due in 2020.
- Wastewater – as communities grow and the population increases, dealing with high volume discharges will be challenging for the region and the environment.
- Landfill – depending on wastewater treatment technology, the waste to landfill will increase; and as population also increases, the available capacity in regional landfill facilities declines rapidly.
- Environment – sustainability is a concern, particularly in relation to the impact from wastewater and landfill activities.

4.2.5 Study Priorities Based on Servicing Challenges

Towards the end of the first part of the study, it was obvious that wastewater was a significant issue for many stakeholders in the region and that it was a far more pressing issue than water. Given the nature of the wastewater challenges faced by the communities, namely hydraulic capacity, it was most appropriate to investigate permanent solutions as a priority and to look for interim options as opposed to investing time on short-term or quick-win options.

SECTION 5

Wastewater Servicing Options

Wastewater servicing is a challenge for most stakeholders across the region, as many local lagoons are at or about to reach hydraulic capacity. For communities in the East particularly, hydraulic capacity is a particular issue over winter months as frozen creeks mean they are required to store treated effluent over winter months.

Some stakeholders in the North and East regions are facing particularly time-pressing wastewater servicing challenges and are seeking to agree upon solutions to progress in 2014, and to be fully operational within the coming years. Grand Coulee also indicated they need to move forward with a solution in the short term if they are to support growth.

There are real opportunities for three regional wastewater solutions in the area:

i) North Wastewater Regional Pipeline – from the Town of Lumsden to the City of Regina's existing WWTP.

ii) East Wastewater Regional Pipeline – from Balgonie, Pilot Butte, White City, Emerald Park, other nearby RM of Edenwold communities and Sakimay land, to the east side of the City of Regina. Upgrading of City of Regina conveyance would be required (further investigation necessary) to transport the wastewater to the existing facility in the north west of the City; alternatively or in the future, an East Regional WWTP could be constructed.

iii) West Wastewater Connection from Grand Coulee to the GTH – enabling a connection from Grand Coulee to the City of Regina's existing West WWTP through the GTH. Upgrades to the City of Regina's Pump Station in the GTH would likely be required.

Biosolids management was briefly considered within the evaluation sections of this report; however, more work should be done to assess viable options for biosolids disposal, as this is typically overlooked in WWTPs. The East Regional WWTP that was costed in this report includes a biosolids management facility.

All opportunities are time sensitive due to the nature of the challenge and the pending growth in the related communities. In order to buy time for the regional solutions, various interim options were identified to create minor additional capacity in the systems that may be appropriate for the affected stakeholders.

5.1 West Wastewater Servicing Options

In the West, wastewater servicing is currently a significant short-term issue for Pense, and a growth challenging issue for Grand Coulee. Grand Coulee is also constrained by the placement of its lagoon and the lagoon's proximity to development. Wastewater within the RM of Pense is managed privately by individual septic systems which are pumped out when required. Belle Plaine has additional lagoon capacity, and the City of Regina has recently built service lines to the West for the GTH.

At the outset of the study, growth rates for the communities in the West were still under review; however, it was thought that some communities (primarily Belle Plaine) may strive for high growth in conjunction with major industrial developments. With this is mind, a regional servicing solution might have been feasible. Various options were investigated, including the following:

- Local Options: local lagoon upgrades, and local WWTPs
- Regional Wastewater Pairing Pipelines: pair Pense with Belle Plaine to utilize available capacity, and Grand Coulee with City of Regina/GTH for wastewater servicing
- Regional Wastewater Pipeline: from Pense, Grand Coulee, and Belle Plaine to City of Regina's West WWTP

As the study progressed and the stakeholders better defined their growth aspirations, the most suitable solution(s) for the stakeholders also became clearer. While the communities in the West have high growth rates, the growth will last a definitive numbers of years until the population hits an approximate limit. As a result of these population caps and the existing relatively small population bodies, a regional wastewater pipeline to service these regional communities in the West with a connection to the City of Regina quickly becomes unaffordable.

Although a complete regional solution appears financially unaffordable, the proximity of Grand Coulee to the GTH makes a direct connection between Grand Coulee and the GTH a possible opportunity for collaboration. Capacity upgrades would likely be required to the pump station in the GTH in addition to the short pipeline and pumping required.

5.1.1 Assumptions and Risks

5.1.1.1 Population Assumptions

- Population assumptions varied over the course of the study, and the best available information was used at the time. Please refer to specific engineering options to understand which population numbers were used.
- Sakimay First Nation Reserve Land is undeveloped, and it is unknown how quickly a population will be established on the land within the coming 30 years. Consequently, population estimates for Sakimay have not been included in the calculations for regional populations.
- The GTH should be reviewed in terms of infrastructure requirements, and the equivalent population or design flow required should be incorporated into the analysis in the future. Commercial/Industrial demand should also be included.
- Requirements from agricultural, potash, and other industrial users across the area have not been included in the wastewater flow projections.

5.1.2 Demand Projections and Service Challenges

The adjusted population caps for the West communities were only formalized after the West Regional Wastewater Pipeline went through engineering conceptual design and cost estimates. This drastically changes the servicing challenges the West region is facing in general, and highlights servicing pressure at Grand Coulee in particular.

Per the Population Projections in Section 3, Figure 5-1 shows the cumulative population projections for the existing communities to the west of Regina from 2011 to 2040, assuming the high growth scenario in all communities. Currently, the cumulative population is approximately 1,700 residents. In 2040, the cumulative population is projected to be approximately 2,750 residents. This results in an AAGR of approximately 1.8 percent in the West. Relative to the East, growth in the West is anticipated to be slow over the next 25 years, with the majority of the growth occurring in Grand Coulee.

Figure 5-1
West Region - Cumulative Population Projections from 2011 to 2040, assuming High Growth Scenarios

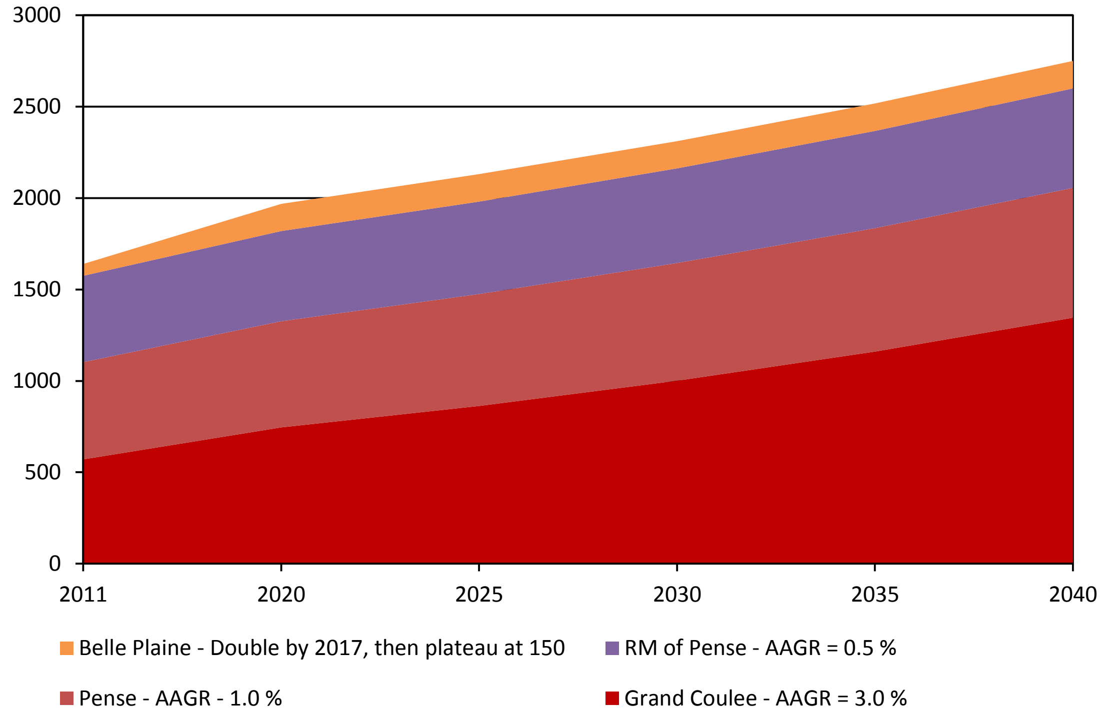


Table 5-1
West Region - Cumulative Population Projections from 2013 to 2040 (data), assuming high growth scenarios

Town/Municipality	AAGR (%)	2011	2020	2025	2030	2035	2040
Grand Coulee	**3.0 %**	571	745	864	1001	1161	1346
Pense	**1.0 %**	532	582	612	643	675	710
RM of Pense	**0.5 %**	471	493	505	518	531	544
Belle Plaine	**4.3 %**	66	150	150	150	150	150
Total		1640	1969	2130	2312	2517	2750

Notes:
RM – Rural Municipality
AAGR – Average Annual Growth Rate

5.1.3 Servicing Options

During the early stages of the study, after collecting information on the stakeholders' current infrastructure and servicing challenges, the following options were identified as potential solutions to the understood challenges:

- Local Lagoon Expansion and/or Upgrades at Pense and Grand Coulee with no improvements at Belle Plaine, the RM of Pense, or the City of Regina
- Local Wastewater Treatment addition at Pense and Grand Coulee with no improvements at Belle Plaine, the RM of Pense, or the City of Regina

- Regional Wastewater Pairing Pipeline connecting Pense with Belle Plaine to utilize existing spare capacity, and connecting Grand Coulee with City of Regina/GTH for wastewater servicing
- Regional Wastewater Pipeline from Pense and Grand Coulee to City of Regina's West WWTP; local lagoons at Belle Plaine remain unchanged
- Regional Wastewater Pipeline from Belle Plaine, Pense, and Grand Coulee to City of Regina's West WWTP

Any required upgrades to the City of Regina's existing West WWTP were not included in the evaluation.

5.1.4 Strengths, Weaknesses, Opportunities, and Threats Analysis

Table 5-2 through Table 5-6 document the SWOT Analysis completed with the stakeholders from the region at the October Working Session, held on October 30, 2013, at the George Bothwell Library in Regina.

A SWOT Analysis is a structured way of evaluating options, capturing Strengths, Weaknesses, Opportunities and Threats. During the working sessions, the stakeholders were facilitated through the analysis by CH2M HILL team members, with the SWOT titles used as prompts to gather feedback from the stakeholders on the options. The bullet points captured in Table 5-2 through Table 5-6 are not an exhaustive list of all points associated with each of the options; instead, they list the significant points that were at the forefront of stakeholders' minds.

Table 5-2
West SWOT Analysis – Local Lagoon Upgrades at Pense and Grand Coulee

Strengths: • Lower capital cost than WWTP (Mech/Bio) • Lower requirement for operator training and certification • Very low operational and maintenance costs for lagoon • No additional staff requirements • Minimal construction disruption • Provides required capacity to Pense and Grand Coulee faster to accommodate pending growth • No new conveyance system required • Fewer requirements for sludge handling / disposal than WWTP (Mech/Bio) (only once every 10-15 years)	**Weaknesses**: • Treatment is limited (minimum standards for secondary treatment only) • Potential for odours • Additional land maybe required • Limited flexibility for future expansion and growth (limited by area, buffer zone required) • Represents the status quo, not a regional effort
Opportunities: • Potential upgrade to advanced lagoon process to improve effluent quality • Option for local reuse/irrigation • Could relocate Grand Coulee lagoon to ease land buffer restrictions, but would require conveyance upgrades and decommissions costs	**Threats**: • Minimal level of treatment impacts quality of local water courses • Contamination of surface or ground water • Treatment may not meet future regulatory requirements • Growth could change effluent discharge quality

Notes:
WWTP – wastewater treatment plant

Table 5-3
West SWOT Analysis – Local Wastewater Treatment Plants at Pense and Grand Coulee

Strengths:	Weaknesses:
• Mechanical WWTPs allow for higher levels of treatment compared to a lagoon • Provides capacity for local future growth • No new conveyance systems required • Potential for land requirements reduction • Fewer requirements for sludge handling / disposal than WWTP (Mech/Bio) (only once every 10-15 years)	• Significant capital investment for the WWTPs construction • Significant operating costs for treatment plant • Flow demand at each of Pense and Grand Coulee is low – cost would be high per cubic metre treated • Construction will cause disruption to existing works and communities • Operators require higher level of training/certification • Complex process, more maintenance required • Decentralized treatment is more expensive on a per capita basis (capital and operating) • Potentially still dependent on seasonal discharge (tbc) • Could limit growth
Opportunities:	**Threats**:
• WWTPs design can be phased/modular to accommodate future growth • Option for local reuse/irrigation	• Time period for design and construction may delay growth • Rising operating costs • Lack of qualified operations staff • Economic strain on local municipality/community

Notes:
WWTP – wastewater treatment plant
tbc – to be confirmed

Table 5-4
West SWOT Analysis – Regional Wastewater Pairing Pipelines
Pair Pense with Belle Plaine, and Grand Coulee with City of Regina/the Global Transportation Hub for Wastewater servicing

Strengths:	Weaknesses:
• Centralized facility allows for better economies of scale (lower cost per cubic metre treated) • Grand Coulee effluent treated to higher level • Addresses land constraints of Grand Coulee • Future growth of Pense can be accommodated by Belle Plaine, and Grand Coulee by Regina • Utilizes existing currently unused capacity at Belle Plaine, recoup some of investment	• **Significant question; enough additional capacity at Belle Plaine for Pense?** • Not truly a long-term option • New conveyance systems required (added cost and construction impacts) • Belle Plaine/Pense treatment quality is limited • Growth at Belle Plaine/Pense would be restricted • Would still require storage for wet weather flows
Opportunities:	**Threats**:
• Conveyance pairing can be twinned to allow for future growth and centralized treatment in the future • Allows for tie-ins / WW connections along conveyance route • Land likely available for expansion	• Minimal level of treatment at Belle Plaine lagoons impacts the local water bodies • Pense dependent on Belle Plaine infrastructure and pipeline maintenance

Notes:
WW - wastewater

Table 5-5
West SWOT Analysis – Regional Wastewater Pipeline from Pense and Grand Coulee to City of Regina's West WWTP, Local Lagoons at Belle Plaine Remain

Strengths: • Advanced WWTP at Regina allows for higher levels of treatment • Centralized facility allows for better economies of scale (lower cost per cubic metre treated) • Additional skilled operators not required, handled by existing Regina staff • Burden of WWTP management shifted away from communities with limited resources • Utilizes existing currently unused capacity at Belle Plaine, recoup some of investment • Regina WWTP could be expanded to support further growth in the Region • Less regulatory pressures on communities	**Weaknesses**: • Conveyance system required and several pump station/upgrades at municipalities • Construction will cause disruption to existing works and communities • Growth at Belle Plaine would be restricted • Communities lose control of utility rate • Would need to consider reducancy/backup • Would still require storage for wet weather flows
Opportunities: • Large WWTP provides opportunity for beneficial reuse of biogas, biosolids • Belle Plaine could still be connected in the future • Allows for tie-ins / WW connections along conveyance route • Can develop lagoon buffer zones in the future: there is a financial benefit associated with this	**Threats**: • Conveyance pipeline right of way granted • Political challenges of regional treatment • Treatment may not meet future regulatory requirements

Notes:
WWTP – wastewater treatment plant
WW - wastewater

Table 5-6
West SWOT Analysis – Regional Wastewater Pipeline from Pense, Grand Coulee and Belle Plaine to City of Regina's West WWTP

Strengths: • Advanced WWTP at Regina allows for higher levels of treatment • Centralized facility allows for better economies of scale (lower cost per cubic metre treated) • Additional skilled operators not required, handled by existing Regina staff • Burden of WWTP management shifted away from commuities with limited resources • Regina WWTP could be expanded to support further growth in the Region • Less regulatory pressures on communities	**Weaknesses**: • Conveyance system required and several pump station/upgrades at municipalities • Construction will cause disruption to existing works and communities • Does not utilize existing infrastructure at Belle Plaine • Communities loose control of utility rate • Would need to consider reducancy/backup • Would still require storage for wet weather flows
Opportunities: • Large WWTP provides opportunity for beneficial reuse of biogas, biosolids • Allows for tie-ins / WW connections along conveyance route	**Threats**: • Conveyance pipeline right-of-way granted • Political challenges of regional treatment

Notes:
WWTP – wastewater treatment plant
WW - wastewater

5.1.4.1 Conclusions from SWOT Analysis

During the October 2013 Working Session, the related stakeholders agreed it was most suitable for this project to focus on investigating the West Regional Wastewater Pipeline, as several stakeholders were hoping for high growth at the time. However, concerns were raised about the cost viability of the pipeline. The smaller wastewater connection between Grand Coulee and the GTH was considered at a high level with conceptual design and capital costs developed. The other local lagoon upgrades, local WWTPs, and pairing pipelines were discarded due to the various SWOT points captured above.

5.1.5 Engineering Conceptual Design and Cost Estimates

The CH2M HILL team has developed cost estimates for certain options and has collected other existing information where appropriate.

The options presented are not isolated optionsl thus, the appropriate solutions will be a combination of the options.

Table 5-7
Overview of Capital and Operation & Maintenance / Replacement Cost Options for West Wastewater Servicing
Costs are at 2014 prices and exclude GST and PST. Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement presented costs are the first and last full years in the 30-year lifecycle. Calculated numbers were rounded to the nearest significant figure.

Option Available	Initial Capital Cost	Operation & Maintenance plus Replacement	± Variance	Construction Year	Notes / Source
West Regional Wastewater Pipeline	$30 million	Not Developed	- 50% + 100%	2015 Operational 2017	CH2M HILL Cost Estimate, December 2013
Grand Coulee Wastewater Connection with the GTH	$10 million	Not Developed	- 50% + 100%	2017 Operational 2016	CH2M HILL Cost Estimate, April 2014
Local Lagoon Upgrades for Regional Communities	$750K to $2M per site	Minimal	Not Applicable	As required Within next 5 years for Grand Coulee	High level CH2M HILL estimate and verbal estimate from local firm

Notes:
km – kilometre(s)
GTH – Global Transportation Hub

5.1.5.1 West Regional Wastewater Pipeline

As part of the RRWWS, a wastewater collection system was identified as a potential servicing solution for the west region communities. For the sake of simplicity, this collection system is known as the West Regional Wastewater Pipeline and is comprised of the following components:

- Gravity collector main from Pense lagoons to proposed Pense Wastewater Pump Station
- Forcemain from Pense Pump Station to existing Regina WWTP. This forcemain has two sizes:
  - 250-mm-diameter pipe from Pense Pump Station to a Junction Tee (located approximately 12 km east of the intersection of Highways 641 and 730)
  - 350-mm-diameter pipe from the Junction Tee to Regina Regional WTP
- 200-mm-diameter forcemain from the Grand Coulee lagoons to the Junction Tee
- Pump stations at Grand Coulee lagoons and near Pense

The purpose of this section of the RRWWS is to establish a discounted cash flow estimate of probable construction and operating costs for the proposed West Regional Wastewater Pipeline.

The Class 5 Cost Estimates used herein are based on a conceptual level of design.

The west end of the West Regional Wastewater Pipeline starts at the Pense lagoons. Figure 5-2 shows a potential layout of the pipelines in aerial view. It will start at a new manhole constructed next to the existing lagoons, described here as the outlet manhole. This outlet manhole will serve as control structure for the water flowing out by gravity in the first part of the East Regional Wastewater Pipeline. A 350-mm-diameter gravity line is proposed to be laid first in the north direction and then in the west direction. The use of gravity mains, when possible due to the terrain conditions, will serve to save some operations costs in the long run. This 6.7-km-long pipeline will convey the wastewater from the Pense lagoons to the wetwell of a proposed pump station, described here as Pense Pump Station. A 250-mm-diameter forcemain starts from the Pense Pump Station and travels first east and then north to Highway 730, then travels east to the Junction Tee. This forcemain, from the pump station to the Junction Tee is 7.22 km long. Another component of the West Regional Pipeline starts at the Grand Coulee lagoons as a 200-mm-diameter, 1.84-km-long forcemain and ends at the Junction Tee. Wastewater will be pumped into this forcemain from the proposed Grand Coulee Pump Station. From the Junction Tee, the West Regional Wastewater Pipeline will increase in diameter to a 350-mm-diameter, 7-km-long forcemain that will travelto the Regina WWTP.

Figure 5-2
Potential Layout of the West Regional Wastewater Pipeline
Elevations have been derived from Google Earth and should be considered approximate. All related data Copyright Google and Digital Globe 2013.

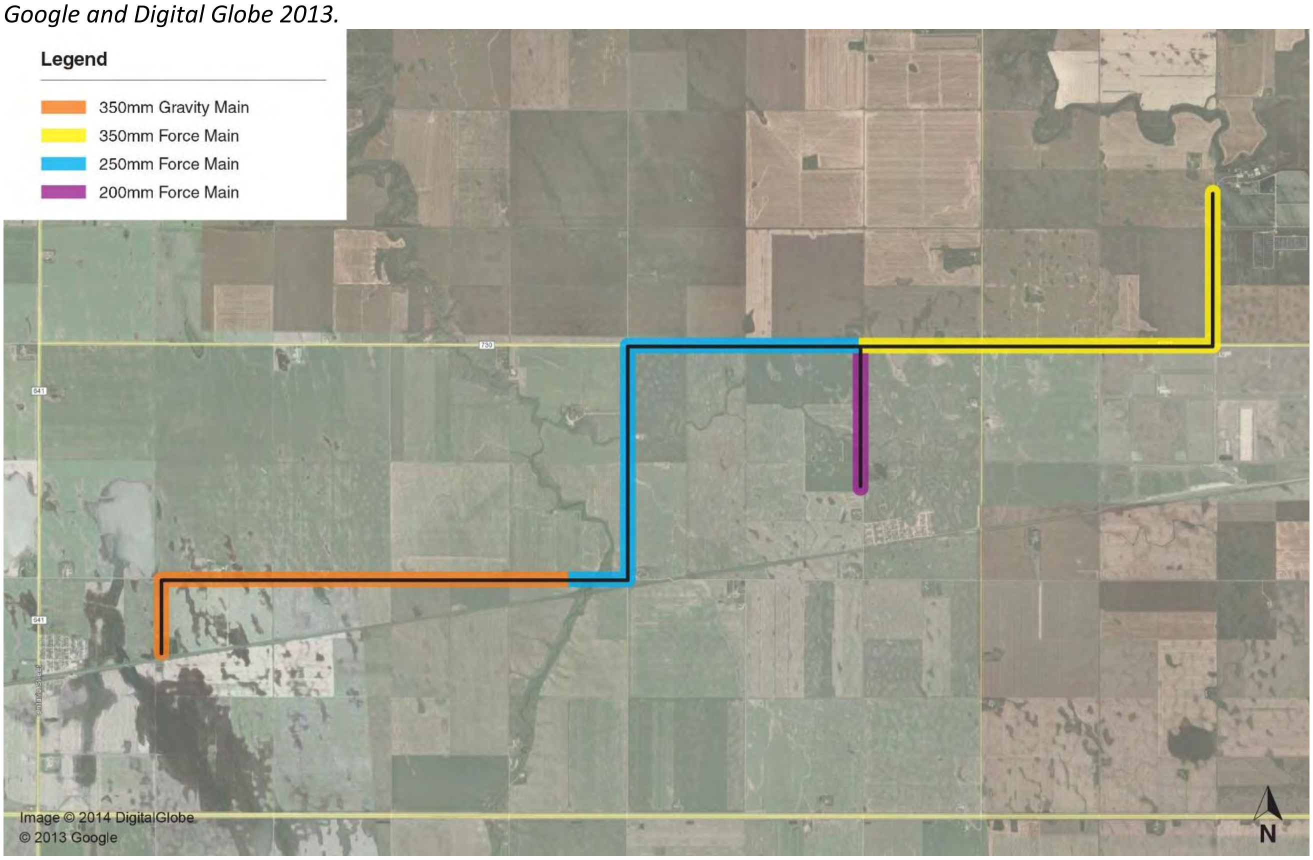


Figure 5-3
Profile of the Proposed Gravity Main from Pense Lagoons to Pense Pump Station (6.7 km)

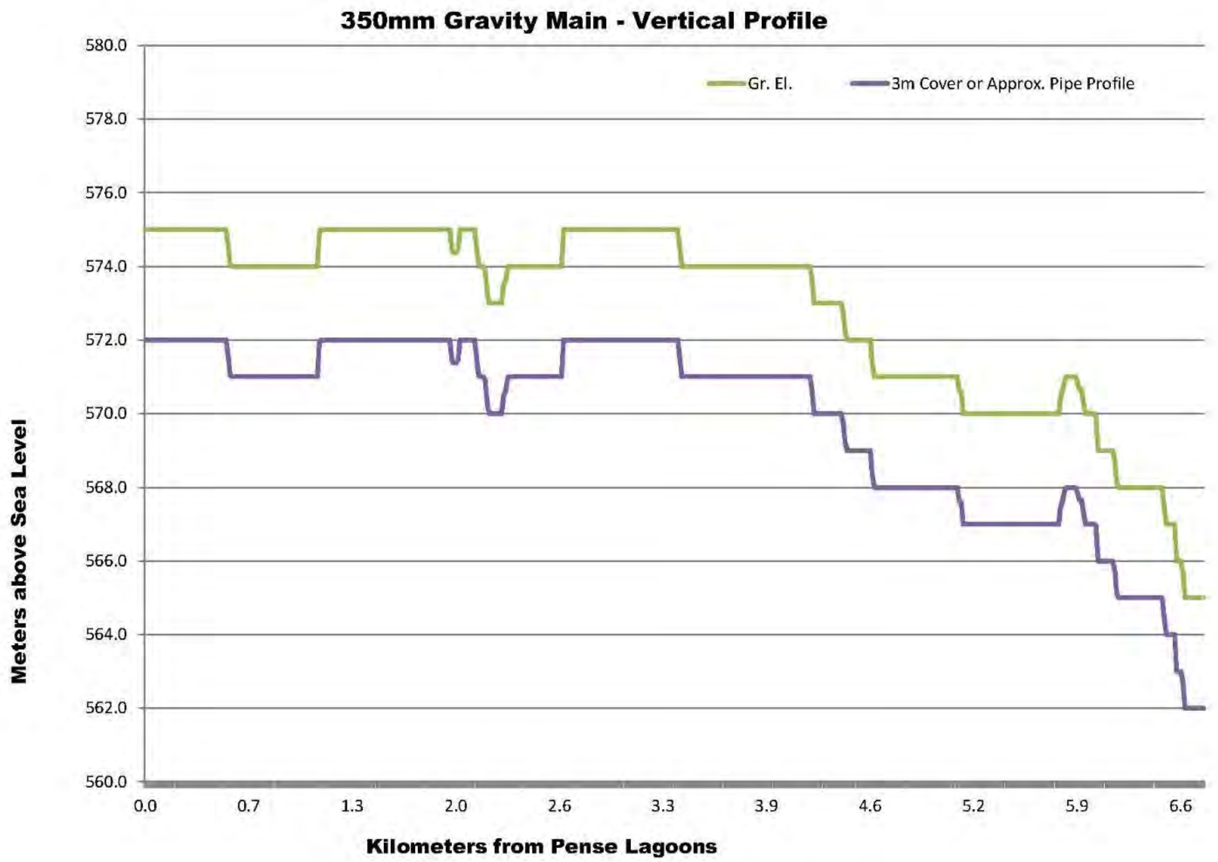


Figure 5-4
Profile of the Proposed Forcemain from Pense Pump Station to Regina Regional Wastewater Treatment Plant (note varied y axis scale)

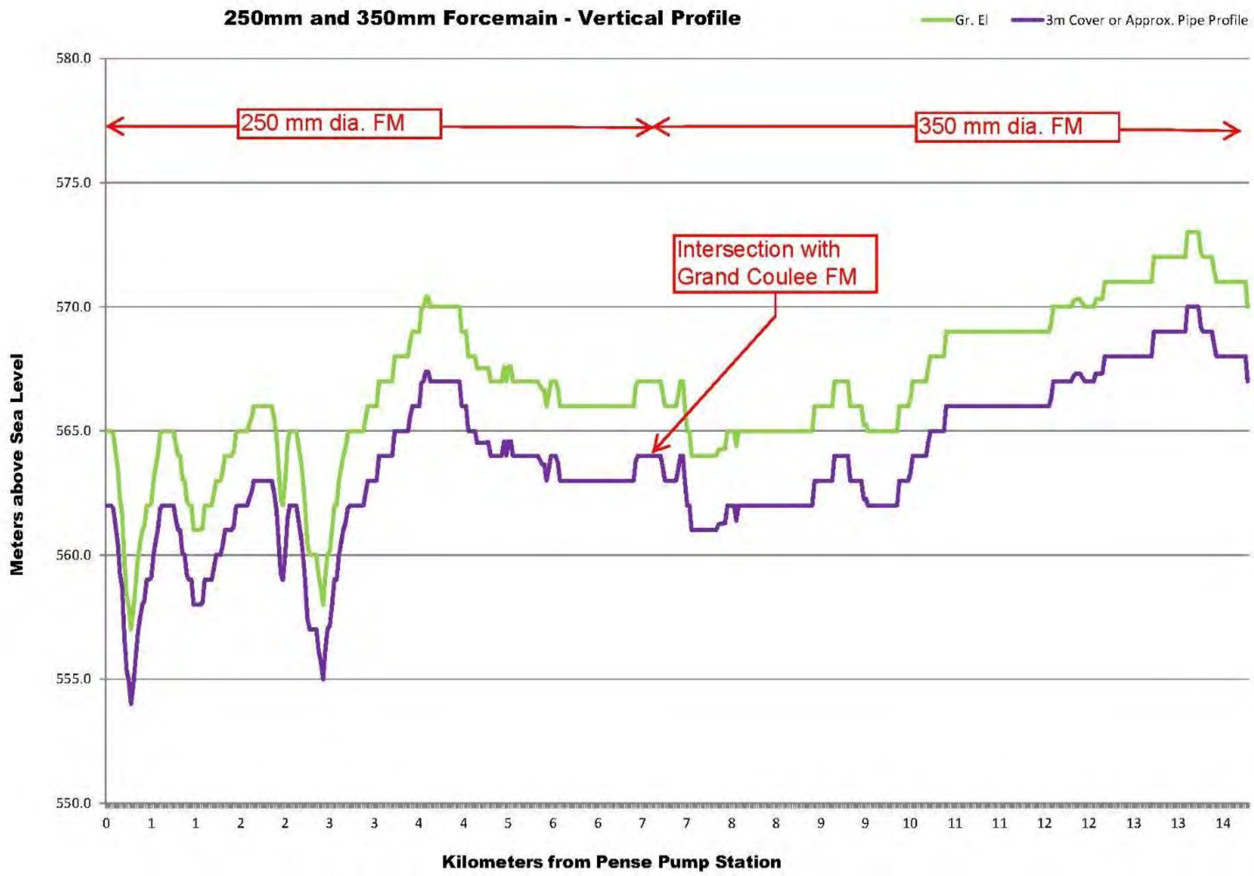
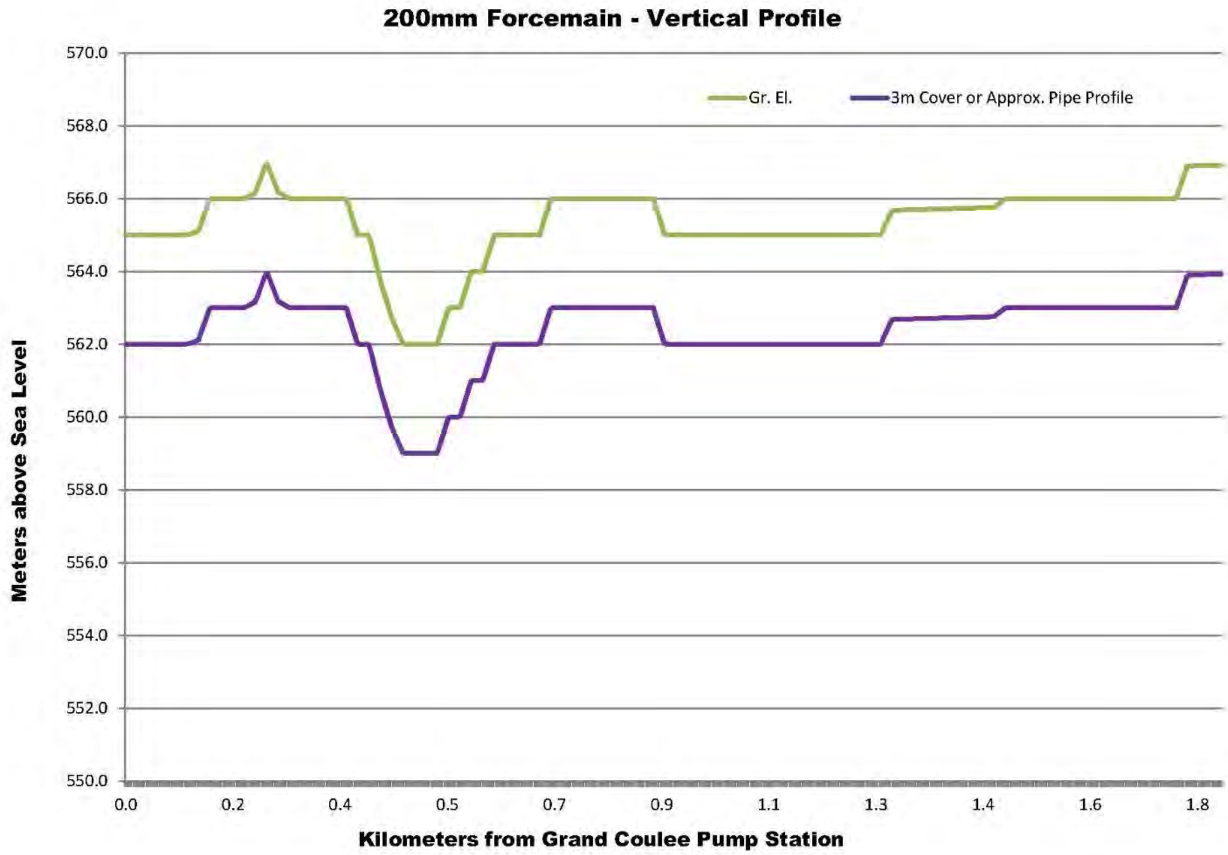


Figure 5-5
Profile of the Proposed Forcemain from Grand Coulee Lagoons to Junction Tee (note varied y axis scale)
Elevations have been derived from Google Earth and should be considered approximate



All related data Copyright Google and Digital Globe 2013.

Cost Estimate Overview

Below is the overview table of Capital Costs based on 2014 costs. Annual Operating and Maintenance costs were not developed for this option, because it was deemed unfeasible based on Capital Costs alone by stakeholders at the West December Working Session.

Table 5-8
West Regional Wastewater Pipeline Cost Estimate Overview for Capital and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$15 million	$30 million	$60 million
Annual O&M /Replacement Costs		*Not Developed*	

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous).

Conceptual Design

The section of the route from Pense lagoons to Pense Pump Station involves construction of an outlet manhole and a pump station; and installation of a sewer gravity main 6.7 km in length of 375-mm-diameter PVC profile pipe. This pipe travels along a rural area, is installed by the open cut method, and includes 1,050-mm-diameter manholes at 150-m intervals.

The section of the route from Pense Pump Station to the Junction Tee involves installation of a sewer forcemain 7.22 km in length of 250-mm-diameter PVC DR 25 pipe. This pipe travels along a rural area and is installed by the open cut method. Installation includes isolation valves, a pipe drainage arrangement, air release valves, and two 50-m-long, 250-mm-diameter PVC DR 25 pipes with 350-mm-diameter steel encasement. Installation is by the trenchless method and crosses a stream.

The section of the route from Grand Coulee Pump Station to the Junction Manhole involves construction of a pump station; and installation of a sewer forcemain 1.84 km in length of 200-mm-diameter PVC DR 25 pipe. This pipe travels along a rural area, is installed by the open cut method, and includes isolation valves, a pipe drainage arrangement, and an air release valve.

The section of the route from the Junction Tee to the Regina WWTP involves installation of a sewer forcemain 7.0 km in length of 350-mm-diameter PVC DR 25 pipe. This pipe travels along a rural area, is installed by the open cut method, and includes isolation valves, a pipe drainage arrangement, and an air release valve. The work also includes the restoration of existing facilities affected by construction.

Figure 5-3, Figure 5-4, and Figure 5-5 shows the pipeline vertical profile. Elevations have been derived from Google Earth and should be considered approximate. All related data Copyright Google and Digital Globe 2013.

Pipe Sizing

Per the assumptions below and the calculations noted in Figure 5-6, a combination of gravity main and forcemain pipes with varying diameters may be appropriate to service the west regional communities, both now and into the future, based on the population projections outlined. The following assumptions apply:

- Average daily wastewater flow used was 454 litres per capita per day (per the City of Regina Development Standards Manual).
- The pump stations and the forcemains and gravity main have been sized for peak capacity.
- The velocity in the forcemain is below 1.6 m/s for the current population as well as for the projected population in the year 2040.
- A gravity main is used where terrain is favorable with respect to elevations.
- Gravity mains have been sized per the following criteria:
    - Sized such that they meet the required year 2040 flows
    - Slope: minimum slope occurring in any pipe section based on the pipe profile was determined and used in corresponding pipe size calculations
    - Roughness Coefficient was assumed to be 0.013
    - Pipe was assumed to be flowing full (conservative estimate)
    - Flowmaster software was used to evaluate the pipe size for each gravity pipe section
- Pipe cover:
    - Forcemain: 3 m average
    - Gravity main: 4 m average

- Pipe material:
  - Forcemain: PVC DR 25
  - Gravity main: PVC, corrugated profile sewer pipe
- Drainage arrangement is at the lowest point in the each section. There are two such arrangements for the 250-mm-diameter forcemain, two such arrangements for the 200-mm-diameter forcemain, and two such arrangement for the 350-mm-diameter forcemain. Detail W-24 (City of Regina) was used for pricing.
- Special sections:
  - 250-mm-diameter forcemain:
    - 50-m crossing installed under a local water body (stream) by trenchless drilling
    - 50-m crossing installed under a local water body (stream) by trenchless drilling
- Bend fittings: Assumed only where sharp changes in horizontal or vertical directions occur. These are as follows:
  - 250-mm-diameter (Pense) forcemain:
    - Five 10-degree bends, four 45-degree bends
  - 350-mm-diameter forcemain:
    - Five 10-degree bends, four 45-degree bends
  - 200-mm-diameter (Grand Coulee) forcemain:
    - Six 10-degree bends, two 45-degree bends
- Isolation valves: Assume these occur every 1,000 m (use City of Regina detail attached), assume they are plug valves
- Air release manholes: Using CH2M HILL Standard design as follows: 100-mm-diameter combined air release-vacuum (CARV) relief valves on 100-mm ductile iron pipe (DIP); manhole diameter: 2,440 mm (8 feet)
  - 250-mm-diameter (Pense) forcemain: 5 manholes
  - 350-mm-diameter forcemain: 2 manholes
  - 200-mm-diameter (Grand Coulee) forcemain: 3 manholes
- Manholes for gravity mains:
  - Manhole every 150 m (per City of Regina guidelines, Details S2, S3)
  - Manhole size: 1,050 mm
  - Outlet manhole to be 1,600 mm by 1,200 mm precast concrete manhole
- Land use: Assume rural land and that pipe is laid parallel to major roads

Figure 5-6
Key Assumptions for the West Regional Wastewater Pipeline

KEY ASSUMPTIONS

Wastewater Flow Per Capita Per Day:	454	Lpcd
Rec. Min. Flow in Pipe greater than:	0.6	m/s
Rec. Max. Flow in Pipe greater than:	1.6	m/s
Extraneous Flow Allowance:	21,000	l/ha/d

Harmon Formula:

$$PeakingFactor = 1 + \frac{14}{4 + \sqrt{Population}}$$

Stakeholder	Area (ha)	Current Pop.	Current Flow
			(Peak, m^3/d)
Pense	132	532	3,729
Grand Coulee	30	571	1,652
Junction Tee to RWWTP			5,381

Stakeholder	Area (ha)	Current Pop.	Current Flow
			(Peak, m^3/d)
Pense	132	710	4,026
Grand Coulee	30	2,000	3,886
Junction Tee to RWWTP			7,912

Stakeholder	2040 Flow	Size	Min. Slope	Vel.
	(Peak, m^3/d)	(mm)	(m/m)	(m/s)
Pense (350-mm Gravity main)	4,026	350	0.00096	0.47*
Grand Coulee	3,886	200	--	1.49
Junction Tee to RWWTP	7,912	350	--	0.99

Notes:
1. Minimum slope selected by visual inspection of pipe profiles
2. Velocity marked "*" is at full capacity flow and is for reference only
l/ha/d = litres per hectare per day
ha = hectares
m3/d = cubic metres per day
mm = millimetres
m/m = metres per metre
m/s = metres per second

Regional Pump Stations

There are three pump stations proposed in this system. This was based on the high level understanding that CH2M HILL engineers had of the existing systems in place at communities. It is very possible that existing systems and pump stations in place at communities could be retrofitted to be appropriate for regional use: however, more information would need to be gathered, and further engineering analysis carried out. The proposed pump stations are named in accordance with the corresponding community and are located at the community's wastewater lagoons. These pump stations are as follows:

1. Pense Pump Station
2. Grand Coulee Pump Station

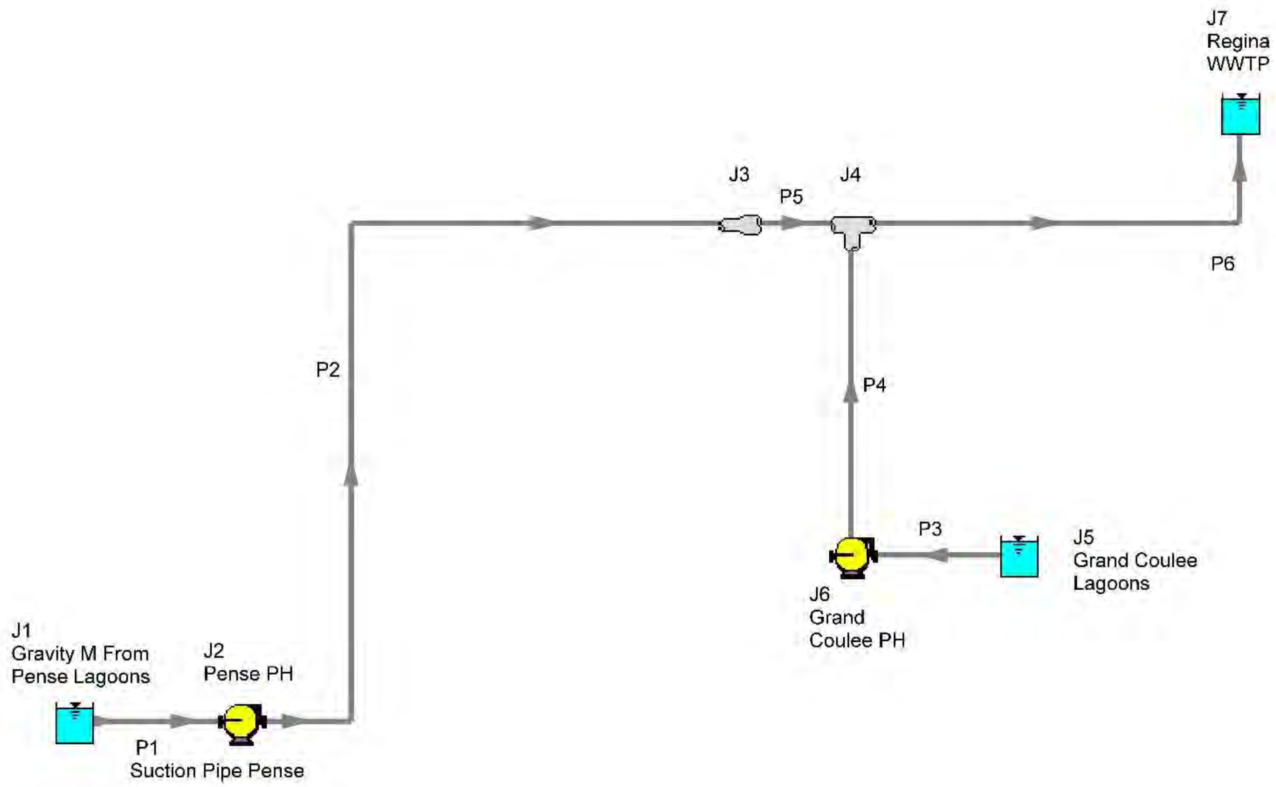
Wastewater is expected to be collected through existing systems and will be collected in the respective community's lagoons which act as an equilibrium storage. It will allow better control for pumping flows and time. The pump stations can pump to the City of Regina's East Region WWTP during off-peak hours, or the pumping could be scheduled so that not all pump stations are pumping at the same time (thus minimizing the flow peak at the WWTP). Each pump station is a typical wet well-dry well pump station, operated on the basis of level changes inside the wet well. The pumps would convey the wastewater directly to the Regina WWTP. A suitable template design for the Pump Stations was developed and used for the cost estimate; this design template is presented in Appendix H.

Analysis was carried out in Fathom software, and pump flow characteristics were determined. Figure 5-7 shows a screen shot of the model developed for this system in AFT Fathom. The selected operating pump flows and heads are shown below. The following assumptions apply to the proposed pump stations:

- Pump stations have been sized to be similar to the Lumsden Pump Station
- Figure 5-6 summarizes the major sizing parameters used for design
- Number of Pump stations: 2
- Number of Pumps:
  - Pense Pump Station: 2 (1 duty, 1 standby), submersible
  - Grand Coulee Pump Station: 2 (1 duty, 1 standby), submersible
- Type of Pump station: Wet well-Dry well
- Wet well Size: 88 m^3 wet well (80 m^3 filled, assume 10 percent headboard)
- Variable Frequency Drive (VFD) equipped?: Yes
- Location: Existing lagoons site (land owned by corresponding community)
- Pumps: Designed to meet current and future pumping demands using VFDs
  - Pense Pump Station: 155 m^3/hr at 38-m head and 168 m^3/hr at 52-m head
  - Grand Coulee Pump Station: 69 m^3/hr at 21-m head and 162 m^3/hr at 45-m head
- Power source: Existing power source available at lagoon site
  - Standby Power Source: Diesel generator, generator room adjacent to pump house
  - Pense Pump Station: 250 kilowatt
  - Grand Coulee Pump Station: 250 kilowatt

Design sketches of the Pense and Grand Coulee Pump Stations can be found in Appendix H.

Figure 5-7
AFT Fathom Model for the West Regional Wastewater Pipeline System



Capital Cost Estimate

Table 5-9 presents a summary of the costs. Costs are presented in 2014 Canadian Dollars and exclude PST and GST.

Table 5-9
West Regional Wastewater Pipeline Cost Estimate Overview for Capital Direct Construction Costs of the East Regina Water Distribution System based on 2014 costs, excluding PST and GST. Calculated numbers were rounded to the nearest significant figure.

Low Range (-50%)	Estimated Costs[a]	High Range (+100%)
$15 million	$30 million	$60 million

This cost estimate has been prepared for guidance in project evaluation based upon the information available at the time of the estimate. The final costs of the project will depend on the actual pipeline route and pump station location; the actual labour and material costs; competitive market conditions; final project costs; implementation schedule; and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

As explained in Section 5.2.5.1 with the North Wastewater Regional Pipeline, following review by the City of Regina of the template pump station design, the capital construction cost estimate was increased to $5 million (excluding engineering and other non-construction costs) based on a similar pump station recently constructed by the City.

Capital Cost Assumptions

Markups

The project will be tendered based on unit price bidding. All markups, contingencies, and other factors are included in the Unit Price.

Table 5-10
General Contractor Markups

Overhead	Included in Unit Price
Profit	Included in Unit Price
Mobilization/Demobilization	Separate line item in Estimate
Contingency	Separate line item in Estimate
Escalation Rate	4.28%

Escalation Rate

The escalation forecast was calculated using CH2M HILL's proprietary escalation model, which incorporates economic data from sources such as Global Insight, Inc.

Estimate Classification

This cost estimate is considered a Budget or Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). It is considered accurate from minus 50 percent to plus 100 percent, based on a conceptual design deliverable.

Estimate Methodology

This cost estimate is considered a 'bottom rolled up' type estimate with cost items and breakdown of Labour, Materials, and Equipment. Some quotations were obtained for various items. The estimate may include allowance cost and dollars per square meter cost for certain components of the estimate.

Construction Labour Costs

The labour cost is built into the unit price of the items in the estimate.

Operating and Maintenance Cost Estimate

Annual Operating and Maintenance costs were not developed for this option as it was deemed unfeasible based on Capital Costs alone by stakeholders at the West December Working Session.

Cost Estimate References

- *Guidelines for Sewage Works Design, EPB 203* (Environmental Protection Branch), 2013, Saskatchewan Ministry of Environment (PoS, 2013)
- *Development Standards Manual*, 2010, City of Regina (City of Regina, 2010a)
- Wastewater flows have been derived from guidelines and formulas in the City of Regina's *Development Standards Manual* (City of Regina, 2010a)
- CH2M HILL conceptual design documents, internal sketches and data presented in this report
- R.S. Means
- Vendor Quotes on Equipment and Materials where appropriate
- CH2M HILL Historical Data
- CH2M HILL Engineer and Estimator Judgment

5.1.5.2 Grand Coulee to Global Transportation Hub Wastewater Connection

As part of the RRWWS, a wastewater collection system was identified as a potential servicing solution for the Village of Grand Coulee through a connection to the Global Transportation Hub (GTH) and on to the City of Regina. For the sake of simplicity, this collection system is called as the Grand Coulee GTH Pipeline in this section. This system is comprised of the following:

- Equilibrium tank located at the site of existing Grand Coulee Lagoons
- Pump station located at the site of existing Grand Coulee Lagoons (GC PS)
- 200-mm-diameter forcemain from the proposed Grand Coulee Lagoons to an existing pump station in the Global Transportation Hub (GTH PS).
- Existing pump station at the GTH

This option will involve three major stakeholders: the Village of Grand Coulee, the GTH Authority, and the City of Regina.

The purpose of this section is to establish an initial capital construction cost for the Grand Coulee GTH Pipeline. No modifications are expected at the GTH PS, and no capital costs related to GTH PS are included in this estimate.

The Class 5 Cost Estimates used herein are based on a conceptual level of design.

Cost Estimate Overview

Table 5-11 shows the overview of Capital Costs based on 2014 costs. Annual Operating and Maintenance costs were not developed for this option due to time and budget constraints; however, the Capital Costs will provide the stakeholders with useful information.

Table 5-11
Grand Coulee GTH Pipeline Cost Estimate Overview for Capital. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$5 million	$10 million	$20 million
Annual O&M /Replacement Costs		*Not Developed*	

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous).

Conceptual Design

Wastewater from Grand Coulee is currently being collected by gravity at the lagoons located to the north of the community. The proposed system will use the existing gravity system to collect water into a new equilibrium tank located at the site of the lagoons. This tank is needed because the GTH PS is already designed with an established peak capacity. Wastewater from the equilibrium tank will be pumped to the GTH PS in off-peak hours, thus making use of its idle capacity during off-peak flows and also avoiding overloading it during peak hours. A new pump station also located at the site of lagoons will take in wastewater from this equilibrium tank and pump it to the wetwell of the GTH PS via a 200-mm forcemain. The forcemain will be 5.9 km long and will be routed through farmland and in the right-of-way of major roads, using PVC DR 25 installed by open cut method (including the necessary isolation valves, pipe drainage arrangement, and air release valve). Figure 5-8 shows the potential layout of the forcemain from Grand Coulee lagoons to the existing pump station at the Global Transportation Hub. Wastewater from the GTH PS will then be conveyed to the existing Regina WWTP through the City's existing wastewater network.

Because all of the current available capacity at the GTH PS is allocated to existing users, Grand Coulee will be expected to contribute a proportional amount towards installing the second pumping train and forcemain, at some point in the future. The addition of this second train is currently estimated at $3.5 million, and this has not been included in this estimate.

Figure 5-8
Layout of the Potential Grand Coulee GTH Wastewater Pipeline

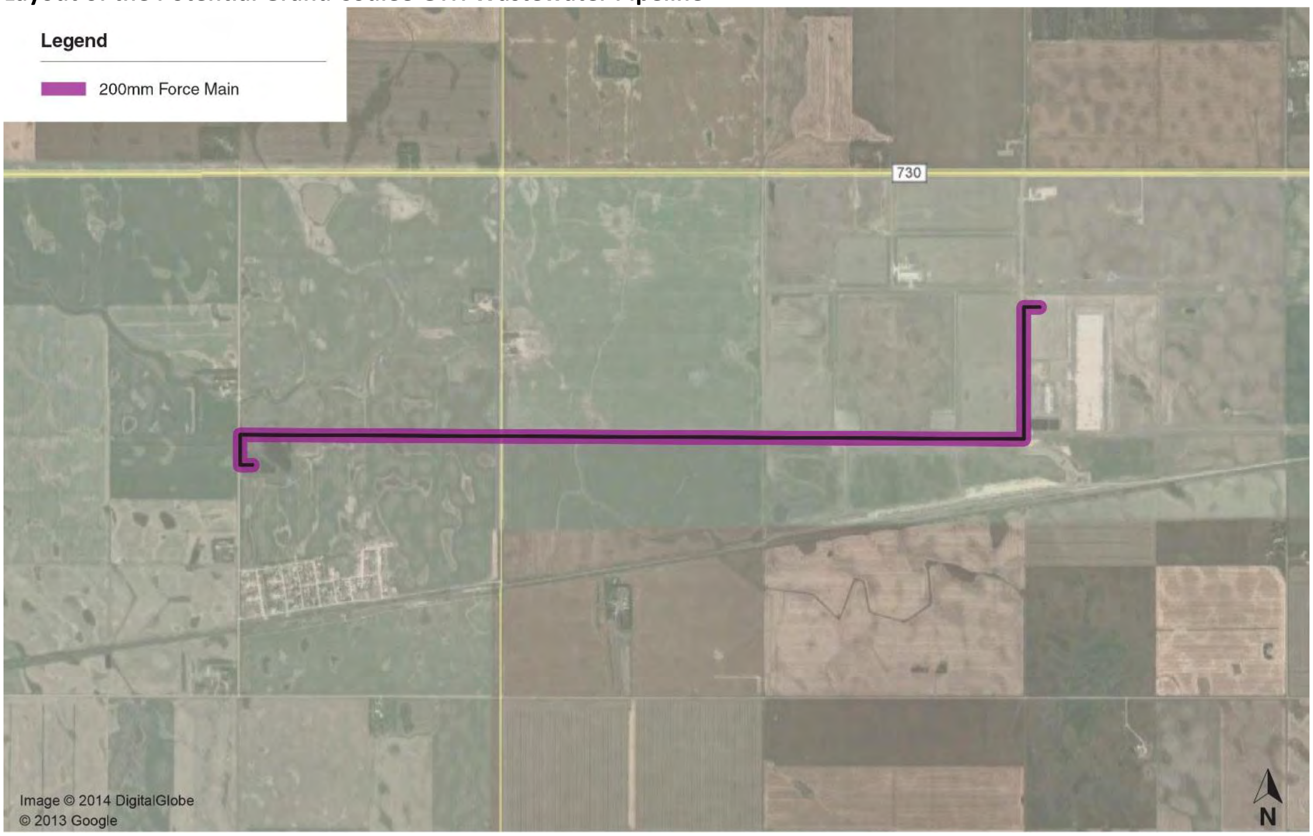


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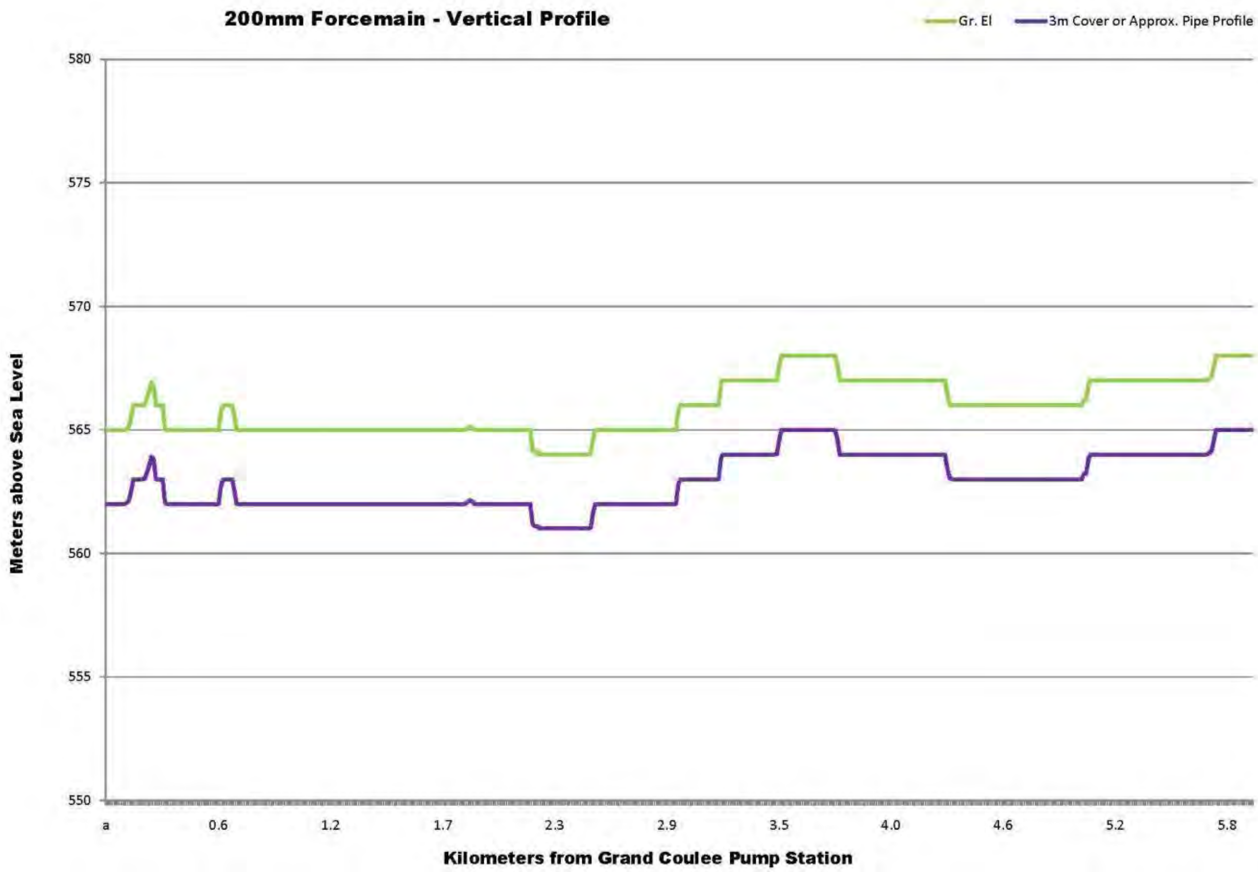
Figure 5-9
Profile of the Proposed Forcemain from Grand Coulee Lagoons to Existing GTH Pump Station (5.9 km)
Elevations have been derived from Google Earth and should be considered approximate.



All related data Copyright Google and Digital Globe 2013.

Pipe Sizing

Per the assumptions below and the calculations noted in Figure 5-10, a combination of gravity main and forcemain pipes with varying diameters may be appropriate to service the West regional communities, both now and into the future, based on the population projections outlined. The following assumptions apply:

- Average daily wastewater flow used was 454 lpcd as per the City of Regina Development Standards Manual.
- The pump station and the forcemain have been sized for peak capacity.
- The velocity in the forcemain is below 1.6 m/s for current, as well as projected, population in the year 2040.
- Pipe cover:
  - Forcemain: 3 m average
- Pipe Material:
  - Forcemain: PVC DR 25
- Drainage arrangement at the lowest point in the each section. There is one such arrangement for the 200-mm-diameter Forcemain; used detail W-24 (City of Regina) for pricing.

- Bend Fittings: Assumed only where sharp changes in horizontal or vertical directions occur. These are as follows:
  - 5 units of 10-degree bends
  - 4 units of 90-degree bends
- Isolation valves: Assume every 1,000 m (use City of Regina detail attached), assume plug valve.
- Air Release Manholes: 2 ARV Manholes
  - Using CH2MHILL Standard; detail, 100-mm-diameter CARV relief valves on 100-mm DIP, manhole diameter: 2,440 mm (8 feet).
- Land Use: Assume rural land. (Pipe laid parallel to major roads or on edges of farm fields)

Figure 5-10
Key Assumptions for the Grand Coulee GTH Pipeline

KEY ASSUMPTIONS			
Wastewater Flow Per Capita Per Day:	454	lpcd	
Rec. Min. Flow in Pipe greater than:	0.6	m/s	
Rec. Max. Flow in Pipe greater than:	1.6	m/s	
Extraneous Flow Allowance:	21000	l/ha/d	
Harmon Fromula:	$PeakingFactor = 1 + \frac{14}{4 + \sqrt{Population}}$		

Stakeholder	Area (ha)	Current Pop.	Current Flow (Peak, m3/d)
Grand Coulee	30	571	1652

Stakeholder	Area (ha)	Current Pop.	Current Flow (Peak, m3/d)
Grand Coulee	30	2000	3886

Stakeholder	2040 Flow (Peak, m3/d)	Size (mm)	Vel. (m/s)
Grand Coulee	3886	200	1.49

Notes:
1. Minimum slope selected by visual inspection of pipe profiles.
2. Velocity marked “*” is at full capacity flow and is for reference only.
Lpcd = litres per capita per day
m/s = metres per second
L/ha/d = litres per hectare per day
ha = hectares
m3/d = cubic metres per day
mm = millimetres

Equilibrium Tank

As part of the future developments, Grand Coulee wishes to eliminate the current lagoons. Also since the GTH PS flows are currently accounted for, it may not be able to take on peak flows from Grand Coulee. For this reason, it is proposed to construct an equilibrium tank at the site of existing lagoons. Wastewater from

Grand Coulee will be stored in this tank and pumped at off-peak hours to the GTH, thus making ideal use of recently constructed infrastructure at GTH.

Following are the details for the equilibrium tank:

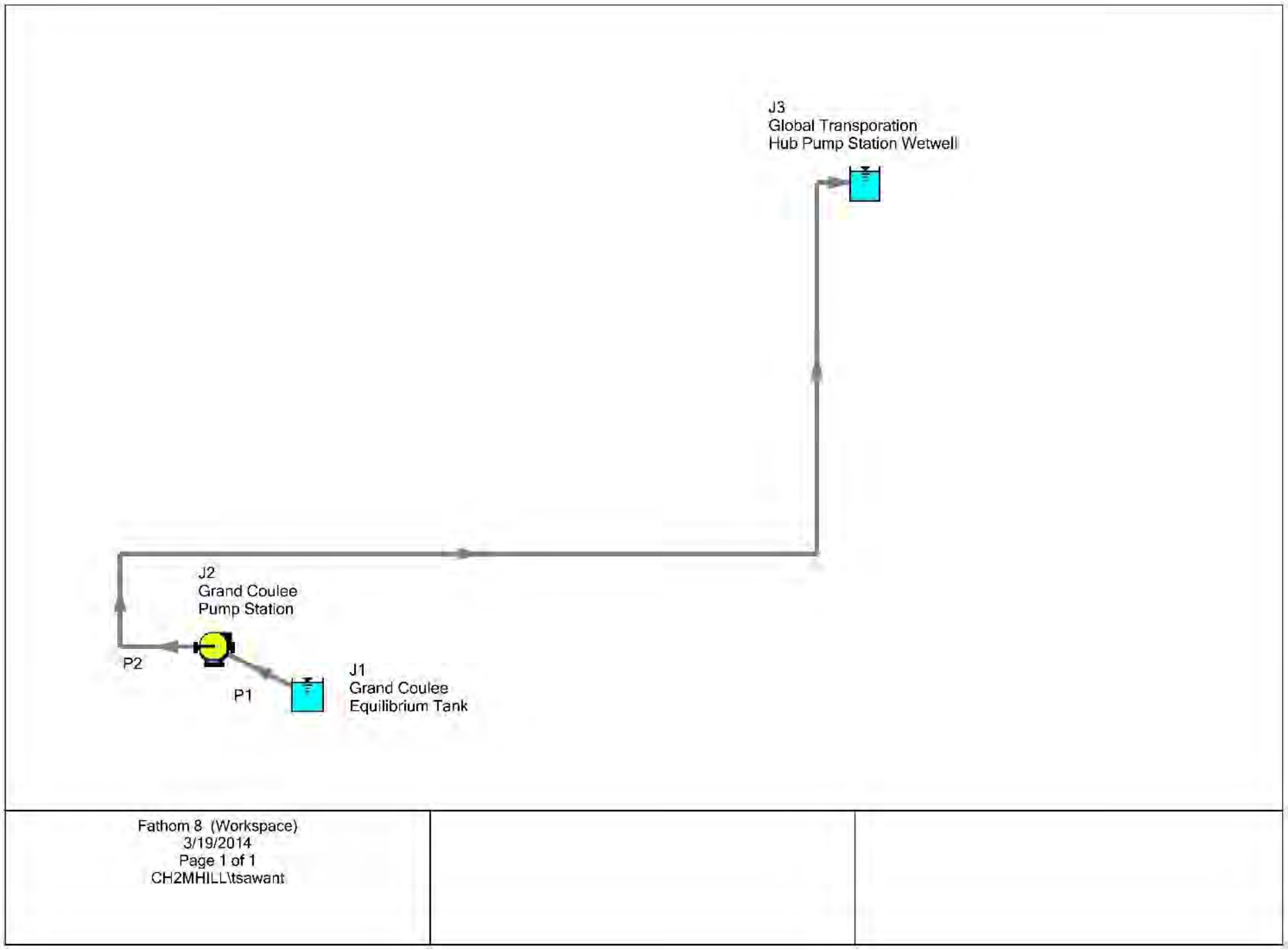
- Type: Underground
- Construction: Concrete
- Assumed Storage Capacity: 4 hr peak flow (approx. Equivalent to 12 hr average flow)
- Storage Volume: 650 m^3

It may be possible to eliminate the equilibrium tanks if the second phase of GTH PS is large enough to incorporate the peak flows from Grand Coulee. This could be done by upsizing the future pumps at GTH PS, in addition to confirming the forcemain capacity downstream of the GTH PS. This will require further investigation and is not considered as part of the current work scope.

Pump Station

There is one new pump station proposed in this system. For convenience, it is referenced here as the Grand Coulee Pump Station. Wastewater will be collected through Grand Coulee's existing collection system and temporarily stored in the proposed equilibrium tank. This will allow better control for pumping flows and time. Wastewater will be pumped to the GTH PS during off-peak flows. The pump station is a typical wet well-dry well pump station operated on the basis of level changes inside the wet well. The pumps would convey the wastewater directly to the wetwell inside GTH PS.

Figure 5-11
Screenshot of the System Model Developed in AFT Fathom



Analysis was carried out in Fathom software, and pump flow characteristics were determined. Figure 5-11shows a screen shot of the model developed for this system in AFT Fathom. The selected operating pump flows and heads are shown below. The following assumptions apply to the proposed pump stations:

- The pump station layout is similar to Lumsden Pump Station. Design sketches of the template pump station that may be suitable can be found in Appendix H.
- Figure 5-10 summarizes the major sizing parameters used for design.
- Number of Pump stations: 1
- Number of Pumps: 2 (1 duty, 1 standby), Submersible.
- Type of Pump station: Wet well-Dry well
- Wet well Size: 30 m^3 wet well (27 m^3 filled, assume 10 percent headboard)
- VFD-equipped: Yes
- Location: Existing lagoons site (land owned by corresponding City)
- Pumps: Designed to meet current and future pumping demands using VFDs
  - Current Population: 69 m^3/hr @ 16-m head
  - Future Population: 161 m^3/hr @ 64-m head

- Power source: Existing power source available at lagoon site
- Standby Power Source: Diesel Generator, generator room adjacent to pump house
  - Generator Size: 60 kW

Capital Cost Estimate

Table 5-12 presents a summary of the costs. Costs are presented in 2014 Canadian Dollars and exclude PST and GST.

Table 5-12
Grand Coulee GTH Pipeline Cost Estimate Overview for Capital Direct Construction Costs based on 2014 costs, excluding PST and GST. Calculated numbers were rounded to the nearest significant figure.

Low Range (-50%)	Estimated Costs[a]	High Range (+100%)
$5 million	$10 million	$20 million

This cost estimate has been prepared for guidance in project evaluation based upon the information available at the time of the estimate. The final costs of the project will depend on the local engineering; actual pipeline route and pump station location; the actual labour and material costs; competitive market conditions; final project costs; implementation schedule; and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help in ensuring proper project evaluation and adequate funding.

Capital Cost Assumptions

Markups

The project will be tendered based on unit price bidding. All markups, contingencies, and other factors are included in the Unit Price.

Table 5-13
General Contractor Markups

Overhead	Included in Unit Price
Profit	Included in Unit Price
Mobilization/Demobilization	Separate line item in Estimate
Contingency	Separate line item in Estimate
Escalation Rate	4.28%

Escalation Rate

The escalation forecast was calculated using CH2M HILL's proprietary escalation model, which incorporates economic data from sources such as Global Insight, Inc.

Estimate Classification

This cost estimate is considered a Budget or Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). It is considered accurate from minus 50 percent to plus 100 percent, based on a conceptual design deliverable.

Estimate Methodology

This cost estimate is considered a 'bottom rolled up' type estimate with cost items and breakdown of Labour, Materials, and Equipment. Some quotations were obtained for various items. The estimate may include allowance cost and dollars per square meter cost for certain components of the estimate.

Construction Labour Costs

The labour cost is built into the unit price of the items in the estimate.

Operating and Maintenance Cost Estimate

Annual Operating and Maintenance costs were not developed for this option due to time and budget constraints; however, the Capital Costs will provide the stakeholders with useful information.

Cost Estimate References

- *Guidelines for Sewage Works Design, EPB 203* (Environmental Protection Branch), 2013, Saskatchewan Ministry of Environment (PoS, 2013)
- *Development Standards Manual*, 2010, City of Regina (City of Regina, 2010a)
- Wastewater flows have been derived from guidelines and formulas in the City of Regina's *Development Standards Manual* (City of Regina, 2010a)
- CH2M HILL conceptual design documents, internal sketches and data presented in this report
- R.S. Means
- Vendor Quotes on Equipment and Materials where appropriate
- CH2M HILL Historical Data
- CH2M HILL Engineer and Estimator Judgment

5.1.6 Triple Bottom Line Evaluation

The December Working Session at Pilot Butte on December 12, 2013, provided stakeholders with the opportunity to review available financial information and to evaluate non-financial aspects of the decision.

With engineering options developed as solutions to future wastewater servicing in the West region, the relevant stakeholders discussed the associated benefits.

During the October Working Session at the City of Regina, stakeholders had the opportunity to discuss a high level SWOT (Strengths, Weaknesses, Opportunities, Threats) evaluation of potential local and regional options to solve wastewater servicing challenges. Full details of the SWOT evaluation are included in Section 5.1.4.

The December Working Session at Grand Coulee provided stakeholders with the opportunity to review available financial information and evaluate non-financial aspects of the decision.

Table 5-14
Attendance at West Working Session at Grand Coulee on December 12, 2013

Community	Attendee
City of Regina	Kevin Syrnick
Village of Grand Coulee	Ralph Stobbe, Elwood Scott, Jim Pratt, Tobi Duck
RM of Pense	Cathy Ripplinger
SaskWater	Nish Prasad
Regional Consultant	Tim Cheesman
CH2M HILL	Iain Cranston (facilitator)

Note:
RM – Rural Municipality

The evaluation followed a high level Triple Bottom Line (TBL) approach; discussing Economic, Social, and Environmental benefits associated with the options. Table 5-15 lists the various factors used for the TBL evaluation and the rating agreed upon by the stakeholders at the December Working Session. Ratings were kept to a simple traffic light (Red/Amber/Green) scale, with green providing the most benefit and red providing the least benefit or a significant challenge. This high level TBL approach was deemed sufficient for this stage of the study; it is intended only as an additional guide to determining which of the options should be viewed more favourably in terms of non-financial benefits and to identifying potential areas of challenge.

Table 5-15
High Level Triple Bottom Line Summary for West Wastewater Servicing Solutions

	Factors	Local Lagoon Upgrades	West Regional Wastewater Pipeline	Grand Coulee GTH Wastewater Link
Economic	Minimizes Construction Risk - financial over run / complications	● G	● R	● G
	Minimizes Deliverability Risk - delay in time to activate	● G	● R	● A
	Minimizes Staffing Risk - attracting the right people and knowledge	● G	● G	● G
Social	Flexibility to supports / facilitate future growth	● A	● G	● A
	Minimizes Construction Disruption on Communities	● A	● G	● G
	Minimizes Operational Nuisance - Noise, Odour, Visual, Traffic etc	● G	● G	● G
Environmental	Meets Effluent Quality Improves Quality and/or Reliability*	● G	● G	● G
	Minimizes Construction Disruption on Environment	● G	● A	● A
	Maximizes opportunities for diversified bio solids reuse	● R	● G	● G

Notes:
*The TBL factor "Meets Effluent Quality Improves Quality and/or Reliability" proved marginally challenging. Whilst all options must meet effluent quality restrictions, this factor allowed stakeholders to distinguish which options potentially could provide a higher level of treatment and/or reliability and therefore reduce environmental risk of pollution spills.
GTH – Global Transportation Hub

The rationale behind the ratings in Table 5-15 that were captured with the stakeholders at the December Working Session is documented in Appendix K.

5.2 North Wastewater Servicing Options

Wastewater servicing is currently a significant issue for the Town of Lumsden, with short-term environmental risks resulting in a halt on growth. Concept and predesign work is already underway for a local WWTP. Challenges are potentially equally as great for communities around Last Mountain Lake; however, that locality is outside of the study area scope. The RM of Lumsden and Craven are in a satisfactory position for wastewater servicing into the medium term.

The conceptual design for the North Regional Wastewater Pipeline suggests a suitable route to be following the road adjacent to the country club. The RM of Sherwood expressed interest in connecting to this regional pipeline to service wastewater in the new development (and potentially connecting to the Sherwood Forest Country Club). This would reduce the costs associated with building and maintaining the regional pipeline, as they could be shared among the Town of Lumsden, the RM of Sherwood, and any other new large communities arising within either the RM of Sherwood or the RM of Lumsden in the future.

5.2.1 Assumptions and Risks

5.2.1.1 North Population Assumptions

- The growth rate of the Town of Lumsden (Lumsden) was assumed to be 2 percent; this aligns with Associated Engineering's local WWTP pre-design figures. These assumptions can be updated, and cost changes will propagate through the model once the assumption is clarified.
- There is currently no wastewater dependency from the RM on the Town of Lumsden system; however, in the future, some developers may want to connect.
- It was assumed that a solution for Lumsden would service the increase in population plus a portion of the existing population, in order to relieve the pressure on the existing infrastructure.
- It was assumed that no population increase for Craven and the City of Regina is required in the North Region, as existing infrastructure can absorb the increased service demand.
- It is understood that the Village of Craven is not expecting any growth in the next 30 years and plans to remain at around its current size; as a result, a low growth rate of 0.5 percent is assumed.

5.2.1.2 CH2M HILL Cost Estimate Assumptions and Exclusions

This estimate is considered a Class 5 and is based on a conceptual level design. Costs are to be considered accurate from minus 50 percent to plus 100 percent.

This estimate should be evaluated for market changes after 90 days of the issue date.

The estimate includes allowances for various items shown on detail estimate sheets in the report.

The capital estimate is based on the assumptions that the work will be done on a competitive bid basis and that the contractor will have a reasonable amount of time to complete the work. All contractors are equal, with a reasonable project schedule, no overtime, constructed as under a single contract, no liquidated damages.

The Net Present Value calculations assume a 4 percent discount rate, as used by the City of Regina.

Both Capital and Operating & Maintenance Costs are expressed in Canadian Dollars.

The cost estimate excludes the following costs:

- Total 5 percent GST Tax is excluded in the estimate. PST is included in local material costs, but may not be included in other services.
- Non-construction or soft costs; services during construction; and land, legal, and owner administration costs are excluded.
- A small allowance has been made for land acquisition and compensation, but this needs local input from stakeholders.
- Material Adjustment allowances above and beyond what is included at the time of the cost estimate are excluded.

5.2.2 Demand Projections and Service Challenges

Per the Population Projections in Section 3, Figure 5-12 shows the cumulative population projections for the existing communities to the north of Regina from 2011 to 2040, assuming the high growth scenario in all communities. Currently, the cumulative population is slightly over 3,600 residents. In 2040, the cumulative population is projected to be approximately 6,300 residents. This results in an AAGR of approximately 1.9 percent in the North. Relative to the East, growth in the North is anticipated to be slow over the next 25 years, with the majority of the growth occurring in Lumsden and the RM of Lumsden.

Figure 5-12
North Region - Cumulative Population Projections from 2011 to 2040, assuming High Growth Scenarios

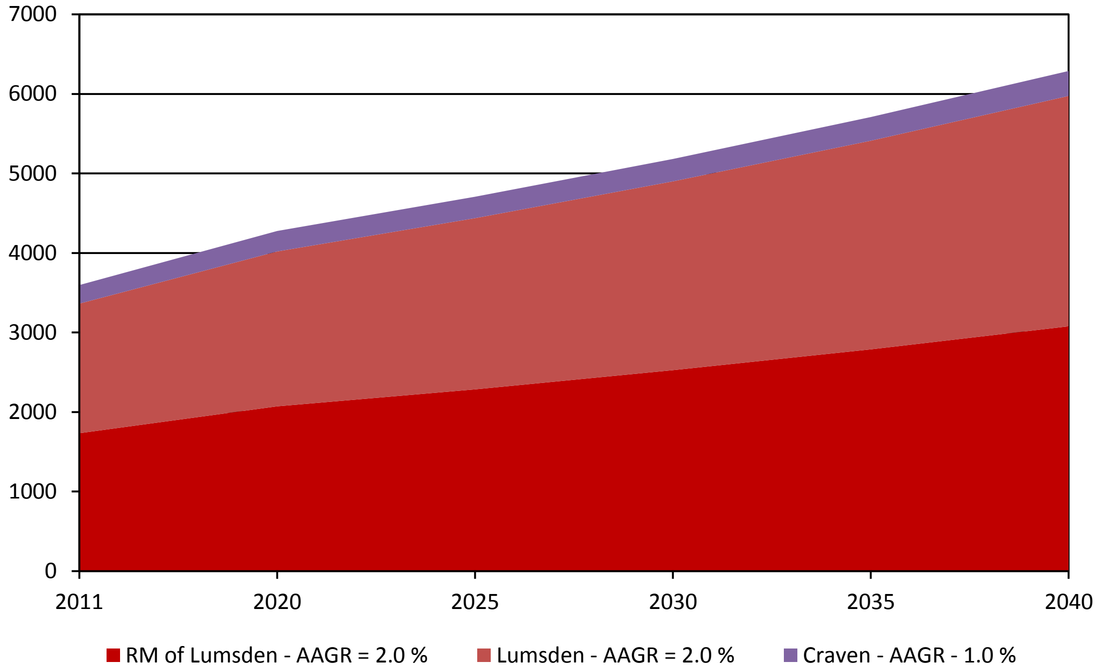


Table 5-16
North Region - Cumulative Population Projections from 2013 to 2040 (data), assuming High Growth Scenarios

Town/Municipality	AAGR (%)	2011	2020	2025	2030	2035	2040
Lumsden	**2.0 %**	1,631	1,949	2,152	2,376	2,623	2,896
RM of Lumsden	**2.0 %**	1,733	2,071	2,287	2,525	2,787	3,078
Craven	**1.0 %**	234	256	269	283	297	312
Total		3,598	4,276	4,708	5,183	5,708	6,286

Notes:
AAGR – Average Annual Growth Rate
RM – Rural Municipality

5.2.3 Servicing Options

During the early stages of the study, after collecting information on the stakeholders' current infrastructure and servicing challenges, the following options were identified as potential solutions to the understood challenges:

- Local lagoon expansion and/or upgrades at the Town of Lumsden, with no improvements at the City of Regina or Craven required
- Local wastewater treatment addition at the Town of Lumsden, with no improvements at the City of Regina or Craven required

- Regional pipeline from the Town of Lumsden to the City of Regina, with no improvements at Craven required; investigation will need to be done on what upgrades may be required to the City of Regina's West WWTP to treat the additional flow from the North
- Regional pipeline from the Town of Lumsden to the Village of Craven, with no improvements at the City of Regina or Craven required

5.2.4 SWOT Analysis

Table 5-17 to Table 5-20 document the SWOT Analysis completed with the stakeholders from the region at the October Working Session, held on October 30, 2013, at the George Bothwell Library in Regina.

A SWOT Analysis is a structured way of evaluation options, capturing Strengths, Weaknesses, Opportunities and Threats. During the working sessions, the stakeholders were facilitated through the analysis by CH2M HILL team members, with the SWOT titles used as prompts to gather feedback from the stakeholders on the options. The bullet points captured in the Table 5-17 through Table 5-20 are not an exhaustive list of all points associated with each of the options; instead, they are a list of the significant points that were at the forefront of stakeholders' minds.

Table 5-17
North SWOT Analysis – Local Wastewater Treatment Plant at the Town of Lumsden

Strengths: • Mechanical WWTP will allow for higher levels of treatment compared to a lagoon • Reduces impact on Qu'Appelle • Adds treatment capacity for future Lumsden growth and nearby RM communities • Lumsden already completed conceptual design, and RFP is out for design which will help earlier capacity delivery • No new conveyance systems required within Lumsden itself	**Weaknesses:** • Significant capital investment for the WWTP construction • Significant ongoing operational costs • Complex process, more maintenance required • Operators require higher level of training/certification – current highest level operator is Level 2 and expect that will require a Level 3 operator
Opportunities: • Partnership between Region & City to train operators and build experience • Could pick up other developments in the RM • Would facilitate reduction in use of septic tanks and fields in RM • Investigate use of future developer fees to supplement WWTP funding • WWTPs design can be phased/modular to accommodate future growth	**Threats:** • Significant reliance upon grant funding • When to press "Go" with confidence in funding availability?

Notes:
WWTP – wastewater treatment plant
RFP – Request for Proposals
RM – Rural Municipality

Table 5-18
North SWOT Analysis – Local Lagoon Expansion

Strengths:	Weaknesses:
• Lower Capital Cost than WWTP • Very Low Operational & Maintenance costs for lagoon itself • No additional staff requirements • Less requirement for sludge handling than WWTP (only once every 10-15 years) • Provides required capacity to Lumsden • Minimal construction disruptions	• Treatment is limited • Cannot expand existing lagoon so new land required elsewhere • Would require pumping station, pipelines and land • May not address odour issues which are a big concern for residents (although could be mitigated through proper design) • Aesthetic concerns of building new lagoon – would be a no go for adjacent developers • High operational cost for pumping to new lagoon • Limited grant funding available
Opportunities:	**Threats:**
• Would facilitate septage hauling (for example, from Regina Beach) if lagoon located on north side • Might offer potential for effluent irrigation but this is dependent on receiving soils and study would be needed. May be problematic after heavy rainfall which would require discharge to river • Potential upgrade to advanced lagoon process to improve effluent quality	• Treatment may not meet future regulatory requirements • Contamination of surface or ground water • Growth could change effluent discharge quality

Notes:
WWTP – wastewater treatment plant

Table 5-19
North SWOT Analysis – Regional Wastewater Pipeline from the Town of Lumsden to the City of Regina's West Wastewater Treatment Plant

Strengths:	Weaknesses:
• Advanced WWTP at Regina allows for higher levels of treatment and better economies of scale (lower cost per cubic metre treated) • Additional skilled operators not required, handled by existing Regina staff • Burden of complex WWTP management shifted away from Lumsden • Greater access for developers to connect to pipeline • Less maintenance spend required compared to WWTP • Would be some smoothing of Regina WWTP peak flows due to transfer main time	• Conveyance system required and several pump station/upgrades to get flows into transfer pipeline • Would not address rural needs without additional infrastructure. However, could potentially rural waste to the pump station • Potentially significant utility costs (under review) • Pipeline capital maintenance costs could be significant in the future • Would still require storage for wet weather flows
Opportunities:	**Threats:**
• Allows for tie-ins / WW connections along conveyance route • Craven could be connected in the future • Diversion of flows from Lumsden to Regina WWTP provides opportunity for beneficial reuse - biogas, biosolids. • Could route pipeline to allow connections to Pense and Grand Coulee	• Difficulties and delays in securing pipeline right of way • Need a tight agreement with City – what would be Lumsden's fall back in event of a conflict? • Concern that Regina plant not fully compliant so what would implications be of pumping to Regina WWTP • (but Regina need to be compliant by 2016 and WWTP upgrades in development)

Notes:
WWTP – wastewater treatment plant
WW - wastewater

Table 5-20
North SWOT Analysis – Regional Wastewater Pipeline from Lumsden to Craven and Upgrade/Expand Craven Lagoons

Strengths: • Shorter conveyance distance	**Weaknesses:** • Would have to buy extra lagoon land now, but owners would not sell or price would be exorbitant if owners aware that it is for a wastewater lagoon • Would still have high pumping costs out of valley in Lumsden and then on to Craven • An analysis of this option was previously carried out by Craven, and the costs were almost as high as pumping flows to Regina • Limited room for population growth • Would still require storage for wet weather flows
Opportunities: • Potential upgrade to advanced lagoon process to improve effluent quality	**Threats:** • Minimal level of treatment at Craven lagoons impacts the local water bodies • Treatment may not meet future regulatory requirements • Lumsden dependent on Craven infrastructure and pipeline maintenance.

5.2.4.1 Conclusions from SWOT Analysis

During the October 2013 Working Session, the related stakeholders agreed it was most suitable for this project to focus on investigating the potential North Regional Wastewater Pipeline and the new WWTP at Lumsden. The other local lagoon upgrades and Lumsden to Craven Wastewater Pipeline were discarded due to the various SWOT points captured above.

5.2.5 Engineering Conceptual Design and Cost Estimates

As concluded in the SWOT Analysis with stakeholders, follow-up investigation and engineering conceptual design of the following options were to be carried out:

- Lumsden to Regina Regional Wastewater Pipeline, from the Town of Lumsden to the City of Regina's West WWTP
- Local WWTP at the Town of Lumsden

Given recent work by Associated Engineering and the recent Request for Proposals (RFP) release for the new advanced treatment plant with the Town of Lumsden, CH2M HILL focused the effort on the pipeline. Information from Associated Engineering's work and the RFP are included in this section of the report for completeness.

5.2.5.1 North Regional Wastewater Pipeline

The North Regional Wastewater Pipeline would be an approximately 30 km long forcemain that would convey wastewater from the Town of Lumsden to the City of Regina's existing WWTP. Figure 5-13 shows a potential layout of the forcemain in aerial view. This involves installation of 400 mm diameter PVC DR 18 pipe laid along the side of the highway; a short section under the railway; a short section under a creek by trenchless installation; installation of air release valves, drain and isolation valves; construction of pump station; and restoration of existing facilities affected by construction. Pipeline sections 1, 2, and 3 in Figure 5-13 align with 10-km sections of the pipeline, and their vertical profiles are illustrated in Appendix L.

Figure 5-13
Layout of the Potential Lumsden Regina Regional North Wastewater Forcemain

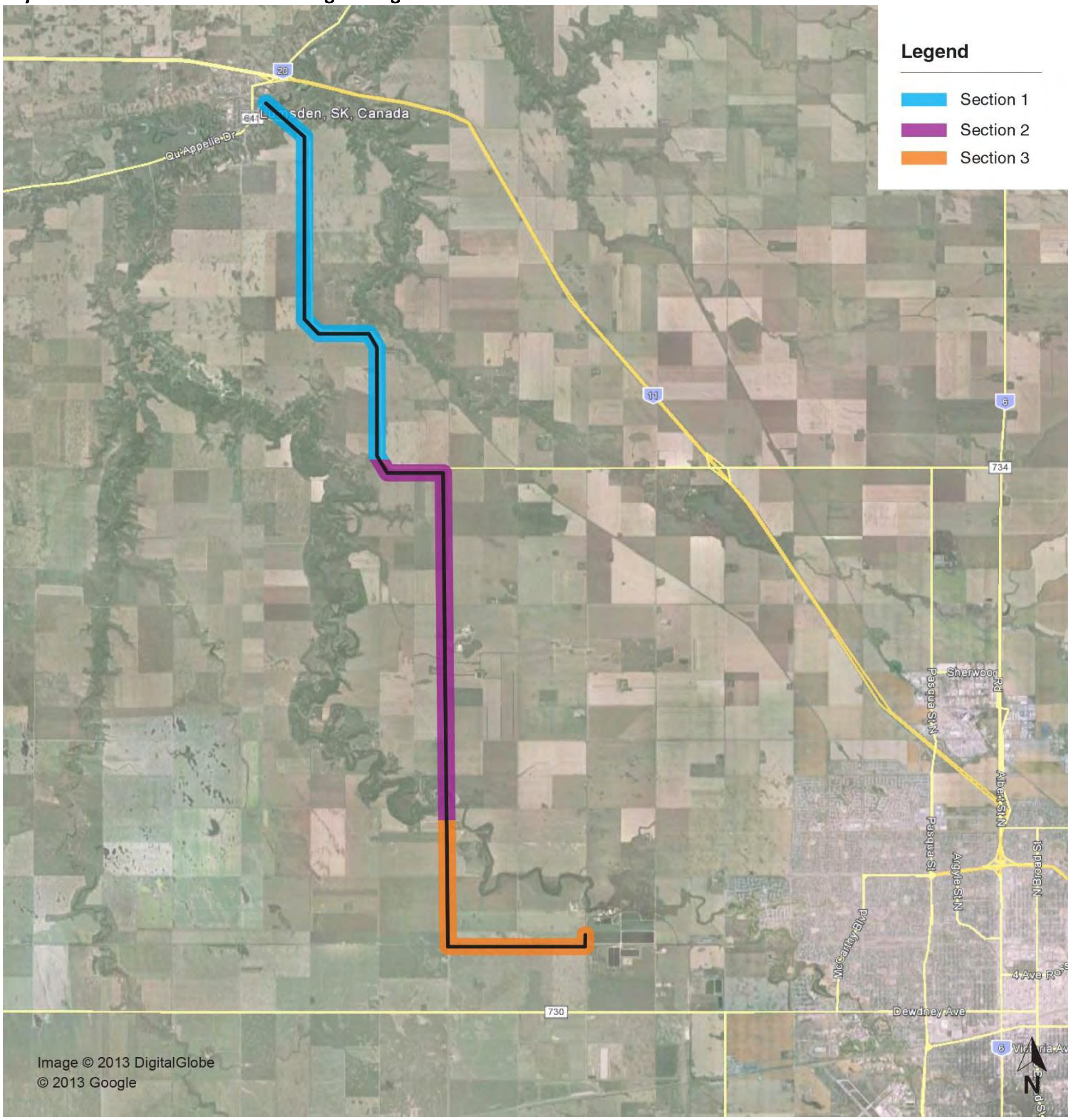
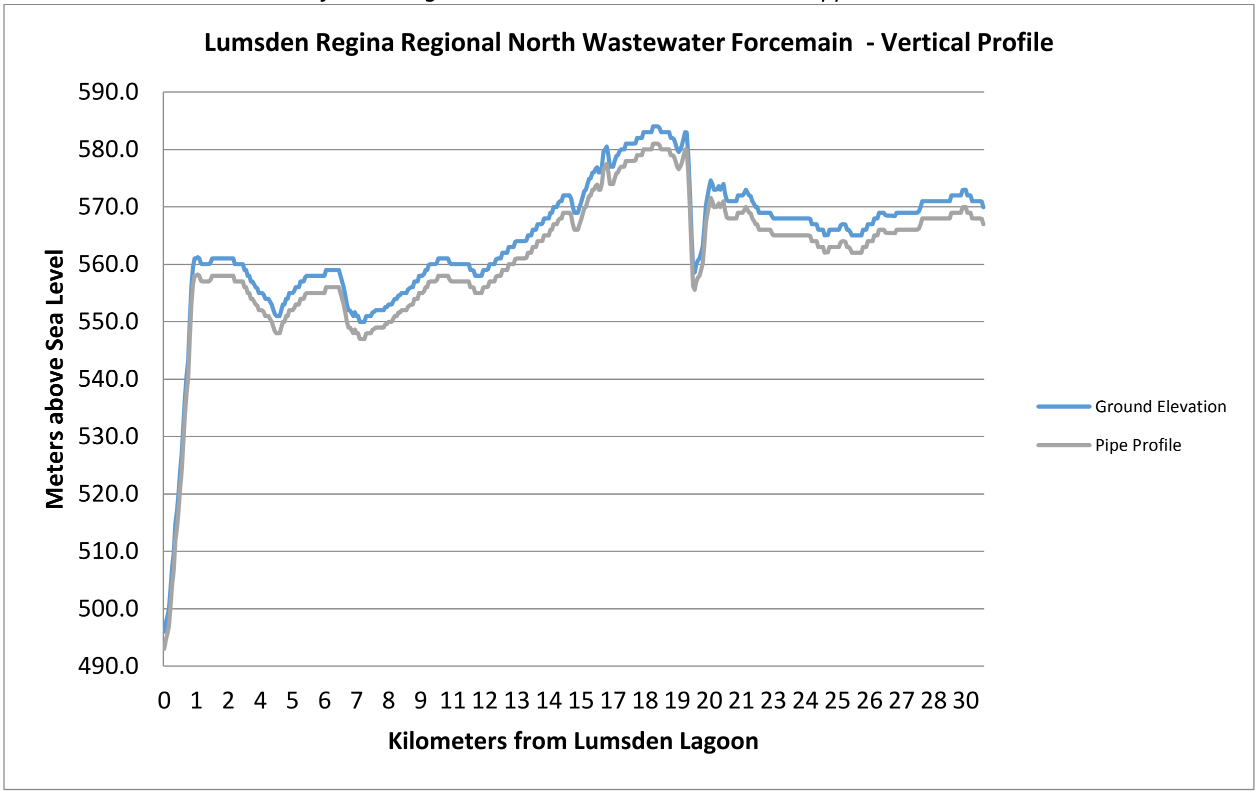


Figure 5-14
Profile of the Potential Lumsden Regina Regional North Wastewater Forcemain
Elevations have been derived from Google Earth and should be considered approximate.



All related data Copyright Google and Digital Globe 2013.

A breakdown of the Vertical Profile graph for each pipeline section is available in Appendix L.

Cost Estimate Overview

Table 5-21 is the overview table of Capital Costs and Operating & Maintenance Costs (including capital replacement of electrical and mechanical components in the pump station at the end of component lifecycle across 30 years) based on 2014 costs.

Table 5-21
North Regional Wastewater Pipeline Cost Estimate Overview (for Capital and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST.) Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$15 million	$30 million	$60 million
Annual O&M /Replacement Costs	$85,000 – $140,000	$170,000 – $280,000	$340,000 – $560,000

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement costs are the first and last full years in the 30 year lifecycle.
O&M – Operations and Maintenance

The Initial Capital Costs noted above, and detailed in Appendix L, included a Pump Station at $2.8 million (excluding engineering and other non-construction costs). Following a review by the City of Regina, it was suggested that (based on a recent similar pump station that the City constructed) this Pump Station would cost closer to $5 million (excluding engineering and other non-construction costs) due to local factors, suppliers, and contractors. It was agreed that the North Regional Wastewater Pipeline cost estimate did not need to be recalculated, as the variance would be absorbed in the estimation range and this was sufficient for this Class 5 estimate. Other Pump Stations proposed in this report for other regional solutions went on to use the estimated cost provided by the City of Regina.

Conceptual Design

The pipeline starts at the site of the existing lagoons in Lumsden located to the northeast side of the town. A pump station at the lagoons would have a large wet well that could potentially allow for the removal of the lagoons to free up land; this possibility would need more analysis.

The pipeline is proposed to be laid primarily along the major road rights-of-way. Near Lumsden, there would be a 50-m length installed under the railway by a trenchless method with steel encasement. The pipeline would follow Highway 734 for approximately 12 km (Section 1), then turn due south on a local county road for approximately 13 km (Section 2). It would then turn due east on Highway 730 and travel approximately 3.5 km before turning due north along the access road to the City of Regina's existing West WWTP for approximately 2.3 km (Section 3). Approximately 19 km from the Lumsden end of the forcemain, the pipeline crosses a local watercourse, Wascana Creek, next to the Sherwood Forest Country Club, where a 200-m section of the pipe would be installed under the creek by a trenchless method. There will be a 3.0-m-diameter manhole at one end of this section for flushing and routine maintenance of the horizontally drilled pipe section. There will be draingage manholes at the low points and air-release/vacuum-relief manholes at the high points in the forcemain.

Figure 5-14 shows the forcemain vertical profile, expanded profiles are available in the Appendices. Elevations have been derived from Google Earth and should be considered approximate. All related data Copyright Google and Digital Globe 2013.

Pipe Sizing

Per the assumptions below and calculations noted in Figure 5-15, a 400-mm-diameter forcemain may be appropriate to service the Town of Lumsden both now and into the future, based on population projections outlined.

- Average daily wastewater flow used was 454 litres per capita per day, per the City of Regina Development Standards Manual.
- The pump station and the forcemain have been sized for peak capacity.
- The velocity in the forcemain is below 1.6 m/s for the current population as well as for the projected population in the year 2040.
- Pipe cover: 3 m average
- Pipe Material: PVC DR 18
- Drainage arrangement at the lowest point in the each pipeline section. There are six such arrangements for this forcemain. Detail W-24 (City of Regina) was used for pricing.
- Near Lumsden, there would be a 50-m length installed under the railway by a trenchless method with steel encasement.
- Approximately 19 km from the Lumsden end of the forcemain, the pipeline crosses a local watercourse, Wascana Creek, next to the Sherwood Forest Country Club, where a 200-m section of the pipe would be installed under the creek by a trenchless method.
- Vertical Fittings: 10 10-degree bends; Horizontal Fittings: 15 45-degree bends

- Isolation valves: Assume they occur every 1,000 m (use City of Regina detail attached), and assume they are plug valves
- Air release manholes: 7 Manholes (CH2MHILL Standard Detail), 100-mm-diameter CARV relief valves on 100-mm DIP, manhole diameter: 2,440 mm (8 feet)
- Land use: Assume it is rural land (and that pipe is laid parallel to major roads)

Figure 5-15
Forcemain Flow Sizing Assumptions

KEY ASSUMPTIONS

Wastewater Flow Per Capita Per Day:	454	lpcd
Minimum Flow Velocity:	0.61	m/s
Maximum Flow Velocity:	1.60	m/s
Extraneous Flow Allowance:	21,000	l/ha/d

Harmon Formula:

$$PeakingFactor = 1 + \frac{14}{4 + \sqrt{Population}}$$

Stakeholder	Area (ha)	Current Pop.	Current Flow (Peak, m^3/d)	FM Size (mm)	Vel. (m/s)
Lumsden	406	1,733	11384.65	400	1.09

Stakeholder	Area (ha)	2040 Pop.	2040 Flow (Peak, m^3/d)	FM Size (mm)	Vel. (m/s)
Lumsden	406	3,078	13323.19	400	1.28

Notes:
lpcd = litres per capita per day
m/s = metres per second
l/ha/d = litres per hectare per day
ha = hectares
m3/d = cubic metres per day
mm = millimetre
m/s = metres per second
FM = forcemain

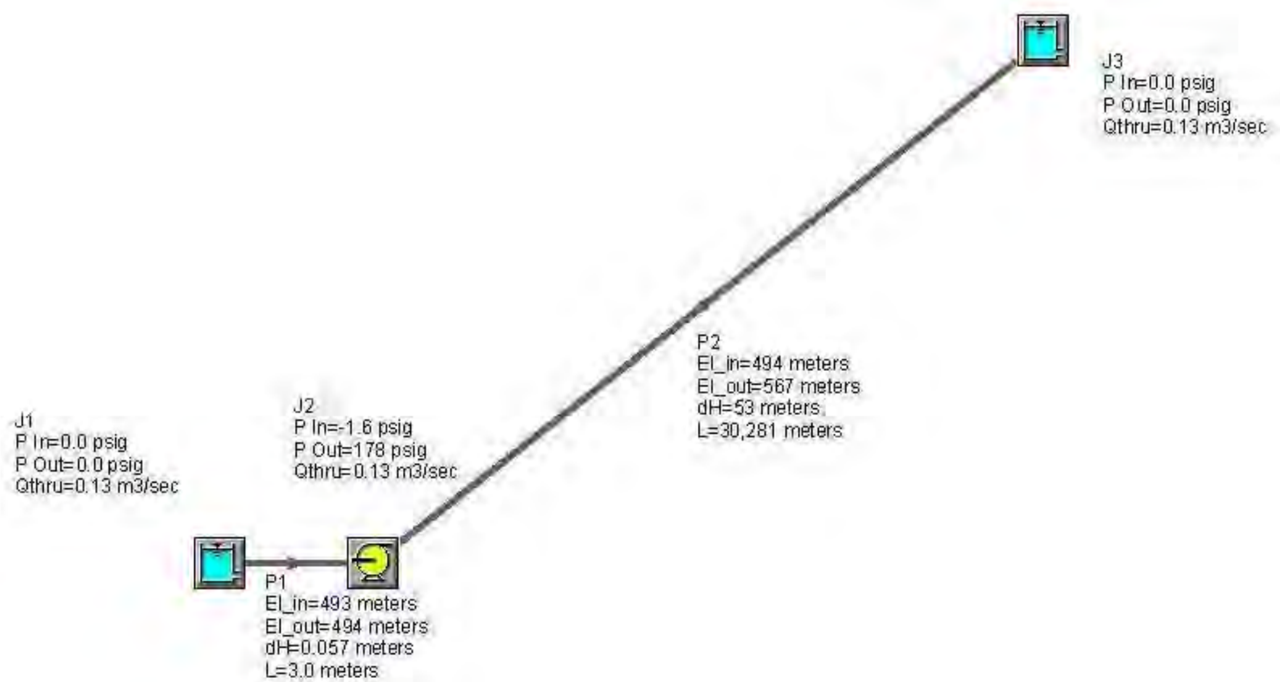
Lumsden Regional Pipeline Pump Station

The assumed pump station is located at the site of Lumsden's wastewater lagoons. Wastewater is expected to be collected through existing systems and will be collected in the pump station's wet well. The pump station may be a typical wet well-dry well pump station operated on the basis of level changes inside the wet well. The pumps would convey the wastewater directly to the RRWWTP.

Based on the parameters in Figure 5-16, a model was created in AFT Fathom for pump sizing and to determine basic design parameters. The operating point of pumps was chosen as 468 m^3/hr at 55-m head. A visual representation of this model is shown in Figure 5-17. The pump station was designed based on the following assumptions:

- The pump station and the forcemain have been sized for peak capacity.
- Figure 5-17 summarizes the major sizing parameters used for design.
- Number of Pump stations: 1
- Number of Pumps: 2 (1 duty, 1 standby), submersibles 455 hp.
- Type of Pump station: Wet well-Dry well
- Wet well Size: 88 m^3 wet well (80 m^3 filled, assume 10 percent headboard)
- VFD–equipped?: Yes
- Location: Existing lagoons site (land owned by Town of Lumsden)
- Pumps: Assumed 468 m^3/hr at 55-m head (2.053 gpm at 78 psi)
- Power source: existing power source available at lagoon site
- Standby Power Source: 500-kW diesel generator, generator room adjacent to pump house

Figure 5-16
AFT Fathom Model for the Lumsden Regina Wastewater Pipeline Pumping Station Located at the Existing Lumsden Lagoon Site



A design template for this pump station and other wastewater regional pump stations is provided in Appendix H.

Capital Cost Estimate

The following is a summary of the costs. Costs are provided in 2014 Canadian Dollars, excluding PST and GST.

Table 5-22
North Regional Wastewater Pipeline Cost Estimate Overview for Capital Direct Construction Costs of the East Regina Water Distribution System (based on 2014 costs). Calculated numbers were rounded to the nearest significant figure.

Low Range (-50%)	Estimated Costs	High Range (+100%)
$15 million	$30 million	$60 million

This cost estimate has been prepared for guidance in project evaluation based upon the information available at the time of the estimate. The final costs of the project will depend on the actual pipeline route and pump station location; the actual labour and material costs; competitive market conditions; final project costs; implementation schedule; and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to make specific financial decisions.

Capital Cost Assumptions

Markups

The project will be tendered based on unit price bidding. All markups, contingencies, and other factors are included in the Unit Price.

Table 5-23
General Contractor Markups

Overhead	Included in Unit Price
Profit	Included in Unit Price
Mobilization/Demobilization	Separate line item in Estimate
Contingency	Separate line item in Estimate
Escalation Rate	4.28%

Escalation Rate

The estimate includes Escalation with the assumption that construction will start around May 2014 with the midpoint of construction being October 2014. It is assumed that there will be 10 months of construction ending around March 2015.

The escalation forecast was calculated using CH2M HILL's proprietary escalation model which incorporates economic data from sources such as Global Insight, Inc.

Estimate Classification

This cost estimate is considered a Budget or Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). It is considered accurate from minus 50 percent to plus 100 percent, based on a conceptual design deliverable.

Estimate Methodology

This cost estimate is considered a bottom rolled up type estimate with cost items and breakdown of Labour, Materials, and Equipment. Some quotations were obtained for various items. The estimate may include allowance cost and dollars per square meter cost for certain components of the estimate.

Construction Labor Costs

The labour cost is built into the unit price of the items in the estimate.

Operating and Maintenance Cost Estimate

This section presents the O&M costs for the Lumsden Regina Wastewater Pipeline for the period of January 1, 2014, to January 1, 2044, and explains the critical assumptions used to arrive at the cost estimate. The 30-year O&M costs are presented in Appendix L.

Data used for the initial capital costs came from preliminary design concepts for the forcemain from CH2M HILL. O&M/Replacement costs have been broken into five categories:

- Labour
- Power
- Maintenance
- Replacement (capital equipment replacement)
- Other Direct Costs

O&M Cost Assumptions

Costing assumptions used to calculate the 30-year O&M expenditures are presented in Table 5-24.

Table 5-24
General O&M Cost Assumptions

Exchange Rate (CAD/USD)	1.04
Discount Rate	4%
Growth Rate of Average Annual Flows (AAF)	2%

Notes:
O&M – Operations and Maintenance
CAD – Canadian dollars
USD – US dollars

Labour

- Assume 1 part-time full time equivalent (FTE) at approximately 208 hours per year. "Mechanic" capable of performing preventative and corrective maintenance on equipment. Assumed that this person would be assigned to other mechanical duties within the region.
- Wage is $22.26 CAD per hour. This is at the top of the 3rd quartile wage range for a "Mechanic" position with CH2M HILL in Canada.
- Fringe multiplier = 1.34, Overtime multiplier = 1.50, Overtime frequency = 5 percent

Power

- Assume electricity power tariff is Sask Power rate E8 (rural).
  - Composite rate of Energy Charge, Demand Charge, and monthly fee is 6.837 cents per kilowatt-hour (₵/kWh).
- Motor loads and duty/standby status data was obtained from CH2M HILL preliminary design information and submersible pumps with VFDs. Motor run times are estimated based on Average Annual Flow (AAF) in 2024 and are scaled to reflect increases in flow.
- 90 percent load factor and 85 percent efficiency factor are assumed for equipment drives.

Maintenance

- Fixed percentages of the capital equipment cost are used based on typical O&M operations throughout the US and Canada.
  - 0.50 percent annually for Preventative Maintenance
  - 1 percent annually for Corrective Maintenance in 2015, scaled to 2 percent annually in 2043
- Preventative and corrective maintenance costs were calculated based upon the capital equipment listed in this conceptual design. The following costs were used but do not include construction, civil, or other costs associated with construction of the facility.

Table 5-25
Maintenance Cost Breakdown

Process Mechanical	$ 257,000
EI&C	$ 60,000
Building Mechanical	$ 15,000

Notes:
E&IC – electrical instrumentation and controls

Replacement

- Equipment is estimated from the list of capital equipment in conceptual design.
- Average lifespan and replacement costs for each piece of equipment are estimated using standard CH2M HILL tables for each specific type of equipment.
- Replacement of duty and standby equipment are estimated at the same rate.
- Replacement costs have been allocated with a stochastic model to account for equipment failures before and after the average lifespan.

Other Direct Costs

- Other direct costs (ODC) were calculated based on standard CH2M HILL project expenses. ODC include items for the, safety supplies, miscellaneous travel expenses, vehicles, and other employee expenses. These were scaled to the size of the facility based on 0.1 FTE.

Design and Cost Estimate References

- *Guidelines for Sewage Works Design*, EPB 203 (Environmental Protection Branch), Saskatchewan Ministry of Environment.
- Development Standards Manual, 2010, City of Regina
- Wastewater flows have been derived from guidelines and formulas in the City of Regina's *Development Standards Manual*
- CH2M HILL conceptual design documents, internal sketches and data presented in this report
- R.S. Means
- Vendor quotes on equipment and materials, where appropriate
- CH2M HILL Historical Data
- CH2M HILL Engineer and Estimator Judgment

5.2.5.2 Lumsden Wastewater Treatment Plant

The most appropriate local treatment option for the Town of Lumsden is to construct a WWTP. Lumsden had already made some progress with this option a few years ago and contracted Associated Engineering to develop a high level preliminary design for location of the plant *(*AE, 2011*)*.

Both the 2011 Extended Aeration WWTP and the 2013 RFP Advanced WWTP used the design flows outlined in Table 5-27.

Table 5-26
Lumsden: Current (2011) and Design (2040) Flows for Wastewater Treatment Facility

Year	Average Dry Weather Flow (ADWF) m^3/d	Average Annual Flow (AAF) m^3/d	Maximum Monthly Flow (MMF) m^3/d	Maximum Daily Flow (MDF) m^3/d	Maximum Hourly Flow (MHF) m^3/d
2011	550	600	750	1,653	2,303
2040	1,000	1,100	1,375	3,000	4,200

Notes:
m^3/d – cubic metres per day

Predesign and Cost Estimate for Extended Aeration WWTP, 2011

As outlined in the predesign report *(*AE, 2011*),* "Preliminary design is based on the extended aeration process with nitrification and de-nitrification and UV disinfection and aerobic digestion of biosolids. Biological treatment will take place in annular shaped, concrete bioreactors with circular secondary clarifiers located in the middle of the bioreactors. Initial build-out will include two process trains, each sized to treat 75% of the design average annual flow. Spatial provision will be made for two additional process trains to be added in the future if real growth exceeds projected growth. The site for the WWTF, chosen during conceptual design is down the hill from the landfill, north of the railway tracks."

"The total preliminary *capital cost estimate for the project, including on-site and off-site items is $10.8M in 2011 dollars. Assuming 4% annual inflation, the preliminary capital cost estimate in 2014 dollars is $12.1 M.* Cost estimates exclude tax. On-site costs include the capital investment for the initial build-out of all plant components. Off-site costs include utility servicing, the access road to the site, the effluent outfall pipeline and structure, pumping station and forcemain upgrades and lagoon decommissioning."

"Annual *operation and maintenance costs are expected to be between $240,000 and $280,000 per year (2011 dollars)*. The 25-year lifecycle cost of the facility is $13.3M in 2011 dollars. The 25-year lifecycle analysis is for the years 2015 to 2040."

More detailed information in addition to the above extract is available in the document *Associated Engineering Preliminary Design Report, December 2011* (AE, 2011).

As part of this study, CH2M HILL reviewed and revised the O&M Costs for the Extended Aeration Upgrade WWTP to provide Lumsden with another data point for comparison purposes. The revised Operating, Maintenance, and Replacement costs are in Appendix L.

Below is the overview table of Capital Costs and O&M Costs (including capital replacement of electrical and mechanical components in the pump station at the end of component lifecycle across 30 years) based on information from Associated Engineering's 2011 report (AE, 2011) and CH2M HILL's 2014 costs.

Table 5-27
Local Extended Aeration Upgrade Wastewater Treatment Plant in Lumsden
Capital Costs from Associated Engineering's predesign in 2011, and O&M from CH2M HILL's cost estimates in 2013. Costs exclude GST and PST. For consistency it is assumed that Associated Engineering's cost are also Class 5 and have associated tolerances. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	\$6 million	\$11 million	\$22 million
Annual O&M /Replacement Costs	\$110,000 – \$200,000	\$220,000 – \$390,000	\$440,000 – \$770,000

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement costs are the first and last full years in the 30 year lifecycle.

The Extended Aeration WWTP was designed with the effluent parameters outlined in Table 5-29.

Table 5-28
Lumsden Extended Aeration Wastewater Treatment Plant: Effluent Parameters

Wastewater Parameter	Design Parameter
Carbonaceous Biochemical Oxygen Demand (CBOD 5)	15 mg/L
Total Suspended Solids (TSS)	20.0 mg /L
Total Residual Chlorine	-
Total Kjeldahl Nitrogen (TKN)	10 mg/L Summer 12 mg/L Winter
Ammonia (NH_3-N)	4 mg/L Summer 10 mg/L Winter
Total Phosphorous (TP)	1.0 mg/L
Fecal coliforms	200 CFU/100 ml

Notes:
mg/L – milligrams per litre
CFU/100 ml – colony-forming units per 100 millilitres

Predesign Engineering Contract for Advanced Wastewater Treatment Plant, 2013

The Town of Lumsden issued an RFP in November 2013 for the "submission of proposals from qualified engineering firms for a preliminary design and a detailed design including the preparation of tender drawings and documents for a MBR (Membrane Bioreactor) *(or other suitable treatment technology)* wastewater treatment facility to meet the needs of the Town of Lumsden and surrounding contributing area for the next 25 to 30 years." Table 5-28 and Table 5-29 outline the design parameters within the RFP.

Table 5-29
Lumsden Wastewater Treatment Plant Request for Proposal: Design Effluent Parameters

Wastewater Parameter	Design Parameter
Carbonaceous Biochemical Oxygen Demand (CBOD 5)	5 mg/L
Total Suspended Solids (TSS)	5.0 mg /L
Total Residual Chlorine	0.0 mg/L
Total Kjeldahl Nitrogen (TKN)	10 mg/L Summer 12 mg/L Winter
Ammonia (NH3-N)	4 mg/L Summer 10 mg/L Winter
Total Phosphorous (TP)	1.0 mg/L
Fecal coliforms	200 CFU/100 ml

Notes:
WWTP – wastewater treatment plant
RFP – Request for Proposals
mg/L – milligrams per litre
CFU/100 ml – colony-forming units per 100 millilitres

The RFP also stated the desire that the treatment facility be under construction by 2015 with completion no later than June 2016.

It is understood that a driver behind moving to an advanced WWTP technology was to attain a capital funding grant from the province. Lumsden has already recognized that the challenges associated with the advanced WWTP option included significantly more complex and costly operations; this situation was also noted through the SWOT Working Session.

Several firms responded to the RFP; however, in light of the alternate North Regional Wastewater Pipeline servicing solution, the Town of Lumsden has taken some time to fully evaluate the options before awarding any engineering contract.

5.2.6 Evaluation

The conceptual design and cost estimate for the North Regional Wastewater Pipeline was delivered to the City of Regina and the Town of Lumsden in December 2013. This was done to help provide more regional data to facilitate the decision-making process.

It was agreed between the Town of Lumsden, the City of Regina, and CH2M HILL that a formal evaluation session (that is, Triple Bottom Line) was not required, as the previous SWOT Working Session and Cost Estimates provided the Lumsden team with the information they required at that stage.

The conceptual design for the North Regional Wastewater Pipeline suggests that a suitable pipeline route would follow the road adjacent to the country club. The RM of Sherwood expressed interest in connecting to this regional pipeline to service wastewater in the new development (and potentially in connecting the Sherwood Forest Country Club). This would reduce the costs associated with building and maintaining the regional pipeline, as they could be shared among the Town of Lumsden, the RM of Sherwood, and any other new large communities arising within either the RM of Sherwood or the RM of Lumsden in the future.

5.3 East Wastewater Servicing Options

As part of the RRWWS, potential solutions to solve wastewater challenges in the East region of the study area were developed for discussion, and they are presented in this section. These include population projections used to determine the future demands, and details of the high level designs and cost estimates for the regional pipeline and regional WWTP options for communities in the East region of the study and communities in the east sectors of the City of Regina.

For the purposes of this study, communities in the East region of the study include the following: City of Regina, Pilot Butte, Balgonie, White City, RM of Edenwold, Sakimay First Nation, and the Village of Edenwold. For the main options outlined, the Village of Edenwold is excluded from the solutions due to its geographical position in the region; Section 5.3.8 evaluates the situation in the Village of Edenwold. Limited information has been available from the RM of Edenwold, and assumptions have been made on Emerald Park to include in the options with White City; however, further understanding is required. No information was available from the RM of Sherwood: as a result, wastewater demands from the region have not been included.

White City and Emerald Park in the east are facing immediate challenges; Pilot Butte and Balgonie do not face immediate challenges, but they will run into hydraulic capacity problems in the coming years due to high growth. For these communities in the East, hydraulic capacity is a particular issue over winter months as frozen creeks mean they are required to store treated effluent over winter months. Moving into the medium term, the City of Regina will require additional wastewater capacity in the East to meet growth plans. There is a real opportunity for a larger regional wastewater solution in the East that could service the East Region into the future; however, implementation timing presents a significant challenge for stakeholders.

This section considers the following options for wastewater servicing in the East region:

- Local Options: local WCRM158 WWTP; local lagoon upgrades for Balgonie and Pilot Butte, and City of Regina conveyance upgrades
- East Regional Wastewater Pipeline: needs all stakeholders on board; flexibility to add East Regional WWTP in the future; further investigation and modelling required of existing City of Regina conveyance and regional lagoons
- East Regional WWTP: needs all stakeholders on board; could be led by Regional board; eases City conveyance challenges
- Interim Options: wastewater tankering / hauling; temporary package treatment plants; water conservation; further investigation required

The options presented are not isolated options, and the appropriate solutions will be a combination of these options. For example, the local WWTP option for WCRM158 would also require local lagoon upgrades at Pilot Butte and Balgonie, as well as upgrades within the City of Regina. Further investigation of existing City of Regina conveyance in dealing with regional flows is required with complex engineering models necessary and discussions to be held around regional partners contributing to this infrastructure.

As mentioned, timing will be a significant challenge. White City and Emerald Park are currently facing wastewater servicing challenges and are facing growth restrictions as a result. These communities wish to put in place a solution as soon as possible, so wastewater regulatory obligations are met and growth is not disrupted. While regional options are viable from an engineering perspective, they will take longer to implement. As a result, interim options were investigated and are documented in Section 5.5 that would ‘buy time’ for stakeholders with immediate challenges prior to a regional solution being operational. The duration of this interim solution would be dependent on the timeframe to negotiate and construct the pipeline. Engineering and construction can be accelerated, but the duration is mainly dependent on politics between stakeholders involved and agreement on the other aspects of the pipeline and future treatment options (including governance and rate setting approaches). This duration could be drastically decreased and delivery accelerated if all stakeholders make a concerted effort to work through challenges, particularly at the political level.

The Village of Edenwold was considered separately due to geographical challenges. It is located 18 km from the nearest town in the study area (Balgonie) and further still from other communities considered to be in the East Region. Regional opportunities for the Village of Edenwold are considered with the Town of Balgonie (or White City) and are also suggested with the more local First Nations' communities. The Village of Edenwold is facing challenges on both sides: raw water supply is limited during periods of drought, and wastewater treatment is operating at capacity. The WTP and wastewater lagoons are managed under contract by SaskWater; the Village of Edenwold is responsible for distribution and collection. In addition to the service challenges, there is also a physical constraint on land use which is halting development and infrastructure improvement. Section 5.3.8 provides more detail on the investigation carried out into solutions for the Village of Edenwold.

5.3.1 Assumptions and Risks

5.3.1.1 Solution Timeframe

During the first phase of the study in 2013, wastewater was identified as a short-term challenge for several communities in the East region. Short-term solutions were reviewed by the engineering team; however, given the nature of their service challenges and the significant projected growth expected by the communities, short-term solutions were were ruled out as an appropriate fix to the problem. The costs associated with short-term solutions were often found to be comparable with longer term solutions for wastewater: as a result, the focus moved toward developing and evaluating longer term solutions.

This report, therefore, focuses on longer term solutions, through 2040, for the East regional communities. Associated with the longer term solutions are potentially longer development times, particularly in terms of governance/political/administration challenges associated with collective efforts. As a result, temporary solutions will be important for a number of regional stakeholders who are already in the midst of wastewater servicing challenges affecting growth. These interim wastewater solutions are explained in Section 5.5.

5.3.1.2 East Population Assumptions

- Population assumptions varied over the course of the study and the best available information was used at the time. Please refer to specific engineering options to understand which population numbers were used.
- Requirements from agricultural/potash/other industrial users (for example, the jail) have not been included in the wastewater flow projections.

5.3.1.3 CH2M HILL Cost Estimate Assumptions

This estimate is considered a Class 5 and is based on a conceptual level design. Costs are to be considered accurate from minus 50 percent to plus 100 percent.

This estimate should be evaluated for market changes after 90 days of the issue date.

The estimate includes allowances for various items shown on detail estimate sheets in the appendices.

The capital estimate is based on the assumption that the work will be done on a competitive bid basis and that the contractor will have a reasonable amount of time to complete the work. All contractors are equal, with a reasonable project schedule, no overtime, constructed as under a single contract, no liquidated damages.

The Net Present Value calculation assumes a 4 percent discount rate as used by the City of Regina.

Both Capital and O&M Costs are expressed in Canadian Dollars.

The cost estimate excludes the following costs:

- Total 5 percent GST Tax is excluded in the estimate. PST is included in local material costs, but may not be included in other services.
- Non-construction or soft costs; services during construction; and land, legal, and owner administration costs, are excluded.
- A small allowance has been made for land acquisition/compensation, but this needs local input from stakeholders.
- Material Adjustment allowances above and beyond what is included at the time of the cost estimate are excluded.

5.3.2 Demand Projections and Service Challenges

Population numbers and growth projections were validated by stakeholders via email or during the December 2013 and February 2014 Working Session. During the course of the project, population numbers fluctuated as stakeholders released more information or adjusted population projections. To ensure the overall project was not delayed, engineering conceptual design was done based on the best information available at the time. As a result, slightly different population numbers were used when costing the solutions. The engineering options presented in this report each note which population numbers were used. Redeveloping the engineering options for the minor difference in population was deemed to add little value at high cost; as a result, redesign was not conducted. The population projections presented in this table represent the very latest and confirmed population numbers for the communities.

As per the Population Projections in Section 3, Figure 5-17 shows the cumulative population projections for the existing communities and planned developments to the East of Regina from 2013 to 2040, assuming the high growth scenario in all communities. Communities to the East of Regina include the following: Pilot Butte, White City, Balgonie, RM of Edenwold, and Sakimay First Nation. Currently, the cumulative population is approximately 12,000 residents. In 2040, the cumulative population is projected to be just over 35,000 residents. This results in an AAGR of approximately 4.1 percent in the East. In summary, growth in the East is anticipated to be fast over the next 25 years.

The population from the Village of Edenwold has not been included in this graph, as the community is being considered separately for regional servicing. Population projections for the Village of Edenwold are detailed later in this report.

Population projections were not available from the RM of Sherwood at the time of the study; as such, numbers for communities within this RM have not been included.

Figure 5-17
East Region - Cumulative Population Projections from 2013 to 2040, assuming High Growth Scenarios

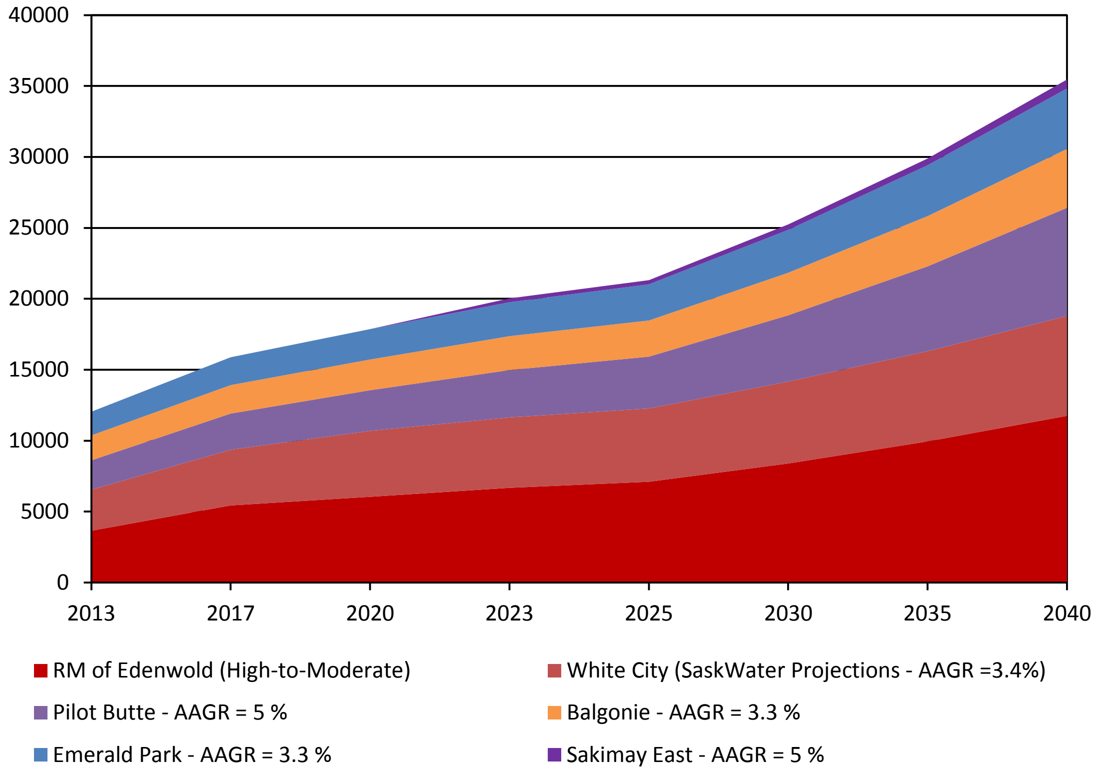
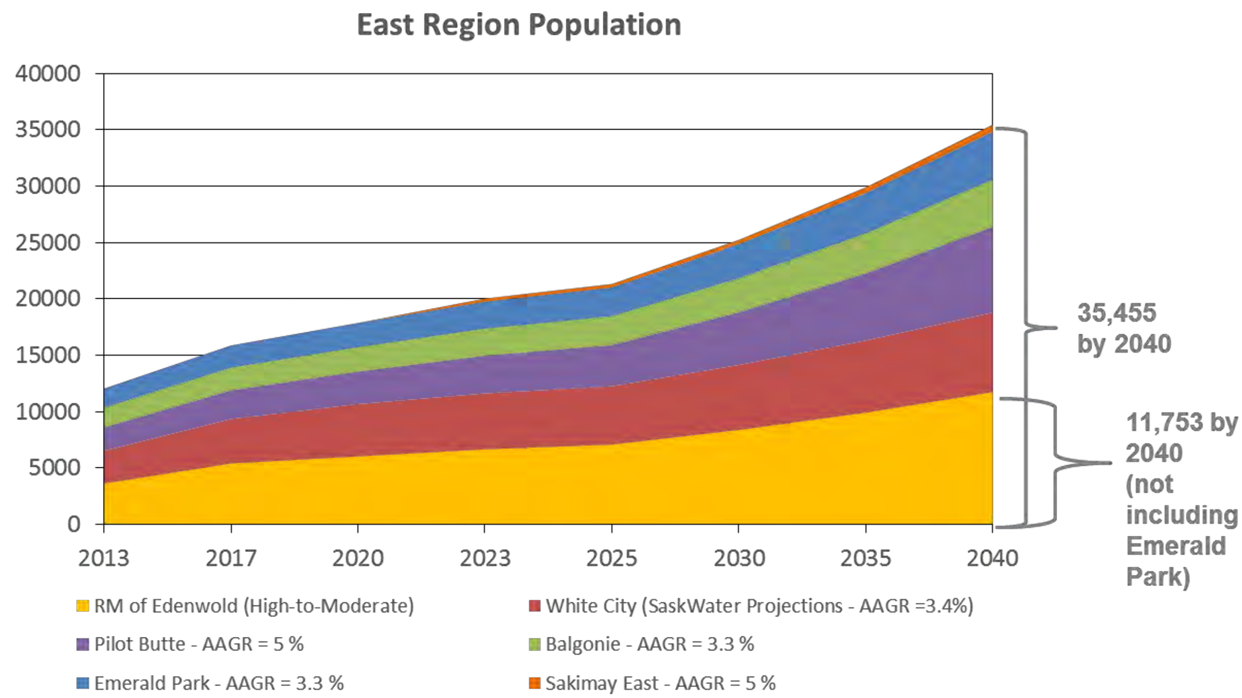


Table 5-30
East Region - Cumulative Population Projections from 2013 to 2040 (data), assuming High Growth Scenarios

Town/Municipality	AAGR (%)	2013	2017	2020	2023[a]	2025	2030	2035	2040
White City	**3.4 %**	2895	3937	4631	4950	5163	5757	6381	7045
Balgonie	**3.3 %**	1748	2005	2176	2407	2560	3011	3542	4166
Pilot Butte	**5.0 %**	2074	2550	2867	3342	3659	4670	5960	7607
Emerald Park	**3.5 %**	1683	1958	2141	2382	2543	3020	3587	4261
RM of Edenwold[b]	**16 % to 3.4 %**	3647	5423	6051	6679	7097	8397	9934	11753
Sakimay East	**5.0 %**	-	-	-	272	300	383	488	623
Total		12046	15872	17866	20032	21322	25238	29893	35455

Notes:
[a]Numbers interpolated from data available in order to populate an appropriate trend for the population graph in the above figure.
[b]RM of Edenwold population projections do not include Emerald Park as they are listed separately. Population numbers are yet to be confirmed by the RM of Edenwold.
Notes:
AAGR – Average Annual Growth Rate
RM – Rural Municipality

Figure 5-18
East Regional Population Projections Graph



**RM of Edenwold AAGR varies from 16 percent to 3.4 percent*

Figure 5-19
City of Regina Population Projection Graph

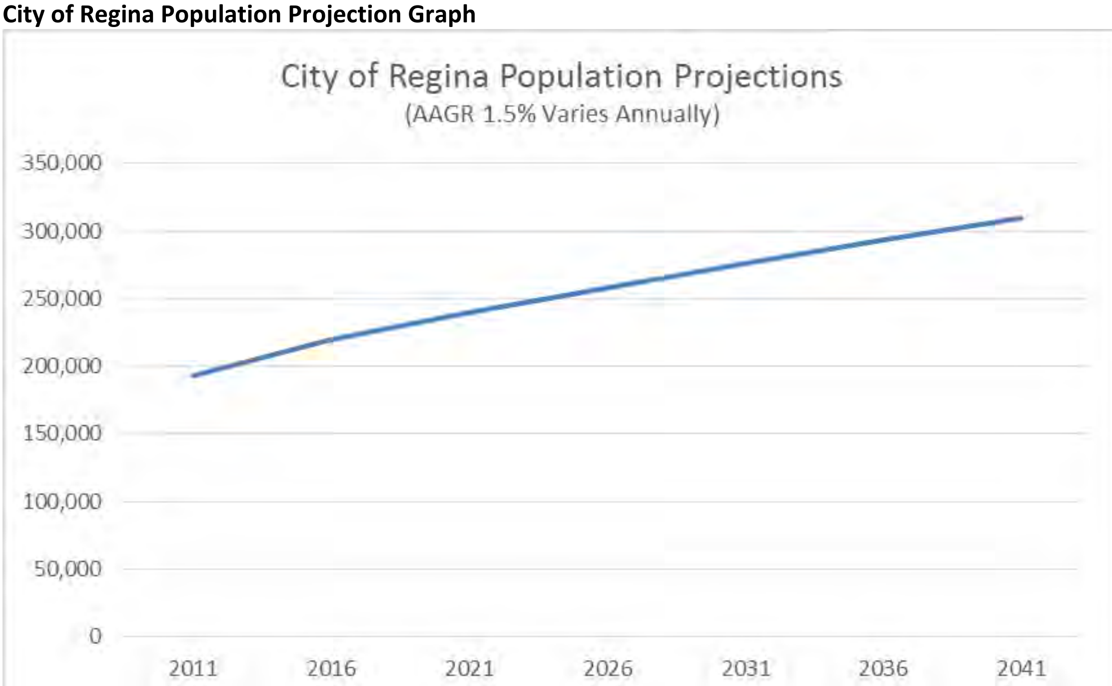


Table 5-31
City of Regina Population Projection (data table)

	AAGR	2011	2016	2021	2026	2031	2036	2041
City of Regina Population Projection	1.5% Varies Annually	193,100	219,892	239,421	257,917	275,879	292,887	309,740

Notes:
AAGR – Average Annual Growth Rate

5.3.3 Servicing Options

During the early stages of the study, after collecting information on the stakeholders' current infrastructure and servicing challenges, the following options were identified as potential solutions to the understood challenges:

- Local lagoon expansion and/or upgrades for all regional stakeholders and City of Regina conveyance upgrades
- Local WWTP addition at White City/Emerald Park (WCRM158), lagoon expansion/upgrades at Pilot Butte and Balgonie; excludes City of Regina conveyance upgrades
- Local WWTP additions for all regional stakeholders; excludes City of Regina conveyance upgrades
- Regional WWTP at White City/Emerald Park (WCRM158) with regional pipeline connecting Pilot Butte, Balgonie, and Sakimay; excludes City of Regina conveyance upgrades; City of Regina could connect to local plant, but sizable upgrades would be required and conveyance would be uphill
- East Regional Wastewater Pipeline connecting White City/Emerald Park (WCRM158), Pilot Butte, Balgonie, Sakimay, and the City of Regina, to a new East Regional WWTP
- East Regional Wastewater Pipeline connecting White City/Emerald Park (WCRM158), Pilot Butte, Balgonie, Sakimay, and the City of Regina; and City of Regina conveyance upgrades to transport wastewater to the City's existing West WWTP

5.3.4 SWOT Analysis

Table 5-32 to Table 5-37 document the SWOT Analysis completed with the stakeholders from the region at the October Working Session, held on October 30, 2013, at the George Bothwell Library in Regina.

A SWOT Analysis is a structured way of evaluation options, capturing Strengths, Weaknesses, Opportunities and Threats. During the working sessions, the stakeholders were facilitated through the analysis by CH2M HILL team members, with the SWOT titles used as prompts to gather feedback from the stakeholders on the options. The bullet points captured in Table 5-32 through Table 5-37 are not an exhaustive list of all points associated with each of the options; instead, they are a list of the significant points that were at the forefront of stakeholders' minds.

Table 5-32
East SWOT Analysis – Local Lagoon Upgrades for all Stakeholders and City of Regina Conveyance Upgrades

Strengths: • Appears to be low engineering cost alternative (land may be expensive) • Simplistic operation and maintenance • No additional staff requirements • Minimal construction disruption • Provides required capacity to communities faster to accommodate pending growth • No new conveyance system required • No change to community facilities • Regina Conveyance Upgrades improve existing Level of Service in City • High demand for Balgonie effluent for irrigation	**Weaknesses:** • Effluent discharge still a problem • Treatment is limited (minimum standards for secondary treatment only) • Potential for odours • Significant land maybe required, plus buffer zone, land for certain communities is very expensive: $5,000/acre in Balgonie versus $100,000/acre in White City • Limited flexibility for future expansion and growth (limited by area) • Regina Conveyance Upgrades would require significant urban construction • Minimal benefit to land/environment, e.g. biosolids reuse
Opportunities: • Potential upgrade to advanced lagoon process to improve effluent quality • Growth immediately outside of Regina East boundary could be easily accommodated in future	**Threats:** • Minimal level of treatment impacts quality of local water courses • Contamination of surface or ground water • Treatment may not meet future regulatory requirements • Growth might change effluent quality

Table 5-33
East SWOT Analysis – New Local WWTP at White City/Emerald Park (WCRM158) and Lagoon Upgrades at Pilot Butte and Balgonie
Excludes Sakimay FN and City of Regina servicing upgrades required, particularly in the East sectors of the City

Strengths: • As per Lagoon option in Table 5-34 • Mechanical WWTPs allow for higher levels of treatment • Lower odour challenges at White City/Emerald Park • Reduced lagoon buffer zone for White City/Emerald Park, can reuse land in future • Provides capacity for local future growth • No new conveyance systems required • Potential for land requirements reduction • High demand for Balgonie effluent for irrigation	**Weaknesses:** • As per Lagoon option in Table 5-34 • Significant capital investment for the WWTPs • Flow demand at each is relatively low for a WWTP – cost would be high per cubic metre treated • Construction will cause disruption to existing works and communities • Operators require higher level of training/certification • Complex process, more maintenance required • Decentralized treatment is more expensive on a per capita basis (capital and operating) • Potentially still dependent on seasonal discharge (tbc) • Minimal benefit to land/environment, e.g. biosolids reuse
Opportunities: • As per Lagoon option in Table 5-34 • Growth outside of Regina East boundary could be easily accommodated in future • WWTPs design can be phased/modular to accommodate future growth • Other East communities could be connected in the future to the WCRM158 WWTP	**Threats:** • As per Lagoon option in Table 5-34 • Time period for design and construction may delay growth • Rising operating costs • Lack of qualified operations staff • Economic strain on local municipality/community, funding capital maintenance and upgrades

Notes:
WWTP – wastewater treatment plant
tbc – to be confirmed

Table 5-34
East SWOT Analysis – New Local WWTPs at White City/Emerald Park (WCRM158), Pilot Butte and Balgonie
Excludes Sakimay FN and City of Regina servicing upgrades required, particularly in the East sectors of the City

Strengths:	**Weaknesses:**
• Mechanical WWTPs allow for higher levels of treatment • Provides capacity for local future growth • No new conveyance systems required • Potential for land requirements reduction • High demand for Balgonie effluent for irrigation	• Significant capital investment for the WWTPs • Flow demand at each is relatively low for a WWTP – cost would be high per cubic metre treated • Construction will cause disruption to existing works and communities • Operators require higher level of training/certification • Complex process, more maintenance required • Decentralized treatment is more expensive on a per capita basis (capital and operating) • Potentially still dependent on seasonal discharge (tbc)
Opportunities:	**Threats:**
• WWTPs design can be phased/modular to accommodate future growth • Option for local reuse / irrigation	• Time period for design and construction may delay growth. • Rising operating costs • Lack of qualified operations staff • Economic strain on local municipality/community, funding capital maintenance and upgrades • Second City WWTP for Regina will be difficult to sell following pending West WWTP Upgrade

Notes:
FN – First Nation
WWTP – wastewater treatment plant

Table 5-35
East SWOT Analysis – Regional WWTP at White City/Emerald Park (WCRM158) and Regional Pipeline connecting Pilot Butte, Balgonie, and Sakimay
Excludes City of Regina servicing upgrades required, particularly in the East sectors of the City

Strengths:	**Weaknesses:**
• Mechanical WWTPs allow for higher levels of treatment • Provides capacity for local future growth • Potential for land requirements reduction • White City can use regional payments to offset capital investments • Regina Conveyance Upgrades improve existing Level of Service in City • Shared cost with additional communities	• Significant capital investment for the WWTPs • Flow demand at each is low – cost would be high per cubic metre treated • Construction will cause disruption to existing works and communities • Operators require higher level of training/certification • Complex process, more maintenance required • Decentralized treatment is more expensive on a per capita basis (capital and operating) • Potentially still dependent on seasonal discharge (tbc) • Regina Conveyance Upgrades would require significant urban construction • High demand for Balgonie effluent for irrigation
Opportunities:	**Threats:**
• Growth outside of Regina East boundary could be easily accommodated in future • WWTPs design can be phased/modular to accommodate future growth • Other East communities could be connected in the future to the WCRM158 WWTP	• Time period for design and construction may delay growth • Rising operating costs • Lack of qualified operations staff • Economic strain on local municipality/community • Bigger divide between Region and City of Regina

Notes:
WWTP – wastewater treatment plant
tbc – to be confirmed

Table 5-36
East SWOT Analysis – Regional East WWTP for Use by White City/Emerald Park (WCRM158), Pilot Butte, Balgonie, Sakimay, and the City of Regina
The potential position of the East Regional WWTP was not investigated, but it was identified that effluent discharge location will significantly affect the treatment quality required and potentially further pipeline construction / conveyance.

Strengths:

- Advanced WWTP at Regional East WWTP allows for higher levels of treatment
- Centralized facility allows for better economies of scale (lower cost per cubic metre treated)
- Additional skilled operators not required, handled by existing Regina staff
- Burden of WWTP managament shifted away from communities with limited resources
- Access to plant for East Regina improves existing Level of Service in City

Weaknesses:

- Conveyance system required and several pump station/upgrades at municipalities
- Construction will cause disruption to existing works and communities
- Lagoon decommissioning has a cost; lagoons may be kept in the short term
- Increased total nutrient loading
- High demand for Balgonie effluent for irrigation
- Would still require storage for wet weather flows
- *If downstream effluent discharge past the Regina/Wascana Creek required => Significant conveyance required through/around the City of Regina*
- *If upstream effluent discharge before Regina/Wascana Creek granted => Seasonal effluent storage likely still required depending where effluent is released.*

Opportunities:

- Could make short term lagoon upgrades for regional communities until WWTP is ready boosting local backup capacity
- Large WWTP provides opportunity for beneficial reuse of biogas, biosolids
- Allows for tie-ins / WW connections along conveyance route

Threats:

- Significant time period for design and construction may delay growth
- Conveyance pipeline right of way granted
- Political challenges of regional treatment
- Needs a short term solution for White City, Emerald Park, and maybe Balgonie

Notes:
WWTP – wastewater treatment plant
WW – wastewater

Table 5-37
East SWOT Analysis – Regional Wastewater from White City/Emerald Park (WCRM158), Pilot Butte, Balgonie, Sakimay and conveyed to the City of Regina's existing West WWTP

Strengths:

- Advanced WWTP at Regina allows for higher levels of treatment
- Would meet effluent discharge quality
- Centralized facility allows for better economies of scale (lower cost per cubic metre treated)
- Additional skilled operators not required, handled by existing Regina staff
- Burden of WWTP mngt shifted away from communities with limited resources
- Off peak flows would utilize investment on West WWTP Upgrades

Weaknesses:

- Conveyance system required and several pump station/upgrades at municipalities
- Significant conveyance required through/around the City of Regina
- Construction will cause disruption to existing works and communities
- Land may be required in Regina for conveyance route at potentially high cost
- Lagoon decommissioning has a cost
- High demand for Balgonie effluent for irrigation
- Would still require storage for wet weather flows

Table 5-37
East SWOT Analysis – Regional Wastewater from White City/Emerald Park (WCRM158), Pilot Butte, Balgonie, Sakimay and conveyed to the City of Regina's existing West WWTP

Opportunities:	Threats:
• Allows for tie-ins / WW connections along conveyance route • Consider locating plant in East / North East to capture industrial area and easier discharge • Large WWTP provides opportunity for beneficial reuse of biogas, biosolids	• Conveyance pipeline right of way granted • Political challenges of regional treatment • Ensuring West WWTP can handle extra demand while still dealing with Regina growth • Needs a short term solution for White City, Emerald Park, and maybe Balgonie

Notes:
WWTP – wastewater treatment plant
WW – wastewater

5.3.4.1 Conclusions from the SWOT Analysis

During the October 2013 Working Session, the related stakeholders agreed it was most suitable for this project to focus on investigating the potential East Regional Wastewater Pipeline, City of Regina Conveyance Upgrades, and East Regional WWTP. The Wastewater Management Authority (WCRM158) representing White City and Emerald Park would pursue the conceptual design and cost estimates for their local WWTP themselves through an RFP which was awarded in December 2013. The other local lagoon upgrades and local treatment plants options were not investigated due to existing information available, or they were discarded due to the various SWOT points captured in Table 5-32 through Table 5-37.

5.3.5 Engineering Conceptual Design and Cost Estimate

The CH2M HILL team have developed Cost Estimates for certain options and have collected other existing information where appropriate.

In dealing with the options, it is important to remember that although the regional options are more expensive, the costs would likely be split between the users. Section 5.3.6 on Cost Sharing gives an indication of the split if cost sharing were based on population use in a regional model.

The options presented are not isolated options, and the appropriate solutions will be a combination of the options.

Table 5-38
Overview of Capital and Operation & Maintenance / Replacement Cost Options for East Wastewater Servicing.
Costs at 2014 prices and exclude GST and PST. Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration, and Miscellaneous). Annual O&M/Replacement presented costs are the first and last full years in the 30-year lifecycle. Calculated numbers were rounded to the nearest significant figure.

Option Available	Initial Capital Cost	Operation & Maintenance plus Replacement	± Variance	Construction Year	Notes / Source
East Regional Wastewater Pipeline	$70 million	$400,000 - $800,000	- 50% + 100%	2015 Operational 2017	CH2M HILL Cost Estimate, December 2013
East Regional Wastewater Treatment Plant[a]	$115 million	$1 million - $2 million	- 50% + 100%	2023 Operational 2024	CH2M HILL Cost Estimate, February 2014

Table 5-38
Overview of Capital and Operation & Maintenance / Replacement Cost Options for East Wastewater Servicing.
Costs at 2014 prices and exclude GST and PST. Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration, and Miscellaneous). Annual O&M/Replacement presented costs are the first and last full years in the 30-year lifecycle. Calculated numbers were rounded to the nearest significant figure.

Option Available	Initial Capital Cost	Operation & Maintenance plus Replacement	± Variance	Construction Year	Notes / Source
Local Wastewater Treatment Plant for WCRM158 White City and Emerald Park	$12-21 million (excluding effluent pipeline)	$350,000 - $500,000	TBC	2015	Proposed cost from RFP December 2013 and initial engineering work in 2014
Local Lagoon Upgrades for Balgonie and Pilot Butte	$750K-$2M per site	Minimal	Not Applicable	As required Within next 5 years	High level CH2M HILL estimate and verbal estimate from local firm

Note:
[a] This smaller East Regional Treatment Plant may be suitable as is explained in the Cost Sharing section of this report.

5.3.5.1 East Regional Wastewater Pipeline

As part of the RRWWS, a wastewater collection system was identified as a potential servicing solution for the east region communities. For the sake of simplicity, this collection system is hereafter referred to as the East Regional Wastewater Pipeline. This system is comprised of the following components:

- Gravity collector main from Balgonie to the east side of the City of Regina (with potential for future connection to an East Regional WWTP should this be advanced)
- Forcemain from White City lagoons that join the gravity collector main
- Gravity main from Pilot Butte to the east side of the City of Regina
- Forcemain from the Pilot Butte lagoons upstream of the Pilot Butte gravity main
- Pump stations at the lagoons of Balgonie, White City, and Pilot Butte

Challenges with the proposed pipeline route were raised by stakeholders at the December Working Session. In particular, excavation and pipe placement parallel to the Trans-Canada Highway at White City are a challenge: it is believed the existing trenches are filled with other utilities. Alternate routes are available and, given the similar distances, the cost estimate would be comparable. It was highlighted at the working session that SaskHighways are currently investigating the addition of various access roads in the region; if this option is appealing, the stakeholders should engage with SaskHighways.

The purpose of this section of the report is to establish a discounted cash flow estimate of probable construction and operating costs for the proposed East Regional Wastewater Pipeline.

The Class 5 Cost Estimates used herein are based on a conceptual level of design.

Infrastructure Overview

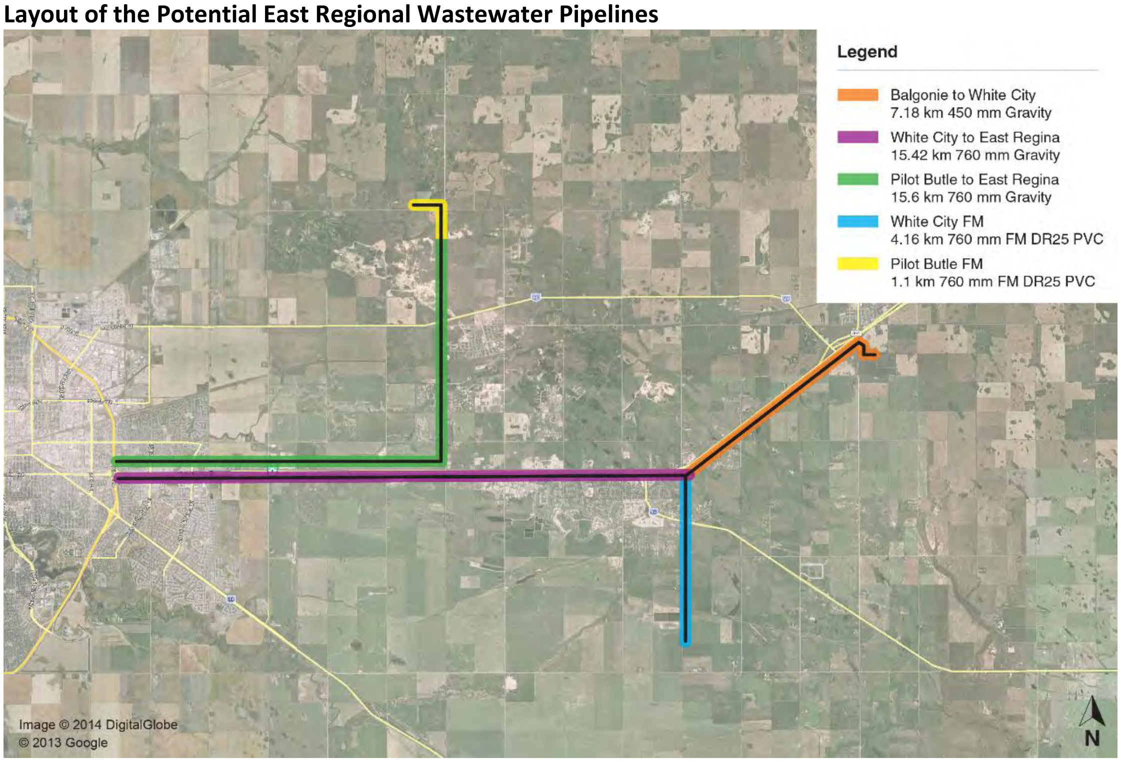
The East Regional Wastewater Pipeline would be comprised of two separate pipelines that share a common trench for part of the route, and one of which forks to two different locations. Figure 5-20 shows a potential layout of the pipelines in aerial view. Approximately 44 km would be required to reach the east of the City of

Regina, at which point the flows could either be connected into the City of Regina network or into an East Regional WWTP. It is calculated that the majority of this pipeline would need to be 760 mm in diameter to accommodate present and future 2040 demands, with the Balgonie to White City pipeline section being a smaller 450 mm in diameter. Pump stations would be required at Pilot Butte, Balgonie, and White City lagoons to have operational control and overcome system losses. The Emerald Park lagoons are already connected to the White City lagoons; as such, no separate forcemain from Emerald Park has been assumed for this system.

Of significant benefit in this situation is the land profile of the East region, which provides a downhill slope for communities in the East to the City of Regina, allowing for use of a gravity main. Figure 5-21, Figure 5-22, and Figure 5-23 show the land profiles and height above sea level. In this situation, the gravity main provides many benefits over a forcemain, including reduced operational costs through reduced pumping and the relatively simple addition of future service connections into the pipeline.

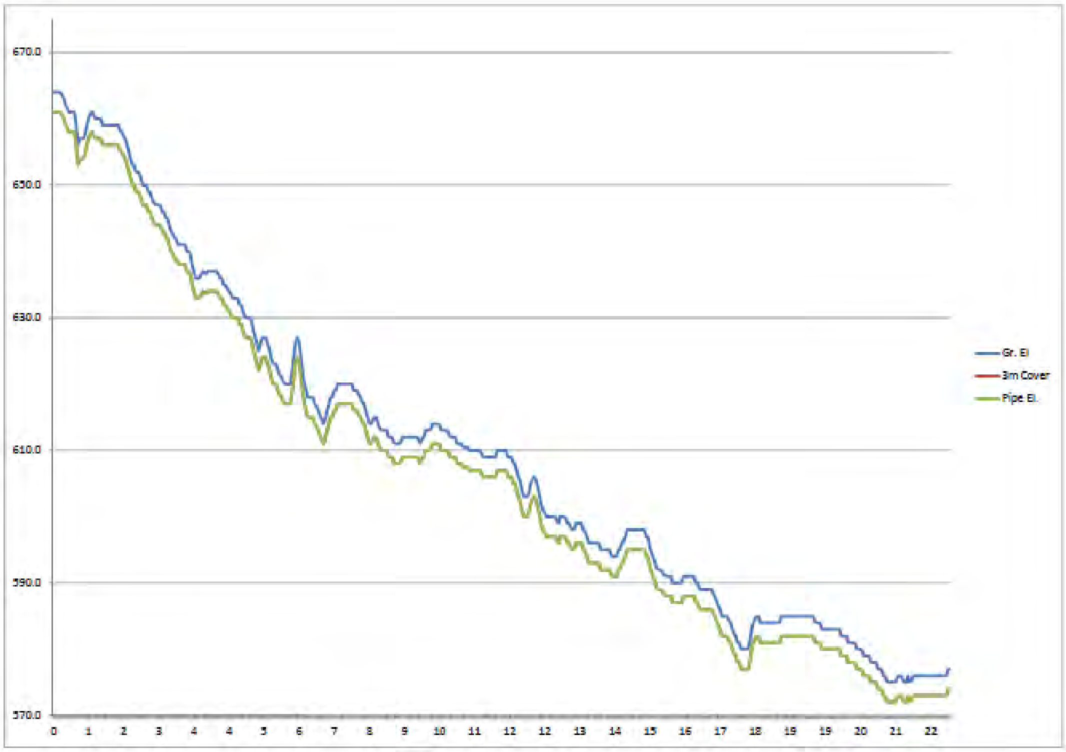
Uncertain community growth profiles and upcoming new communities make it challenging to size pipelines that will be suitable for both present and future demands, as associated flow velocities and volumes may vary. One solution to this is, as proposed, to have two pipelines going east that can be constructed at low cost using the same trench.

Figure 5-20
Layout of the Potential East Regional Wastewater Pipelines



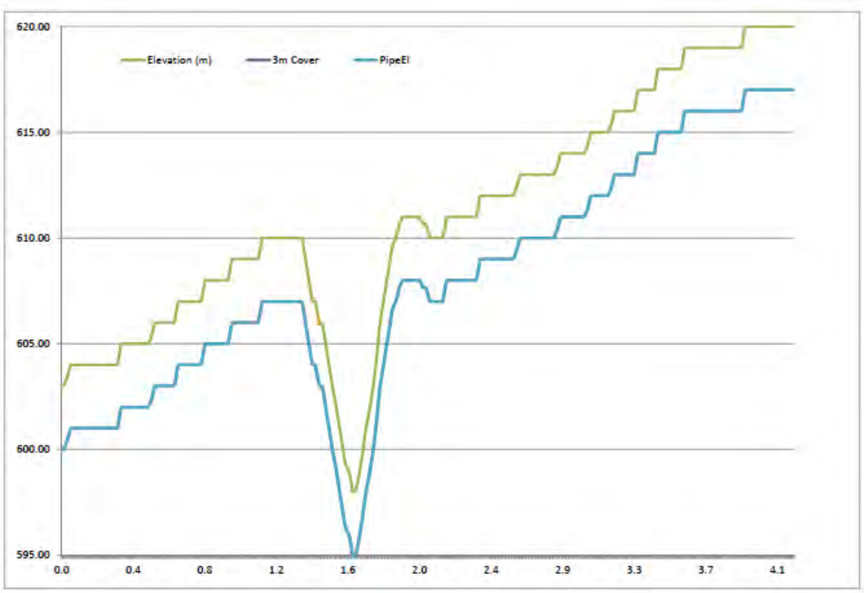
All related data Copyright Google and Digital Globe 2013.

Figure 5-21
Profile of the Potential Balgonie to White City (at 7.18 km), and White City to East Regina Pipelines (EastRegionalFM_ProfileAll.pdf)
Elevations have been derived from Google Earth and should be considered approximate.



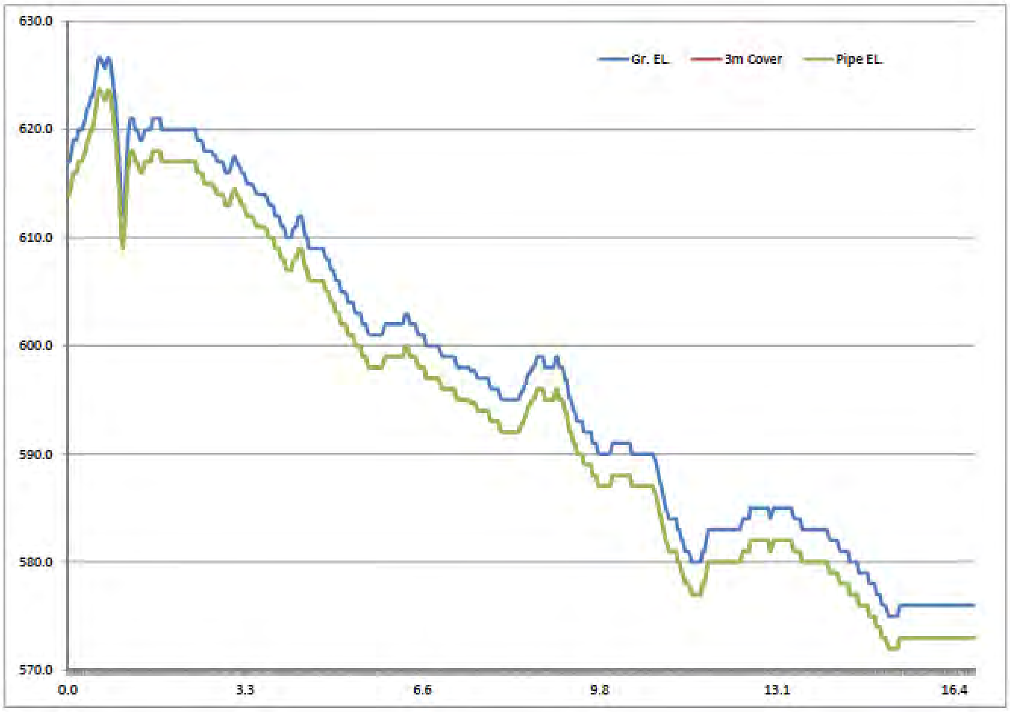
All related data Copyright Google and Digital Globe 2013.

Figure 5-22
Profile of the Potential White City Lagoon to White City Land Pipeline (note varied y axis scale) (WhiteCityFM_ProfileALL.pdf)
Elevations have been derived from Google Earth and should be considered approximate.



All related data Copyright Google and Digital Globe 2013.

Figure 5-23
Profile of the Potential Pilot Butte to East Regina Pipeline (note varied y axis scale) (PilotButteFM_ProfileALL.pdf)
Elevations have been derived from Google Earth and should be considered approximate.



All related data Copyright Google and Digital Globe 2013.

Cost Estimate Overview

It is assumed that the East Regional Wastewater Pipelines would not be operational until 2017 and that the midpoint of construction would be August 2015. This is an ambitious timeline, but could potentially be achieved if the stakeholders work well together and to tight procurement schedules.

Table 5-39 presents an overview of Capital Costs and O&M Costs (including capital replacement of electrical and mechanical components in the pump station at the end of component lifecycle across 30 years) based on 2014 costs.

Table 5-39
East Regional Wastewater Pipeline Cost Estimate Overview for Capital and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$35 million	$70 million	$140 million
Annual O&M /Replacement Costs	$190,000 – $380,000	$380,000 – $760,000	$760,000 – $1.5 million

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement costs are the first and last full years in the 30 year lifecycle.

Conceptual Design

Pipeline Layout

Work in this option involves, installation of four sewer conveyance pipes to/from different locations, as follows:

- The section of the route from Balgonie to White City involves construction of a pump station; and installation of sewer gravity main 7.18 km in length of 450-mm-diameter PVC profile pipe along rural area. Installation is by the open cut method and includes 1,050-mm manholes at 150-m intervals. *This is marked by the **orange** line in* Figure 5-20 *"Layout of the Potential East Regional Wastewater Pipelines"*
- The section of the route from White City to East Regina involves installation of 15.42 km of 750-mm-diameter PVC profile pipe along a 80 percent rural area and 20 percent suburban area. Installation is by the open cut method and includes 1,200-mm manholes at 150-m intervals. *This is marked by the **purple** line in* Figure 5-20*.*
- The section of the route from White City Lagoons to the Junction Manhole involves construction of a pump station; and installation of a sewer forcemain 4.16 km long of 750-mm-diameter PVC along a 70 percent rural area and 30 percent suburban area. Installation is by the open cut method, with 50 m of 750-mm-diameter PVC with 900-mm steel encasement installed by the trenchless method and 50 m of 750-mm-diameter installed by the trenchless method. Also included are construction of isolation valves, pipe drainage, and an air release valve; and restoration of existing facilities affected by construction. *This is marked by the **blue** line in* Figure 5-20*.*
- The section of the route from Pilot Butte to East Regina involves construction of a pump station; and installation of a sewer forcemain 1.1 km in length of 750-mm-diameter PVC along a rural area. Installation is by the open cut method and includes isolation valves, pipe drainage, and an air release valve. Also included is installation of 15.6 km of 750-mm-diameter PVC profile pipe along an 80 percent rural area and 20 percent suburban area by the open cut method; installation of two lengths of 50 m of 750-mm-diameter PVC with 900-mm steel encasement by the trenchless method; and installation of 1,200-mm manholes at 150-m intervals. *These are marked by the **yellow** and **green** lines in.*

Figure 5-21, Figure 5-22, and Figure 5-23 shows the pipeline vertical profile, expanded profiles are available in the Appendices. Elevations have been derived from Google Earth and should be considered approximate. All related data Copyright Google and Digital Globe 2013.

Pipe Sizing and Assumptions

As per the assumptions below and calculations noted in Figure 5-24, a combination of three sewer pipes with varying diameters may be appropriate to service the east regional communities both now and into the future based on population projections outlined.

- Average daily wastewater flow used was 454 litres per capita per day, per the City of Regina Development Standards Manual.
- The pump stations and the forcemain and gravity mains have been sized for peak capacity.
- The velocity in the forcemain is below 1.6 m/s for the current as well as the projected population in the year 2040.
- Forcemains are proposed in sections that have higher elevations downstream (short length sections only). For the most part, the flow is downhill, and the flow will be by gravity.
- Gravity mains have been sized per the following criteria:
  - Sized such that they meet the required year 2040 flows

- Slope: Minimum slope occurring in any pipe section based on pipe profile was determined and used in corresponding pipe size calculations
- Roughness Coefficient was assumed to be 0.013
- Pipe was assumed to be flowing full (conservative estimate)
- Flowmaster software was used to evaluate the pipe size for each gravity pipe section

- Pipe cover:
  - Forcemain: 3 m average
  - Gravity main: 4 m average
- Pipe Material:
  - Forcemain: PVC DR 25
  - Gravity main: PVC, corrugated profile sewer pipe
- Drainage arrangements will be included at the lowest point in each pipeline section.
  - There is one such arrangement for the forcemain from Pilot Butte to Regina, and one such arrangement on the White City forcemain.
  - Pricing detail W-24 from City of Regina Design Standards Manual was used.
- Special Sections:
  - East Regional Collector Gravity Main (760 mm):
    - 50-m crossing installed under a railway by trenchless drilling; crossing is located approximately 4.8 km from intersection of Ring Road and Victoria Avenue
  - Pilot Butte Gravity Main (760 mm):
    - 50-m crossing installed under a railway by trenchless drilling; crossing is located approximately near the intersection of Railway Avenue and Highway 624
    - 50-m crossing installed under a railway by trenchless drilling; crossing is located approximately 4.8 km from intersection of Ring Road and Victoria Avenue
  - White City Forcemain (760 mm):
    - 50-m crossing installed under a railway by trenchless drilling; crossing is located approximately 0.25 km from White City Lagoons
    - 50-m crossing installed under a local water body (stream) by trenchless drilling; crossing is located approximately 1.65 km from White City Lagoons
- Bend Fittings: assumed only where sharp changes in horizontal or vertical directions occur, as follows:
  - Pilot Butte Forcemain:
    - Two 10-degree bends, six 45-degree bends
  - White City Forcemain:
    - Two 10-degree bends, four 45-degree bends
- Isolation valves: assume every 1,000 m (use City of Regina detail attached), and assume they are plug valves

- Air Release Manholes: two manholes, one each at the Pilot Butte Forcemain and White City Forcemain, using CH2M HILL Standard Detail, 100-mm-diameter CARV relief valves on 100-mm DIP; manhole diameter: 2,440 mm (8 feet)
- Manholes for Gravity Mains:
  - Manhole every 150 m (per City of Regina guidelines, Details S2, S3)
  - Manhole size 1,050 mm for 450-mm-diameter gravity main
  - Manhole size 1,200 mm for 760-mm-diameter gravity main
  - One junction manhole of 3,000-mm-diameter located approximately 1,km east of the intersection of Highways 48 and 1
- Land use: assume 80 percent rural land and 20 percent suburban land (and that pipe will be laid parallel to major roads)

Figure 5-24
Key Assumptions for the East Regional Wastewater Pipeline

KEY ASSUMPTIONS		
Wastewater Flow Per Capita Per Day:	454	lpcd
Rec. Min. Flow in Pipe greater than:	0.61	m/s
Rec. Max. Flow in Pipe greater than:	1.6	m/s
Extraneous Flow Allowance:	21000	l/ha/d

Harmon Formula:

$$PeakingFactor = 1 + \frac{14}{4 + \sqrt{Population}}$$

Stakeholder	Area (ha)	Current Pop.	Current Flow (Peak, m^3/d)
Balgonie	315	1,625	9,311
White City	600	2,895	17,142
Emerald Park	450	1,417	11,829
Pilot Butte	469	1,848	12,880
Sakimay Lands	67	100	1,600

Stakeholder	Area (ha)	2040 Pop.	2040 Flow (Peak, m^3/d)
Balgonie	315	3,233	11,627
White City	600	7,045	22,528
Emerald Park	450	3,649	15,031
Pilot Butte	469	7,607	20,457
Sakimay Lands	67	1,000	3,132

Pipeline	Current Flow (Peak, m^3/d)	Size (mm)	Min. Slope (m/m)	Vel. (m/s)
Balgonie Gravity Main	9,311	450	0.0022	0.85*

Figure 5-24
Key Assumptions for the East Regional Wastewater Pipeline

White City Forcemain	28,970	760	--	0.77
Pilot Butte Forcemain	12,880	760	--	0.34
Pilot Butte Gravity Main	12,880	760	0.000645	0.65*
East Regional Gravity Main	39,881	760	0.0028	1.35*

Stakeholder	2040 Flow (Peak, m^3/d)	Size (mm)	Min. Slope (m/m)	Vel. (m/s)
Balgonie Gravity Main	11,627	450	0.0022	0.85*
White City Forcemain	37,559	760	--	1.00
Pilot Butte Forcemain	20,457	760	--	0.54
Pilot Butte Gravity Main	20,457	760	0.000645	0.65*
East Regional Gravity Main	52,318	760	0.0028	1.35*

Notes:
1. "Balgonie Gravity Main" contains flows from Balgonie only.
2. "White City Forcemain" contains flows from White City, Emerald Park and Balgonie.
3. "East Regional Gravity Main" contains flows from Balgonie, White City, Emerald Park and Sakimay Lands.
4. Minimum slope is selected by visual inspection of pipe profiles.
5. Velocities marked "*" are at full capacity flow and are for reference only.
ha = hectares
m^3/d = cubic metres per day
mm = millimetres
m/m = metres per metre
m/s = metres per second

Pump Stations

There are three pumps stations proposed in this system. This was based on the high level understanding that CH2M HILL engineers had of the existing systems in place at communities. It is very possible that existing systems and pump stations in place at communities could be retrofitted to be appropriate for regional use; however, more information would need to be gathered and further engineering analysis carried out. The proposed pump stations are named in accordance with the corresponding community and are located at the community's wastewater lagoons. These pump stations are as follows:

1. Balgonie Pump Station
2. White City Pump Station
3. Pilot Butte Pump Station

Wastewater is expected to be collected through existing systems and will be collected in the communities' local lagoons which act as equilibrium storage. This will allow for improved control for pumping flows and time. The pump stations are typically expected to pump to the east side of the City of Regina (and potentially an East Regional WWTP) during off-peak hours. Alternatively, pumping could be scheduled so that not all pump stations are pumping at the same time, thus minimizing the flow peak at the designated treatment plant. Further investigation is required with complex engineering models necessary to understand flows across the region along with regional lagoons, City of Regina conveyance, and treatment plant capacity. The pump station is a typical wet well-dry well pump station operated on the basis of level changes inside the wet well. Though most of the flow will be conveyed by gravity, the pumps are assumed to operate at heads capable of providing operational control to overcome any minor losses and elevation differences. The pumps would convey the wastewater directly to the east side of the City of Regina (and potentially the

East Regional WWTP. A suitable template design for the Pump Stations was developed and used for the cost estimate; this design template is presented in Appendix H.

Analysis was carried out in AFT Fathom software, and it was determined that nominal pumping is required in the pipeline due to the land profile. Accordingly, it is assumed that the proposed pumping stations at the Pilot Butte, Balgonie, and White City lagoons will have operating heads as noted below. The following assumptions apply to the proposed pump stations:

- Number of Pump stations: 3
- Number of Pumps:
  - Balgonie Pump Station: 2 (1 duty, 1 standby), submersible. 26 kW (35 HP)
    - White City Pump Station: 2 (1 duty, 1 standby), submersible. 160 kW (215 HP)
    - Pilot Butte Pump Station: 2 (1 duty, 1 standby), submersible. 63 kW (85 HP)
- Type of Pump station: Wet well-Dry well
- Wet well Size: 88 m^3 wet well (80 m^3 filled, assume 10 percent headboard)
- VFD–equipped?: Yes
- Location: Existing lagoons site (land owned by corresponding community)
- Pumps: Designed to meet current and future pumping demands using VFDs
  - Balgonie Pump Station (Current & Future): 388 m^3/hr at 10-m head and 485 m^3/hr at 10-m head
  - White City Pump Station (Current & Future): 1,208 m^3/hr at 23-m head and 1,565 m^3/hr at 23-m head
  - Pilot Butte Pump Station (Current & Future): 536 m^3/hr at 20-m head and 853 m^3/hr at 20-m head
- Power source: Existing power source available at lagoon site
- Standby Power Source: diesel generator, generator room adjacent to pump house
  - Balgonie Pump Station: 50 kW
  - White City Pump Station: 250 kW
  - Pilot Butte Pump Station: 130 kW

Design sketches of the Pump Station design template can be found in Appendix H.

Capital Cost Estimate

The following is a summary of the costs. Costs are shown in 2014 Canadian Dollars, excluding PST and GST.

Table 5-40
East Regional Wastewater Pipeline Cost Estimate Overview for Capital Direct Construction Costs of the East Regina Water Distribution Syst*em* based on 2014 costs. Calculated numbers were rounded to the nearest significant figure.

Low Range (-50%)	Estimated Cost	High Range (+100%)
$35 million	$70 million	$140 million

This cost estimate has been prepared for guidance in project evaluation based upon the information available at the time of the estimate. The final costs of the project will depend on the actual pipeline route and pump station location; the actual labour and material costs; competitive market conditions; final project costs; implementation schedule; and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

As explained in Section 5.2.5.1 with the North Wastewater Regional Pipeline, following review by the City of Regina of the template pump station design, the capital construction cost estimate was increased to $5,000,000 (excluding engineering and other non-construction costs) based on a similar pump station recently constructed by the City.

Capital Cost Assumptions

Markups

The project will be tendered based on unit price bidding. All markups, contingencies, and other factors are included in the Unit Price.

Table 5-41
General Contractor Markups

Overhead	Included in Unit Price
Profit	Included in Unit Price
Mobilization/Demobilization	Separate line item in Estimate
Contingency	Separate line item in Estimate
Escalation Rate	6.83%

Escalation Rates

The estimate includes Escalation with the assumption that construction will start around May 2014 with the midpoint of construction being August 2015. It is assumed that there will be 30 months of construction ending around November 2016.

The escalation forecast was calculated using CH2M HILL's proprietary escalation model which incorporates economic data from sources such as Global Insight, Inc.

Estimate Classification

This cost estimate is considered a Budget or Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). It is considered accurate from minus 50 percent to plus 100 percent, based on a conceptual design deliverable.

Estimate Methodology

This cost estimate is considered a 'bottom rolled up' type estimate with cost items and breakdown of Labour, Materials, and Equipment. Some quotations were obtained for various items. The estimate may include allowance cost and dollars per square meter cost for certain components of the estimate.

Construction Labour Costs

The labour cost is built into the unit price of the items in the estimate.

Operating and Maintenance Cost Estimate

This section presents the O&M costs for the East Sewer Collection System for the period of January 1, 2014, to January 1, 2044. This memo explains the critical assumptions used to arrive at the cost estimate. The 30-year O&M costs are presented in Appendix M.

It is assumed that the plant will not be operational until 2017 and that the midpoint of construction is August 2015.

Data used for the initial capital costs came from Preliminary design concepts for the forcemain from CH2M HILL. O&M/Replacement costs have been broken into five categories:

- Labour
- Power
- Maintenance
- Replacement (Capital equipment replacement)
- ODC

General Assumptions and Exclusions

Costing assumptions used to calculate the 30-year O&M expenditures are presented in Table 5-42.

Table 5-42
Operating and Maintenance Cost Estimate General Cost Assumptions

Exchange Rate (CAD/USD)	1.04
Discount Rate	4%
Growth Rate of Average Annual Flows (AAF)	5%

Notes:
CAD – Canadian dollars
USD – US dollars

Labour

- Assume 1 part-time FTE at approximately 270 hours per year. "Mechanic" capable of performing preventative and corrective maintenance on equipment. Assumed that this person would be assigned to other mechanical duties within the region. Automation of Lift station will be capable of notification to operations staff for abnormal operation conditions 24 hours per day by automated call out.
- Wage is $22.26 CAD per hour. This is at the top of the 3rd quartile wage range for a "Mechanic" position with CH2M HILL in Canada.
- Fringe multiplier = 1.34, Overtime multiplier = 1.50, Overtime frequency = 5 percent

Power

- Assume electricity power tariff is Sask Power rate E8 (rural).
  - Composite rate of Energy Charge, Demand Charge, and monthly fee is 6.837 cents per kilowatt-hour.
- Motor loads and duty/standby status was based on data provided in the East Regional Pipeline Preliminary Design.
- Motor run times were estimated based on AAF in 2017 and scaled to reflect increases in flow. It is assumed that these pumps are equipped with VFDs.
- 90 percent load factor and 85 percent efficiency factor have been assumed for equipment drives.

Maintenance

- Fixed percentages of the capital equipment cost are used based on typical O&M operations throughout the US and Canada
  - 0.50 percent annually for Preventative Maintenance
  - 1 percent annually for Corrective Maintenance in 2017, scaled to 2 percent annually in 2043
- Preventative and corrective maintenance costs were calculated based on the capital equipment costs from CH2M HILL's Preliminary Design. Capital costs were included for the purposes of PM/CM costs for valves, pump stations, and manholes but not for pipes. The PM/CM cost for gravity mains and forcemains is assumed to be negligible in the first 30 years of operation.

Replacement

- Equipment estimated based on the pipeline equipment list provided by CH2M HILL.
- Average lifespan and replacement costs for each piece of equipment are estimated using standard CH2M HILL tables for each specific type of equipment.
- Replacement of duty and standby equipment are estimated at the same rate.
- Replacement costs have been allocated with a stochastic model to account for equipment failures before and after the average lifespan.

Other Direct Costs

- ODC were calculated based on standard CH2M HILL project expenses. ODC include safety supplies, miscellaneous travel expenses, vehicles, and other employee expenses. These were scaled to the size of the facilities based on 0.13 FTE.

5.3.5.2 East Regional Wastewater Treatment Plant

As part of the RRWWS, a regional WWTP located to the east of the City of Regina was identified as being a potential servicing solution for the East stakeholders.

The purpose of this Estimate of Construction and O&M Costs is to establish an Engineer's opinion of probable construction and operating costs for the proposed option.

It should be noted that a range of growth scenarios and associated treatment works capacities were considered for estimating purposes. A detailed estimate was prepared for the upper bound cost scenario and is included in Appendix N. Subsequent discussions and analysis concluded that a lesser capacity plant is the more realistic option and a revised cost estimate was prepared. The revised Class 5 Estimate shown in this section is based on a conceptual level of design and utilizes pro-rata modification to the cost components generated for the upper bound cost scenario. If the East Regional WWTP is appealing as an option, more work should be done to develop a more accurate population demand including sensitivity analysis in the event projections are not met. Of particular significance is the population share that the City of Regina would direct to the facility, as that would certainly change the size of the plant and costs would need adjusted accordingly.

Infrastructure Overview

Following a review of the effluent quality requirements by CH2M HILL engineers, it was suggested that a Biological Nutrient Removal (BNR) WWTP would be sufficient. The BNR configuration would be equipped with tertiary disk filtration, UV disinfection, and Anaerobic Sludge Digestion.

Cost Estimate Overview

Below is the overview table of Capital Costs and O&M Costs (including capital replacement of electrical and mechanical components at the end of component lifecycle across 30 years) based on 2014 costs.

Table 5-43
East Regional Wastewater Treatment Plant (19.5ML/d; 50,000 population equivalent) Cost Estimate
Overview for Capital and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$58 million	$115 million	$230 million
Annual O&M /Replacement Costs	$500,000 – $1 million	$1 million – $2 million	$2 million – $4 million

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration, and Miscellaneous).
Annual O&M/Replacement costs are the first and last full years in the 30-year lifecycle.
ML/d – megalitres per day

Conceptual Design

Following a review of the effluent quality requirements, it was suggested that a BNR WWTP would be sufficient. The BNR configuration would be equipped with tertiary disk filtration, UV disinfection, and Anaerobic Sludge Digestion.

The facility was sized according to the parameters listed in Table 5-44, using future population projects for the regional stakeholders, as well as the effluent quality requirements also outlined in Table 5-45.

In terms of location, no specific location was identified at this stage in the study. Engineers worked with the design brief of a location somewhere on the East side of the City. As a result, any transportation of treated effluent from the treatment process has not been included in this estimate.

Population and Flow Requirements

Future populations for the regional communities (Balgonie, White City, Emerald Park, and Pilot Butte) and a subset of the East of the City of Regina were calculated from projected growth rates. Projections may fluctuate as growth estimates from communities are updated; however, for the purposes of this estimate, these numbers are deemed sufficient.

The Sakimay First Nation lands in the East are undeveloped, and it is unknown how quickly a population will be established on the land within the coming 30 years. Growth will likely be gradual once servicing is established. Consequently, population estimates for Sakimay have not been included in the calculations for regional populations; it is assumed that they could easily be serviced from the nearest community and that they will be a small variation in the overall flows.

Table 5-44
East Regional Wastewater Treatment Plant Estimated Flow Basis

Community	Population (2040-2043)	Flows (lpd)	Flows (m^3/day)
Balgonie	7,045	2,818,000	2,818
White City	4,166	1,666,400	1,666
Emerald Park	7,607	3,042,800	3,043
Pilot Butte	4,261	1,704,400	1,704
Sakimary Land (East)	2,350	940,000	940
RM of Edenwold	623	249,200	249
City of Regina, East	22,500	9,000,000	9,000
TOTAL	48,552	19,420,800	19,420 (~19.5ML/d)

Notes:
lpd – litres per day
m^3/day – cubic metres per day
ML/d – megalitres per day

Effluent Quality Requirements

Effluent quality requirements for an East Regional Plant were aligned with requirements placed on a WWTP for the WCRM158 Wastewater Management Authority Inc. (White City and Emerald Park to the East of the City of Regina). It was assumed the East Regional WWTP would have to meet similar effluent quality requirements, as both would discharge into the same watercourse.

A treated effluent pipeline may be required depending on the location of the East Regional WWTP and this is not included in this cost estimate.

These effluent quality requirements are detailed in the WCRM158 Wastewater Management Authority Inc. RFP package released in October 2013, including the *Downstream Use and Impact Study* (AECOM, 2013).

Table 5-45
East Regional Wastewater Treatment Plant Assumed Effluent Quality Requirements

Wastewater Parameter	Design Parameter
Total Suspended Solids (TSS)	≤10.0 mg/L
Biochemical Oxygen Demand (BOD)	≤5.0 mg/L
Total Kjeldahl Nitrogen (TKN)	≤3.0 mg/L
Ammonia (NH_3-N)	≤1.0 mg NH_3/L
Un-ionized Ammonia	≤0.019 mg/L
Total Phosphorous (TP)	≤0.5 mg/L
pH	6.5 – 9.0
Esherichia coliform (E. coli)	≤100 col/100 mL
Dissolved Oxygen (DO)	≥6.0 mg/L

Notes:
mg/L – milligrams per litre
CFU/100 ml – colony-forming units per 100 millilitres
mg NH_3/L = milligrams of ammonia per litre

Process Equipment Selection

- Influent Raw Sewage Pumping: Four adjustable-speed pumps (three duty, one standby)
- Screening: Two duty mechanical bar screens and two duty constant speed pumps
- Grit Removal: Two duty Vortex units and two duty constant speed grit pumps
- Primary Treatment: Two round primary clarifiers, three adjustable-speed primary sludge pumps (two duty, one standby), and two primary scum pumps
- Primary Sludge Fermenter: Two duty gravity thickeners
- Disinfection: UV (closed vessel since CPES doesn’t have channel type)
- Anaerobic Digestion: Screw centrifugal mixing pumps system and biogas flaring
- Dewatering: Two centrifuges (duty/standby) and two screw conveyors (one inclined and one flat)
- Chemical Systems
  - Ferric chloride dosing
  - Polymer dosing

- Pumps
  - Two duty adjustable-speed centrifugal thickener feed pumps
  - Two duty adjustable-speed thickened primary sludge pumps
  - Two adjustable-speed fermenter filtrate pumps (duty/standby)
  - Two adjustable-speed progressing cavity centrifuge feed pumps (duty/standby)
  - Two adjustable-speed hopper type progressing cavity dewatered sludge pumps (duty/standby)
  - Two adjustable-speed dry-pit centrifugal centrate pumps (duty/standby)
- BNR
  - Biological Process: Two three-pass bioreactors with two adjustable-speed axial flow recycle pumps and five submersible mixers per bioreactor. SRT = 14 days, Average MLSS = 3,446 mg/L. Five adjustable-speed multi-stage blowers (four duty, one standby).
  - Secondary Clarification: Two round secondary clarifiers and one secondary scum pump
  - Returned Activated Sludge (RAS) Pumping: Three adjustable-speed pumps (two duty, one standby)
  - Waste-activated Sludge (WAS) Pumping: Three adjustable-speed pumps (two duty, one standby)

Capital Cost Estimate

Table 5-46 is a summary of the costs in 2014 Canadian Dollars, excluding PST and GST.

Table 5-46
East Regional Wastewater Treatment Plant (19.5ML/d; 50,000 population equivalent) Cost Estimate
Overview for Capital Direct Construction Costs of the East Regina Water Distribution System based on 2014 costs. Calculated numbers were rounded to the nearest significant figure.

Low Range (-50%)	Estimated Costs[a]	High Range (+100%)
$58 million	$115 million	$230 million

This cost estimate has been prepared for guidance in project evaluation based upon the information available at the time of the estimate. The final costs of the project will depend on the location; the actual labour and material costs; competitive market conditions; final project costs; implementation schedule; and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

This cost estimate prepared is considered a Budget or Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). It is considered accurate from minus 50 percent to plus 100 percent, based on a conceptual design deliverable.

CH2M HILL's Cost Estimating System

CH2M HILL's Parametric Cost Estimating System (CPES) is used to develop project-specific capital and annual costs for water and wastewater facilities. CPES is also used to improve the accuracy and efficiency of cost estimating, as it is continuously updated with data from current projects.

CPES allows CH2M HILL to:

- Increase the accuracy of conceptual cost estimating by calculating quantity take-offs and applying an appropriate unit cost, as opposed to the more conventional approach of using cost curves at this stage in a project.
- Make accurate cost estimates to be developed before any drawings are produced.
- Reduce substantially the amount of time required to develop cost estimates.
- Integrate output from the capital costs models seamlessly into the O&M cost models to accurately estimate annual and life-cycle costs.
- Provide cost information quickly that can be used to compare multiple process alternatives in a decision evaluation process.

Operating and Maintenance Cost Estimate

This section presents the O&M costs for the East Regional WWTP for the period of January 1, 2014, to January 1, 2044, with activation in 2024. This report section explains the critical assumptions used to arrive at the cost estimate.

Data for the O&M/Replacement costs came from various sources based on typical contract operations of similar type WWTPs. O&M/Replacement costs have been broken into seven categories:

- Labour
- Power
- Chemicals
- Solids
- Maintenance
- Replacement (Capital equipment replacement)
- ODC

The detailed 30-year O&M costs are presented in Appendix N.

5.3.6 Cost Sharing

In dealing with the options, it is important to remember that, although the complete regional options can be more expensive than the local option, the costs (both capital and operating) would likely be split between the users. Figure 5-25 illustrate a potential cost split of the East Regional Wastewater Pipeline and Treatment Plant (19.5ML/d; 50,000 population equivalent) based on initial capital costs, first year O&M costs, and population served. There are many other ways to finance and cost share the regional options, and each has associated positive and negative considerations.

Costs to upgrade the City of Regina's existing conveyance network to accept the East Regional wastewater flows have not been included in this Cost Sharing section; however, stakeholders should be aware that this investment may be required. Further investigation into the City of Regina's existing conveyance network needs to be carried out to better understand what additional investment would be required. More information on the City's wasterwater servicing challenges with relation to East regional flows can be found in Section 5.4.

At the time of developing the Preliminary Design and Cost Estimate for the East Regional WWTP, population projections were at the early stages of being developed and limited information was available. If the East Regional WWTP is appealing as an option, more work should be done to develop a more accurate population demand (including sensitivity analysis in the event projections are not met). Of particular significance is the population share that the City of Regina would direct to the facility, as that would certainly change the size of the plant, and costs would need adjusted accordingly.

With regards to the East Regional Wastewater Pipeline, it is assumed that the City of Regina will not contribute to the capital or O&M costs, as it does not handle wastewater from City sources. As a result, the City's percentage share of the East Regional Wastewater Pipeline is 0 percent.

Since the initial investigation, the City of Regina highlighted the option that a simple connection from the southeast areas of the City to an East Regional WWTP would be the Creeks Pumping Station. Within the City's current growth plan over the next 25 years (Design Regina), the Creeks Pumping Station will serve a total population of 22,500. The potential cost sharing of a regional pipeline and 19.5ML/d WWTP based solely on population served is provided in Figure 5-25.

The MS Excel file used to generate Figure 5-25 has been shared with the City of Regina project team, and it can be updated in the future if more information becomes available.

Figure 5-25
Potential Cost Split of the East Regional WWTP (19.5ML/d) and Regional Pipeline based on Capital Construction Cost and Population Served

Potential Cost Split of the East Regional Wastewater Pipeline and WWTP based on Population served - with 22,500 from City of Regina East

Pop. Projections, Cost Share % in $CAN			East WW Pipeline			East Regional WWTP			Combined Solution		
	2013	2040	Share (%)	Initial Capital	First Year O&M	Share (%)	Initial Capital	First Year O&M	Share (%)	Initial Capital	First Year O&M
White City	2,895	7,045	27%	$ 18,398,202	$ 102,888	15%	$ 16,686,759	$ 145,102	19%	$ 35,084,961	$ 247,990
Balgonie	1,748	4,166	16%	$ 10,880,706	$ 60,848	9%	$ 9,868,558	$ 85,814	11%	$ 20,749,264	$ 146,662
Pilot Butte	2,074	7,607	29%	$ 19,864,884	$ 111,090	16%	$ 18,017,006	$ 156,670	21%	$ 37,881,890	$ 267,760
RM of Edenwold*	743	2,350	9%	$ 6,137,087	$ 34,320	5%	$ 5,566,201	$ 48,402	6%	$ 11,703,287	$ 82,722
Emerald Park	1,683	4,261	16%	$ 11,126,420	$ 62,222	9%	$ 10,091,414	$ 87,751	12%	$ 21,217,834	$ 149,974
Sakimay East		623	2%	$ 1,628,101	$ 9,105	1%	$ 1,476,651	$ 12,840	2%	$ 3,104,753	$ 21,945
City of Regina, East**		22,500	0%	$ -	$ -	46%	$ 53,293,410	$ 463,421	29%	$ 53,293,410	$ 463,421
		48,552	*100%*	*$ 68,035,400*	*$ 380,474*	*100%*	*$ 115,000,000*	*$ 1,000,000*	*100%*	*$ 183,035,400*	*$ 1,380,474*

Based on high growth rates as per population projections. Assumes all above populations connect to a regional solution.

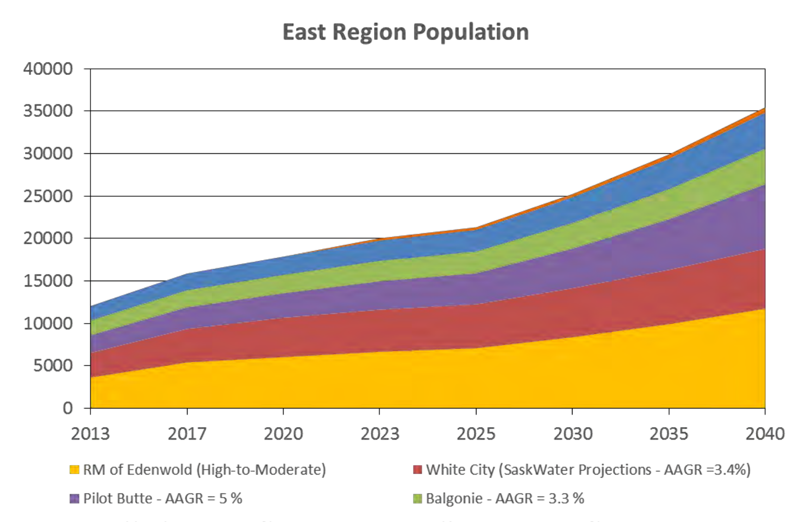
Excludes any City of Regina conveyance upgrades. Results are conceptual only; more in-depth analysis advised with detailed sensitivity analysis calculated

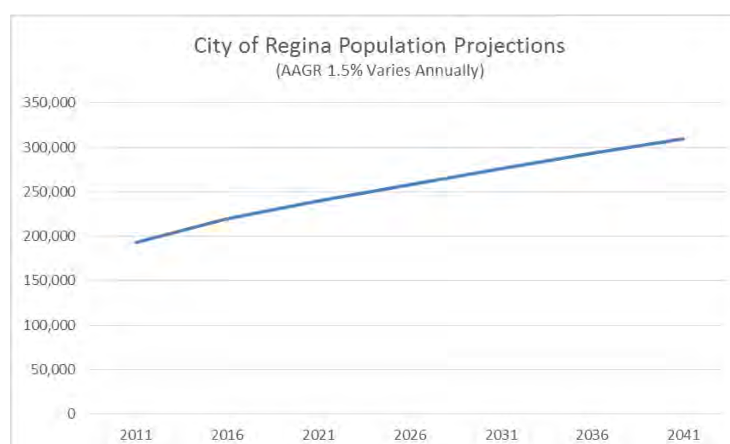
Emerald Park population to be added to RM of Edenwold share

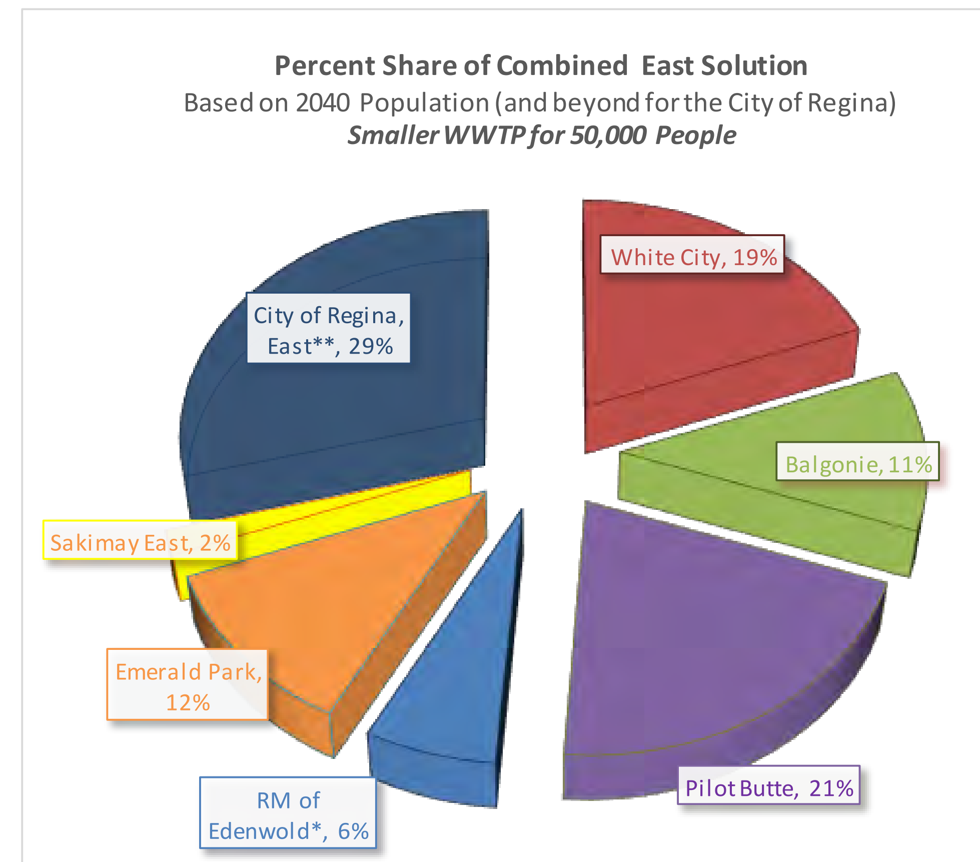
*Estimated population of the RM of Edenwold that would connect 20%

Smaller East Regional WWTP Cost is estimated from Larger WWTP, more investigation required

Cost Estimates with Variance, excluding NPV		- 50%	Estimation	+ 100%
East Wastewater Pipeline	Initial Capital Costs (inc Engineering)	$ 34,017,700	$ 68,035,400	$ 136,070,800
East Wastewater Pipeline	First Year Operating & Maintenance Costs	$ 190,237	$ 380,474	$ 760,949
East Regional WW Treatment Plant	Initial Capital Costs (inc Engineering)	TBC	$ 115,000,000	TBC
East Regional WW Treatment Plant	First Year Operating & Maintenance Costs	TBC	$ 1,000,000	TBC







City of Regina, East population project of 87,000 is appropriate for the East Regional WWTP when considering growth beyond 2040. **22,500 is assuming diversion from the Creeks Pumping Station.

These results are conceptual only and require more in-depth analysis, a detailed sensitivity analysis should be calculated to get a more appropriate population demand and WWTP size.

5.3.7 Triple Bottom Line Evaluation

The December Working Session at Pilot Butte on December 12, 2013, provided stakeholders with the opportunity to review available financial information and evaluate non-financial aspects of the decision.

With engineering options developed as solutions to future wastewater servicing in the East region, the relevant stakeholders discussed the associated benefits.

During the October Working Session at the City of Regina, stakeholders had the opportunity to discuss a high level SWOT (Strengths, Weaknesses, Opportunities, Threats) evaluation of potential local and regional options to solve wastewater servicing challenges. Full details of the SWOT evaluation are included in the Final Report.

Table 5-47
Attendance at East Working Session at Pilot Butte on December 12, 2013

City of Regina – Kevin Syrnick, Kelly Scherr	WCRM158 – Ron Hilton
Town of White City – Shauna Bzdel, Cecil Snyder, Marius Jimenez	Town of Pilot Butte – Wayne Engel, Ed Sigmeth, Laurie Rudolph, Ed Isomber, Robert Shaw, Nat Ross
Sakimay / Four Horse Developments – Linda Falstead, Cameron Sangwais, Tim Ponace, Randy Sangwais	SaskWater – Nish Prasad
Town of Balgonie – Shaun McBain	CH2M HILL – Iain Cranston (facilitator)

The evaluation followed a high level Triple Bottom Line (TBL) approach; discussing Economic, Social, and Environmental benefits associated with the options. Table 5-48 lists the various factors used for the TBL evaluation and the rating agreed by the stakeholders at the December Working Session. Ratings were kept to a simple traffic light (Red/Amber/Green) scale, with green providing the most benefit and red providing the least benefit or a significant challenge. This high level TBL approach was deemed sufficient for this stage in the study; it is intended only as an additional guide to determining which of the options should be viewed more favourably in terms of non-financial benefits and to identifying potential areas of challenge.

Table 5-48
High Level Triple Bottom Line Summary for East Wastewater Servicing Solutions

	Factors	Local WWTP at White City/RM of Edenwold	Lagoon Upgrades for Balgonie and Pilot Butte	East Regional Wastewater Pipeline	East Regional WWTP
Economic	Minimizes Construction Risk - financial over run / complications	• R	• G	• A	• R
	Minimizes Deliverability Risk - delay in time to activate	• A	• A	• A	• R
	Minimizes Staffing Risk - attracting the right people and knowledge	• A	• G	• G	• G
Social	Flexibility to supports / facilitate future growth	• G	• A	• G	• G
	Minimizes Construction Disruption on Communities	• G	• G	• G	• G
	Minimizes Operational Nuisance - Noise, Odour, Visual, Traffic etc	• G	• G	• G	• G

Table 5-48
High Level Triple Bottom Line Summary for East Wastewater Servicing Solutions

	Factors	Local WWTP at White City/RM of Edenwold	Lagoon Upgrades for Balgonie and Pilot Butte	East Regional Wastewater Pipeline	East Regional WWTP
Environmental	Meets Effluent Quality Improves Quality and/or Reliability*	• R	• A	• G	• G
	Minimizes Construction Disruption on Environment	• G	• G	• G	• A
	Maximizes opportunities for diversified bio solids reuse	• G	• R	• G	• G

Notes:
*The TBL factor "Meets Effluent Quality Improves Quality and/or Reliability" proved marginally challenging. Whilst all options must meet effluent quality restrictions, this factor allowed stakeholders to distinguish which options potentially could provide a higher level of treatment and/or reliability and therefore reduce environmental risk of pollution spills.
WWTP – wastewater treatment plant
RM – Rural Municipality

The rationale behind the ratings in Table 5-48 that were captured with the stakeholders at the December Working Session is documented in Appendix M.

5.3.8 Village of Edenwold Investigation

The Village of Edenwold was considered separately due to geographical challenges. It is located 18 km from the nearest town in the study area (Balgonie) and further still from other communities considered to be located in the East Region. The Village of Edenwold community is facing challenges on both sides: raw water supply is limited during periods of drought, and wastewater treatment is operating at capacity. The WTP and wastewater lagoons are managed under contract by SaskWater; the Village of Edenwold is responsible for distribution and collection accordingly. In addition to the service challenges, there is also a physical constraint on land use which is halting development and infrastructure improvement.

The study conducted a high level assessment of the following options for the Village of Edenwold:

- Local Options: local lagoon expansion; local WWTP utilizing treated effluent for non-potable water use
- Regional Options with nearby First Nations: potential option for water and wastewater options; limited research was done into this option, as the nearby First Nations were out of the study area
- East Regional Wastewater Pipeline: connecting the Village of Edenwold with Balgonie; a shared trench pipeline for wastewater and water pipeline to Balgonie

Note: The options above noted Balgonie as the connection point for a regional pipeline; this was because Balgonie is the nearest regional community. The pipeline could be connected to another regional community, for example White City, which would be of particular relevance to SaskWater (which services both the Village of Edenwold and White City).

In connecting to an East regional community, either Balgonie or White City, the Village of Edenwold would in turn benefit from any other regional solutions developed across the wider East region. Engineering pre-designs and cost estimates elsewhere in this report do not factor in the population for the Village of Edenwold; however, the relatively small populations that would be added would result in marginal cost increases for the overall regional solution.

As SaskWater play a key role in water and wastewater servicing for the Village of Edenwold, CH2M HILL kept in close touch with SaskWater through the initial investigation. Through SaskWater's role, they have a deep understanding of the servicing issues the Village of Edenwold faces and have been assessing various go forward options over recent years. Consequently, it was agreed that SaskWater would take responsibility for assessing servicing options for the Village of Edenwold.

5.3.8.1 Servicing Options and SWOT Analysis

Table 5-49 to Table 5-53 document the SWOT Analysis completed with the stakeholders from the region at the October Working Session, held on October 30, 2013, at the George Bothwell Library in Regina. Initial notes and conceptual ideas are documented within the notes of Table 5-49 through Table 5-53.

A SWOT Analysis is a structured way of evaluation options, capturing Strengths, Weaknesses, Opportunities and Threats. During the working sessions, the stakeholders were facilitated through the analysis by CH2M HILL team members, with the SWOT titles used as prompts to gather feedback from the stakeholders on the options. The bullet points captured in the below tables are not an exhaustive list of all points associated with each of the options; instead, they are a list of the significant points that were at the forefront of stakeholders' minds.

Table 5-49
Village of Edenwold SWOT Analysis – Local Lagoon Upgrades
Expand the storage and facultative lagoons at the Village of Edenwold

Strengths: • Lower capital cost than WWTP (Mech/bio) • Lower requirement for operator training and certification • Very low Operational and Maintenance costs for Lagoon • Less requirements for sludge handling / disposal than WWTP (Mech/bio) (only once every 10-15 years) • Appears to be low engineering cost alternative (land may be expensive) • Provides required capacity to communities faster to accommodate pending growth • No new conveyance system required • No change to community facilities	**Weaknesses:** • Treatment is limited (minimum standards for secondary treatment only) • Potential for odours • Additional land maybe required • Limited flexibility for future expansion and growth (limited by area) • Represents the status quo, not a regional effort
Opportunities: • Potential upgrade to advanced lagoon process to improve effluent quality • Opportunity for local reuse / irrigation	**Threats:** • Minimal level of treatment impacts quality of local water courses • Contamination of surface or ground water • Treatment may not meet future regulatory requirements • Growth might change effluent quality

Notes:
WWTP – wastewater treatment plant

Table 5-50
Village of Edenwold SWOT Analysis – Regional Wastewater Pipeline to Balgonie Lagoons
Regional wastewater pipeline to transport raw wastewater from the Village of Edenwold to Balgonie. More engineering analysis is required to evaluate the feasibility of this option given the low flows and fluid velocities based on the population assumptions and conveyance distance. An expansion to the Balgonie storage and facultative lagoons depends on a wider regional solution. Option would benefit from any potential Regional Wastewater solution reaching Balgonie, as the Village of Edenwold would in turn be connected.

Strengths: • Lower operation and maintenance requirements for Village of Edenwold • No additional staff requirements • High demand for Balgonie effluent for irrigation	**Weaknesses**: • Treatment is limited (minimum standards for secondary treatment only) • Potential for odours • Additional land maybe required • Requires agreement with Balgonie • Limited flexibility for future expansion and growth (limited by area) • Conveyance system required and several pump station/upgrades at municipality • Construction will cause disruption to existing works and communities
Opportunities: • Potential upgrade to advanced lagoon process in Balgonie to improve effluent quality • Could be connected to potential future regional solution through Balgonie	**Threats**: • Minimal level of treatment impacts quality of local water courses • Contamination of surface or ground water • Lagoon effluent discharge may not meet future regulatory requirements • Conveyance pipeline right of way granted • Ensuring Balgonie lagoons can handle extra demand while still dealing with Regina growth

Table 5-51
Village of Edenwold SWOT Analysis – Local WWTP and Use Treated Effluent for Non-potable Water Use
BNR WWTP constructed in the Village of Edenwold. High quality effluent is then used as non-potable water supply. Cost to construct non-potable water supply system has not been included. Only limited parts of this option have been costed. The NPC presented does not illustrate the complete cost for this option.

Strengths: • Mechanical WWTPs allow for higher levels of treatment • Provides capacity for local future growth • Self-sufficiency and water conservation • Partly solves challenges associated with water servicing • Appears to be low engineering cost alternative (land may be expensive) • Provides required capacity to communities faster to accommodate pending growth • No new conveyance system required • No change to community facilities	**Weaknesses**: • Significant capital investment for the WWTP and non-potable • Very low flows – engineering feasibility study required • Construction will cause disruption to existing works and communities • Operators require higher level of training/certification • Complex process, more maintenance required • Decentralized treatment is more expensive on a per capita basis (capital and operating) • Potentially still dependent on seasonal discharge (tbc)
Opportunities: • Can provide a phased approach to support future growth • Opportunity to spearhead water reuse in Canada/Saskatchewan • Reduce volume of WW discharged into environment	**Threats**: • Significant challenges around perception of wastewater reuse • Time period for design and construction may delay growth • Lack of qualified operations staff • Economic strain on local municipality/community

Notes:
WWTP – wastewater treatment plant
tbc – to be confirmed
WW - wastewater

Table 5-52
Village of Edenwold SWOT Analysis – Regional Wastewater Pipeline to Balgonie and Shared Trench with Regional Water Pipeline
Refer to Village of Edenwold Water Section 4.2.2.4 for more detail on the water servicing challenges faced by the community.
If water and wastewater pipelines were constructed at the same time, they could share the same route and benefit from economies of scale in design and construction. Engineering analysis is required to evaluate the feasibility of this option given the low flows and fluid velocities based on the population assumptions and conveyance distance. No additional treatment capacity is added to the region. Option would benefit from any potential Regional Wastewater solution reaching Balgonie, as the Village of Edenwold would in turn be connected. Costs for this option have not be estimated, as the WSA indicated early on that this would likely not be approved.

Strengths: • Cleaner water source – treated water from Pilot Butte WTP • Seasonal reliability • Simplify treatment • Burden of WTP management shifted away from community with limited resources • Lower operational and maintenance requirements for Village of Edenwold • No additional staff requirements • High demand for Balgonie effluent for irrigation	**Weaknesses**: • WSA/SaskEnv indicate this would likely not be permitted, shared trench seen as high risk • Requires agreement with both Balgonie and Pilot Butte • Wasted investment in recent WTP upgrade • Additional land maybe required • Conveyance system required and several pump station/upgrades at municipality • More complex trench design to prevent contamination
Opportunities: • Potentially more funding available to Village of Edenwold as it's a regional project • Could allow for growth in community and also along pipeline route (tie-ins) • Potential upgrade to advanced lagoon process in Balgonie to improve effluent quality • Could be connected to potential future regional solution through Balgonie	**Threats**: • Contamination of surface or ground water • Treatment may not meet future regulatory requirements • Dependent on water allocations – Pilot Butte may limit the amount of water that is purchased • Limited control over cost base • Requires additional land and permitting • Potential health risks of shared trench

Notes:
WTP – water treatment plant
WSA – Water Security Agency

Table 5-53
Village of Edenwold SWOT Analysis – Combine (Wastewater and Water) efforts with Neighboring First Nations Community
Refer to Village of Edenwold Section 4.2.2.4 for more detail on the water servicing challenges faced by the community.
It is understood that the Village of Edenwold is near a First Nation communities. It is believed these communities are the Piapot First Nation; however, initial research was not able to confirm the name of the communities. These are outside of the scope of the study, and they were not evaluated. It is suggested they should be investigated by the Village of Edenwold and SaskWater. This could be an option for both Water and Wastewater services. Costs for this option have not be estimated.

Strengths: • Conveyance systems required are shorter in distance	**Weaknesses**: • Requires shared responsibility for maintenance and capital cost • May still be a low flow to justify a mechanical WWTP
Opportunities: • Makes a local WWTP more viable	**Threats**: • Dependence on First Nation community for continued financing support and servicing of their internal wastewater collection systems

Notes:
WWTP – wastewater treatment plant

5.3.8.2 Servicing Options Conclusions

As SaskWater plays a key role in water and wastewater servicing for the Village of Edenwold, CH2M HILL kept in close touch with SaskWater through the initial investigation. Through SaskWater's role, they have a deep understanding of the servicing issues the Village of Edenwold faces and have been assessing various go forward options over recent years. Consequently it was agreed that SaskWater would take responsibility for assessing servicing options for the Village of Edenwold.

5.4 City of Regina Servicing Options

The City requested that CH2M HILL review existing studies and comment on providing wastewater treatment to some of the communities to the east of the City (including Balgonie, Pilot Butte, White City, Emerald Park, and the Great Plains Industrial Park). City of Regina conveyance upgrades will likely be required to transport wastewater to the City's West WWTP whether in the short or long term, and these could incur high costs. Further investigation is required with complex engineering models necessary and discussions to be held around regional stakeholders contributing to this infrastructure. A high level review of existing study conclusions and recommendations led to the recommendation that, if wastewater from these communities were to be accepted, the connection point for them would be within the City's southeast sector, near Chuka Creek and Highway 33. Of several study recommendations proposed for capacity improvements for the southeast sector, the recommendation of this report is to proceed with the conveyance upgrades for the southeast and the twinning of the South Trunk. The City should also look to complete work on the Level of Service Framework to help in ensuring quality of service across the system.

5.4.1 Background

In the past several years, the Regina region has experienced significant population growth. Both the City of Regina and the surrounding communities have shared in this population increase. The RM of Edenwold is situated directly east of Regina, and the towns within the RM's boundary include Balgonie, Pilot Butte, and White City. Situated immediately west of the Town of White City are the residential area of Emerald Park and the Great Plains Industrial Park, both of which are managed by the RM of Edenwold. There are several scattered rural residential areas within the RM as well.

The recent growth has resulted in the reduction of capacity in local wastewater treatment systems, and an immediate solution is necessary. Currently, the Towns of Balgonie, Pilot Butte, and White City and the community of Emerald Park each have wastewater lagoons. The community of Emerald Park has recently connected to the White City system to alleviate its own system issues. The location of the Emerald Park lagoons is apparently also restricting further development in that area.

5.4.2 Purpose

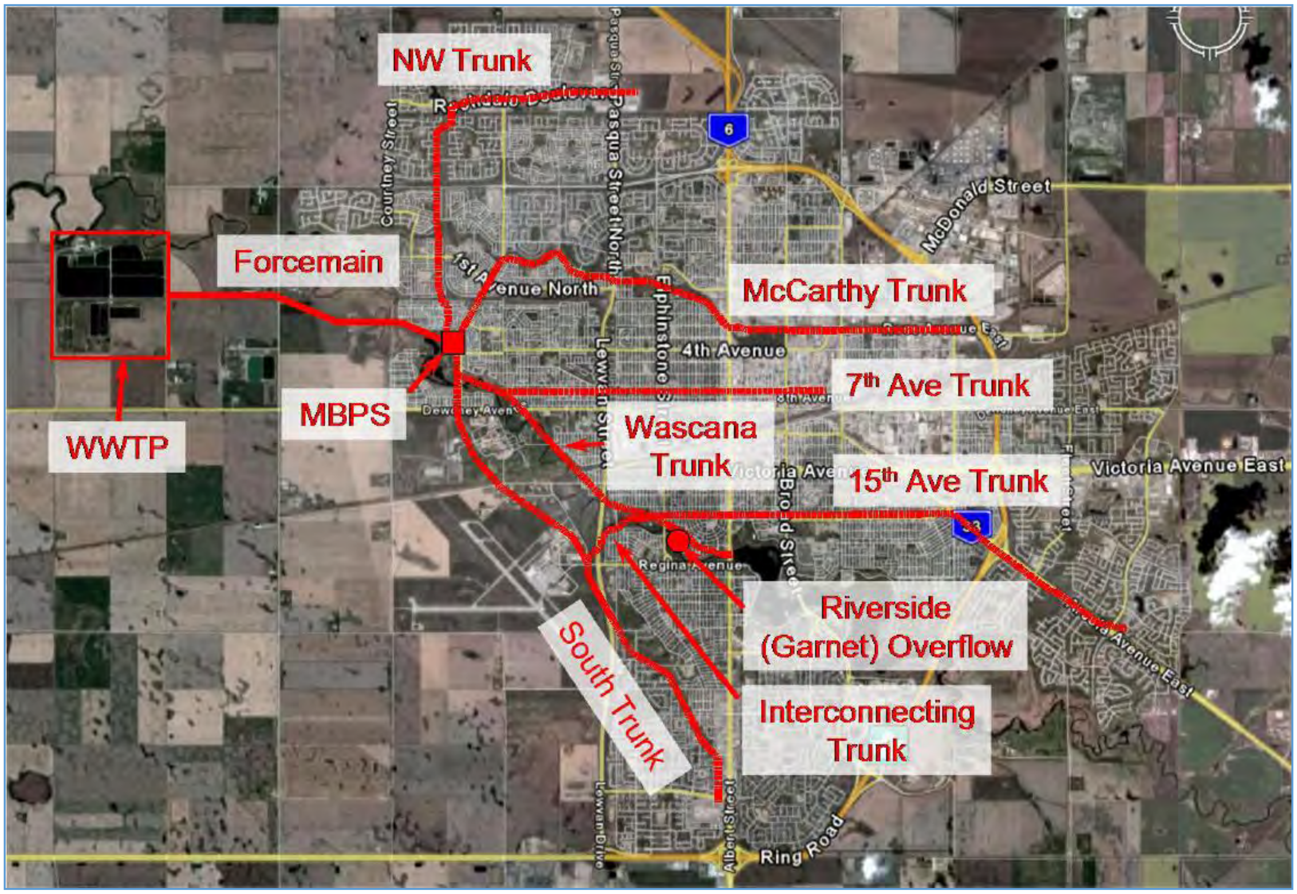
The City of Regina requested that CH2M HILL review available reports and provide comment on the concept of Regina providing wastewater treatment for portions of the RM of Edenwold. The objective of this technical memorandum is as follows:

1. Provide comments comparing various options of upgrading Regina trunk sewers to the concept of constructing a bypass trunk around or through the City.
2. Identify future steps to narrow and eliminate potential options with the goal of facilitating a solution.

5.4.3 Regina Wastewater Conveyance System

Regina's wastewater collection system was assessed by AECOM in 2012 (AECOM, 2012a); in general, it appears that the collection system capacity is taxed in terms of peak flow based on the 1-in-25-year stormwater event. An observation is that all wastewater flows are routed through a single large pump station, the MBPS. Based on the importance of this pump station, it is assumed that there are several layers of redundancy, such as back-up power and redundant pumps; however, the pump station may still be vulnerable to locational problems, such as a fire emergency. Several options for upgrading various sewer trunks in each City sector (Northeast, Southeast, Southwest, and Northwest) were presented in separate studies. Some of those options may have the potential to be part of a solution to bring sewer water through Regina to Regina's WWTP from the regional communities to the east of the City. For simplified comparison purposes, a common point of Victoria Avenue East (near the Regina Memorial Gardens Cemetery) has been assumed for the flow coming from the communities to the east. For reference, Figure 4 from the *Citywide Wastewater Collection System Assessment* (AECOM, 2012a) report is reproduced below.

Figure 5-26
City of Regina Wastewater Collection System



The following four sections briefly describe the issues with connecting to each City sector.

5.4.3.1 Northwest Sector

While the Northwest sector has the fewest number of capacity issues, the conveyance system required to connect to it from the Victoria Avenue area would be an estimated 12.5 km long forcemain. Assuming the same per unit cost ($1,500/m)[8] of the Southeast sector bypass forcemain AECOM estimated, a forcemain to the Northwest might have a construction cost of $36.1 million including 15 percent design and 25 percent contingency, as in the AECOM study. Based on the cost and the lack of benefit to areas of the City the forcemain would pass through, connection to the Northwest trunk is not recommended.

5.4.3.2 Southwest Sector

The Southwest sector has significant capacity issues, similar to other sectors. This fact, coupled with the forcemain that would be required to get to the Southwest sector, made options related to this sector unattractive. AECOM estimated the forcemain and lift station construction cost to be $53.9 million

[8] Cost estimate for 800mm forcemain construction in 2012 (AECOM, 2012a)

(including design and contingency)[9]. Based on the cost and the lack of benefit to areas of the City the forcemain would pass through, connection to the Southwest sector is not recommended; however, a significant Southwest sector upgrade will be included in the recommendation and deserves some discussion.

In the Southwest sector, the Wascana Trunk completes the last leg of the journey of wastewater originating in the Southeast; however, it is surcharged under existing conditions during a 1-in-25-year stormwater event[10]. Twinning the South Trunk from the Wascana/South Trunk Interconnector to the MBPS would provide relief to both the South and Wascana Trunks. AECOM's model indicated that peak flow in South Trunk at the Interconnector would be lowered by 1.6 m in response to the 1-in-25-year stormwater event at Stage 1 (235,000) population. [11] AECOM also found that increasing the capacity of the MBPS forcemain system would be *"...only marginally effective at reducing water levels in the upper reaches of the Wascana Trunk and thereby preventing overflows at Garnet Street."*[12] The report goes on to make the following important and guiding statement. *"Assuming the South Trunk is twinned, the existing forcemain capacity* (MBPS) *is sufficient to prevent overflows at Garnet and to prevent surcharging in the South Trunk during a 25 year event for both the existing condition and Stage 1* (235,000) population *level of development."*[13]

5.4.3.3 Northeast Sector

Potential connection to the Northeast sector trunk (McCarthy Trunk) was reviewed. AECOM identified several areas requiring upgrades to increase the level of service for existing conditions and also for future development; a number of options were presented. There are upgrades required to the area generally northeast of Ross Ave and Park Street to service existing conditions. If these upgrades are completed, the upper reaches of the McCarthy Trunk would be fully utilized; therefore, it appears that any new connection would likely have to be made downstream of McDonald or Winnipeg Streets and would also depend on an upgrade downstream to reduce the backwater in the lower reaches of the trunk. In addition, future servicing of the upstream East Regina Industrial Lands would further reduce capacity.

Any connection from the Victoria Avenue area would be estimated 6.5 km long and require a forcemain for approximately the first 2 km. Based on the unit rates ($1,500/m of forcemain and $1,500/m for 600-mm-diameter main)[14] from the AECOM studies, this connection might have a construction cost of $17.8 million including design and contingency. There would likely be additional upgrades required in developed areas downstream of the connection point as well, but these upgrades were not investigated. Connecting to the Northeast sector is not recommended, because it is less attractive than connecting to the Southeast sector.

5.4.3.4 Southeast Sector (Recommended Sector)

The Southeast sector is the closest sector from the flow origin of the east regional communities and will see significant population growth. The southeast servicing study provided storage, conveyance upgrades, a bypass forcemain, and a new southeast WWTP as a separate potential options to improve capacity and accommodate future flows. In addition, one detention facility has already been constructed. The four approaches are discussed below.

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[9] Table 19 (Forcemain and lift station only) Pg 118 (AECOM, 2012a)

[10] Pg 28 of Reference (AECOM, 2012a)

[11] Pg 84 of Reference (AECOM, 2008)

[12] Pg 88 of Reference (AECOM, 2008)

[13] Pg 89 of Reference (AECOM, 2008)

[14] Cost estimate for forcemain construction in 2012 (AECOM, 2012a)

Detention / Storage

An option based solely on storage was presented. AECOM indicated that using detention storage to serve all of Stage 2 Southeast sector growth (28,042) will reach or exceed the Arcola Trunk capacity, and a large overflow would probably result at the Garnet Street overflow during a 1-in-25-year stormwater event[15]. Given this statement, determining a long term solution for bringing wastewater flows through the City from the east regional communities should not be based solely on peak flow attenuation through storage. Further investigation and modelling is required.

A detention facility has recently been constructed to accommodate the Creeks residential development. The detention facility is located immediately southwest of Arcola Avenue, west of Tower Road, and north of Chuka Creek at East Sandpiper Crescent. It currently has 1,000 m³ capacity, but is expandable to 5,000 m³. AECOM indicated that the capacity of this facility may be increased to 5,000 m³ in the future and that the actual increase necessary might be less (1,000 m³ to 3,500 m³).[16]

Conveyance Upgrades

Several conveyance upgrades were presented to reduce the risk of basement flooding and to increase capacity. The situation of the system is such that there is no single "silver bullet" solution. Instead, to address all of the apparent issues, the upgrades represent a package. A brief list of the upgrades, along with their benefits and remaining issues, is as follows:

1. Upgrade the MBPS to 350 ML/day.[17] (see footnote)
   Benefit: Improvements (reduction) in the South and Wascana Trunks
   Remaining Issues: There are still upstream capacity restrictions.
2. Provide a parallel relief upgrade for the Arcola Trunk.
   Benefit: Capacity increase in Arcola Trunk
   Remaining Issues: Sub-trunk along Prince of Wales still has a high level of surcharge during the 1-in-15-year stormwater event.
3. Provide a parallel relief upgrade for the sub-trunk along Woodland Grove Drive.
   Benefit: Capacity increase for Prince of Wales
   Remaining Issues: Surcharging north of Quance Street remains, as does risk of basement flooding at Tanager Cresecent. There is a relatively flat hydraulic grade line along Arcola Trunk from Woodland Grove Drive to Prince of Wales.
4. Twin the 450-mm pipe along Arcola from Woodland Grove Drive to Prince of Wales.
   Benefit: This would resolves the flat hydraulic grade within Arcola Trunk within limits of upgrade.
5. Provide a parallel 375-mm pipe along Prince of Wales.
   Benefit: This would result in lower flow levels along Prince of Wales and north of Quance Street.

The estimated construction cost of all of these option 2008 was $39.7 million (of which $12 million is for the upgrading of the MBPS[18]) and $3.6 million Net Present Value (NPV) of O&M cost for 25 years. They are generally ranked from most-to-least benefit.

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[15] Pg 92 of Reference (AECOM, 2012b)

[16] Pg 86 of Reference (AECOM, 2012b)

[17] Based on the 1958 Forcemain Predesign Report (AECOM, 2008), only 290 to 300 ML/d is achievable, based on the existing WWTP piping configuration (Pg 63). Also, the Primary Treatment Plant's capacity is 250 ML/d. Also see Section 3.2 regarding impact of increasing MBPS capacity. Twinning the South Trunk would have the same benefits, but the interconnecting Pasqua Trunks would also benefit.

[18] Twinning the South Trunk is also approximately $12 million in 2008 Construction Cost (~$17.5 million in 2013), pg 79 (AECOM, 2008)

It is assumed that, if these upgrades were to occur, they would be incrementally cheaper as the upgrade becomes larger.

Bypass Forcemain around the Southwest Sector

An option was presented that proposes to construct a bypass forcemain around the Southwest sector of the City to the WWTP in the west. The estimated construction cost of this option was $68 million plus $9.4 million NPV (25 years) O&M. Compared to the conveyance options described above, the forcemain option has no benefit if only a portion of it were constructed: therefore, this option has to be taken as a single $68 million cost to reap any benefit. It appears that, for the same or similar benefit, the conveyance options would be cheaper.

Southeast Wastewater Treatment Plant

The last option presented was to construct a new WWTP in the Southeast sector, approximately southeast of the Creeks detention facility previously mentioned. CH2M HILL recently (that is, in December 2013) estimated the cost of a new WWTP to be $105 million plus $17 million NPV (30 years) O&M. (CH2M HILL, 2013) The estimate range was minus 50 percent to plus 100 percent. This cost assumes wastewater flows from the area east of Regina are received.

5.4.3.5 Delivery Concept

Since there is an immediate need to provide capacity for the communities to the east, and since there appears to be relatively immediately available capacity in the design of the detention facility meant to service the Creeks development, a potential short term solution exists of building out the detention facility and connecting the east regional flows to it. In order to lessen the effect the incoming peak flows would have, it is suggested that the existing regional lagoons (or some of them) could be used as buffer storage, prior to strategically pumping the flows to the detention facility. The concept indicates that the east regional flows would be delivered to the Creeks detention facility overnight and during non-peak hours during the day. As a side note, Regina's existing WWTP would benefit from any treatment the existing east regional lagoons might provide, for as long as they may be operational. As growth occurs in the City and the regional communities, the stakeholders would then have the option to consider long term options if required (for example, a new regional WWTP located in the east could be connected). Further investigation is required with complex engineering models necessary to understand flows across the region along with regional lagoons, City of Regina conveyance, and treatment plant capacity.

This concept demonstrates a phased approach to infrastructure investment alongside the phased growth in the City and region. The addition of a regional wastewater pipeline would solve regional servicing challenges and would utilize the City's existing conveyance investments, while also providing additional population to fund future upgrades and expansions. In the longer term, if growth continues to be high and City conveyance capacities are being reached, then a new regional WWTP located in the east could be considered.

Creeks Residential Development Storage Detention Facility

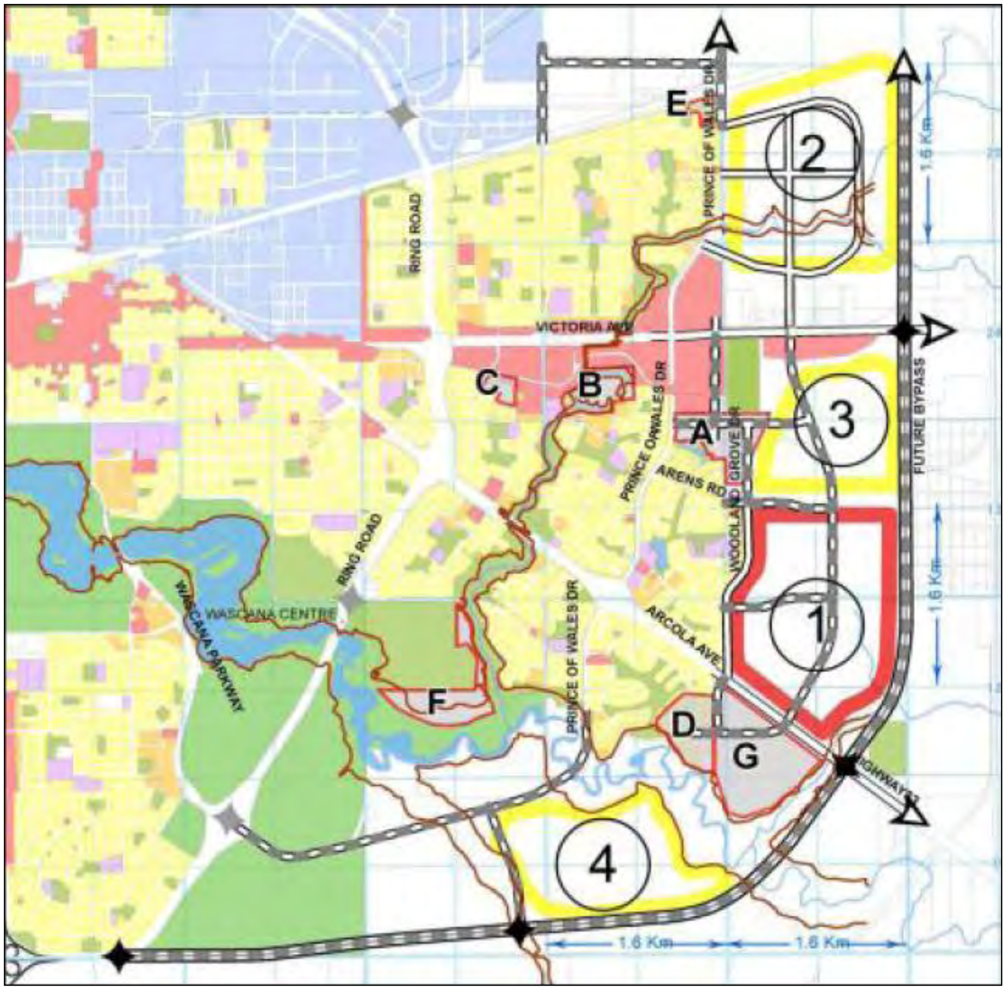
It appears there may be available storage capacity in the Creeks detention facility design; therefore, a potential opportunity exists to receive flows from the east regional communities. It appears that connection to this detention facility may be an immediately available option, at least in terms of infrastructure required. The estimated construction cost to upgrade the detention facility is $7 million.[19]

Based on the information on page 84 of the *Southeast Serviceability Study* (AECOM, 2012b), there will ultimately be an estimated 17,548 people contributing to the detention facility from Greens on

[19] Reference (AECOM, 2012b)

Gardener/South and 50 percent of the Creeks and Other Infill (Area 1, D & G). Figure 3.13 from the *Southeast Serviceability Study* (AECOM, 2012b) is reproduced below in Figure 5-27 to show the noted areas.

Figure 5-27
Residential Development Areas from the Southeast Study Plan



Based on 2011 population data, the population of between 8,210 and 6,585[20] from the area to the east of Regina may be added, roughly the equivalent of 50 percent of the Area 1, D & G ultimate population (See Table 5-54 below). If the Area 1, D & G and east regional areas are combined, the total population would be 25,758. If these extra flows are added, it would be somewhat equivalent to starting Stage 2 growth much earlier than planned.

Table 5-54
Population Estimates for Regina Southeast Sectors

Residential Area	Population
Creeks	2,044†
Greens on Gardiner/South Half of The Townes	12,779†
Other Infill/SE Sector	2,725†

20 2011 population, lower number is if Pilot Butte does not connect initially. From internal CH2M HILL document prepared, current as of Jan 15, 2014.

Table 5-54
Population Estimates for Regina Southeast Sectors

Residential Area	Population
Balgonie	1,625‡
Pilot Butte	1,848‡
RM of Edenwold	1,426‡
Emerald Park	1,417‡
White City	1,894‡
Total	25,758

Notes:
†At Stage 1
‡At 2011

Conveyance Upgrades

Since it was identified that a Stage 2 servicing option based solely on storage will reach or exceed the Arcola Trunk capacity, it stands to reason that conveyance capacity upgrades would be required if the flows from the east regional communities were to be added. It is worth noting that the model used in AECOM's report did not include flows from as far away as the east regional communities, since it was not in the scope of the study. Flows from further away would probably have an effect on peak flow, but the added flow's peak would probably occur later in the combined hydrograph. In other words, the added peak flow would not be purely additive on the model's peak flow. The addition of storage complicates matters by further drawing out the model's peak flow, but its effect is not readily apparent.

5.4.4 Impact of Downtown Growth

The City of Regina *Downtown Serviceability Study* (AECOM, 2014) indicated that, in response to the 1-in-25-year stormwater event, the Wascana Trunk downstream of the 15th Avenue Trunk is surcharged by 1.5 to 2.0 m.[21] A quantitative description of the impact of twinning the South Trunk on the Wascana Trunk during Stage 1 or Stage 2 population was not available; however, it would have a significant positive impact and warrants further investigation. It appears reasonable to assume that the twinning of the South Trunk might impact the Wascana Trunk in a similar way as does the South Trunk at the Interconnector. This would also benefit the other areas served by the Wascana Trunk, including downtown, although it appears level of service for the downtown area would benefit more from improvements to the 7th Avenue Trunk, which uses the downtown system as capacity relief.[22] Please refer to the City of Regina *Downtown Serviceability Study* (AECOM, 2014) for more information and cost estimates.

5.4.5 Implementing a Level of Service Framework to Understand Impacts

The City has recently taken steps forward in developing a Level of Service Framework for the Utility, including the sewer and wastewater system. A full suite of Customer Level of Service measures has been defined and benchmarked, and many Technical Level of Service measures exist across operations; however, they have not been fully integrated. To help in ensuring that the City understands its current Level of Service, understands any impacts a regional connection may have, and monitors the additional loads on the

[21] Pg 80 of Reference (AECOM, 2014)

[22] Pg 96 of Reference (AECOM, 2014)

system once implemented, it is important for the City to establish a complete and robust Level of Service Framework for the sewer and wastewater system.

5.4.6 Discussion of Cost Allocation

5.4.6.1 Local Improvements and Latecomer Charge

Necessarily, the initial construction of infrastructure for the City is arranged by the City; however, it does not make sense for a City to build infrastructure only for the current population. When the City grows, the systems recently built will then immediately become under capacity. Therefore, it makes sense for the systems to be constructed to accommodate some anticipated level of growth. The principle of users paying their fair share dictates that some portion of the initially constructed system should be borne by the future users. This could include both local citizens and regional community users.

In Saskatchewan, the *Local Improvements Act* is the governing policy for this type of arrangement (PoS, 1993). A manual has been produced by the Ministry of Government Relations and acts as a guide to this Act PoS, 2012). The guide states that “Generally, a local improvement is any work or service paid for by charging all or a part of the cost against the lands that benefit from the work or service. The benefit received by these lands must be different from or greater than the benefit generally received by other lands in the municipality.” The *Local Improvements Act* itself indicates the following:

> *“Works and services that may be undertaken:*
> *3 A work or service or any combination of works or services, by bylaw, may be undertaken by a municipality as a local improvement where any land specially assessed for the work or service is benefited by it, and without limiting the foregoing, works and services of the following descriptions may be undertaken as local improvements: ….*
>
> > *(f) constructing, deepening, enlarging or extending a sanitary sewage system or storm sewer system;*
> > *(i) providing additional capacity to certain buildings that impose a heavy load on a sewer or water system;”* (PoS, 1993)

In British Columbia, municipalities may require a developer to construct excess infrastructure to accommodate future development. The cost of this excess infrastructure can be borne by either the municipality or the developer, and the party that finances the excess is entitled to recoup those funds from latecomers who benefit from the excess or extended service. In either case, the municipality calculates, coordinates, collects, and distributes the funds. This is termed a “latecomer charge.” It is not known how this arrangement may fit within the provincial Acts governing Saskatchewan municipalities.

5.4.6.2 Costs of Sewer Upgrades

For the City of Regina, there are existing capacity issues that require upgrades and also upgrades necessary to create capacity for growth. The cost of the former should be borne by the existing users, and the cost of the latter by the future users; however, both stand to benefit from some upgrades. For example, upsizing a 375-mm-diameter sewer main to 450-mm may provide existing users with capacity improvements, but upsizing it to 600-mm may provide the future capacity for growth. In this case, the opportunity is to share a proportion of the installation cost and the material cost which results in lower costs for both parties. It is recognized, however, that existing users have already paid for the existing sewer.

5.4.6.3 Connection with City of Regina Official Community Plan

The City of Regina’s latest *Official Community Plan* (OCP) (City of Regina, 2013) documented a number of priorities and objectives that align both with regional growth and cooperation, and also with the cost allocation and cost sharing notes in Sections 6.1 and 6.2 of the OCP. The engagement processes identified the desire to “achieve long term financial viability” as a Community Priority for the City. The OCP listed the following financial principles to support achieving long term financial viability:

1.16 Ensure that growth pays for growth

1.17 Consider options for allocating costs to non-residents for the use of City of Regina services which are not fully cost recovered through user fees.

1.19 Encourage surrounding municipal governments and government agencies to provide 10-year forecasts of capital expenditures to allow for improved joint planning.

1.20 Apply the benefits model to ensure that costs shared with other municipalities and external agencies are paid for on a proportionate basis.

1.21 Collect development charges through the use of development levies or servicing fees in accordance with The Planning and Development Act, 2007.

The City of Regina in the OCP also explicitly outlines the regional collaboration goal: to "Support a more sustainable and beneficial approach to growth within the region through collaborative regional planning and service delivery."

5.4.7 Comments and Recommendation

Throughout the four options described in the *Southeast Serviceability Study*, there is a common geographical theme (AECOM, 2012b). In general, flows pass through the area near Arcola Avenue southeast of Woodland Grove Drive. For this reason, it is likely that—regardless of the upgrading option(s) selected by the City—some upgrade, and therefore some capacity, will be designed and built in this area. Since there is also an existing, expandable detention facility in this location, routing the flows from the east regional communities to this detention facility appears logical.

The selected connection point for the flows from the east regional communities is near the junction of Chuka Creek and Highway 33. Coincidentally, Chuka Creek originates in the White City area and has an average slope of 0.25 percent. If connection to this area is developed as the preferred solution, consideration should be given to the use of following the Chuka Creek alignment from the White City area. This alignment might be able to provide a mostly gravity conveyance solution.

The recommended engineering approach is as follows:

1. Twin the South Trunk from the Interconnector to the MBPS.
2. Complete several or all of the conveyance option upgrades, and determine additional capacity increases necessary to handle east regional flows.
3. Develop the option of connecting the east regional trunk to the Creeks Storage Detention Facility area in the short term, with the expectation that capacity will increase in the long term and reliance on the detention facility will decrease.
4. Until sufficient capacity develops through the conveyance upgrades, use some or all of the existing lagoons in the communities of Balgonie, White City, Pilot Butte, and Emerald Park as strategic storage.

If growth in the Southeast area does not occur as planned, the connection location would still be a good choice because of the positive likelihood that necessary upgrades will occur to service existing populations. This demonstrates a phased approach to infrastructure investment alongside the phased growth in the City and region. The addition of a regional wastewater pipeline would solve regional servicing challenging and would utilize the City's existing conveyance investments, while also providing additional population to fund future upgrades and expansions. In the longer term, if growth continues to be high and City conveyance capacities are being reached, then a new regional WWTP located in the east could be considered. Further investigation is required with complex engineering models necessary to assess the impacts on City infrastructure with the inclusion of increasing regional flows to understand how the network could react.

It is important that the City of Regina establishes a complete and robust Level of Service Framework for the sewer and wastewater system. This will help to ensure that the City of Regina understands its current Level of Service, understands any impacts a regional connection may have, and monitors the additional loads on the system once implemented.

5.5 Wastewater Interim Options

This section is most applicable to communities in the East; however, this information has been separated as it provides useful details for all stakeholders who may experience wastewater servicing challenges in the future. Communities in the North and West face slightly different challenges and routes to solutions, but some of the options explained below may be useful.

East stakeholders, particularly White City and Emerald Park, need to secure from 2 to 5 years in wastewater servicing capacity to facilitate growth until a regional wastewater pipeline would be in place. The duration of this interim solution would be dependent on the timeframe to negotiate and construct the pipeline. Engineering and construction can be accelerated, but the duration is mainly dependent on politics between stakeholders involved and agreement on the other aspects of the pipeline and future treatment options, including governance and rate setting approaches. This duration could be drastically decreased and delivery accelerated if all stakeholders were to make a concerted effort to work through challenges, particularly at the political level.

If it is decided to progress a regional solution, then stakeholders should make every effort to ensure this is done efficiently to reduce these interim costs. It may also be worth considering that, potentially, the costs could be marginally shared by all stakeholders in the interest of working towards a better longer term regional solution.

For the North stakeholders, namely the Town of Lumsden, an immediate wastewater solution is required; however, as indicated previously in this report, the choice between options is simpler than it is in other regions. It is understood that the preference of the Town of Lumsden is to move straight to the long-term solution, whether it be local treatment or a regional pipeline, and to have this solution implemented as soon as possible.

For the West stakeholders, namely the Village of Grand Coulee, wastewater servicing solutions are required. As indicated previously in this report, only low to moderate growth is planned in the West: as a result, time pressures and scalable solutions are not as significant. The Town of Pense has wastewater challenges; however, it is understood that these are due to mechanical lagoon drainage issues as opposed to capacity issues.

5.5.1 Water Security Agency Input

CH2M HILL involved the regulator, the WSA, early in this regional effort, so that progress was being made in the right direction and the WSA would be in a position to support regional solutions. As indicated, the regional options will potentially take longer to become operational, and all stakeholders highlighted the need for an interim solution. The end goal and final regional solution would likely provide a higher quality wastewater treatment solution for the region, but the stakeholders would need additional time to get that solution in place. This is particularly pertinent to the East stakeholders.

CH2M HILL contacted the WSA following the December 2013 Working Session to get its opinion on which short-term interim options WSA would be comfortable with, as most potential interim options involve more frequent effluent discharging. The interim options suggested to the WSA were as follows, and it was noted any additional ideas from the WSA would be welcomed:

- Aerate lagoons – shorter treatment times with more frequent effluent discharging
- Chemicals / Enzymes – shorter treatment times with more frequent effluent discharging

- Package Treatment Plants – bring in small, container-sized treatment plants; potential for sharing mobile units between communities; shorter treatment times with more frequent effluent discharging
- Tankering – haul the excess flow to another community with lagoon capacity or to the City of Regina
- Lagoon Dredging – from high level discussions, it would appear most communities have dredged lagoons recently, so only limited benefit would be provided

The WSA responded with the following feedback on the above options:

- All interim solutions would need to meet effluent quality limits and potentially storage requirements.
- There are ice-damming concerns with overland effluent discharge in winter; as a results, 210-plus days of effluent storage is required for most stakeholders. This is also noted in the latest Water Security Agency and Saskatechewan Ministry of Environment "Guidelines for Sewage Works Designs" released in January 2013.
- Aeration, chemicals, enzymes, or package treatment plants may be viable if there are no storage concerns.
- The WCRM158 Downstream Use and Impact Study has effluent limits that would need to be met if the system discharges to Chukka Creek.
- Tankering is a possible option, but likely a very expensive alternative.
- Lagoon dredging would likely not provide a significant increase in capacity if it was done recently.

It is suggested that stakeholders keep the WSA involved in work to resolve the servicing challenges moving forward.

5.5.2 Wastewater Tankering and Hauling

Given that the existing lagoons can sufficiently treat the existing wastewater flows, an option potentially exists to transport the extra excess wastewater from the additional population to another site for treatment. This would involve utilizing tanker hauling raw wastewater from one of the challenged communities to another community in the region with treatment capacity. This could be to the City of Regina's existing West WWTP or to a neighbouring community's lagoons which currently have capacity. A number of communities across the region were identified as having short-term capacity.

Raw wastewater contains a significant volume of water; as a result, a significant number of tankers are required. Dewatered sludge reduces the volume significantly; however, these additional facilities were not evaluated as an interim option as they do not increase hydraulic capacity which is remains a major challenge over winter.

On average, the annual tankering costs to transport raw wastewater equates to $2,950 per year per person. This excludes any treatment costs from the receiving community. This cost multiplies with the new population number to be a significant amount of money; as suggested by the WSA, this option in isolation is cost prohibitive.

5.5.2.1 Assumptions

- Raw wastewater will be hauled directly from lagoons at regional communities and transported to a site with wastewater treatment capacity: either the City of Regina or another regional stakeholder where capacity is available.
- The calculations assume community lagoons are at capacity with the 2013 population and that the excess wastewater flow from the additional population through growth will be tankered.
- Treatment costs by the receiving community have been excluded; however, it would be fair for the community to charge a reasonable handling fee if necessary.

- The population from 2014 to 2018 for the communities was calculated by extrapolating the population projection points calculated in Section 3 of the report for 2011 and 2020.
- A total of 200 litres per capita per day wastewater flows for the regional communities has been assumed. Without investigation of flow data from communities, it was assumed that this calculation is satisfactory for the regional communities. In reality, this number may be higher or lower for each community, and this would affect their flows and in turn their hauling costs.
- Three local haulage companies (ACME Sewer & Industrial, Barry Sewer Services and Atlas Sanitary Sewer Services) were contacted to collect local data points.
  - While large 4,000-gallon tankers are widely available, haulage companies in the region were using 2,800-gallon tankers which required more frequent regular trips. These smaller-sized tankers are to be expected, as the primary business of local haulage companies is believed to be residential or leisure septage tank clearing, rather than large scale volume transportation.
  - Hauling rates varied marginally between the companies, and a weekday rate of $130 per hour was assumed. This rate includes the tanker, other related equipment, and labour time, and excludes GST and PST.
- Days to haul were converted from 7 days to 5 days to avoid weekend overtime charges from haulage companies. Hauling the same volume of wastewater, but over fewer days per week, resulted in more trips for those days.
- Adjustments for seasonal flow variations are not included in the calculations.
- All costs are at 2014 Canadian Dollars, excluding PST and GST.

Table 5-55
Wastewater Trucking and Hauling Assumptions

Wastewater Flow Per Capita Per Day:	200	Lpcd		
Hauling Truck Capacity:	2800	Gallons	10640	Litres
Round Trip Estimate (hours)	3	Includes loading, unloading and travel		
Hauling Days Per Year on Week Days	260	Days available		
Hauling Rate ($ per hour)	130	$ including equipment and labour, excluding GST		

Notes:
Lpcd – litres per capita per day

Cost Estimate

Table 5-56
Wastewater Trucking and Hauling Cost Estimates for Balgonie

	2014	2015	2016	2017	2018
Year	1	2	3	4	5
Balgonie, 50 km One Way					
Population	1,809	1,870	1,931	1,992	2,054
Extra-Population	61	122	184	245	306
Reqired Capacity, L (per day, 7-day Week)	12,244	24,489	36,733	48,978	61,222

Table 5-56
Wastewater Trucking and Hauling Cost Estimates for Balgonie

	2014	2015	2016	2017	2018
Year	1	2	3	4	5
Reqired Capacity, L (per day, 5-day Week)	17,142	34,284	51,427	68,569	85,711
Truck Loads (loads per day)	2	4	5	7	9
Service Hours per Day	6	12	15	21	27
Service Hours per Year (260 week days)	1,560	3,120	3,900	5,460	7,020
Annual Cost ($)	$202,800	$405,600	$507,000	$709,800	$912,600
Average Daily Hauling Cost ($)	$556	$1,111	$1,389	$1,945	$2,500
Average Annual Cost per Person ($)	$3,313	$3,313	$2,760	$2,898	$2,981

Notes:
L – litre(s)
km – kilometre(s)

Table 5-57
Wastewater Trucking and Hauling Cost Estimates for White City

	2014	2015	2016	2017	2018
Year	1	2	3	4	5
White City, 40 km One Way					
Population	2,806	3,110	3,415	3,719	4,023
Extra-Population	304	608	912	1216	1521
Reqired Capacity, L (per day, 7-day Week)	60,822	121,644	182,467	243,289	304,111
Reqired Capacity, L (per day, 5-day Week)	85,151	170,302	255,453	340,604	425,756
Truck Loads (loads per day)	9	17	25	33	41
Service Hours per Day	27	51	75	99	123
Service Hours per Year (260 week days)	7,020	13,260	19,500	25,740	31,980
Annual Cost ($)	$912,600	$1,723,800	$2,535,000	$3,346,200	$4,157,400
Average Daily Hauling Cost ($)	$2,500	$ 4,723	$6,945	$9,168	$11,390
Average Annual Cost per Person ($)	$3,001	$ 2,834	$2,779	$2,751	$ 2,734

Notes:
L – litre(s)
km – kilometre(s)

Table 5-58
Wastewater Trucking and Hauling Cost Estimates for Emerald Park

	2014	2015	2016	2017	2018
Year	1	2	3	4	5
Emerald Park, 40 km One Way					
Population	1,761	1,824	1,888	1,951	2,014
Extra-Population	63	127	190	253	317
Reqired Capacity, L (per day, 7-day Week)	12,667	25,333	38,000	50,667	63,333
Reqired Capacity, L (per day, 5-day Week)	17,733	35,467	53,200	70,933	88,667
Truck Loads (loads per day)	2	4	5	7	9
Service Hours per Day	6	12	15	21	27
Service Hours per Year (260 week days)	1,560	3,120	3,900	5,460	7,020
Annual Cost ($)	$202,800	$405,600	$507,000	$709,800	$912,600
Average Daily Hauling Cost ($)	$556	$1,111	$1,389	$1,945	$2,500
Average Annual Cost per Person ($)	$3,202	$3,202	$2,668	$2,802	$2,882

Notes:
L – litre(s)
km – kilometre(s)

5.5.3 Temporary Package Treatment Plants

Temporary Package Treatment Plants are typically housed in a temporary modular structures, for example a steel shipping container. The shipping container versions, in particular, allow for very simple transportation to work sites using standard trucks and winches or cranes.

These Temporary Package Treatment Plants are typically found in remote work camps (for example, in oil and gas or mining sites), where treated water and wastewater servicing is required for the labour force.

Generally speaking, Temporary Package Treatment Plants have a shorter life-cycle than have permanent Treatment Plants (which may be built with long-term cement structure, for example). The membranes will typically last 7 years before needing replacement, while the structure itself will last typically 20 to 30 years or more with regular maintenance. This compares to a permanent treatment plant, which could last well beyond 60 years with correct maintenance and necessary upgrades. For both options, the standard maintenance of pumps and other equipment would apply.

5.5.3.1 Concerns in this Regional Setting

With specific regard to this project and the challenges faced by its regional stakeholders, particularly in the East, installing a Temporary Package Treatment Plant will not necessarily solve the problem.

Current lagoons are at or nearing capacity for a number of stakeholders, and this is due to the volume of wastewater being generated. Over the summer period, treated effluent from the lagoons is discharged either for irrigation or to temporary summer water flows. In the winter period, however, effluent discharge is not permitted by the regulator for communities which do not have a flowing water body into which to discharge. This results in a storage challenge associated with hydraulic capacities over the winter period due to the volume of wastewater.

The Temporary Package Treatment Plant will be able to treat the wastewater significantly more quickly than the holding time required in the lagoons. However, over the winter period, the regional stakeholders will not be able to discharge the treated effluent.

5.5.3.2 Assumptions

- Cost information was supplied by FilterBoxx Packaged Water Solutions Inc. (FilterBoxx) based in Calgary, Alberta. FilterBoxx is just one of many companies supplying this type of package treatment technology. CH2M HILL's inclusion of their costs in this report is not an endorsement or a recommendation.
- Specifications and prices noted in this section are specific to FilterBoxx; however, the products and prices are likely to be similar with other suppliers. Cost information supplied by FilterBoxx is for estimate budget purposes only. If this is a reasonable option, then this vendor (or another) should be engaged for more accurate pricing.
- Plants are not necessarily immediately available from vendors. In the case where construction is required to build a new plant, the lead time could be 4 to 6 months.

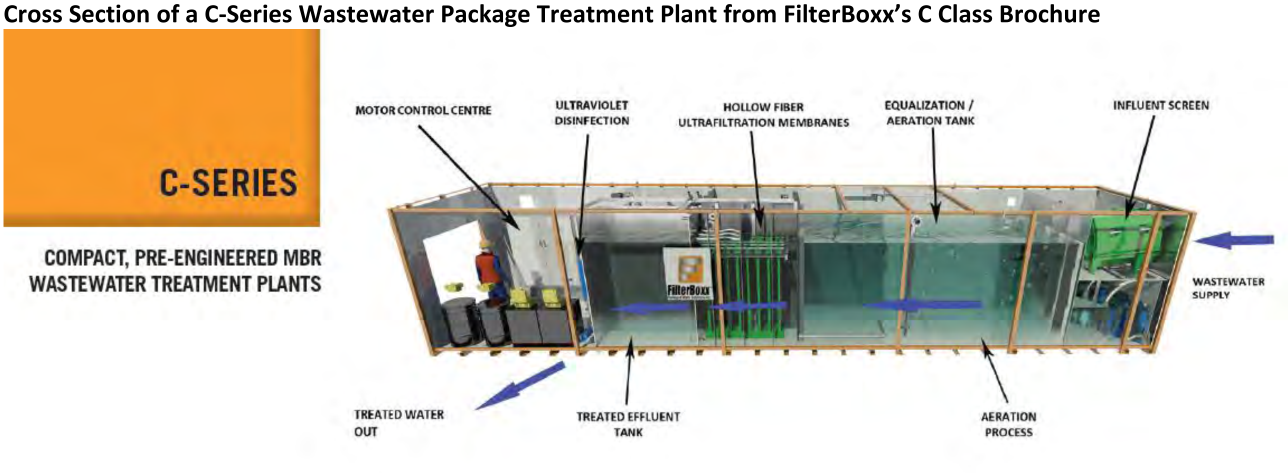
5.5.3.3 Treatment System

The standard features associated with the Package Treatment Plants investigated are as follows:

- Advanced hollow fiber membrane bioreactor (MBR) treatment system
- 2-mm screening
- UV disinfection
- Fully automated programmable logic controller (PLC) controlled system
- Highly portable pre-engineered building
- Built-in hydraulic retention time

Plants are available in a variety of standard sizes, accommodating flows of 38 m^3/day, 75 m^3/day, 150 m^3/day, or 300 m^3/ day. It is also worth noting that these plants are created using a modular design and can be expanded as population or influent flow increases.

Figure 5-28
Cross Section of a C-Series Wastewater Package Treatment Plant from FilterBoxx's C Class Brochure



FilterBoxx advertises their plants' high quality effluent treatment parameters as noted in Table 5-59.

Table 5-59
Effluent Treatment Parameters of a C-Series Wastewater Package Treatment Plant from FilterBoxx's C Class Brochure
Additional treatment options are available, including nutrient removal and sludge handling

Wastewater Parameter	Design Parameter
Carbonaceous Biochemical Oxygen Demand (CBOD 5)	< 10 mg/L
Total Suspended Solids (TSS)	< 10 mg/L
Total coliforms	< 1,000 CFU/100 ml
Fecal coliforms	< 200 CFU/100 ml

Notes:
mg/L – milligrams per litre
CFU/100 ml – colony-forming units per 100 millilitres

5.5.3.4 Cost Estimate

Table 5-60
Cost Estimate for Budgeting Purposes of a C-Series Wastewater Package Treatment Plant from FilterBoxx
Additional treatment options are available, including nutrient removal and sludge handling

Flow (m^3/day)	System	Footprint	Selling price	Cost of operations per year[a]	Daily rent with ops (3-year contract)[b]	Daily rent with ops (4-year contract)[b]	Daily rent with ops (5-year contract)[b]	Operator daily rate[c]
460	C450	1 x Process Building (65' x 12') 2 x EG Tanks (44' x 8.5') 2 x Bioreactor Tanks (44' x 8.5') 1 x Sludge Holding Tank (30' x 8')	$1,705,000	$132,000	$2,360	$1,875	$1,555	$1,000
150	C150	2 x (50' x 10')	$967,000	$92,000	$1,395	$1,105	$925	$1,000
68	C75	1 x (50' x 10')	$600,000	$82,000	$950	$750	$650	$1,000
1700	C450 x 4	4 x Process Buildings (65' x 12') 8 x EG Tanks (44' x 8.5') 8 x Bioreactor Tanks (44' x 8.5') 4 x Sludge Holding Tanks (30' x 8')	$5,830,000	$312,000	$8,760	$6,940	$5,800	$1,000

Notes:
[a]Operations costs include; Administrative reporting, Repair & Maintenance, Parts & Labour, Critical Spare Parts, Safety visits, Membrane rehabilitation.
[b]Daily rental rates include the above Operations costs over the rental term, parts replacements and an annual audit on the system to ensure proper performance.
[c]m^3/day – cubic metres per day

Power costs are not included in Table 5-60. Power usage information was provided by FilterBoxx for a C-150 plant which estimated 1 year's energy consumption at 218,616 kWh. Assuming an electricity power tariff as per other sections of this report (Sask Power rate E8 [rural] at 6.837 cents per kilowatt-hour), the estimated power cost would be $14,950 per year.

5.5.3.5 Notes from the Vendor

- Vendors typically offer a variety of payment options which ease the financial burden on regional stakeholders (for example, capital purchase and buy back, or rentals and long term leasing).
- There is a daily check list for operators where they operate the plants as needed. For the most part, operators do not have much to do, as the system is fully automated. It is not overly demanding on the operator, but they do need to be available and competent to react to plant upsets or emergencies. FilterBoxx's field operators typically work a day shift and are on call 24 hours.
- In Alberta, Wastewater Operators need a Level 1 certification to operate the FilterBoxx C series plants. It is assumed that a similar requirement would be in place for Saskatchewan, but the decision is with the local jurisdiction and further investigation should be carried out.
- FilterBoxx offers operator training. Stakeholder trainees would shadow the vendor operator for a few weeks until they are comfortable taking over. With FilterBoxx's remote monitoring system, they can assist operators from their base (or anywhere with an internet connection) in operations and preventative maintenance. In most cases, they can assist remotely, thereby saving the costs of having to send a Service Technician to site. Limits and alarm points can be set to send warnings, emails, or texts to the operator if any targets are out of normal operations; the operator can adjust these settings if needed to correct the situation.
- Details of the contact at FilterBoxx that CH2M HILL spoke to are as follows:

  Steve Lemke C.E.T.
  Rental Services Account Manager
  FilterBoxx Packaged Water Solutions Inc.
  O: (403) 203-4747 | F: (403) 203-4774 | C: (403) 990-7958
  steve.lemke@filterboxx.com | www.filterboxx.com

As mentioned above; CH2M HILL's inclusion of FilterBoxx's products and costs in this report is not an endorsement or recommendation.

5.5.4 Water Conservation

As mentioned previously in this report, a region-wide Water Conservation Programme would prove beneficial and would delay the required investment in water infrastructure, particularly in the East region. This water conservation would have a knock on effect to the wastewater demands of the communities, and would delay the required capacity increase for wastewater in a similar vein. It is not expected that this would be a stand-alone solution; however, it would potentially reduce the costs of other interim solutions, particularly tankering.

More analysis can be done to evaluate whether or not there will be reasonable benefit to be gained by this activity.

Water conservation is explained in more detail in Section 6.3.3 where water servicing challenges and solutions are investigated.

5.5.5 Further Investigation Required

From this initial investigation, a feasible interim solution will be relatively complex. Further analysis is required to ensure that a suitable wastewater solution will be found.

Thoughts on potentially viable short-term interim wastewater solutions include (but are not limited to) the following:

1. Ensure that deep lagoon dredging was done recently to ensure the maximum available capacity.
2. Utilize Package Treatment Plant(s) over the summer period to release treated effluent, resulting in empty lagoons moving into the winter storage season.
   a. Lagoons may be large enough to hold all winter influent (more investigation is required).
   b. Minor dredging may be required depending upon how long the interim solution is in place.
3. Combine Package Treatment Plant and Hauling / Tankering options.
   a. If the lagoons are not large enough to hold all winter influent, then hauling / tankering may be required to release the excess winter flows.
4. Share a Package Treatment Plant geographically between multiple regional communities over the summer period.
   a. This is dependent on available volumes to treat and a treatment plant large enough to process the volume quickly (more investigation is required).
5. Water and wastewater conservation would be a potential addition to any option to alleviate wastewater influent.

If a Package Treatment Plant has some appeal for regional stakeholders, then a suitable vendor should be engaged as soon as possible to provide expertise on the challenges the communities face.

SECTION 6

Water Servicing Options

While wastewater servicing is an immediate concern for a number of regional stakeholders, in the longer term (as communities grow), water servicing will become an issue, namely with communities east of the City of Regina. Raw water supply in the East is limited by the ground water available in the Zehner Aquifer, and it is unclear how much additional water may be available past the existing allocations, or indeed how the aquifer will react at high abstraction rates. As a result, an alternative regional water supply will likely be required to support growth in the East.

In the North, minor-to-moderate infrastructure upgrades will be required between 2025 and 2035 to continue meeting water demands up to 2040. In the West, only minor infrastructure upgrades will be required in the future, as all of the municipalities purchase treated water from the Buffalo Pound Supply Line (BPSL). Relative to the North and West, higher growth is expected in the communities to the east of Regina. In the East, high growth is anticipated in the next 25 years, requiring minor-to-moderate infrastructure upgrades between 2025 and 2035 to continue meeting water demands up to 2040.

With the significant growth anticipated to the east of Regina in the next 25 years, higher water allocations will be required to meet increasing water demands. The total usable supply capacity of the Zehner Aquifer has already been allocated to the existing users. New developments will need to obtain water from existing users or will require an alternative water source, such as treated water from the BPSL. Proposed new communities within the RMs of Sherwood and Edenwold will likely face significant pressures on gaining water servicing, given the already stretched allocations. If growth in the East continues to be high, as desired by the municipalities, the total allocation limit for the Zehner Aquifer will be reached in the next 10 to 15 years. Thus, a regional solution will be required to continue servicing the municipalities and developments in the East into the long-term (that is, 2040).

As part of the RRWWS, feasible options were explored for overcoming the water demand challenges in the region to the east of the City of Regina. The potential solutions explored include the following: (i) development of the East Regina Regional Pipeline; (ii) development of an East Regina Regional Water Grid System; and (iii) implementation of water conservation and water re-use measures to reduce current and future water demands in each community. The options presented are not isolated options, and the appropriate solutions will likely be a combination of these options. For example, the water conservation measures would marginally reduce demands and postpone the point at which allocation limits would be reached; however, once allocation limits are reached, a regional watermain would still need to be constructed to supply the demand.

Although the water servicing challenges are not as pressing as the wastewater servicing challenges, the region should take these challenges seriously and use the available time to develop an optimum solution for all stakeholders. Notably, implementing water conservation and water re-use measures in the short term would not only postpone the water servicing challenges, but would also benefit wastewater servicing by reducing influent wastewater flows. This would be of immediate benefit to the communities in the East who are currently experiencing significant wastewater servicing challenges.

This section of the report provides the following:

- Reviews the existing and planned water infrastructure and water allocations within the Study Area, in relation to future, long-term water demand projections, to identify future water supply and treatment challenges and to propose potential regional solutions.
- Presents the projected water demands up to 2040 for each community in the Study Area and outlines the assumptions made to develop the projections. Capacities of the existing and planned infrastructure are compared with the projected demands to determine if upgrades/expansions will be required.

- Outlines the information obtained by the WSA on the water allocation limits and aquifer capacities within the Study Area. Water allocation limits are compared to the projected water demands of each community to identify potential water shortages in the next 25-plus years.
- Outlines potential regional water solutions for the communities east of Regina, as growth is occurring rapidly in the east and groundwater shortages are anticipated to occur before 2040 as the total allocation limit of the Zehner Aquifer is reached.

6.1 Water Demand Projections

In the East, high growth is anticipated in the next 25 years, requiring minor-to-moderate infrastructure upgrades between 2025 and 2035 to continue meeting water demands up to 2040. Relative to the East, lower growth is expected to the north and west of Regina. In the North, minor-to-moderate infrastructure upgrades will be required between 2025 and 2035 to continue meeting water demands up to 2040. In the West, only minor infrastructure upgrades will be required in the future, as all of the municipalities purchase treated water from the BPSL.

6.1.1 Average Day Water Demand (Per Capita)

Average day water demands (ADDs) were obtained for each municipality from the *Saskatchewan Community Water Use Records* prepared by the Saskatchewan Watershed Authority (SWA, 2013). ADDs were collected for the years that correspond to the census population data (that is, 1996, 2001, 2006, and 2011). For each of the years, the ADD per capita was calculated; an average of all 4 years was determined and used to project the future water demands. Since Pilot Butte has recently installed its water system and since residents previously relied on unmetered private water wells, no water consumption data is available. An ADD per capita of 350 litres per capita per day (Lpcd) was assumed for Pilot Butte as towns with similar populations (such as White City and Lumsden) had an ADD per capita ranging between 300 and 400 Lpcd approximately. This falls into the average water demands range (230 to 450 Lpcd) reported in the *Saskatchewan Community Water Use Records* report. Table 6-1 below shows the historical ADD data and the ADD per capita that was selected for each municipality.

Table 6-1
Estimation of Average Day Water Demand Per Capita for Each Municipality

Municipality	Population 1996 Census	Population 2001 Census	Population 2006 Census	Population 2011 Census	ADD 1996 (m^3/d)	ADD 2001 (m^3/d)	ADD 2006 (m^3/d)	ADD 2011 (m^3/d)	ADD per Capita - 1996	ADD per Capita - 2001	ADD per Capita - 2006	ADD per Capita - 2011	Average ADD per Capita -
White City	907	1101	1113	1894	238	339	345	559	262	308	310	295	294
Pilot Butte	1481	1850	1872	1848	-	-	-	-	-	-	-	-	355
Edenwold	198	226	242	238	66	65	53	50	333	288	219	208	262
Grand Coulee	336	366	435	571	83	86	97	92	247	235	223	162	217
Craven	278	264	274	234	101	95	-	110	363	360	-	469	397
Lumsden	1530	1596	1523	1631	524	575	861	655	342	360	565	402	417
Pense	534	533	507	532	97	215	155	142	182	403	306	267	289
Belle Plaine	64	70	64	66	12	13	15	16	188	186	234	242	312[a]

Note:
[a]Selected based on monitored average day demand for 2008; higher than average ADD reported in Saskatchewan Community Water Use Records
ADD – Average Day Water Demand
m^3/d – cubic metres per day
Lpcd – litres per capita per day

Over the last few years, water consumption per capita has decreased in Balgonie as a results of public education and adjustment of the water rates. Water consumption data received from Balgonie is summarized in Table 6-2. Thus, a per capita consumption rate of 216 Lpcd was used in the assessment.

Table 6-2
Per Capita Consumption Rates for Balgonie
2004 to 2012

Year	Annual Consumption (L)	Average Daily Consumption (L)	Consumption – (Lpcd)
2004	181,385,750	496,947	308
2005	140,504,000	384,942	234
2006	211,124,550	578,423	334
2007	229,743,150	629,433	356
2008	169,369,200	464,025	249
2009	174,105,750	477,002	241
2010	155,098,125	424,926	215
2011	155,443,015	425,871	215
2012	156,463,753	428,667	216

Notes:
L – litre(s)
Lpcd – litres per capita per day

In cases where the per capita water demand was unknown or not reported, a value of 350 Lpcd was used.

6.1.2 Peaking Factors

Peaking factors are required to calculate the peak day demand (PDD) and peak hourly demand (PHD) for each municipality. In the *Saskatchewan Community Water Use Records* report, the Saskatchewan Watershed Authority has recommended that the PDD be taken as two to three times the ADD and the PHD be taken as three to four times the ADD (that is, for the distribution pumps), for design purposes (SWA, 2013). Additionally, Table 6-3 was provided, which includes peaking factors for various sized communities.

Table 6-3
Recommended Peaking Factors For Municipal Water Supply System (Saskatchewan Watershed Authority, 2013)

Population Range	Peak Day Factor (For Supply and Treatment)	Peak Hour Factor (For Distribution)
Up to 500	3.00	4.50
501 - 1,000	2.75	4.13
1,001 - 2,000	2.50	3.75
2,001 - 3,000	2.25	3.38
3,001 - 10,000	2.00	3.00
10,001 - 25,000	1.90	2.85
25,001 - 50,000	1.80	2.70
50,001 - 75,000	1.75	2.62
75,001 - 150,000	1.65	2.48

Table 6-3
Recommended Peaking Factors For Municipal Water Supply System (Saskatchewan Watershed Authority, 2013)

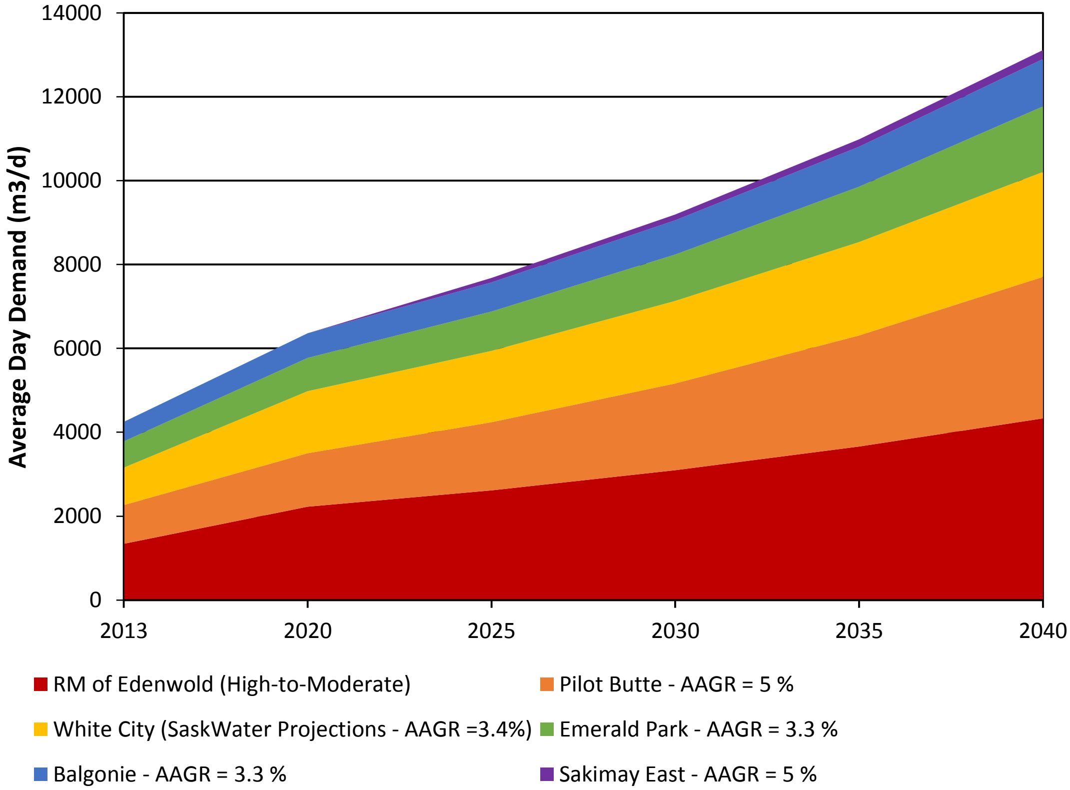
Population Range	Peak Day Factor (For Supply and Treatment)	Peak Hour Factor (For Distribution)
Greater than 150,000	1.50	2.25

6.1.3 Projected Water Demands

6.1.3.1 East Water Demand Projections

Figure 6-1 shows the cumulative ADD water demands for all the existing communities and planned developments to the East of Regina from 2013 to 2040, assuming the high growth scenario in all communities. The cumulative ADD in 2040 is projected to be approximately 13,000 m^3/d.

Figure 6-1
East Region - Cumulative Average Day Water Demand from 2013 to 2040



White City

Table 6-4 shows the projected ADD for White City for the years of 2020, 2025, 2030, 2035, and 2040, based on the SaskWater projections. It was assumed that 5 percent of the raw water is wasted during treatment since the WTP employs conventional treatment. According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, the storage reservoir at the WTP will need to be sized to contain 4,748 m^3 by 2040. Currently the treated water storage reservoir has a capacity of 1,000 m^3. White City is planning to expand the storage reservoir capacity to 2,500 m^3 by 2014; this should provide sufficient capacity until 2018. In 2018, an additional capacity increase will be required; an increase of 1,500 m^3 is anticipated. This will increase total capacity to 4,000 m^3, which should be sufficient until 2033.

Table 6-4
White City – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d) [a]				
	2020	2025	2030	2035	2040
SaskWater Projections	1,408	1,621	1,865	2,118	2,374

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per day

Table 6-5 and Table 6-6 show the projected PDDs and PHDs, based on the peaking factors presented in Table 6-5. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. White City has two raw water wells (located in two separate areas) that draw water from the Zehner Aquifer. Currently, only one well is used at any given time to supply water at a flow rate of around 1,309 m^3/d. In the future, both wells can be used at the same time to provide a maximum flow rate of 5,236 m^3/d; however, a higher water allocation will need to be requested from the WSA. To reach the projected maximum raw flow demand for 2040, additional wells and raw water pumping infrastructure will be required by 2032. At the moment, the raw water supply line is restricting growth. SaskWater is currently twinning half of the supply system to increase capacity from 1,898 m^3/d to 2,619 m^3/d in 2013/2014. In 2016, SaskWater plans to twin the second half of the supply system to increase capacity to 5,236 m^3/d and to allow both well sites to run at the same time. To reach the projected maximum raw flow demand for 2040, additional raw water supply infrastructure will be required by 2032.

The WTP is also being expanded to increase capacity. In the first phase of expansion, the WTP will be expanded to service a PDD of 4,419 m^3/d by the end of 2014. In the second phase of the expansion, the WTP will be expanded to service a PDD of 6,546 m^3/d; this will occur when it is required (and it could be as late as 2027). After the second expansion is complete, the treatment capacity should be sufficient to meet the projected maximum raw flow demand for 2040; additional filters may be required if the original filters are removed from service.

Table 6-5
White City – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d) [a]				
	2020	2025	2030	2035	2040
SaskWater Projections	3,779	4,351	5,006	5,685	6,372

Notes:
[a]Includes water wasted during treatment
m^3/d – cubic metres per day

Distribution pumps are typically sized to handle PHDs. At the White City WTP, there are currently two vertical turbine pumps each rated at 20.15 L/s (73 m^3/h). In 2014, two more vertical turbine pumps will be added, each rated at 63.4 L/s (228 m^3/h). The existing two pumps will be used as jockey pumps. Assuming all of the pumps will pump from the same wet well, the firm capacity will be around 374 m^3/h, which should be sufficient until 2035.

Table 6-6
White City – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/h) [a]				
	2020	2025	2030	2035	2040

SaskWater Projections	198	228	263	298	334

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per hour

Pilot Butte and Balgonie

Balgonie has entered into an agreement with the Town of Pilot Butte which will allow for the purchase of treated water. Under the WSA allocation, Pilot Butte can provide treated water to Balgonie to serve the current population and also a limited future population, an allocation of up to 300 ML per year or 300 dam3/yr. Under the current contract with Pilot Butte, water will be supplied to Balgonie residents only; if Balgonie wishes to add additional users located along the pipeline, a new agreement would be required. Under the moderate growth scenario (2.4 percent), there should be sufficient water to meet the projected demands up to the year 2040. Under the high growth scenario (3.3 percent), the agreement will need to be revised to continue meeting demands past 2030.

To transfer, boost chlorinate, and store the treated water from the Town of Pilot Butte, Balgonie is constructing a chlorination building, a new reservoir, and a pipeline. The new reservoir will allow for further expansion in the future, when required. The estimated completion date for all of the upgrades is March 31, 2014. Thus, the capacity of the Pilot Butte raw water supply and water treatment systems should be assessed for both the population of Pilot Butte and Balgonie together. Storage and distribution will be assessed separately.

According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. Table 6-7 shows the projected PDDs for Pilot Butte and Balgonie, based on the peaking factors presented in Table 6-3. It was assumed that approximately 20 percent of the raw water is wasted during treatment, since it is treated in a membrane WTP with reverse osmosis; this factor was used to convert the treated water demands into raw water supply for the assessment. Different low, moderate, and high growth rate scenarios were selected for each town based on historical growth and desired growth. For Pilot Butte, moderate and high growth rates of 1.5 percent and 5 percent were selected. For Balgonie, moderate and high growth rates of 2.4 percent and 3.3 percent were selected. Total water demands were calculated by summing the water demands for Balgonie and Pilot Butte.

Table 6-7
Total Water Demands for Pilot Butte and Balgonie – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/d) [1]				
	2020	2025	2030	2035	2040
Moderate Growth	3,240	3,497	3,778	4,087	4,208
High Growth	4,185	4,803	5,771	7,202	9,001

Notes:
[1]Includes water wasted during treatment. Assessed for shared infrastructure.
m3/d – cubic metres per day

The existing raw water supply wells (two wells) for Pilot Butte can each provide 37.8 L/s, resulting in a peak supply capacity of 75.6 L/s or 6,532 m^3/d. Under the moderate growth scenario, there should be sufficient raw water pumping capacity up to the year 2040. Under the high growth scenario, the raw water pumping capacity will need to be increased after 2030 to meet the projected PDD. Under the high growth scenario, the water allocation will need to be increased to allow for continued growth to 2040 (and this point is discussed further in Section 6.2). In the future, Pilot Butte plans to install a third well that can provide 37.8 L/s and will increase the peak supply capacity to 113.4 L/s or 9,798 m^3/d.

The existing raw water supply line has a capacity of around 94.6 to 113.6 L/s (8,173 to 9,815 m^3/d). Under the moderate growth scenario, there should be sufficient raw water supply capacity up to the year 2040. Under the high growth scenario, the raw water supply capacity may need to be increased after 2035 to meet the projected PDD.

The WTP consists of four membrane trains, with a total treatment capacity of 65 L/s (5,616 m^3/d). Under the moderate growth scenario, the existing WTP capacity should be sufficient up to the year 2040; however, under the high growth scenario, the WTP capacity will need to be increased in the next 15 years to meet the projected PDD.

Since Balgonie and Pilot Butte have separate storage and distribution systems, demands and capacities will be assessed separately.

Pilot Butte

Distribution pumps are typically sized to handle the PHDs. Table 6-8 shows the projected peak hourly water demands for Pilot Butte, based on the peaking factors presented in Table 6-3. The demands do not include water that is wasted during treatment. Currently, the Pilot Butte WTP employs four distribution pumps: 2 at 34.7 L/s and 2 at 68.1 L/s. This results in a firm pumping capacity of 205.6 L/s (740 m^3/h). Assuming a duty/standby configuration, with one 68.1 L/s pump reserved for standby, the rated capacity would be approximately 137.5 L/s (495 m^3/h), which should be sufficient up to the year 2040 under both the moderate and high growth scenarios.

Table 6-8
Total Water Demands for Pilot Butte – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/h) [a]				
	2020	2025	2030	2035	2040
Moderate Growth (1.5 %)	101	106	112	117	123
High Growth (5 %)	127	162	207	264	338

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per day

According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Table 6-9 shows the projected ADDs for Pilot Butte for the years of 2020, 2025, 2030, 2035, and 2040, based on the moderate and high AAGRs. The demands do not include water that is wasted during treatment. The existing storage capacity is around 3,369 m^3. At the moderate and high growth rates, the storage reservoir at the WTP will need to be sized to contain 1,992 m^3 and 5,324 m^3, respectively, in the year 2040. Thus, the existing storage capacity should be sufficient under the moderate growth rate scenario. Additional storage capacity will be required in the next 15 to 20 years, under the high growth rate scenario.

Table 6-9
Pilot Butte – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/d) [a]				
	2020	2025	2030	2035	2040

Moderate Growth (1.5 %)	718	754	793	833	875
High Growth (5 %)	1,018	1,299	1,658	2,116	2,700

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per day

Balgonie

Distribution pumps are typically sized to handle the PHDs. Table 6-10 shows the projected peak hourly water demands for Balgonie, based on the peaking factors presented in Table 6-3. The demands do not include water that is wasted during treatment. The City of Balgonie plans to purchase new distribution pumps to deliver the treated water to residents.

Table 6-10
Balgonie – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/h) [a]				
	2020	2025	2030	2035	2040
Moderate Growth (2.4 %)	61	69	78	87	87
High Growth (3.3 %)	66	78	81	96	112

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per day

According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Table 6-11 shows the projected ADDs for Balgonie for the years of 2020, 2025, 2030, 2035, and 2040, based on moderate and high AAGRs. The demands do not include water that is wasted during treatment. The existing storage capacity is approximately 1,390 m^3 for two holding tanks; however, the town is planning on building a new reservoir to store the treated water purchased from Pilot Butte. Upgrades should be complete by the end of March 2014. The reservoir will have a capacity of 2,000 m^3. Under the moderate and high growth scenarios, the reservoir should have sufficient capacity up to the year 2040.

Table 6-11
Balgonie – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/d) [1]				
	2020	2025	2030	2035	2040
Moderate Growth (2.4 %)	435	489	551	620	698
High Growth (3.3 %)	470	553	650	765	900

Notes:
[1]Does not include water wasted during treatment
m^3/d – cubic metres per day

Currently there are no large industries located in the Town of Balgonie. A proposed commercial development is to be constructed in the RM of Edenwold and has requested water service from Balgonie. The proposed first phase of the development anticipates using 45 to 56 m^3/d. This will not have a large impact on the projected population water demands (amounting to less than a 10 percent increase).

Village of Edenwold

Table 6-12 shows the projected ADDs for Edenwold for the years of 2020, 2025, 2030, 2035, and 2040, based on low and moderate-to-high average annual growth rates. It was assumed that 15 percent of the raw water is wasted during treatment, since the WTP employs both filtration and GAC. According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, at the low and moderate-to-high growth rates, the storage reservoir at the WTP will need to be sized to contain 144 m^3 and 198 m^3, respectively. Currently the treated water storage reservoir is at capacity with a volume of 121.5 m^3. The capacity of the reservoir will need to be increased in the near-term, regardless of what growth scenario occurs.

Table 6-12
Edenwold – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d) [a]				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	65	67	69	70	72
Moderate - High Growth (1.6 %)	72	78	84	91	99

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per day

Table 6-13 and Table 6-14 show the projected PDDs and PHDs, based on the peaking factors presented in Table 6-3. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. The 1.6-km, 50-mm-diameter supply line leading to the WTP maintains a pressure of 588 kPa (60 psi) via a pressurized storage tank. The supply line is likely reaching its capacity and will need to be upsized in the near future to meet the projected PDD over the next 25 years. The existing WTP has a design capacity of 262 m^3/d (182 L/min); however, since there are only two filters, the firm capacity would be considered to be 131 m^3/d. Additionally, there is only one GAC contactor; hence, when it is taken offline to be regenerated, there is no backup system for organics removal. An additional filter and GAC contactor will need to be added to increase the firm capacity to 262 m^3/d. Once the firm capacity is increased, the Edenwold WTP should have enough capacity to meet the projected peak water demands in 2040 under the low growth scenario. Under the moderate-to-high growth scenarios, the capacity of the WTP will need to be increased further to meet the projected peak water demands.

Table 6-13
Edenwold – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/d) [a]				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	217	223	229	234	240
Moderate - High Growth (1.6 %)	240	260	281	304	329

Notes:
aIncludes water wasted during treatment
m3/d – cubic metres per day

Distribution pumps are typically sized to handle the PHDs. At the Edenwold WTP, there are three pumps, one duty (10.8 m^3/h) and two standby (16.2 m^3/h each) end suction centrifugal pumps. The total flow capacity of the distribution pumps is 43.2 m^3/h. If only one pump is used for standby in the future and two for duty, the firm capacity will be 27 m^3/h which exceeds the projected PHDs estimated for the year 2040 under the low and moderate-to-high growth rate scenarios.

Table 6-14
Edenwold – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/h)[a]				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	12	13	13	13	14
Moderate - High Growth (1.6 %)	13	15	16	17	19

Notes:
aDoes not include water wasted during treatment
m3/d – cubic metres per day

Rural Municipality of Edenwold (not including Emerald Park)

The RM of Edenwold expanded its WTP in 2011 to allow for servicing of new residential and commercial developments, including those north of Highway 1. Additionally, raw water wells, a raw water supply line, and a pump house were constructed in 2012. The RM no longer purchases water from SaskWater.

(Note: No information has been provided on the water supply, treatment, or storage/distribution infrastructure to include in the assessment).

Table 6-15 shows the projected ADDs and PDDs for the RM of Edenwold (not including Emerald Park) for the years of 2020, 2025, 2030, 2035, and 2040, based on moderate and high-to-slow growth rate scenarios. A consumption per capita of 350 Lpcd was assumed.

Table 6-15
RM of Edenwold – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Demand - Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
ADD – High-to-Moderate	1998	2615	3093	3660	4330
PDD – High-to-Moderate	3996	5229	6187	7320	8227

Notes:
m^3/d – cubic metres per day
ADD – average daily demand
PDD – peak daily demand

Emerald Park

Previously, Emerald Park received raw water from the SaskWater Regina East Non-Potable Supply System, which also supplies water to the Town of White City. However, in 2011, Emerald Park constructed their own raw water supply well and infrastructure to convey raw water to their WTP. Since 2012, Emerald Park has been receiving/treating raw water from the new supply well.

(Note: No information has been provided on the water supply, treatment, or storage/distribution infrastructure to include in the assessment)

Table 6-16 shows the projected ADDs and PDDs for Emerald Park for the years of 2020, 2025, 2030, 2035, and 2040, based on moderate and high AAGRs. A consumption per capita of 350 Lpcd was assumed.

Table 6-16
Emerald Park – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Demand - Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040

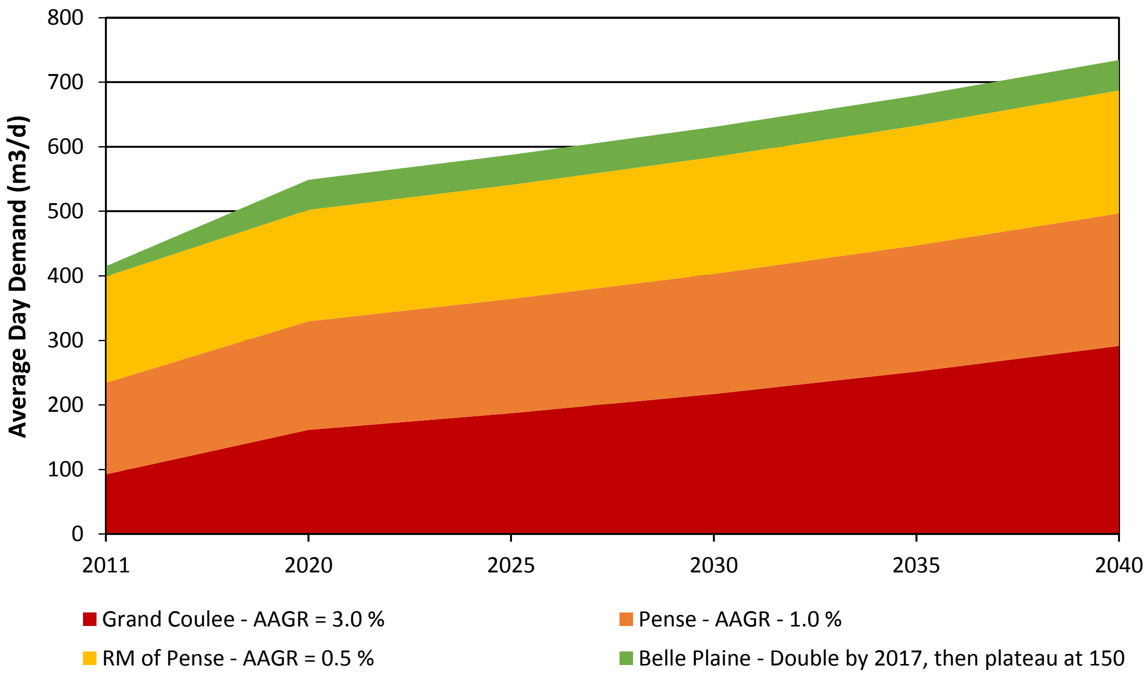
ADD - Moderate Growth (3.0 %)	744	863	1000	1160	1344
ADD - High Growth (3.5 %)	789	937	1113	1322	1570
PDD - Moderate Growth (3.0 %)	1675	1941	2251	2319	2689
PDD - High Growth (3.5 %)	1775	2108	2226	2643	3139

Notes:
m^3/d – cubic metres per day
ADD – average daily demand
PDD – peak daily demand

6.1.3.2 West Water Demand Projections

Figure 6-2 shows the cumulative ADD water demands for all the existing communities to the west of Regina from 2011 to 2040, assuming the high growth scenario in all communities. The cumulative ADD in 2040 is projected to be approximately 730 m^3/d.

Figure 6-2
West Region - Cumulative Average Day Water Demand from 2011 to 2040



Grand Coulee

Table 6-17 shows the projected ADD for Grand Coulee for the years of 2020, 2025, 2030, 2035, and 2040, based on a moderate AAGR. According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, at the moderate growth rate, the storage reservoir at the WTP will need to be sized to contain 584 m^3. Currently, the treated water storage reservoir has a capacity of 924 m^3 which should be sufficient to the year 2040.

Table 6-17
Grand Coulee – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040

Moderate Growth (3.0 %)	161	187	217	251	292

Notes:
m^3/d – cubic metres per day

Table 6-18 and Table 6-19 show the projected PDDs and PHDs, based on the peaking factors presented in Table 6-3. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. The capacity of the 150-mm-diameter supply line to Grand Coulee is likely similar to that of Pense, approximately 1,000 m^3/d, which exceeds the projected peak day demands for year 2040, under the moderate growth rate scenario.

Table 6-18
Grand Coulee – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
Moderate Growth (3.0 %)	444	515	542	629	729

Notes:
m^3/d – cubic metres per day

Distribution pumps are typically sized to handle the PHDs. At the Grand Coulee WTP, there are two electric distribution pumps. Each pump has a capacity of 35.9 m^3/h (158 gpm) resulting in a total capacity of 71.8 m^3/h, which exceeds the projected PHDs estimated for the year 2040 for the moderate growth rate scenario. A third engine driven pump is available for emergency/standby and has a capacity of 136.4 m^3/h (37.9 L/s); the engine driven pump is reaching the end of its useful service life and will need to be replaced soon.

Table 6-19
Grand Coulee – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/h)				
	2020	2025	2030	2035	2040
Moderate Growth (3.0 %)	28	32	34	39	46

Notes:
m^3/d – cubic metres per day

There are currently no large industrial or commercial users in Grand Coulee, and no industrial or commercial developments have been planned for the future.

Pense

Table 6-20 shows the projected ADDs for Pense for the years of 2020, 2025, 2030, 2035, and 2040, based on low and moderate AAGRs. According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, at the low and moderate growth rates, the storage reservoir at the WTP will need to be sized to contain 356 m^3 and 410 m^3, respectively. Currently, the treated water storage reservoir has a capacity of 607 m^3 which should be sufficient to the year 2040.

Table 6-20
Pense – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	161	165	169	174	178
Moderate Growth (1.0 %)	168	177	186	195	205

Notes:
m^3/d – cubic metres per day

Table 6-21 and Table 6-22 show the projected PDDs and PHDs, based on the peaking factors presented in Table 6-3. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. The capacity of the 150-mm-diameter supply line to Pense is 11.4 L/s (985 m^3/d), which exceeds the projected peak day demands for year 2040, under the low and moderate growth rates.

Table 6-21
Pense – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	443	454	466	477	489
High/Desired Growth (1.0 %)	463	487	512	538	565

Notes:
m^3/d – cubic metres per day

Distribution pumps are typically sized to handle the PHDs. At the Pense WTP, there are two distribution pumps; each pump has a capacity of 13.87 L/s (50 m^3/h), which exceeds the projected PHDs estimated for the year 2040 for the low and moderate growth rate scenarios.

Table 6-22
Pense – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/h)				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	28	28	29	30	31
Moderate Growth (1.0 %)	29	30	32	34	35

Notes:
m^3/d – cubic metres per day

There are currently no large industrial or commercial users in Pense, and no industrial or commercial developments have been planned for the future.

Rural Municipality of Pense

Most of the residents in the RM of Pense rely on private wells. However, the RM does supply water to two Hamlets (Stony Beach and Keystown) via the BPSL. The Hamlets are not anticipated to grow significantly due to the existing infrastructure (i.e. age and lack of), availability of lots, and location. Table 6-23 shows the projected ADDs for the Hamlets for the years of 2020, 2025, 2030, 2035, and 2040.

Table 6-23
Hamlets in the RM of Pense – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
Stony Beach – Low Growth	4	5	5	5	5
Keystown – Low Growth	8	8	9	9	9

Notes:
m^3/d – cubic metres per day

Belle Plaine

Table 6-24 shows the projected ADD for Belle Plaine for the years of 2020, 2025, 2030, 2035, and 2040, based on doubling the population in the next 4 years, then plateauing at a population of 150 and maintaining that population throughout 2020 to 2040. According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, the storage reservoir at the WTP will need to be sized to contain 94 m^3 in 2040. Currently, the treated water storage reservoir has a capacity of 107.7 m^3 which should be sufficient to the year 2040.

Table 6-24
Belle Plaine – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
High/Desired Growth (6.5 %)	47	47	47	47	47

Notes:
m^3/d – cubic metres per day

Table 6-25 and Table 6-26 show the projected PDDs and PHDs, based on the peaking factors presented in Table 6-3. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. Since the supply line currently taps off of a 150-mm-diameter header, there should be sufficient capacity to continue supplying Belle Plaine to the year 2040. No information was provided on the capacity of the chlorination system; hence, it may require upgrades to meet the future PDDs.

Table 6-25
Belle Plaine – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2020	2025	2030	2035	2040
High/Desired Growth (6.5 %)	140	140	140	140	140

Notes:
m^3/d – cubic metres per day

Distribution pumps are typically sized to handle PHDs. At the Belle Plaine WTP, the treated water is pumped from the storage reservoir to the distribution system via two end suction pumps (duty, standby) which each have a capacity of 14.3 m^3/h (3.97 L/s). Thus, sufficient pumping capacity will be available up to 2040.

Table 6-26
Belle Plaine – Projected Peak Hourly Demands for 2020, 2025, 2030, 2035, and 2040

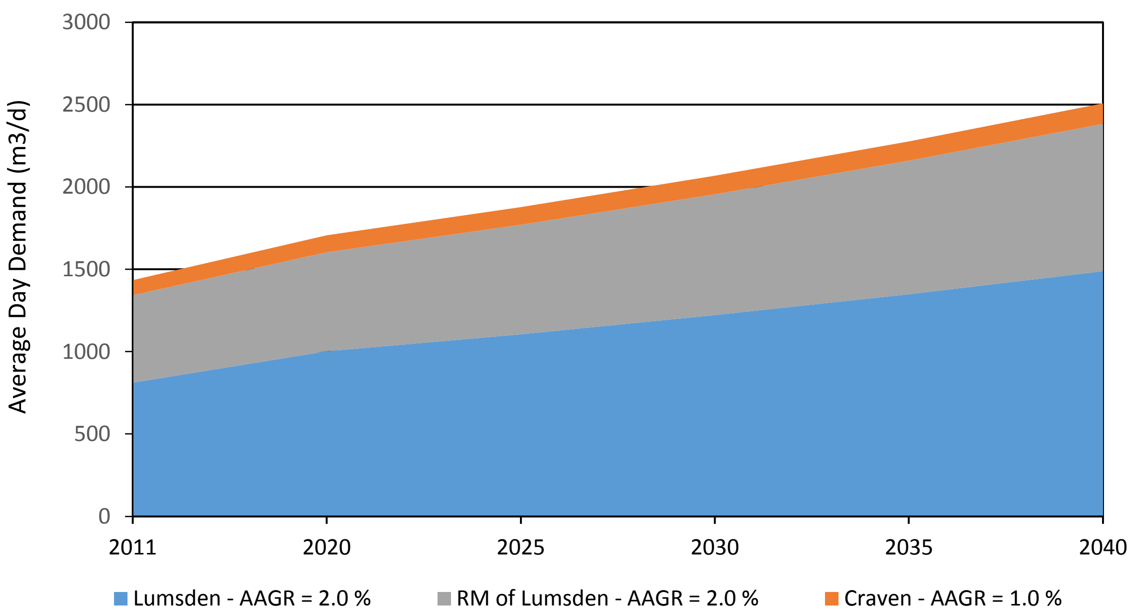
Growth Scenario	Projected Water Demands (m³/h)				
	2020	2025	2030	2035	2040
High/Desired Growth (6.5 %)	9	9	9	9	9

Notes:
m^3/d – cubic metres per day

6.1.3.3 North Water Demand Projections

Figure 6-3 shows the cumulative ADD water demands for all the existing communities to the North of Regina from 2011 to 2040, assuming the high growth scenario in all communities. The cumulative ADD in 2040 is projected to be approximately 2,500 m^3/d.

Figure 6-3
North Region - Cumulative Average Day Water Demand from 2011 to 2040



Craven

Table 6-27 shows the projected ADDs for Craven for the years of 2020, 2025, 2030, 2035, and 2040, based on low and high AAGRs. According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, at the low and high growth rates, the storage reservoir at the WTP will need to be sized to contain 214 m^3 and 248 m^3, respectively. Currently, the treated water storage reservoir has a capacity of 222 m^3 which should be sufficient to the year 2040 under the low growth rate scenario. Under the moderate growth rate scenario, the existing storage capacity will be sufficient to the year 2030.

Table 6-27
Craven – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m³/d) -Raw				
	2020	2025	2030	2035	2040

Low Growth (0.5 %)	97	100	102	105	107
Moderate Growth (1.0 %)	102	107	112	118	124

Notes:
m^3/d – cubic metres per day

Table 6-28 shows the projected PDDs, based on the peaking factors presented in Table 6-3. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. The total capacity of the raw water pumps is 200 gpm (greater than 1,000 m^3/d), which exceed the projected PDDs under the low and moderate growth scenarios. The capacity of the 75-mm-diameter raw water supply pipe will likely need to be increased before 2040, when the friction loss becomes too high. This could be accomplished by replacing the raw water pumps to increase the pumping head, rather than replacing the raw water supply pipeline.

Table 6-28
Craven – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands (m^3/d) -Raw				
	2020	2025	2030	2035	2040
Low Growth (0.5 %)	292	299	307	314	322
Moderate Growth (1.0 %)	305	321	337	354	372

Notes:
m^3/d – cubic metres per day

Distribution pumps are typically sized to handle PHDs. At the Craven WTP, most of the treated water flows by gravity from the reservoir to the distribution system; a separate distribution system exists for a subdivision located on the east side of the village. Treated water is conveyed by two distribution pumps and two hydropneumatic tanks.

Lumsden and the Rural Municipality of Lumsden

Table 6-29 shows the projected ADDs for Lumsden for the years of 2020, 2025, 2030, 2035, and 2040, based on low, moderate, and high AAGRs. The future treated water demands for the Minerva Ridge community were factored into the ADD, assuming a future population of 44 residents in 2020, but no additional growth. It was assumed that 5 percent of the raw water is wasted during treatment, since the WTP employs greensand filtration. Future water demands may be slightly overestimated, as the Town has enacted a Water Conservation Bylaw requiring the installation of low flow toilets in any new construction.

According to the WSA, for systems requiring fire protection, the minimum storage capacity should be equal to twice the average daily consumption. Thus, at the moderate and high growth rates, the storage reservoir at the WTP will need to be sized to contain 2,038 m^3 and 2,456 m^3, respectively. Currently, the treated water storage reservoir has a capacity of 1812 m^3. To meet the 2040 projected ADD under the moderate and high growth rate scenarios, the storage capacity will need to be expanded in the next 10 to 15 years.

Table 6-29
Lumsden – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)[a]				
	2020	2025	2030	2035	2040
Moderate Growth (1.4 %)	790	846	905	969	1,037
High Growth (2.0 %)	832	917	1,010	1,114	1,228

Notes:
[a]Does not include water wasted during treatment
m^3/d – cubic metres per day

Table 6-30 shows the projected PDDs, based on the peaking factors presented in Table 6-3. According to the WSA, supply and treatment infrastructure for water treatment should be sized to handle PDD. Two wells currently serve as the main source of water supply to the WTP, with a total capacity of 5,236 m^3/d (60.6 L/s). The future populations for the Deer Valley Golf Estates and Dodd's Subdivision have been factored into the peak demand projections (assumed growth and water consumption are the same as selected for Lumsden). Under moderate and high growth scenarios, sufficient capacity is available to meet the projected PDDs for 2040. Additionally a third well is available, licensed for up to 129,000 m^3 annually; however, in the *2010 Waterworks System Assessment* completed by KGS Group, it was indicated that this well might be classified as potentially Groundwater Under the Direct Influence of Surface Water (GUDI) based on its close proximity to Boggy Creek and the suspected hydraulic connection to the Creek. It was recommended that a hydrogeological investigation will be required to ascertain the status of the well and its suitability as a backup water source.

The raw water supply line carrying water from the two main wells to the WTP (located south of Lumsden on a hill) is a 7.97-km-long, 200-mm-diameter, class 150 PVC pipe. Larger raw water supply pumps will be required in the future to offset friction losses in the 200-mm line as the demand increases.

The WTP has a total capacity of 3,974 m^3/d, when both greensand filters are in operation; otherwise the firm capacity is 1,987 m^3/d. To meet the projected PDDs in 2040 under both growth rate scenarios, a third filter with pump will need to be added into the WTP to increase firm capacity. The chemical metering systems and oxidation detention tank may also need to be updated or expanded.

Table 6-30
Lumsden – Projected Peak Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)[a]				
	2020	2025	2030	2035	2040
Moderate Growth (1.4 %)	2,142	2,296	2,461	2,638	2,828
High Growth (2.0 %)	2,254	2,489	2,748	2,697	2,978

Notes:
[a]Includes water wasted during treatment
m^3/d – cubic metres per day

In the Town of Lumsden, only residents connected to the upper portion of the distribution system rely on distribution pumps (around 11 percent); all other residents receive their water via gravity flow. Additional pumping capacity may be required in the future depending on where and when future development occurs.

Currently, there are no large industries located in the Town of Lumsden. No large industrial or commercial developments are planned for the future.

Rural Municipality of Lumsden

The residents in the RM of Lumsden mostly rely on private wells for their water supply; however, some of the residents are serviced by other water supply pipelines branching off of the BPSL. A few communities or developments that were previously mentioned (that is, Deer Valley, Minerva Ridge, and Dodd's Subdivision) receive water from the Town of Lumsden.

Future ADDs were projected for the residents of the RM that are not currently serviced by the Town of Lumsden. Table 6-31 shows the projected ADDs for the years of 2020, 2025, 2030, 2035, and 2040, based on moderate (1.5 percent) and high (2.0 percent) AAGRs.

Table 6-31
RM of Lumsden – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Growth Scenario	Projected Water Demands-Raw (m^3/d)[a]				
	2020	2025	2030	2035	2040
Moderate Growth (1.5 %)	582	627	675	727	783
High Growth (2.0 %)	602	665	734	810	895

Notes:
[a]Assumed an average water consumption rate of 350 Lpcd. Mostly unmetered private wells, no information is available.
m^3/d – cubic metres per day

6.1.3.4 Sakimay Lands

Sakimay Regina West Lands

The first phase of development for the Sakimay Regina West Lands will include tenant businesses (such as hotel, truck stop, office park, or food services) in the northwest section of the lands, amounting to over 250 workers. Tenancy is expected to start in 2 years' time. There will be light industrial business tenants as well. The first phase will continue to be developed for the next 5 to 7 years. Following the first phase of development, the second phase will commence, consisting of light industrial business tenants.

Approximate water demands for each phase of development were estimated using design factors outlined in the *Sakimay First Nation Lands Concept Plan* (Stantec, 2011). Design factors are listed below:

- Per capita consumption of 225 Lpcd
- Peak Day Factor of 2.1
- Mixed Use Equivalent Population: 35 persons per hectare (c/ha)
- Dry Industrial Equivalent Population: 25 c/ha

Table 6-32 summarizes the ADDs and PDDs for each phase of development.

Table 6-32
Sakimay – Projected Demands for Sakimay Regina West Lands

Demands	Land Area (ha)	Equivalent Population	ADD (m^3/d)	PDD (m^3/d)
Phase I, Mixed Use Commercial + Dry Industrial (2015 – 2020/22)				
	12	424	95	200
Phase II, Dry Industrial (2020/22+)				
	83	2,075	467	980
Total			**562**	**1,181**

Notes:
m^3/d – cubic metres per day
ADD – average daily demand
PDD – peak daily demand

Sakimay Regina East Lands

Future water demands for the Sakimay Regina East Lands were estimated based on several assumptions:

- Commercial development will start in 2023

- Commercial development equivalent population = 65 capita per hectare (65 c/ha)
- initially, 68 hectares will be developed in 2023; and between 2023 and 2040, a 5 percent AAGR will occur

Table 6-33
Sakimay East – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Table 6-33 summarizes the ADDs and PDDs for the Sakimay Regina East Lands based on the assumptions listed above. A consumption per capita of 350 Lpcd was assumed.

Table 6-33
Sakimay East – Projected Average Day Demands for 2020, 2025, 2030, 2035, and 2040

Demand - Growth Scenario	Projected Water Demands-Raw (m^3/d)				
	2023	2025	2030	2035	2040
ADD - Moderate Growth (5.0 %)	95	105	134	171	218
PDD - Moderate Growth (5.0 %)	286	315	402	513	600

Notes:
m^3/d – cubic metres per day
ADD – average daily demand
PDD – peak daily demand

Sakimay Regina South Lands

The Sakimay Regina South Lands are set aside for a residential, fully self-contained, First Nation's community development. The lands will be developed over the next 10 years; upon completion, a population of 1,000 is anticipated. Assuming a per capita demand of 415 Lpcd and a Peak Day Factor of 2.1, the projected ADDs and PDDs will be approximately 415 m^3/d and 872 m^3/d in 2023, respectively. Water servicing could be provided by connecting to the City of Regina's water distribution system.

6.1.3.5 City of Regina Outside City Limits Customers

The City of Regina has provided billing data for customers with a surcharge rate for the period from January 1, 2010, to December 31, 2012. These customers are located outside City limits. Some of the users are connected to the City's water distribution system, and others receive potable water from the BPSL. The total annual consumption for each customer was determined for 2012 and is noted in Table 6-34 below.

Table 6-34
City of Regina Outside City Limits Customers – 2012 Water Consumption

Water Consumption User Band	Number of Customers	Total Overall Consumption
High (greater than 10 dam^3/year)	14	1,374
Moderate (less than 10 dam^3/year and > 1 dam^3/year)	26	77.3
Low (less than 1 dam^3/year).	41	13.5

Notes:
dam^3/year - cubic decameter/year

6.1.3.6 Regina Water Demand Projections

Scenario 1: Regina Per Capita Consumption = 415 Litres Per Capita Per Day

Water demands were initially projected for Regina using the population projections and design factors from the 2010 Regina *Development Standard Manual*. An ADD of 415 Lpcd was used for per capita consumption and peaking factors of 2.1 and 3.2 for peak day and peak hour, respectively.

Table 6-35
Regina - Projected Demands for 2016, 2021, 2026, 2031, 2036, and 2041 (415 Litres Per Capita Per Day)

Table 6-35 shows the projected ADDs, PDDs, and PHDs for Regina for the years of 2016, 2021, 2026, 2031, 2036, and 2041.

Table 6-35
Regina - Projected Demands for 2016, 2021, 2026, 2031, 2036, and 2041 (415 Litres Per Capita Per Day)

Demand Type	Projected Water Demands-Raw (m^3/d)					
	2016	2021	2026	2031	2036	2041
Average Day Demand	80,137	91,255	99,360	107,036	114,490	121,548
Peak Day Demand	191,636	208,655	224,775	240,429	255,251	269,938
Peak Hourly Demand	292,017	317,951	342,514	366,367	388,954	411,335

Notes:
m^3/d – cubic metres per day

Scenario 2: Regina Per Capita Consumption = 370 Litres Per Capita Per Day

Looking at the more recent 2011 data, the total annual treated water flow to the BPSL was 27,482 ML. The 2011 population for Regina according to the 2011 census was 193,100. This equates to a per capita consumption of 389 Lpcd, which is significantly less than the value of 415 Lpcd, typically used for design. Furthermore, the treated water flow from the BPSL is not only distributed to the City of Regina but is also distributed to communities in the west (such as Belle Plaine, Pense, and Grand Coulee), and commercial and industrial users, external to the City. Thus, the actual annual consumption for the City of Regina would be calculated as the annual consumption reported for the BPSL minus the annual demand for external users. In 2011, the consumption of water by external users was 1,437 ML. Thus, the actual consumption for the City of Regina was 26,045 ML. This results in a per capita consumption of 370 Lpcd. Table 6-36 shows the projected ADDs, PDDs, and PHDs based on the per capita consumption of 370 Lpcd for the years of 2016, 2021, 2026, 2031, 2036, and 2041.

Table 6-36
Regina – Projected Demands for 2016, 2021, 2026, 2031, 2036, and 2041 (370 Litres Per Capita Per Day)

Demand Type	Projected Water Demands-Raw (m^3/d)					
	2016	2021	2026	2031	2036	2041
Average Day Demand	81,360	88,586	95,429	102,075	108,368	114,604
Peak Day Demand	170,856	186,030	200,402	214,358	227,573	240,668
Peak Hourly Demand	260,352	283,474	305,374	326,641	346,778	366,732

Notes:
m^3/d – cubic metres per day

Regina – Industrial and Commercial Growth

In addition to population growth, some commercial and industrial growth is also planned for the City of Regina. Further development will occur in the West Industrial Lands (GTH) and East Regina Industrial Lands. Existing land will be developed into employment areas, and additional land has been set aside for new employment areas in the future. Water demands for the West Industrial Lands (GTH) were estimated in the *Intermodal Facility and Industrial Lands Servicing Study* (AECOM, 2008). The anticipated demands up to Phase II are summarized in Table 6-37. Based on the proposed land use concept developed for the East Regina Industrial Lands (AECOM, 2012), additional water demands were estimated and are summarized in Table 6-38.

Table 6-37
Regina – Projected Demands for West Industrial Lands (Global Transportation Hub)

Node	Total Gross Area (Ha)	Developed Area (Ha)	Population Density per person (Ha)	Total Population	Total ADD (L/s)	Max Day (L/s)	Max Hour (L/s)	ADD (m³/d)	PDD (m³/d)	PHD (m³/d)
PHASE I Short Term (0 to 25 years)										
Phase I - Stage I (Short Term 0 to 3 years)										
Subtotal Stage I	194	55	25	1,363	7	14	21	570	1,201	1,832
Phase I - Stage II (Medium Term 3 to 25 years)										
Subtotal Stage II	459	344	25/35	10,480	51	106	162	4,363	9,176	13,971
Phase I - Stage III (Long Term beyond 25 years)										
Subtotal Stage III	256	192	25	4,800	23	49	74	2,004	4,216	6,428
PHASE II Long Term (beyond 25 years)										
Subtotal Phase II	365	274	35	9,583	46	97	147	3,974	8,346	12,718
Total Phase I & II								**10,912**	**22,939**	**34,949**

Notes:
Ha – hectare(s)
ADD – Average Daily Demand
PDD – Peak Daily Demand
PHD – Peak Hourly Demand
L/s- Litres Per Second
m3/d – cubic metres per day

Table 6-38
Regina – Projected Demands for Regina East Industrial Lands

Area	Total Gross Area (Ha)	Developed Area (Ha)	Equivalent Population Density per person (Ha)	Total Population	ADD (m^3/d)	PDD (m^3/d)	PHD (m^3/d)
Light Industrial Area - 1	24	0	25	604	251	527	803
Light Industrial Area - 2	40	32	25	201	83	175	267
Mixed Industrial Area	104	9	35	3,352	1,391	2,921	4,452
Light Industrial Area - 3	148	4	25	3,601	1,494	3,138	4,781
Rail Service Area	63	Pending	Pending	0	0	0	0
Heavy Industrial Area	100	Pending	65	6,500	2,698	5,665	8,632
Total					**5,917**	**12,426**	**18,935**

Notes:
Ha – hectare(s)
ADD – Average Daily Demand
PDD – Peak Daily Demand
PHD – Peak Hourly Demand
m^3/d – cubic metres per day

6.1.3.7 Buffalo Pound Water Treatment Plant and Supply Line

The BPWTP was designed to have a treatment capacity of 205 ML/d and is physically expandable to 275 ML/d, with the addition of one cascade, one set of flocculation tanks, two clarifiers, four filters, four GAC contactors, and one UV reactor, as well as expansions of the lagoons and the raw water system to allow for redundancy. Based on the existing formal agreement, the City's share of the treatment capacity (including users tapping off of the BPSL) is approximately 149 ML/d (73 percent). This would amount to approximately 200 ML/d in the future, when the WTP's capacity is expanded to 275 ML/d. Detailed planning for the expansion of the BPWTP to 275 ML/d has not yet been initiated however discussions are taking place around installing a second UV reactor and creating physical space (but not installing) a third UV reactor. Each UV reactor would be sized for 205 ML/d; so, with three reactors, the plant would have a firm capacity of 410 ML/d or nominal capacity of 615 ML/d.[23]

As of 2013, the City is currently using approximately 76 ML/d of treated water on average, with a maximum demand of approximately 140 ML/d (139.1 ML/d in July 2007). Currently, the Major Capital Project, set at $33.4 million, includes a new UV system, a new screw pump, the WTP electrical substation replacement, and other related capital work. The rest of the upgrade work is unfunded and estimated to exceed $100 million, including upgrades to the residual lagoons, Lake Pump Station Substation, clearwells, electrical redundancy, back-up power supply, and ozone/BAC for taste and odour.

The licence to withdrawal surface water permits 338 ML/d of water to be treated by the BPWTP; however, the current allocation can likely be increased in the future to allow for growth in the Region as Buffalo Pound Lake is fed from Lake Diefenbaker. The raw water intake supply system currently has maximum capacity of 295 ML and the BPSL has a maximum capacity of 225 ML/d.

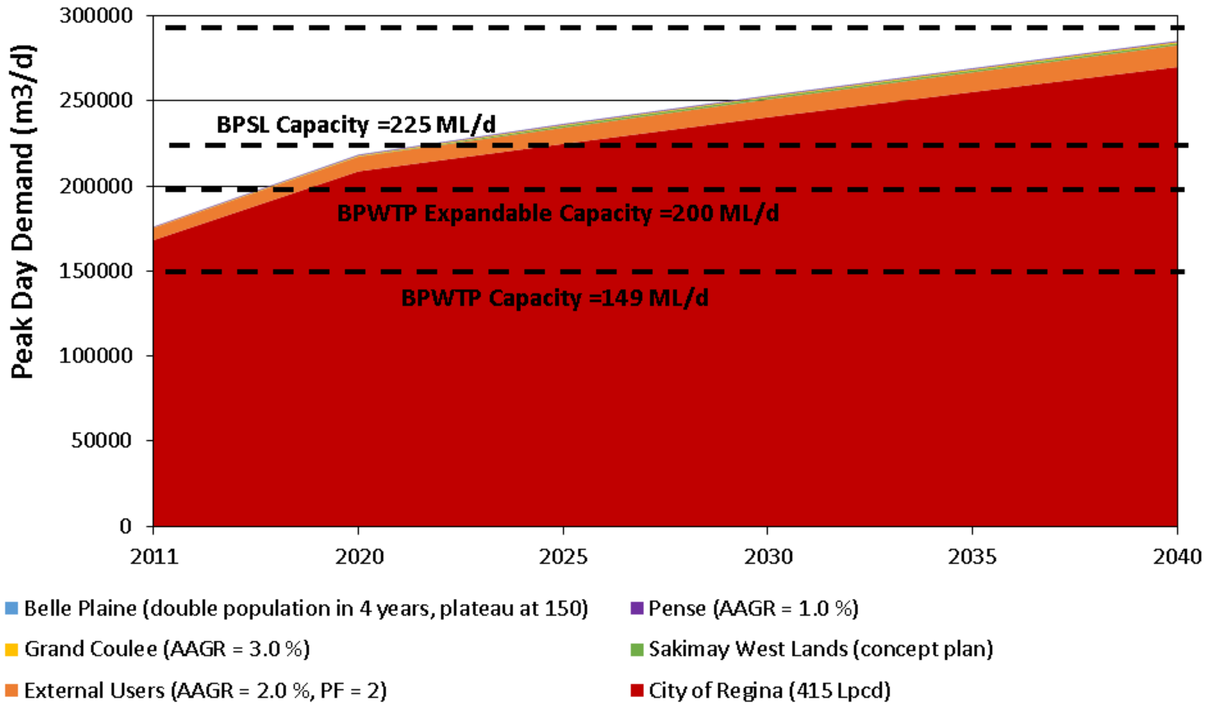
Cumulative PDDs were calculated based on the projected current/planned user-base to determine if/when capacity issues would arise for the raw water supply system, the BPWTP, and the BPSL, under the two different per capita consumption scenarios outlined below.

Scenario 1: Existing User Base with Regina Per Capita Consumption = 415 Litres Per Capita Per Day

Figure 6-4 summarizes the projected cumulative PDDs for 2020, 2025, 2030, 2035, and 2040, for the existing user base, assuming a per capita consumption of 415 Lpcd for the City of Regina. The high growth scenarios were selected for Pense and Grand Coulee. For the external user base, not including Grand Coulee, Pense, and Belle Plaine, an annual average growth rate of 2 percent and peaking factor of 2 were assumed.

[23] Per email from Ryan Johnson, BPWTP General Management, on March 17, 2014, to Kevin Syrnick, City of Regina.

Figure 6-4
Projected Cumulative Peak Day Water Demands for Existing/Planned User Base of the BPSL (415 Litres Per Capita Per Day)

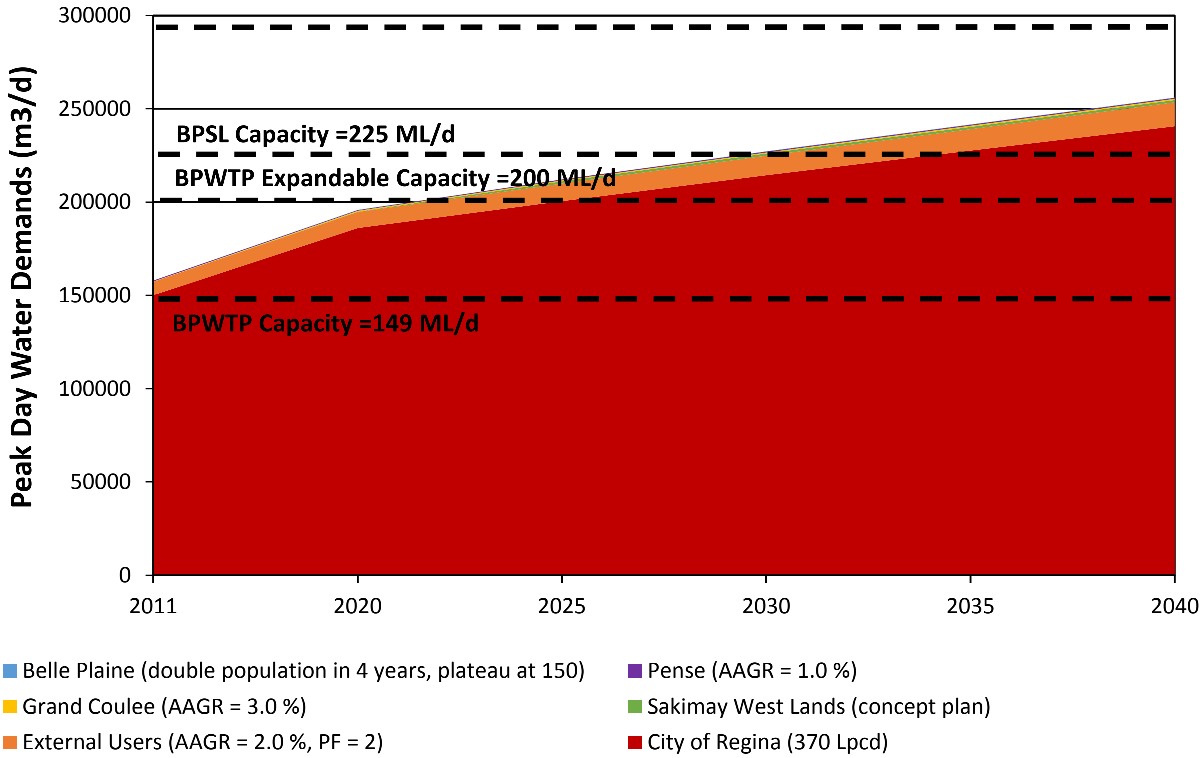


Under Scenario 1, it appears that the PDD has already exceeded Regina's share of the BPWTP capacity (greater than 149 ML/d) and the expandable capacity (200 ML/d); however, this is not the case, as the PDD of 139.1 ML/d, reached in July 2007, has not been exceeded. Additionally, it appears that the capacity of the BPSL (225 ML/d) will be reached shortly after 2020. Although the maximum capacity of the raw water supply system will not be exceeded, expansions will likely be required to allow for redundancy. Projections developed under these assumptions do not align well with the existing demands; thus projections were also developed assuming a lower per capita consumption rate for the City of Regina.

Scenario 2: Existing User Base with Regina Per Capita Consumption = 370 Litres Per Capita Per Day

Figure 6-5 summarizes the projected cumulative PDDs for 2020, 2025, 2030, 2035, and 2040, for the existing user base, assuming a per capita consumption of 370 Lpcd for the City of Regina. The high growth scenarios were selected for Pense and Grand Coulee. For the external user base, not including Grand Coulee, Pense, and Belle Plaine, an annual average growth rate of 2 percent and peaking factor of 2 were assumed.

Figure 6-5
Projected Cumulative Peak Day Water Demands for Existing/Planned User-Base of the BPSL (370 Litres Per Capita Per Day)



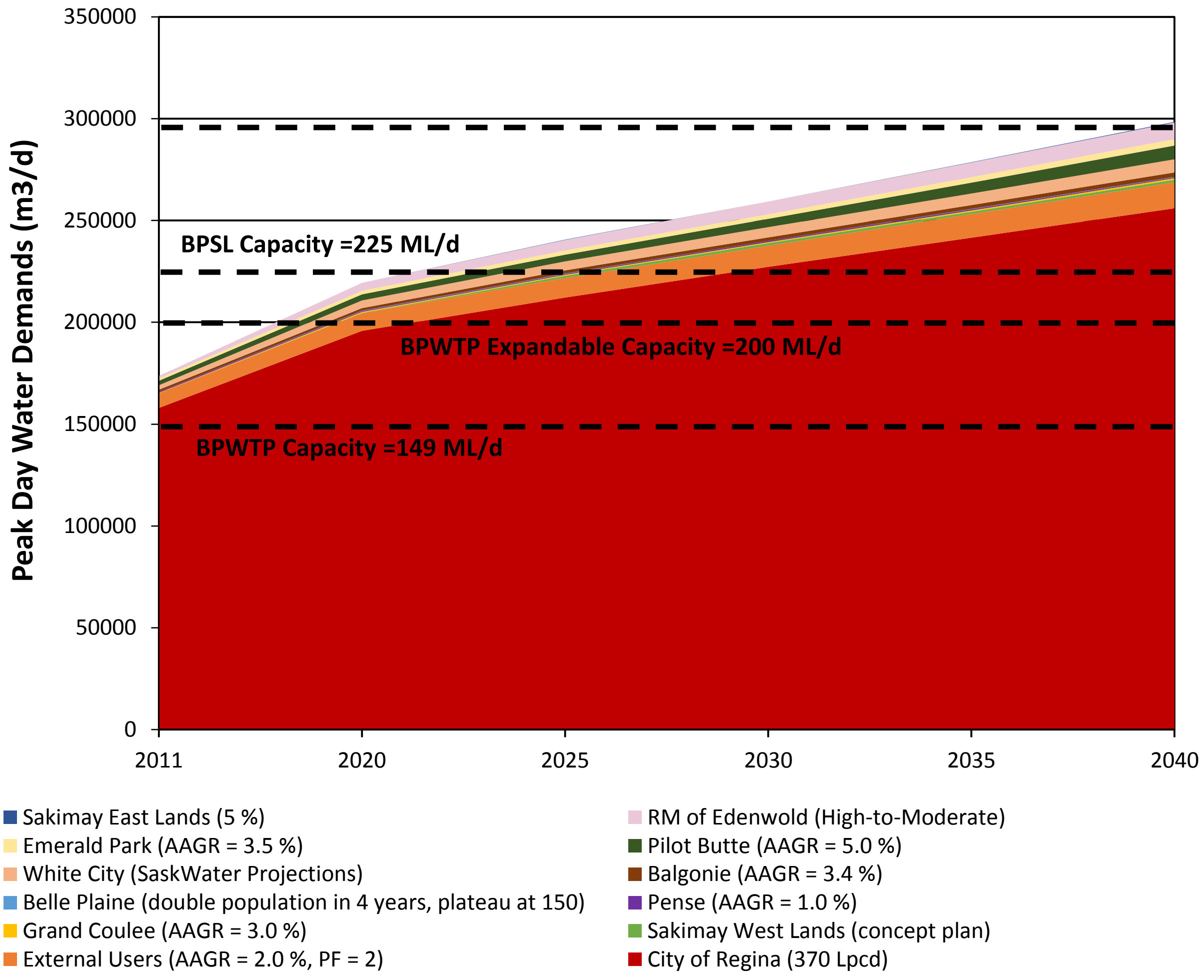
Under Scenario 2, it appears that the PDD slightly exceeds Regina's share of the BPWTP capacity (greater than 149 ML/d) and will not exceed Regina's share of the expandable capacity (200 ML/d) until after 2020. Additionally, it appears that the capacity of the BPSL (225 ML/d) will be reached by 2030. Although the maximum capacity of the raw water supply system will not be exceeded, expansions will likely be required to allow for redundancy. Projections developed under these assumptions are more realistic as they align closer with the existing demands.

Cumulative PDDs were calculated based on the projected current/planned user-base as well as the potential future user-base east of Regina, to determine if and when capacity issues would arise for the raw water supply system, the BPWTP, and the BPSL, under the two different per capita consumption scenarios outlined below.

Scenario 1: Potential Future Regional User Base with Regina Per Capita Consumption = 415 Litres Per Capita Per Day

Figure 6-6 summarizes the projected cumulative PDDs for 2020, 2025, 2030, 2035, and 2040, for the potential future user-base, assuming a per capita consumption of 415 Lpcd for the City of Regina. The high growth scenarios were selected for Pense, Grand Coulee, Pilot Butte, Balgonie, and Emerald Park. For the existing external user base, not including Grand Coulee, Pense, and Belle Plaine, an annual average growth rate of 2 percent and peaking factor of 2 were assumed.

Figure 6-6
Projected Cumulative Peak Day Water Demands for Potential Future User-Base of the BPSL (415 Litres Per Capita Per Day)

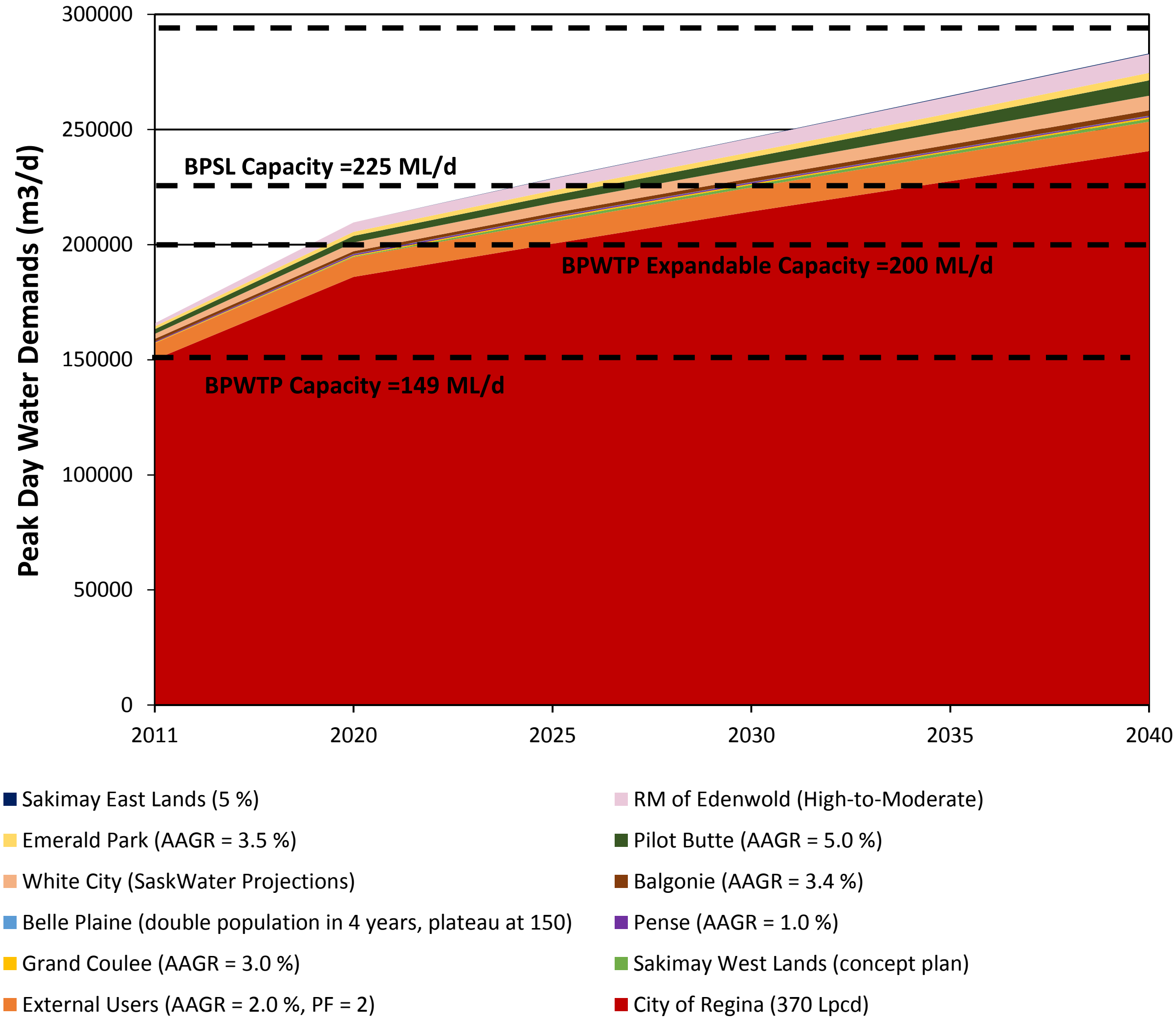


Assuming that the East will not require treated water until after 2025, under Scenario 1 the capacity of the BPWTP will need to be increased passed its expandable capacity before 2020, to continue meeting the PDD of the existing user-base and to service the future user-base. Additionally, it appears that the capacity of the BPSL (225 ML/d) will need to be increased in 2025, to service the East. The maximum capacity of the raw water supply system will be met by 2040; however, expansions will likely be required earlier to allow for redundancy. Projections developed under these assumptions do not align well with the existing demands; thus projections were also developed assuming a lower per capita consumption rate for the City of Regina.

Scenario 2: Potential Future Regional User Base with Regina Per Capita Consumption = 370 Litres Per Capita Per Day

Figure 6-7 summarizes the projected cumulative PDDs for 2020, 2025, 2030, 2035, and 2040, for the potential future user-base, assuming a per capita consumption of 370 Lpcd for the City of Regina. The high growth scenarios were selected for Pense, Grand Coulee, Pilot Butte, Balgonie, and Emerald Park. For the existing external user base, not including Grand Coulee, Pense, and Belle Plaine, an annual average growth rate of 2 percent and peaking factor of 2 were assumed.

Figure 6-7
Projected Cumulative Peak Day Water Demands for Potential Future User-Base of the BPSL (370 Litres Per Capita Per Day)



Assuming that the East will not require treated water until after 2025, under Scenario 2 the capacity of the BPWTP will need to be increased passed its expandable capacity before 2022, to continue meeting the PDD of the existing user-base and to service the future user-base. Additionally, it appears that the capacity of the BPSL (225 ML/d) will need to be increased in 2025, to service the East. Depending on the degree of storage provided by each community in the East, the City may only be required to provide for ADDs, postponing upgrades of the BPSL for a few more years (that is, until 2027). Although the maximum capacity of the raw water supply system will not be exceeded, expansions will likely be required to allow for redundancy. Projections developed under these assumptions are more realistic as they align closer with the existing demands.

6.2 Water Allocations

Significant growth is anticipated to the east of Regina in the next 25 years. Higher water allocations will be required to meet increasing water demands. Municipalities located to the east of Regina are currently reliant on groundwater from the Zehner Aquifer; however, the total usable supply capacity of the Zehner Aquifer has already been allocated to the existing users. New developments will need to obtain water from existing users or will require an alternative water source, such as treated water from the BPSL. If growth in the east continues to be high, as desired by the municipalities, the total allocation limit for the Zehner Aquifer will be reached in the next 10 to 15 years. Thus, a regional solution will be required to continue servicing the municipalities and developments in east into the long-term (that is, until 2040).

6.2.1 Current Water Allocations

The WSA is responsible for determining allocation limits and approving licences for allocations in Saskatchewan. The WSA will be reviewing the allocation limits in 2020 based on realized growth, and aquifer monitoring. Municipalities currently relying fully or partially on groundwater for drinking water supply include White City, Pilot Butte, Balgonie (will be purchasing water from Pilot Butte), the RM of Edenwold, Craven, Lumsden, and the RM of Lumsden. The Village of Edenwold relies on surface runoff collected from adjacent agricultural cropland into two ponds. The remaining communities located in the Study Area (that is, Pense, Grand Coulee, Belle Plaine, and the RM of Pense) receive treated water through an agreement with the City of Regina.

Most of the municipalities located east of Regina are growing fast, resulting in an increased reliance on local aquifers (that is, Zehner Aquifer). The WSA has released a Zehner Aquifer Management plan for the Regina East Area to establish allocation limits for the affected municipalities based on the best information available and projected municipality growth. Table 6-39 summarizes the allocation limits established for each municipality based on their expected growth.

Table 6-39
Ground Water Allocation and Use for Selected Communities East of Regina (Courtesy of the Water Security Agency, 2013)

Community	Allocation Limit (dam^3/year)	Licenced Allocation (dam^3/year)	2012 Water Use (dam^3/year)
Pilot Butte	700 [a]	700	260 (estimate)[b]
Balgonie	300 [c]	300	156 (treated)[d]
White City (provided by SaskWater)	750	750	289 (raw)
RM of Edenwold (including Emerald Park)	950	950	179 (raw)
RM of Edenwold (irrigation project)	N/A	6.3	Unknown

Notes:
[a] Allocation limit was 1000 dam^3/yr but has recently been decreased to 700 dam^3/yr, as 300 dam^3/yr has been allocated to Balgonie.
[b] Operation of Pilot Butte wells has only recently commenced, and estimated use is based on 350 litres per capita per day at a population of 2,059 people.
[c] Allocation limit was 400 dam^3/yr for the wells. Now that Balgonie will be receiving treated water from Pilot Butte, a portion of Pilot Butte's total allocation limit has been re-allocated to Balgonie.[d] Treated water use does not include losses during the treatment process and under represents the actual withdrawal from the aquifer.
dam^3/year - cubic decameter/year
RM – Rural Municipality

The third column in Table 6-39 shows the actual licensed allocation to each municipality based on reviews of their existing well sites. All of the municipalities, except for Balgonie and the RM of Edenwold (irrigation project), have been licenced up to their allocation limits. However, Balgonie will be shutting down its wells in the near future and purchasing treated water from Pilot Butte. The fourth column provides information on the current water use for each municipality, derived from multiple sources. All of the numbers provided in the fourth column are estimates.

Licenced allocations for the Town of Lumsden and the Village of Craven are shown in Table 6-40. Both of these communities rely on ground water; however, the wells are developed in different aquifers or segments of aquifers that are not constrained by development to the same extent as those in Regina East.

Lumsden supplies raw water to Deer Valley and a few other subdivisions in the RM of Lumsden. The RM of Lumsden also operates a tank load facility for the filling of spray tanks.

Table 6-40
Licensed Ground Water Use for Selected Communities West of Regina (Courtesy of the Water Security Agency, 2013)

Community	Licenced Allocation (dam^3/year)	Raw Water Use (dam^3/year)
Craven	65.7[a]	46 (2012)
Lumsden (including Deer Valley)	460[b]	239 (2011)

Notes:
[a]The Village of Craven has an additional allocation of 24.6 dam^3/year from well No. 1, which is no longer in use and believed to have been decommissioned.
[b]The Town of Lumsden has an additional allocation of 129.1 dam^3/year from well #3 which is not connected to the treatment plant and is reserved for emergency use only.
dam^3/year - cubic decameter/year

The other municipalities located in the Study Area received treated water from the BPWTP supply line to Regina. Licencing of water use by these municipalities was previously assumed to be captured by the allocations serving Moose Jaw and Regina; however, as these communities are using water outside of those incorporated areas, they are considered distinct end users and require their own allocation. The WSA is currently working to rectify this issue and intends to issue Water Rights Licences to these communities based on their previous use, with room for future growth. Proposed allocations for the communities are listed in Table 6-41.

Table 6-41
Proposed Allocation of Surface Water for Selected Communities West of Regina (Courtesy of the Water Security Agency, 2013)

Community	Proposed Allocation (dam^3/year)
Belle Plaine	10
Grand Coulee	40
Pense	70
RM of Pense	3

Notes:
dam^3/year - cubic decameter/year
RM – Rural Municipality

Since the volumes of water used by these communities are relatively small compared to the Cities of Regina and Moose Jaw, it is anticipated that substantial growth (relative to their current size) could be accommodated from Buffalo Pound Lake, provided an agreement can be struck with the City of Regina for additional delivery via the BPSL.

6.2.2 Projected Future Allocations Required

The WSA is planning on reviewing and revising water allocation limits in 2020 based on realized growth, and monitoring of the response of the aquifer. Individual allocations may be reviewed earlier or more frequently based on the terms of their respective Licences. Since future abstraction rates are unknown at the present, it is not possible to determine which municipalities will face water supply challenges in the future and when they will occur. However, the current water allocation limits presented in the previous section can be compared with the current and future projected ADDs to assess which municipalities are anticipated to face challenges first and require higher allocations or an alternative water supply in the future. This will allow for prioritization of solutions for municipalities that may face raw water shortages. Table 6-42 shows the allocation limits and proposed allocation limits compared with the current and projected ADDs for the municipalities located within the study area.

Table 6-42
Comparison of Current Allocation Limits and Proposed Limits with Current and Future Projected Average Day Water Demands

Municipality	Current or Proposed Allocation Limit	Current Average Day Demand Estimate	Growth Scenario	Projected Average Day Water Demands (m^3/d)				
				2020	2025	2030	2035	2040
White City	750 $dam^3/year$ 2,055 m^3/d	560 m^3/d (WSA, 2011)	SaskWater (3.4 %)	1,482	1,706	1,963	2,229	2,499
Pilot Butte + Balgonie (shared)	1,000 $dam^3/year$	Pilot Butte: 712 m^3/d (WSA, 2012) Balgonie: 429 m^3/d (2012)	Moderate Growth	1,440	1,554	1,679	1,816	1,967
	2,739 m^3/d		High Growth	1,860	2,315	2,885	3,601	4,500
Pilot Butte (separate)	700 $dam^3/year$	Pilot Butte: 712 m^3/d (WSA, 2012)	Moderate Growth (1.5 %)	898	943	991	1041	1094
	1917 m^3/d		High Growth (5 %)	1273	1624	2073	2645	3375
Balgonie (separate)	300 $dam^3/year$	Balgonie: 429 m^3/d (2012)	Moderate Growth (2.4 %)	544	611	689	775	873
	822 m^3/d		High Growth (3.3 %)	588	691	813	956	1125
RM of Edenwold (Including EP)	950 $dam^3/year$ 2,603 m^3/d	490 m^3/d (WSA, 2012)	High-to-Moderate	2,787	3,552	4,206	4,981	5,900
Emerald Park (EP)	250 $dam^3/year$	Unknown	Moderate Growth	744	863	1,000	1,160	1,344
	685 m^3/d		High Growth	789	937	1,113	1,322	1,570
Grand Coulee	40 $dam^3/year$ 110 m^3/d	92 m^3/d (WSA, 2011)	Moderate Growth (3.0 %)	161	187	217	251	292
Pense	70 $dam^3/year$	154 m^3/d (estimated)	Low Growth (0.5 %)	161	165	169	174	178
	191 m^3/d		Moderate Growth (1.0 %)	168	177	186	195	205
Belle Plaine	10 $dam^3/year$ 27 m^3/d	20 m^3/d (EPEC, 2008)	High Growth (6.5 %)	47	47	47	47	47
Craven	90.3 $dam^3/year$	91 m^3/d (estimated)	Low Growth (0.5 %)	97	100	102	105	107
	250 m^3/d		Moderate Growth (1.0 %)	102	107	112	118	124
Lumsden	460 $dam^3/year$			952	1,020	1,094	1,172	1,257

Table 6-42
Comparison of Current Allocation Limits and Proposed Limits with Current and Future Projected Average Day Water Demands

Municipality	Current or Proposed Allocation Limit	Current Average Day Demand Estimate	Growth Scenario	Projected Average Day Water Demands (m^3/d)				
				2020	2025	2030	2035	2040
		605 m^3/d (2011, KGS)	Moderate Growth (1.4 %)					
	1260 m^3/d		High Growth (2.0 %)	1,002	1,106	1,221	1,349	1,489
RM of Pense	3 $dam^3/year$ 8 m^3/d	2.6 $dam^3/year$ (WSA, 2011)		13	13	13	14	14

Notes:
$dam^3/year$ - cubic decameter/year
m^3/d – cubic metres per day
RM – Rural Municipality

Looking at Table 6-42, it appears that Grand Coulee will be challenged first with a raw water shortage if the allocation of 40 $dam^3/year$ is not increased, as the estimated current ADD of 92 m^3/d results in a yearly demand of 33 $dam^3/year$, which approaches the proposed limit. However, Grand Coulee is supplied with water from the BPSL, which is supplied by the BPWTP; it has been assumed that the BPWTP and BPSL will continue to consider the future demands of the existing users and plan upgrades and expansions accordingly. Thus, increasing the water allocation should not be a problem for Grand Coulee, nor for other communities supplied by the BPSL.

Other municipalities supplied by the BPSL include Pense, the RM of Pense, and Belle Plaine. If Pense continues to grow at a low growth rate, the proposed allocation of 70 $dam^3/year$ should be sufficient up to and past the year 2040. If Pense grows at the moderate growth rate, the proposed allocation will need to be increased to 75 $dam^3/year$ to reach 2040. The RM of Pense will require a higher allocation to allow any growth at all in the future; the current allocation limit of 3 $dam^3/year$ appear to be approaching the current combined annual demands of Stony Beach and Keystown. If Belle Plaine doubles its population in the next four years and plateaus at a population of 150, the proposed allocation will need to be increased to 17 $dam^3/year$ to reach 2040.

The North is expecting low to moderate growth in the future. The Village of Craven has been allocated 90.3 $dam^3/year$ between three wells developed into shallow glacial deposits. Since 2009, reported usage has ranged from 30 to 50 $dam^3/year$. However, there is little monitoring data on file to show how the aquifer has responded. The current allocation limit for Craven appears to be sufficient past the year 2040, under the low and moderate growth scenarios.

The Town of Lumsden has been allocated 460 $dam^3/year$ between the two newer wells (Wells 4 and 5) which are both developed into the Lumsden Aquifer. For planning purposes and establishing availability for allocation, the WSA considers the use by Lumsden to be from the Regina Aquifer, even though there has been some debate over the issue. At the present, the annual amount of water withdrawn from both wells has been approximately 200 to 250 $dam^3/year$. Considerable monitoring data has been collected by the Town which suggests that under the current use, the aquifer is stable. Lumsden's allocation limit of 460 $dam^3/year$ should be sufficient to the year 2040 under the moderate growth scenario. If Lumsden grows at the high growth rate, the proposed allocation will need to be increased to 550 $dam^3/year$ to reach 2040; otherwise, Lumsden will begin to face challenges in the next 15 to 20 years.

The East is expecting significant growth in the future. White City has been allocated 750 dam^3/year between two wells (each located in a different area) that draw from the Zehner Aquifer. The current allocation should be sufficient to the year 2030 based on the raw annual average water demand projections. Following 2030, the allocation will need to be increased to 920 dam^3/year to meet the 2040 demands.

Pilot Butte will be providing Balgonie with treated water as soon as the supply infrastructure is constructed in 2014. Pilot Butte has previously been allocated 1,000 dam^3/year between the raw water wells that draw from the Zehner Aquifer. Although Balgonie has an allocation of 400 dam^3/year from its existing raw water wells, this allocation will not be transferred over to Pilot Butte. Thus, together the towns will share an allocation of 1,000 dam^3/year, which will be distributed as 700 dam^3/year to Pilot Butte and 300 dam^3/year to Balgonie. Should both communities realize their full projected growth, additional well locations will need to be investigated and established to sustainably supply the combined current maximum allocations for both towns through a single WTP. Under the moderate growth scenario, the allocation limit should be sufficient to the year 2040 for both communities. Under the high growth scenario, the allocation limits for Pilot Butte and Balgonie will need to be increased to 1,240 dam^3/year and 415 dam^3/year, respectively, to reach 2040; otherwise, both communities will begin to face challenges in the next 10 to 15 years.

Emerald Park has been allocated 250 dam^3/year from the Zehner Aquifer. Under both the moderate and high growth scenarios, the allocation limit will be reached soon, before 2020. Thus, the RM of Edenwold's total allocation of 950 dam^3/year will need to be re-distributed to allow for more growth in Emerald Park. Looking at the combined demands for the RM of Edenwold, including Emerald Park, the total allocation will need to be increased to 2,153 dam^3/year in the next couple of years to allow for growth to the year 2040, assuming that all of the planned residential areas are filled in by 2040 due to rapid growth throughout the RM.

Limited information was available from the RM of Sherwood and the RM of Edenwold over the course of the study. New communities within the RMs will likely face significant pressures on gaining water servicing given the already stretched allocations.

6.3 Potential East Regina Water Solutions

As part of the RRWWS, feasible options were explored for overcoming the water demand challenges in the region east of City of Regina which are presented in this section. The potential solutions explored include the following: (i) development of the East Regina Regional Pipeline; (ii) development of an East Regina Regional Water Grid System; and (iii) implementation of water conservation and water re-use measures to reduce current and future water demands in each community.

The options presented are not isolated options, and the appropriate solutions will be a combination of these options. For example, the water conservation measure would marginally reduce demands and postpone the point at which allocation limits would be reached; however, at that point, a regional watermain would still need to be constructed to supply the demand. Further investigation of existing water infrastructure within the City of Regina is required to understand what upgrades might be required to bring the additional volume of potable water to the East of the City, these costs are not included in the below estimates.

6.3.1 East Regina Watermain Pipeline

This solution involves the installation of a network of pipelines and infrastructure for distributing treated water from the City of Regina to the East region, which includes the following:

- East Regional Pump Station
- East Regional Watermain
- Watermain to Pilot Butte and Balgonie (operational 2013)
- Watermain to Sakimay

- Watermains to RM of Edenwold
- Watermain to Emerald Park
- Watermain to White City

This solution will allow communities to purchase treated water from the City of Regina and limit or eliminate dependence on groundwater obtained from the Zehner Aquifer. This will allow for more growth in the long term and will open the door for new developments. Treated water would simply be conveyed to each community for storage and distribution.

Table 6-43
Cost Estimate Overview for Capital and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$15 million	$30 million	$60 million
Annual O&M /Replacement Costs	$40,000 – $170,000	$80,000 - $340,000	$160,000 – $680,000

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement costs presented are the first and last full years in the 30-year lifecycle.
O&M – Operations and Maintenance

Councils and citizens from the communities in the East may be less supportive of this solution, as it does not allow for the use of recent investments, including existing raw water supply and treatment infrastructure. Pipeline routing along Highway 1, between White City and Emerald Park, may present some challenges, as there are already many existing pipelines in the trenches. Additional land procurement will likely pose a challenge for most of the pipeline routes, as there may be significant delays in negotiating routes. Section 6.4 discusses this potential solution in more detail and presents a Class 5 conceptual design and cost estimate.

6.3.2 East Regina Regional Water Grid System

This solution involves a regional water grid system with connections from Pilot Butte, White City, SaskWater, and the City of Regina through a similar Regional Water Main system as outlined in the previous option. Balgonie will also be part of the grid, as it will be connected to Pilot Butte via the new pipeline that is currently being constructed. This solution will allow communities to share existing resources and improve redundancy in the system. Governance, pricing, ownership, and management would need to be addressed. At a high level, there would be a mechanism for communities who have recently invested heavily in their water infrastructure to recoup some of their investment.

Councils and citizens from the communities in the East will likely be more accepting of this solution, as it allows their recent investments to be utilized. The same infrastructure challenges that exist with the East Regina Regional Watermain Pipeline still apply to this option. There may also be additional water quality problems with blending multiple potable water supplies; however, these can likely be managed operationally.

6.3.3 Water Conservation and Water Reuse

This solution involves water conservation and water reuse to reduce current and future water demands in each community. Water conservation and other initiatives to reduce the water demand, such as water reuse, will not solve long-term growth problems; however, they can buy the region more time to strategize for the future at minimal cost. Additionally, water conservation will benefit the local environment, reduce waste generation, and reduce the costs associated with wastewater management.

The WSA has developed a guide for identifying water conservation measures in the home, entitled *Water Use in Your Home* (WSA, 2010). Three different conservation approaches are recommended: (i) reduce water consumption; (ii) retrofit existing taps, toilets, and appliances; and (iii) replace existing water-using devices with water efficient devices. Examples of actions that can be taken for each water conservation approach are provided in Table 6-44 below. The majority of water conservation actions are focused around reducing consumption, rather than retrofitting or replacing appliances and devices.

Table 6-44
Water Conservation Measures, extracted from the Water Security Agency's Water Conservation Booklet "Water Use in Your Home"

Water Using Device	Reduce Consumption	Retrofit	Replace
Toilets	Stop running/fix leaks.	Install early closing toilet flapper.	Install a low flush toilet.
	Flush toilet less often.	Install an adjustable toilet tank ballcock.	Install a dual flush toilet.
		Install a toilet dam.	Install a composting toilet.
Faucets	Tightly turn off taps after use.	Insulate pipes.	Install a low flow faucet aerator or swivel sprayer.
	Do not run water while washing hands or brushing teeth.		
	Plug sink while shaving.		
	Collect cold water in a container while waiting for hot water.		
Baths and Showers	Tightly turn off taps after use.		Install a low flow showerhead.
	Take shorter showers.		
	Bath instead of showering.		
	Turn off shower while scrubbing.		
Sinks	Plug sink to wash dishes or use a wash bucket in the sink.	Insulate pipes.	Install a low flow showerhead.
	Strain and use left-over dish water to water plants.		
Dishwashers	Wash full loads only, and avoid pre-rinsing if not required.		Replace older inefficient models with newer "ENERGY STAR" rated models.
	Use the shortest wash cycle.		
	Avoid using the heat-dry, rinse-hold, and pre-rinse features.		
Food Preparation	Thaw foods in refrigerator.		
	Chill water in fridge for drinking.		
	Select appropriate sized pots and pans when cooking.		
	Steam vegetables instead of boiling.		

Table 6-44
Water Conservation Measures, extracted from the Water Security Agency's Water Conservation Booklet "Water Use in Your Home"

Water Using Device	Reduce Consumption	Retrofit	Replace
	Reuse water used to wash produce to water plants.		
Laundry Machines	Wash full loads only or match water level to load (if adjustable). Pretreat stains. Only use the perma-press cycle when necessary. Only wash dirty items.	Insulate pipes.	Replace with front-loading washing machine.
Gardens and Lawn	Collect water in a rain barrel. Do not over-water lawn. Water in the morning when temperatures are lower and winds are calmer. Use mulch to reduce evaporation and weeds. Aerate lawn periodically.		Replace broken hoses. Use trickle irrigation hoses. Replace damaged outdoor taps.

Water reuse could involve the treatment and reuse of wastewater for irrigation and other non-potable applications to reduce the potable water consumption in each community. In the home, grey water (wastewater from bathtubs, showers, bathroom sinks, washing machines, dishwashers, and kitchen sinks) can be re-used for watering plants and lawns.

In some communities, the implementation of water conservation practices at the user-level may be challenging, unless residents are properly educated and motived. Approaches for gaining support include public education, tax rebates (for the installation of water saving devices or retrofits), development of new bylaws (for example, outdoor water use bylaw), increases in water rates, and changes to water rate structures (that is, replacing a declining block rate structure with an inclining block rate structure).

Water conservation would also benefit wastewater servicing by reducing influent flows. This would be of immediate benefit to the communities in the East who are currently under significant wastewater servicing challenges.

6.3.4 Options Evaluation

The February Working Session, held at White City on February 5, 2014, provided stakeholders with the opportunity to review future water challenges, review available financial information, and evaluate non-financial aspects of the decision. At this stage, only very high-level discussions had taken place on the water options; the group collectively opted to follow the TBL approach to help structure the discussions. As a result, the TBL results captured should be considered as concept level only, and more work should be done to clarify the benefits of each option.

Table 6-45
Attendance at East Working Session at White City on February 5, 2014

City of Regina – Kevin Syrnick	Town of Pilot Butte – Ed Sigmeth, Laurie Rudolph, Ed Isomber, Gerhardt Ernst
Town of White City – Shauna Bzdel, Cecil Snyder, Marius Jimenez, Bruce Evans	SaskWater – Nish Prasad
Rural Municipality of Edenwold – Stan Capnerhurst, Jim Sigmeth, Wade Hoffman	Water Security Agency – Jeff Hovdebo
Town of Balgonie – Shaun McBain	CH2M HILL – Iain Cranston (facilitator)

The non-financial evaluation followed a high level TBL approach: discussing Economic, Social, and Environmental benefits associated with the options. Table 6-46 lists the various factors used for the TBL evaluation and the rating agreed upon by the stakeholders at the December Working Session. Ratings were kept to a simple traffic light (Red/Amber/Green) scale, with green providing the most benefit and red providing the least benefit or a significant challenge. This high level TBL approach was deemed sufficient for this stage in the study; it is intended only as an additional guide to determining which of the options should be viewed more favourably in terms of non-financial benefits and to identifying potential areas of challenge. The same TBL framework was utilized in the wastewater servicing options; as a result, some factors were not applicable.

Table 6-46
High Level Triple Bottom Line Summary for East Water Servicing Solutions (Note that these are not isolated options)

	Factors	Regional East Watermain from BPWTP	Regional Water Grid with connections from Pilot Butte, White City, SaskWater, and City of Regina	Water Conservation, Water Reuse / Former Domestic Wells / Wastewater Reuse
Economic	Minimizes Construction Risk - financial over-run / complications	• A	• A	• G
	Minimizes Deliverability Risk - delay in time to activate	• A	• G	• G
	Minimizes Staffing Risk - attracting the right people and knowledge	• G	• G	• G
Social	Flexibility to supports / facilitate future growth	• G	• G	• A
	Minimizes Construction Disruption on Communities	• A	• A	NA
	Minimizes Operational Nuisance – such as Noise, Odour, Visual, and Traffic	• G	• G	• A
Environmental	Meets Effluent Quality Improves Quality and/or Reliability*	• G	• A	NA
	Minimizes Construction Disruption on Environment	• A	• A	• G

Table 6-46
High Level Triple Bottom Line Summary for East Water Servicing Solutions (Note that these are not isolated options)

Factors	Regional East Watermain from BPWTP	Regional Water Grid with connections from Pilot Butte, White City, SaskWater, and City of Regina	Water Conservation, Water Reuse / Former Domestic Wells / Wastewater Reuse
Maximizes opportunities for diversified bio solids reuse	NA	NA	NA

Notes:
*The TBL factor "Meets Effluent Quality Improves Quality and/or Reliability" proved marginally challenging. Whilst all options must meet drinking quality restrictions, this factor allowed stakeholders to distinguish which options potentially could provide a higher level of treatment and/or reliability and therefore reduce water quality risks.
Notes:
BPWTP – Buffalo Pound Water Treatment Plant
NA – not applicable

The rationale behind the ratings in Table 6-46 that were captured with the stakeholders at the February Working Session is documented in Appendix O.

6.4 East Regina Water Pipeline

This East Regina Water Pipeline considers a network of pipelines and infrastructure for distributing treated water from BPWTP through the City of Regina to the East regional communities, which includes the following:

- East Regional Pump Station
- East Regional Watermain
- Watermain to Pilot Butte and Balgonie
- Watermain to Sakimay
- Watermains to Rural Municipality of Edenwold
- Watermain to Emerald Park
- Watermain to White City

This section of the report presents the engineering presdesign and cost estimate of the proposed regional watermain distribution network. The Class 5 Cost Estimates used herein are based on a conceptual level of design.

Further investigation of existing and additional water infrastructure within the City of Regina is required to understand what infrastructure might be required to bring the additional volume of potable water to the East of the City, these costs are not included in the below estimate.

6.4.1 General Assumptions and Exclusions

This estimate should be evaluated for market changes after 90 days of the issue date.

The estimate includes allowances for various items shown on detail estimate sheets in the appendices.

The capital estimate is based on the assumption that the work will be done on a competitive bid basis and that the contractor will have a reasonable amount of time to complete the work. All contractors are equal, with a reasonable project schedule, no overtime, constructed as under a single contract, no liquidated damages.

The Net Present Value calculations assumes a 4 percent discount rate (as used by the City of Regina).

Both Capital and O&M Costs are expressed in Canadian Dollars.

The cost estimate excludes the following costs:

- Total 5 percent GST Tax is excluded in the estimate. PST is included in local material costs, but may not be included in other services.
- Non-construction or soft costs; services during construction; and land, legal, and owner administration costs are excluded.
- A small allowance has been made for land acquisition and compensation, but this needs local input from stakeholders.
- Material Adjustment allowances above and beyond what is included at the time of the cost estimate are excluded.

6.4.2 Infrastructure Overview

The proposed water distribution system starts at a pump station in the eastern part of Regina, located near the intersection of East Ring Road and the Trans-Canada Highway. Further investigation of existing and additional water infrastructure within the City of Regina is required to understand what is needed to bring the additional regional water to this point, these potential upgrades have not been included. From the pump station in the eastern part of Regina, the East Region Watermain (500-mm-diameter, DR 18), which is about 8.8 km long, is proposed to be installed in a due easterly direction in the right-of-way of the Trans-Canada Highway. This pipeline section involves a railway crossing approximately 4.8 km east of the pump station that will be a trenchless installation. Approximately 5.7 km east of the pump station, there is a tee that branches to the 0.5-km-long Sakimay Watermain (150-mm-diameter, DR 18). At the end of the 500-mm-diameter pipe, there is a tee (known as Pilot Butte Junction in this report) that will split water flows in two watermains: one is the proposed 4.5-km-long Pilot Butte Watermain (350-mm-diameter, DR 18); and the other is the proposed 5.25-km-long White City Watermain (300-mm-diameter, DR 18). Both the cities of Pilot Butte and Balgonie get their water supply from the Pilot Butte Watermain. Balgonie is already connected to Pilot Butte, so its water demands will be met from this existing pipeline. There is a small section of the Pilot Butte Watermain, approximately 3.1 km from the Pilot Butte Junction that will be laid under an existing railway crossing by trenchless installation.

It is proposed that RM of Edenwold obtains water via the two 0.75-km-long watermains (150-mm-diameter, DR 18). The junction for RM of Edenwold Watermains is 1.63 km to the east of the Pilot Butte Junction. It is proposed to have the 0.75-km-long Emerald Park Watermain (300-mm-diameter, DR18) supply the community with their water demand. The tee for Emerald Park Watermain is located 3.26 km east of the Pilot Butte Junction. White City lies at the east end of the White City Watermain.

Figure 6-8 shows the layout of the proposed water distribution system. Different pipe sizes are shown with different colours for a summary of pipelines involved in the proposed distribution system design. Figure 6-9 shows the pipe profile of the 500-mm-diameter Regina Regional Watermain (up to 8.8 km from the pump house), and the 300-mm-diameter White City Watermain. Points of interconnections with different watermains are also shown for reference.

Figure 6-8

Layout of the Potential East Regina Water Distribution System

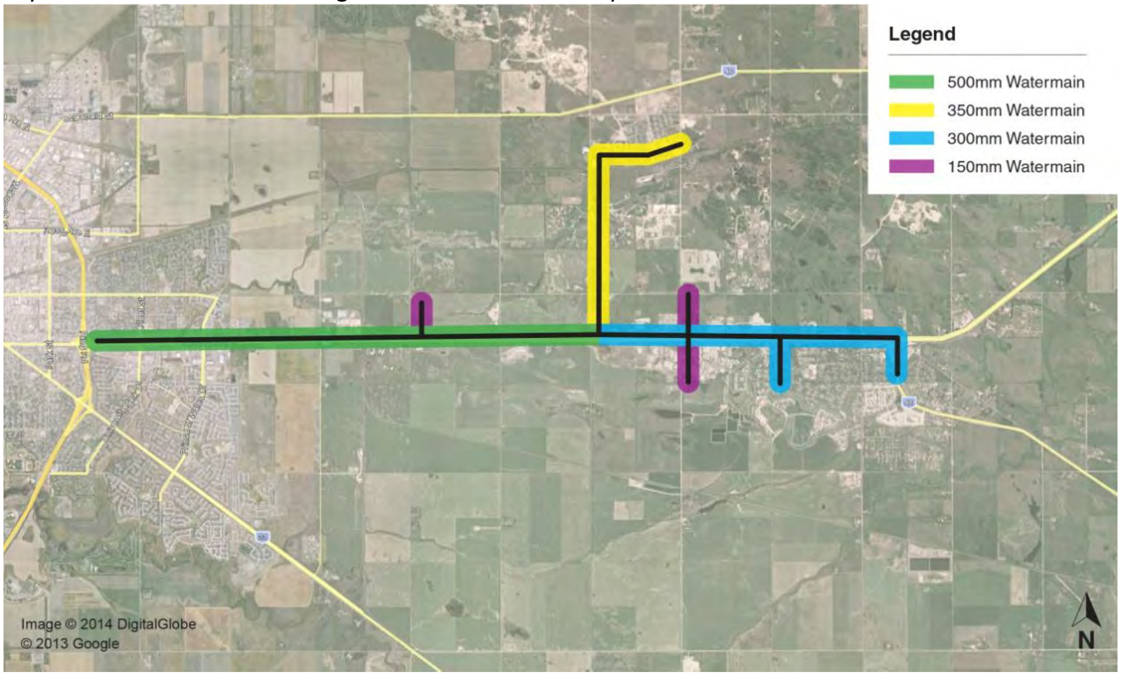
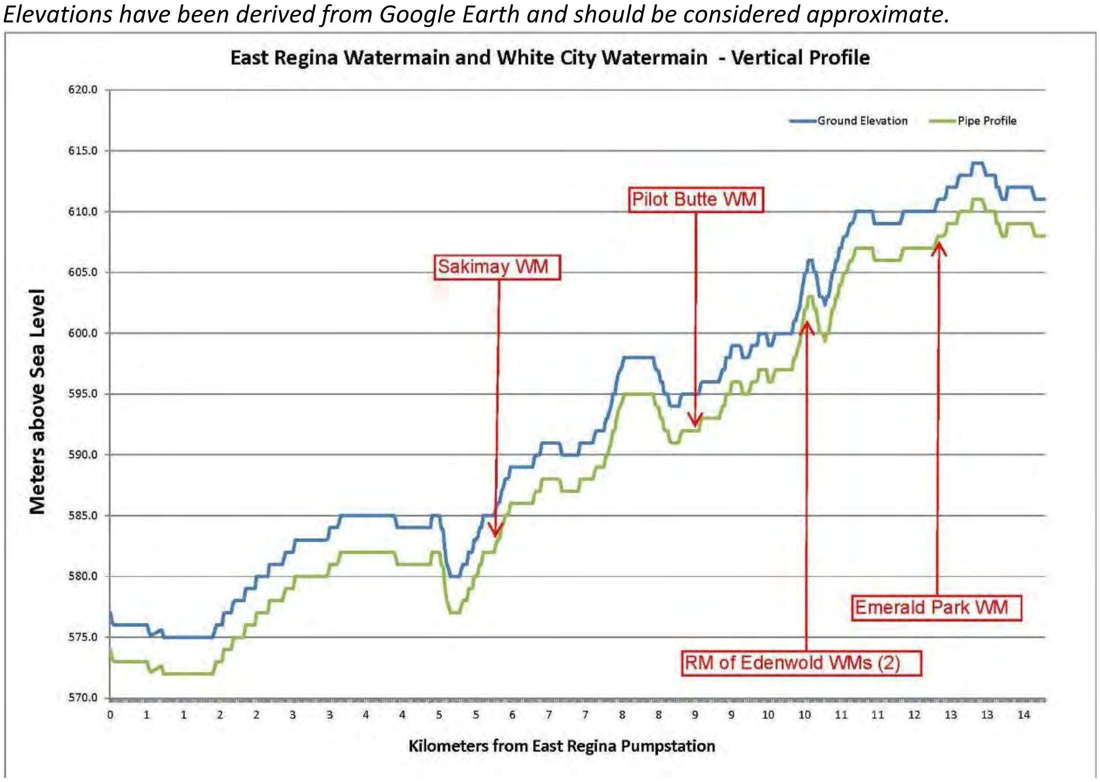


Figure 6-9

Profile of the Proposed East Regina and White City Watermains

Elevations have been derived from Google Earth and should be considered approximate.



All related data Copyright Google and Digital Globe 2013.

6.4.3 Cost Estimate Overview

Table 6-47 is the overview table of Capital Costs and O&M Costs (including capital replacement of electrical and mechanical components in the pump station at the end of component lifecycle across 30 years) based on 2014 costs.

Further investigation of existing and additional water infrastructure within the City of Regina is required to understand what infrastructure might be required to bring the additional volume of potable water to the East of the City, these costs are not included in the below estimate.

Table 6-47
East Regional Water Pipeline Cost Estimate Overview for Capital and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Initial Capital Costs	$15 million	$30 million	$60 million
Annual O&M /Replacement Costs	$40,000 – $170,000	$80,000 - $340,000	$160,000 – $680,000

Notes:
Capital Costs include Construction Costs and Non-Construction Costs (Engineering, Administration and Miscellaneous). Annual O&M/Replacement costs are the first and last full years in the 30 year lifecycle.
O&M – Operations and Maintenance

6.4.4 Conceptual Design

6.4.4.1 Pipeline Layout

The proposed design has seven watermains, four of which are shorter than 1 km in length, as follows:

- East Regina Watermain: It is a 500-mm-diameter watermain, 8.8 km long, installed in the right-of-way of the Trans-Canada Highway by the open cut method. There is a 50-m section of this pipe at a railway crossing that will be installed via the trenchless method. This is marked by the ***green*** line in Figure 6-8.
- Sakimay Watermain: It is a 150-mm-diameter watermain, 0.5 km long, starting from a tee on the East Regina Watermain. It will be installed via the open cut method. The branch for it is located approximately 5.7 km east of the pump station. The Sakimay Watermain is marked by the single ***purple*** line on the west side of Figure 6-8.
- Pilot Butte Watermain: It is a 350-mm-diameter watermain, 4.5 km long, starting from the east end of the East Regina Watermain and installed in the right-of-way of Highway 624 and 1st Ave by the open cut method. It includes a 50-m section that passes under a railway crossing and that will be installed by the trenchless method. It is proposed that this watermain have the capacity to carry water demands for both Pilot Butte and Balgonie. There is an existing watermain between Pilot Butte and Balgonie which will continue to be used to convey water to Balogine. The Pilot Butte Watermain is depicted by the ***yellow*** line in Figure 6-8.
- White City Watermain: Starting from the east end of the East Regina Watermain, the White City Watermain is a 300-mm-diameter, 5.25 km long pipeline that will be laid in the right-of-way of the Trans-Canada Highway by the open cut method. There is a small section of the pipe along the White City Drive as it approaches the water distribution facilities at White City. This watermain is shown in the ***blue*** line (east-west alignment) in Figure 6-8.
- RM of Edenwold, Watermain 1 and Watermain 2: These watermains are proposed to serve the populated communities of RM of Edenwold that are located in the north and south direction of Trans-Canada Highway. Accordingly, there will be one watermain in each direction branching off from the White City Watermain approximately 1.63 km from its west end (west end also known as Pilot Butte

Junction). Each of these watermains is proposed to be 150 mm in diameter, 0.75 km long in the north-south alignment, shown by two ***purple*** lines on the east side of Figure 6-8.

- Emerald Park Watermain: It is a 300-mm-diameter, 0.75-km-long pipeline that will be laid in the right-of-way of Emerald Park Road. This watermain branches off from the White City Watermain approximately 3.26 km from its west end. This watermain is shown in the ***blue*** line (north-south alignment) in Figure 6-8.

Figure 6-9 shows the East Regina and White City Watermains in vertical profile. Elevations have been derived from Google Earth and should be considered approximate. All related data Copyright Google and Digital Globe 2013.

6.4.4.2 Pipe Sizing

Per the assumptions below and the parameters noted in Table 6-48, the watermains were sized for serving the East Regina Communities for both current and future populations. The Figure 6-8 following assumptions apply:

- The pump station and the watermains have been sized for peak capacity.
- The pipelines are designed for peak flows up to each community. It is assumed that existing water distribution infrastructure (reservoir and pump station) at each community will be used to distribute the water, per their respective demands.
- Discharge of each watermain is assumed to be into a local community reservoir. The discharge elevation is assumed to be 10 m above ground elevation at each location to take account of discharge into the top of the reservoir. This could potentially be reduced once local reservoirs are better understood.
- Watermain sizes: Various diameters and lengths as shown in Table 6-48.
  - 300 mm-diameter pipeline includes
    - 5.25-km White City Watermain
    - 0.75-km Emerald Park Watermain
  - 150-mm-diameter pipeline includes
    - 0.75 km each of RM of Edenwold Watermain 1 and Watermain 2
    - 0.5-km Sakimay Watermain
- Material: PVC, DR18
- Land use: Assume rural land, and assume that pipe will be laid parallel to major roads
- Excavation:
  - Type: Open Trench
  - Special Section
    - Horizontal Drill: 50-m (railway crossing) East Regina Watermain
      - Encasement: Steel pipe, dia. 24in
      - Depth: 4-m cover
    - Horizontal Drill: 50-m (railway crossing) Pilot Butte Watermain
      - Encasement: Steel pipe, dia. 18in
      - Depth: 4-m cover
- Depth: 3-m cover
- Fittings: See Table 6-48
- Isolation valve:

- Number: See Table 6-48
- Type: Assume Butterfly valve

- Pipe drainage arrangement: 2 locations (City of Regina detail)
- Air release manholes: See Table 6-48 for corresponding ARVs
  - 100-mm-diameter CARV relief valves on 100-mm DIP
  - Manhole diameter: 2,440 mm (8 feet)

Table 6-48
Pipeline and Fittings Summary

Diameter	Length	Iso. Valve	Drainage	ARV	H. Bend-90	H. Bend-45
mm	km	Unit	MH	Unit	Unit	Unit
500	8.8	8	2	2	2	0
350	4.5	4	0	1	1	1
300	6.0	5	0	5	9	0
150	2.0	3	0	3	8	0

Notes:
Iso. Valve - Isolation Valve
MH - manhole
ARV - air release/vacuum Relief Valve
H-Bend-90: Horizontal bend 90 degrees
H-Bend-45: Horizontal bend 45 degrees
mm – millimetre(s)
km – kilometre(s)

6.4.4.3 East Regina Pump Station

The assumed pump station is located at the intersection of East Ring Road and the Trans-Canada Highway. The source of water is assumed to be an existing or new reservoir which is not considered in the costing scope of this report. The pump is proposed to be sized for meeting the peak flows of all the East communities and discharging at an elevation of 10 m above ground elevation at each community's discharge point. On the suction side, the pump station will be directly connected to the reservoir, and the pump is proposed to be installed in a dry well. The operation will be based on water demands of the East communities. To meet the varying community demands, the pump will have VFDs installed with it. The following assumptions apply to the proposed pump stations:

- The pump station and the watermains have been sized for peak capacity.
- Figure 6-10 below summarizes the major sizing parameters used for design.
- Number of pump stations: 1
- Pumps: 2 (1 duty, 1 standby), centrifugal, dry pit
- Type: Dry pit, pumps connected directly to pipes from reservoir
- VFDs?: Yes
- Land use: Semi-urban land
- Location: Near the intersection of East Ring Road and the Trans-Canada Highway
- Pumps:
  - Current: 153 L/s at 71 m (2,419 gpm at 101 psi)

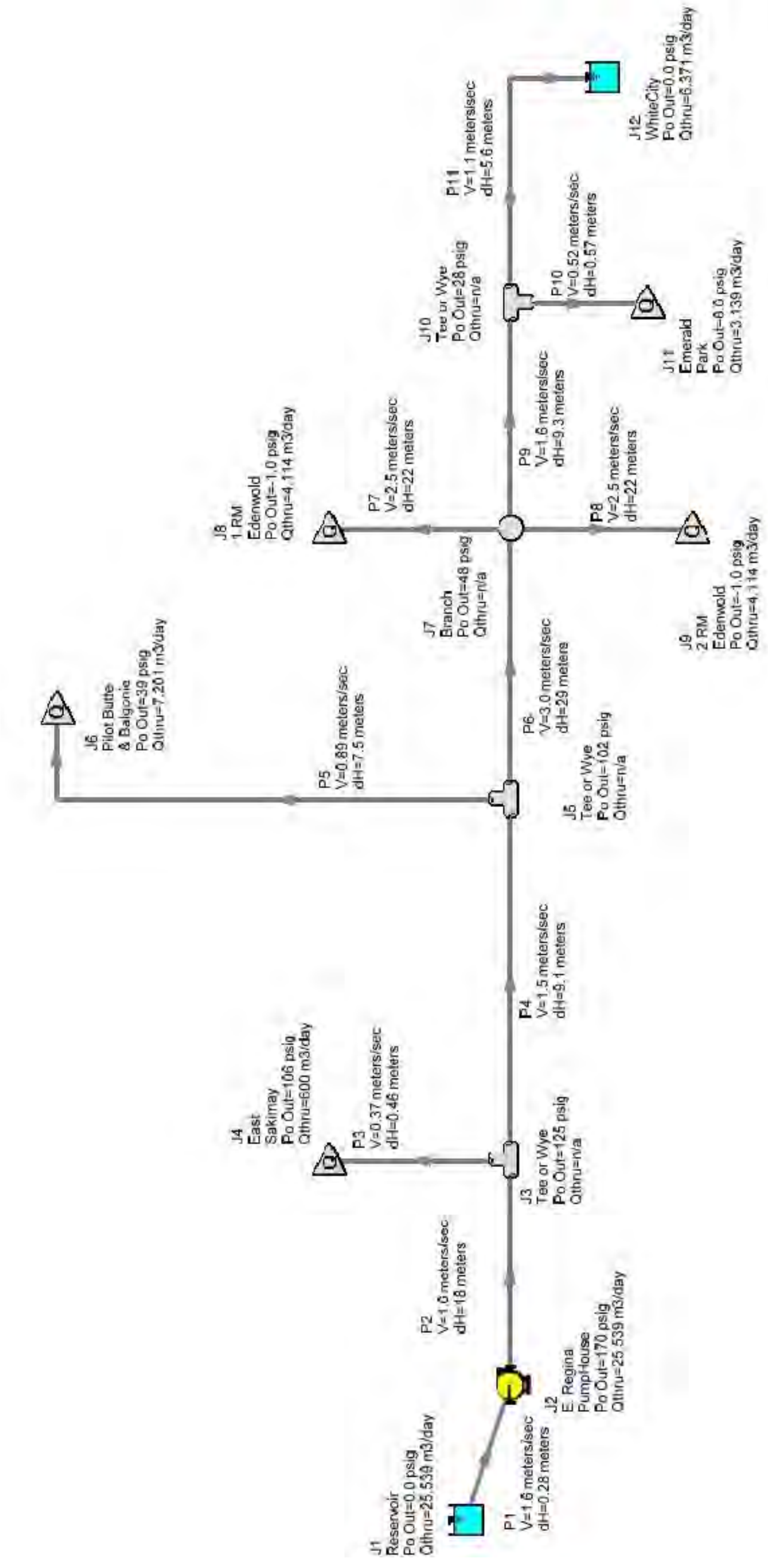
  - Future: 296 L/s at 120 m (4,683 gpm at 171 psi)

- Standby power source: 500-kW diesel generator, generator room adjacent to pump house

6.4.4.4 East Regina Water Distribution System AFT Fathom Model

Based on the details and assumptions in paragraphs above, a model was created in AFT Fathom for pump sizing and to determine basic design parameters. The operating point of pumps was chosen as 296 L/s at 120-m head (year 2040). A visual representation of this model is shown in Figure 6-10.

Figure 6-10
AFT Fathom Model for the East Regina Water Distribution System



6.4.5 Capital Cost Estimate

6.4.5.1 Capital Overview

Table 6-49 provides a summary of the costs. Costs are shown in 2014 Canadian Dollars, excluding PST and GST.

Table 6-49
Cost Estimate Overview for Capital Direct Construction Costs of the East Regina Water Distribution System based on 2014 costs. Calculated numbers were rounded to the nearest significant figure.

Low Range (-50%)	Estimated Cost	High Range (+100%)
$15 million	$30 million	$60 million

This cost estimate has been prepared for guidance in project evaluation based upon the information available at the time of the estimate. The final costs of the project will depend on the actual pipeline route and pump station location; the actual labour and material costs; competitive market conditions; final project costs; implementation schedule; and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to make specific financial decisions.

6.4.5.2 Capital Assumptions

Markups

The project will be tendered based on unit price bidding. All markups, contingencies, and other factors are included in the Unit Price.

Table 6-50
General Contractor Markups

Overhead	Included in Unit Price
Profit	Included in Unit Price
Mobilization/Demobilization	Separate line item in Estimate
Contingency	Separate line item in Estimate
Escalation Rate	4.28%

Escalation Rate

The estimate includes Escalation with the assumption that construction will start around January 2015 with the midpoint of construction being October 2015. It is assumed that there will be 18 months of construction ending around July 2016.

The escalation forecast was calculated using CH2M HILL's proprietary escalation model which incorporates economic data from sources such as Global Insight, Inc.

Estimate Classification

This cost estimate is considered a Budget or Class 5 estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). It is considered accurate from minus 50 percent to plus 100 percent, based on a conceptual design deliverable.

Estimate Methodology

This cost estimate is considered a 'bottom rolled up' type estimate with cost items and breakdown of Labour, Materials, and Equipment. Some quotations were obtained for various items. The estimate may include allowance cost and dollars per square meter cost for certain components of the estimate.

Construction Labour Costs

The labour cost is built into the unit price of the items in the estimate.

6.4.6 Operations and Maintenance Cost Estimate

6.4.6.1 Operations and Maintenance Overview

This section presents the O&M costs and assumptions for the East Regina Water Distribution System for the period of January 1, 2014, to January 1, 2044, and explains the critical assumptions used to arrive at the cost estimate. The 30-year O&M costs are presented in Appendix N.

Table 6-51
Cost Estimate Overview for and O&M/Replacement across 30 years with estimation range included. Costs at 2014 prices and exclude GST and PST. Calculated numbers were rounded to the nearest significant figure.

Estimation Range	- 50%	Estimation	+ 100%
Annual O&M /Replacement Costs	$40,000 – $170,000	$80,000 - $340,000	$160,000 – $680,000

Notes:
Annual O&M/Replacement costs are the first and last full years in the 30-year lifecycle.
O&M – Operations and Maintenance

Data used for the initial capital costs came from preliminary design concepts for the forcemain from CH2M HILL. O&M/Replacement costs have been broken into five categories:

- Labour
- Power
- Maintenance
- Replacement (Capital equipment replacement)
- ODC

6.4.6.2 Operations and Maintenance Assumptions

Costing assumptions used to calculate the 30-year O&M expenditures are presented in Table 6-52.

Table 6-52
General Cost Assumptions

Exchange Rate (CAD/USD)	1.04
Discount Rate	4%
Growth Rate of Average Annual Flows (AAF)	5%

Notes:
CAD – Canadian dollars
USD – US dollars

Labour

- Assume 1 part-time FTE at approximately 208 hours per year. “Mechanic” capable of performing preventative and corrective maintenance on equipment. It is assumed that this person would be assigned to other mechanical duties within the region.
- Wage is $22.26 CAD per hour. This is at the top of the 3rd quartile wage range for a “Mechanic” position with CH2M HILL in Canada.
- Fringe multiplier = 1.34, Overtime multiplier = 1.50, Overtime frequency = 5 percent

Power

- Assume electricity power tariff is Sask Power rate E8 (rural).
  - Composite rate of Energy Charge, Demand Charge, and monthly fee is 6.837 cents per kilowatt-hour
- Motor loads and duty/standby status data was obtained from CH2M HILL preliminary design information and submersible pumps with VFDs. Motor run times were estimated based on AAF in 2024 and were scaled to reflect increases in flow.
- 90 percent load factor and 85 percent efficiency factor have been assumed for equipment drives.

Maintenance

- Fixed percentages of the capital equipment cost are used based on typical O&M operations throughout the US and Canada.
  - 0.50 percent annually for Preventative Maintenance
  - 1 percent annually for Corrective Maintenance in 2015, scaled to 2 percent annually in 2043
- Preventative and corrective maintenance cost were calculated based upon the capital equipment listed in this conceptual design. The following costs were used but do not include construction, civil, or other costs associated with construction of the facility.

Table 6-53
Maintenance Cost Breakdown

Process Mechanical	$257,000
EI&C	$60,000
Building Mechanical	$15,000

Notes:
E&IC – electrical and instrumentation controls

Replacement

- Equipment estimated from the list of capital equipment in conceptual design.
- Average lifespan and replacement costs for each piece of equipment are estimated using standard CH2M HILL tables for each specific type of equipment.
- Replacement of duty and standby equipment is calculated at the same rate.
- Replacement costs have been allocated with a stochastic model to account for equipment failures before and after the average lifespan.

6.4.6.3 Other Direct Costs

- ODC were calculated based on standard CH2M HILL project expenses. ODC include safety supplies, miscellaneous travel expenses, vehicles, and other employee expenses. These were scaled to the size of the facility based on 0.1 FTE.

6.4.7 Design and Cost Estimate References

- *Guidelines for Sewage Works Design*, EPB 203 (Environmental Protection Branch), Saskatchewan Ministry of Environment. (PoS, 2013)
- *Development Standards Manual*, 2010, City of Regina (City of Regina, 2010)
- Wastewater flows have been derived from guidelines and formulas in the City of Regina's *Development Standards Manual* (City of Regina, 2010)
- CH2M HILL conceptual design documents, internal sketches and data presented in this report
- R.S. Means
- Vendor Quotes on Equipment and Materials where appropriate
- CH2M HILL Historical Data
- CH2M HILL Engineer and Estimator Judgment

6.5 Village of Edenwold Water Servicing

The Village of Edenwold was considered separately due to geographical challenges. It is located 18 km from the nearest town in the study area (Balgonie) and further still from other communities considered to be in the East Region. The Village of Edenwold is facing challenges on both sides; raw water supply is limited during periods of drought, and wastewater treatment is operating at capacity. The WTP and wastewater lagoons are managed under contract by SaskWater; the Village of Edenwold is responsible for distribution and collection accordingly. In addition to the service challenges, there is also a physical constraint on land use which is halting development and infrastructure improvement.

The study conducted a high level assessment of the following options for the Village of Edenwold:

- Local Options: locate an alternative local water source; local WWTP utilizing treated effluent for non-potable water use.
- Regional Options with nearby First Nations: potential option for water and wastewater options. Limited research was done into this option, as the nearby First Nations were out of the study area.
- East Regional Wastewater Pipeline: connecting the Village of Edenwold with Balgonie/White City; a shared trench pipeline for wastewater and a water pipeline to Balgonie

Note: The options above noted Balgonie as the connection point for a regional pipeline; this was due to Balgonie being the nearest regional community. The pipeline could be connected to another regional community, for example White City, which would be of particular relevance to SaskWater (which services both the Village of Edenwold and White City).

Notably, implementing water conservation and water re-use measures in the short term would not only postpone the water servicing challenges but would also benefit wastewater servicing by reducing influent wastewater flows. More investigation is required to assess whether or not this would be of benefit to the Village of Edenwold. More information is available on Water Conservation in Section 6.3.3.

In connecting to an East regional community, either Balgonie or White City, the Village of Edenwold would in turn benefit from any other regional solutions developed across the wider East region. Engineering pre-designs and cost estimates elsewhere in this report do not factor in the population for the Village of

Edenwold; however, the relatively small populations that would be added would result in marginal cost increases for the overall regional solution.

As SaskWater plays a key role in water and wastewater servicing for the Village of Edenwold, CH2M HILL kept in close touch with SaskWater through the initial investigation. Through SaskWater's role, they have a deep understanding of the servicing issues the Village of Edenwold faces and have been assessing various go forward options over recent years. Consequently, it was agreed that SaskWater would take responsibility for assessing servicing options for the Village of Edenwold.

6.5.1 Servicing Options and SWOT Analysis

Table 6-54 to Table 6-55 document the SWOT Analysis completed with the stakeholders from the region at the October Working Session, held on October 30, 2013, at the George Bothwell Library in Regina. Initial notes and conceptual ideas are documented within the notes of the SWOT tables below.

A number of servicing options overlap with the Village of Edenwold's Wastewater Servicing options. As a result, please refer to the SWOT Analysis tables within Section 5.3.4 for the following options:

- Local WWTP utilizing treated effluent for non-potable water use
- Regional Wastewater Pipeline to Balgonie and shared trench with Regional Water Pipeline
- Combine (Wastewater and Water) efforts with Neighbouring First Nations Community

A SWOT Analysis is a structured way of evaluation options, capturing Strengths, Weaknesses, Opportunities and Threats. During the working sessions, the stakeholders were facilitated through the analysis by CH2M HILL team members, with the SWOT titles used as prompts to gather feedback from the stakeholders on the options. The bullet points captured in Table 6-54 and Table 6-55 are not an exhaustive list of all points associated with each of the options; instead, they are a list of the significant points that were at the forefront of stakeholders' minds.

Table 6-54
Village of Edenwold SWOT Analysis – Alternative Local Water Source
This option would involve the investigation and development of an alternative water source for the Village of Edenwold. The alternative source could be used to replace the existing raw water supply or it could be blended with the existing raw water supply prior to treatment. Investigation would need to be completed to determine a suitable location for the well in terms of groundwater quality and availability. Additionally, potential water allocations would need to be investigated via discussions with the Water Security Agency. Costs for this option have not been estimated.

Strengths:	Weaknesses:
• May offer more reliable water source • Appears to be a low cost alternative • Simplistic operation and maintenance • No additional staff requirements • Does not require dependence on other municipalities • Minimal additional infrastructure	• Might require additional treatment/upgrades to WTP • May require a deep well (> 100 m) • Efforts may be worthless, if water is unusable
Opportunities:	**Threats:**
• Two sources available - provides redundancy • Could allow for growth in Village of Edenwold	• Well could run dry • Ground water might be/may become contaminated

Notes;
WTP – water treatment plant
m – metre(s)

Table 6-55
Village of Edenwold SWOT Analysis – Regional Treated Water Pipeline from Balgonie (or White City) to the Village of Edenwold
Regional water supply line to connect the Village of Edenwold with Balgonie (and Pilot Butte) supply system. More engineering analysis is required to evaluate the feasibility of this option given the low flows and fluid velocities based on the population assumptions and conveyance distance. No additional treatment capacity is added to the region. Through the Water Allocations work completed elsewhere in this study, it is clear that this option is likely to be unfeasible due to the limited allocations available for Pilot Butte. Option would benefit from any potential Regional Wastewater solution reaching Balgonie, as Village of Edenwold would in turn be connected.

Strengths: • Cleaner water source – treated water from Pilot Butte WTP • Seasonal reliability • Simplify treatment • Burden of WTP management shifted away from community with limited resources	**Weaknesses:** • Residents would likely have to pay much higher water rates to recover capital investment and through supply charges • Requires agreement with both Balgonie and Pilot Butte • Wasted investment in recent WTP upgrade
Opportunities: • Potentially more funding available to Village of Edenwold as it's a regional project • Could allow for growth in community and also along pipeline route (tie-ins)	**Threats:** • Dependent on water allocations – Pilot Butte may limit the amount of water that is purchased • Limited control over cost base • Requires additional land and permitting

Notes:
WTP – water treatment plant

SECTION 7

Study Outcomes and Final Stakeholder Presentation/Workshop

The following objectives were agreed upon for the Regina and Region Water and Waster Study at the outset of the project:

1. Identify opportunities to coordinate the provision of water and wastewater services across the region.
2. "Build bridges" and improve stakeholder relationships, particularly between the City of Regina and regional stakeholders.
3. Focus on engineering to discuss what is possible and feasible, avoiding political complications that could cloud the investigation of appropriate options.

Through the delivery of the project, collectively CH2M HILL combined with the City of Regina and the regional stakeholders have met these objectives and have progressed regional thinking in the census metropolitan area for potential water and wastewater solutions:

- A significant objective for the study was to "build bridges" and improve stakeholder relationships, particularly between the City of Regina and regional stakeholders. Relationships have been built: some barriers have been addressed, and overall trust and openness has improved.
- All parties have a much better understanding of one another: communities are talking to each other more about their difficulties. Regional stakeholders have a better understanding of one another's water and wastewater servicing outlook and challenges.
- Regional opportunities are being discussed, with an eye to solving stakeholder challenges at lower costs and with better solutions. Various engineering options have been identified and evaluated, including the following:
  - Pre design of options along with Capital and Operations & Maintenance costs (including replacement)
  - North Regional Wastewater Pipeline: active discussions underway with Lumsden
  - East Regional Wastewater Pipeline: a real solution option for the region, but a time sensitive one
  - East Regional Wastewater Treatment Plant
  - West Regional Wastewater Pipeline: small population bodies make a pipeline less financially viable, but a connection between Grand Coulee and the GTH is feasible
  - East Regional Watermain / Supply Network: if aggressive growth is realized, potential solution options will be limited

As a general rule, the unit cost of infrastructure solutions decreases with size: therefore, by working together and pooling financial resources, there should be an opportunity for the stakeholders to achieve a better value-for-money solution. In addition, larger scale regional infrastructure may qualify for Provincial or Federal part-funding and may open the door for alternate funding and delivery models such as Design-Build-Operate (DBO) and Public Private Partnerships (P3).

7.1 Opportunities to Progress

7.1.1 Regional Wastewater Servicing Opportunities

There are real opportunities for three regional wastewater solutions in the area:

i) North Wastewater Regional Pipeline – from the Town of Lumsden to the City of Regina's existing WWTP.

ii) East Wastewater Regional Pipeline – from Balgonie, Pilot Butte, White City, Emerald Park, other nearby RM of Edenwold communities and Sakimay First Nation land, to the east side of the City of Regina. Upgrading of City of Regina conveyance would be required to transport the wastewater to the existing facility in the northwest of the City; alternatively or in the future, an East Regional WWTP could be constructed.

iii) West Wastewater Connection from Grand Coulee to the GTH – enabling a connection from Grand Coulee to the City of Regina's existing West WWTP through the GTH. Upgrades to the City of Regina's Pump Station in the GTH would likely be required.

These opportunities are time sensitive due to the nature of the challenge and the pending growth in the related communities. In order to defer the required investment and create minor additional capacity in the systems, various interim options were also reviewed that may be appropriate for the affected stakeholders.

7.1.2 Regional Water Servicing Opportunities

In the short term, water conservation and water reuse can reduce current and future water demands in each community. Water conservation and other initiatives to reduce the water demand, such as water reuse, will not solve long term growth problems; however, they can buy the region more time to strategize for the future at minimal cost. Additionally, water conservation will benefit the local environment, reduce waste generation, and reduce the costs associated with wastewater management. This would be of immediate benefit to the communities in the East who are currently experiencing significant wastewater servicing challenges by reducing influent flows.

The WSA has already developed communications materials concerning water conservation that could potentially be leveraged by the region. Stakeholders should build on the relationships developed through the course of this study: it is recommended that this Water Conservation effort be shared by all stakeholders involved in the study, since all communities stand to benefit locally and regionally. The cost of developing and implementing the campaign would be marginal when split by all stakeholders. This exercise would also bring stakeholders closer together within the working relationships, which in turn would benefit the more complex regional engineering solutions.

In the medium term, the East Regional Stakeholders should work together with the City of Regina and BPWTP to progress the East Regional Watermain option. Although the water servicing challenges are not as pressing as the wastewater servicing challenges, the region should take these challenges seriously and use the available time to develop an optimum solution for all stakeholders. The complexities in reaching a political and economic agreement, particularly with the water grid option involving multiple potable supplies, should not be overlooked.

7.2 Regional Challenges

Many challenges were raised throughout the project associated with progressing regional servicing opportunities. These are not trivial challenges: while the stakeholders involved thus far have managed to overcome some of the engineering difficulties faced by the communities, more challenges await the stakeholders. The following are the most significant challenges the communities will face moving forward:

- **RM of Sherwood and RM of Edenwold**: The RM of Edenwold has had limited resources available to attend working sessions and provide data throughout the study. Both these RMs are integral to any regional solution as they both;
    a. Have their own water and wastewater servicing challenges associated with planned growth that the options considered could resolve

   b. Own much of the land that regional pipelines would travel through and, as such, are major stakeholders in right-of-way discussions

- **Timing of East and North regional discussions and progress**: These opportunities are time-sensitive due to the nature of the challenge and the pending growth in the related communities. In order to defer the required investment and create minor additional capacity in the systems, various interim options were also reviewed that may be appropriate for the affected stakeholders. Action Plans need to be put in place immediately to allow infrastructure decisions to be made in 2014 for the affected communities.

- **Governance, Finances, and Politics**: This study has proven a number of viable regional options from an engineering perspective; however, there are many complications to the options proposed at both governance and political levels. Capital investment sharing is just one of the aspects of the options that needs to be agreed upon; overall governance and funding responsibilities also need to be discussed and confirmed. These discussions will be particularly sensitive around setting servicing rates and financial agreements for regional servicing, as these issues will in turn impact citizens' water and wastewater bills. Thus far, most stakeholders have been involved at the Town Manager / Administrator level: moving forward, more political level involvement from Mayors and Councilors will be required, as they will ultimately approve the major investment decisions for the communities.

7.3 Final Stakeholder Presentation

As mentioned, this study is another step forward in regional collaboration; however, much more work is required to take the engineering options developed first through the political cycles and then onward through to operational solutions. As a result, the emphasis at the Final Stakeholder Presentation was on moving forward and further progressing appropriate regional options.

To complete this study, a Final Stakeholder Presentation took place on 28th May 2014 at the City of Regina South Leisure Centre. The objectives of this presentation were as follows:

- Review the outcomes and options from the RRWWS.
- Discuss Action Plans for moving forward within the regional groups.
- Understand what challenges might face the regional groups and, where appropriate, discuss mitigating actions.

SECTION 8

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Appendix A
Acronyms and Abbreviations

µg/L	micrograms per litre
AACEI	Association for the Advancement of Cost Engineering International
AAF	Average Annual Flow
AAGR	average annual growth rate
ADD	average day water demand
ADWF	Average Dry Weather Flow
BNR	Biological Nutrient Removal
BOD	biochemical oxygen demand
BPSL	Buffalo Pound Supply Line
BPWTP	Buffalo Pound Water Treatment Plant
CH2M HILL	CH2M HILL Canada Limited
City	City of Regina
CMA	Census Metropolitan Area
CPES	Parametric Cost Estimating System
CPR	Canadian Pacific Railway
CT	contact time
dam^3/year	cubic decameter/year
FTE	full time equivalent
GAC	granular activated carbon
GTH	global transportation hub
gpm	gallons per minute (US)
igpm	International gallons per minute
IMAC	interim maximum acceptable concentration
IMF	Intermodal Facility
km	kilometre(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
Lpcd	litres per capita per day
L/d	litres per day
L/h	litres per hour
L/min	litres per minute
L/s	litres per second

LTRGS	*Long Term Residential Growth Study*
m	metre(s)
m^3/d	cubic metres per day
m^3/h	cubic metres per hour
MBPS	McCarthy Boulevard Pumping Station
MBR	Membrane Bioreactor
MDF	Maximum Daily Flow
MHF	Maximum Hourly Flow
ML	megalitre(s)
ML/d	megalitres per day
mm	millimetre(s)
MMF	Maximum Monthly Flow
NTU	Nephelometric Turbidity Unit
OCP	Official Community Plan
ODC	other direct costs
PAC	powdered activated carbon
PDD	peak day demand
PE	polyethylene
PHD	peak hourly demand
PLC	programmable logic controller
psi	pounds per square inch
Pt/Co	Platinum-Cobalt
PVC	polyvinyl chloride
RAS	returned activated sludge
RM	Rural Municipality
RRWWS	Regina and Region Water and Wastewater Study
SDWQSO	Saskatchewan Drinking Water Quality Standards and Objectives
SWOT	strengths, weaknesses, opportunities, and threats
T&O	taste and odour
THM	trihalomethane
TDH	Total Dynamic Head
TSS	total suspended solids
TTHM	Total Trihalomethanes
UV	ultraviolet
VFD	variable frequency drive

WAS	waste activated sludge
WTP	water treatment plant
WWTP	wastewater treatment plant
WSA	Water Security Agency

Appendix B
List of Tables

Appendix C
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Appendix D
Invitation Letter

Appendix D
Stakeholder Invitation to Participate in the Study

This letter was sent to the Village of Grand Coulee as an invitation to participate. Duplicate letters were sent to all other stakeholders

REGINA
Infinite Horizons
City of Regina

May 3, 2013

Tobi Duck, Administrator
Village of Grand Coulee
Box 72, Site 200
GRAND COULEE SK S4P 2Z2

Dear Ms. Duck:

Re: Regina and Region Water and Wastewater Study (RRWW Study)

The RRWW Study provides an exciting opportunity to support beneficial regional collaboration, and we look forward to working with you on this project. This project is being managed and funded by the City of Regina; CH2MHill is the project consultant and will be responsible for preparing the Study deliverables. As a follow up to your conversation with Jeremy Fenton, Senior Planner with the City of Regina, we are taking this opportunity to provide a brief overview of next steps, and to thank you for your commitment to participate.

On May 9, 2013, we will be hosting a presentation of the RRWW Study at the regularly scheduled Moose Jaw-Regina Industrial Corridor Stakeholders Committee meeting. The purpose of this presentation is to provide an overview of the Study objectives, process, etc, and to answer any questions you may have. Following this meeting, we would be happy to meet with you at your municipal office to discuss the project further.

Data and information sharing is vitally important to this project, as it will inform key objectives of the Study, such as: 1) identifying current and future serving requirements; and, 2) identifying issues and opportunities for providing cost effective services. The type of information that can benefit this Study includes: current or proposed official community plans; water or wastewater servicing studies; information relating to current water and wastewater assets/ operations; population or land-use studies; and, water or wastewater usage data. If you have this information, we ask that you please begin compiling it, as we will contact you in the near future to discuss data sharing.

The City of Regina looks forward to working with you on this exciting project and we thank you for your participation. Should you have any questions, or cannot attend the above noted meeting, or would like to establish a one-on-one meeting at your office, please contact: Kevin Syrnick, RRWW Study Project Manager, at: 306.777.7430 or ksyrnick@regina.ca.

Sincerely,

Kelly Wyatt
Director, Construction & Compliance

Construction & Compliance Division
Community Planning & Development Division
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Regina.ca

Appendix E
Stakeholder Engagement Tables
(list of working session attendees)

Appendix E
Stakeholder Attendees

TABLE E-1
Study Kick Off and Understanding Challenges Working Session at the City of Regina on July 27th, 2013

Community	Attendee
City of Regina	Kevin Syrnick, Loretta Gette, Brent Rostad, Kelly Wyatt, Diana Hawryluk
Balgonie	Shaun McBain
Town of White City	Shauna Bzdel, Darryle Bulych
Pilot Butte	Laurie Rudolph, Ed Zsombor, Robert Dunn
Village of Grand Coulee	Irv Brunas, Jolene Siemens, Jim Pratt
Village of Edenwold	Christine Galbraith
SaskWater	Randy Avery, Nish Prasad
Town of Lumsden and RM	Darcie Cooper, Dave Cherney
Sakimay	Linda Falstead, Cameron Sangwais,
WCRM158 and Regional Consultant	Ron Hilton
Regina Regional Opportunities Committee	Dwight Mercer
Water Security Agency (WSA) and Sask Environment	Greg Holovach
CH2M HILL	Iain Cranston, Andy Whittaker (facilitators)

TABLE E-2
Attendance at SWOT Evaluation Working Session at the City of Regina on October 12th 2013

Community	Attendee
City of Regina	Kevin Syrnick Diana Hawryluk, Kelly Scherr, Loretta Gette
Moose Jaw-Regina	Dwight Mercer, Meka Okochi
Balgonie	Valerie Hubbard, Shaun McBain
Town of White City	Shauna Bzdel
Pilot Butte	Laurie Rudolph, Ed Sigmeth, Ed Zsombor, Nat Ross
Village of Grand Coulee	Tobi Duck, Elwood Scott, Irv Brunas
Village of Edenwold	Christine Galbraith
RM of Edenwold	Not Available
RM of Pense	Cathy Ripplinger
Town of Pense	Jennifer Lendvay
WSA	Ryan Evans, Greg Holovach, Jim Waggoner, Jeff Hovdebo, Don Turner, Arasu Thirunavukkarasu
SaskWater	Nish Prasad, Randy Avery, Rynette Moore, Allan Dlugan,
Town of Lumsden and RM	Darcie Cooper, Dave Cherney, Brian Mathison, Rhonda Philips
RM of Lumsden	Tom Harrison
Belle Plaine	Edwin Siemens, Jeffrey Halliday
Sakimay	Cameron Sangwais,
WCRM158	Ron Hilton
Craven	Adri Vandeven
Regional Consultants	Tim Cheesman, Pam Fiske
CH2M HILL	Iain Cranston (facilitator), Paul Smeaton, Kelly Griffiths

Note:
SWOT – Strengths, Weaknesses, Opportunities, Threats

TABLE E-3
Attendance at East Working Session at Pilot Butte on December 12th 2013

Community	Attendee
City of Regina	Kevin Syrnick, Kelly Scherr
Town of White City	Shauna Bzdel, Cecil Snyder, Mauricio Jimenez
Sakimay / Four Horse Developments	Linda Falstead, Cameron Sangwais, Tim Ponace, Randy Sangwais
Balgonie	Shaun McBain
WCRM158	Ron Hilton
Pilot Butte	Wayne Engel, Ed Sigmeth, Laurie Rudolph, Ed Zsombor, Robert Shaw, Nat Ross
SaskWater	Nish Prasad
CH2M HILL	Iain Cranston (facilitator)

TABLE E-4
Attendance at West Working Session at Grand Coulee on December 12th 2013

Community	Attendee
City of Regina	Kevin Syrnick
Village of Grand Coulee	Ralph Stobbe, Elwood Scott, Jim Pratt, Tobi Duck
RM of Pense	Cathy Ripplinger
SaskWater	Nish Prasad
Regional Consultant	Tim Cheesman
CH2M HILL	Iain Cranston (facilitator)

TABLE E-5
Attendance at East Working Session at White City on February 5th 2014

Community	Attendee
City of Regina	Kevin Syrnick
Town of White City	Shauna Bzdel, Cecil Snyder, Mauricio Jimenez, Bruce Evans
RM of Edenwold	Stan Capnerhurst, Jim Sigmeth, Wade Hoffman
Balgonie	Shaun McBain
Pilot Butte	Ed Sigmeth, Laurie Rudolph, Ed Zsombor, Gerhardt Ernst
SaskWater	Nish Prasad
WSA	Jeff Hovdebo
CH2M HILL	Iain Cranston (facilitator)

TABLE E-6
Attendance at Final Stakeholder Presentation at the City of Regina South Leisure Centre on May 28th 2014

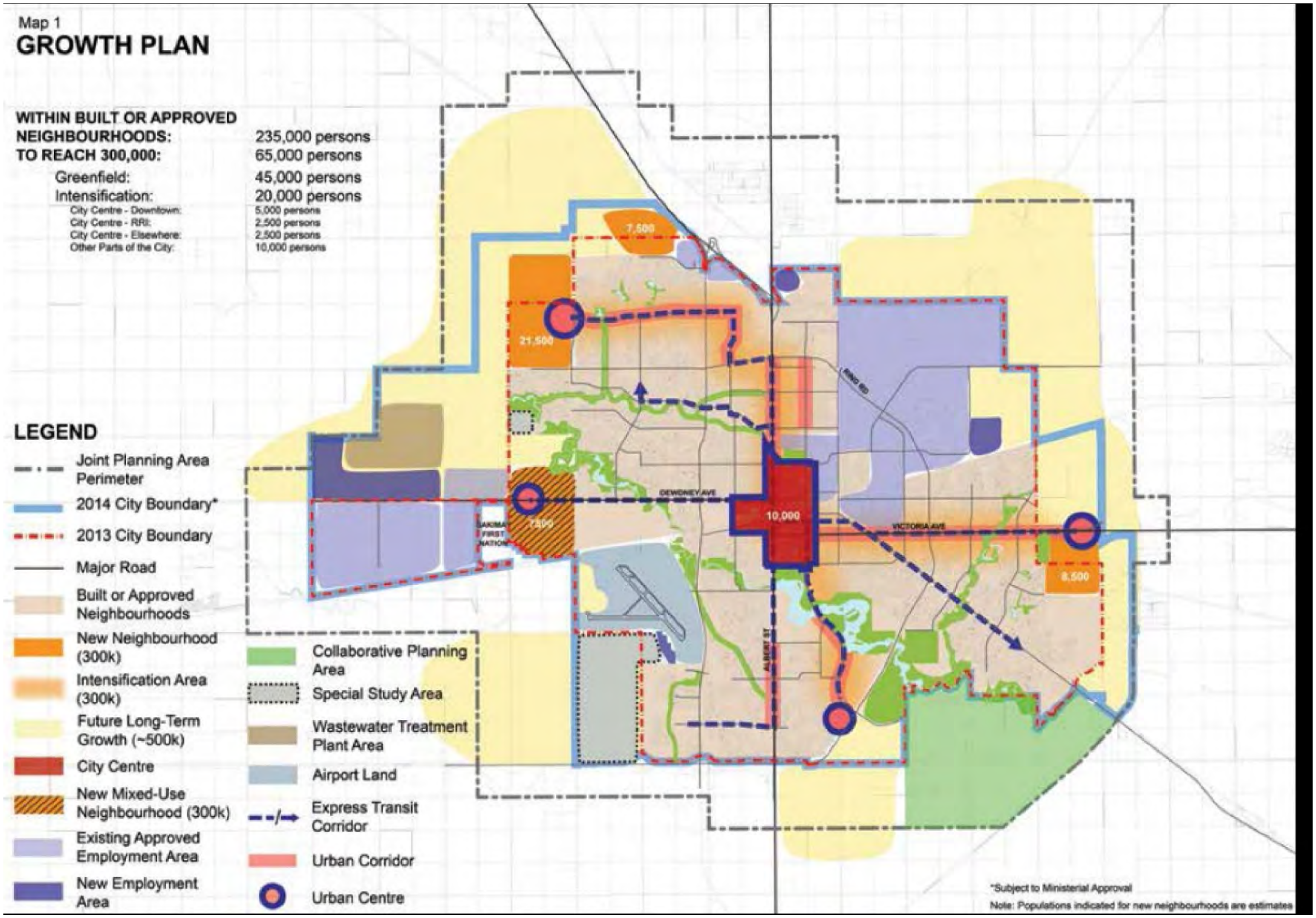
Community	Attendee
City of Regina	Kevin Syrnick, Diana Hawryluk, Kelly Scherr, Loretta Gette, Doug Cavers, Brent Rothstad, Graham Bateson, Stacey Debusschere
Balgonie	Shaun McBain, Tom Williams
Town of White City	Shauna Bzdel, Bruce Evans, Cecil Snyder, Mauricio Jimenez
Pilot Butte	Laurie Rudolph, Ed Sigmeth, Robert Shaw
Village of Edenwold	Christine Galbraith, Dean Stephenson
RM of Edenwold	Wade Hoffman, Tom Williams
RM of Pense	Cathy Ripplinger
WSA	Ryan Evans, Greg Holovach, Jeff Hovdebo, Don Turner
SaskWater	Nish Prasad
Town of Lumsden and RM	Dave Cherney
Town of Lumsden	Bryan Matheson
Belle Plaine	Tim Cheesman
Sakimay	Cameron Sangwais,
Village of Craven	Wendy Dunn
CH2M HILL	Iain Cranston (facilitator), Paul Smeaton, Kelly Griffiths

Appendix F
Stakeholder Land Use Maps

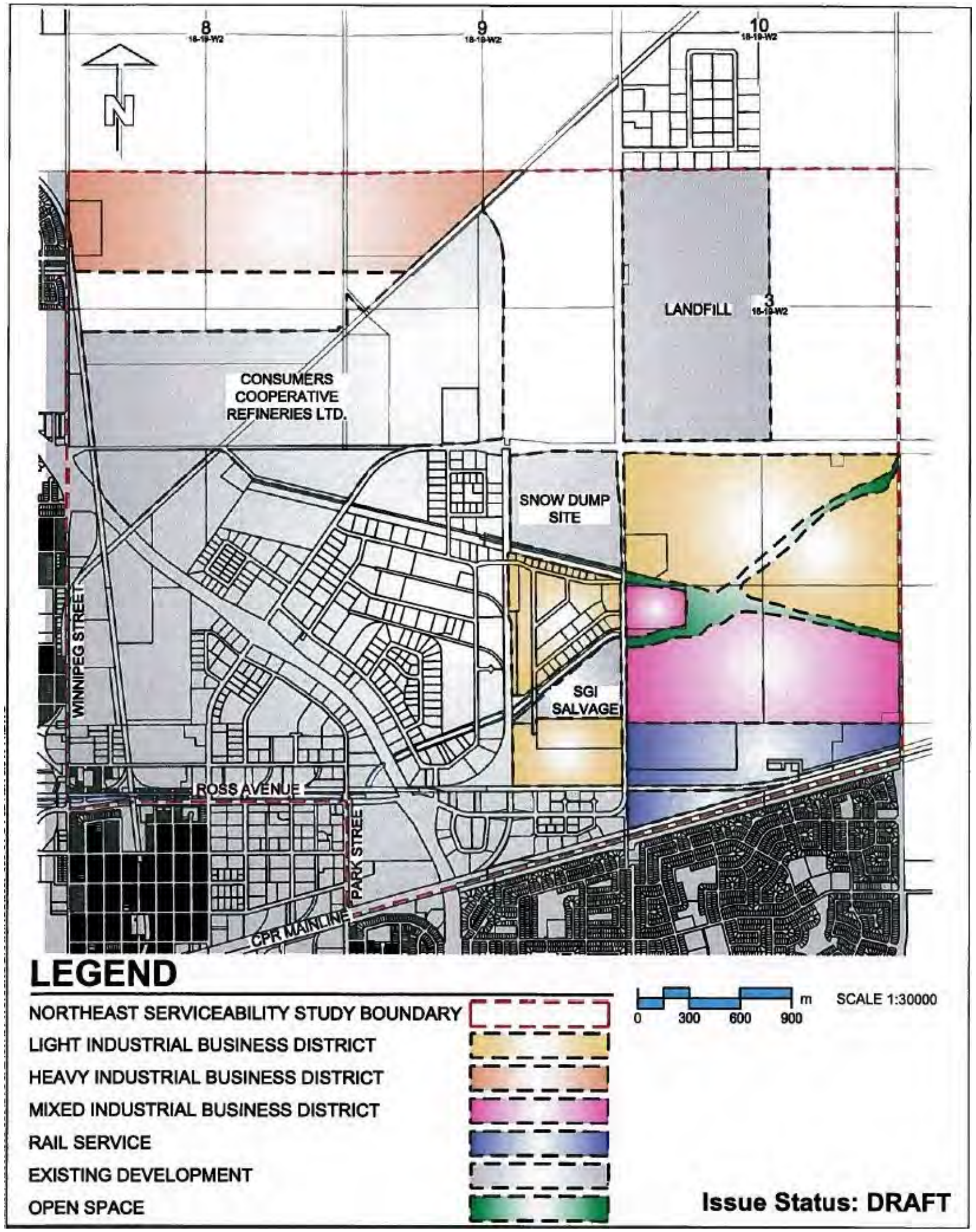
Appendix F
Land Use Maps

City of Regina and the RM of Sherwood

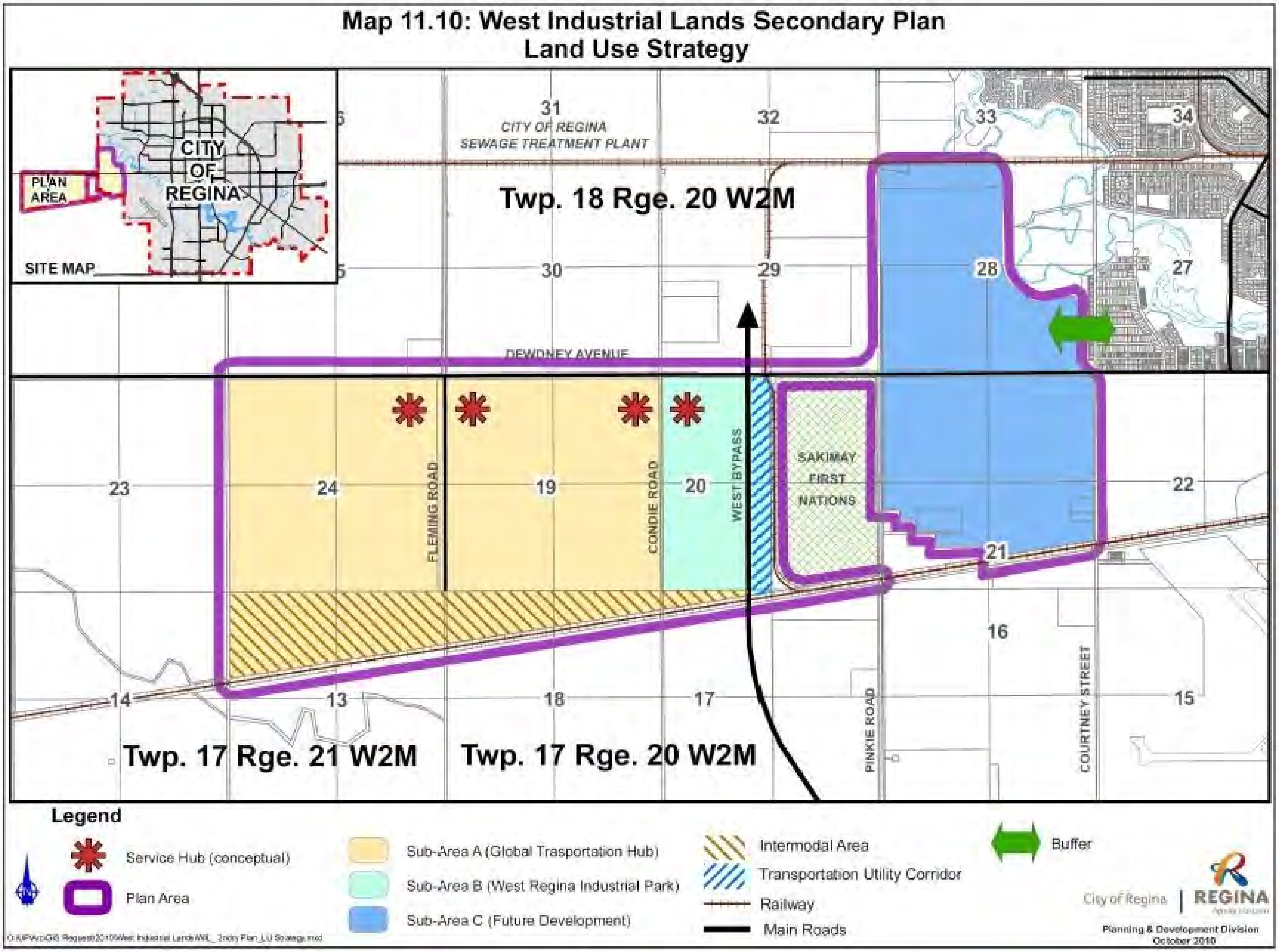
City of Regina Land Use and Growth Plan from the *Official Community Plan*, January 2014



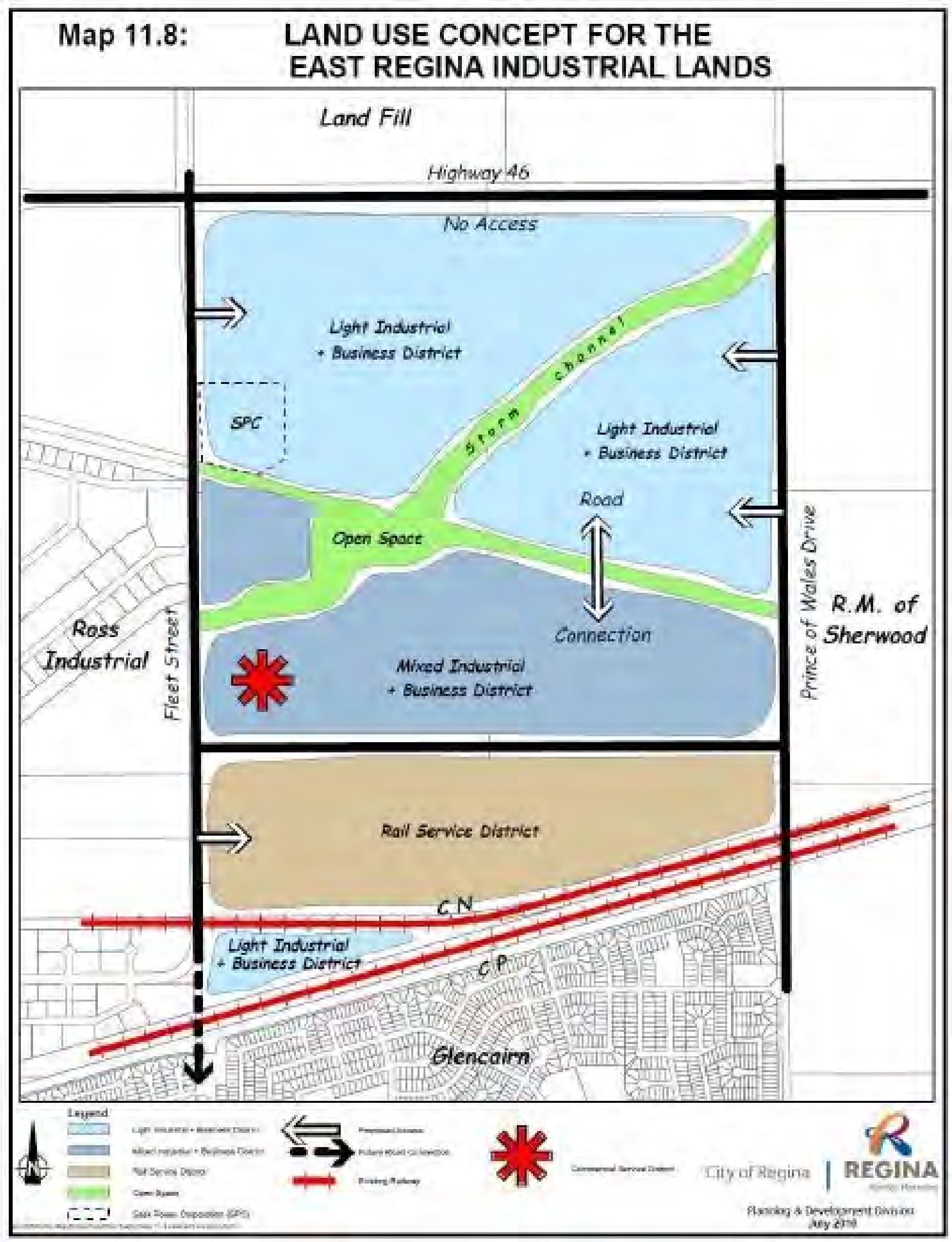
Existing and Future Land Use for the Northeast Sector of Regina (Northeast Serviceability Study, 2012)



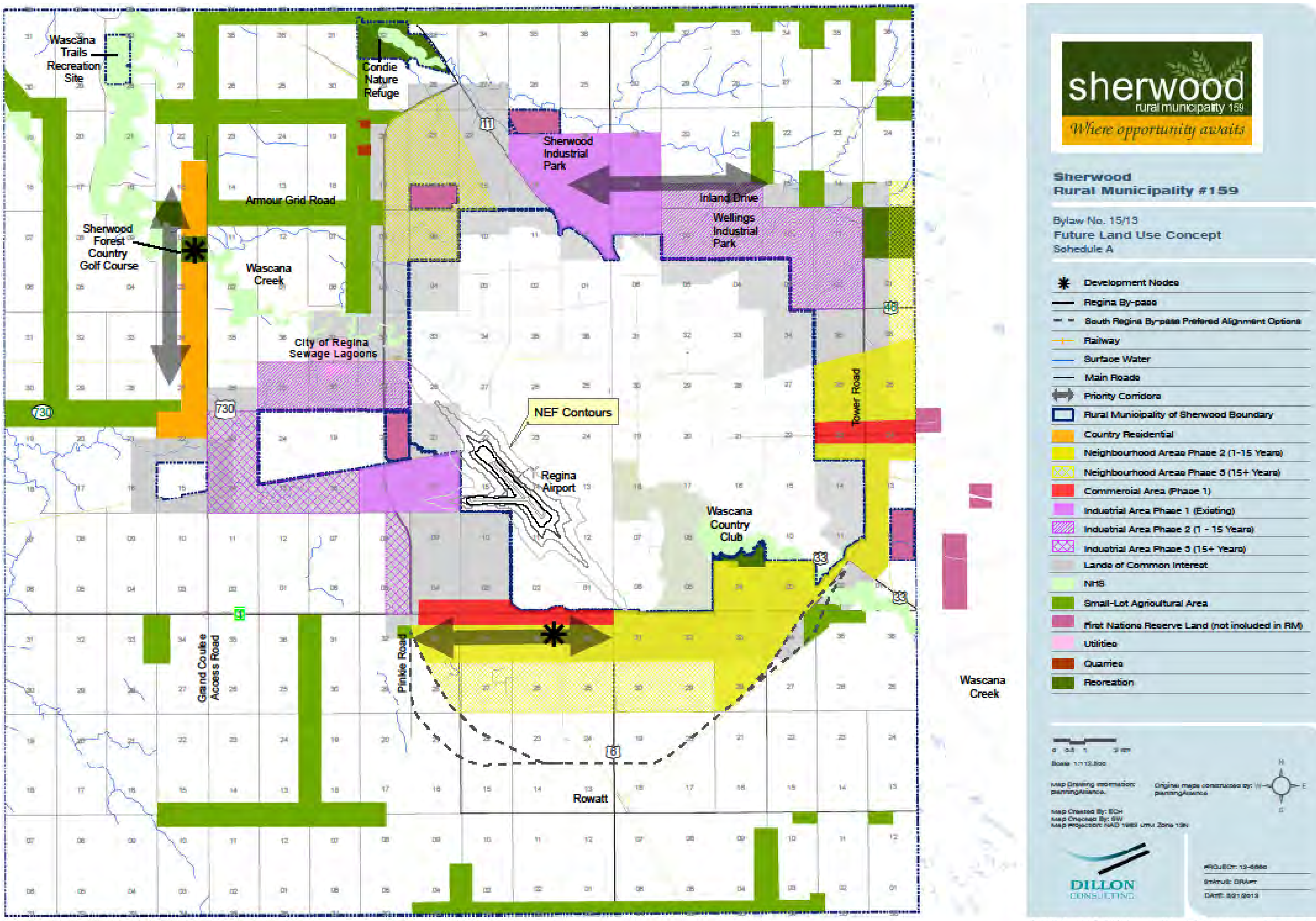
Existing and Future Land Use Secondary Plan for the West Industrial Lands (Regina Development Plan Part A Policy Plan, 2010)



Existing and Future Land Use Secondary Plan for the East Regina Industrial Lands (Regina Development Plan Part A Policy Plan, 2010)

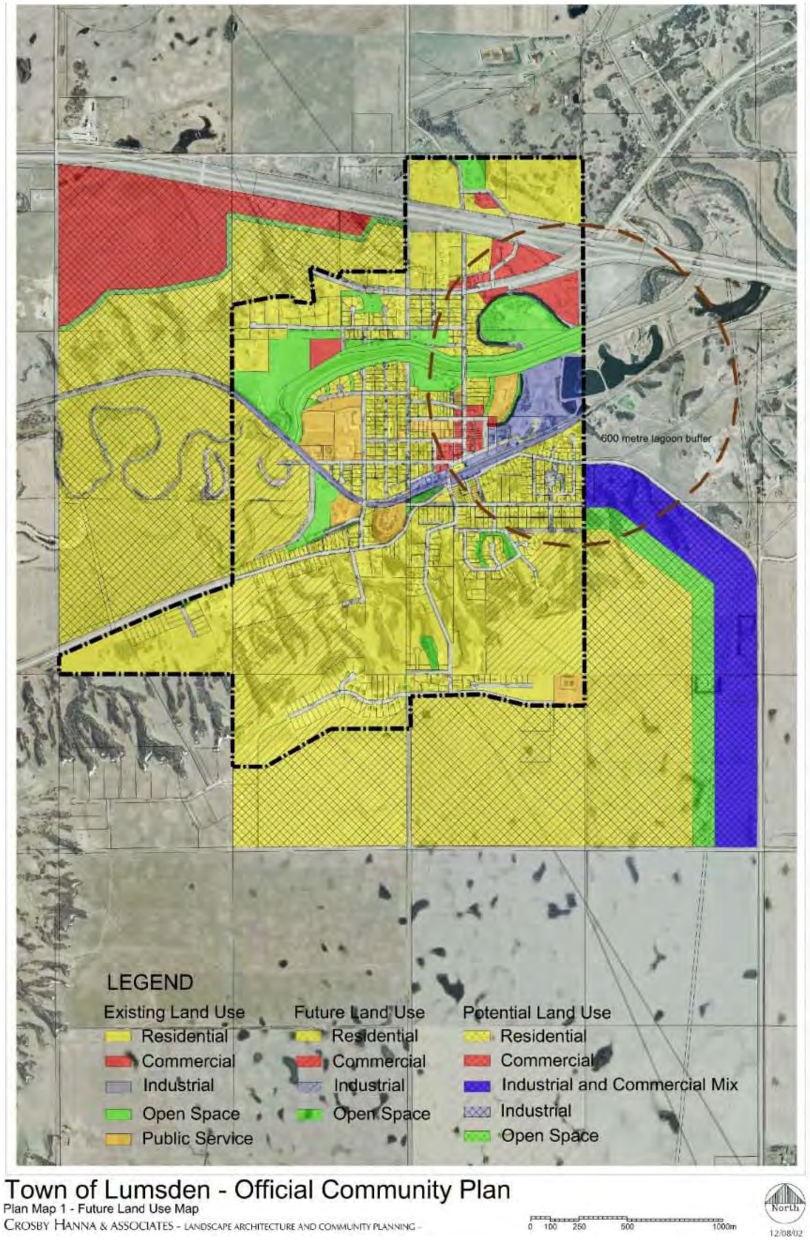


Existing and Future Land Use Map for the Rural Municipality of Sherwood (Official Community Plan Rural Municipality of Sherwood #159, 2013 – draft pending approval)

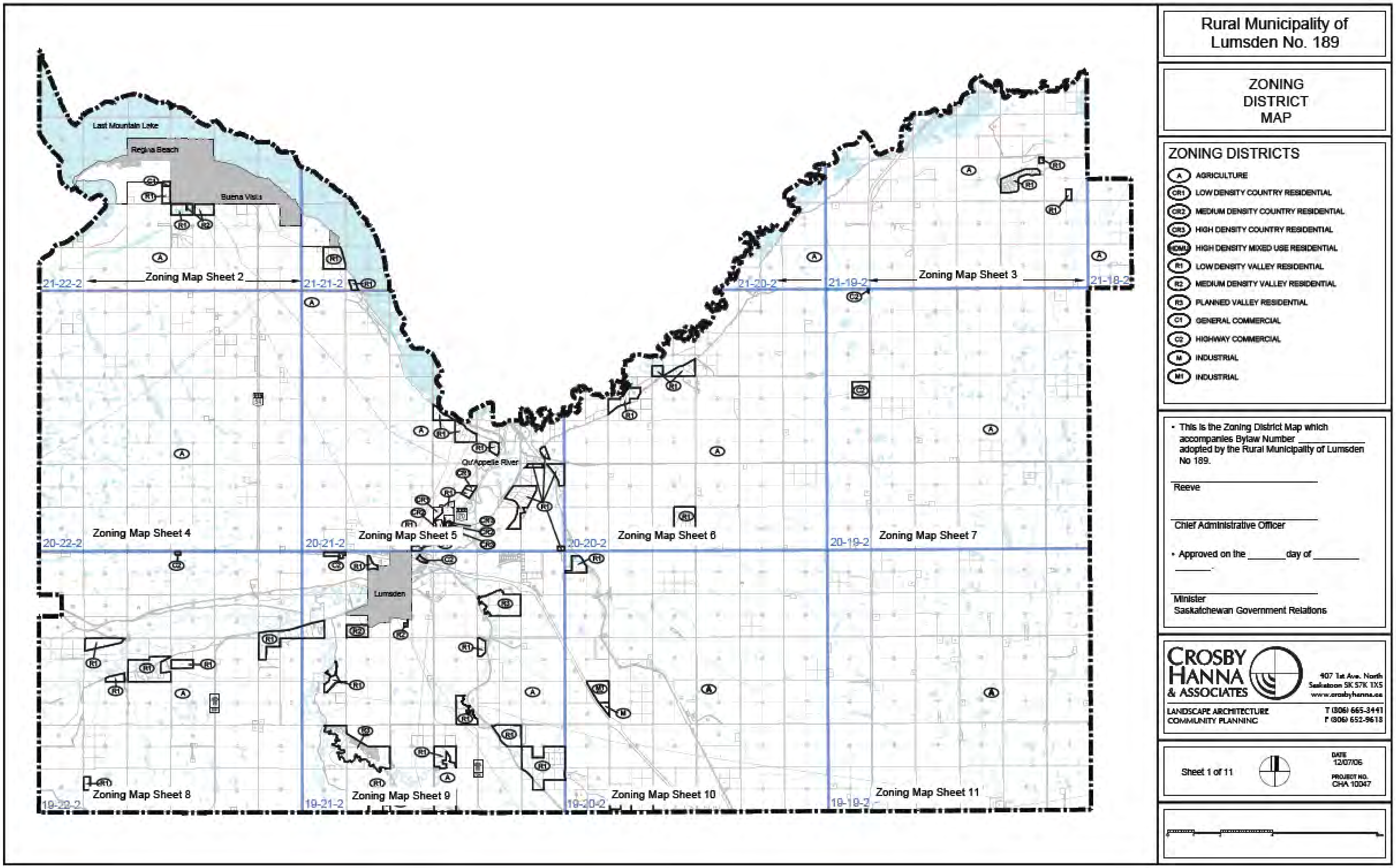


North Region

Existing and Future Land-use Plan for the Town of Lumsden



Existing Land-use Plan for the RM of Lumsden

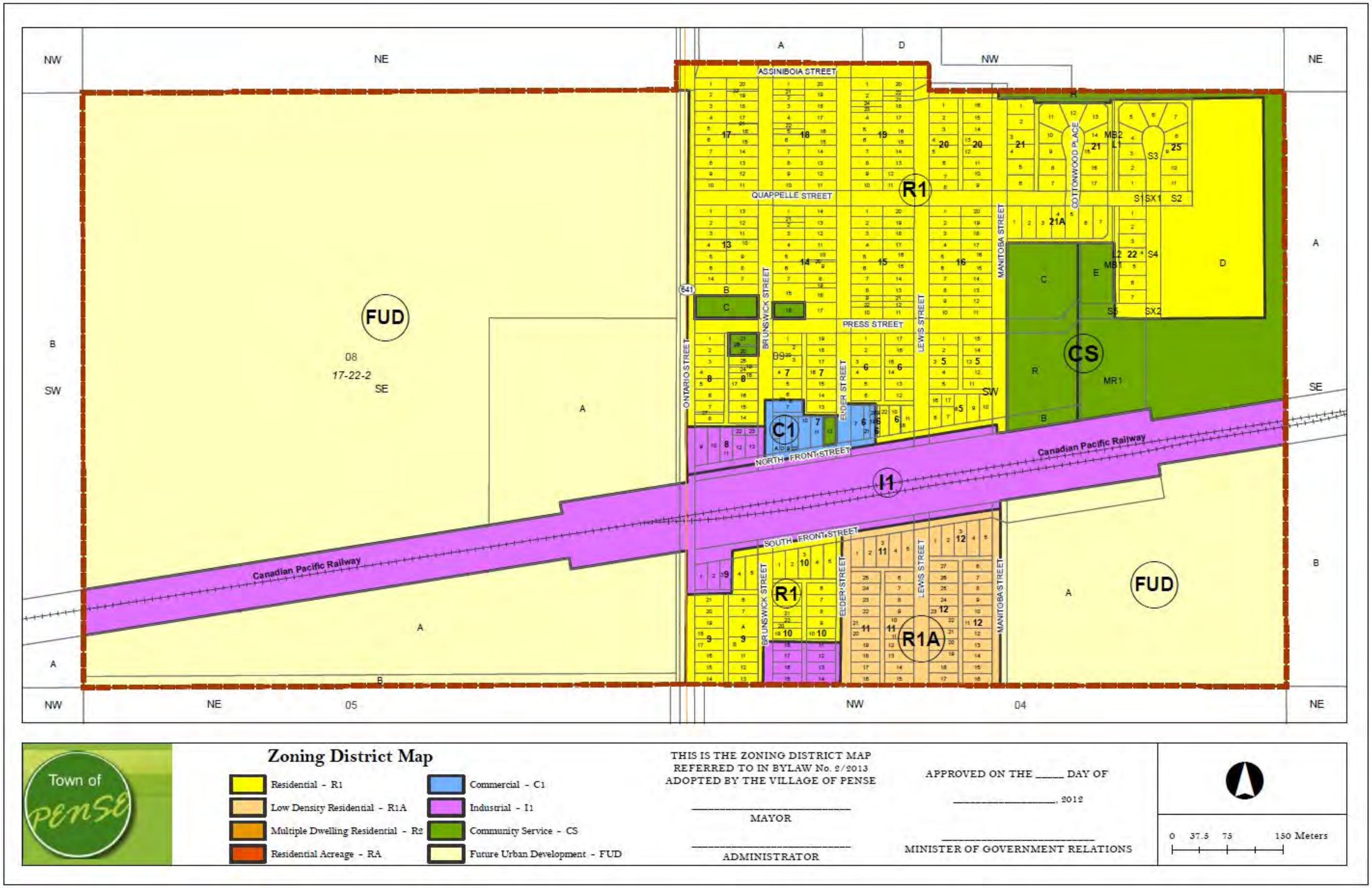


West Region

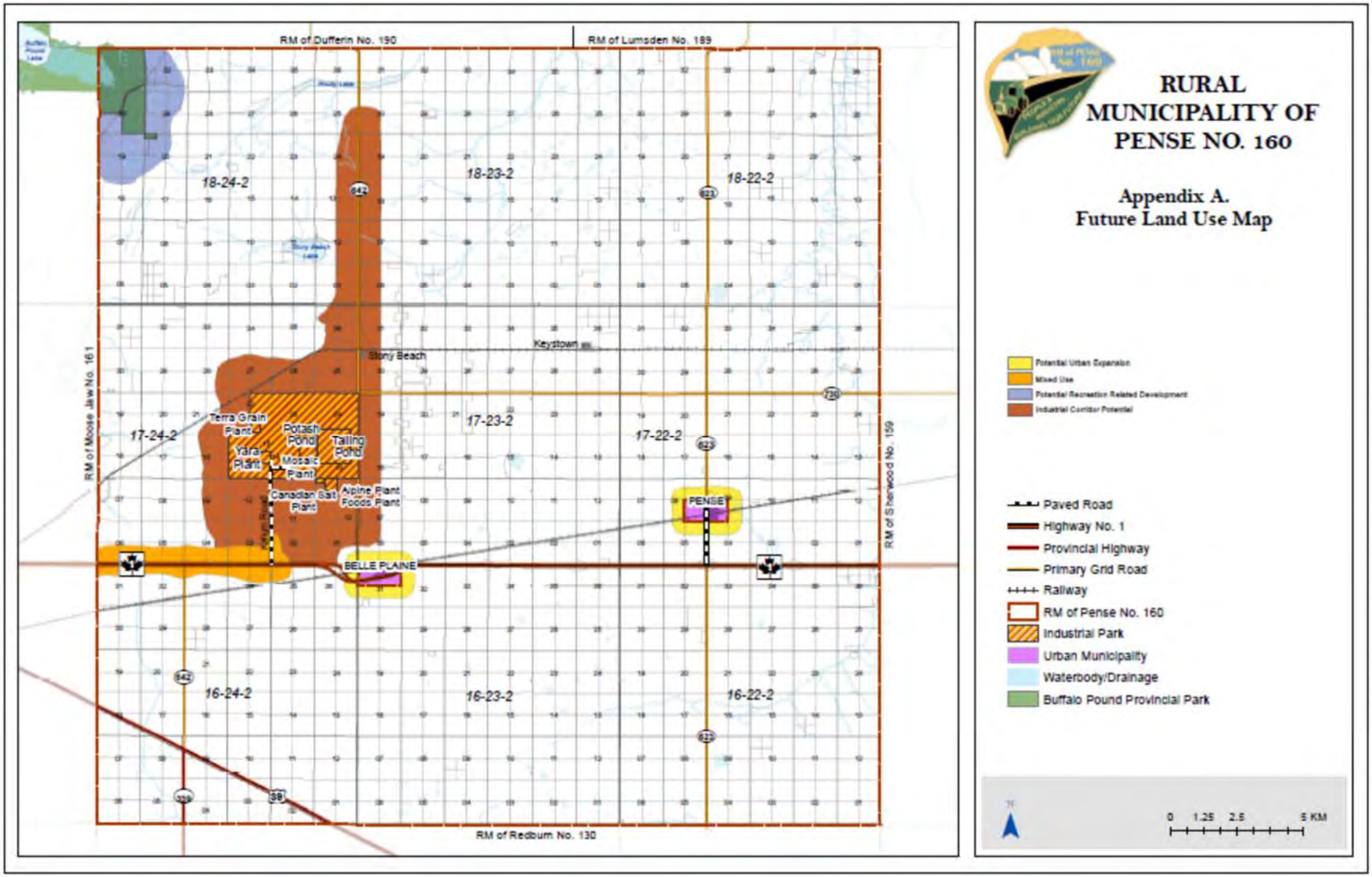
Existing Land-use Map for the Village of Grand Coulee

WBG030414142753CGY

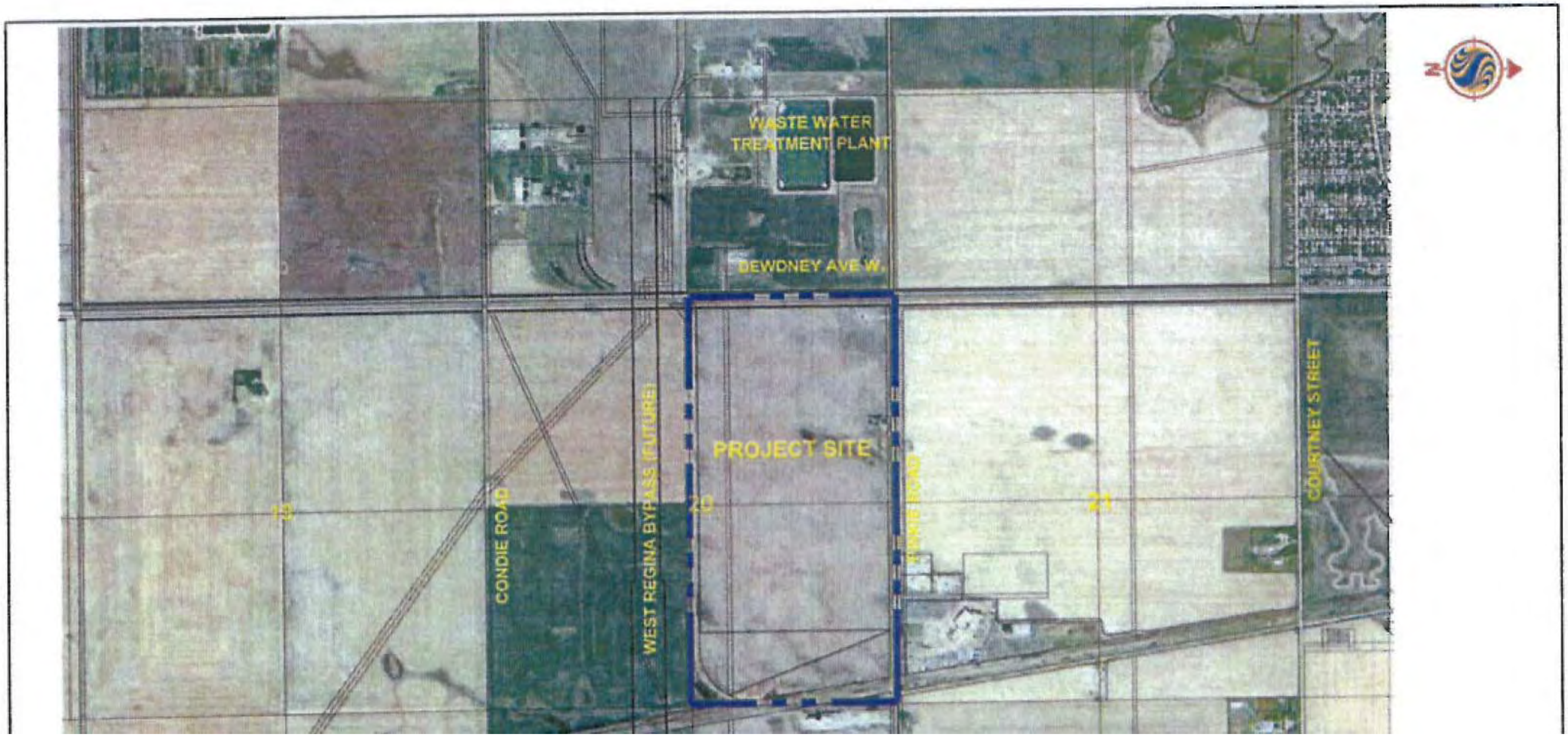
Existing Land-use Map for the Town of Pense



Existing and Future Land-use Map for the RM of Pense

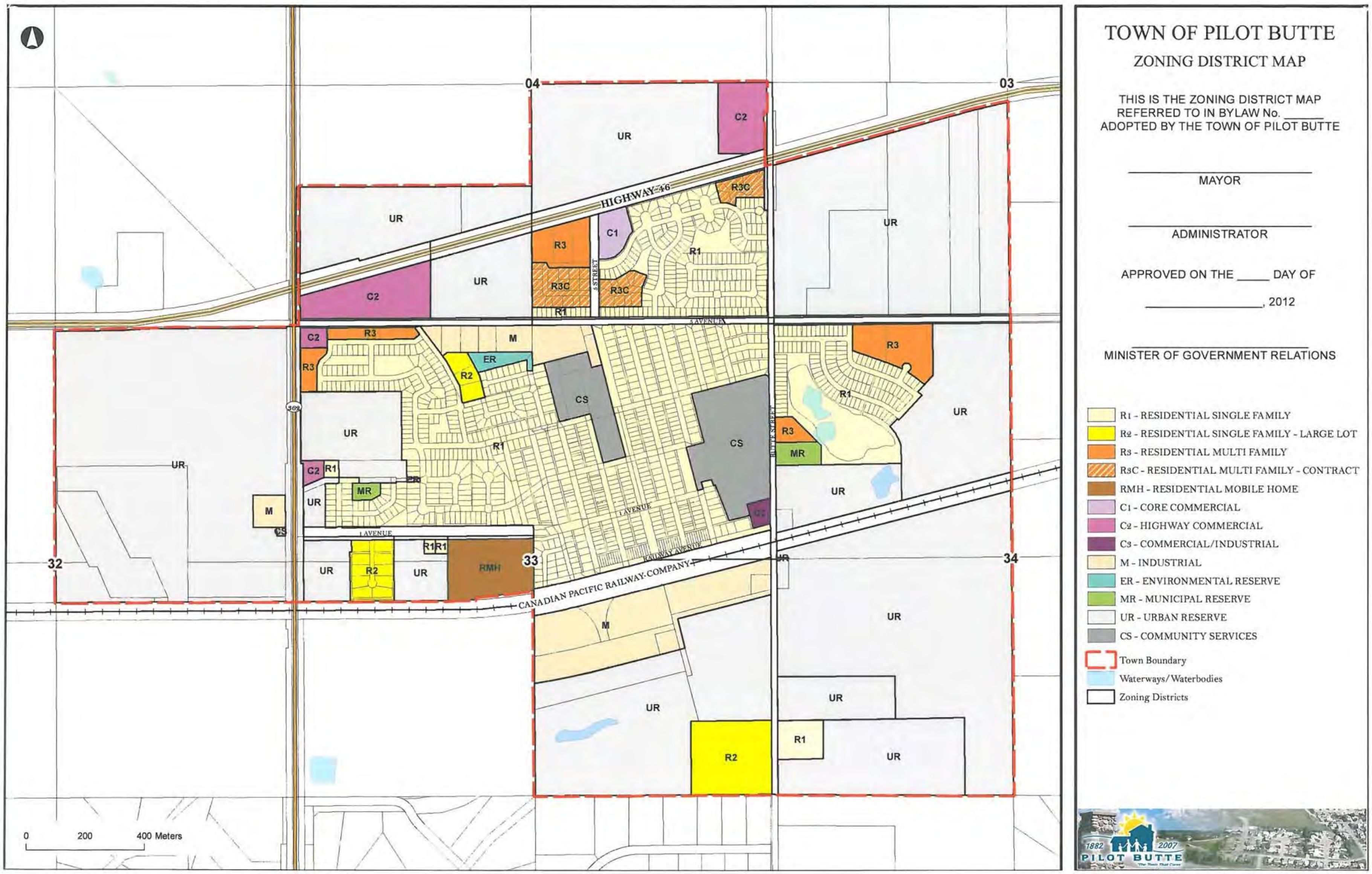


Sakimay Lands west of the City of Regina

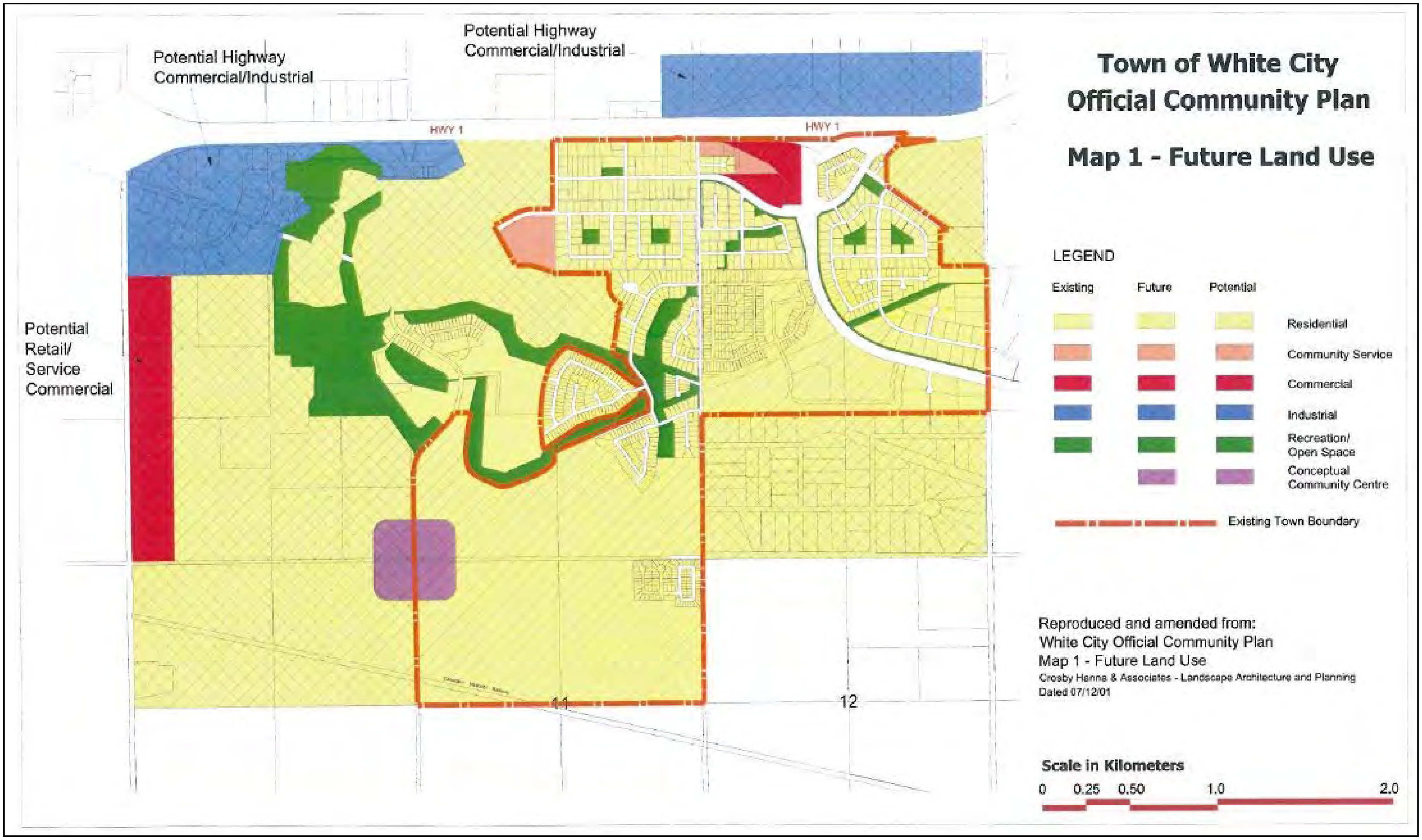


East Region

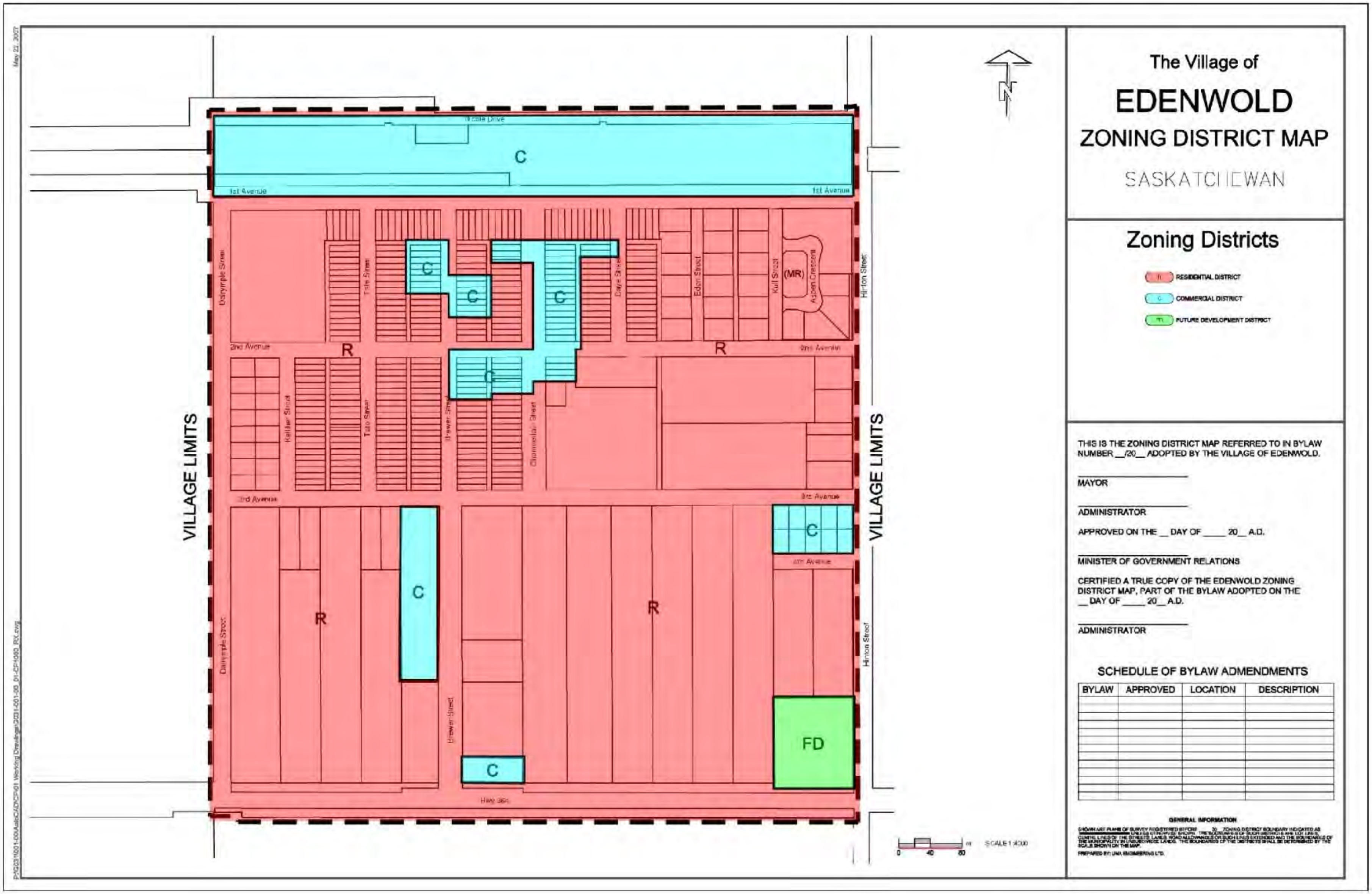
Existing Land-use Plan for the Town of Pilot Butte (Town of Pilot Butte Zoning District Map, 2012)



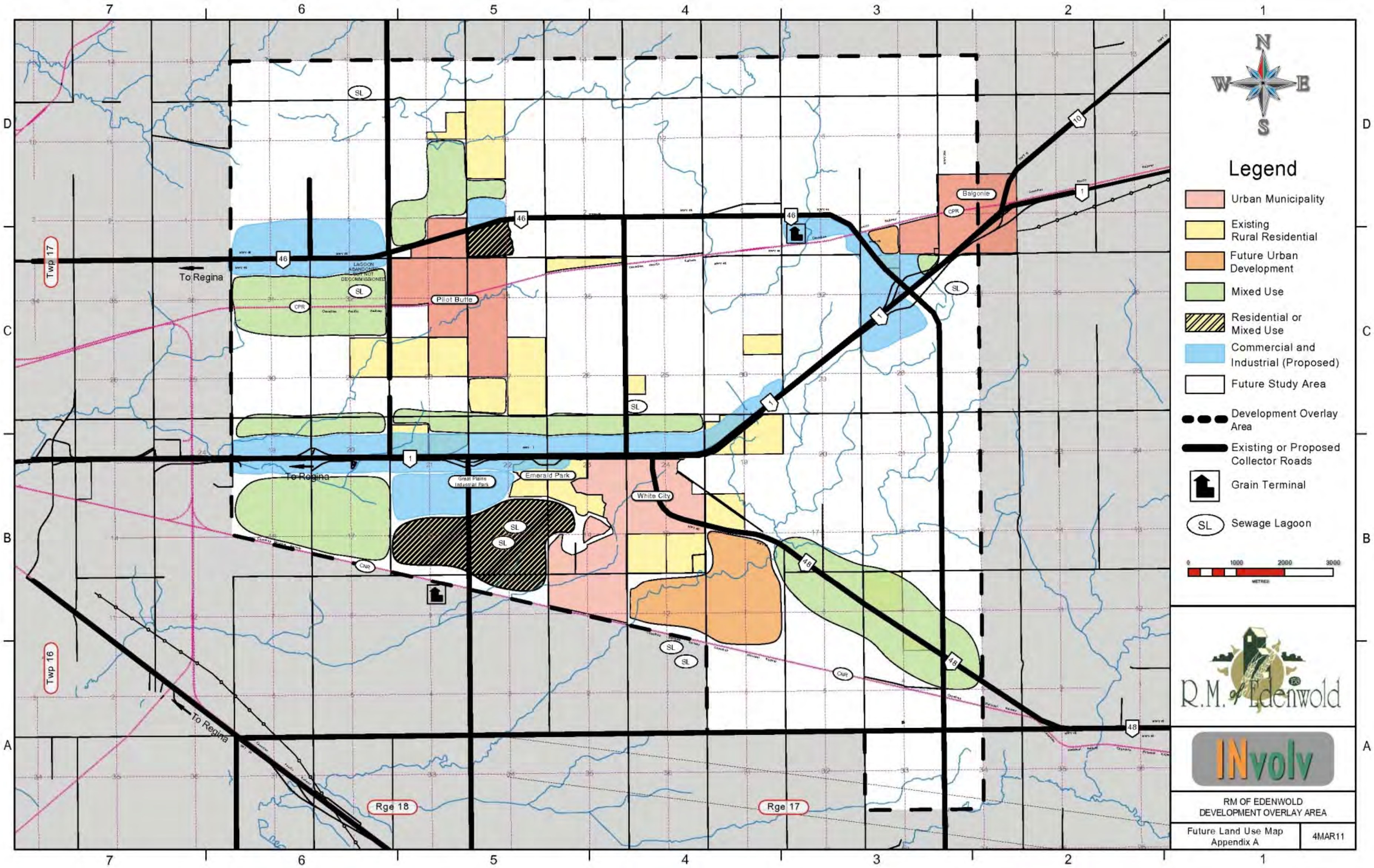
Existing and Future Land-use in White City



Existing Land-use Map for the Village of Edenwold

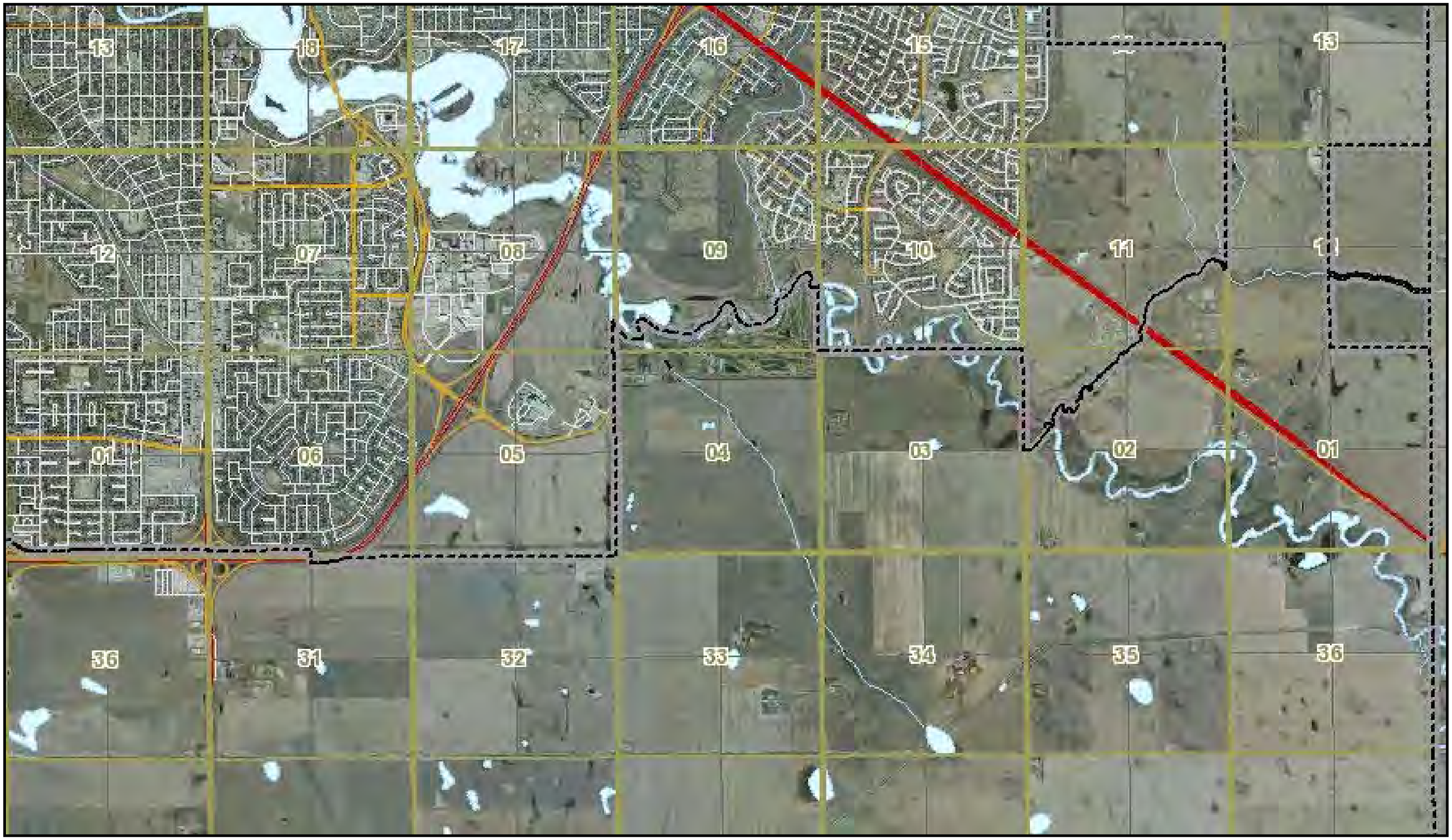


Existing and Future Land-use Map for the Rural Municipality of Edenwold



Sakimay Lands east of the City of Regina

Sakimay Lands southeast of the City of Regina



Appendix G
Infrastructure Overview Table

Appendix G
Infrastructure Overview Table

Regina and Region Water and Wastewater Study
Current Infrastructure Overview Table, 2013
Information captured is the best available from the stakeholders at this phase of the study

NA		Not Available
G	Good	No capacity issues; capacity available for future growth; water quality good; wastewater compliant with permit; condition gooc
A	Fair	Capacity of infrastructure is approaching limits; not enough capacity available for the future; infrastructure approaching end of useful lif
R	Poor	Infrastructure cannot support current demands; and/or needs immediate upgrades/replacement; and/or poor water quality; and/or wastewater compliance with permit at risl

				Water Infrastructure (Current and Planned Upgrades in 2013)									Wastewater Infrastructure (Current and Planned Upgrades in 2013)									
Stakeholder	Population (Census 2011)	Growth Rate		Well(s)	Buffalo Pound Connection	Other Water Supply	Water Treatment Plant	Distribution Chlorination	Reservoir(s)	Distribution Pump(s)	Pipes/Mains	**Water Overall**	Wastewater Treatment Plant	Lagoon(s)	Effluent to creek	Effluent to irrigation	Lift Station(s)	Interconnection with Storm	Pipes/Mains	Septage Tanks	Septage Managed Locally	**Wastewater Overall**
Regina	193,100	Moderate - High	Own/Operate Capacity/ Condition	Y R	Y G			Y G	Y A	Y A	Y G	G	Y R	Y R	Y G		Y A	Y A	Y G		Y R	R
RM of Sherwood	929	Decline	Own/Operate Capacity/ Condition									NA								Y G	Y A	NA
Balgonie	1,625	High	Own/Operate Capacity/ Condition	Y R		Y G		Y A	Y G	Y A	Y ?	A		Y A		Y G	Y G		Y G			G
Pilot Butte	1,848	Decline recently	Own/Operate Capacity/ Condition	Y G			Y G	? G	Y G	Y G	Y G	G		Y G		Y G	Y G		Y G		Y ?	G
White City	1,894	High	Own/Operate Capacity/ Condition	N (SaskWater) G			N (SaskWater) A		Y G	Y G	Y G	A		Y R		Y A	Y G		Y G		Y ?	R
Edenwold	238	Moderate - Decline	Own/Operate Capacity/ Condition			N (SaskWater) R	N (SaskWater) G		Y A	Y G	Y A	A		Y R		Y G	Y R		Y R		Y ?	R
RM of Edenwold	4,167	High	Own/Operate Capacity/ Condition	Y		Y	?	?	?	?	Y	NA		Y R			Y G		Y G	Y G	Y ?	R
Lumsden	1,631	Moderate - High	Own/Operate Capacity/ Condition	Y G			Y G		Y G	Y G	Y G	G		Y R	Y G		Y A	Y	Y A		Y ?	R
RM of Lumsden	1,733	Moderate - High	Own/Operate Capacity/ Condition	?		Y G		?	?	?	Y ?	G								Y G	Y ?	G
Craven	234	Decline	Own/Operate Capacity/ Condition	Y A				Y G	Y G	Y ?	Y A	A		Y G			Y A		Y A		Y ?	A
Grand Coulee	571	High	Own/Operate Capacity/ Condition		Y (SaskWater) A			Y G	Y G	Y G	Y G	G		Y R		Y G	Y R	Y G	Y G	Y A	Y ?	R
Pense	532	Decline - Moderate	Own/Operate Capacity/ Condition		Y G			Y G	Y G	Y G	Y A	G		Y R		Y R	Y A		Y G		Y ?	R
RM of Pense	471	Decline	Own/Operate Capacity/ Condition		Y A			N A	N A		Y A	A								Y G	N (Contract)	G
Belle Plaine	66	Low	Own/Operate Capacity/ Condition		Y G			Y G	Y G	Y G	Y G	G		Y G		Y G	Y G		Y G	Y G	Y ?	G
Sakimay Land	na	na	Own/Operate Capacity/ Condition	N	N	N	N	N	N	N	N		N	N	N	N	N	N	N	N	N	
SaskWater	na	na	Own/Operate Capacity/ Condition	Y	Y	Y	Y	N	Y	N	N		N	N	N	N	N	N	N	N	N	

Cell: K11
Comment: Griffiths, Kelly /WPG
A new pumping station is required in the northwest to address pressure issues - second pressure zone being constructed

Cell: M16
Comment: icransto:
Items upgraded to Amber following July Workshop and input from Balgonie. Will move to Green in 2014

Cell: E17
Comment: Griffiths, Kelly /WPG:
High Selenium

Cell: G17
Comment: Griffiths, Kelly /WPG:
New pipeline being built to transfer water from Pilot Butte to Balgonie

Cell: J17
Comment: icransto:
Tender out in 2013 for construction of new third reservoir (with the functionality to expand in the future)

Cell: O17
Comment: icransto:
Downgraded to Amber.
Current lagoon has some capacity - weather and time of year dependent. Local farmer uses for irrigation which boosts capacity. Have had to discharge to Wascana Creek during extreme weather events (eg. 2011 flood). Would like more waste capacity to support growth.
There is also an old lagoon that could be refurbished if required.

Cell: M22
Comment: icransto:
Going through major upgrade and refurb program, 20 year planning horizon, mainly Raw->WTW

Cell: W22
Comment: icransto:
Upgraded to Green following review by White City at the July workshop Jan 2014; downgraded to Red. Lagoons at capacity and growth halted.

Cell: H23
Comment: Griffiths, Kelly /WPG:
Upgrades over next five years to increase capacity for future growth. First phase of upgrades has begun

Cell: O23
Comment: icransto:
Lagoon contruction complete 5 years ago, capacity is ok, clarified at July workshop Jan 2014; downgraded to Red. Lagoons at capacity and

growth halted.

Cell: G26
Comment: icransto:
Surface water source not reliable, clarified during July workshop

Cell: O29
Comment: icransto:
Lagoons at capacity, looking to add Sewage Treatment/WWTW with White City

Cell: M31
Comment: icransto:
New infrastructure recently installed with extra capacity

Cell: W34
Comment: icransto:
Infrastructure is owned and operated by a private individuals

Cell: G35
Comment: Cranston, Iain/CGY:
May score A if downstream treatment is included as Dodds Subdivision has had some water permitting challenges with their own WTP

Cell: E38
Comment: Griffiths, Kelly /WPG:
Not a capacity issue; well service life coming to end.

Cell: J38
Comment: Griffiths, Kelly /WPG:At the current av. Demand - provides over two days of storage. Not much growth expected.

Cell: L38
Comment: Griffiths, Kelly /WPG:
Old pipes; no major breaks but needs replacement

Cell: F41
Comment: Griffiths, Kelly /WPG:
May require a booster station in the future; no redundancy in supply line

Cell: I41
Comment: icransto:
Last chlorinated in 2011/2012 due to flushing out stored water

Cell: J41
Comment: icransto:
Further increasing their reservoir storage

Cell: F44
Comment: Griffiths, Kelly /WPG:
Lots of capacity; however no redundancy

Cell: L44
Comment: Griffiths, Kelly /WPG:
Water pressure to 5 farmers is inadequate

Cell: J46
Comment: Griffiths, Kelly /WPG:
No treated water storage at either Hamlet

Cell: M46
Comment: Cranston, Iain/CGY:
Rated as AMBER not RED despite water capacity challenges. Growth plans in the RM are moderate but not in the hamlet communities experiencing the challenges

Cell: W46
Comment: icransto:
Infrastructure is owned and operated by a private individuals

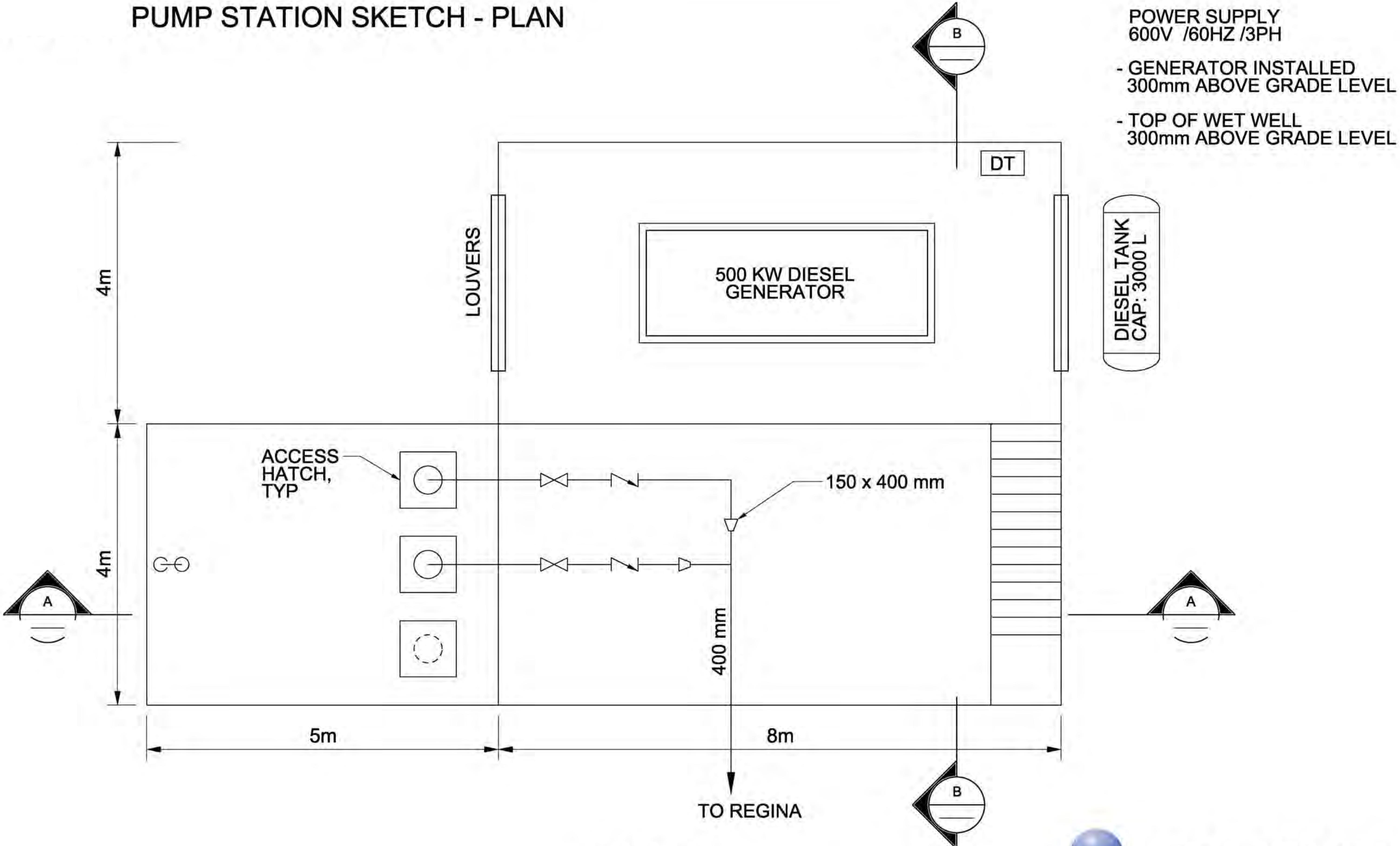
Cell: F47
Comment: Cranston, Iain/CGY:
Water connections to Buffalo Pound Supply Line but pressure/age/condition is a challenge. Looking to connect Stony Beach to Alpine Foods supply line. No additional development is permitted in the hamlets due to water servicing capacity.

Cell: I47
Comment: Griffiths, Kelly /WPG:
Low chlorine residuals have been found repeatably in the Stony Beach distribution system. Flushing has been recommended.

Cell: L47
Comment: Griffiths, Kelly /WPG:
Pressure is fine now, but may not be sufficient in the future

Appendix H
Wastewater Pump Station Design Template

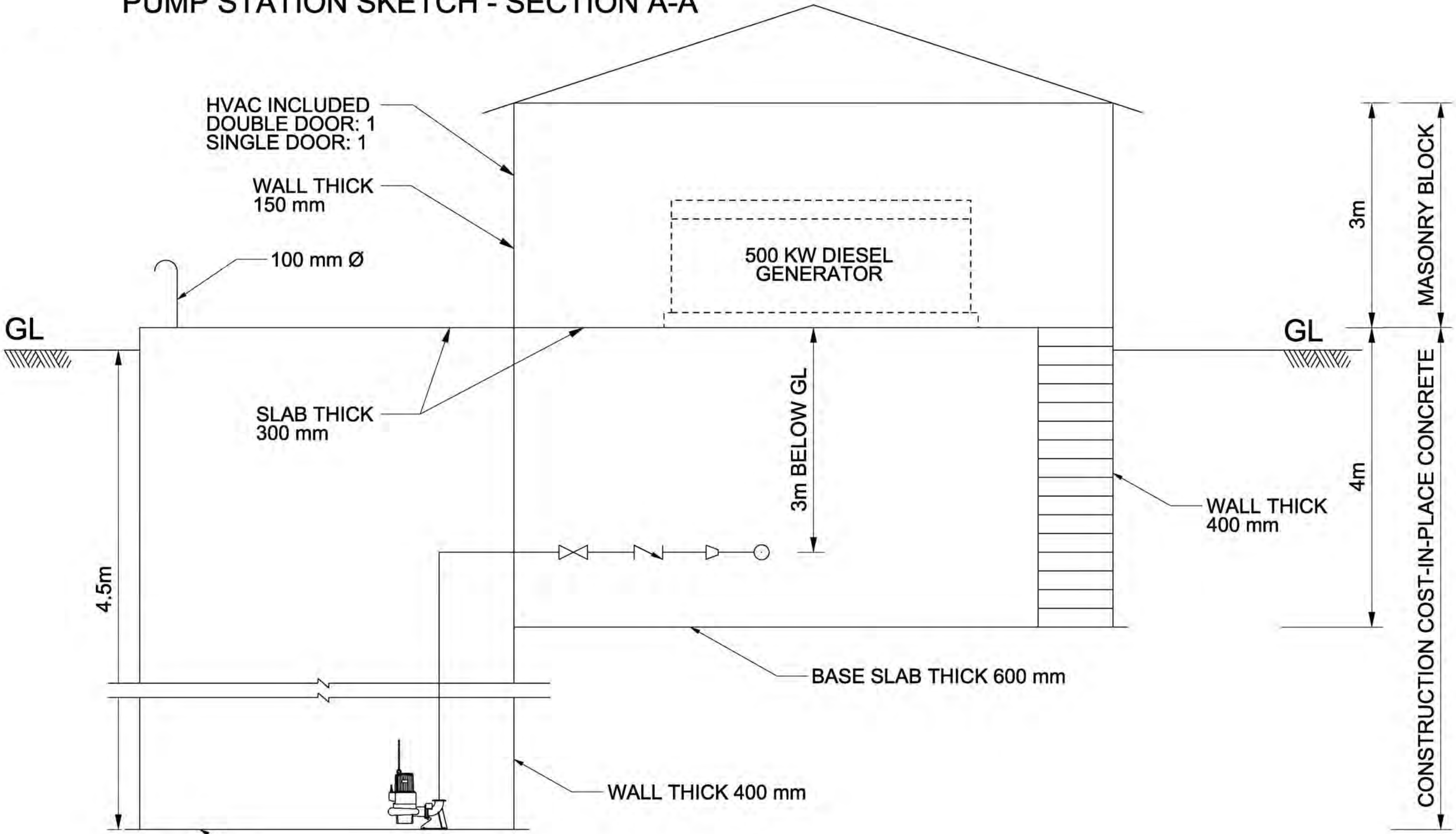
PUMP STATION SKETCH - PLAN



PLAN

CH2MHILL

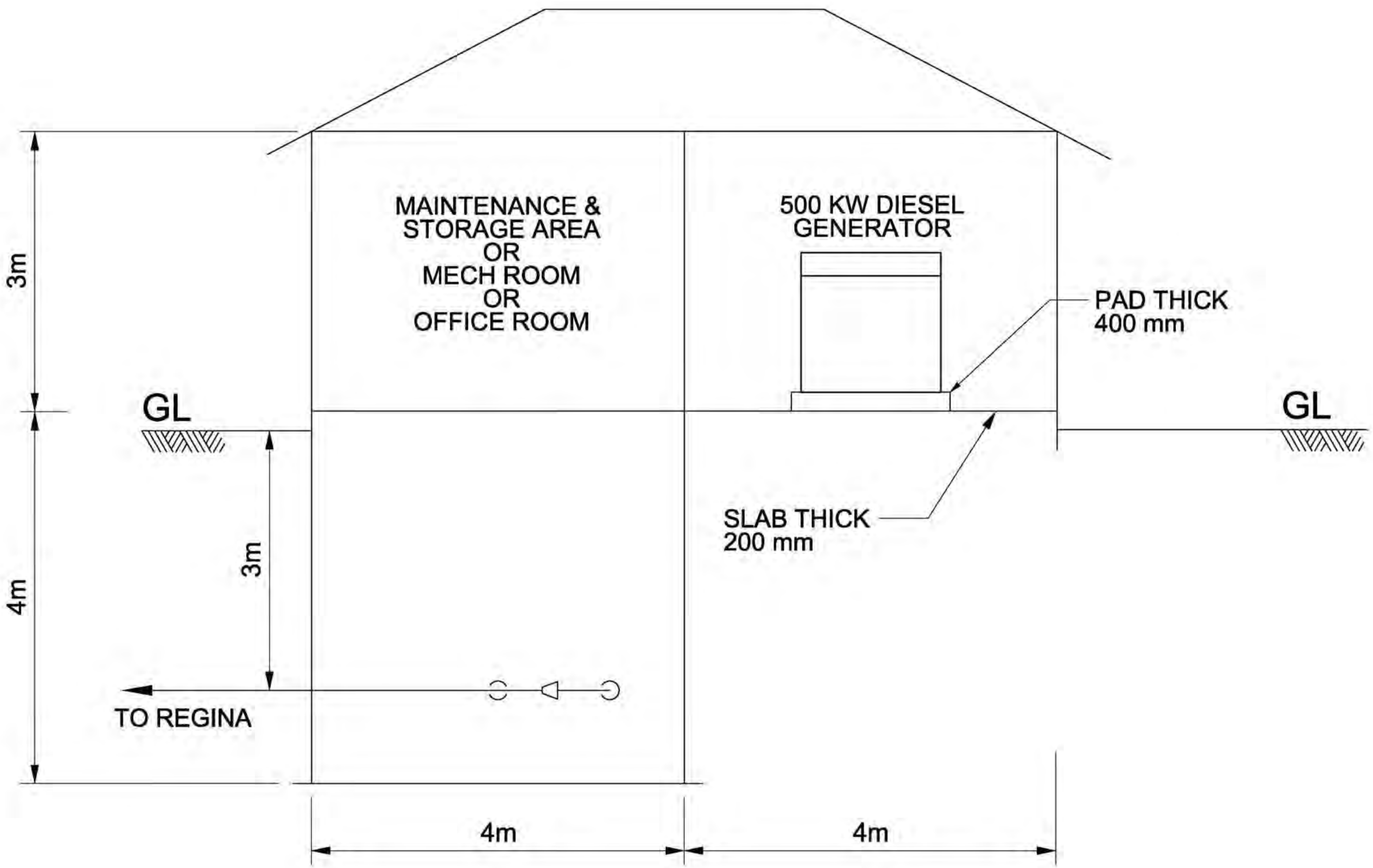
PUMP STATION SKETCH - SECTION A-A



SECTION A-A

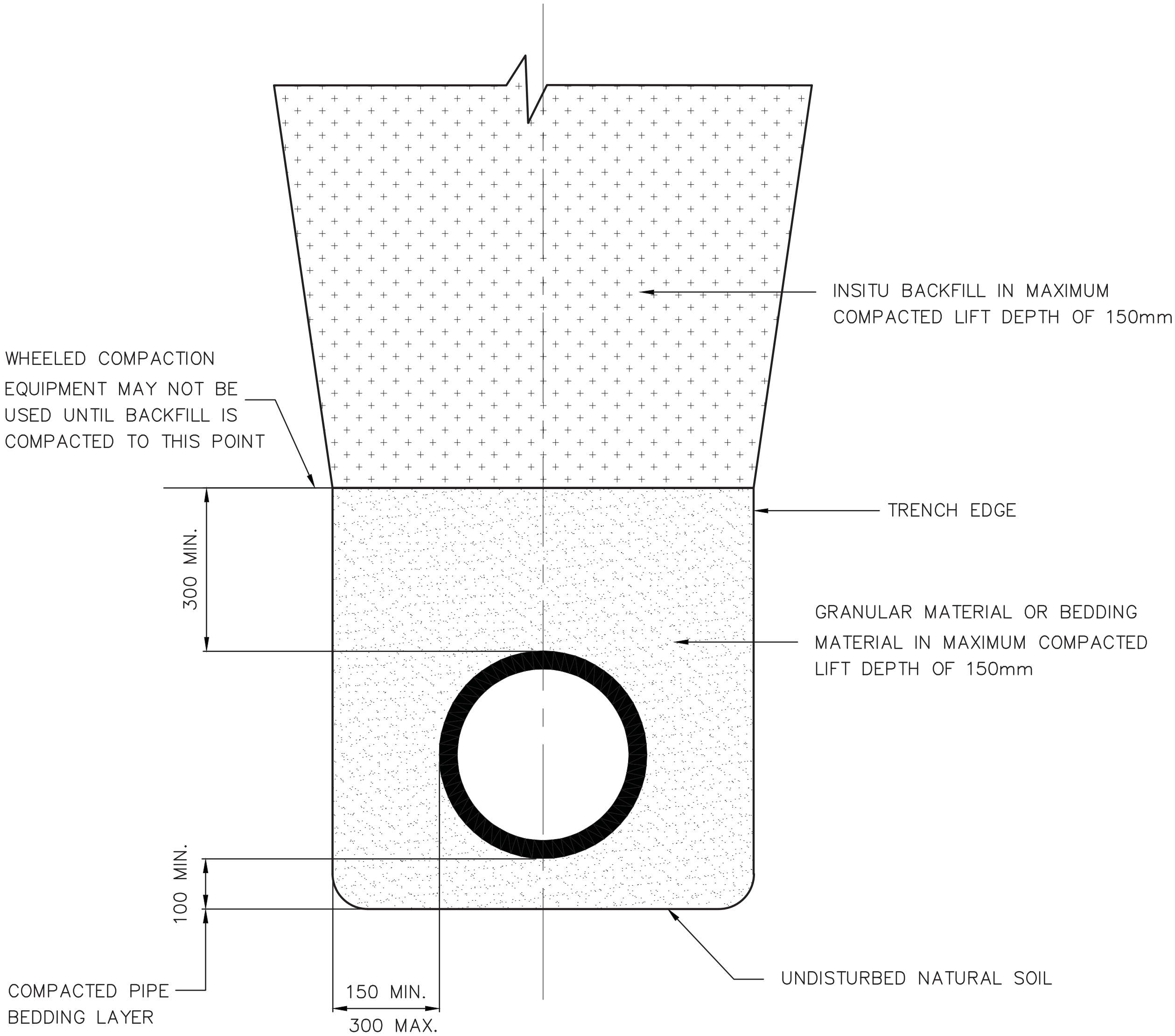
CH2MHILL

PUMP STATION SKETCH - SECTION B-B



SECTION B-B

Appendix I
Pipeline Design Standards



NOTE

1. BACKFILL COMPACTION TO BE A MINIMUM OF 95% STANDARD PROCTOR DENSITY.

2. INSITU BACKFILL MOISTURE CONTENT TO BE +/− 3% OF ADJACENT UNDISTURBED TRENCH SIDE.

3. SIDE CLEARANCE MUST BE ADEQUATE TO PERMIT COMPACTION OF BACKFILL AT SIDE OF PIPE

4. THE GUIDELINE MINIMUM FOR COMPACTION TESTING IS ONE TEST FOR EACH $1000m^2$ FOR EACH LIFT IN THE PIPE BEDDING ZONE AND TRENCH BACKFILL ZONE.

5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

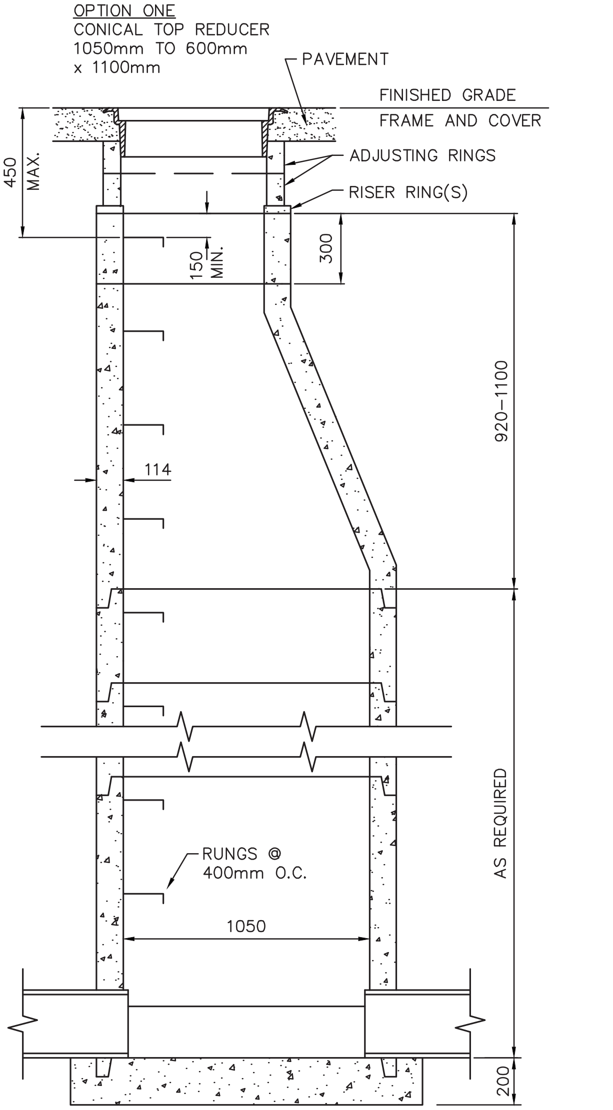
Date	Revisions	By
JAN/02	NOTES 1 & 2 CORRECTED	BW
JAN/03	GENERAL REVISIONS	BW
JAN/03	TITLE BLOCK	MLG
NOV/05	TITLE BLOCK	BW
JUL/10	TITLE BLOCK	JJA

City of Regina | REGINA Infinite Horizons

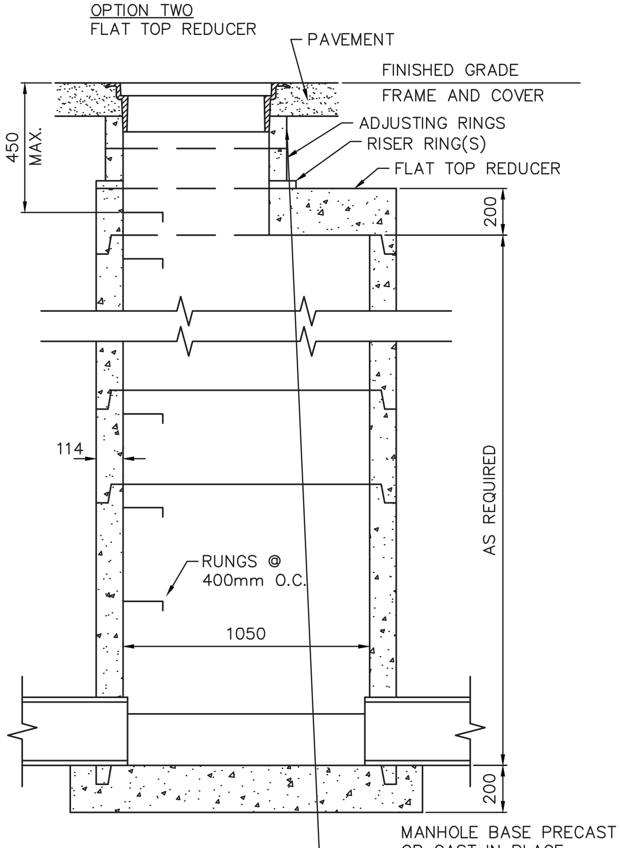
CONSTRUCTION STANDARDS

Standard Flexible Pipe Bedding and Trench Backfill

Designed By:	Approved: Stella Madsen
Date: JAN/01	Scale: NTS
Digital File: STDS-20.dwg	S-20



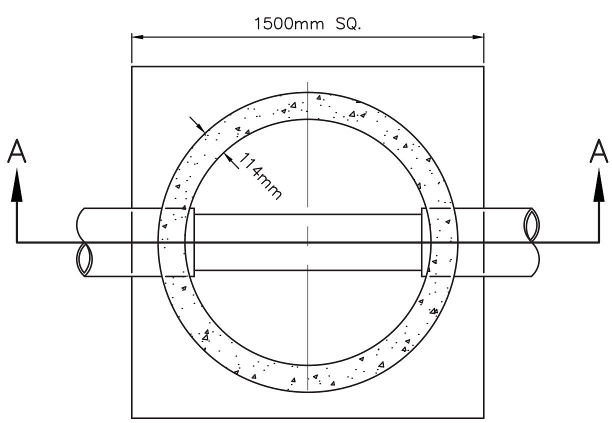
SECTION A–A



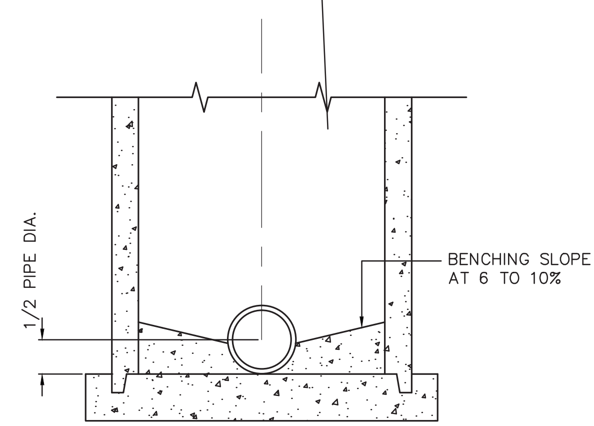
SECTION A–A

NOTES:

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED



PLAN



DETAIL OF BENCHING

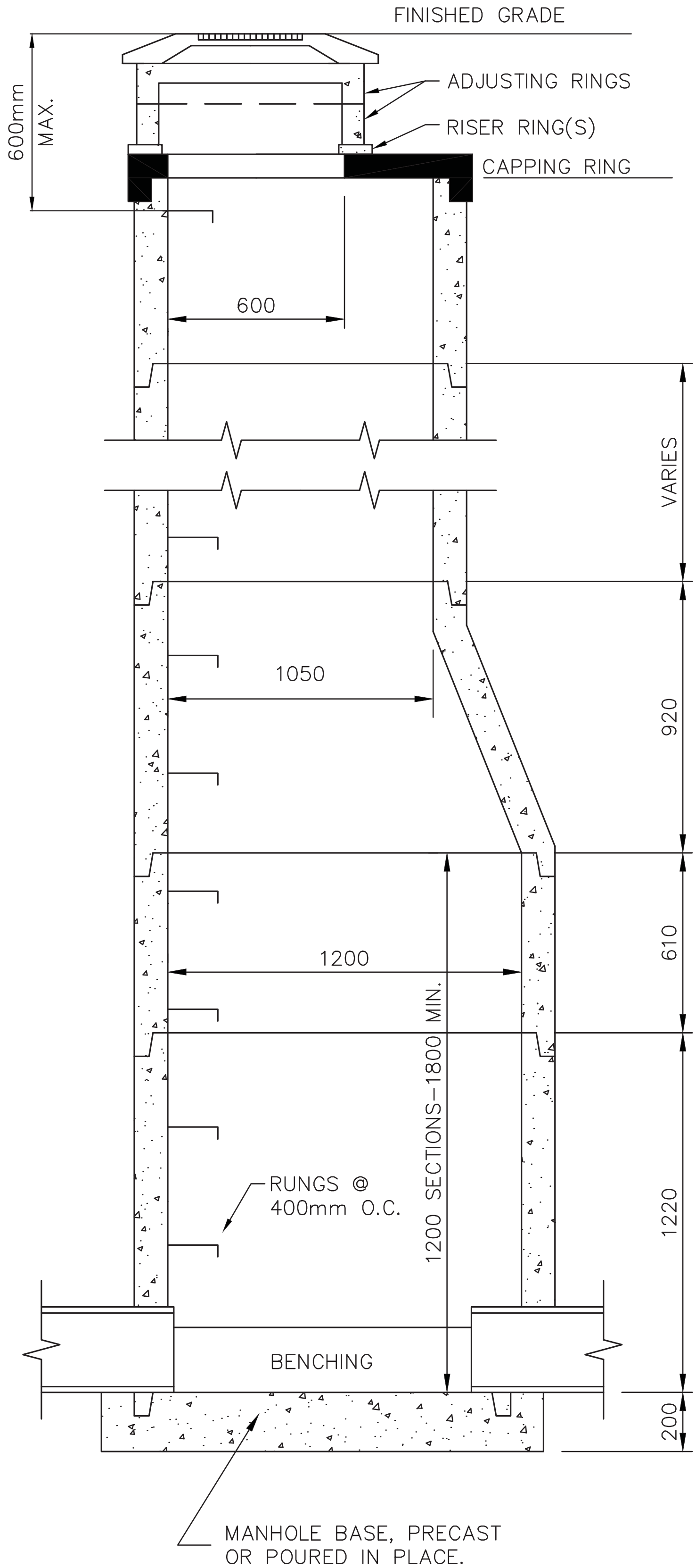
Date	Revisions	By
JAN/03	TITLE BLOCK	MLG
MAR/04	ADDED FLAT TOP OPTION'	CJK
NOV/05	REVISED DIM	BW
NOV/05	TITLE BLOCK	BW
JUL/10	TITLE BLOCK	JJA

City of Regina | REGINA Infinite Horizons

CONSTRUCTION STANDARDS

Pre-Cast Manhole 1050 Dia.

Designed By:	Approved: Stella Madsen	
Date JAN/01	Scale NTS	S-2
Digital File: STDS-2.dwg		



NOTE

1. INSTALL RUNG 150mm BELOW TOP EDGE OF FIRST RISER
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
3. DEEP MANHOLE REFERS TO A MANHOLE WITH DEPTH > 5m

Date	Revisions	By
JAN/03	TITLE BLOCK	MLG
NOV/05	TITLE BLOCK	BW
NOV/05	REVISED	DM
JUL/10	TITLE BLOCK	JJA

City of Regina | REGINA Infinite Horizons

CONSTRUCTION STANDARDS

Pre-Cast Concrete Deep Manhole

Designed By:

Approved: Kelly Wyatt

Date: JAN/11

Scale: NTS

S-3

Digital File: STDS-3.dwg

Appendix J
Net Present Cost (NPC) and Net Present Value (NPV) Calculation Explanation

Appendix J
Net Present Value (NPV) and Net Present Cost (NPC)

What is NPV?

Net Present Value (NPV) is the preferred method for comparing investment/intervention options. The NPV financial analysis technique takes account of cash flow and the time value of money through inflation and interest rates. It is used to allow projects to be compared today for projected benefits and costs in the future.

NPV represents the value of project across a period of time in today's money.

$$NPV = I_0 + \sum_{t=1}^{n} \frac{S_t}{(1+k)^t}$$

S_t =the expected net cash receipt at the end of year t
I_0 = the initial investment outlay
k = the discount rate, i.e. the required minimum annual rate of return on new investment
n = the project's duration in years

Costs are noted as positive, benefits and cost reductions are noted as negative numbers.

Why should we use discounted cash flow calculations in business cases?

Historically 'Payback Period' was considered a valid way of evaluating the validity of a business case. For example; a capital investment of $200k presents the opportunity to reduce operating costs by $50k per annum – this would equate to a Payback Period of 4 years. From there Managers can decide whether to proceed or not. This however is a drastically oversimplified view of investment economics as the value of the benefit is not static into the future, the value of money depreciates.

Inflation and interest rates are not an ignorable part of business case economics – particularly when it capital projects spanning several years are involved. Giving the changing value of money during the lifetime of an investment, it is important that a more realistic value for the benefit is used when doing business cases to allow a more effective decision to be made. Time discounted cash flow calculations provide a way to take account of this variance in the value of money over time.

> *"A dollar received tomorrow is not equivalent to a dollar in the hand today…as the typical capital investment decision invariably involves the comparison of present outlays and future benefits, problems relating to the timing of receipts and outlays lie at the very heart of the capital budgeting process." Levy & Sarnat*

Time discounted cash flow calculations are used extensively by all infrastructure and investment orientated organizations across the world.

Why is Net Present Value better than the other methods?

There are a number of different ways to account for discounted cash flow however NPV is widely recognized as the most effective.

Internal Rate of Return (IRR) is another time discounted measure of investment worth that uses repetitive applications of the NPV calculation initially with a random discount rate until the discount rate that makes the NPV zero and this is the IRR. Whilst an investment's NPV can vary depending on the discount rate, a project's IRR is fixed and is independent of the discount rate.

The NPV is a dollar number whilst the IRR is a percentage. As a result when comparing investment opportunities the IRR method will direct you to the project with the highest percentage return, whilst the NPV will direct you to the project with the highest absolute return.

> *"The IRR method always prefers a 500% return on a $1 investment compared to a 20% return on $100…few would argue in favor of the IRR preference…Most individuals, as is true of most firms, have goals which are set out in terms of absolute returns, and not in percentage terms. And since the NPV reflects absolute returns, this ensures optimality when mutually exclusive choice situations arise." Levy & Sarnat*

The final decision making must take account of affordability within the capital program as these methods do not account for an organization's financial state.

As mentioned above, Payback Period is another calculation associated with business cases and investment decisions however this has no mechanism to take account of the time value of money. It is strongly advised not to consider Payback Period when making investment decisions but instead use the Net Present Value method.

Worked Example (from Levy & Sarnat):

	Year 0	Year 1	Year 2	Year 3
Project A – Capital Cost	1,000			
Operating Cost		-505	-505	-505
Project B – Capital Cost	11,000			
Operating Cost		-5,000	-5,000	-5,000

Assuming a 10% discount rate (accounting for inflation and interest rates), that is if we assume that the organization can acquire funds or find alternative uses for funds at 10%.

$$NPV\ Project\ A = 1{,}000 + \frac{-505}{(1+10\%)^1} + \frac{-505}{(1+10\%)^2} + \frac{-505}{(1+10\%)^3} = -256$$

$$NPV\ Project\ B = 11{,}000 + \frac{-5{,}000}{(1+10\%)^1} + \frac{-5{,}000}{(1+10\%)^2} + \frac{-5{,}000}{(1+10\%)^3} = -1{,}434$$

Now to compare the NPV and IRR methods; the IRR prefers Project A due to the higher IRR % however the NPV method preference Project B due to the higher value benefit presented over the duration of the investment.

	IRR	NPV
Project A	<u>24%</u>	256
Project B	17%	<u>1,434</u>

NPV and Microsoft Excel:

Excel has a specific function to do NPV calculations; simply specify the discount rate and the group of cells to be included in the analysis. It is important to note; the NPV function ignores blanks so you must put zeros in empty columns in your timeline to ensure that year is counted.

With regard to selecting the preferred option, we are primarily interested in the **Net Present Cost (NPC)** of our intervention options. This is exactly the same as NPV except that we are looking for the lowest cost option rather than the highest value option.

Source: Capital Investment & Financial Decisions by Levy & Sarnat, Fifth Edition

Appendix K
West Regional Wastewater

West Regional Wastewater Pipeline Capital Cost Estimate Breakdown

West Regional Wastewater Options Triple Bottom Line Notes

West Regional Wastewater Pipeline Capital Cost Estimate Breakdown		
Description		**Total Amount**
CONSTRUCTION COST:		
Part A: SEWER (BY GRAVITY AND BY FORCEMAIN), APPURTENANCES AND PUMP STATIONS		$ 18,217,000.00
Part B: RESTORATION		$ 681,000.00
Part C: MISCELLANEOUS ITEMS		$ 1,078,000.00
Part D: PROVISIONAL ITEMS		$ 2,910,000.00
Sub-Total of Part A to D		**$ 22,886,000.00**
Escalation to Mid-Point of Construction at 5.82%		**$ 1,332,000.00**
TOTAL CONSTRUCTION COST (Excluding PST and GST)		**$ 24,218,000.00**
NON-CONSTRUCTION COST:		
Part A: ENGINEERING	12%	$ 2,906,160.00
Part B: ADMINISTRATION	3%	$ 726,540.00
Part C: MISCELLANEOUS	2%	$ 484,360.00
TOTAL NON-CONSTRUCTION COST (Excluding PST and GST)		**$ 4,117,060.00**
TOTAL CAPITAL COST (Excluding PST and GST)		**$ 28,335,060.00**

TOTAL CAPITAL COST (Including PST and GST)	**$ 31,168,566.00**

Appendix K - West Regional Wastewater Options Triple Bottom Line Notes

	Benefits Evaluation Criteria																		
	Economic						Social						Environmental						Other Notes
Option	Minimizes Construction Risk (Financial over run, complications…)	RAG	Minimizes Deliverability Risk (delay in time to activate)	RAG	Minimizes Staffing Risk (attracting the right people + knowledge)	RAG	Flexibility to supports / facilitate future growth	RAG	Minimizes Construction Disruption on Communities	RAG	Minimizes Operational Nuisance (Noise, Odour, Visual, Traffic etc.)	RAG	Meets Effluent Quality Improves Quality and/or Reliability	RAG	Minimizes Construction Disruption on Environment	RAG	Maximizes opportunities for diversified bio solids reuse	RAG	
Local Lagoon Upgrades	Lagoon expansions simple to build with low construction risk. Belle Plain and Pense land is relatively affordable and available. Zoning maps in OCPs are potentially incorrect.	G	Stakeholders feel delay risk is low for lagoon expansion. Local farmers would be impacted - timing, crops etc. Would need to acquire land. Will take time.	G	Lagoons simple to operate and would use existing processes and staff. Minimal risk.	G	Lagoons provide only a limited amount of future growth before the same capacity problems would arise. Particular problem for Grand Coulee. Zoning maps in OCPs are potentially incorrect.	A	Site is far enough from the populations that construction will cause minimal disruption to communities. Local farmers would be impacted - timing, crops etc. Would need to acquire land. Will take time. Amber for Grand Coulee. Green for Belle Plaine and Pense.	A	Site is far enough from the populations that operations will cause minimal disruption to communities.	G	Grand Coulee - now completely gravity system, Wastewater going to the lagoons level has been reduced, less flow due to extraction of storm water. At least 40% reduction, only operating pumps 3-4 hours per day. Belle Plaine - big drainage improvements have changed demand. Lagoon expansions at risk of not meeting future regulatory requirements.	G	Short term construction will cause environmental disruption, with more land required, but potential for longer term benefit. Opportunity for more marsh land and duck sanctuaries. Potentially increase wetlands area benefit.	G	Lagoons offer minimal opportunity for biosolids reuse. Potentially dredge lagoons and utilize some biosolids.	R	Operational cost will be high. Potential in long term to sell effluent to local potash, but that's unstable.
Regional Pipeline	Low growth rates in communities with low populations makes this option more challenging to fund. Potentially a lot of RM acreages being developed.	R	High risks associated with time delays due to number of stakeholders/parties involved. Must have the RMs of Pense and Sherwood involved; they control all planning etc. Need to pick a date for communities to move on regional solution so that people don't invest locally unnecessarily. Likely 5-8 years away, and communities would need an interim solution. If interim solutions are not feasible for this length of time then this option might be invalid.	R	Assuming treatment is resourced with the City of Regina this option provides a very simple operation for the regional communities. No treatment knowledge is required at the local communities, simply pump and pipe, operation and maintenance.	G	Peak flows can be managed by using existing lagoons for storage and pumping at off peak times, future supporting future growth. Could potentially release land for development if lagoons can be decommissioned.	G	Work can be done with minimal disruption to roads and traffic.	G	Very simple operation for regional stakeholder and communities will have very limited problems.	G	Central treatment plant will treat effluent to a high quality. Reliability of central treatment plant will be higher than smaller local plants with limited resources.	G	Disruption to environment in digging trenches for pipeline. Would lose wetland marsh and duck sanctuary in Grand Coulee. Amber for Grand Coulee. Green Pense and Belle Plaine	A	Central treatment plant with larger treatment volumes provides a much greater opportunity for biosolids reuse.	G	
Grand Coulee GTH link	Estimate length ~2 miles / ~3.5 km pipe to connect Grand Coulee with Global Transportation Hub (GTH).	G	Risks associated with time delays due to number of stakeholders/parties involved; RM of Sherwood, GTH, City of Regina, and Grand Coulee.	A	Assuming treatment is resourced with the City of Regina this option provides a very simple operation for the regional communities. No treatment knowledge is required at the local communities, simply pump and pipe, operation and maintenance.	G	Limited capacity in GTH pumping station that is managed by the City of Regina, designed to specifically service GTH requirements. Grand Coulee could potentially keep their lagoons if necessary. GTH growth will cause Grand Coulee growth which will further challenge capacity.	A	Minimal disruption on Grand Coulee and GTH.	G	Very simple operation for regional stakeholder and communities will have very limited problems.	G	Central treatment plant will treat effluent to a high quality. Reliability of central treatment plant will be higher than smaller local plants with limited resources.	G	Disruption to environment in digging trenches for pipeline, however it is a very short length of pipe. Would lose wetland marsh and duck sanctuary in Grand Coulee. Amber for Grand Coulee. Green Pense and Belle Plaine	A	Central treatment plant with larger treatment volumes provides a much greater opportunity for biosolids reuse.	G	

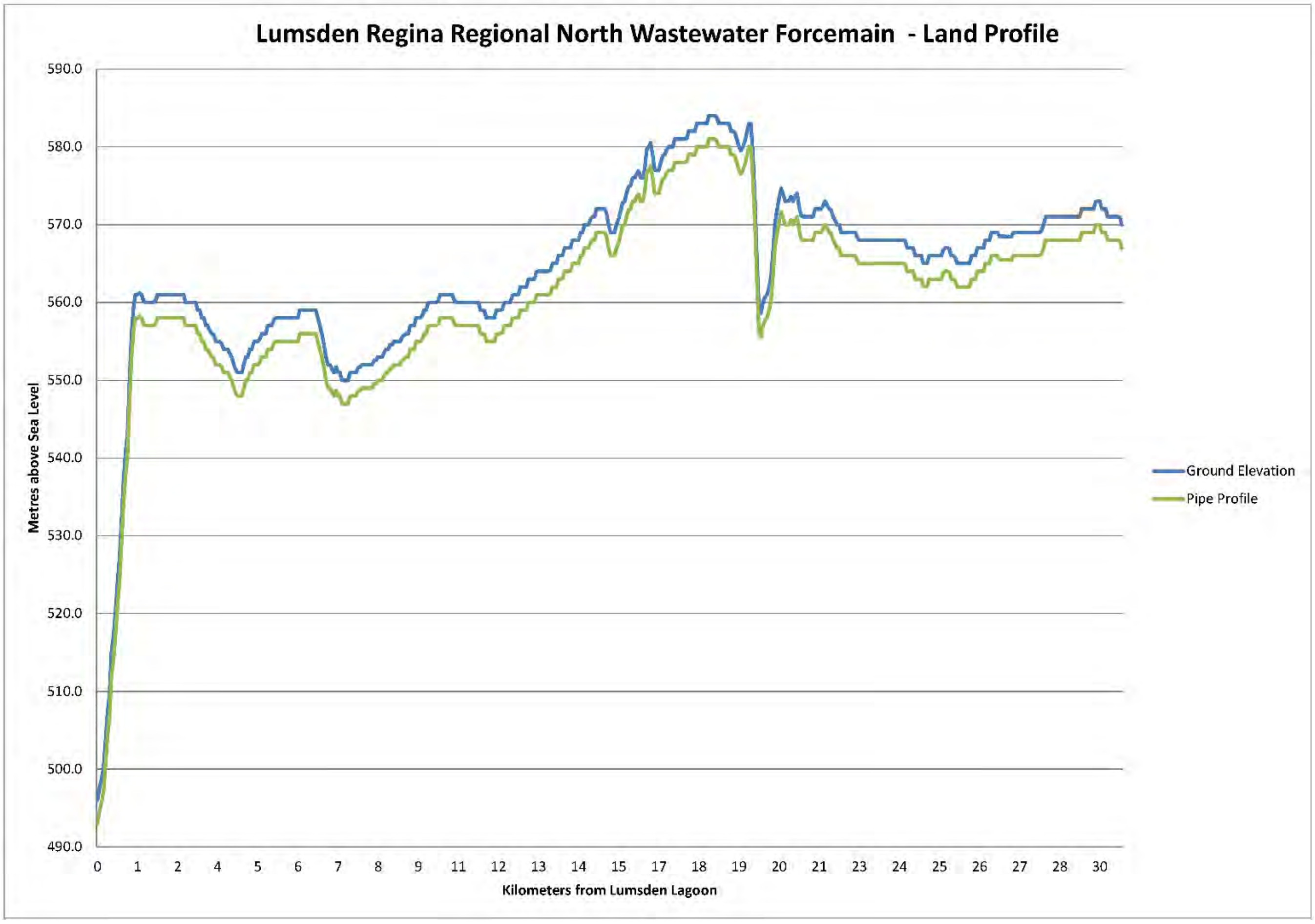
Appendix L
North Regional Wastewater

North Regional Wastewater Pipeline Profile Breakdown

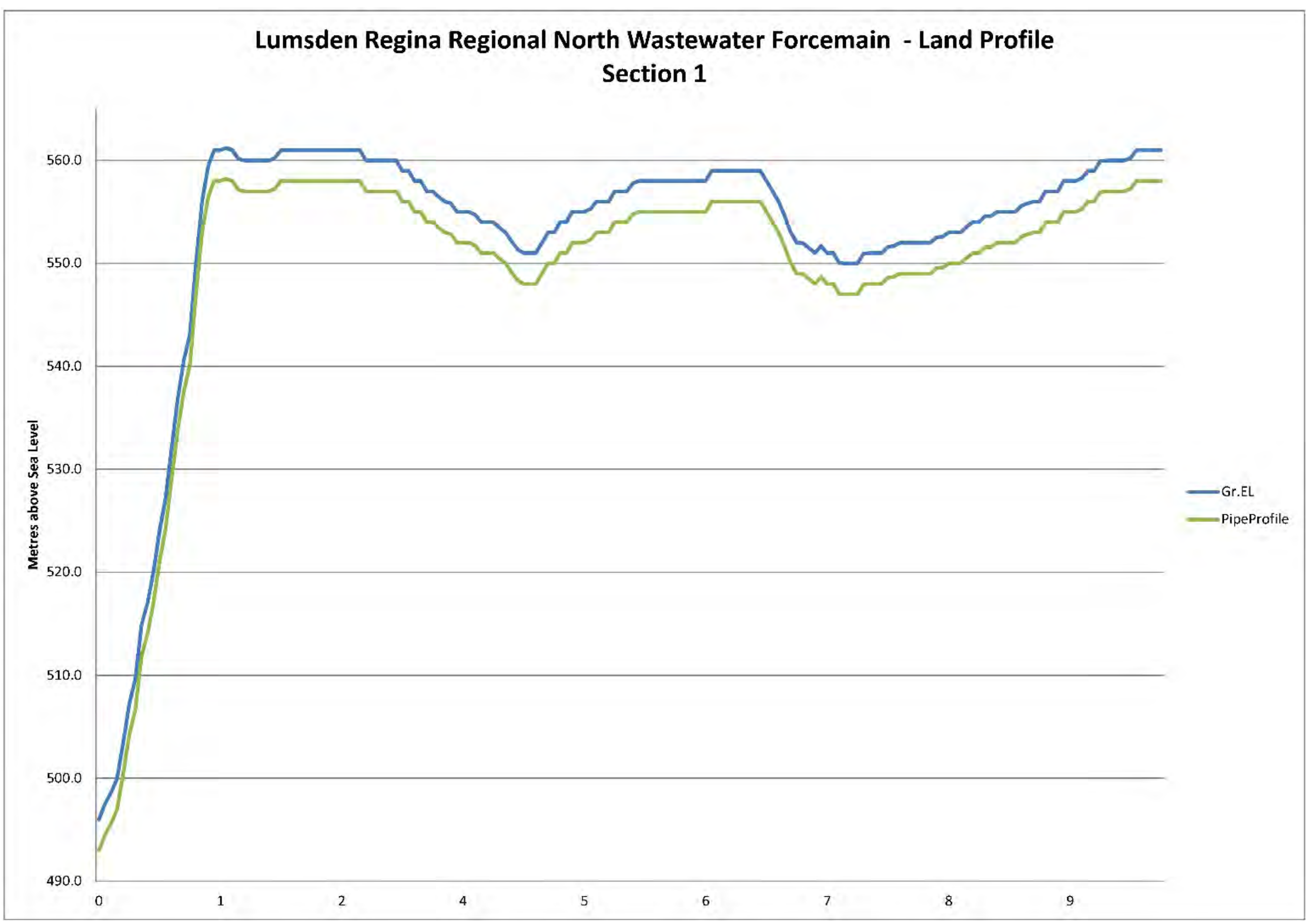
North Regional Wastewater Pipeline Capital Cost Estimate Breakdown

North Regional Wastewater Pipeline Operating, Maintenance and Replacement Costs across 30 Years

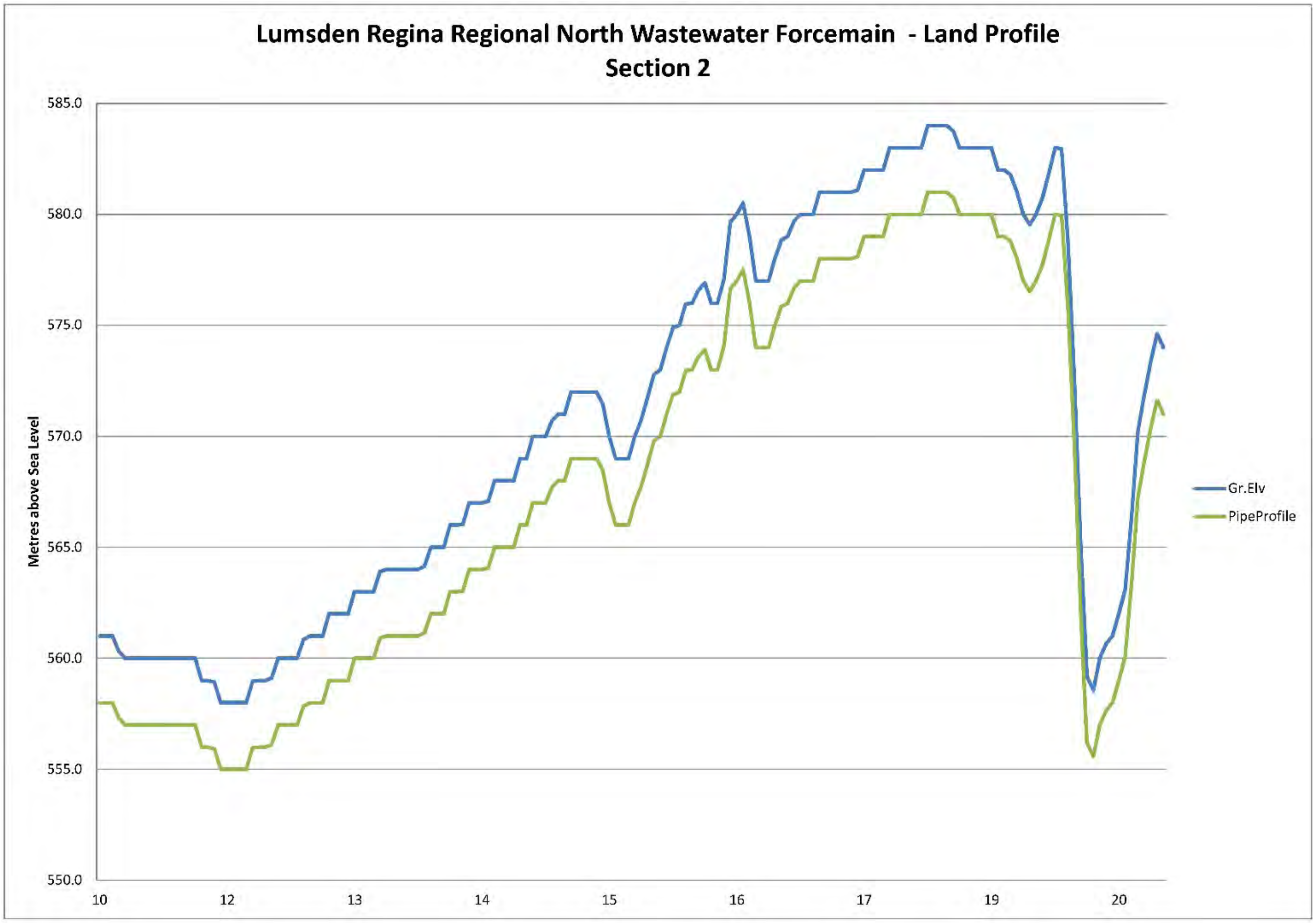
Revised Lumsden Local Wastewater Treatment Plant Operating, Maintenance and Replacement Costs across 30 Years



Lumsden Regina Regional North Wastewater Forcemain - Land Profile
590.0
580.0
570.0
560.0
550.0
540.0
530.0
520.0
510.0
500.0
490.0
Metres above Sea Level
0 1 2 4 5 6 7 8 9 11 12 13 14 15 17 18 19 20 21 23 24 25 26 27 28 30
Kilometers from Lumsden Lagoon
Ground Elevation
Pipe Profile



Lumsden Regina Regional North Wastewater Forcemain - Land Profile
Section 1
560.0
550.0
540.0
530.0
520.0
510.0
500.0
490.0
Metres above Sea Level
0 1 2 4 5 6 7 8 9
Gr.EL
PipeProfile


Lumsden Regina Regional North Wastewater Forcemain - Land Profile
Section 2
Metres above Sea Level
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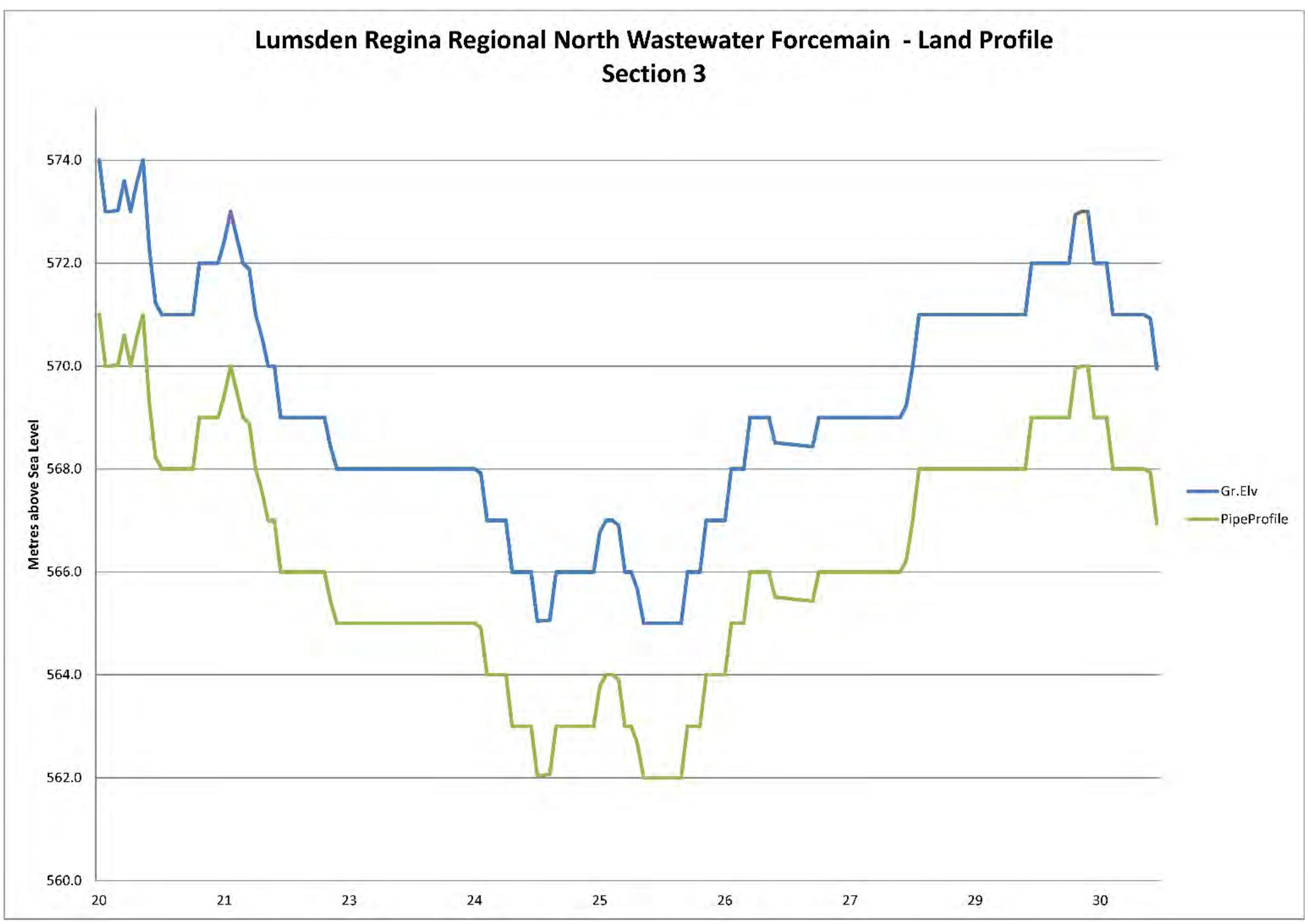
580.0
575.0
570.0
565.0
560.0
555.0
550.0
10
12
13
14
15
16
17
19
20
Gr.Elv
PipeProfile


Lumsden Regina Regional North Wastewater Forcemain - Land Profile
Section 3
Metres above Sea Level
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570.0
568.0
566.0
564.0
562.0
560.0
20
21
23
24
25
26
27
29
30
Gr.Elv
PipeProfile

North Regional Wastewater Pipeline Capital Cost Estimate Breakdown

Description		Total Amount
CONSTRUCTION COST:		
Part A: SEWER FORCEMAIN, APPURTENANCES AND PUMP STATION		$ 17,734,000.00
Part B: RESTORATION		$ 740,000.00
Part C: MISCELLANEOUS ITEMS		$ 965,000.00
Part D: PROVISIONAL ITEMS		$ 2,839,000.00
Sub-Total of Part A to D		**$ 22,278,000.00**
Escalation to Mid-Point of Construction at 4.28%		**$ 953,000.00**
TOTAL CONSTRUCTION COST (Excluding PST and GST)		**$ 23,231,000.00**
NON-CONSTRUCTION COST:		
Part A: ENGINEERING	12%	$ 2,787,720.00
Part B: ADMINISTRATION	3%	$ 696,930.00
Part C: MISCELLANEOUS	2%	$ 464,620.00
TOTAL NON-CONSTRUCTION COST (Excluding GST)		**$ 3,949,270.00**
TOTAL CAPITAL COST (Excluding GST)		**$ 27,180,270.00**

TOTAL CAPITAL COST (Including GST)	**$ 28,539,283.50**

North Regional Wastewater Pipeline Operating, Maintenance, and Replacement Costs across 30 Years

1.04	Exchange Rate (CAD/USD)
4%	Discount Rate
2%	Growth Rate of AAF

Total NPV = **$ 26,883,213**

O&M NPV = **$ 3,652,213**

Capital Costs include Engineering and other Non-Construction Costs

	Capital		Labor		Power		Maintenance		Replacement		Administration		**TOTAL**	
Year	Capital Expenditure	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV
2014	$ 23,231,000	$ 23,231,000	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 23,231,000	$ 23,231,000
2015	$ -	$ -	$ 6,552	$ 6,300	$ 102,957	$ 98,997	$ 40,527	$ 38,968	$ -		$ 15,150	$ 14,567	$ 165,185	$ 158,832
2016	$ -	$ -	$ 6,552	$ 6,057	$ 105,016	$ 97,093	$ 41,492	$ 38,361	$ -		$ 15,150	$ 14,007	$ 168,209	$ 155,519
2017	$ -	$ -	$ 6,552	$ 5,824	$ 107,116	$ 95,226	$ 42,456	$ 37,744	$ -		$ 15,150	$ 13,468	$ 171,274	$ 152,262
2018	$ -	$ -	$ 6,552	$ 5,600	$ 109,259	$ 93,395	$ 43,421	$ 37,117	$ 3,372		$ 15,150	$ 12,950	$ 177,753	$ 151,944
2019	$ -	$ -	$ 6,552	$ 5,385	$ 111,444	$ 91,599	$ 44,386	$ 36,482	$ 3,338		$ 15,150	$ 12,452	$ 180,869	$ 148,661
2020	$ -	$ -	$ 6,552	$ 5,178	$ 113,673	$ 89,837	$ 45,351	$ 35,842	$ 3,304		$ 15,150	$ 11,973	$ 184,030	$ 145,442
2021	$ -	$ -	$ 6,552	$ 4,979	$ 115,946	$ 88,109	$ 46,316	$ 35,196	$ 3,271		$ 15,150	$ 11,513	$ 187,235	$ 142,283
2022	$ -	$ -	$ 6,552	$ 4,787	$ 118,265	$ 86,415	$ 47,281	$ 34,548	$ 3,239		$ 15,150	$ 11,070	$ 190,486	$ 139,186
2023		$ -	$ 6,552	$ 4,603	$ 120,631	$ 84,754	$ 48,246	$ 33,897	$ 3,206		$ 15,150	$ 10,644	$ 193,785	$ 136,150
2024	$ -	$ -	$ 6,552	$ 4,426	$ 123,043	$ 83,123	$ 40,527	$ 27,378	$ 34,917		$ 15,150	$ 10,235	$ 220,188	$ 148,751
2025	$ -	$ -	$ 6,552	$ 4,256	$ 125,504	$ 81,525	$ 50,176	$ 32,593	$ 31,076		$ 15,150	$ 9,841	$ 228,457	$ 148,401
2026	$ -	$ -	$ 6,552	$ 4,092	$ 128,014	$ 79,957	$ 51,141	$ 31,942	$ 27,657		$ 15,150	$ 9,462	$ 228,513	$ 142,729
2027	$ -	$ -	$ 6,552	$ 3,935	$ 130,574	$ 78,419	$ 52,106	$ 31,293	$ 24,615		$ 15,150	$ 9,099	$ 228,996	$ 137,529
2028	$ -	$ -	$ 6,552	$ 3,783	$ 133,186	$ 76,912	$ 53,071	$ 30,647	$ 21,907		$ 15,150	$ 8,749	$ 229,865	$ 132,741
2029	$ -	$ -	$ 6,552	$ 3,638	$ 135,850	$ 75,433	$ 54,035	$ 30,004	$ 19,498		$ 15,150	$ 8,412	$ 231,084	$ 128,313
2030	$ -	$ -	$ 6,552	$ 3,498	$ 138,567	$ 73,982	$ 55,000	$ 29,365	$ 17,353		$ 15,150	$ 8,089	$ 232,622	$ 124,199
2031	$ -	$ -	$ 6,552	$ 3,363	$ 141,338	$ 72,559	$ 55,965	$ 28,731	$ 15,444		$ 15,150	$ 7,777	$ 234,449	$ 120,360
2032	$ -	$ -	$ 6,552	$ 3,234	$ 144,165	$ 71,164	$ 56,930	$ 28,102	$ 13,745		$ 15,150	$ 7,478	$ 236,542	$ 116,764
2033	$ -	$ -	$ 6,552	$ 3,110	$ 147,048	$ 69,795	$ 57,895	$ 27,479	$ 12,233		$ 15,150	$ 7,191	$ 238,878	$ 113,381
2034	$ -	$ -	$ 6,552	$ 2,990	$ 149,989	$ 68,453	$ 58,860	$ 26,863	$ 10,888		$ 15,150	$ 6,914	$ 241,438	$ 110,189
2035	$ -	$ -	$ 6,552	$ 2,875	$ 152,989	$ 67,137	$ 59,825	$ 26,253	$ 9,690		$ 15,150	$ 6,648	$ 244,205	$ 107,165
2036	$ -	$ -	$ 6,552	$ 2,764	$ 156,048	$ 65,845	$ 60,790	$ 25,651	$ 21,907		$ 15,150	$ 6,392	$ 260,447	$ 109,897
2037	$ -	$ -	$ 6,552	$ 2,658	$ 159,169	$ 64,579	$ 61,755	$ 25,056	$ 19,498		$ 15,150	$ 6,147	$ 262,123	$ 106,350
2038	$ -	$ -	$ 6,552	$ 2,556	$ 162,353	$ 63,337	$ 62,720	$ 24,468	$ 17,353		$ 15,150	$ 5,910	$ 264,127	$ 103,042
2039	$ -	$ -	$ 6,552	$ 2,458	$ 165,600	$ 62,119	$ 63,685	$ 23,889	$ 15,444		$ 15,150	$ 5,683	$ 266,430	$ 99,942
2040	$ -	$ -	$ 6,552	$ 2,363	$ 168,912	$ 60,925	$ 64,649	$ 23,318	$ 13,745		$ 15,150	$ 5,464	$ 269,008	$ 97,028
2041	$ -	$ -	$ 6,552	$ 2,272	$ 172,290	$ 59,753	$ 65,614	$ 22,756	$ 12,233		$ 15,150	$ 5,254	$ 271,839	$ 94,278
2042	$ -	$ -	$ 6,552	$ 2,185	$ 175,736	$ 58,604	$ 66,579	$ 22,203	$ 10,888		$ 15,150	$ 5,052	$ 274,904	$ 91,674
2043	$ -	$ -	$ 6,552	$ 2,101	$ 179,251	$ 57,477	$ 67,544	$ 21,658	$ 9,690		$ 15,150	$ 4,858	$ 278,186	$ 89,201

Revised Lumsden Local Wastewater Treatment Plant Operating, Maintenance, and Replacement Costs across 30 Years

1.04	Exchange Rate (CAD/USD)
4%	Discount Rate
2%	Growth Rate of AAF

Total NPV = $ 15,491,880
Total O&M = $ 4,689,880

Capital Costs include Engineering and other Non-Construction Costs

	Capital		Labor		Power		Chemicals		Solids		Maintenance		Replacement		Other Direct Costs		**TOTAL**	
Year	Capital Expenditure	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV
2014	$ 10,802,000	$ 10,802,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,802,000	$ 10,802,000
2015	$ -	$ -	$ 88,296	$ 84,900	$ 28,655	$ 27,553	$ 10,311	$ 9,914	$ 5,023	$ 4,830	$ 45,871	$ 44,106	$ -	$ -	$ 40,315	$ 38,764	$ 218,470	$ 210,068
2016	$ -	$ -	$ 88,296	$ 81,635	$ 28,782	$ 26,610	$ 10,517	$ 9,723	$ 5,124	$ 4,737	$ 46,963	$ 43,420	$ -	$ -	$ 40,315	$ 37,273	$ 219,996	$ 203,399
2017	$ -	$ -	$ 88,296	$ 78,495	$ 28,911	$ 25,702	$ 10,727	$ 9,536	$ 5,226	$ 4,646	$ 48,055	$ 42,721	$ -	$ -	$ 40,315	$ 35,840	$ 221,530	$ 196,940
2018	$ -	$ -	$ 88,296	$ 75,476	$ 29,043	$ 24,826	$ 10,942	$ 9,353	$ 5,331	$ 4,557	$ 49,147	$ 42,011	$ 35	$ 30	$ 40,315	$ 34,461	$ 223,109	$ 190,714
2019	$ -	$ -	$ 88,296	$ 72,573	$ 29,178	$ 23,982	$ 11,161	$ 9,173	$ 5,438	$ 4,469	$ 50,239	$ 41,293	$ 448	$ 368	$ 40,315	$ 33,136	$ 225,074	$ 184,994
2020	$ -	$ -	$ 88,296	$ 69,782	$ 29,315	$ 23,168	$ 11,384	$ 8,997	$ 5,546	$ 4,383	$ 51,331	$ 40,568	$ 1,908	$ 1,508	$ 40,315	$ 31,861	$ 228,095	$ 180,267
2021	$ -	$ -	$ 88,296	$ 67,098	$ 29,455	$ 22,383	$ 11,611	$ 8,824	$ 5,657	$ 4,299	$ 52,423	$ 39,837	$ 7,044	$ 5,353	$ 40,315	$ 30,636	$ 234,802	$ 178,431
2022	$ -	$ -	$ 88,296	$ 64,517	$ 29,598	$ 21,627	$ 11,844	$ 8,654	$ 5,770	$ 4,216	$ 53,516	$ 39,103	$ 22,200	$ 16,221	$ 40,315	$ 29,458	$ 251,538	$ 183,796
2023	$ -	$ -	$ 88,296	$ 62,036	$ 29,744	$ 20,897	$ 12,081	$ 8,488	$ 5,886	$ 4,135	$ 54,608	$ 38,367	$ 54,936	$ 38,598	$ 40,315	$ 28,325	$ 285,865	$ 200,845
2024	$ -	$ -	$ 88,296	$ 59,650	$ 29,892	$ 20,194	$ 12,322	$ 8,324	$ 6,004	$ 4,056	$ 55,700	$ 37,629	$ 82,608	$ 55,807	$ 40,315	$ 27,235	$ 315,136	$ 212,895
2025	$ -	$ -	$ 88,296	$ 57,355	$ 30,044	$ 19,516	$ 12,569	$ 8,164	$ 6,124	$ 3,978	$ 56,792	$ 36,891	$ 81,424	$ 52,892	$ 40,315	$ 26,188	$ 315,563	$ 204,984
2026	$ -	$ -	$ 88,296	$ 55,149	$ 30,198	$ 18,862	$ 12,820	$ 8,007	$ 6,246	$ 3,901	$ 57,884	$ 36,154	$ 40,665	$ 25,399	$ 40,315	$ 25,181	$ 276,424	$ 172,654
2027	$ -	$ -	$ 88,296	$ 53,028	$ 30,356	$ 18,231	$ 13,076	$ 7,853	$ 6,371	$ 3,826	$ 58,976	$ 35,420	$ 38,545	$ 23,149	$ 40,315	$ 24,212	$ 275,936	$ 165,720
2028	$ -	$ -	$ 88,296	$ 50,989	$ 30,517	$ 17,623	$ 13,338	$ 7,702	$ 6,498	$ 3,753	$ 60,068	$ 34,688	$ 52,128	$ 30,103	$ 40,315	$ 23,281	$ 291,160	$ 168,138
2029	$ -	$ -	$ 88,296	$ 49,028	$ 30,681	$ 17,036	$ 13,605	$ 7,554	$ 6,628	$ 3,681	$ 61,161	$ 33,960	$ 68,789	$ 38,196	$ 40,315	$ 22,385	$ 309,475	$ 171,840
2030	$ -	$ -	$ 88,296	$ 47,142	$ 30,848	$ 16,470	$ 13,877	$ 7,409	$ 6,761	$ 3,610	$ 62,253	$ 33,237	$ 72,801	$ 38,869	$ 40,315	$ 21,524	$ 315,151	$ 168,261
2031	$ -	$ -	$ 88,296	$ 45,329	$ 31,019	$ 15,924	$ 14,154	$ 7,266	$ 6,896	$ 3,540	$ 63,345	$ 32,520	$ 63,588	$ 32,644	$ 40,315	$ 20,697	$ 307,613	$ 157,920
2032	$ -	$ -	$ 88,296	$ 43,585	$ 31,193	$ 15,398	$ 14,437	$ 7,127	$ 7,034	$ 3,472	$ 64,437	$ 31,808	$ 64,859	$ 32,016	$ 40,315	$ 19,901	$ 310,572	$ 153,307
2033	$ -	$ -	$ 88,296	$ 41,909	$ 31,371	$ 14,890	$ 14,726	$ 6,990	$ 7,175	$ 3,405	$ 65,529	$ 31,103	$ 77,411	$ 36,742	$ 40,315	$ 19,135	$ 324,822	$ 154,175
2034	$ -	$ -	$ 88,296	$ 40,297	$ 31,552	$ 14,400	$ 15,021	$ 6,855	$ 7,318	$ 3,340	$ 66,621	$ 30,405	$ 82,553	$ 37,676	$ 40,315	$ 18,399	$ 331,676	$ 151,372
2035	$ -	$ -	$ 88,296	$ 38,747	$ 31,737	$ 13,927	$ 15,321	$ 6,723	$ 7,465	$ 3,276	$ 67,713	$ 29,715	$ 69,765	$ 30,615	$ 40,315	$ 17,691	$ 320,611	$ 140,695
2036	$ -	$ -	$ 88,296	$ 37,257	$ 31,925	$ 13,471	$ 15,628	$ 6,594	$ 7,614	$ 3,213	$ 68,806	$ 29,033	$ 45,281	$ 19,106	$ 40,315	$ 17,011	$ 297,864	$ 125,685
2037	$ -	$ -	$ 88,296	$ 35,824	$ 32,117	$ 13,031	$ 15,940	$ 6,467	$ 7,766	$ 3,151	$ 69,898	$ 28,359	$ 30,649	$ 12,435	$ 40,315	$ 16,357	$ 284,981	$ 115,624
2038	$ -	$ -	$ 88,296	$ 34,446	$ 32,313	$ 12,606	$ 16,259	$ 6,343	$ 7,922	$ 3,090	$ 70,990	$ 27,695	$ 25,357	$ 9,892	$ 40,315	$ 15,728	$ 281,451	$ 109,800
2039	$ -	$ -	$ 88,296	$ 33,121	$ 32,513	$ 12,196	$ 16,584	$ 6,221	$ 8,080	$ 3,031	$ 72,082	$ 27,039	$ 38,245	$ 14,346	$ 40,315	$ 15,123	$ 296,115	$ 111,078
2040	$ -	$ -	$ 88,296	$ 31,847	$ 32,717	$ 11,801	$ 16,916	$ 6,101	$ 8,242	$ 2,973	$ 73,174	$ 26,393	$ 56,413	$ 20,348	$ 40,315	$ 14,541	$ 316,073	$ 114,004
2041	$ -	$ -	$ 88,296	$ 30,623	$ 32,925	$ 11,419	$ 17,254	$ 5,984	$ 8,406	$ 2,915	$ 74,266	$ 25,757	$ 77,717	$ 26,953	$ 40,315	$ 13,982	$ 339,180	$ 117,633
2042	$ -	$ -	$ 88,296	$ 29,445	$ 33,138	$ 11,051	$ 17,599	$ 5,869	$ 8,575	$ 2,859	$ 75,358	$ 25,130	$ 101,208	$ 33,751	$ 40,315	$ 13,444	$ 364,489	$ 121,549
2043	$ -	$ -	$ 88,296	$ 28,312	$ 33,354	$ 10,695	$ 17,951	$ 5,756	$ 8,746	$ 2,804	$ 76,451	$ 24,514	$ 118,768	$ 38,083	$ 40,315	$ 12,927	$ 383,881	$ 123,092

Appendix M
East Regional Wastewater Pipeline

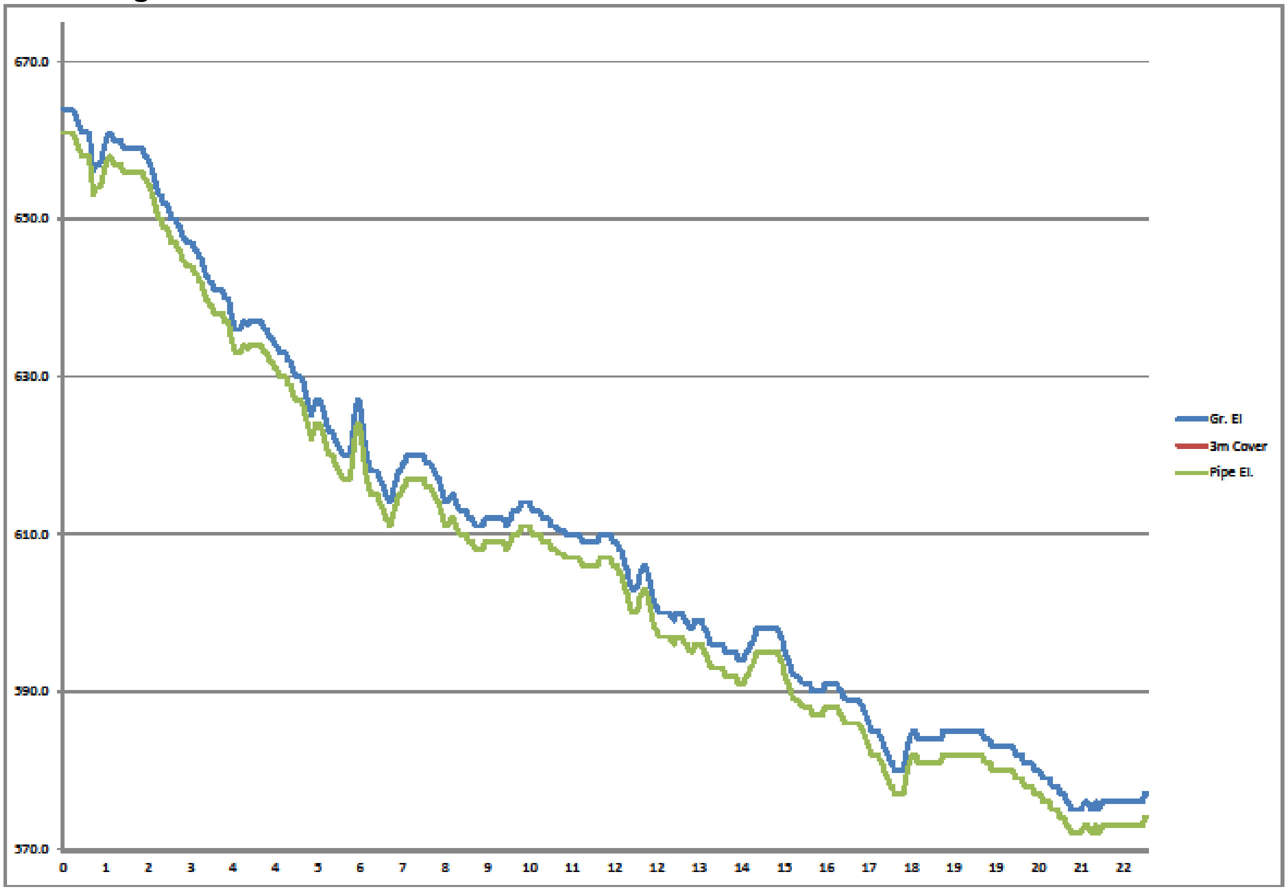
East Regional Wastewater Pipeline Profile Breakdown

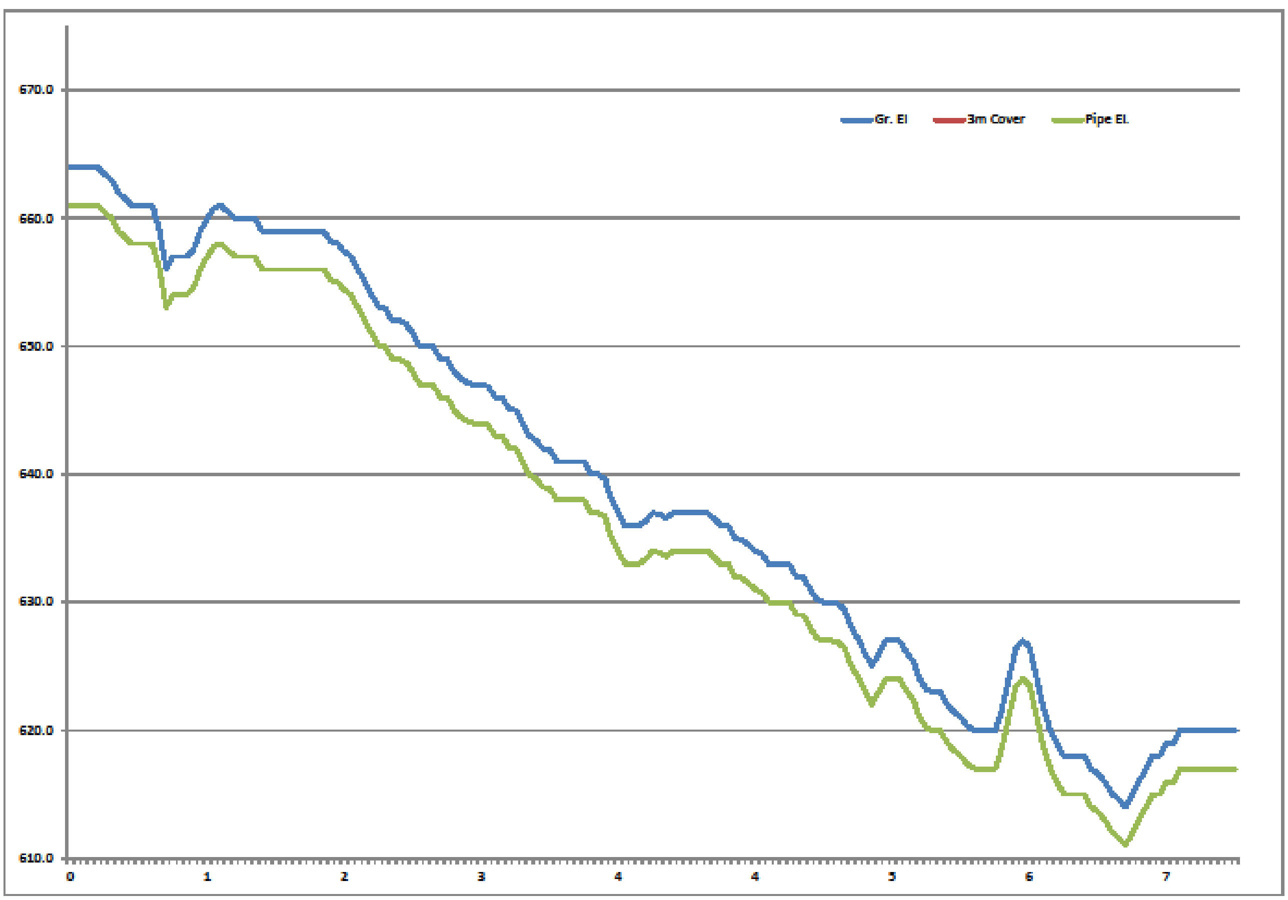
East Regional Wastewater Pipeline Capital Cost Estimate Breakdown

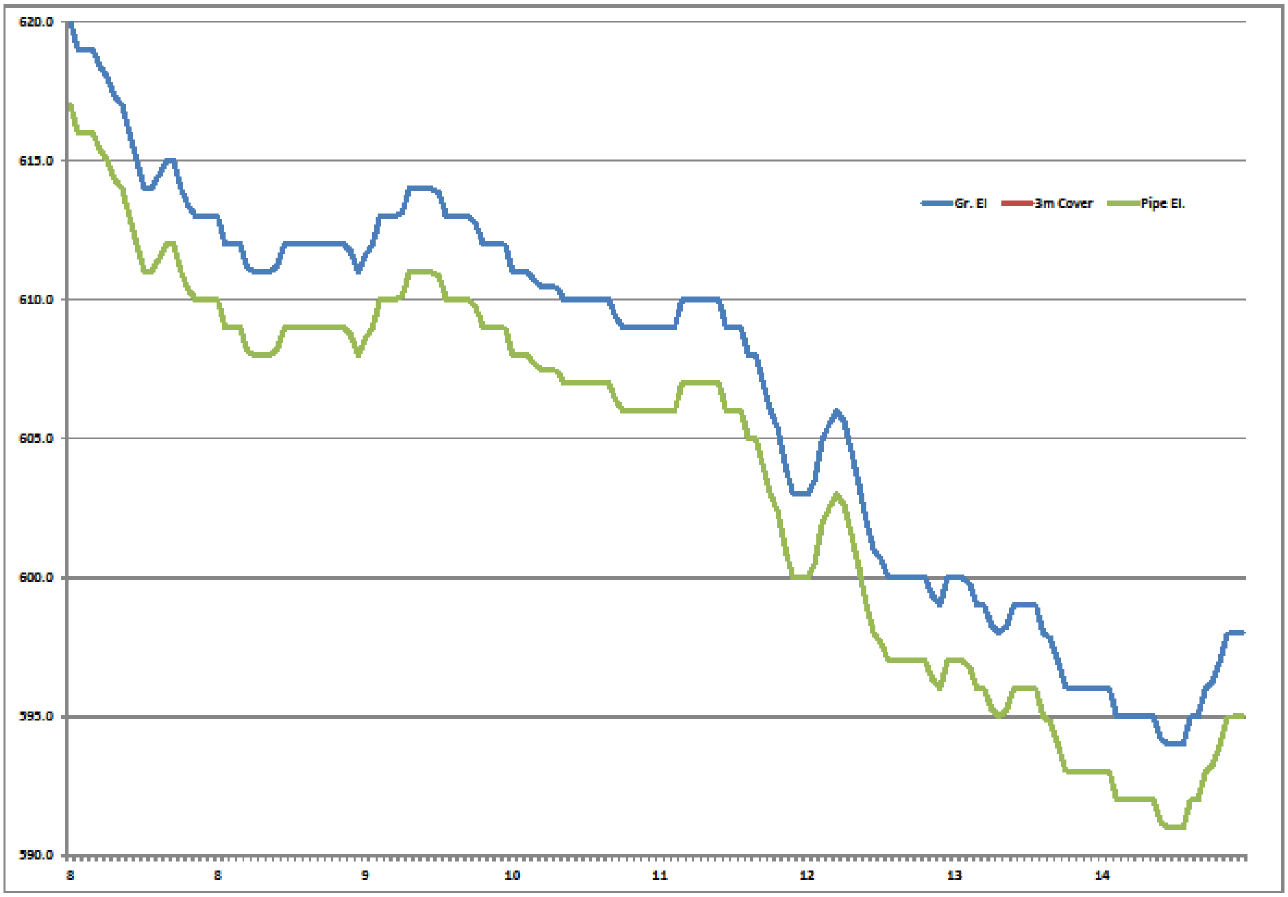
East Regional Wastewater Pipeline Operating, Maintenance and Replacement Costs across 30 Years

East Regional Wastewater Options Triple Bottom Line Notes

East Regional FM






620.0
615.0
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600.0
595.0
590.0
Gr. El
3m Cover
Pipe El.
8
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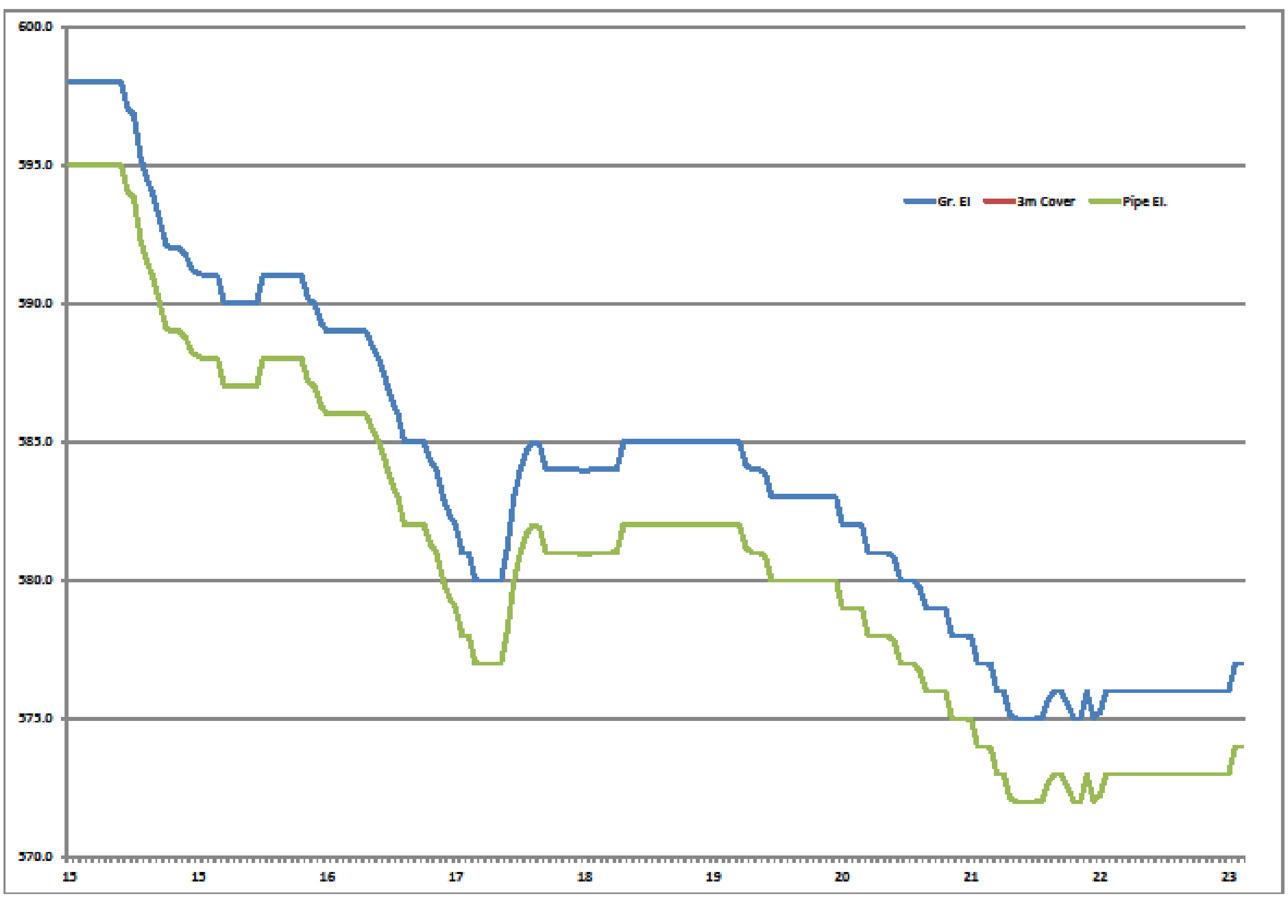
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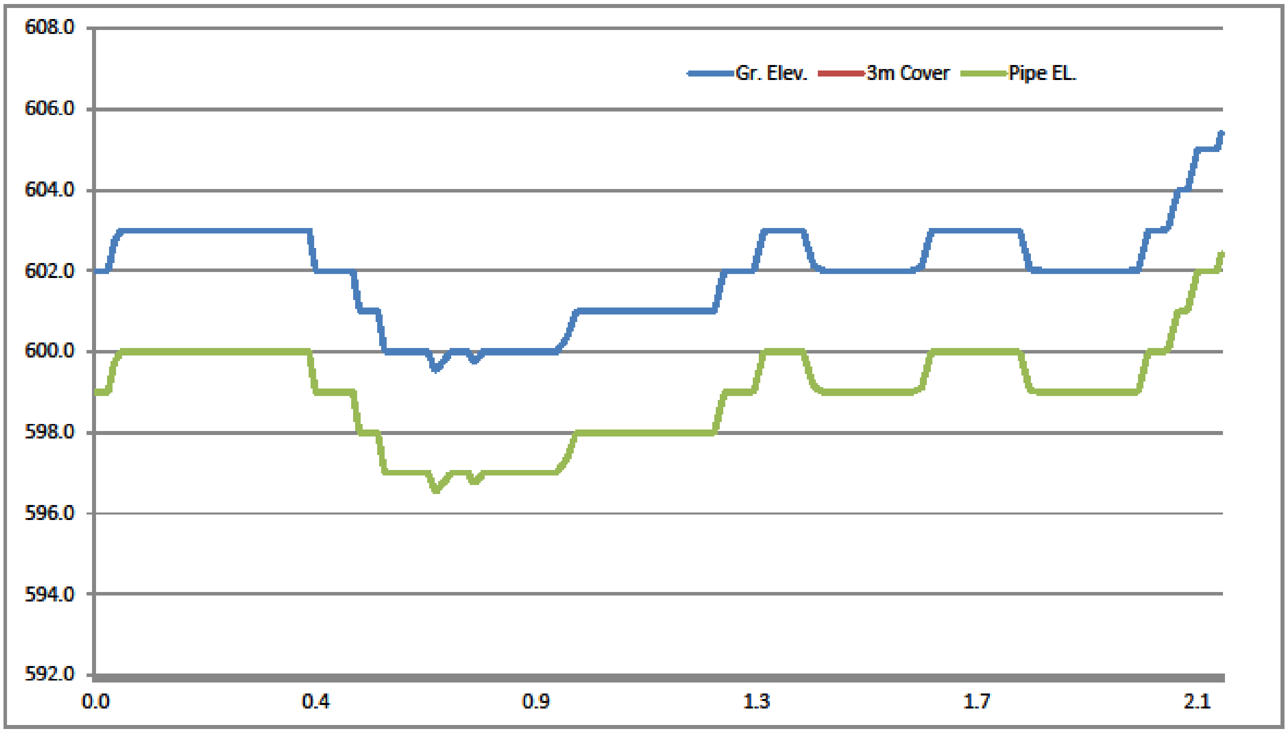
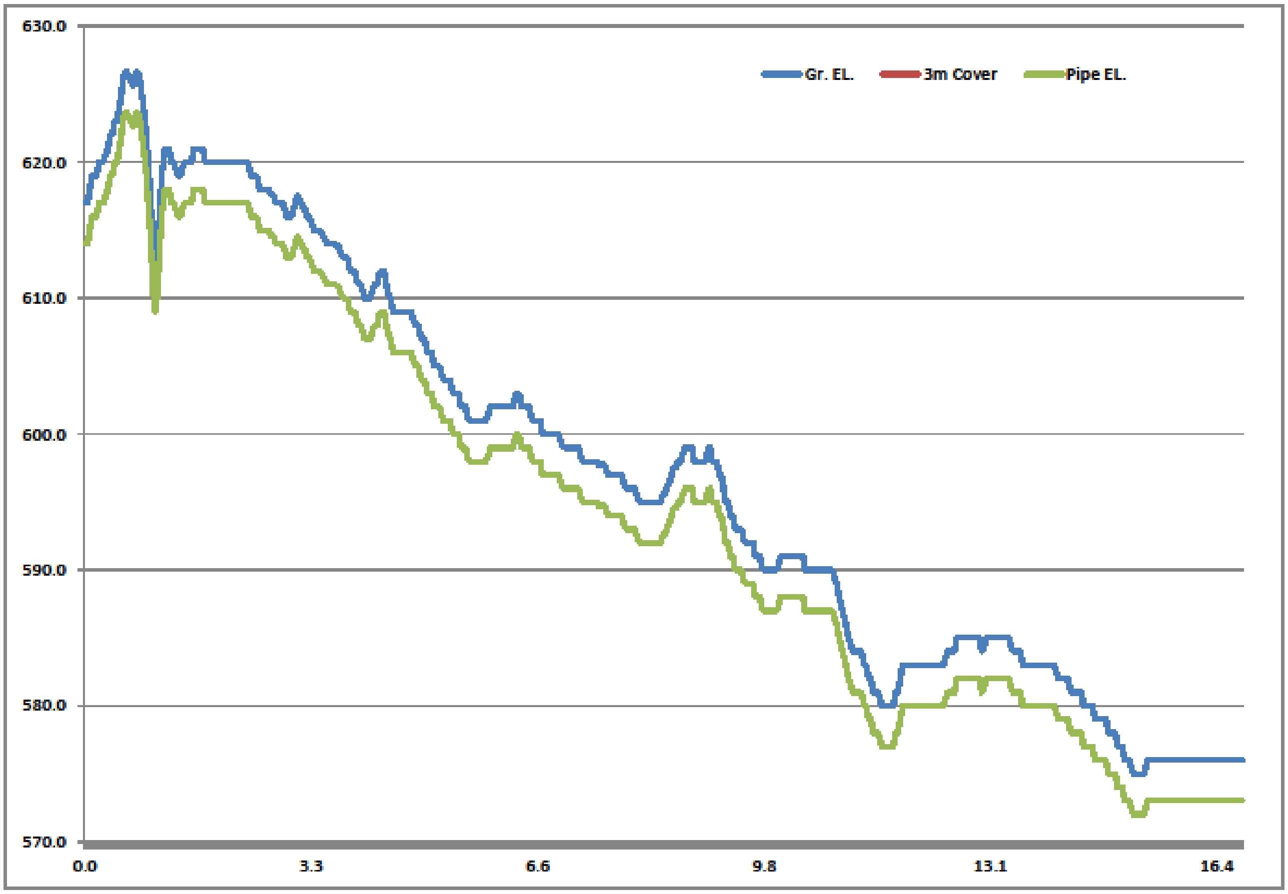
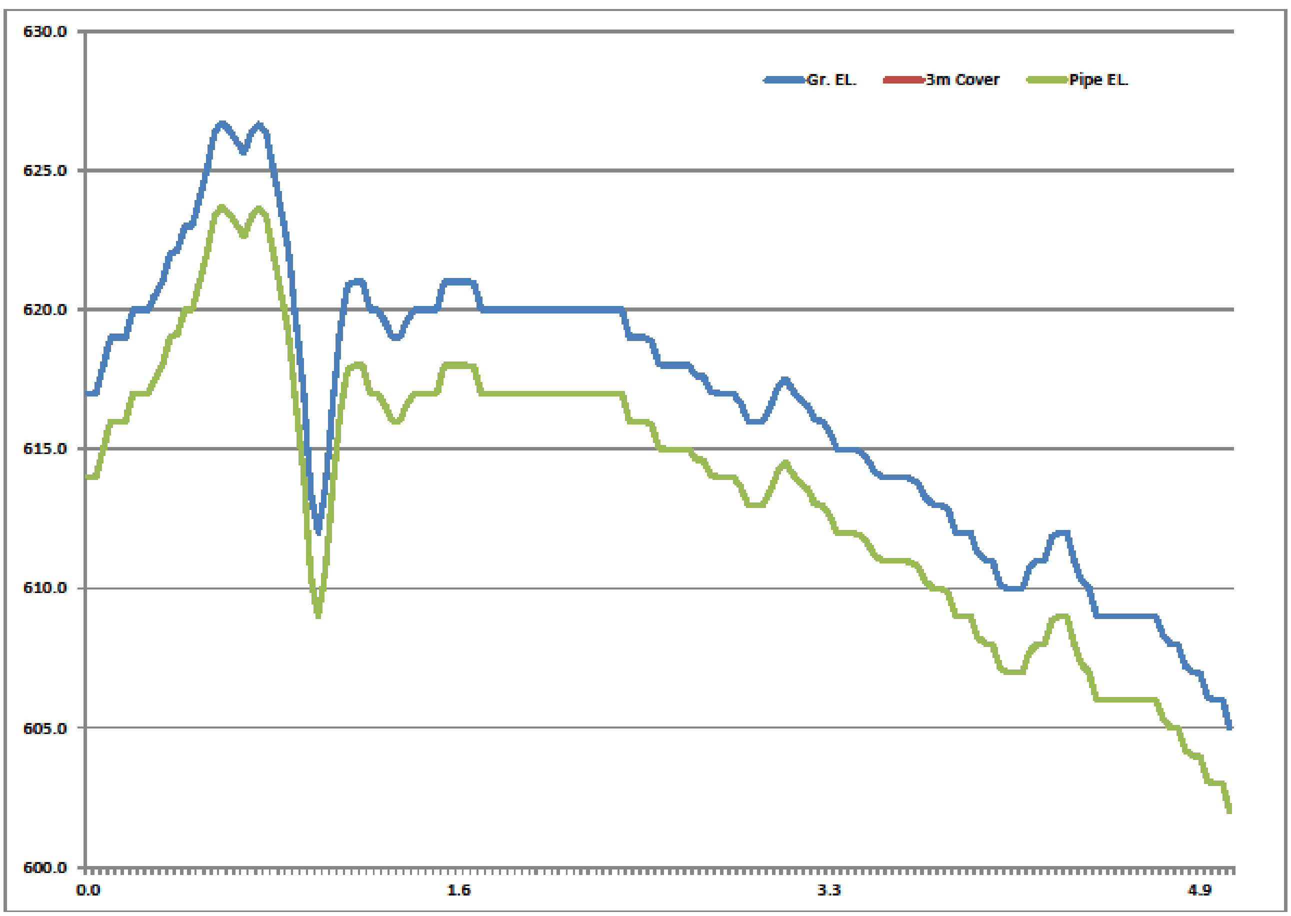
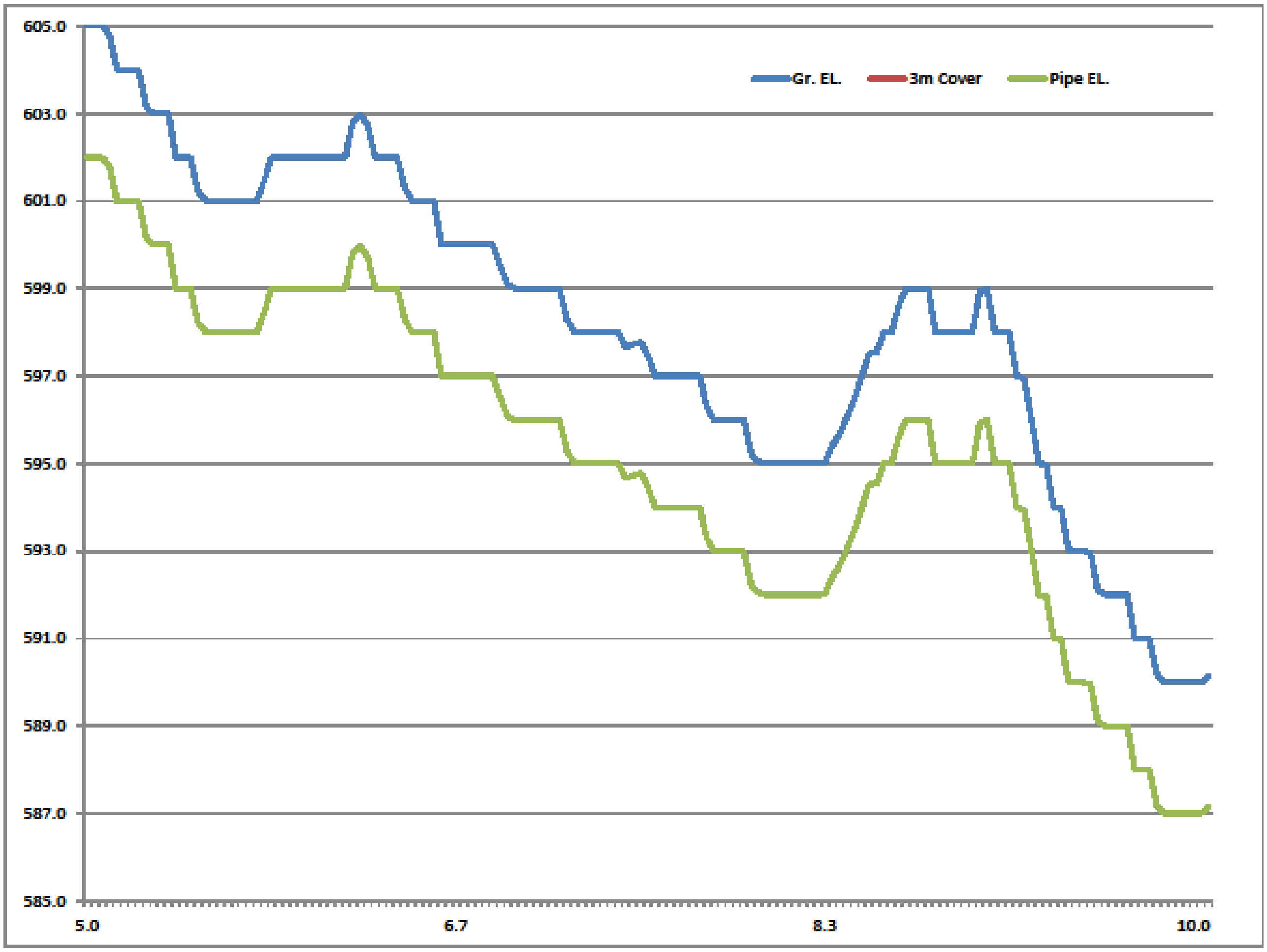
Emerald Park FM



Pilot Butte FM



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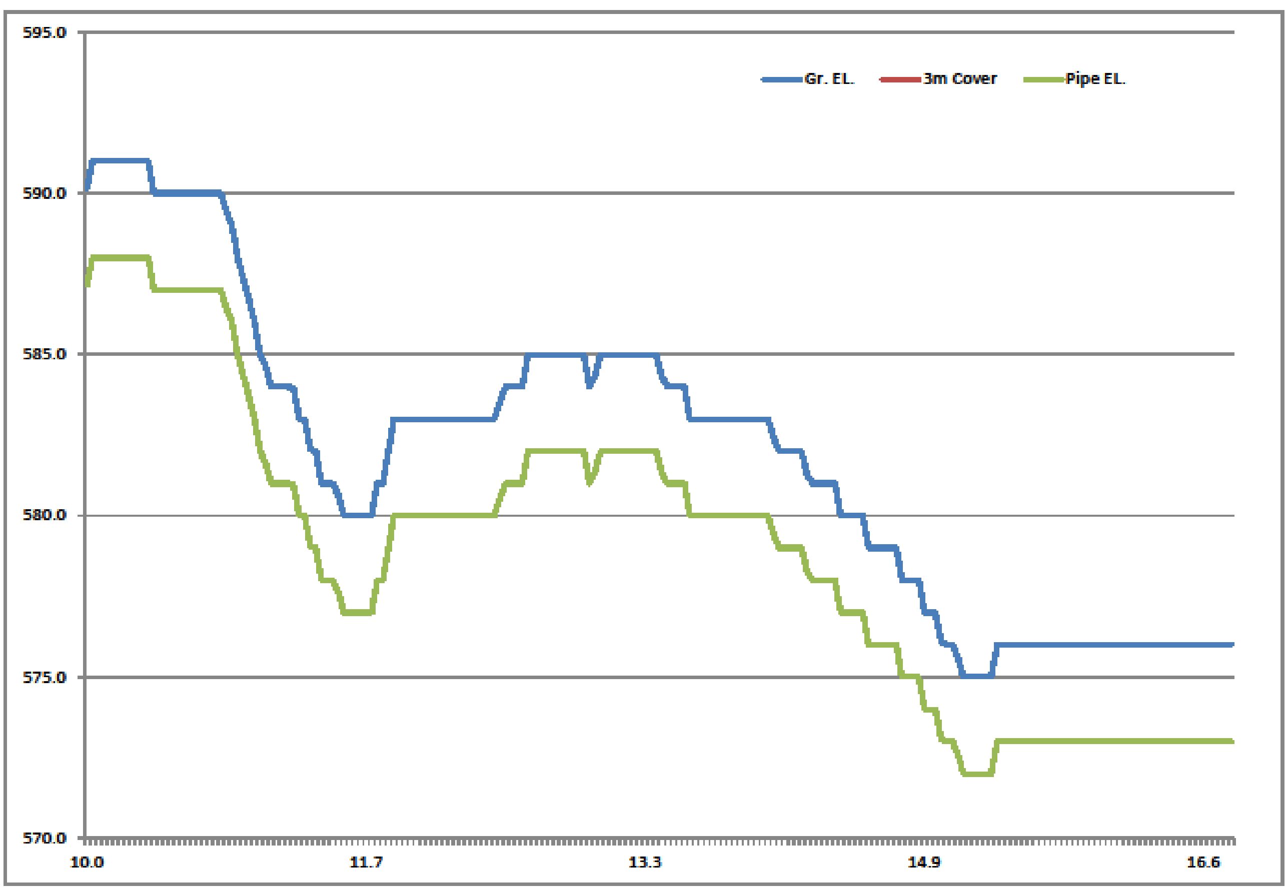
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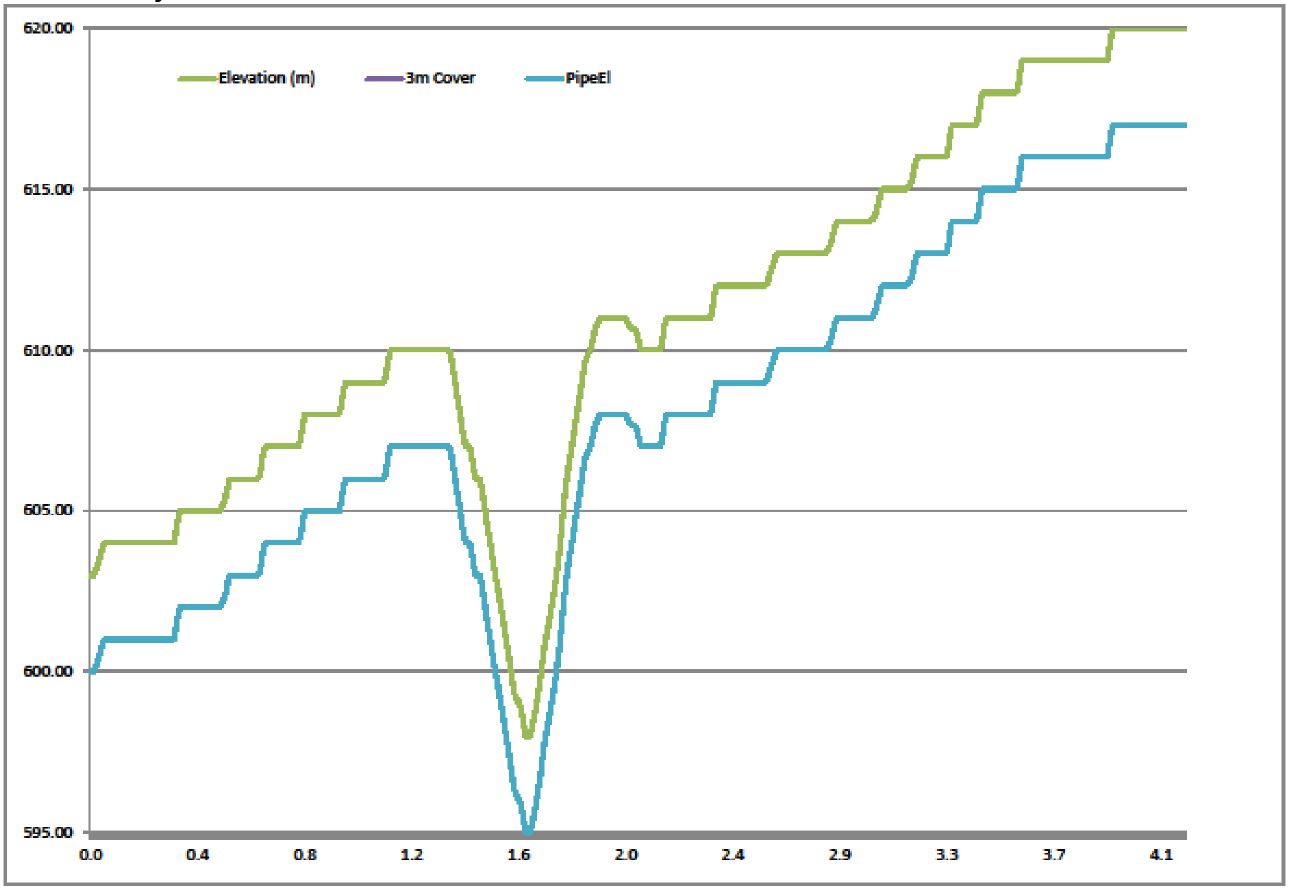
White City FM



East Regional Wastewater Pipeline Capital Cost Estimate Breakdown

Description		Total Amount
CONSTRUCTION COST:		
Part A: SEWER (BY GRAVITY AND BY FORCEMAIN), APPURTENANCES AND PUMP STATION		$ 51,393,000.00
Part B: RESTORATION		$ 2,749,000.00
Part C: MISCELLANEOUS ITEMS		$ 2,785,000.00
Part D: PROVISIONAL ITEMS		$ 8,316,000.00
Sub-Total of Part A to D		**$ 65,243,000.00**
Escalation to Mid-Point of Construction at 6.83%		**$ 2,792,400.00**
TOTAL CONSTRUCTION COST (Excluding PST and GST)		**$ 68,035,400.00**
NON-CONSTRUCTION COST:		
Part A: ENGINEERING	12%	$ 8,164,248.00
Part B: ADMINISTRATION	3%	$ 2,041,062.00
Part C: MISCELLANEOUS	2%	$ 1,360,708.00
TOTAL NON-CONSTRUCTION COST (Excluding GST)		**$ 11,566,018.00**
TOTAL CAPITAL COST (Excluding GST)		**$ 79,601,418.00**

TOTAL CAPITAL COST (Including GST)	**$ 83,581,488.90**

East Regional Wastewater Pipeline Operating, Maintenance, and Replacement Costs across 30 Years

1.04	Exchange Rate (CAD/USD)
4%	Discount Rate
5%	Growth Rate of AAF

Total NPV = **$ 73,531,894**
O&M NPV = **$ 8,113,240**

Capital Costs include Engineering and other Non-Construction Costs

	Capital		Labor		Power		Maintenance		Replacement		Administration		**TOTAL**	
Year	Capital Expenditure	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV
2014	$ -	$ -			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2015	$ 68,035,400	$ 65,418,654	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 68,035,400	$ 65,418,654
2016	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2017	$ -	$ -	$ 8,517	$ 7,572	$ 77,970	$ 69,315	$ 284,292	$ 252,734	$ -	$ -	$ 14,734	$ 13,098	$ 385,512	$ 342,719
2018	$ -	$ -	$ 8,517	$ 7,280	$ 80,679	$ 68,965	$ 291,581	$ 249,245	$ -	$ -	$ 14,734	$ 12,594	$ 395,511	$ 338,085
2019	$ -	$ -	$ 8,517	$ 7,000	$ 83,524	$ 68,651	$ 298,871	$ 245,650	$ -	$ -	$ 14,734	$ 12,110	$ 405,646	$ 333,411
2020	$ -	$ -	$ 8,517	$ 6,731	$ 86,512	$ 68,371	$ 306,160	$ 241,963	$ -	$ -	$ 14,734	$ 11,644	$ 415,923	$ 328,710
2021	$ -	$ -	$ 8,517	$ 6,472	$ 89,648	$ 68,125	$ 313,450	$ 238,196	$ 54	$ 41	$ 14,734	$ 11,196	$ 426,403	$ 324,031
2022	$ -	$ -	$ 8,517	$ 6,223	$ 92,942	$ 67,911	$ 320,740	$ 234,361	$ 63	$ 46	$ 14,734	$ 10,766	$ 436,995	$ 319,308
2023	$ -	$ -	$ 8,517	$ 5,984	$ 96,400	$ 67,729	$ 328,029	$ 230,469	$ 321	$ 225	$ 14,734	$ 10,352	$ 448,000	$ 314,759
2024	$ -	$ -	$ 8,517	$ 5,754	$ 100,031	$ 67,577	$ 335,319	$ 226,529	$ 1,002	$ 677	$ 14,734	$ 9,954	$ 459,602	$ 310,491
2025	$ -	$ -	$ 8,517	$ 5,533	$ 103,843	$ 67,454	$ 342,608	$ 222,552	$ 2,941	$ 1,910	$ 14,734	$ 9,571	$ 472,643	$ 307,020
2026	$ -	$ -	$ 8,517	$ 5,320	$ 107,846	$ 67,360	$ 349,898	$ 218,545	$ 7,501	$ 4,685	$ 14,734	$ 9,203	$ 488,496	$ 305,113
2027	$ -	$ -	$ 8,517	$ 5,115	$ 112,049	$ 67,294	$ 357,188	$ 214,518	$ 15,600	$ 9,369	$ 14,734	$ 8,849	$ 508,088	$ 305,145
2028	$ -	$ -	$ 8,517	$ 4,918	$ 116,463	$ 67,254	$ 364,477	$ 210,477	$ 27,912	$ 16,119	$ 14,734	$ 8,508	$ 532,103	$ 307,276
2029	$ -	$ -	$ 8,517	$ 4,729	$ 121,097	$ 67,241	$ 371,767	$ 206,429	$ 38,525	$ 21,392	$ 14,734	$ 8,181	$ 554,640	$ 307,972
2030	$ -	$ -	$ 8,517	$ 4,547	$ 125,963	$ 67,253	$ 379,057	$ 202,381	$ 49,169	$ 26,252	$ 14,734	$ 7,866	$ 577,439	$ 308,299
2031	$ -	$ -	$ 8,517	$ 4,372	$ 131,072	$ 67,289	$ 386,346	$ 198,340	$ 52,975	$ 27,196	$ 14,734	$ 7,564	$ 593,644	$ 304,761
2032	$ -	$ -	$ 8,517	$ 4,204	$ 136,436	$ 67,349	$ 393,636	$ 194,310	$ 62,950	$ 31,074	$ 14,734	$ 7,273	$ 616,273	$ 304,210
2033	$ -	$ -	$ 8,517	$ 4,043	$ 142,069	$ 67,432	$ 400,925	$ 190,296	$ 65,255	$ 30,973	$ 14,734	$ 6,993	$ 631,500	$ 299,737
2034	$ -	$ -	$ 8,517	$ 3,887	$ 147,984	$ 67,538	$ 408,215	$ 186,304	$ 61,806	$ 28,208	$ 14,734	$ 6,724	$ 641,256	$ 292,661
2035	$ -	$ -	$ 8,517	$ 3,738	$ 154,194	$ 67,665	$ 415,505	$ 182,337	$ 75,236	$ 33,016	$ 14,734	$ 6,466	$ 668,185	$ 293,222
2036	$ -	$ -	$ 8,517	$ 3,594	$ 160,714	$ 67,814	$ 422,794	$ 178,400	$ 83,368	$ 35,177	$ 14,734	$ 6,217	$ 690,127	$ 291,203
2037	$ -	$ -	$ 8,517	$ 3,456	$ 167,561	$ 67,984	$ 430,084	$ 174,496	$ 93,481	$ 37,928	$ 14,734	$ 5,978	$ 714,376	$ 289,841
2038	$ -	$ -	$ 8,517	$ 3,323	$ 174,750	$ 68,174	$ 437,373	$ 170,629	$ 86,824	$ 33,872	$ 14,734	$ 5,748	$ 722,198	$ 281,745
2039	$ -	$ -	$ 8,517	$ 3,195	$ 182,299	$ 68,383	$ 444,663	$ 166,801	$ 75,671	$ 28,386	$ 14,734	$ 5,527	$ 725,884	$ 272,291
2040	$ -	$ -	$ 8,517	$ 3,072	$ 190,225	$ 68,612	$ 451,953	$ 163,014	$ 74,218	$ 26,770	$ 14,734	$ 5,314	$ 739,646	$ 266,782
2041	$ -	$ -	$ 8,517	$ 2,954	$ 198,547	$ 68,859	$ 459,242	$ 159,273	$ 69,355	$ 24,053	$ 14,734	$ 5,110	$ 750,394	$ 260,249
2042	$ -	$ -	$ 8,517	$ 2,840	$ 207,285	$ 69,125	$ 466,532	$ 155,578	$ 66,600	$ 22,210	$ 14,734	$ 4,913	$ 763,668	$ 254,666
2043	$ -	$ -	$ 8,517	$ 2,731	$ 216,460	$ 69,408	$ 473,822	$ 151,932	$ 64,676	$ 20,739	$ 14,734	$ 4,724	$ 778,209	$ 249,534

Appendix K - East Regional Wastewater Options Triple Bottom Line Notes

	Benefits Evaluation Criteria																		
	Economic						Social						Environmental						Other Notes
Option	Minimizes Construction Risk (Financial over run, complications…)	RAG	Minimizes Deliverability Risk (delay in time to activate)	RAG	Minimizes Staffing Risk (attracting the right people + knowledge)	RAG	Flexibility to supports / facilitate future growth	RAG	Minimizes Construction Disruption on Communities	RAG	Minimizes Operational Nuisance (Noise, Odour, Visual, Traffic etc.)	RAG	Meets Effluent Quality Improves Quality and/or Reliability	RAG	Minimizes Construction Disruption on Environment	RAG	Maximizes opportunities for diversified bio solids reuse	RAG	
Local WWTP at White City/RM of Edenwold (estimate $12-15m construction without effluent pipeline, no opex yet)	Building a high tech WWTP will be challenging and is prone to construction cost risks. Significant financial risks around source(s) of funding. Suggested to continue to buy land and irrigate effluent, but land cost has gone up.	R	Risk with contractors during construction could delay build. Risk in delay in start due to potential regional opportunities. Need to pick a date for communities to move on regional solution so that people don't invest locally unnecessarily.	A	MBR membrane plant would require Level 3 / Level 4 Operator. Very limited supply in Saskatchewan. Challenge to attract staff to town. Could potentially look to share operators with Regina. Regina could potentially provide an emergency L3/4 operator to cover holidays etc. Need more home grown talent.	A	Opportunity to add modules to WWTP for additional treatment capacity in the future. Land near storage lagoons and WWTP is relatively far away from White City / Emerald Park and would not restrict growth area.	G	Site is far enough from the populations that construction will cause minimal disruption to communities.	G	Site is far enough from the populations that operations will cause minimal disruption to communities. Prevailing wind is in opposite direction.	G	Still challenges with continuous effluent discharge. Option to pipe effluent to Wascana Creek. Effluent quality is high - will dilute pollution in wascana creek, induce flow in stagnant water body. Potentially need to treat WW twice to meet quality requirements. Cost to treat will be very high. High Operational risks with high tech plant resulting in reliability challenges.	R	Construction will cause minimal disruption to the environment.	G	Still challenges around biosolids, strategy to be developed. Varied depending on which WWTP design option is selected.	A	Operational cost will be high. Potential in long term to sell effluent to local potash, but that's unstable.
Lagoon Upgrades for Balgonie and Pilot Butte	Lagoon expansions simple to build with low construction risk. Opportunity for Pilot Butte to pickup cheaper land now to safeguard future. Lagoon expansion would cover up to 10k people. Balgonie land is also relatively affordable and available.	G	Moderate risk associated with securing/acquiring land (and environmental permits) that could delay timescales.	A	Lagoons simple to operate and would use existing processes and staff. Minimal risk.	G	Lagoons provide only a limited amount of future growth before the same capacity problems would arise. Land near lagoons for Pilot Butte and Balgonie is relatively far from the population are and would not restrict growth area.	A	Site is far enough from the populations that construction will cause minimal disruption to communities.	G	Site is far enough from the populations that operations will cause minimal disruption to communities.	G	Lagoon expansions at risk of not meeting future regulatory requirements. Lagoons from Pilot Butte and Balgonie dump effluent North into the Qu'Appelle River system, not Wascana Creek. Minor risks associated with operations and reliability. Opportunity for marsh land and duck sanctuaries as done West of Regina.	A	Additional lagoons will require more land area. Land not highlighted as having environmental concerns.	G	Lagoons offer minimal opportunity for biosolids reuse.	R	
East Regional Wastewater Pipeline	Complicated route along Highway 1 at White City / Emerald Park, lots already in the trenches. Land procurement will be a problem for most pipeline routes. There are Service Roads being built by Sask Highways - potential to piggy back on project - up to Ochap through Cindercrete then along to Sakimay. Gerald Beaden is the contact at Sask Highways.	A	Unless there are simple rights of way for the pipeline route there could be significant delays in negotiating routes. Time to get governance setup for regional options could be delayed due to politics etc. which would delay the overall project. Likely 5-8 years away, and communities would need an interim solution. If interim solutions are not feasible for this length of time then this option might be invalid.	A	Assuming treatment is resourced with the City of Regina this option provides a very simple operation for the regional communities. No treatment knowledge is required at the local communities, simply pump and pipe, operation and maintenance.	G	Having the East Pipeline as a gravity main is great news, high potential for tie ins and ability to support future growth. Peak flows can be managed by using existing lagoons for storage and pumping at off peak times, future supporting future growth.	G	Work can be done with minimal disruption to roads and traffic.	G	Very simple operation for regional stakeholder and communities will have very limited problems.	G	Central treatment plant will treat effluent to a high quality. Reliability of central treatment plant will be higher than smaller local plants with limited resources.	G	Land not highlighted as having environmental concerns.	G	Central treatment plant with larger treatment volumes provides a much greater opportunity for biosolids reuse.	G	
East Regional Wastewater Treatment Plant	Significant financial risks around source(s) of funding. Financial risks associated with volatile inflation rates due to timeframe of constructions. Would need a carefully structured contract. Building a large WWTP will be challenging and is prone to construction cost risks.	R	High risks associated with time delays due to number of stakeholders/parties involved. Must have the RMs of Sherwood and Edenwold involved; they control all planning etc. Need to pick a date for communities to move on regional solution so that people don't invest locally unnecessarily. Likely 8-10 years away, and communities would need an interim solution. If interim solutions are not feasible for this length of time then this option might be invalid. With the pipeline established an interim solution would be for wastewater to be treated by Regina's existing facility.	R	The BNR plant suggested is simpler than an advanced MBR to operate. Resources can be pulled together by all stakeholders and staffing risk is reduced significantly.	G	Opportunity to add modules to WWTP for additional treatment capacity in the future. Septage Receiving Station can be added to take RM waste at little cost.	G	Dependent on location. Will likely be situated away from population centres and cause minimal construction disruption.	G	Dependent on location. Will likely be situated away from population centres and cause the least operational nuisance possible.	G	Central treatment plant will treat effluent to a high quality. Reliability of central treatment plant will be higher than smaller local plants with limited resources.	G	Dependent on location. Provides smaller footprint than local lagoons or multiple local treatment plants in the region overall.	A	Central treatment plant with larger treatment volumes provides a much greater opportunity for biosolids reuse.	G	

Appendix N
East Regional Wastewater Treatment Plant

East Regional Wastewater Treatment Plant Operating, Maintenance, and Replacement Costs across 30 Years (38ML/d; 95,000 population equivalent)

Operations and Maintenance Cost Assumptions (38ML/d; 95,000 population equivalent)

East Regional Wastewater Treatment Plant (19.5ML/d; 50,000 population equivalent)

East Regional Wastewater Treatment Plant Operating, Maintenance, and Replacement Costs across 30 Years (38ML/d; 95,000 population equivalent)

1.04	Exchange Rate (CAD/USD)
4%	Discount Rate
5%	Growth Rate of AAF

Total NPV = $ 123,380,213
O&M NPV = $ 17,992,202

Capital Costs include Engineering and other Non-Construction Costs

	Capital		Labor		Power		Chemicals		Solids		Maintenance		Replacement		Administration		**TOTAL**	
Year	Capital Expenditure	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV	Annual Cost	2014 NPV
2014	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2015	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2016	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2017	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2018	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2019	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2020	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2021	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2022	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2023	$ 150,000,000	$ 105,388,010	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2024	$ -	$ -	$ 403,065	$ 272,296	$ 368,212	$ 248,751	$ 256,446	$ 173,246	$ 104,750	$ 70,765	$ 150,000	$ 101,335	$ -	$ -	$ 120,950	$ 81,710	$ 1,403,423	$ 948,102
2025	$ -	$ -	$ 403,065	$ 261,823	$ 381,128	$ 247,573	$ 269,268	$ 174,912	$ 109,988	$ 71,446	$ 155,263	$ 100,856	$ -	$ -	$ 120,950	$ 78,567	$ 1,439,662	$ 935,177
2026	$ -	$ -	$ 403,065	$ 251,753	$ 394,690	$ 246,522	$ 282,732	$ 176,593	$ 115,487	$ 72,133	$ 160,526	$ 100,264	$ 8	$ 5	$ 120,950	$ 75,545	$ 1,477,458	$ 922,816
2027	$ -	$ -	$ 403,065	$ 242,070	$ 408,931	$ 245,593	$ 296,868	$ 178,292	$ 121,261	$ 72,826	$ 165,789	$ 99,569	$ 91	$ 55	$ 120,950	$ 72,639	$ 1,516,955	$ 911,044
2028	$ -	$ -	$ 403,065	$ 232,760	$ 423,883	$ 244,782	$ 311,712	$ 180,006	$ 127,324	$ 73,527	$ 171,052	$ 98,778	$ 597	$ 345	$ 120,950	$ 69,846	$ 1,558,583	$ 900,043
2029	$ -	$ -	$ 403,065	$ 223,808	$ 439,583	$ 244,085	$ 327,297	$ 181,737	$ 133,691	$ 74,234	$ 176,315	$ 97,901	$ 3,603	$ 2,000	$ 120,950	$ 67,159	$ 1,604,504	$ 890,924
2030	$ -	$ -	$ 403,065	$ 215,200	$ 456,068	$ 243,498	$ 343,662	$ 183,484	$ 140,375	$ 74,947	$ 181,578	$ 96,946	$ 11,957	$ 6,384	$ 120,950	$ 64,576	$ 1,657,655	$ 885,036
2031	$ -	$ -	$ 403,065	$ 206,923	$ 473,377	$ 243,019	$ 360,845	$ 185,248	$ 147,394	$ 75,668	$ 186,841	$ 95,919	$ 32,953	$ 16,917	$ 120,950	$ 62,093	$ 1,725,426	$ 885,787
2032	$ -	$ -	$ 403,065	$ 198,964	$ 491,552	$ 242,644	$ 378,888	$ 187,030	$ 154,764	$ 76,396	$ 192,104	$ 94,828	$ 81,661	$ 40,310	$ 120,950	$ 59,704	$ 1,822,983	$ 899,876
2033	$ -	$ -	$ 403,065	$ 191,312	$ 510,635	$ 242,369	$ 397,832	$ 188,828	$ 162,502	$ 77,130	$ 197,367	$ 93,679	$ 138,555	$ 65,764	$ 120,950	$ 57,408	$ 1,930,906	$ 916,490
2034	$ -	$ -	$ 403,065	$ 183,954	$ 530,673	$ 242,192	$ 417,724	$ 190,644	$ 170,627	$ 77,872	$ 202,630	$ 92,478	$ 146,255	$ 66,749	$ 120,950	$ 55,200	$ 1,991,923	$ 909,088
2035	$ -	$ -	$ 403,065	$ 176,878	$ 551,712	$ 242,110	$ 438,610	$ 192,477	$ 179,158	$ 78,621	$ 207,893	$ 91,230	$ 110,927	$ 48,678	$ 120,950	$ 53,077	$ 2,012,315	$ 883,071
2036	$ -	$ -	$ 403,065	$ 170,075	$ 573,804	$ 242,120	$ 460,540	$ 194,328	$ 188,116	$ 79,377	$ 213,156	$ 89,942	$ 133,446	$ 56,308	$ 120,950	$ 51,036	$ 2,093,077	$ 883,185
2037	$ -	$ -	$ 403,065	$ 163,534	$ 597,000	$ 242,218	$ 483,567	$ 196,196	$ 197,522	$ 80,140	$ 218,419	$ 88,618	$ 223,487	$ 90,675	$ 120,950	$ 49,073	$ 2,244,010	$ 910,454
2038	$ -	$ -	$ 403,065	$ 157,244	$ 621,355	$ 242,404	$ 507,746	$ 198,083	$ 207,398	$ 80,910	$ 223,682	$ 87,263	$ 283,835	$ 110,730	$ 120,950	$ 47,185	$ 2,368,031	$ 923,820
2039	$ -	$ -	$ 403,065	$ 151,196	$ 646,929	$ 242,674	$ 533,133	$ 199,987	$ 217,768	$ 81,688	$ 228,945	$ 85,881	$ 291,820	$ 109,467	$ 120,950	$ 45,370	$ 2,442,610	$ 916,264
2040	$ -	$ -	$ 403,065	$ 145,381	$ 673,781	$ 243,026	$ 559,790	$ 201,910	$ 228,656	$ 82,474	$ 234,208	$ 84,476	$ 229,714	$ 82,855	$ 120,950	$ 43,625	$ 2,450,165	$ 883,748
2041	$ -	$ -	$ 403,065	$ 139,790	$ 701,976	$ 243,457	$ 587,779	$ 203,852	$ 240,089	$ 83,267	$ 239,471	$ 83,053	$ 191,435	$ 66,393	$ 120,950	$ 41,947	$ 2,484,766	$ 861,758
2042	$ -	$ -	$ 403,065	$ 134,413	$ 731,581	$ 243,966	$ 617,168	$ 205,812	$ 252,094	$ 84,068	$ 244,734	$ 81,613	$ 207,945	$ 69,345	$ 120,950	$ 40,334	$ 2,577,536	$ 859,550
2043	$ -	$ -	$ 403,065	$ 129,243	$ 762,666	$ 244,550	$ 648,027	$ 207,791	$ 264,698	$ 84,876	$ 249,997	$ 80,162	$ 251,252	$ 80,564	$ 120,950	$ 38,783	$ 2,700,655	$ 865,969

Operations and Maintenance Cost Assumptions (38ML/d; 95,000 population equivalent)

Costing assumptions used to calculate the 30-year O&M expenditures are presented in Table 1.

Table 1
Operating and Maintenance Cost Estimate General Cost Assumptions

Exchange Rate (CAD/USD)	1.04
Discount Rate	4%
Growth Rate of Average Annual Flows (AAF)	5%

Notes:
CAD – Canadian dollars
USD – US dollars

Labour

- Assume the WWTP is fairly well automated, with alarms in place to signal callouts during the night. Plant would be staffed 8 hours per day, 7 days per week. There will be 5 FTEs total.
  - Project Manager
  - Lead Operator
  - Operator II
  - Operator
  - Maintenance Specialist
- Hourly wages at the top of the 3rd quartile wage range for CH2M HILL in Canada for each craft position listed above were used. The higher end of the range was selected based on the limited number of certified operators in Saskatchewan. The Project Manager's salary was estimated using the CH2M HILL's USA average for this level position (due to a lack of data).
- Fringe multiplier = 1.34, Overtime multiplier = 1.50, Overtime frequency = 5 percent

Power

- Assume electricity power tariff is Sask Power rate E8 (rural).
  - Composite rate of Energy Charge, Demand Charge, and monthly fee is 6.837 cents per kilowatt-hour.
- Motor loads and duty/standby status data was obtained from CH2M HILLs preliminary design concepts utilizing CH2M HILL process electrical models. Motor run times were estimated based on AAF in 2024 and scaled for certain equipment to reflect increases in flow.
- 90 percent load factor and 85 percent efficiency factor were assumed for equipment drives.

Chemicals

- Chemical costs were proportionately scaled up each year to match the AAF. Table 2 presents the chemical required for based on obtaining 20 percent dry cake and less than 1 mg/L of phosphorus in the effluent of the treatment plant.

Table 2
Chemical Cost Assumptions

	Active %	Dose	Flow/Load	Price (CAD)	TOTAL (CAD/Year)
Ferric Chloride	47	40 mg/L	10.11 mgd	$1,866	$539,965
Polymer	100	7.27 kg/ton	3.35 tons/day	$5.38	$47,814
TOTAL					$587,779

Notes:
CAD – Canadian dollars
mg/L – milligrams per litre
mgd – million gallons per day
kg/ton – kilograms per ton

Solids

- Solids generated were based on average BOD and total suspended solids (TSS) raw water characterizations for a domestic WWTP at 3.35 tons per day of 20 percent biosolids on average in year 2044.
- $30 CAD/wet ton (2,000 lbs.) is assumed as the landfill tipping fee.
- Grit production at 0.50 cubic feet per million gallons
- Screenings production at 8 cubic feet per million gallons

Maintenance

- Fixed percentages of the capital equipment cost are used based on typical O&M operations throughout the US and Canada
  - 0.50 percent annually for Preventative Maintenance
  - 1 percent annually for Corrective Maintenance in 2024, scaled to 2 percent annually in 2043
- Preventative and corrective maintenance cost were calculated based on the estimated value of the equipment listed in the Process Breakdown Cost Estimate in Table 3. The civil, structural, and other non-mechanical equipment costs have been excluded from this calculation.

Replacement

- Equipment list is based on data from the Process Breakdown Cost Estimate in Table 3 and supplemented with additional standard WWTP equipment.
- Average lifespan and replacement costs for each piece of equipment are estimated using standard CH2M HILL tables for each specific type of equipment.
- Replacement of duty and standby equipment is estimated at the same rate.
- Replacement costs have been allocated with a stochastic model to account for equipment failures before and after the average lifespan.

Other Direct Costs

- ODC were calculated based on standard CH2M HILL project expenses. ODC include items for the office, safety supplies, miscellaneous travel expenses, vehicles, and other employee expenses. These were scaled to the size of the facility.
- Laboratory materials and services were calculated based on 5 day per week permit analysis requirements as conducted by an outside contract laboratory. In-house laboratory analysis conducted by the operator for daily, weekly, or monthly process testing is sufficient to operate the facility. The laboratory cost is estimated at $67,571 annually.

Design and Cost Estimate References

- *Guidelines for Sewage Works Design*, EPB 203 (Environmental Protection Branch), Saskatchewan Ministry of Environment. (PoS, 2013)
- *Development Standards Manual*, 2010, City of Regina (City of Regina, 2010)
- Wastewater flows have been derived from guidelines and formulas in the City of Regina's *Development Standards Manual* (City of Regina, 2010)
- CH2M HILL conceptual design documents, internal sketches and data presented in this report
- R.S. Means
- Vendor Quotes on Equipment and Materials, where appropriate
- CH2M HILL Historical Data & CH2M HILL's CPES
- CH2M HILL Engineer and Estimator Judgment

East Regional Wastewater Treatment Plant (19.5ML/d; 50,000 population equivalent)

It should be noted that a range of growth scenarios and associated treatment works capacities were considered for estimating purposes.

The detailed estimate in this Appendix was prepared for the upper bound cost scenario. Subsequent discussions and analysis concluded that a lesser capacity plant is the more realistic option and a revised cost estimate was prepared. The revised Class 5 Estimate shown in the main report is based on a conceptual level of design and utilizes pro-rata modification to the cost components generated for the upper bound cost scenario.

Table 3
East Regional Wastewater Treatment Plant Order of Magnitude Cost Estimate (38ML/d; 95,000 population equivalent)

Item	Estimate
Influent Pump Station	$2,000,000
Headworks	$4,000,000
Primary Sludge Pump Station	$1,000,000
Primary Clarifiers	$2,000,000
Aeration Tanks	$6,000,000
Blowers	$2,000,000
Secondary Clarifiers	$3,000,000
RAS/WAS Pump Station	$2,000,000
Gravity Fermentor	$5,000,000
Anaerobic Digestion	$13,000,000
Dewatering	$3,000,000
Open Channel UV	$4,000,000
Tertiary Disk Filtration	$3,000,000
Subtotal	$50,000,000
Additional Project Costs	$30,000,000
Subtotal With Additional Project Costs	$80,000,000
Contractor Profit and Overhead	$16,000,000
Estimating Contingency	$24,000,000
Subtotal with Contractor Costs	$121,000,000
Escalation (to Mid Point of Construction, 5-year construction)	$11,000,000
Subtotal with Escalation	$132,000,000
Local Adjustment Factor	$4,000,000
Subtotal with Local Factor	$136,000,000
Engineering	$14,000,000
TOTAL Including Engineering	$150,000,000

Notes:
RAS – returned activated sludge
WAS – waste activated sludge
UV - ultraviolet

Appendix O
East Regional Water Pipeline

East Regional Water Pipeline Capital Cost Estimate Breakdown

East Regional Water Pipeline Operating, Maintenance and Replacement Costs across 30 Years

East Regional Water Options Triple Bottom Line Notes

East Regional Water Pipeline Capital Cost Estimate Breakdown

Description		Total Amount
CONSTRUCTION COST:		
Part A: WATER MAINS, APPURTENANCES AND PUMP STATION		$ 18,594,000.00
Part B: RESTORATION		$ 639,000.00
Part C: MISCELLANEOUS ITEMS		$ 1,105,000.00
Part D: PROVISIONAL ITEMS		$ 2,962,000.00
Sub-Total of Part A to D		**$ 23,300,000.00**
Escalation to Mid-Point of Construction at 6.53%		**$ 1,521,000.00**
TOTAL CONSTRUCTION COST (Excluding PST and GST)		**$ 24,821,000.00**
NON-CONSTRUCTION COST:		
Part A: ENGINEERING	12%	$ 2,978,520.00
Part B: ADMINISTRATION	3%	$ 744,630.00
Part C: MISCELLANEOUS	2%	$ 496,420.00
TOTAL NON-CONSTRUCTION COST (Excluding PST and GST)		**$ 4,219,570.00**
TOTAL CAPITAL COST (Excluding PST and GST)		**$ 29,040,570.00**

TOTAL CAPITAL COST (Including PST and GST)	**$ 31,944,627.00**

1.04	Exchange Rate (CAD/USD)
4%	Discount Rate
5%	Growth Rate of AAF

Total NPV = **$ 31,655,294**
O&M NPV = **$ 3,731,669**

Capital Costs include Engineering and other Non-Construction Costs

	Capital		Labor		Power		Maintenance		Replacement		Administration		**TOTAL**	
Year	Capital Expenditure	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV	Annual Cost	NPV
2014	$ -	$ -			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2015	$ 29,040,570	$ 27,923,625	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 29,040,570	$ 27,923,625
2016	$ -	$ -	$ 3,145	$ 2,907	$ 26,081	$ 24,113	$ 42,990	$ 39,747	$ -	$ -	$ 7,367	$ 6,811	$ 79,582	$ 73,578
2017	$ -	$ -	$ 6,290	$ 5,591	$ 54,373	$ 48,337	$ 88,103	$ 78,323	$ -	$ -	$ 14,734	$ 13,098	$ 163,499	$ 145,350
2018	$ -	$ -	$ 6,290	$ 5,376	$ 56,695	$ 48,463	$ 90,225	$ 77,125	$ -	$ -	$ 14,734	$ 12,594	$ 167,944	$ 143,559
2019	$ -	$ -	$ 6,290	$ 5,170	$ 59,134	$ 48,604	$ 92,348	$ 75,903	$ -	$ -	$ 14,734	$ 12,110	$ 172,505	$ 141,786
2020	$ -	$ -	$ 6,290	$ 4,971	$ 61,694	$ 48,758	$ 94,470	$ 74,661	$ -	$ -	$ 14,734	$ 11,644	$ 177,187	$ 140,034
2021	$ -	$ -	$ 6,290	$ 4,780	$ 64,382	$ 48,925	$ 96,593	$ 73,403	$ 90	$ 69	$ 14,734	$ 11,196	$ 182,089	$ 138,373
2022	$ -	$ -	$ 6,290	$ 4,596	$ 67,205	$ 49,106	$ 98,715	$ 72,130	$ 160	$ 117	$ 14,734	$ 10,766	$ 187,104	$ 136,715
2023	$ -	$ -	$ 6,290	$ 4,419	$ 70,169	$ 49,300	$ 100,838	$ 70,847	$ 1,021	$ 718	$ 14,734	$ 10,352	$ 193,051	$ 135,635
2024	$ -	$ -	$ 6,290	$ 4,249	$ 73,281	$ 49,506	$ 102,960	$ 69,556	$ 1,404	$ 948	$ 14,734	$ 9,954	$ 198,669	$ 134,214
2025	$ -	$ -	$ 6,290	$ 4,086	$ 76,549	$ 49,725	$ 105,083	$ 68,260	$ 4,672	$ 3,035	$ 14,734	$ 9,571	$ 207,327	$ 134,676
2026	$ -	$ -	$ 6,290	$ 3,928	$ 79,980	$ 49,955	$ 107,206	$ 66,960	$ 7,559	$ 4,721	$ 14,734	$ 9,203	$ 215,767	$ 134,768
2027	$ -	$ -	$ 6,290	$ 3,777	$ 83,583	$ 50,198	$ 109,328	$ 65,660	$ 12,113	$ 7,275	$ 14,734	$ 8,849	$ 226,047	$ 135,758
2028	$ -	$ -	$ 6,290	$ 3,632	$ 87,365	$ 50,451	$ 111,451	$ 64,360	$ 18,278	$ 10,555	$ 14,734	$ 8,508	$ 238,117	$ 137,507
2029	$ -	$ -	$ 6,290	$ 3,492	$ 91,337	$ 50,716	$ 113,573	$ 63,063	$ 27,023	$ 15,005	$ 14,734	$ 8,181	$ 252,957	$ 140,458
2030	$ -	$ -	$ 6,290	$ 3,358	$ 95,508	$ 50,992	$ 115,696	$ 61,771	$ 36,095	$ 19,272	$ 14,734	$ 7,866	$ 268,322	$ 143,259
2031	$ -	$ -	$ 6,290	$ 3,229	$ 99,887	$ 51,279	$ 117,818	$ 60,485	$ 41,267	$ 21,185	$ 14,734	$ 7,564	$ 279,996	$ 143,742
2032	$ -	$ -	$ 6,290	$ 3,105	$ 104,485	$ 51,577	$ 119,941	$ 59,206	$ 51,758	$ 25,549	$ 14,734	$ 7,273	$ 297,207	$ 146,710
2033	$ -	$ -	$ 6,290	$ 2,985	$ 109,313	$ 51,885	$ 122,064	$ 57,937	$ 55,945	$ 26,554	$ 14,734	$ 6,993	$ 308,344	$ 146,353
2034	$ -	$ -	$ 6,290	$ 2,870	$ 114,382	$ 52,203	$ 124,186	$ 56,677	$ 70,203	$ 32,040	$ 14,734	$ 6,724	$ 329,795	$ 150,514
2035	$ -	$ -	$ 6,290	$ 2,760	$ 119,705	$ 52,531	$ 126,309	$ 55,428	$ 75,110	$ 32,961	$ 14,734	$ 6,466	$ 342,147	$ 150,145
2036	$ -	$ -	$ 6,290	$ 2,654	$ 125,294	$ 52,868	$ 128,431	$ 54,192	$ 70,882	$ 29,909	$ 14,734	$ 6,217	$ 345,630	$ 145,841
2037	$ -	$ -	$ 6,290	$ 2,552	$ 131,162	$ 53,216	$ 130,554	$ 52,969	$ 50,491	$ 20,486	$ 14,734	$ 5,978	$ 333,230	$ 135,200
2038	$ -	$ -	$ 6,290	$ 2,454	$ 137,324	$ 53,573	$ 132,676	$ 51,760	$ 33,910	$ 13,229	$ 14,734	$ 5,748	$ 324,934	$ 126,764
2039	$ -	$ -	$ 6,290	$ 2,359	$ 143,794	$ 53,939	$ 134,799	$ 50,565	$ 13,420	$ 5,034	$ 14,734	$ 5,527	$ 313,036	$ 117,425
2040	$ -	$ -	$ 6,290	$ 2,269	$ 150,587	$ 54,315	$ 136,921	$ 49,386	$ 8,284	$ 2,988	$ 14,734	$ 5,314	$ 316,815	$ 114,272
2041	$ -	$ -	$ 6,290	$ 2,181	$ 157,720	$ 54,700	$ 139,044	$ 48,223	$ 8,530	$ 2,958	$ 14,734	$ 5,110	$ 326,317	$ 113,172
2042	$ -	$ -	$ 6,290	$ 2,097	$ 165,210	$ 55,094	$ 141,167	$ 47,076	$ 10,446	$ 3,483	$ 14,734	$ 4,913	$ 337,845	$ 112,664
2043	$ -	$ -	$ 6,290	$ 2,017	$ 173,074	$ 55,496	$ 143,289	$ 45,946	$ 15,638	$ 5,015	$ 14,734	$ 4,724	$ 353,025	$ 113,198

Appendix K - East Regional Water Options Triple Bottom Line Notes

	Benefits Evaluation Criteria																		
	Economic						Social						Environmental						Other Notes
Option	Minimizes Construction Risk (Financial over run, complications…)	RAG	Minimizes Deliverability Risk (delay in time to activate)	RAG	Minimizes Staffing Risk (attracting the right people + knowledge)	RAG	Flexibility to supports / facilitate future growth	RAG	Minimizes Construction Disruption on Communities	RAG	Minimizes Operational Nuisance (Noise, Odour, Visual, Traffic etc.)	RAG	Meets Water Quality Improves Quality and/or Reliability	RAG	Minimizes Construction Disruption on Environment	RAG	Not Applicable	RAG	
Regional East Watermain from Buffalo Pound	Complicated route along Highway 1 at White City / Emerald Park, lots already in the trenches. Land procurement will be a problem for most pipeline routes. There are Service Roads being built by Sask Highways - potential to piggy back on project - up to Ochap through Cindercrete then along to Sakimay. Gerald Beaden is the contact at Sask Highways.	A	Unless there are simple rights of way for the pipeline route there could be significant delays in negotiating routes. Politics and Governance could significantly affect timescales. Stakeholders would like to see Governance options and approach discussed early in the process.	A	Minimal risk. Ample regional experience with pipelines.	G	Significant benefit in supporting future growth. Allocations from the local aquifer will be reached in 2030-2040. Whilst detailed analysis might find more local water it is not expected to be a significant amount and it will be unable to support a larger population into the future.	G	Work can be done with minimal disruption to roads and traffic. Challenges may occur along Highway 1 at White City / Emerald Park.	A	Water would simply arrive at communities for storage and distribution.	G	BPWTP supply meets all water quality requirements. Reliable supply however concerns around system vulnerability and community dependency on the shared supply.	G	Unknown at this stage.	A			
Regional Water Grid with connections from Pilot Butte, White City, SaskWater, and City of Regina.	Pipeline challenges noted above apply. Existing treatment assets already in place and operational.	A	Light Green - Green. This option will be easier for stakeholders to gain buy in from their Council / Citizens as it allows their recent investments to be utilized. Politics and Governance could significantly affect timescales. Stakeholders would like to see Governance options and approach discussed early in the process.	G	Water grid would provide a simple platform to share resources and expertise between communities.	G	Significant benefit in supporting future growth. Allocations from the local aquifer will be reached in 2030-2040. Whilst detailed analysis might find more local water it is not expected to be a significant amount and it will be unable to support a larger population into the future.	G	Work can be done with minimal disruption to roads and traffic. Challenges may occur along Highway 1 at White City / Emerald Park.	A	Current operations would continue. Currently very minimal impact to residents.	G	Potential problems with blending supply. Should still meet regulations as already treated from plant.	A	Unknown at this stage.	A			
Water Conservation, Water Reuse / Former Domestic Wells / Wastewater Reuse Short term option to compliment	Cost of a full Conservation initiative across all stakeholders would be minimal. Short time scales. Need to be wary of this initiative distracting stakeholders from the more pressing Wastewater challenges.	G	Short time scales to activate.	G	Can pull collective expertise from regional stakeholders, in house communications/marketing departments, other provincial WSA campaigns and more.	G	Water conversation and other initiatives will not solve long term growth problems however they will buy the region more time to design the way forward. Water conversation will also benefit Wastewater servicing by reducing influent flows.	A	Not applicable.		This may be challenging for some communities, and may cause nuisance with citizens depending how strictly conservation measures are enforced (e.g. through bylaws and fines)	A	Not applicable.		Water conversation would benefit the local environment.	G			Collective effort to develop and test messaging, develop and track performance measures, will deliver great results and further build working relationships across the region.