CHESTERMERE

Chestermere Stormwater Master Plan

October 2020

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Executive Summary

This Stormwater Master Plan (SMP) outlines a strategy and requirements for future stormwater utilities in the City of Chestermere between the existing City boundary and the Old Municipal Boundary (annexation lands). Development in the annexation lands is currently proceeding on the basis of an interim strategy using zero-release stormwater management facilities. This approach has been taken to protect water quality until an independent outfall is provided for the annexation lands.

Currently, there are no constructed minor or major drainage systems in the annexation lands. Stormwater management and design is complicated by the lack of any regional stormwater conveyance system, which has meant that the design of storm trunks and outfalls in the annexation lands has generally not proceeded. Previously, the City partnered with the Co-operative Stormwater Management Initiative ("CSMI", MPE 2014) for a more regional approach to stormwater management. However, in December 2019, the City Council directed Administration to explore alternative options for stormwater management that will maximize efficiencies, bring stability to the stormwater utility, promote smart spending as outlined in the 2019-2022 Strategic Vision, and immediately withdraw from the CSMI.

An extensive review of available background documents was undertaken to summarize and incorporate the history and status of stormwater management in Chestermere. The City's Design Guidelines (City of Chestermere, 2011), promote an integrated approach to site development and include a section on stormwater, which advocates for low impact development (LID) approaches, while the 2015 Integrated Stormwater Management Plan (ISMP) (Urban Systems, 2015) characterizes stormwater catchments, defines stormwater release rates and volume targets, assesses LID effectiveness, reviews regulatory considerations and wetland preservation requirements, and develops a range of high-level stormwater servicing options. Recent developer drainage concepts for various parts of the Chestermere annexation lands generally appear to be following the stormwater rate and volume targets that were recommended in the ISMP. The recent developer plans also include designs for intermediate retention ponds and preservation of wetlands that have been deemed important for ecological and environmental functions.

To arrive at a Stormwater Master Plan, an overall stormwater servicing strategy was developed for the ultimate build-out scenario, based on the background documents, City design guidelines, existing drainage conditions, and the stormwater infrastructure proposed by developers. The stormwater servicing strategy integrates the proposed stormwater infrastructure with future storm ponds, trunks and pump stations. The proposed infrastructure was designed with a general understanding of the site grades, previous preliminary drainage plans, and a digital watershed delineation and overland flow path analysis. A key element of the servicing strategy is to use the natural drainage pattern in the area to direct all stormwater south to a centralized pond, which will be used to maintain required stormwater release rates to an ultimate outfall that is being considered under a separate future investigation. This

centralized pond concept is the primary means for maximizing infrastructure efficiencies and reducing capital costs, in line with the City Council's December 2019 directive.

To develop the servicing strategy, the annexation lands were broken into four parts (east, west, southeast, and southwest), based on topography and drainage patterns. Locations and sizing for stormwater sewer mains were then conceptually designed in order to deliver all drainage to the centralized pond. Two options (A and B) were developed and are based on whether the northeastern catchment is included in the centralized system.

Sizing and costing of the centralized pond will be conducted through a separate feasibility study. However, the feasibility for the storm mains to connect to the proposed centralized pond was checked given standard requirements for pond designs and geographical considerations for land area, elevations, and required pipe slopes, depths, and inverts. This includes an assumed high water level (HWL) for the pond of 1021 m, as provided by the City, as well as the assumption that a wet pond will be installed, since this is needed to avoid the need for additional pump stations. The analysis indicated that no major obstacles should exist for the drainage infrastructure to connect the centralized pond system. However, one pump station will likely be required to service the southeast area.

Conceptual level capital costs for the servicing strategy in each area were developed using unit rates compiled by the project team. These costs exclude the centralized pond, which will be sized in the future and exclude branches extended from the stormwater trunks. The total estimated capital cost for the infrastructure considered in this strategy is $18,541,000 for Option A and $19,784,000 for Option B. Of these costs, roughly 70% are related to the costs of the storm trunks, which have a total length of approximately 15.3 km and 15.6 km for Option A and B, respectively. Further optimization of the preliminary designs is recommended to possibly reduce the capital costs. For example, relocating the centralized pond may reduce trunk costs and/or eliminate the need for a pump station in the southeast area.

Further recommendations for this strategy include to encourage coordination among stakeholders and to encourage the implementation of LID technologies by developers.

1. Introduction

The City of Chestermere (the City) retained Kerr Wood Leidal Associates (KWL) in association with MPE Engineering (MPE) to prepare two reports to assist with future stormwater management planning. The two reports involve two separate assignments as follows:

1) A detailed assessment of the City's existing stormwater system to outline the capacity and constraints of the current stormwater system; and
2) An updated Stormwater Master Plan (SMP) to provide a plan for future stormwater utilities required by development.

This report summarizes the updated SMP and focuses on the annexation lands mainly outside the Old Municipal Boundary as shown on Figure 1-1.

As part of a separate project, the City is also currently evaluating alternatives to obtain an approved outfall for future Chestermere development. A regional stormwater outfall is required for new development to occur in the annexed lands. The existing development in Chestermere outfalls to the Western Irrigation District (WID) but due to the stormwater quality guidelines that were introduced in 2007 by WID this is no longer an option for stormwater from the annexed lands. Currently, post 2009 annexation lands are under an interim zero release condition until an approved outfall can be secured.

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City of Chestermere

Comprehensive Stormwater Master Plan

MPE Engineering Ltd.

KERR WOOD LEIDAL consulting engineers

Legend

- CN Railway
- Pre-2009 Annexation Boundary
- City Boundary
- Existing Stormwater System Assessment
- Stormwater Master Drainage Plan Area

N

HWY 1

CHESTERMERE BLVD

HWY 1

EAST MERGANSER DR

Chestermere Lake

DRAFT

Coordinate System: NAD 1983 UTM Zone 12N

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Date September 2019

Scale 1:30,000

Stormwater Master Drainage Plan Area

Figure 1-1

2. Scope of Work

Developing the updated SMP involved reviewing background documents and developer submissions, subcatchment mapping, and developing a conceptual SMP including future pond locations and trunk alignments. An extensive review of the background documents was undertaken to understand the history and status of stormwater management in Chestermere. A complete list of the documents that were reviewed is provided in the References section at the end of this report. The background review included the following:

- Regional stormwater planning documents including the Co-operative Stormwater Management Initiative ("CSMI", MPE,2014), and the City of Chestermere Integrated Stormwater Master Plan ("ISMP", Urban Systems, 2015);
- City of Chestermere Bylaws, Engineering Design and Construction Standards, and Wetland Policy to identify stormwater management design criteria and standards and wetlands of special interest to the City;
- Chestermere Municipal Development Plan (2016), and Chestermere Utility Master Plans (2010, 2017);
- Various Area Structure Plans (ASPs), to understand planned land developments and previous stormwater management concepts. Plans reviewed included:
    - Waterbridge Master ASP;
    - Mountain View Park ASP;
    - Edgewater Crossing ASP;
    - Chestermere Gateway ASP;
    - Waterford ASP; and
    - Westmere ASP.
- Developer-submitted Master Drainage Plans (MDP) and Staged Master Drainage Plans (SMPD) across the Annexation area. Using the developer submissions, a list of the proposed stormwater management facilities such as ponds and pump stations was compiled.

Following the review of the background documents, the following tasks were undertaken:

- Preparing figures for proposed catchment areas according to the developer submissions;
- Identifying a conceptual servicing strategy to convey stormwater to a centralized pond location.

- Developing Class ‘D’ cost estimates for the proposed offsite infrastructure, excluding the infrastructure within the developer MDP’s and SMDP’s, which will be paid for by the developer; and
- Preparing a summary report including figures, cost estimates, and conclusions and recommendations.

3. Stormwater Master Planning Considerations

To provide the context for the updated SMP, this section provides an overview of the existing stormwater management system, two recent reports which considered regional stormwater management, and the Chestermere Drainage Design Standards and Wetlands policy.

3.1 Existing Drainage System Background

The area considered for the SMP is between the current City boundary and the Old Municipal Boundary (pre-2004) and is shown in Figure 3-1: Stormwater Master Plan Area, and will be generally referred to as the Annexation lands or Outline Plan Areas. The natural topography around Chestermere generally drains the land from north to south and most of the natural runoff enters the Western Headworks Canal, located on the south side of Chestermere. The total area of the Annexation lands is approximately 2115 ha. External catchments to the north and west are currently draining into the Annexation lands and managing the runoff from these areas is an important consideration in the overall SMP and servicing strategy. Development in the area is currently proceeding on the basis of an interim strategy using zero-release stormwater management facilities. There is no constructed minor or major drainage systems in the annexation lands.

In 1980, AESRD imposed a moratorium on stormwater drainage to the Western Headworks (WH) Canal, and in 2005 the City and the Western Irrigation District (WID) signed a Use of Works agreement to manage stormwater that is directed into the irrigation system. In 2007, the WID established very high water quality standards for any new urban developments that have generally required developers in the region to rely on zero-release approaches to manage stormwater. Such approaches are being proposed as an interim measure for developers in the Annexation lands until an independent outfall is provided. This approach involves the irrigation of absorbent landscaping, Municipal Reserve lands, and agricultural lands using the stormwater ponds as the water source. These stormwater ponds need to be substantially larger than typical ponds with an outfall in order to adequately contain the runoff from developments.

External runoff from the relatively large West Creek Basin also enters the existing Chestermere system through the Westmere area and is conveyed southward into the Rainfall Falls South stormwater pond, which discharges into the Rainbow Falls Underdrain (also known as the West Creek Underdrain). The underdrain is comprised of 2 X 1350 mm concrete pipes below the Western Headworks (WH) Canal, a 1650 mm diameter concrete pipe that discharges to Chestermere Lake, and two 600 mm X 1200 mm concrete box culverts which are overflows to the WH Canal during the 1:100 year flow. The underdrain was sized based on a 1:100 year pre-development

flow rate for the West Creek Basin of 7.2 m^3/s, which is comprised of 4.18 m^3/s of peak flow to Chestermere Lake, plus up to 3.02 m^3/s of peak flow to the WH Canal.

Stormwater management and design is currently complicated by the lack of a regional stormwater conveyance system, which has meant that the design of storm trunks and outfalls in the Annexation lands has generally not proceeded. In 2014, a decision was made by the City of Chestermere and CSMI partners to adopt the Out-of-Canal option for the regional conveyance of stormwater. The objective was to provide an outfall to manage existing drainage issues and provide conveyance for future development, while protecting water quality in the main irrigation system. A water balance analysis, completed in 2015, recommended stormwater targets to manage downstream constraints. The CSMI master stormwater agreement between the partners, executed in 2018, provided an overall framework on how stormwater will be managed throughout the system. However, in December 2019, the City Council directed Administration to explore alternative options for stormwater management that will maximize efficiencies, bring stability to the stormwater utility, promote smart spending as outlined in the 2019-2022 Strategic Vision, and immediately withdraw from the CSMI.

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City of Chestermere

Comprehensive Stormwater Master Plan

MPE Engineering Ltd.

KERR WOOD LEIDAL consulting engineers

Legend

- City Boundary
- Pre-2009 Annexation Boundary
- CN Railway
- Approved Pond Location

N

HWY 1

Waterbridge North MASP

North Acreages

Bridgeport

Mountain View Park ASP

CHESTERMERE BLVD

Bridgeport

Chestermere Lake

East Acreages

Chelsea

Dawson's Landing

Waterford Stage 3

Waterford Stage 1

South Shores

Sierra Vista

Waterford Stage 2

Edgewater ASP

Paradise Meadows

Edgewater Crossing

Edgewater ASP

Webster

Bablake

South Light Industrial

DRAFT

Coordinate System: NAD 1983 UTM Zone 12N

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Scale 1:30,000

Master Plan Area

Figure 3-1

3.2 Design Guidelines & Standards

The City's Design Guidelines (City of Chestermere, 2011), promote an integrated approach to site development and include a section on Stormwater which advocates for Low Impact Development (LID) approaches including permeable pavers, grassed swales, landscape strips or planters adjacent to parking areas, and grey water recycling for irrigation purposes. Based on our review of the recent development MDP's and SDMP's, it appears that the adoption of LID practices has been very limited to date and no specific examples where LID will be adopted were found, apart from using stormwater for irrigation. The irrigation option is seen as the most economically favourable LID practice.

The City's Engineering Design and Construction Standards (City of Chestermere, 2013) cover design and installation requirements for the storm drainage system. Section 2.1 indicates that the minor system is to be designed for the 1:5 year event and the major system for the 1:100 year event, and that the City discourages the use of stormwater pumping stations. The City's Engineering Design Standards do not currently provide any technical guidance regarding green infrastructure such as rainwater harvesting, green roofs, bioretention, etc. It is understood that the City is supportive of the use of Green Infrastructure approaches and is interested in on-going research into bioretention performance in cold climates.

3.3 Wetlands

The City's Wetland Policy was approved by Council in 2013 and was supported by a detailed wetland inventory. The inventory covered 2380 ha of land that had been annexed by Chestermere up to that time, but excludes the current Mountain View Park ASP and East Acreages lands. The inventory concluded that of the 275 wetlands identified, 28 were rated as having exceptional ecological and hydrological significance. The City later adopted the Wetlands Bylaw (City of Chestermere, 2015) which states that (Section 11.3):

> "*The wetlands … with the numbers 1,2,3,4,5,6,7,8, and 9 on the map attached as Appendix A shall be retained to the extent practicable. These wetlands will be integrated with a City-approved stormwater system, provided that the operation of the qualified stormwater system maintains the wetlands' incoming water quality, hydrology, and wetland classification*".

The wetlands to be retained (if practicable) are illustrated in Figure 3-2. The Bylaw identified an additional three wetlands that "*shall be prioritized for retention*" and these are illustrated in Figure 3-3.

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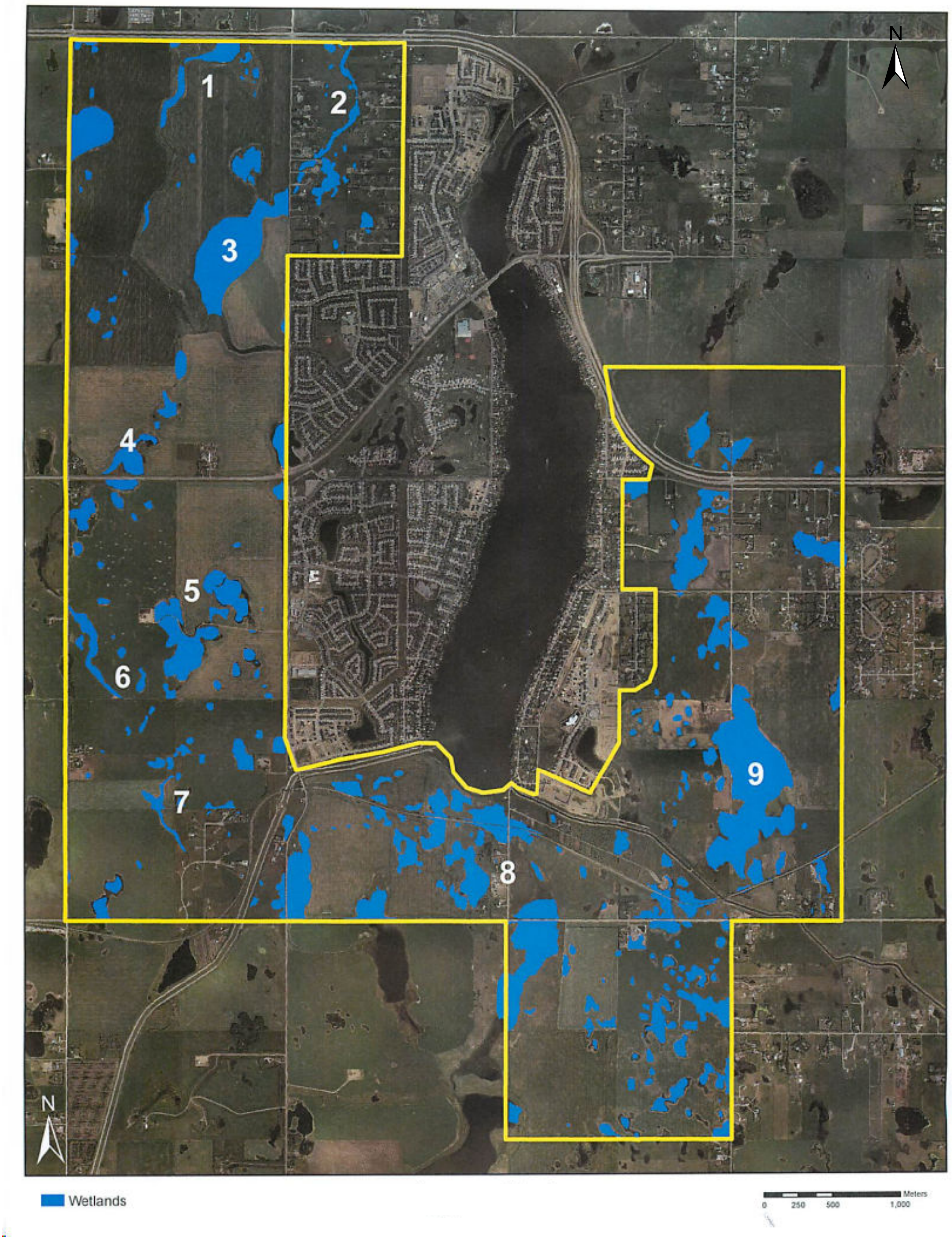

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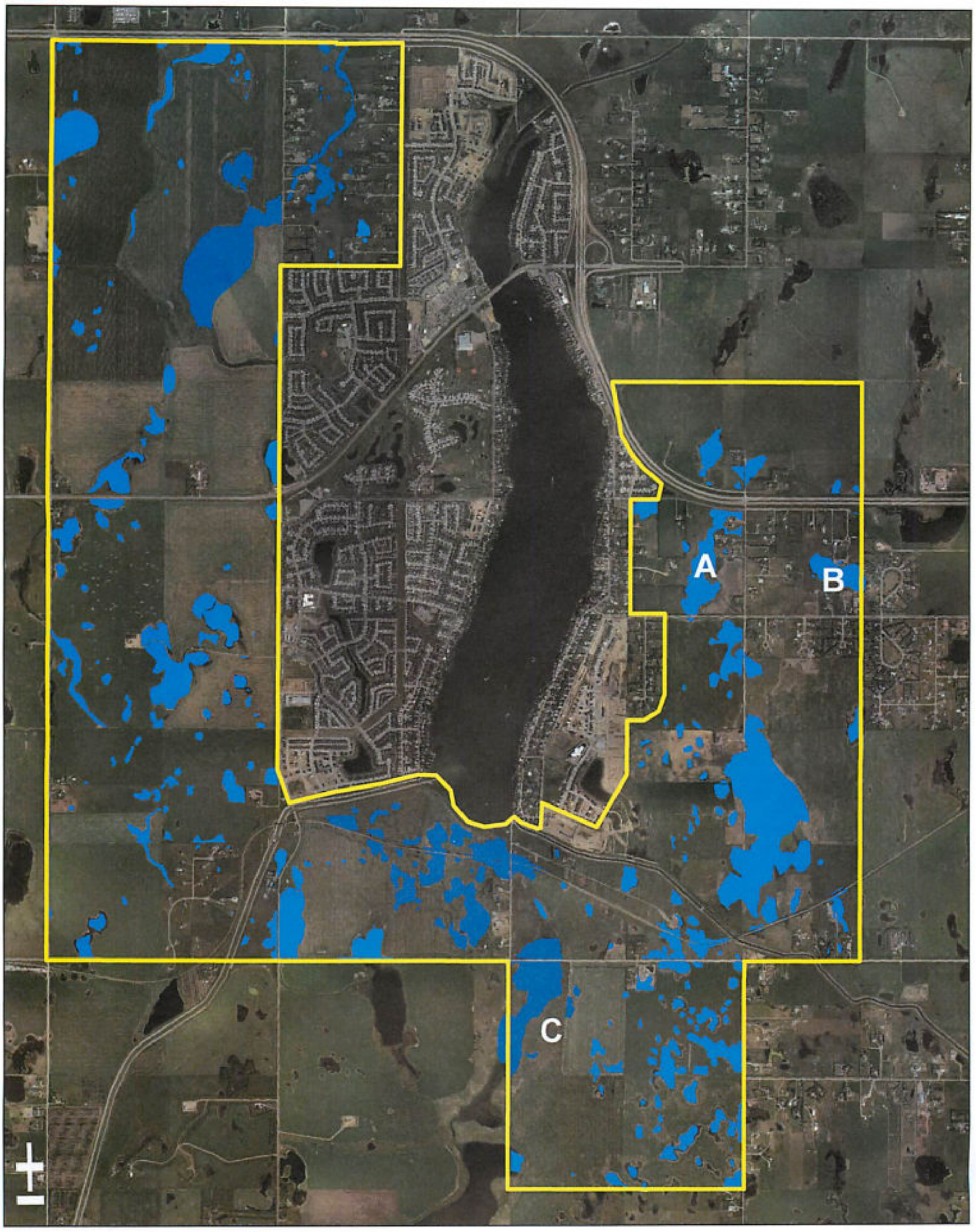
Wetlands to be Retained:
Wetland Policy Clause 11.3 (a)

Figure 3-2



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Wetlands Prioritized for Retention: Wetland Policy Clause 11.3 (b)

Figure 3-3

The requirements in the wetland bylaw could impact the alignment of future storm trunks and routing of external flows and raise the possibility of integrating wetlands into the constructed stormwater system. There are at least two noteworthy examples in Chestermere where wetlands were explicitly considered in the developers' submission. The first case is in the Bridgeport / Dawson's Landing area where the proposal is to retain two existing wetlands and that "*To maintain the wetlands … infrastructure will be in place to provide options for managing wetland hydrology. These options include providing a supplemental water source or facilitating wetland drawdown, as needed, to meet the targeted hydroperiod*" (Westhoff Engineering Resources, 2016). The second case is in the Chestermere Industrial Park, where the proposal is to replace an existing wetland with a "Naturalized Wet Pond" stormwater management facility, as a pilot study involving Alberta Environment and Parks (McElhanney, 2017). These examples show that novel approaches and additional technical effort may frequently be needed to incorporate wetlands in the overall drainage design.

3.4 Integrated Stormwater Master Plan

This report by Urban Systems was prepared in 2015 to develop a stormwater master plan for the City's new Annexation lands. The study scope included catchment characterization, definition of stormwater release rates and volume targets, assessment of Low Impact Development (LID) effectiveness, and review and discussion regarding regulatory considerations, wetland preservation, and development of "high-level" stormwater servicing strategies. At the time of the study, neither the Shepard Regional Drainage Plan nor the CSMI regional servicing strategy had been selected. The study recommended / flagged the following:

- A maximum allowable post-development release rate of 0.8 L/s/ha and target volume control (annual average runoff depth) of 40 mm, consistent with the values in the Shepard Regional Drainage Plan;
- The City should promote and encourage the use of LID's and should establish minimum LID requirements for new subdivisions; and
- The study flagged that a CSMI servicing option for the area north of Highway 1 would reroute West Creek Basin flows around the northern town boundary and would cut-off much of the base flow to Wetland W1 (which is to be retained according to the City's Wetland Policy) and the naturalized drainage system downstream. The total external catchment area is approximately 3000 ha and it will be important to coordinate the runoff from this area with the future servicing system.

The recent developer drainage concepts for various parts of the Chestermere Annexation lands generally appear to be following the stormwater rate and volume targets that were recommended in the ISMP. In most cases, this means that all

post-development runoff will be managed on-site using a zero-release approach. Once a regional stormwater outfall is in place, the ponds will release at the approved rate, which in most cases is 0.8 L/s/ha.

4. Approved Developer Stormwater Plans

The following two sections provide an overview of the stormwater management concepts to date in each of the Outline Plan areas, based on our review of the developer submitted MASP's, ASP's, MDP's, and SDMP documents. The Outline Plan Boundaries are in Section 3, Figure 3-1.

4.1 West Catchments

Existing Conditions

This section covers the area west of Rainbow Road, between Highway 1 on the north and Township Road 240 on the south. Most of the existing area is currently agricultural land, except for some country residential development at the far south end in Paradise Meadows. Runoff from the West Area drains either into Chestermere Lake via the West Creek Underdrain or drains overland into WH Canal.

The West Creek Basin flows into the area through two channels that intersect Highway 1. The east channel has a catchment area outside of Chestermere of between 1938 ha (Westhoff, 2012) and 2755 ha (Urban Systems, 2015). The runoff from the east channel is conveyed under Highway 1 and enters the Waterbridge North MASP area under Rainbow Road, approximately 1 km south of Highway 1. It then drains into a large wetland, which in turn drains into a box culvert under Rainbow Road. From the box culvert, the runoff is routed through a constructed naturalized drainage system crossing several communities within the Old Municipal Boundary. The second West Creek Basin channel has a reported catchment area as low as 282 ha (Urban Systems, 2015) and as high as 851 ha (Westhoff, 2012). The runoff from this second channel flows under Highway 1 and into the same large wetland that drains into the box culvert under Rainbow Road ultimately to the West Creek Underdrain.

The third external catchment is the Belvedere East catchment, which is part of the Belvedere ASP area. The Belvedere East catchment has a total external drainage area of 826 ha. Of this, 491 ha lies north of Highway 1 and 335 ha lies south of Highway 1 (Westhoff, 2015a). The flow is conveyed southward in a natural channel that discharges to the WH Canal.

Existing Stormwater Management Concepts

Most of the west area is covered by the Waterbridge Master Area Structure Plan (B&A Planning Group, 2014). The Waterbridge MASP covers a total area of 970.9 ha and the stormwater management concept from the MASP is shown in Figure 4-1. According to the Waterbridge MASP, 1) all existing stormwater flows would be allowed to enter Waterbridge and the external flows would intermix with flows generated within the MASP area, and 2) the combined stormwater flows would be conveyed south to

the Shepard Ditch Stormwater Management System by natural or man-made channels or piped systems.

Most of the Waterbridge MASP area will be re-graded during development and runoff will be diverted to stormwater ponds which will ultimately connect to the regional conveyance system. The only exception is the Waterbridge North MASP area, which will continue to drain into the box culvert under Rainbow Road and into the Old Town communities. The planned land use in the MASP area is predominantly residential, except for some light industrial / business park at the north end, and a mixed-use / Town Centre zone along Highway 1A.

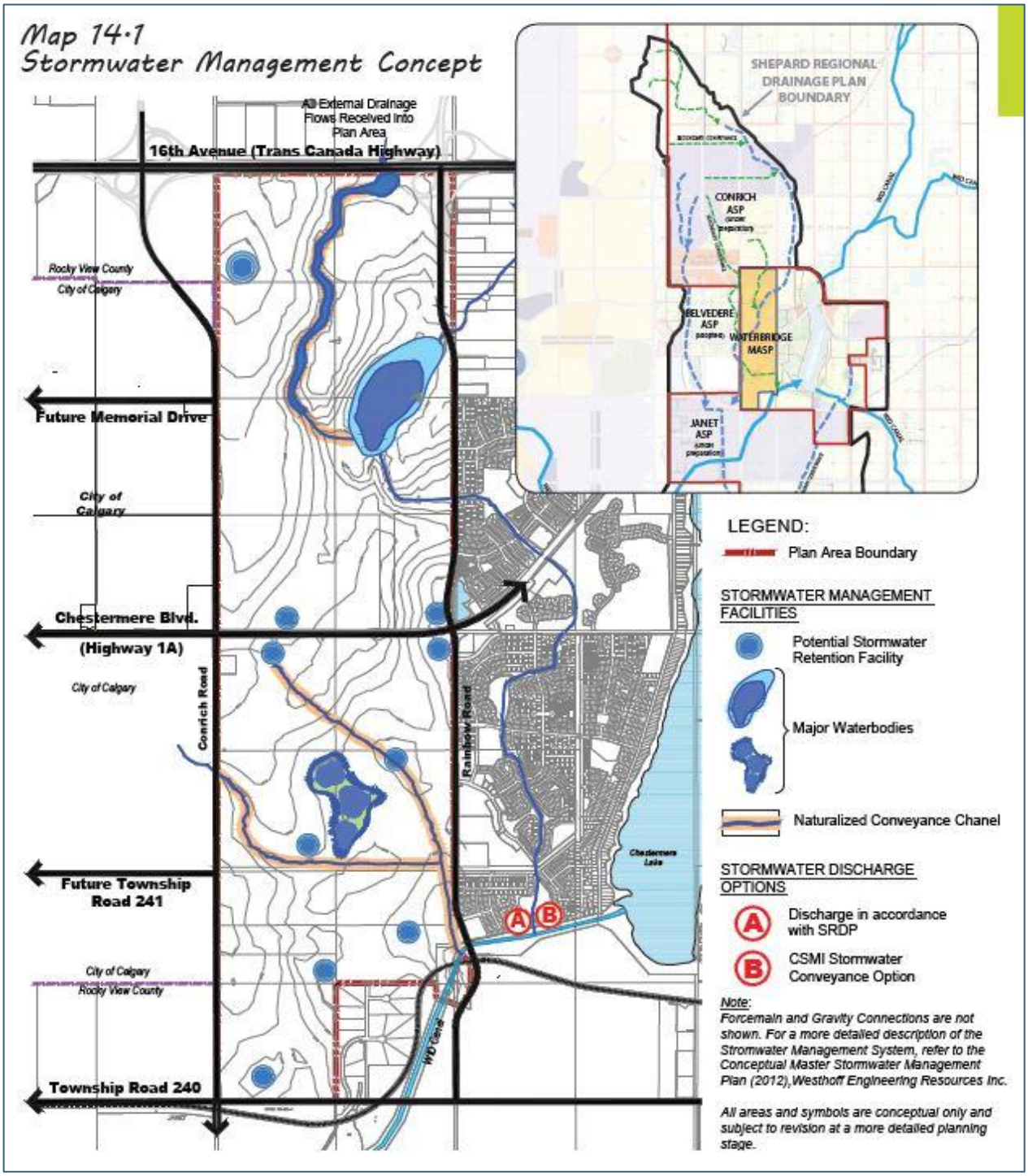


Figure 4-1: Waterbridge MASP – Stormwater Management Concept

It was assumed that the future development areas in the West Creek Basin north of Highway 1 will be diverted east. Development in areas such as Belvedere and Conrich are likely to be redirected away from Chestermere, as noted in the Conrich MDP and CSMI, however, it is still planned to allow undeveloped areas to continue down West Creek.

The following sections give an overview of the stormwater management concepts that have been proposed in the various MDP's and SMDP's for new developments.

North Acreages

This area is an existing county residential. No ASP's or drainage concepts have been developed for this area.

Waterbridge North MASP

This area is bounded by Highway 1 on the north side and the Bridgeport Outline Plan boundary on the south. This area has two well-established natural drainage channels and a large wetland. Most of the runoff is conveyed southeast into an existing culvert under Rainbow Road. There are no detailed drainage plans available for this area.

Bridgeport

A Staged Master Drainage Plan was prepared for this area (Westhoff, 2016) and it proposes Pond 1, Pond 1A, and Pond 1B. Pond 1 and Pond 1A will be interconnected by a drainage ditch. Pond 1A and Pond 1B will discharge separately to an off-site stormwater trunk, which has yet to be designed. The Bridgeport pond details are summarized in Table 4-1: Bridgeport Pond Summary. The unit release rates from Pond 1A and Pond 1B range from 0.76 L/s/ha to 0.78 L/s/ha and therefore meet the ISMP targets.

Table 4-1: Bridgeport Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 1	68.55	1040.4	0	0.0550	110,861	Drains to Pond 1A
Pond 1A	106.63	-	0	0.1340	190,974	
Pond 1B	31.88	1032.9	0	0.0250	54,536	
Total	**207.06**		**0**	**0.214**	**356,371**	

Dawson's Landing

Two ponds are proposed in this area just south of Highway 1A. Pond 2A is planned in the NE part of the area and includes a Nautilus Pond (clarifier), main pond, and vegetated wetland. Pond 2B is planned in the centre of the area and will be a conventional wet pond, with zero release in the interim.

The ultimate unit release rates vary from 0.88 L/s/ha for Pond 2A to 0.79 L/s/ha, therefore the release rate for Pond 2A appears to be slightly greater than the target of 0.8 L/s/ha in the ISMP. These ponds will discharge to a future trunk in Rainbow Road.

Table 4-2: Dawson's Landing Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 2A	78.73	1028.8	not defined (see Magna report)	0.0695	104,024	See Pond Report (Magna, 2018)
Pond 2B	86.15	1030.5	0	0.0680	149,723	See Pond Report (Westhoff, 2018c)
Total	**164.88**		**0**	**0.1375**	**253,747**	

Chelsea

The Chelsea area is bounded by Highway 1A on the north and the west boundary of Chestermere on the west, and the total area is 128 ha. According to the pond report (Westhoff, 2017b) runoff will be managed using three ponds in series, with the release rate controlled by the downstream pond (Pond 3). Details on the three ponds are in Table 4-3: Chelsea Pond Summary.

Table 4-3: Chelsea Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 1	18.31	N/A	N/A	2.2020	11,344	Spill to Pond 2
Pond 2	48.9	1035.7	N/A	0.0540	57,533	Spill to Pond 3
Pond 3	58.94	1033.5	0	0.1010	82,822	Overall discharge controlled by Pond 3
Total	**126.15**		**0**		**151,699**	

Waterford Stage 1

Drainage concepts for Waterford Stage 1, Stage 2, and Stage 3 were presented in the Waterford MDP (Westhoff, 2015b). Waterford Stage 1 is an L-shaped area and the planned land use is a mixture of single family residential, townhouses, high-density mid-rise condominiums, and commercial uses. Two ponds operating independently are planned. A storm trunk servicing plan was developed as part of the MDP for this area (Westhoff, 2017a). Details on the planned ponds are in Table 4-4.

Table 4-4: Waterford Stage 1 Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 1	61.15	1029.8	0	0.0490	84,011	Pond data from Pond Report (Westhoff, 2018b)
Pond 2	15.83	1032.5	0	0.0130	28,222	Pond data from Pond Report (Westhoff, 2018b)
Total	**76.98**		**0**	**0.062**	**112,233**	

Waterford Stage 2

This area is at the extreme southwest corner of the west Annexation area and is currently used for agricultural purposes. According to the SMDP (Urban Systems, 2018), the ultimate pond discharge will be conveyed northeast in a piped system to connect to the existing West Creek Underdrain. A summary of the pond characteristics is in Table 4-5. The unit release is 0.83 L/s/ha @ High Water Level and is slightly greater than the ISMP target of 0.8 L/s/ha.

Table 4-5: Waterford Stage 2 Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 1	64.1	1032.0	0	0.0531	89,728	

Waterford Stage 3

This area is on the west side of Waterford Stage 1. One pond is planned for Waterford Stage 3, according to the MDP for the area (Westhoff, 2015b) and the required pond volume is between approximately 78,000 and 97,000 m^3. The MDP did not provide any further details on the pond.

Paradise Meadows

This area is adjacent to the CN Railway and is existing county residential. No ASP's or drainage concepts have been developed for this area.

4.2 South Catchments

Existing Conditions

The land use in the south catchments is mainly agricultural and the land generally drains south toward the Shepard Slough Complex and ultimately the Bow River. The area includes extensive wetlands, one of which is to be retained according to the City's Wetlands Policy. The lowest elevation in the south catchments is approximately 1018 masl (roughly 7 meters below the level in Chestermere Lake) and it will be necessary to pump stormwater northward from much of the area up to the future central pond system.

Existing Stormwater Management Concepts

A stormwater servicing strategy was previously presented for the south area in the ISMP (Urban Systems, 2015). The strategy included three ponds and pump station to convey flow to the CSMI system. More recently, updated drainage plans have been submitted for the South Shore area, and a stormwater servicing concept is included in the Area Structure Plan (ASP) for Edgewater Crossing.

Edgewater Crossing

The Edgewater Crossing ASP has a stormwater management concept with four drainage areas, four ponds, and potential future tie-ins to the Shepard Slough System to the south. Two of the ponds in the ASP are next to each other and were combined for the purposes of this report. The ASP indicates that consideration should be given to constructing engineering stormwater wetlands in compensation for the existing wetlands in the area.

South Shores

This area is within the Old Municipal Boundary. A single stormwater pond is planned at the east end of the area, and the pond details are in Table 4-6. The planned maximum discharge rate from the pond at the Normal Water Level (NWL) and above is 160 L/s (IBI Group, 2017). The planned discharge location is the WH Canal (that drains into Chestermere Lake).

The planned discharge into the WH Canal could potentially be changed to discharge into the future centralized pond system. South Shores was included in the present study to flag this option and facilitate discussion.

Table 4-6: South Shores Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ NWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 1	32.01	1022.4	N/A	0.1600	37,829	Pumped to WH Canal

4.3 East Catchments

Existing Conditions

The east catchments are east of the Old Municipal Boundary, between Township Road 243 on the north and one section south of Township Road 240 on the south side. The existing east catchments north of Canal A generally drain southward toward Canal A. One notable exception to the general (north to south) drainage pattern is the northeast part of the Mountain View Park ASP area, which drains from south to north. The catchments that are south of Canal A generally drain south toward the Shepard Slough system. The east catchments have extensive natural low areas that have no well-defined drainage outlet. There are also extensive wetlands and Wetland 9 in the Sierra Vista area is to be retained according to the City's Wetland Policy.

There is currently no stormwater minor system in the east catchments and the land use is mainly country residential or agricultural. The CN Railway and the WID Canal 'A' cross the south side of the east catchments. A watershed delineation by KWL showed that approximately 73 ha of catchment on the north side of Highway 1 may be draining into the Mountain View Park ASP area. A field check is recommended to confirm culvert locations and the general drainage patterns on the north side of Highway 1.

Existing Stormwater Management Concepts

The planned land use in the area is predominantly residential, except for areas of light industrial or commercial lands in parts of the Mountain View Park ASP, Sierra Vista, and Webster Outline Plan areas.

Under the centralized pond strategy, two options were developed to manage runoff from the East catchment. Under Option A, runoff from most of the east Annexation lands will be conveyed south under the WH Canal to the centralized pond; however, under the drainage concept in the ISMP (Urban Systems, 2015) runoff from the Mountain View Park ASP catchment S1 would be released to off-site stormwater facilities in Rocky View County (RVC) and runoff from catchment S2 would be released south into the East Acreages area and ultimately to the centralized pond system. Under Option B, all runoff would be conveyed south under the WH Canal to the centralized pond.

There are two approved drainage plans for parts of the east catchment, and these are discussed in the following sections.

Mountain View Park ASP

According to the approved drainage report (Stantec, 2009), this area will be serviced by one on-site pond ("Pond B") and two off-site ponds in RVC, as previously mentioned. Pond B is an irrigation – evaporation pond with zero release and the Pond B characteristics are in Table 4-6. If the pond has been constructed, then the data in Table 4-6 is out of date and should be updated based on as-builts. The emergency overland spill route for Pond B was not defined in the drainage report. It may be advisable to provide an escape route to the south, which is discussed later in Section 5.3.

Table 4-7: Mountain View Park ASP Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Future Pond B	118.1	N/A	N/A	0.0	376,300	Pond data from Table 5.2 (Stantec, 2009); Irrigation and evaporation pond.

Bablake

This area is bounded by Canal A on the north and the CN Railway on the south. The area is also known as Kinniburgh South. The drainage concept (ISL Engineering, 2017) is for one pond to service the west portion of the development and one pond to service the east portion. The west portion is within the Old Municipal Boundary, and the proposal is for the west pond to release to the WH Canal at 2.1 L/s/ha.

The report proposes that the east pond will release to a future storm trunk at 1.5 L/s/ha (ultimate build-out) based on the release rate that was identified in the Utility Master Plan (Stantec, 2010). According to the report, if an interim zero-release approach is required for the east pond, a larger pond will be required.

Further information on the Bablake ponds is in Table 4-8: Bablake Outline Plan Pond Summary.

Table 4-8: Bablake Outline Plan Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
West Pond	20.7	missing	N/A	0.0435	9,300	Inside Old Municipal Boundary >> Discharge to WH Canal
East Pond	20.9	missing	See Notes	0.0314	9,350	Design release rate 1.5 L/s/ha exceeds the ISMP recommended release rate 0.8 L/s/ha; the East Pond analysis and sizing did not consider a zero-discharge scenario.

Webster

One stormwater pond is proposed to service Webster (McElhanney Consulting, 2017). The pond was sized based on the ultimate build-out and assuming a release rate of 0.8 L/s/ha by continuous pumping to the future CSMI system. Details on the Webster pond are in Table 4-9.

Table 4-9: Webster Outline Plan Pond Summary

Pond	Catchment Area (ha)	Normal Water Level (m)	Interim Discharge @ HWL (m^3/s)	Ultimate Discharge @ HWL (m^3/s)	Ultimate Pond Storage Volume @ HWL (m^3)	Notes
Pond 1	40.87	1016.0	0	0.03270	112,918	Continuous pumping to CSMI @ 0.8 L/s/ha.

East Acreages, Sierra Vista, South Light Industrial

No developer drainage concepts have been submitted for these areas. The future servicing strategy for these lands is discussed in Section 5.4.

5. Ultimate Stormwater Servicing Strategy

5.1 Introduction

KWL developed an overall stormwater servicing strategy for the ultimate build-out scenario, based on the background documents, existing drainage conditions, and the stormwater infrastructure proposed by Developers. The stormwater strategy integrates the proposed stormwater infrastructure with future storm ponds, trunks and pump stations. The servicing strategy is based on the following assumptions:

- A single 'centralized pond' will be used for stormwater regional discharge strategy;
- Sizing of the centralized pond will be determined through future work to evaluate various options under a separate project titled 'Chestermere Stormwater Outfall Feasibility Study';
- The centralized pond will be located on the south end of Chestermere as identified by the City; and
- All developments will meet Alberta Environment water quality standards, 0.8 liters/second/hectare peak discharge rate and a 40 millimeter/hectare volume control from the developed lands.

Two options were developed for the servicing strategy, with moderate differences in stormwater conveyance for the East catchments, For Option A, runoff from the Mountain View Park ASP catchment will be released to the off-site stormwater management facilities located in Rocky View Country (see Section 5.5 for further details). For Option B, runoff from the Mountain View Park ASP catchment will be conveyed to the centralized pond system. To arrive at preliminary alignments and locations for future infrastructure, it was assumed that the following wetlands will be retained:

- Wetland #3 in Waterbridge North MASP;
- Wetland #4 in the Bridgeport area;
- The portion of the wetland within the South Light Industrial area; and
- Wetland #9 in the Sierra Vista area.

The proposed infrastructure was designed with a general understanding of the site grades, previous preliminary drainage plans, and a digital watershed delineation and overland flow path analysis. The proposed stormwater servicing strategies for each area are discussed in the following sections. The required pipe diameters were estimated assuming full flow in the pipe, a Manning's n of 0.013, and pipe slopes consistent with the City's design standards. It was also assumed that the minimum pipe diameter was 450 mm, regardless of the contributing area.

5.2 Centralized Pond Assumptions

A centralized pond concept was provided by the City for servicing the west, southwest, east, and southeast catchments. Sizing and costing of the centralized pond will be conducted through a separate feasibility study, as previously indicated. However, the feasibility for the storm mains to connect to the proposed centralized pond was checked given standard requirements for pond designs and geographical considerations for land area, elevations, and required pipe slopes, depths, and inverts. In addition, the proposed approximate invert for the pond was checked for conceptual feasibility by back calculated all pipe inverts and checking against existing ground elevations and bury depth requirements. Inverts will require a more detailed confirmation during preliminary design. The following table provides a summary of the pond parameters used for the ultimate stormwater servicing strategy.

Table 5-1: Assumed Parameters for Pond Design

Parameter	Assumption
Location	Directly east of Range Rd 282 between the CN railway and Township Rd 240
Pond design	Stormwater reservoir (wet pond)
High water level	1021 m (provided by the City)
Upper normal water level	1019 m
Lower normal water level	1017.5 m
Pond bottom	1014.5 m
Inlets	Minimum obvert 0.8 m below lower normal water level Minimum invert 0.1 m above pond bottom
Storm main bury depth	Minimum obvert 1.2 m below surface elevation
Approximate Inlet Pipe(s) Invert	1016.3 m

5.3 West Area

The west area encompasses a total area of approximately 1120 ha and the proposed servicing strategy is illustrated in Figure 5-1. The west area will be serviced by a gravity storm trunk that travels from Chestermere Boulevard along Rainbow Road, passes underneath the existing canal and CN railway and then connects to the centralized pond. Trenchless methods (e.g., auger boring) will be needed to install the gravity main under the CN Railway. This means that releases from part of the North Acreages, all Waterbridge North MASP, and the Bridgeport area will need to be conveyed under Rainbow Road and into the existing drainage system in the Old Town, that ultimately drains to the centralized pond. This requires a total trunk length of 5330 m and a maximum pipe size of 1,050 mm. The trunk sizing details and costs are provided in Appendix A.

5.4 Southwest Area

The southwest area encompasses a total area of approximately 160 ha and the proposed servicing strategy is shown in Figure 5-1. All releases will be conveyed by gravity to the centralized pond. The total trunk length is 1530 m and the maximum pipe size is 525 mm. The trunk sizing details and costs are provided in Appendix A.

5.5 East Area

The east area encompasses a total area of approximately 940 ha and the proposed servicing strategy is shown in Figure 5-1. Of this area, under option A, approximately 294 ha will be released off-site to stormwater management facilities to be located in Rocky View Country (Stantec, 2009) while under option B, this area will be conveyed to the centralized pond system. The City will need to determine the preferred arrangement in the long term. The catchments will be conveyed by gravity to the south, pass under the canal and then release into the centralized pond. Trenchless methods (e.g., auger boring) will be needed to install the gravity main under the CN Railway. The total pipe length up to the node connection with the southeast area is 3570 m for Option A and 3950 m for Option B. For Option A, the maximum pipe diameter is 900 mm while for Option B, the maximum pipe diameter is 1050 mm. The trunk sizing details and costs are provided in Appendix A.

5.6 Southeast Area

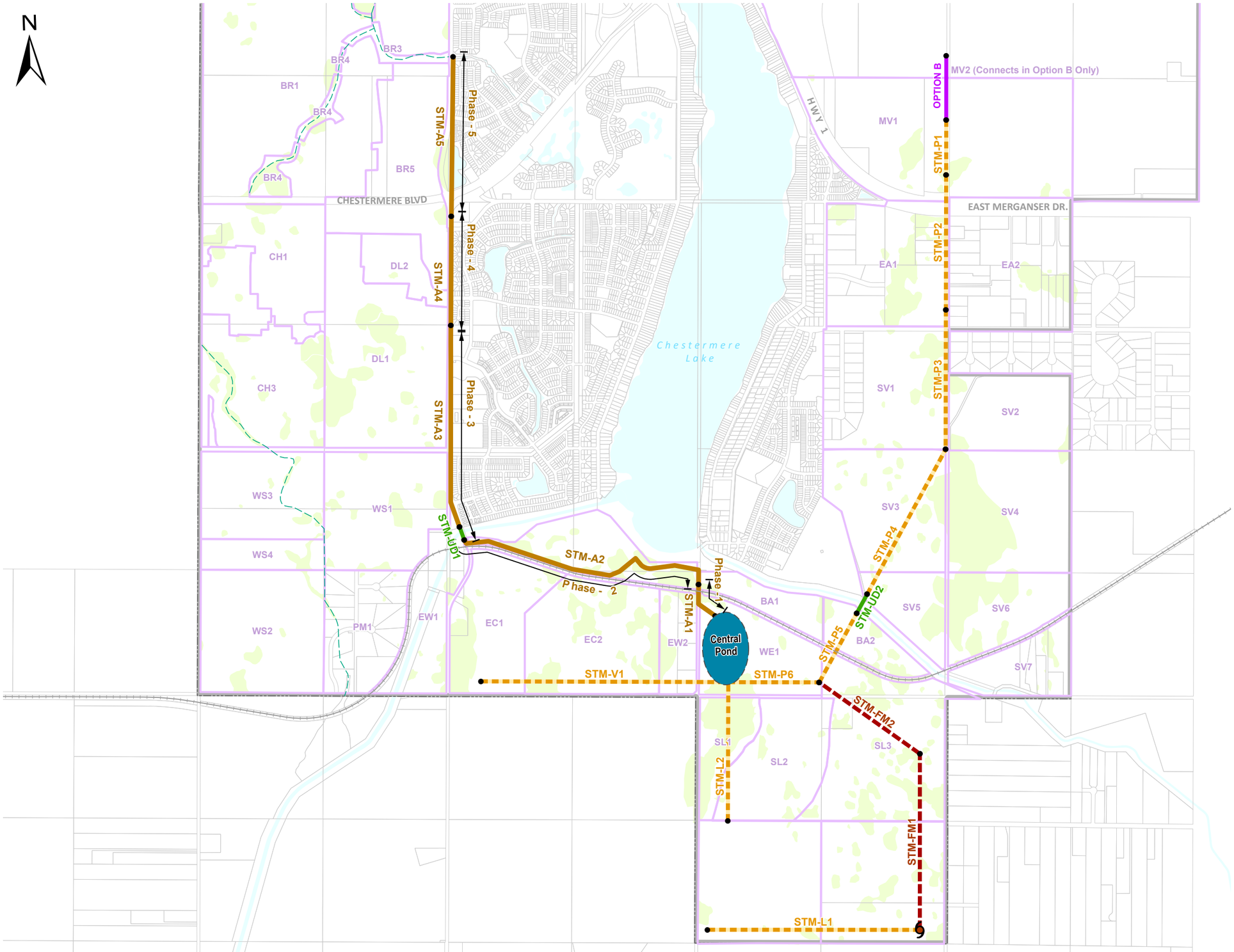
The servicing strategy for this area is more challenging due to lower elevations and the inconsistent overall drainage pattern. The proposed servicing strategy for the total area of 274 ha is shown in Figure 5-1. KWL checked whether it would be feasible to drain the area by gravity to the proposed centralized pond and found that much of this area is too low for gravity drainage. The high-water level for the pond is 1021 m. If designing for a wet pond (stormwater reservoir), using applicable design standards, the pond bottom would have a minimum possible elevation of 1014.5 m (see Table 5-1). Based on existing land elevations and bury depth requirements, this is above the highest possible invert of the inlet pipe from the southeast area using a gravity pipe system (1014 m). Therefore, a forcemain would likely be required for drainage. Some alternate options such as insulating the pipe to allow for a shallower bury depth or moving and placing fill may also be available. However, as a conservative approach, the pump station has been included in the cost estimate.

One pump station would be needed to service the forcemain in the southwest catchment. The total contributing area to Pump Station #1 is 209 ha and the design flow is 251 L/s, assuming a factor of safety of 1.5 is applied. The forcemain will connect to the storm sewer that services the east catchments, which then connects to the centralized pond. Prior to the pump station, the initial gravity main would have a

length of 1390 m and diameter of 450 mm. After the pump station, the forcemain would have a length of 1990 m and a diameter of 400 mm. The gravity sewer after the connection with the east area would have a length of 595 m and a diameter of 1050 mm.

Catchment SL2 drains to the northwest, which can be serviced by a gravity main with a length of 910 m and diameter of 450 mm. The trunk sizing details and costs are provided in Appendix A.

N



City of Chestermere
Comprehensive Stormwater Master Plan

Legend

- City Boundary
- Wetlands
- Catchment
- CN Railway
- Existing Ditch
- Central Pond
- Pump Station
- Future Trunk - West Development
- Future Trunk
- Underdrain
- Future Forcemain
- Option B Only

Servicing Strategy

Figure 5-1

Project No. 3058-002

Date October 2020

Scale 1:25,000 0 100 200 400 (m)

DRAFT

MPE Engineering Ltd.

KERR WOOD LEIDAL consulting engineers

Coordinate System: NAD 1983 UTM Zone 12N

Scale Disclaimer: The map scale of 1:25,000 is only valid on a 11"x17" print.

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5.7 Cost Estimates

Approximate capital costs for the servicing strategy in each area were developed using unit rates compiled by MPE and KWL. The largest source of uncertainty exists around the capital costs for the pump station, which depends on the station depth, foundation conditions, back-up generator needs, etc. Based on KWL's recent experience with small storm and sanitary pump stations in BC (e.g., with design capacities between 10 L/s and 250 L/s), the capital cost for the pump station was estimated to be $800,000. There is also uncertainty for the costs of the underdrains as the final depths and sizing will require additional modelling and survey. The depths and sizes of the underdrains will influence control structures and valves, which have non-linear cost growth with increasing size. The following assumptions and cost rates were used:

- Open cut installation for all storm pipe;
- Gravity trunk unit costs ranging from $478/m for 450 mm pipe to $1,300/m for 1,350 mm diameter pipe;
- No allowance was included for surface rehabilitation, since this will vary considerably depending on the final land use;
- Manholes at 185 m spacing (Type 5A manholes for trunks <= 600 mm; Type 1-S manholes for pipes > 600 mm) and average depth of 4 m;
- Underdrain diameters between 900 mm to 1050 mm at depths between 2.5 m and 5 m;
- Forcemain (pressure pipe) unit costs ranging from $450/m for 200 mm forcemain to $700 per m for 400 mm diameter forcemain, including allowances for valves and fittings;
- Railway trenchless boring costs of $1300/m;
- 45% allowance for contingency (30%) and engineering (15%) was added to the cost for each item;
- No capital costs for future ponds were included since the pond costs will be borne by the developer; and
- Any improvements to the storm system within the Old Town were not included.

The capital cost summaries for Option A and Option B are in the tables that follow, and a detailed cost breakdown is provided in Appendix A. These costs exclude the developer funded pond, as noted. The total estimated capital cost for Option A is $18,541,000 and the total estimate capital cost for Option B is 19,785,000

Of the costs, approximately 70% is related to the cost of the storm trunks, which have a total length of approximately 15.3 km and 15.6 km for Option A and B, respectively. Further optimization of the preliminary designs is recommended to possibly reduce the capital cost. For example, relocating the centralized pond may reduce trunk costs and/or eliminate the need for a pump station.

Table 5-2: Capital Cost Summary for Option A (Excluding Rocky Mountain ASP)

Description	Cost	Engineering and Contingency @ 45%	Total Cost
West Catchments			
Stormwater Trunks	$4,388,000	$1,974,000	$6,362,000
Stormwater Underdrains	$273,000	$123,000	$396,000
Stormwater Manholes	$312,000	$140,000	$452,000
Total (Rounded)	$4,973,000	$2,237,000	**$7,210,000**
Southwest Catchments			
Stormwater Trunks	$841,000	$379,000	$1,220,000
Stormwater Manholes	$72,000	$32,000	$104,000
Total (Rounded)	$913,000	$411,000	**$1,324,000**
East Catchments			
Stormwater Trunks	$2,322,000	$1,045,000	$3,367,000
Stormwater Underdrain	$320,000	$144,000	$464,000
Stormwater Manholes	$181,000	$81,000	$262,000
Total (Rounded)	$2,823,000	$1,270,000	**$4,093,000**
Southeast Catchments			
Stormwater Trunks	$1,633,000	$735,000	$2,368,000
Stormwater Manholes	$242,000	$109,000	$351,000
Stormwater Pump Station	$800,000	$360,000	$1,160,000
Stormwater Forcemains	$1,388,000	$625,000	$2,013,000
Stormwater Connections	$15,000	$7,000	$22,000
Total (Rounded)	$4,078,000	$1,836,000	**$5,914,000**
Grand Total			
Grand Total (Rounded)	**$12,787,000**	**$5,754,000**	**$18,541,000**

Table 5-3: Capital Cost Summary for Option B (Including Rocky Mountain ASP)

Description	Cost	Engineering and Contingency @ 45%	Total Cost
West Catchments			
Stormwater Trunks	$4,388,000	$1,974,000	$6,362,000
Stormwater Underdrains	$273,000	$123,000	$396,000
Stormwater Manholes	$312,000	$140,000	$452,000
Total (Rounded)	$4,973,000	$2,237,000	**$7,210,000**
Southwest Catchments			
Stormwater Trunks	$841,000	$379,000	$1,220,000
Stormwater Manholes	$72,000	$32,000	$104,000
Total (Rounded)	$913,000	$411,000	**$1,324,000**
East Catchments			
Stormwater Trunks	$3,101,000	$1,395,000	$4,496,000
Stormwater Underdrain	$361,000	$163,000	$524,000
Stormwater Manholes	$218,000	$98,000	$316,000
Total (Rounded)	$3,680,000	$1,656,000	**$5,336,000**
Southeast Catchments			
Stormwater Trunks	$1,633,000	$735,000	$2,368,000
Stormwater Manholes	$242,000	$109,000	$351,000
Stormwater Pump Station	$800,000	$360,000	$1,160,000
Stormwater Forcemains	$1,388,000	$625,000	$2,013,000
Stormwater Connections	$15,000	$7,000	$22,000
Total (Rounded)	$4,078,000	$1,836,000	**$5,914,000**
Grand Total			
Grand Total (Rounded)	**$13,644,000**	**$6,140,000**	**$19,784,000**

5.8 Phasing Plan

Construction of the stormwater servicing extensions should be completed in phases so that costs are shared throughout the timeline of development. The City provided an intent for phasing of development for the west catchments (see Figure 5-1) while the extent of phasing for the east catchments has not yet been defined at the time of preparing this servicing plan. Given the smaller area of the southwest and southeast catchments, these upgrades would likely be completed each in a single future phase. To assist with planning purposes, the construction cost estimate was split into costs for each phase for the west catchments. Costs are provided in 2020 dollar figures. The cost breakdowns for Option A and Option B are summarized in the following tables.

Table 5-4: Capital Cost Summary by Construction Phasing Option A (Excluding Rocky Mountain ASP)

Description	Cost	Engineering and Contingency @ 45%	Total Cost
West Catchments			
Phase 1	$467,000	$210,000	$677,000
Phase 2	$1,634,000	$735,000	$2,369,000
Phase 3	$1,322,000	$595,000	$1,917,000
Phase 4	$630,000	$284,000	$914,000
Phase 5	$920,000	$414,000	$1,334,000
Total	$4,973,000	$2,238,000	**$7,211,000**
East Catchments			
Total	$2,823,000	$1,270,000	**$4,093,000**
Southwest Catchments			
Total	$913,000	$411,000	**$1,324,000**
Southeast Catchments			
Total	$4,078,000	$1,836,000	**$5,914,000**
Grand Total			
Grand Total (Rounded)	**$12,787,000**	**$5,755,000**	**$18,542,000**

Table 5-5: Capital Cost Summary by Construction Phasing Option B (Including Rocky Mountain ASP)

Description	Cost	Engineering and Contingency @ 45%	Total Cost
West Catchments			
Phase 1	$467,000	$210,000	$677,000
Phase 2	$1,634,000	$735,000	$2,369,000
Phase 3	$1,322,000	$595,000	$1,917,000
Phase 4	$630,000	$284,000	$914,000
Phase 5	$920,000	$414,000	$1,334,000
Total	$4,973,000	$2,238,000	**$7,211,000**
East Catchments			
Total	$3,680,000	$1,656,000	**$5,336,000**
Southwest Catchments			
Total	$913,000	$411,000	**$1,324,000**
Southeast Catchments			
Total	$4,078,000	$1,836,000	**$5,914,000**
Grand Total			
Grand Total (Rounded)	**$13,644,000**	**$6,141,000**	**$19,785,000**

6. Conclusions

A conceptual stormwater servicing strategy was developed for the City's Annexation lands. No major barriers or obstacles for stormwater servicing were identified during this project, apart from the relatively high capital costs per area for servicing the southeast catchments.

Conclusions for the stormwater master plan include:

- Stormwater management and design is currently complicated by the lack of any regional stormwater conveyance system, which has meant that the design of storm trunks and outfalls in the annexation lands has generally not proceeded. There is no constructed minor or major drainage systems in the annexation lands.
    - Implementation of the ultimate stormwater servicing strategy will provide a path forward for stormwater management to be integrated with future development.
- The City's Engineering Design and Construction Standards adequately cover design and installation requirements for the storm drainage system.
    - These requirements have been applied and preserved in the updated SMP and ultimate stormwater servicing strategy.
- The total area of the annexation lands is approximately 2115 ha and the natural topography around Chestermere generally drains the land from north to south.
    - The stormwater servicing strategy incorporates the natural drainage patterns into a centralized approach that maximizes efficiencies and should ultimately reduce costs, in line with the City Council's December 2019 directive.
- External catchments to the north and west are currently draining into the annexation lands.
    - Managing the runoff from these areas is an important consideration for the SMP.
- Of the 275 wetlands that have been identified in the annexation lands, 28 were rated as having exceptional ecological and hydrological significance.
    - The requirements in the wetland bylaw impact the alignment of future storm trunks and routing of external flows, and raise the possibility of integrating wetlands into the constructed stormwater system when development proceeds.

- Developers are generally using 0.8 L/s/ha for the post-development release rate in the annexation lands.
    - This is consistent with municipal and provincial standards and is key for implementing the ultimate stormwater servicing strategy in terms of pipe sizing and design of the centralized pond system.
- The developer's drainage submissions frequently mention the use of LID approaches but there is relatively little information on specific LID locations, geometries, design parameters, and hydrologic benefits of using LIDs.
    - Additional coordination and engagement would be required to effectively ensure LIDs are being implemented successfully during new development.
- The total conceptual capital cost for implementing the ultimate stormwater servicing strategy, excluding the centralized pond and costs borne by developers, is $18,541,000 for Option A and $19,784,000 for Option B.
    - Construction phasing and further refinement of the centralized pond system will be key to reducing costs, increasing efficiencies, and aligning capital spending with development, replacement costs, and asset management planning.

7. Recommendations

Based on the findings of this assessment, the following general recommendations are made for the SMP:

- Consider proceeding with the proposed ultimate stormwater servicing strategy as it provides the potential to reduce costs in comparison to other approaches while maximizing efficiencies for future development;
- Continue plans to assess options and design criteria for the ultimate stormwater outfall from the centralized pond;
- Complete construction of the stormwater servicing extensions in phases so that costs are shared throughout the timeline of development;
- Further optimize the conceptual designs with the goal of reducing capital costs. For example, relocating the centralized pond may reduce trunk costs and/or eliminate the need for a pump station in the southeast area;
- Once conceptual designs are further optimized and refined, develop a life cycle cost assessment and cost sharing structure for stormwater infrastructure that abides by the 'user pay' principle; and

- As plans proceed, ensure the SMP and ultimate stormwater servicing strategy continue to align with other development, replacement costs, and asset management plans prepared by the City.

After review of background material and existing developer plans, the following specific recommendations are made for the SMP:

- In terms of stormwater management, continue requiring developers to adhere to the City's Engineering Design and Construction Standards and wetlands policy;
- Encourage coordination between developers in the southeast area, with an eye on avoiding the need for a pump station;
- Work with developers and others to standardize an approach to assessing and implementing LIDs;
- Give consideration to constructing engineered stormwater wetlands in compensation for existing wetlands that are not retained during development;
- If infrastructure such as intermediate storm ponds or LIDs in approved developer plans has already been constructed, ensure that these elements are incorporated into the City's database and record drawings; and
- Perform a field check to confirm the culvert locations and the general drainage patterns on the north side of Highway 1 in the Mountain View Park ASP area. This will confirm the drainage pattern for roughly 73 ha in the east catchments area.

Report Submission

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Revision History

Revision #	Date	Status	Revision	Author
1	October 20, 2020	Final	Issued as Final	JLN / CK

APEGA Permit # P07929

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Appendix A

Infrastructure Design & Capital Cost Tables

West Catchments - Cost Estimate

UARR = 0.8 L/s/ha

ID	Cumulative Contributing Area (ha)	Discharge (L/s)	*n*	Pipe Slope (%)	Min. Pipe Dia. (mm)	Design Pipe Dia. (mm)	Length (m)	Unit Cost ($/m)	Cost ($)	Engineering and Contingency @ 45%	Total Cost ($)
Pipe											
STM-A5	562	450	0.013	0.22	709	900	1039	$ 825	$ 857,192	$ 385,736	$ 1,242,928
STM-A4	643	515	0.013	0.22	746	900	713	$ 825	$ 588,497	$ 264,824	$ 853,321
STM-A3	861	689	0.013	0.22	832	900	1329	$ 825	$ 1,096,326	$ 493,347	$ 1,589,673
STM-A2	1087	869	0.013	0.16	964	1050	1700	$ 900	$ 1,529,766	$ 688,395	$ 2,218,161
STM-A1	1119	895	0.013	0.16	974	1050	351	$ 900	$ 315,747	$ 142,086	$ 457,833
Sub Total							**7566**		**$4,387,528**	**$1,974,387**	**$6,361,915**
Description	**Unit**	**Qty**						**Unit Cost ($)**	**Cost ($)**	**Engineering and Contingency @ 45%**	**Total Cost ($)**
Manhole											
Underdrain Controls	m	12						$ 2,600	$ 31,200	$ 14,040	$ 45,240
Underdrain	m	86						$ 1,300	$ 111,553	$ 50,199	$ 161,752
Railway Crossing	m	100						$ 1,300	$ 130,000	$ 58,500	$ 188,500
Type 5A Manhole	m	0						$ 2,000	$ -	$ -	$ -
Type 1S Manhole 1.2m x 1.2m	m	120						$ 2,600	$ 312,000	$ 140,400	$ 452,400
Subtotal									**$312,000**	**$140,400**	**$847,892**
TOTAL COST											**$7,209,807**

Southwest Catchments - Cost Estimate

UARR = 0.8 L/s/ha

ID	Cumulative Contributing Area (ha)	Discharge (L/s)	n	Pipe Slope (%)	Min. Pipe Dia. (mm)	Design Pipe Dia. (mm)	Length (m)	Unit Cost ($/m)	Cost ($)	Engineering and Contingency @ 45%	Total Cost ($)
Pipe											
STM-V1	160	128	0.013	0.16	469.3	525	1530	$550	$841,206	$378,543	$1,219,749
Sub Total							**6653**		**$841,206**	**$378,543**	**$1,219,749**
Description	**Unit**	**Qty**						**Unit Cost ($)**	**Cost ($)**	**Engineering and Contingency @ 45%**	**Total Cost ($)**
Manhole											
Type 5A Manhole	m	36						2,000.00	$72,000	$32,400	$104,400
Type 1S Manhole 1.2m x 1.2m	m	0						2,600.00	$0	$0	$0
Subtotal									**$72,000**	**$32,400**	**$104,400**
TOTAL COST											**$1,324,149**

East Catchments - Cost Estimate Option A

UARR = 0.8 L/s/ha

ID	Cumulative Contributing Area (ha)	Discharge (L/s)	n	Pipe Slope (%)	Min. Pipe Dia. (mm)	Design Pipe Dia. (mm)	Length (m)	Unit Cost ($/m)	Pipe Cost ($)	Engineering and Contingency @ 45%	Total Cost ($)
Pipe											
STM-P1	129	103	0.013	0.18	423.4	450	354	$478	$169,131	$76,109	$245,240
STM-P2	264	211	0.013	0.12	598.6	600	882	$596	$525,469	$236,461	$761,931
STM-P3	372	297	0.013	0.12	680.1	675	914	$715	$653,886	$294,249	$948,135
STM-P4	493	394	0.013	0.12	756.2	900	1077	$825	$888,847	$399,981	$1,288,828
STM-P5	650	520	0.013	0.12	838.8	900	102	$825	$84,323	$37,945	$122,269
Sub Total							**6931**		**$2,321,656**	**$1,044,745**	**$3,366,401**
Description	**Unit**	**Qty**						**Unit Cost ($)**	**Cost ($)**	**Engineering and Contingency @ 45%**	**Total Cost ($)**
Underdrain Controls	m	12						$2,600	$31,200	$14,040	$45,240
Underdrain	m	130						$1,300	$169,247	$76,161	$245,408
Railway Crossing	m	100						$1,200	$120,000	$54,000	$174,000
Type 5A Manhole	m	28						$2,000	$56,000	$25,200	$81,200
Type 1S Manhole 1.2m x 1.2m	m	48						$2,600	$124,800	$56,160	$180,960
Subtotal									**$501,247**	**$225,561**	**$726,808**
TOTAL COST											**$4,093,209**

East Catchments - Cost Estimate Option B

UARR = 0.8 L/s/ha

ID	Cumulative Contributing Area (ha)	Discharge (L/s)	n	Pipe Slope (%)	Min. Pipe Dia. (mm)	Design Pipe Dia. (mm)	Length (m)	Unit Cost ($/m)	Pipe Cost ($)	Engineering and Contingency @ 45%	Total Cost ($)
Pipe											
STM-P1	422.44	337.9	0.013	0.12	713.6	750	734	$870	$638,432	$287,294	$925,727
STM-P2	558.18	446.5	0.013	0.12	792.2	900	882	$825	$727,370	$327,316	$1,054,686
STM-P3	665.37	532.3	0.013	0.12	846.2	900	914	$825	$754,273	$339,423	$1,093,695
STM-P4	786.80	629.4	0.013	0.12	901.1	900	1077	$825	$888,847	$399,981	$1,288,828
STM-P5	943.76	755.0	0.013	0.12	964.7	1050	102	$900	$91,989	$41,395	$133,384
Sub Total							**6573**		**$3,100,910**	**$1,395,410**	**$4,496,320**
Description	**Unit**	**Qty**						**Unit Cost ($)**	**Cost ($)**	**Engineering and Contingency @ 45%**	**Total Cost ($)**
Underdrain Controls	m	12						$3,000	$36,000	$16,200	$52,200
Underdrain	m	130						$1,500	$195,285	$87,878	$283,163
Railway Crossing	m	100						$1,300	$130,000	$58,500	$188,500
Type 5A Manhole	m							$2,000	$0	$0	$0
Type 1S Manhole 1.2m x 1.2m	m	84						$2,600	$218,400	$98,280	$316,680
Subtotal									**$579,685**	**$260,858**	**$840,543**
TOTAL COST											**$5,336,863**

Southeast Catchments - Cost Estimate

UARR = 0.8 L/s/ha

ID	Cumulative Contributing Area (ha)	Discharge (L/s)	n	Pipe Slope (%)	Min. Pipe Dia. (mm)	Design Pipe Dia. (mm)	Length (m)	Unit Cost ($/m)	Pipe Cost ($)	Engineering and Contingency @ 45%	Total Cost ($)
Pipe											
STM-L1	79.40	63.5	0.013	0.18	353.4	450	1389	$478	$664,148	$298,866	$963,014
STM-FM1	144.17	173.0	0.013	0.16	331.9	400	1176	$700	$823,445	$370,550	$1,193,995
STM-FM2	209.00	250.8	0.013	0.12	399.6	400	807	$700	$564,956	$254,230	$819,186
STM-L2	64.92	51.9	0.013	0.18	327.7	450	907	$478	$433,670	$195,152	$628,822
STM-P6	858.95	687.2	0.013	0.12	931.2	1050	595	$900	$535,608	$241,024	$776,632
Sub Total							**6573**		**$3,021,827**	**$1,359,822**	**$4,381,649**
Description	**Unit**	**Qty**						**Unit Cost ($)**	**Cost ($)**	**Engineering and Contingency @ 45%**	**Total Cost ($)**
Type 5A Manhole	m	100						$2,000	$200,000	$90,000	$290,000
Type 1S Manhole 1.2m x 1.2m	m	16						$2,600	$41,600	$18,720	$60,320
Pump Station #1	each	1						$800,000	$800,000	$360,000	$1,160,000
Connect - FM1 to STM Pipe	each	1						$15,000	$15,000	$6,750	$21,750
Subtotal									**$1,056,600**	**$475,470**	**$1,532,070**
TOTAL COST											**$5,913,719**