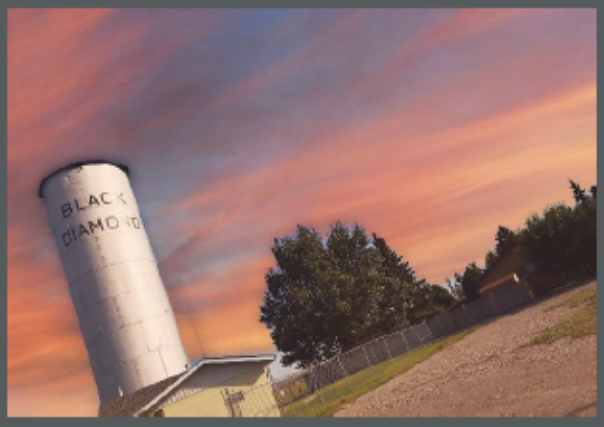
URBAN SYSTEMS

REPORT



Annexation Lands Servicing Review

Prepared for:

Town of Black Diamond

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Revised

February 2021

File: 0925.0032.01

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List of Abbreviations

ac	Acres
ha	Hectares
upa	Units per acre
AT	Alberta Transportation
MR	Municipal Reserve
WRSSC	Westend Regional Sewage Services Commission
ADF	Maximum Daily Flow
MDF	Average Daily Flow
PHF	Peak Hour Flow
m^3	Cubic metres
L/c/d	Litres per capita per day
L/s	Litres per second
m^3/h	Cubic metres per hour
ADD	Average Day Demand
MDD	Maximum Day Demand
PHD	Peak Hour Demand
MLD	Mega-litres per day
mm	Millimetres
m	Metres
SMDP	Staged Master Drainage Plan
vpd	Vehicles per day
ASP	Area Structure Plan
v/c	Volume to capacity ratio

Executive Summary

The Town of Black Diamond (Town) contracted Urban Systems Ltd. (USL) in summer 2018 to assess the servicing for three individual quarter sections on the east boundary of the Town. These quarter sections, their land uses, and their proposed densities were identified in the *Joint Growth Strategy*, O2 Planning, 2016, that was undertaken by both the Town of Black Diamond and the Town of Turner Valley. The assessment of these quarter sections required a review of the existing Town systems for water, wastewater and roads, and determining the remaining capacities. Stormwater management for each quarter section was also reviewed. Additional infrastructure and upgrades were then recommended. The short-term servicing of each quarter section was also reviewed to determine if any development can take place in the interim.

In 2019, the Town requested that an additional quarter section be added to the servicing review (Area 5). The review for Area 5 involved two separate scenarios: Scenario 1 where Area 3 is not annexed and no development occurs, and Scenario 2 where the annexation of Area 3 proceeds and is included in the servicing review of Area 5.

In 2020, the Town requested the report be updated to reflect the final areas included in the approved annexation – Area 2, 3, 5, 6, and 7.

The following recommendations were provided and are enclosed in this report:

- A sanitary system be constructed along the western edges of Area 2, which then extends along the east and south borders of Area 3 to service Area 5 and 7. This will consist of both gravity and forcemains based on the existing elevations.
- With the hydraulic connection of both the Westend sanitary trunk and the existing gravity system in the Town of Black Diamond, the system generally has sufficient capacity to allow for development of three of the four quarter sections of annexed lands.
    - Both the development of the 4th quarter section or the 72 L/s from Turner Valley, will trigger upgrades to the gravity system upstream of the wastewater treatment lagoon.
- There are currently proposed upgrades for the Wastewater Treatment Lagoon in Black Diamond, which will extend the design life of the treatment facility to 2036. A concept design was created for the grant application. The grant was approved. As of November 2020, MPE is waiting for the agreement to proceed with detailed design. Construction is likely to proceed in 2022. Further upgrades will be required, and additional study will be needed in the next 20 years or if the population in both Black Diamond and Turner Valley approaches 7,989 residents, which is expected between 2030 and 2033.
- The Town of Black Diamond 6th Street Water Looping Project was completed in fall 2020. A 400mm watermain was constructed from 4th Ave SE to 1 Ave NE. Areas 2 and 6 can be serviced from this main.

- Area 3 can be serviced by connecting to the Westend sanitary gravity main. Water connections can be provided by existing infrastructure and the new 6th Street water main loop.
- Area 5 can be serviced off of existing water connections within the Willow Ridge community and along Township Road 201 (418 Avenue) for both Scenarios. Added redundancy is required in both Scenarios, however, due to only one feeder main into the Willow Ridge community, the following is recommended:
    - In Scenario 1, a 250mm water main is proposed along the east side of Highway 22 from the existing 250mm water main between Highway 22 and 1st Street SE south until Township Road 201 where the proposed 250mm main will head west to tie-in the existing 250mm main south of 3rd Street SW.
    - In Scenario 2, a 250mm water main is proposed to extend from the Area 3 water main connection on Willow Ridge Boulevard south across Township Road 201 and then head west to tie in to the existing 250mm stub south of 3rd Street SW.
- Additional water license will be required as the combined population (jobs and residents) of Black Diamond approaches 8,304 people, or approximately between years 2056 and 2066.
- The Water Treatment Plant in Turner Valley (where Black Diamond receives its treated water) has recently been upgraded and its design life has been extended to the approximately year 2036. Review of the system is required prior to that date or if the population approaches the combined population of 7,989 people similarly to the Wastewater Treatment Lagoon.
- No upgrades will be required to the existing water reservoir for Scenario 1. Scenario 2 – full build out of the annexed lands will require a reservoir upgrade, expected beyond 2056.
- Based on flow monitoring in 2020, there is 10.3 L/s of spare sanitary capacity in the 300mm gravity main.
- It is unknown if the Kaiser ASP area will develop prior to the annexation lands.
- There will be underground storm systems on the proposed roads to handle road drainage.
- It will be the responsibility of the developer(s) of each quarter section to manage stormwater runoff.
- With full built out of the annexed lands, eight intersections, new and existing, will require upgrades.

1.0 Introduction

Previously, Urban Systems Ltd. (USL) was retained by the Town of Black Diamond (Town) to prepare a servicing review of three (3) quarter sections that are proposed for annexation. In October of 2018, after the submission of the servicing review, it was identified by the Town that there was one more possible quarter section, Area 5, to be reviewed south of the existing Town boundary. The location of Area 5 is represented in Figure 1, as well as the previous three areas that were reviewed.

In 2019, the Town requested that two possible servicing scenarios be reviewed: one where Area 3 is annexed to the Town (Scenario 1) and its proposed infrastructure be utilized in the servicing strategy for Area 5, and the other where Area 3 is not annexed and none of its proposed infrastructure will be in place (Scenario 2).

In 2020, following the annexation of 821 acres of land from Foothills County, the Town requested this document be updated to reflect the final annexed areas.

The scope of the review and update is as follows:

- Provide capacities of existing infrastructure and incorporate sanitary flow monitoring results from spring 2020,
- Provide short and long-term servicing for the quarter sections (Areas 2, 3, 5, 6 and 7- the Strategic lands), including the two separate scenario reviews for Area 5,
- Remove Area 1 from the report, as it was not included in the annexation,
- Review the interim sanitary servicing option of Area 2 being serviced by the existing gravity trunk,
- Identify triggers for the staging of the upgrades identified in previous studies for the above listed Areas,
- Identify the infrastructure to be included in the Offsite Levy Bylaw Update,
- Discuss water looping within the NE Industrial area, and
- Provide estimated costs for the proposed servicing strategy.

The information contained within this report has been prepared to assist the Town with the Offsite Levy Bylaw updates and facilitation of future developments. All assumptions and sources of information have been listed within the report.

2.0 Background Information

2.1 Annexation Area

821 acres of land was annexed in January 2020. Four quarter sections and the Strategic lands were annexed from the MD of Foothills. Each of these quarter sections has their own respective land use designations as per the *Turner Valley & Black Diamond Joint Growth Strategy,* O2 Planning & Design Inc., 2016, or as directed by the Town, which is comprised of commercial, industrial and residential. The annexation map is included in Appendix A.

These quarter sections are identified as Areas 2, 3, 5, 6, and 7 (the Strategic lands) in **Figure 1**. The land uses for Areas 2, 3, 5, and 7 were identified as a part of the *Joint Growth Servicing Study* in 2016 that was undertaken by both the Town of Black Diamond and the Town of Turner Valley. More information on this study can be found in both the *Turner Valley/Black Diamond Joint Growth Strategy – Scenario 3 Design Brief*, MPE Engineering, Ltd. 2016 and the *Black Diamond and Turner Valley Joint Growth Strategy – Scenario 3,* Urban Systems Ltd., 2016. These land uses were identified for the growth of both communities and were used to develop the servicing strategy for the *Joint Growth Servicing Study*. The information from these briefs has been used and updated within the context of this report. The land use proposed for Area 6 was provided by the Town.

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

Legend

- Commercial
- Industrial
- Residential
- Strategic
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

Scale: 1:15,000

QS-SW SEC-20 TWP-020 RGE-02 MER-5
QS-SE SEC-20 TWP-020 RGE-02 MER-5
QS-SW SEC-21 TWP-020 RGE-02 MER-5
QS-SE SEC-21 TWP-020 RGE-02 MER-5
QS-NW SEC-17 TWP-020 RGE-02 MER-5
QS-NE SEC-17 TWP-020 RGE-02 MER-5
QS-NW SEC-16 TWP-020 RGE-02 MER-5
QS-NE SEC-16 TWP-020 RGE-02 MER-5
QS-SW SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-17 TWP-020 RGE-02 MER-5
QS-SW SEC-16 TWP-020 RGE-02 MER-5
QS-SE SEC-16 TWP-020 RGE-02 MER-5
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QS-NE SEC-08 TWP-020 RGE-02 MER-5
QS-NW SEC-09 TWP-020 RGE-02 MER-5
QS-NE SEC-09 TWP-020 RGE-02 MER-5
QS-SW SEC-08 TWP-020 RGE-02 MER-5
QS-SE SEC-08 TWP-020 RGE-02 MER-5
QS-SW SEC-09 TWP-020 RGE-02 MER-5
QS-SE SEC-09 TWP-020 RGE-02 MER-5
QS-NW SEC-05 TWP-020 RGE-02 MER-5
QS-NE SEC-05 TWP-020 RGE-02 MER-5
QS-NW SEC-04 TWP-020 RGE-02 MER-5
QS-NE SEC-04 TWP-020 RGE-02 MER-5

1 Avenue NW
2 Street NW
3 Street NW
1 Street NW
Centre Avenue W
1 Avenue NE
3 Street NE
Centre Avenue E
Hwy 7
1 Avenue SE
6 Street SE
2 Avenue SE
1 Avenue SW
2 Avenue SW
3 Avenue SW
4 Street SW
5 Street SW
1 Street SW
5 Avenue SW
2 Street SW
4 Avenue SE
1 Street SE
Government Road S
6 Avenue SW
3 Street SW
418 Avenue W

Area 2
- **Land Uses: Industrial, Residential**
- **Developable Area: 152.5 ac/61.7 ha**
- **Population: 1,988 Residents & 237 Jobs**

Area 2
160ac/64.7ha

Area 7
125.8ac/50.9ha

Area 5
- **Land Uses: Commercial, Residential**
- **Developable Area: 136.5 ac/55.2 ha**
- **Population: 2,004 Residents & 193 Jobs**

Area 3
160ac/64.7ha

Area 6
150.5ac/60.9ha

Area 7
- **Land Uses: Sheep River, Country Residential, Agricultural, PUL**
- **Proposed Land Use: Residential**
- **Developable Area: 21.25 ac/8.6 ha**
- **Population: 332 Residents**

Area 5
160ac/64.7ha

Area 3
- **Land Uses: Commercial, Residential**
- **Developable Area: 134.4 ac/54.4 ha**
- **Population: 1,727 Residents & 572 Jobs**

Area 6
- **Residential**
- **Developable Area: 148.6 ac/60.1 ha**
- **Population: 2,318 Residents**

Population and Developable Area

FIGURE 1

2.2 Population

In the *Joint Growth Servicing Strategy,* the projected population within the existing Town boundary is predicted to extend to 3,427 people. The predicted populations for the annexation lands were calculated using the proposed land use types and are summarized below in Table 1. The proposed annexation areas are projected to increase the Town population by 8,369 residents and 1,002 jobs, increasing the total projected population to 11,796 residents and 1,002 new jobs. The following sections 2.2.1 and 2.2.2 will discuss further how the population and jobs for the proposed land uses: Residential, Commercial, and Industrial.

Table 1: Total Estimated Town Populations

Area	Land Use	Developable Area (ha)	Developable Area (ac)	Density		Residential Population (residents)	Work Population (jobs)
2	Residential	51.6	127.5	15.6	people/ac	1,988	-
	Industrial	10.1	25.0	9.5	jobs/ac	-	237
3	Residential	44.8	110.7	15.6	people/ac	1,727	-
	Commercial	9.6	23.7	24.1	jobs/ac	-	572
5	Residential	52.0	128.5	15.6	people/ac	2,004	-
	Commercial	3.2	8.0	24.1	jobs/ac	-	193
6	Residential	60.9	148.6	15.6	people/ac	2,318	
7	Residential	8.6	21.25	15.6	people/ac	332	
			Total Proposed Annexation Population			8,369	1,002
Black Diamond Ultimate Population[1]						3,427	-
			Total			11,796	1,002

It should be noted that the ultimate population within the Town of Turner Valley, including the existing Town boundary and their proposed annexation lands, is 13,464 people as per the *Joint Growth Servicing Strategy*. A summary of the population calculations can be found in Appendix A – Population Estimation Summary.

[1] This is the estimated population within the existing Town boundary at full build-out.

2.2.1 Residential Population

The Town has identified that the target density for the annexation area will be 6.5 units per acre (upa), whereas 8 upa was used in the previous *Joint Growth Strategy*. This lower density was selected by the Town as it is expected to represent a more achievable density. The Town provided USL with the information that the household size in Black Diamond has been trending towards 2.4 people per unit over the last 5 years and therefore, this household size was used to estimate the residential population. By multiplying the household size by the latest density target, the population equivalent for residential becomes 15.6 people per acre.

To determine the residential population, the developable area was estimated for the areas with residential land uses. The density variables presented above were then applied to the developable area to determine the population.

Areas 2, 3, 5, 6, and 7 have residential land uses. The total developable residential area of Area 2 was estimated to be 51.6ha (127.5ac), which excludes non-developable lands as follows:

- the surface area of the wetland identified to be maintained in the *Kaiser Area Structure Plan (ASP) Technical Background Report,* Urban Systems Ltd., 2017,
- the future road right of way, of which a width of 26m was assumed

The developable residential area for Area 3 was estimated to be 44.8 ha (110.70 ac), which was estimated by removing the water course running north south through the quarter section. This water course was estimated at approximately 15% of the total quarter section (the size will need to be determined prior to development). The summary of the populations can be found in Table 1 in the previous section.

The developable residential area for Area 5 was estimated to be 52.0ha (128.5ac), which includes the removal of the area of the water course on the western edge of the quarter section (9.53ha) and 0.25ha for a possible wetland at the north-east corner of the quarter section.

The developable residential area for Area 6 was estimated to be 60.90ha (148.6ac), which was determined by removing the future road widening for 6th Street. No area was removed for potential wetlands at this time.

Area 7 was identified in the *Joint Growth Strategy, Scenario 3* as being Strategic River Valley Lands. These lands are a key component to providing connectivity between the towns, ensuring ecological health for the area, preserving environmentally sensitive areas, and promoting the integration of a parks and open space network within future development. The area includes lands within the Sheep River Floodway and Flood Fringe. Existing land uses include the Sheep River, a Country Residential parcel (golf course driving range), an agricultural parcel (undeveloped south of the river), and a Public Utility Lot (north of the river) which contains a baseball diamond. An area for residential development is identified in the SE corner of Area 7. The developable area is estimated at 8.6 ha (21.25ac).

2.2.2 Service Population

The service population describes the population generated from both commercial and industrial land uses. These populations were calculated using the same densities as were identified in the *Joint Growth Servicing Strategy*. They are as follows:

- Commercial = 24.1 jobs per acre
- Industrial = 9.5 jobs per acre

Areas 2, 3, and 5 have some form of service area that would produce jobs for the Town. To determine the number of potential jobs, the developable service area is estimated, similar to the residential developable area above.

Area 2 will contain a portion of land identified as Industrial. To estimate the amount of developable Industrial area, the area of the existing County road and the area of the future road right of way on the western edge of Area 2 were removed from the Industrial developable area calculation. The estimated developable area is therefore estimated to be 10.1ha (25.0ac).

An area of commercial land use is designated for a portion of Area 3. This is estimated to be approximately 15% of the entire quarter section at 9.60ha (23.7ac).

The commercial area of Area 5 was estimated to be 5% of the entire quarter section with an estimated developable area of 3.2ha (8ac). The calculation of the developable area includes the removal of 0.1ha for the potential wetland at the north east corner of the quarter section.

2.3 Population Projection

For reference in this document, the projected population of both the Towns of Black Diamond and Turner Valley has been provided in Appendix B. The population was estimated using the lower and higher growth trends between 2015 and 2075 as identified in the *Turner Valley & Black Diamond Joint Growth Strategy* and applying them to 2016 Canadian Census population of both Black Diamond (2,700 people) and Turner Valley (2,559 people). These trends are outlined below:

- Lower Growth Trend:
  - 2015 – 2035: Growth rate of 2.50%
  - 2035 – 2055: Growth rate of 2.25%
  - 2055 – 2075: Growth rate of 2.00%

- Higher Growth Trend:

- 2015 – 2035: Growth rate of 3.00%
- 2035 – 2055: Growth rate of 2.75%
- 2055 – 2075: Growth rate of 2.50%

With the population projections presented above, the timeline of infrastructure upgrades can be estimated.

3.0 Existing Wastewater Infrastructure

3.1 Existing Wastewater Gravity Pipe System

The wastewater for the entire Town is conveyed via a 300mm gravity main to the wastewater lagoon at the north end of the Town. From the *Black Diamond Proposed Annexation Study,* BSEI Municipal Consulting Engineers, 2012, it is understood that the overall capacity of the gravity system is 45 L/s; of which 31 L/s is the existing flow in the system. In spring 2020, flow monitoring was completed for the downstream end of the sanitary system. The measured flow in the gravity system was 35.5 L/s.

In addition to the Town of Black Diamond gravity system, the Westend Regional Sewage Services Commission (WRSSC) operates a 525mm gravity main (the Westend main). This 525mm main is hydraulically connected with the 300mm gravity main upstream of the lagoon to provide an overall capacity of 280 L/s for the wastewater treatment system. Approximately 146 L/s of the 280 L/s capacity is allocated for Black Diamond. This information was presented in the *Westend Regional Sewage Services Commission - Westend Sanitary Trunkmain Relocation Design Report*, Urban Systems Ltd, 2015.

3.1.1 Existing 300mm Gravity Main Capacity

Flow monitoring performed from May - August 2020, measured the flows at 5 separate manholes at the downstream end of the system, prior to the hydraulic connection with the 525mm Westend main. The memo summarizing the results are included in Appendix G. The results show that the gravity main has approximately 10 L/s of remaining capacity at the desired 85% of pipe capacity. There is one length of pipe upstream of the hydraulic connection that has a slope of 0.2% and is the pinch point of the system. Based on how development proceeds in the Town, it could be considered to twin this length of pipe to gain capacity in the system, prior to constructing the new sanitary main along future 6th Street along the east side of the Town.

3.1.2 Existing Westend Capacities

As described above, the WRSSC operates a 525mm gravity through the Town of Black Diamond. Upstream of the gravity main is a forcemain that conveys all of the sanitary flows from Turner Valley via a pump station at the golf course. The ultimate design capacity of the forcemain and its lift station will be 134 L/s. The design capacity of the 525mm gravity main was calculated to be 217 L/s, which has been estimated for when the pipe is at 85% of its capacity. Given the capacity of the gravity main and that only 134 L/s from Turner Valley are projected in the upstream forcemain, there is a remaining 83 L/s of spare capacity in the

gravity main allocated to black Diamond flows. Please refer to **Figure 2** for the capacities within the Westend system and the Town's gravity system for more information.

3.2 Existing Wastewater Treatment Facilities

Wastewater from both Black Diamond and Turner Valley is currently treated in an aerated lagoon system located in Black Diamond operated by the WRSSC.

The WRSSC operates the Turner Valley Main Lift Station, force main and gravity system (the Westend main), the Transfer Lift Station and force main at the lagoon, as well as the overall aerated lagoon system. The capacity of the existing system is summarized below in Table 2.

Table 2: Existing Lagoon Capacity[2]

Item	Complete Mix Cell	Aerated Cells
Volume (m^3)	8,551	112,289
Require Retention (days)	2	28
Max. Monthly Average Daily Wastewater Volume (m^3)	4,162	4,000

On behalf of the WRSSC, MPE submitted a revised final report in late 2015 to Alberta Environment and Parks (AEP) that discussed required upgrades to the existing aerated lagoon. From the *WRSSC Revised Plan for Operating Approval*, MPE Engineering Ltd. 2015, it is estimated that these upgrades would need to take place prior to 2020 as the projected population of both Towns would exceed 5,300 people and both Towns would have a maximum monthly average daily flow of over 4,200 m^3 per day. This exceeds the lagoons design capacity of 4,000 m^3 per day. These upgrades and the approved funding grant are discussed further in Section 4.3.3.

[2] Information provided from the *Black Diamond Proposed Annexation Study,* BSEI Municipal Consulting Engineers, 2012.

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

Scale: 1:15,000

Legend

- Existing Sanitary Main
- Existing 300mm Sanitary Main
- Existing Westend Sanitary System
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

280 L/s CAPACITY AT LAGOON
(WITH BOTH 300 mm & 500mm HYDRAULICALLY CONNECTE)
- 134 L/s FROM TURNER VALLEY
- 146 L/s FOR BLACK DIAMOND

CAPACITY OF BLACK DIAMOND 300mm MAIN IS 45 L/s UPSTREAM OF THE 300mm AND 525mm MAINS HYDRAULICALLY CONNECT

WESTEND GRAVITY MAIN 85% DESIGN CAPACITY = 217 L/s
ALLOCATED DESIGN FLOW = 134 L/s

WESTEND FORCEMAIN AND PUMP STATION DESIGN CAPACITY = 134 L/s

POINT WHERE WESTEND FORCEMAIN ENDS AND WESTEND GRAVITY MAIN BEGINS

QS-SW SEC-20 TWP-020 RGE-02 MER-5
QS-SE SEC-20 TWP-020 RGE-02 MER-5
QS-SW SEC-21 TWP-020 RGE-02 MER-5
QS-SE SEC-21 TWP-020 RGE-02 MER-5
QS-NW SEC-17 TWP-020 RGE-02 MER-5
QS-NE SEC-17 TWP-020 RGE-02 MER-5
QS-NW SEC-16 TWP-020 RGE-02 MER-5
QS-NE SEC-16 TWP-020 RGE-02 MER-5
QS-SW SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-17 TWP-020 RGE-02 MER-5
QS-SW SEC-16 TWP-020 RGE-02 MER-5
QS-SE SEC-16 TWP-020 RGE-02 MER-5
QS-NW SEC-08 TWP-020 RGE-02 MER-5
QS-NE SEC-08 TWP-020 RGE-02 MER-5
QS-NW SEC-09 TWP-020 RGE-02 MER-5
QS-NE SEC-09 TWP-020 RGE-02 MER-5
QS-SW SEC-08 TWP-020 RGE-02 MER-5
QS-SE SEC-08 TWP-020 RGE-02 MER-5
QS-SW SEC-09 TWP-020 RGE-02 MER-5
QS-SE SEC-09 TWP-020 RGE-02 MER-5
QS-NW SEC-05 TWP-020 RGE-02 MER-5
QS-NE SEC-05 TWP-020 RGE-02 MER-5
QS-NW SEC-04 TWP-020 RGE-02 MER-5
QS-NE SEC-04 TWP-020 RGE-02 MER-5

Area 2
Area 3
Area 5
Area 6
Area 7

2 Street NW
3 Street NE
1 Avenue NE
HWY 2
Centre Avenue E
1 Avenue SE
6 Street SE
1 Avenue SW
4 Street SW
5 Street SW
2 Avenue SW
2 Avenue SE
3 Avenue SW
1 Street SW
1 Street SE
2 Street SW
5 Avenue SW
4 Avenue SE
3 Street SW
Government Road S
Riverwood Crescent SW
Willow Ridge Manor SW
418 Avenue W

Existing Sanitary Systems Capacity

FIGURE 2

4.0 Wastewater Servicing Concept

The overall wastewater servicing concept for Areas 2,5, 6 and 7 (Scenario 1) is shown in **Figure 3** and the overall wastewater servicing concept for all of the annexed lands (Scenario 2) is demonstrated in **Figure 4**. A summary of the sanitary demand calculations can be found in Appendix C.

4.1 Criteria

In order to estimate the sanitary flows for the annexed lands, criteria from the *Foothills Regional Water and Wastewater Collaborative (FRWWC) – Regional Wastewater Treatment Feasibility Study*, MPE Engineering Ltd. (MPE) & USL, 2016, was used. The criteria are summarized in Table 3 below.

Table 3: Wastewater Flow Criteria

Item	Value	Units
Total Community Wastewater Demand	264	L/c/d
MDF[3]:ADF[4] Ratio	2.2	-
PHF[5]:ADF Ratio	5.0	-

[3] MDF: Maximum Daily Flow
[4] ADF: Average Daily Flow
[5] PHF: Peak Hour Flow

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 21

Scale: 1:15,000

Legend

- LS Proposed Lift Station
- Proposed Sanitary Main
- Existing Sanitary Main
- Existing 300mm Sanitary Main
- Existing Westend Sanitary System
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

QS-SW SEC-20 TWP-020 RGE-02 MER-5
QS-SE SEC-20 TWP-020 RGE-02 MER-5
QS-SW SEC-21 TWP-020 RGE-02 MER-5
QS-SE SEC-21 TWP-020 RGE-02 MER-5
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QS-NE SEC-17 TWP-020 RGE-02 MER-5
QS-SW SEC-16 TWP-020 RGE-02 MER-5
QS-NE SEC-16 TWP-020 RGE-02 MER-5
QS-SW SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-16 TWP-020 RGE-02 MER-5
QS-NW SEC-08 TWP-020 RGE-02 MER-5
QS-NE SEC-08 TWP-020 RGE-02 MER-5
QS-NW SEC-09 TWP-020 RGE-02 MER-5
QS-NE SEC-09 TWP-020 RGE-02 MER-5
QS-SW SEC-08 TWP-020 RGE-02 MER-5
QS-SE SEC-08 TWP-020 RGE-02 MER-5
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QS-SE SEC-09 TWP-020 RGE-02 MER-5
QS-NW SEC-05 TWP-020 RGE-02 MER-5
QS-NE SEC-05 TWP-020 RGE-02 MER-5
QS-NW SEC-04 TWP-020 RGE-02 MER-5
QS-NE SEC-04 TWP-020 RGE-02 MER-5

TOTAL FLOW = (52.4+20.2+34+35.4+33.6+5.1) = 180.7L/s
TOTAL BLACK DIAMOND ALLOCATION = 146 L/s
TOTAL OVERAGE = (180.7-146) L/s = 34.7 L/s

280 L/s CAPACITY AT LAGOON
(WITH BOTH 300 mm & 500mm HYDRAULICALLY CONNECTED)
- 134 L/s FROM TURNER VALLEY
- 146 L/s FOR BLACK DIAMOND

CAPACITY OF BLACK DIAMOND 300mm MAIN IS 45 L/s UPSTREAM OF THE 300mm AND 525mm MAINS HYDRAULICALLY CONNECT

TIE IN TO EXISTING GRAVITY MAIN TO LAGOON

PROPOSED 525 PVC GRAVITY MAIN

PROPOSED 300 HDPE FORCE MAIN

WESTEND MAIN

HWY 7

Centre Avenue W

Centre Avenue E

1 Avenue NW

1 Avenue NE

1 Street NW

2 Street NW

3 Street NW

3 Street NE

ESTIMATED FUTURE FLOWS WITHIN EXISTING TOWN BOUNDARY = 52.4 L/s

KAISER DEMAND TO 300mm MAIN = 7.8 L/s

PROPOSED 300 HDPE FORCE MAIN

AREA 2 DEMAND = 34.0 L/s

LS

4 Street SW

5 Street SW

3 Avenue SW

4 Avenue SW

5 Avenue SW

1 Street SE

6 Street SE

KAISER DEMAND TO WESTEND = 20.2 L/s

PROPOSED 525 PVC GRAVITY MAIN

Area 2

4 Avenue SE

PROPOSED 450 PVC GRAVITY MAIN

6 Avenue SW

Government Road S

3 Street SW

AREA 7 DEMAND = 5.1 L/s

Area 7

Area 3

PROPOSED 450 PVC GRAVITY MAIN

Area 6

AREA 6 DEMAND = 35.4 L/s

Riverwood Crescent SW

Willow Ridge Manor SW

418 Avenue W

PROPOSED 375 PVC GRAVITY MAIN TO SERVICE 72.0 L/s FROM TURNER VALLEY AND AREA 7

PROPOSED 450 PVC GRAVITY MAIN TO SERVICE 72.0 L/s FROM TURNER VALLEY AND AREA 5 & 7

Area 5

AREA 5 DEMAND = 33.6 L/s

Overall Sanitary Servicing (Excluding Area 3)

FIGURE 3

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URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 21

Scale: 1:15,000

Legend

- LS Proposed Lift Station
- Proposed Sanitary Main
- Existing Sanitary Main
- Existing 300mm Sanitary Main
- Existing Westend Sanitary System
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

QS-SW SEC-20 TWP-020 RGE-02 MER-5
QS-SE SEC-20 TWP-020 RGE-02 MER-5
QS-SW SEC-21 TWP-020 RGE-02 MER-5
QS-SE SEC-21 TWP-020 RGE-02 MER-5
QS-NW SEC-17 TWP-020 RGE-02 MER-5
QS-NE SEC-17 TWP-020 RGE-02 MER-5
QS-SW SEC-16 TWP-020 RGE-02 MER-5
QS-NE SEC-16 TWP-020 RGE-02 MER-5
QS-SW SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-16 TWP-020 RGE-02 MER-5
QS-NW SEC-08 TWP-020 RGE-02 MER-5
QS-NE SEC-08 TWP-020 RGE-02 MER-5
QS-NW SEC-09 TWP-020 RGE-02 MER-5
QS-NE SEC-09 TWP-020 RGE-02 MER-5
QS-SW SEC-08 TWP-020 RGE-02 MER-5
QS-SE SEC-08 TWP-020 RGE-02 MER-5
QS-SW SEC-09 TWP-020 RGE-02 MER-5
QS-SE SEC-09 TWP-020 RGE-02 MER-5
QS-NW SEC-05 TWP-020 RGE-02 MER-5
QS-NE SEC-05 TWP-020 RGE-02 MER-5
QS-NW SEC-04 TWP-020 RGE-02 MER-5
QS-NE SEC-04 TWP-020 RGE-02 MER-5

TOTAL FLOW = (52.4+35.1+20.2+15.6+34+33.6) = 191.1L/s
TOTAL BLACK DIAMOND ALLOCATION = 146 L/s
TOTAL OVERAGE = (191.1-146) L/s = 45.1 L/s

280 L/s CAPACITY AT LAGOON
(WITH BOTH 300 mm & 500mm HYDRAULICALLY CONNECTED)
- 134 L/s FROM TURNER VALLEY
- 146 L/s FOR BLACK DIAMOND

CAPACITY OF BLACK DIAMOND 300mm MAIN IS 45 L/s UPSTREAM OF THE 300mm AND 525mm MAINS HYDRAULICALLY CONNECT

TIE IN TO EXISTING GRAVITY MAIN TO LAGOON

PROPOSED 525 PVC GRAVITY MAIN

PROPOSED 400 HDPE FORCE MAIN

WESTEND MAIN

PROPOSED 300 HDPE FORCE MAIN

KAISER DEMAND TO 300mm MAIN = 7.8 L/s

AREA 2 DEMAND = 34.0 L/s

LS

PROPOSED 525 PVC GRAVITY MAIN

Area 2

ESTIMATED FUTURE FLOWS WITHIN EXISTING TOWN BOUNDARY = 52.4 L/s

KAISER DEMAND TO WESTEND = 20.2 L/s

PROPOSED 450 PVC GRAVITY MAIN

AREA 3 CONNECTION TO WESTEND MAIN

AREA 7 DEMAND = 5.1 L/s

Area 7

Area 3

AREA 3 DEMAND = 35.1 L/s

Area 6

AREA 6 DEMAND = 35.4 L/s

PROPOSED 375 PVC GRAVITY MAIN TO SERVICE 72.0 L/s FROM TURNER VALLEY AND AREA 7

PROPOSED 450 PVC GRAVITY MAIN TO SERVICE 72.0 L/s FROM TURNER VALLEY AND AREA 5 &7

Area 5

AREA 5 DEMAND = 33.6 L/s

1 Avenue NW
2 Street NW
3 Street NW
1 Street NW
1 Avenue NE
3 Street NE
Centre Avenue W
Centre Avenue E
HWY 7
5 Street SW
4 Street SW
3 Avenue SW
4 Avenue SW
5 Avenue SW
1 Street SE
6 Street SE
4 Avenue SE
Government Road S
6 Avenue SW
3 Street SW
Riverwood Crescent SW
Willow Close
Manor SW
418 Avenue W

Overall Sanitary Servicing (Including Area 3)

FIGURE 4

U:\Projects_CALV\5595\0100\01\Design\GIS\Projects\MXD\Annexation Figures_20201109\Fig04 Annexation Overall Sanitary Servicing Area3_20201109.mxd Last modified by jwillies on November 21, 2020 at 9:00:34 AM

The above criteria were used to present a conservative estimate to the wastewater flows. The total community flow encompasses flows from all three land uses (commercial, industrial, and residential), as well as inflow and infiltration. Peak wastewater flow rates were calculated using the peaking factors provided in Table 3.

4.2 Service Population

Using the populations calculated in Section 2.2 of this report and the criteria presented in Table 3, the flows for the three service areas were calculated as tabulated in Table 4 and Table 5.

Table 4: Anticipated Wastewater Flow per Land Use

Area	Land Use	Population	Anticipated Flows (L/s)
2	Residential	1,988	30.4
	Industrial	237	3.6
3	Residential	1,727	26.4
	Commercial	572	8.7
5	Residential	2,004	30.6
	Commercial	193	2.9
6	Residential	2318	35.4
7	Residential	332	5.1

Table 5: Anticipated Wastewater Flow per Area

Area	Total Flow Per Area (L/s)
Ex Town	52.4
2	34.0
3	35.1
5	33.6
6	35.4
7	5.1

4.3 Wastewater Servicing Concept

4.3.1 Overall System – Scenario 1 (excluding Area 3)

As demonstrated in **Figure 3**, a new sanitary conveyance system is proposed along the western edge of Areas 2 and 6 (future 6th Street) , along the south side of Area 3, and the north side of Area 5. This new system will consist of a 375mm gravity main starting from the NW corner of Area 5. The gravity main will then extend to the east, to the SE corner of Area 3 and then proceed north for approximately 1,000 metres. A portion of 525mm gravity main adjacent to Area 2 will end at a lift station. At this point, the wastewater

will be conveyed by the lift station via a 300mm force main to north of Highway 7. The system will convey the flows via a 525mm gravity main west to the existing sanitary system and the Westend main. Appendix H contains the Drawing E – Sanitary Catchment Areas from the 6th Street Watermain Looping engineering drawings illustrating the sanitary pipe design.

The proposed system has been sized to accommodate the growth of Areas 2, 5, 6, and 7 as well as the additional flow of 72 L/s from Turner Valley, which is in addition to their design allocation of 134 L/s in the Westend system, as described in the *Joint Growth Servicing Strategy*. For the purposes of this review, the projected flows from the build out of the original Town boundary is 52 L/s. based on projected population at full build out.

It is unknown if the Kaiser ASP area will develop prior to the annexed lands. In the event that it does not develop and utilize the remaining capacity in the gravity main, other options have been reviewed to immediately service the annexed lands with the remaining capacity.

Below in Table 6 is a summary of the expected sanitary demand of the overall system in Scenario 1 compared to the design capacity of 146 L/s for Black Diamond in the hydraulically connected Westend and Black Diamond gravity mains.

Table 6: Overall Sanitary Demands vs. Pipe Capacity (Scenario 1)

Area	Discharge Main	Projected Flows (L/s)
Ex Town	300mm Trunk	52.4
Kaiser	525mm Westend Trunk	20.2
2	Proposed 300mm FM	34.0
6	Proposed 450mm	35.4
5	Proposed 450mm	33.6
7	Proposed 375mm	5.1
Total Capacity Required		**180.7**
Total Capacity at Lagoon		**146**
Overage		**34.7**

As can be noted above from Table 6, the existing mains - Black Diamond gravity 300mm and Westend 525mm mains would be able to handle approximately 80% of the flows from the annexed lands for Scenario 1. Upgrades would be required to accommodate flows above 146 L/s.

Given the information above in Table 6, the additional 72 L/s of sanitary flow from Turner Valley would also trigger upgrades on the gravity system upstream of the wastewater treatment facility. A review of possible upgrades would be required if either of these situations occur.

It should be noted that the anticipated flows (52.4 L/s) assuming full build-out within the original Town boundary are greater than the capacity of the 300mm main (45 L/s). Given that the projected capacity exceedance is marginal and there is excess capacity in the 525mm main, no upgrade would be required to the 300mm main. It is recommended that the Town monitor growth patterns to ensure that the growth and resulting flows match the assumptions made in this report.

4.3.2 Overall System – Scenario 2 (including Area 3)

In **Figure 4**, similar to Scenario 1 as presented in **Figure 3**, a new sanitary conveyance system is proposed to service Areas 2, 5, 6, and 7. The proposed system has been sized to accommodate the additional flow of 72 L/s from Turner Valley, which is in addition to their design allocation of 134 L/s in the Westend system, as described in the *Joint Growth Servicing Strategy*. Area 3 will be serviced by connecting to the gravity portion of the Westend main.

It is unknown if the Kaiser ASP area will develop prior to the annexed lands. In the event that it does not develop and utilize the remaining capacity in the gravity main, other options have been reviewed to immediately service the annexed lands with the remaining capacity.

Below in Table 7 is a summary of the expected sanitary demand of the overall system in Scenario 2 compared to the design capacity of 146 L/s for Black Diamond in the hydraulically connected Westend and Black Diamond gravity mains.

Table 7: Overall Sanitary Demands vs. Pipe Capacity (Scenario 2)

Area	Discharge Main	Projected Flows (L/s)
Ex Town	300mm Trunk	52.4
Kaiser	525mm Westend Trunk	20.2
2	Proposed 300mm FM	34.0
6	Proposed 450mm	35.4
3	525mm Westend Trunk	35.1
5	Proposed 450mm	33.6
7	Proposed 375mm	5.1
Total Capacity Required		**215.8**
Total Capacity at Lagoon		**146**
Overage		**69.8**

As demonstrated above in Table 7, the existing mains - Black Diamond gravity 300mm and Westend 525mm mains would be able to handle approximately 67% of the future flows at the downstream end of the system. Upgrades would be required to accommodate flows above 146 L/s. Timing for these upgrades will be dictated by rate of development within the overall annexation areas.

Given the information above in Table 7, the additional 72 L/s of sanitary flow from Turner Valley would also trigger upgrades on the gravity system upstream of the wastewater treatment facility. A review of possible upgrades would be required if either of these situations occur.

4.3.3 Wastewater Treatment

As mentioned in Section 3.2, MPE submitted a report on behalf of the WRSSC in late 2015 to AEP regarding required upgrades to the existing aerated lagoon. It had been identified that the existing system operates within the current Environment Protection and Enhancement Act (EPEA) approval requirements but would have challenges meeting future requirements as the Town grew. As of November 2020, the understanding is that the application for these upgrades has been provided funding and detailed design will begin once the agreement is in place. Construction is expected in 2022. These improvements include:

- Upgrades to the Turner Valley Main Lift Station and to the Transfer Station at the lagoon
- Removal of sludge from the existing cells
- Addition of a third partial mix cell
- Addition of a SAGR system (three cells), after the third partial mixing cell
- Addition of chemical injection, following the SAGR system
- Addition of a UV system, following the chemical injection

These upgrades were sized for an estimated population of 7,989 people in the year 2036 for both Black Diamond and Turner Valley combined (3,986 people for Black Diamond respectively). The estimated population and wastewater flows are summarized in Table 8 below.

Table 8: Projected Wastewater Generation by 2036

Year	Population	Average Day (m^3/day)	Maximum Monthly Average Daily Flow (m^3/day)	Maximum Dry Weather Flow (m^3/day)
2036	7,989	3,492	6,286	7,528

All information presented above is from the *WRSSC Revised Plan for Operating Approval*.

Using the information in the *WRSSC Revised Plan for Operating Approval*, Table 9 below summarizes the wastewater flow requirements for Black Diamond and Turner Valley if all annexed lands were developed, including the wastewater flows from within the existing Town boundaries. The Turner Valley wastewater flows are as per the *Joint Growth Servicing Strategy*. This is the anticipated population within the Turner Valley town boundary, including their proposed annexation lands.

Table 9: Black Diamond Projected Wastewater Generation

Area	Population[6]	Average Day Flow (m^3/day)	Maximum Daily Flow (m^3/day)	Peak Hour Flow (m^3/h)
Turner Valley (Full Build-out)	7,340	1,938	4,263	404
Ex. Black Diamond Boundary Build-out	3,427	905	1,990	189
2	2,226	588	1,293	122
3	2,299	607	1,335	126
5	2197	580	1276	121
6	2318	612	1347	128
7	332	88	193	19
Total Build-out	**20,139**	**5,318**	**11,697**	**1,109**
Capacity of Proposed WRSSC Upgrades (approx. 2036)	**7,989**	**3,492**	**6,286**	**-**

The average day flow listed above was calculated by applying the total community wastewater demand of 264 L/c/d (see Table 3) to the anticipated population and jobs. The maximum daily flow was then calculated by the MDF:ADF ratio of 2.2 and the peak hour flow was found using the PHF:ADF of 5.0.

From Table 9, it can be observed that the anticipated maximum daily flow of build-outs of both Towns exceeds the design maximum daily flows for the lagoon. Therefore, further upgrades to the system will be required when the Town's population is approaching the design population of 7,989 people (*Revised Plan for Operating Approval)*. Given the growth rates from Section 2.3 and Appendix B, it is projected that the design population of 7,989 people be achieved between both Towns around 2030 to 2033 depending on either a lower or higher growth trend. This is sooner than what was presented in the *WRSSC Revised Plan for Operating Approval*.

5.0 Existing Water Infrastructure

5.1 General

The Town of Black Diamond receives its water supply from the Sheep River Regional Utility Commission (SRRUC). Water is supplied and treated through the SRRUC water supply and treatment plant located in Turner Valley. The treated water is then pumped to Black Diamond through a 250mm transmission main

[6] Includes the sum of all jobs and residents.

owned and operated by SRRUC. Water is transferred to the Town via a metering station into the Town's treatment water storage reservoir.

5.2 Existing Water Supply

The Town of Black Diamond has three water licenses for a total diversion capacity of 954,660m3 per year. All the Town's water licences point of diversion is located at the SRRUC water diversion system in Turner Valley. The SRRUC diverts water from the Sheep River under the restrictions for the Town's licenses and treats and delivers water to the Town.

5.3 Existing Water Treatment

As mentioned previously, Black Diamond's treated water is treated at the SRRUC water treatment plant located in Turner Valley. After the flood of 2013, the water treatment supply system was upgraded to meet the estimated 25-year demand of the SRRUC customers: the Town of Black Diamond, the Town of Turner Valley and the MD of Foothills. From the *Quad Regional Water System: Water Treatment Plan and Mechanical Upgrades - Final*, MPE Engineering Ltd., 2012, the following criteria was used to determine the plant capacity.

Table 10: Water Treatment Plant Upgrade Criteria

	Units	Black Diamond	Turner Valley	Rural	Total
Population	People	4,006	4,006	890	8,902
Per Capita Water Usage	L/c/d	410			
Average Day Demand (ADD)	m^3/d	1,642.5	1,642.5	365	3,650
Maximum Day Demand (MDD)	m^3/d	3,285	3,285	730	7,300

It should be noted that the per capita usage presented in Table 10 was the design per capita usage. The actual per capita usage for all of SRRUC's customers is less than this usage based on water usage records and therefore capacity could provide for a larger population.

The upgrades made to the system included:

- Ultraviolet disinfection (three reactors, low pressure)
- Three direct filtration (DF) treatment train identical to the existing treatment trains
- Clearwell (baffled) with regional distribution pumps
- Chlorine disinfection system upgrade

- Taste, odour, organic removal
- Direct intake
- Infiltration gallery and vaults were also constructed

5.4 Existing Water Storage

There is an existing below ground reservoir located in the 600 block of 1st Street SE. As stated in the *Quad Regional Water System: Water Treatment Plan and Mechanical Upgrades – Final*, the storage capacity of the reservoir is 4,545 m^3. This reservoir existed when the Town of Black Diamond had their own water treatment plant, that was destroyed in the 2013 flood. Following the flood in 2013, the treated water comes from the SRRUC water treatment plant in Turner Valley via the 250mm SRRUC transmission line that comes from the south along Highway 22 and fills the Town's water storage reservoir.

6.0 Water Servicing Concept

6.1 Criteria

To determine the overall water demand for the proposed annexation areas, the criteria from the *Calgary Regional Partnership Water and Wastewater Servicing Masterplan*, 2014, for Average Consumption, the Maximum Daily Demand (MDD) to Average Day Demand (ADD) ratio, and the Peak Hour Demand (PHD) to ADD ratio were used. They are summarized in Table 11 below.

Table 11: Water Demand Criteria

Average Consumption	**315**	**L/c/d**
MDD:ADD	2.2	
PHD:ADD	4.0	

The criteria listed in Table 11 will be used to determine demand for each proposed annexed area, as well as to calculate the required reservoir size (see Section 6.6). It should be noted that the average consumption listed above is similar to the estimated per capita usage for Black Diamond once major system leaks were repaired in 2017. The estimated per capita usage is approximately 317 L/c/d.

A summary of the water demand calculations can be found in Appendix D.

6.2 Service Population

The demand for each quarter section was calculated using the criteria provided in Table 11, as well as the projected populations from Section 2.2. The ADD was calculated distributing the average consumption over the projected population. The MDD & PHD could then be calculated using the ratios provided in Table 11. Please see Table 12 below for a summary of the estimated demands.

Table 12: Anticipated Water Demand per Area

Area	Land Use	Population[7]	ADD (MLD[8])	MDD (MLD)	PHD (L/s)
2	Residential	1,988	0.63	1.38	29.0
	Industrial	237	0.07	0.17	3.5
3	Residential	1,727	0.54	1.20	25.2
	Commercial	572	0.18	0.40	8.3
5	Residential	2,004	0.63	1.39	29.2
	Commercial	193	0.06	0.13	2.8
6	Residential	2318	0.73	1.61	33.8
7	Residential	332	0.10	0.23	4.8
Ex Town	-	3,427	1.08	2.38	50.0
Total	**-**	**12,798**	**4.02**	**8.89**	**-**

In Table 13 and Table 14 below, the demands above were combined with an assumed 10% system loss and converted to litres per second to represent the demands of the overall system in each scenario.

Table 13: Converted Overall Water Demand (Scenario 1)

ADD	42.0	L/s
MDD	92.4	L/s
PHD	168.1	L/s

Table 14: Converted Overall Water Demand (Scenario 2)

ADD	51.2	L/s
MDD	112.5	L/s
PHD	204.7	L/s

6.3 Overall Water Servicing Concept

The overall water servicing concept for Scenario 1 is demonstrated in **Figure** 5 and the overall water servicing concept for Scenario 2 is presented in **Figure 6**.

[7] Includes the sum of all jobs and residents
[8] MLD = Megalitres per day

URBAN systems

Annexation Lands Servicing Review

Date: 2021 / 1 / 27

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Overall Water Servicing (Excluding Area 3)

Legend

- PRV — Proposed Pressure Reducing Valve
- RES — Existing Water Reservoir
- Quad Regional Water Line
- Proposed Watermain
- Watermain - Constructed 2020
- Existing Watermain
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

QS-SW SEC-20 TWP-020 RGE-02 MER-5
QS-SE SEC-20 TWP-020 RGE-02 MER-5
QS-SW SEC-21 TWP-020 RGE-02 MER-5
QS-SE SEC-21 TWP-020 RGE-02 MER-5
QS-NW SEC-17 TWP-020 RGE-02 MER-5
QS-NE SEC-17 TWP-020 RGE-02 MER-5
QS-NW SEC-16 TWP-020 RGE-02 MER-5
QS-NE SEC-16 TWP-020 RGE-02 MER-5
QS-SW SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-17 TWP-020 RGE-02 MER-5
QS-SW SEC-16 TWP-020 RGE-02 MER-5
QS-SE SEC-16 TWP-020 RGE-02 MER-5
QS-NW SEC-08 TWP-020 RGE-02 MER-5
QS-NE SEC-08 TWP-020 RGE-02 MER-5
QS-NW SEC-09 TWP-020 RGE-02 MER-5
QS-NE SEC-09 TWP-020 RGE-02 MER-5
QS-SW SEC-08 TWP-020 RGE-02 MER-5
QS-SE SEC-08 TWP-020 RGE-02 MER-5
QS-SW SEC-09 TWP-020 RGE-02 MER-5
QS-SE SEC-09 TWP-020 RGE-02 MER-5
QS-NW SEC-05 TWP-020 RGE-02 MER-5
QS-NE SEC-05 TWP-020 RGE-02 MER-5
QS-NW SEC-04 TWP-020 RGE-02 MER-5
QS-NE SEC-04 TWP-020 RGE-02 MER-5

Area 2
Area 3
Area 5
Area 6
Area 7

1 Avenue NW
1 Avenue NE
Centre Avenue W
Centre Avenue E
1 Avenue SW
1 Avenue SE
2 Avenue SW
2 Avenue SE
3 Avenue SW
4 Avenue SE
5 Avenue SW
6 Avenue SW
1 Street NW
2 Street NW
3 Street NW
1 Street SW
2 Street SW
3 Street SW
4 Street SW
5 Street SW
1 Street SE
6 Street SE
3 Street NE
Government Road S
Riverwood Crescent SW
Willow Ridge Manor SW
418 Avenue W
HWY 7

PRV
PRV
PRV
RES

400 PVC WATERMAIN PHASE 1
NE INDUSTRIAL WATERMAIN LOOPING
(INCLUDES PRV INSTALLATION)

PROPOSED 250 PVC WATERMAIN

Regional Water Line 250

PROPOSED 250 PVC WATERMAIN
EXTENSION SOUTH OF
WILLOW RIDGE BLVD

PROPOSED 250
WATERMAIN EXTENSION

PROPOSED 250 PVC
WATERMAIN TIE IN

FIGURE
5

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URBAN systems

Annexation Lands Servicing Review

Date: 2021 / 1 / 27

Scale: 1:15,000

Legend

- PRV — Proposed Pressure Reducing Valve
- RES — Existing Water Reservoir
- Quad Regional Water Line
- Proposed Watermain
- Watermain - Constructed 2020
- Existing Watermain
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

QS-SW SEC-20 TWP-020 RGE-02 MER-5
QS-SE SEC-20 TWP-020 RGE-02 MER-5
QS-SW SEC-21 TWP-020 RGE-02 MER-5
QS-SE SEC-21 TWP-020 RGE-02 MER-5
QS-NW SEC-17 TWP-020 RGE-02 MER-5
QS-NE SEC-17 TWP-020 RGE-02 MER-5
QS-NW SEC-16 TWP-020 RGE-02 MER-5
QS-NE SEC-16 TWP-020 RGE-02 MER-5
QS-SW SEC-17 TWP-020 RGE-02 MER-5
QS-SE SEC-17 TWP-020 RGE-02 MER-5
QS-SW SEC-16 TWP-020 RGE-02 MER-5
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QS-NW SEC-08 TWP-020 RGE-02 MER-5
QS-NE SEC-08 TWP-020 RGE-02 MER-5
QS-NW SEC-09 TWP-020 RGE-02 MER-5
QS-NE SEC-09 TWP-020 RGE-02 MER-5
QS-SW SEC-08 TWP-020 RGE-02 MER-5
QS-SE SEC-08 TWP-020 RGE-02 MER-5
QS-SW SEC-09 TWP-020 RGE-02 MER-5
QS-SE SEC-09 TWP-020 RGE-02 MER-5
QS-NW SEC-05 TWP-020 RGE-02 MER-5
QS-NE SEC-05 TWP-020 RGE-02 MER-5
QS-NW SEC-04 TWP-020 RGE-02 MER-5
QS-NE SEC-04 TWP-020 RGE-02 MER-5

Area 2
Area 3
Area 5
Area 6
Area 7

1 Avenue NW
1 Avenue NE
Centre Avenue W
Centre Avenue E
1 Avenue SW
1 Avenue SE
2 Avenue SW
2 Avenue SE
3 Avenue SW
4 Avenue SE
5 Avenue SW
6 Avenue SW
418 Avenue W
1 Street NW
2 Street NW
3 Street NW
1 Street SW
2 Street SW
3 Street SW
4 Street SW
5 Street SW
1 Street SE
3 Street NE
6 Street SE
Government Road S
Riverwood Crescent SW
Willow Ridge Manor SW
HWY 7

PRV
PRV
PRV
RES

400 PVC WATERMAIN PHASE 1
NE INDUSTRIAL WATERMAIN LOOPING
(INCLUDES PRV INSTALLATION)

PROPOSED 250 PVC WATERMAIN

Regional Water Line 250

PROPOSED 250 PVC WATERMAIN
EXTENSION SOUTH OF
WILLOW RIDGE BLVD

PROPOSED 250
WATERMAIN EXTENSION

PROPOSED 250 PVC
WATERMAIN TIE IN

Overall Water Servicing (Including Area 3)

FIGURE 6

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6.3.1 NE Industrial Water Looping

It was identified through numerous reviews of the Town's existing water system that although the NE Industrial area has sufficient fire flows to meet legislative building code requirements, the NE Industrial area within the Town did not have sufficient water pressure to maintain the Fire Underwriter Survey recommended fire flows for the area. This problem was primarily due to the fact the water system in the industrial park was not looped.

In 2020, a looped system was created by construction a 400mm water main, connecting the existing 250mm main at the east end of 4th Ave to the existing 250mm main at the east end of 1St Ave NE. A connection was made to the existing 250mm main in 1st Ave SE. This also included the installation of a pressure reducing valve (PRV) at the west end of 1st Ave NE, as shown in **Figures 5** and **6**. This is required as the Industrial area is at a higher pressure zone than the north west corner of the Town.

With the water looping in place, the NE industrial area has increased fire flows in the range of 163 L/s to 184 L/s.

The construction of this loop strengthens the overall Town system and supports development in the annexed lands. Actual construction costs have been incorporated into the overall costs.

6.3.2 Overall System (Scenario 1)

Please refer to **Figure 5** for the overall water servicing plan for Scenario 1, which excludes Area 3. The 400mm watermain constructed along future 6th Street has connected the existing 250mm watermains along 4th Ave SE and 1st Ave NE. Area 2 will be serviced from this looped main. The main along future 6th Street will be extended south in future to allow for Area 6 to be serviced.

Upon review of the utilities near Area 5, it was identified that there were several existing mains within the Willow Ridge development that could either be tied into or extended to service Area 5. Therefore, it is proposed that a 200mm water main be extended from the 200mm water main on Willow Ridge Manor, as well as a proposed connection at the existing 250mm stub on Township Road 201 (418 Avenue in Figure 5) south of 3rd Street SW.

During the review, it was identified that the Willow Ridge and Riverwood communities were serviced through two separate water connections: one main along Willow Ridge Boulevard and one along 3rd Street SW at the north end of the neighbourhood. However, the water main along 3rd Street SW has a pressure reducing valve (PRV) meaning that water is only being fed out of the neighbourhood to a lower pressure zone leaving only one water main servicing the community. In order to provide redundancy, an additional 250mm water main is proposed from the 250mm water main between Highway 22 and 1st Street SE. This proposed main would extend south along the entire western edge of Area 3 and across Highway 22 to tie in to the existing 250mm stub on Township Road 201 (418 Avenue).

To service Area 7, a 250mm water main will be extended west along Township Road 201.

6.3.3 Overall System (Scenario 2)

Similar to Scenario 1, the 400mm watermain constructed along future 6th Street has connected the existing 250mm watermains along 4th Ave SE and 1st Ave NE. Area 2 will be serviced from this looped main. In future, the main along future 6th Street will be extended south and then west through Area 3 to tie to the existing systems in Riverwood, to allow both Areas 3 and Area 6 to be serviced.

As shown in **Figure 6**, similar servicing to Scenario 1 is proposed for Scenario 2 for Area 5 and 7 where a 250mm water main is extended from the existing main on Willow Ridge Manor, as well as the proposed connection to the existing 250mm stub located along Township Road south of 3rd Street SW. A 250mm main is extended west along Township Road South to the boundary of Area 7.

However, redundancy will still be required as only one water main would be servicing the Willow Ridge/Riverwood neighbourhood. Yet we do acknowledge there is a bypass installed at the PRV near 3rd Street and 6th Ave. To address this in Scenario 2, a 250mm extension on Willow Ridge Boulevard from the proposed 250mm water main along the proposed road through Area 3 is proposed to extend south on the west side of Highway 22 and connect to the 250mm stub on Township Road 201 (418 Avenue in Figure 6).

6.4 Water Diversion Licensing

Given the water demands presented in Table 13 and Table 14, the population in the existing Town boundary, as well as the proposed population in the annexation areas for both scenarios, the Town will require the following volumes of water for each scenario:

- Scenario 1 = 1,388,242 m^3 per year, which is 433,582m^3 over the existing Town water license allocation as presented in Section 5.2
- Scenario 2 = 1,692,175 m^3 per year which is 737,515m^3 over the existing Town water license allocation as presented in Section 5.2

Therefore, the Town would have to explore additional water licensing options above the 954,679m^3 of current water licensing around a combined population (jobs and residents) of 8,304 people. Using the projected lower and higher growth rates as presented in Section 2.3, and applying that to the 2016 census population of Black Diamond, it is estimated that additional water licensing allocation will be required somewhere between 2056 and 2066. Please refer to Appendix B for the tabulated, detailed population projections of Black Diamond. Please note that Turner Valley's water supply and treatment was not taken into consideration.

6.5 Water Treatment

Given the parameters upon which the current water treatment facility was sized, the water treatment plant would have to be upgraded further to service the surrounding communities. Currently, the plant will service the area until there is maximum daily demand of 7,300 m^3 per day. This demand amounts to a total estimated population of 9,160 people using the per capita usage presented in Table 11. From Appendix B, it can be estimated that both Turner Valley and Black Diamond will approach this population range between

2034 and 2039 so further study closer to that time frame is recommended. Given that water usage in the Town is steadily decreasing and a lower average consumption was used for this report compared to the design of the water treatment plant, the design life of the water treatment plant may extend past 2036 but review of the system is still recommended prior to that date or design population.

6.6 Water Storage

To calculate the required reservoir size, the AEP Standards and Guidelines for a Municipal Water Works, Wastewater and Storm Drainage Systems are used to determine the ultimate reservoir size using the following formula:

S = A + B + (Greater of C or D)

Where S = Total storage requirement, m3

A = Fire storage, m3

B = Equalization storage (approximately 25% of projected maximum daily design flow), m3

C = Emergency storage (minimum of 15% of projected average daily design flow), m3

D = Disinfection contact time (T_{10}) storage to meet the CT requirements, m3, as detailed in Section 1.10.3.7.

Using the equation supplied above and the values shown in Table 15 and Table 16: Required Reservoir Storage (Scenario 2), the required reservoir storage for both scenarios was calculated. A fire flow of 197 L/s for 2.5 hours was utilized for fire flow sizing. The equalization and emergency storage for both scenarios were calculated from the demand values presented in Table 13 and Table 14. Therefore, the required reservoir sizing for each scenario is summarized in Table 15 and Table 16 below.

Table 15: Required Reservoir Storage (Scenario 1)

A – Fire Storage	**1,773**	**m^3**
B – Equalization Storage	2,001	m^3
C – Emergency Storage	546	m^3
D – Disinfection Contact Time (T_{10}) Storage[9]	303	m^3
Total Required Storage	**4,320**	**m^3**

[9] Disinfection Contact Time (T_{10}) Storage was not used to calculate the required reservoir size as this volume was less than the required Emergency Storage.

Table 16: Required Reservoir Storage (Scenario 2)

A – Fire Storage	1,773	m^3
B – Equalization Storage	2,439	m^3
C – Emergency Storage	665	m^3
D – Disinfection Contact Time (T_{10}) Storage[10]	370	m^3
Total Required Storage	**4,877**	**m^3**

The existing reservoir storage is 4,545 m^3. There is sufficient storage to service Scenario 1. Scenario 2 will require additional storage. Additional storage in the reservoir would only occur after acquiring additional water licenses, which is expected beyond 2056.

7.0 Stormwater Servicing Concept

The overall stormwater servicing for each quarter section requires a stormwater management facility for each area, as well as a system of ditches or pipes for the pond outlets. It will be the responsibility of the developer(s) to provide an ultimate stormwater management facility. As well, the developer(s) will be required to provide a detailed review of how the stormwater will be managed in each area. A Staged Master Drainage Plan (SMDP) and a Pond Report will be required to support development. The developer will be responsible for maintaining pre-development runoff rates and treating stormwater to meet AEP guidelines.

A minor system will be required under the majority of the proposed roadways to handle drainage. This will involve the construction of a system of storm mains and catch basins. Depending on the location, the stormwater from the roads will drain to the nearest stormwater management facility.

It is recommended that the Town conduct further study into their stormwater infrastructure in order to develop a framework for developers to abide by. Some examples of the types of studies include:

- Overall Stormwater Strategy for the Town, similar to a Master Drainage Plan that can implement stormwater policy for the Town. *(Update: this study is underway with completion expected in 2021)*
- Wetland Investigations to determine the classes of any existing wetlands within the annexed areas. This will help determine what wetlands might be of interest to the Town to preserve and what will be the development requirements around wetlands.
- Watercourse Investigation in Areas 3 and 5 to determine extents, capacity and design characteristics of the existing watercourse.

[10] Disinfection Contact Time (T_{10}) Storage was not used to calculate the required reservoir size as this volume was less than the required Emergency Storage.

8.0 Area 2 Servicing

8.1 Ultimate

Please refer to **Figure 7** for the ultimate configuration to service Area 2. The existing contours of the quarter section is shown on **Figure 8** for reference. The proposed ultimate servicing for Area 2 will remain the same regardless of Scenario 1 and 2.

8.1.1 Sanitary

A lift station is proposed to deliver the sanitary demand of 34 L/s from Area 2 (see Figure 7). This lift station will be sized to accommodate higher flows to service Areas 5, 6 and 7. A proposed 300mm force main will then take the flows from the lift station to the 525mm gravity main headed to the wastewater lagoon.

A 525/450mm gravity main is also proposed to be extended south of the lift station along future 6th Street to the south-west corner of Area 2. This main has been sized to accommodate flows from Area 6, 5, 7 and 72 L/s from Turner Valley.

Depending on timing, Area 6 may be serviced north through Area 2. Oversizing would be required.

8.1.2 Water

Area 2 will be serviced by connecting to the newly constructed 400mm water main along future 6th Street. As such, the developer will tie to the existing system to service the water demand of 32.5 L/s. The developer(s) within Area 2 would also be required to provide a system that loops internally to the quarter section, as well as connect south to Area 6. There will be enough pressure in the area regardless of whether or not the quarter section is looped; however, looping is recommended for redundancy.

8.1.3 Storm

A stormwater management facility is recommended at the east edge of the quarter section at the existing low point as shown in **Figure 7** and **Figure 8**. All stormwater within the quarter section will be collected, conveyed and discharged at the facility. The stormwater facility would then discharge to the south-east towards the existing ravine via a system of ditches along the south-east corner of the quarter section. It is recommended that the stormwater outfall for Area 2 be combined with the stormwater outfall for Area 6. It will be the responsibility of the developer to design and construct these systems as well as to propose interim strategies for development depending on the timing of adjacent landowners.

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

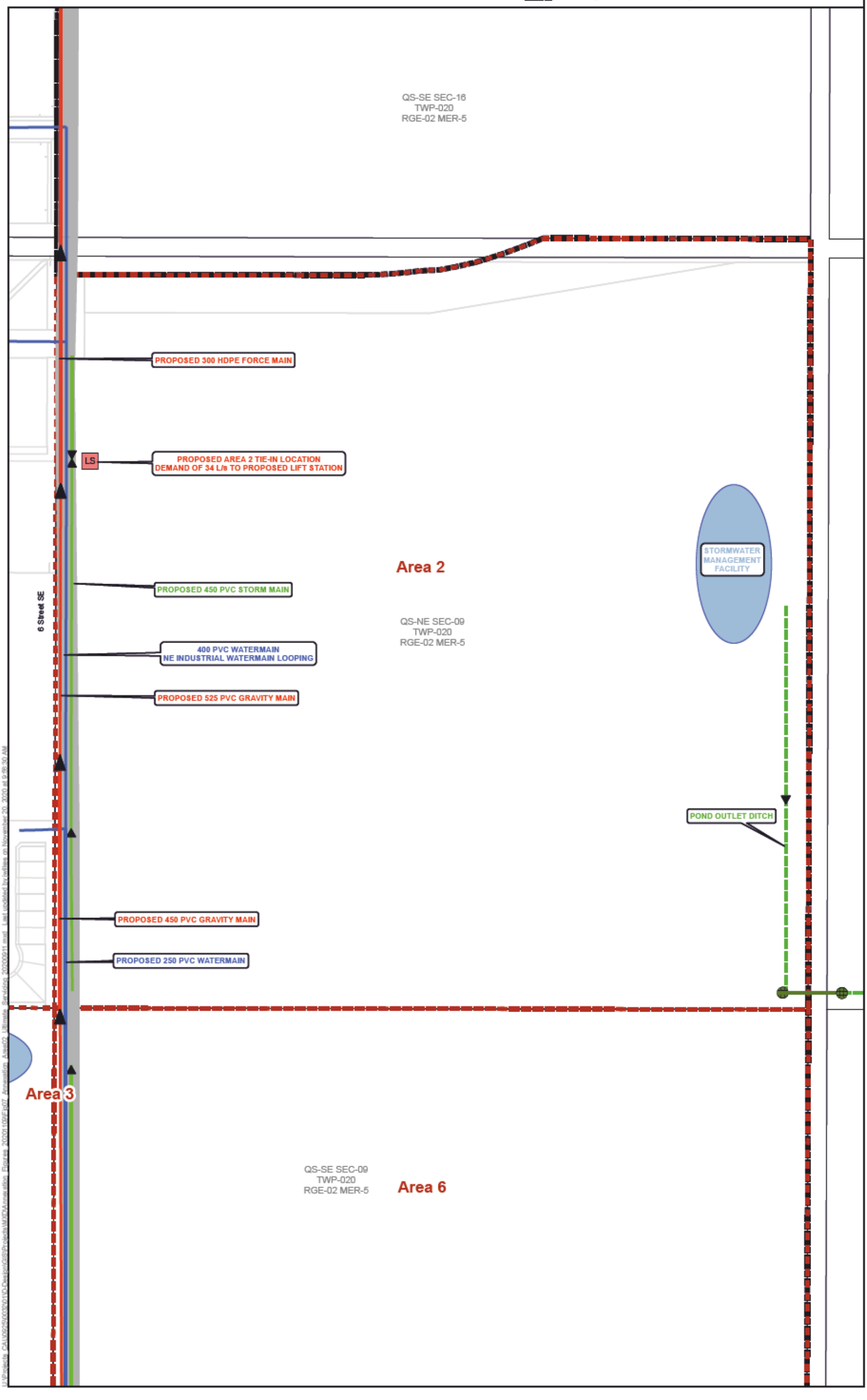
Legend

- LS Proposed Lift Station
- Proposed Sanitary Main
- Proposed Watermain
- Proposed Storm Main
- Proposed Ditches
- Proposed Culverts
- Stormwater Management Facility
- Proposed Road (26m)
- Annexation Areas
- Existing Town Boundary

TOWN OF BLACK DIAMOND

N

Scale: 1:4,000



Area 2 - Ultimate Servicing

FIGURE 7

URBAN systems

Annexation Lands Servicing Review

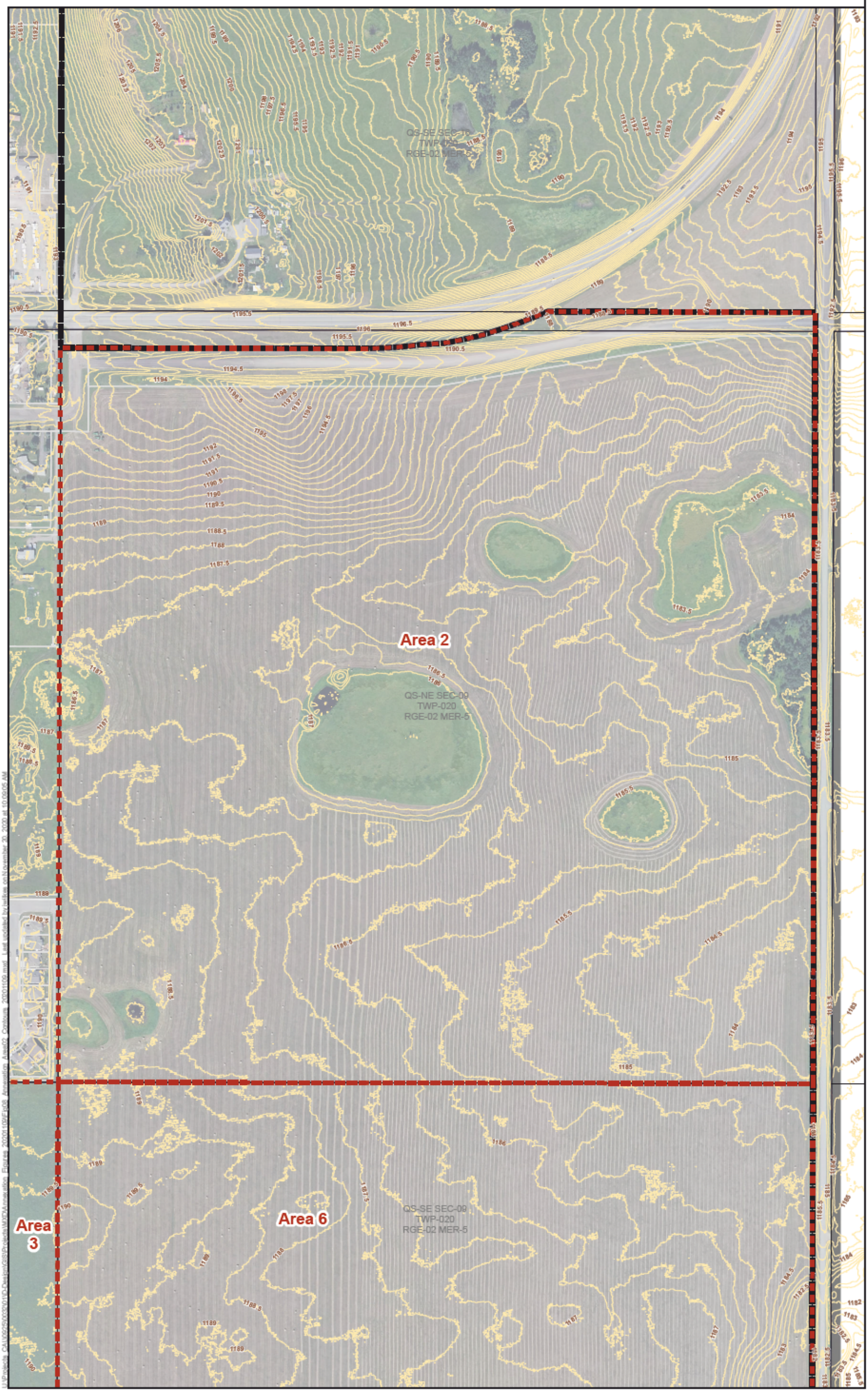
Date: 2020 / 11 / 20

Legend

- Existing Contours (0.5m)
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

TOWN OF BLACK DIAMOND

Scale: 1:4,000



Area 2 - Existing Contours

FIGURE 8

8.1.3.1 Wetlands

A brief desktop review of the quarter section identified the possibility of wetlands in the area. It was identified by the Town that preserving wetlands are a priority but to be conservative, for the purpose of this study, the surface areas of the wetlands were not removed from the developable area calculation. As the classes of these wetlands are unknown, the Town preferred to assume all the area is developable, therefore meaning the wetlands could be removed, in order to size infrastructure appropriately.

It is recommended that a further review of the wetlands take place at the time of an ASP to identify the class of the wetlands.

8.2 Short Term

Due to development interest from the current landowner, the opportunities for Area 2 to develop in the short term were explored. The 400mm watermain along future 6th Street is now existing. The Kaiser area is currently undeveloped. We have also assumed that only Area 2 would initiate development in the short term. This is due to the capacity constraints of the existing sanitary system.

Area 2 would be serviced in the short and long term by the recently constructed 400mm water main. A stub was provided at the intersection of 4th Ave SE.

Based on the wastewater flow monitoring, as outlined in Sec. 3.1.1, there is approximately 10 L/s of spare capacity in the 300mm Black Diamond sanitary gravity trunk main. The 250mm main within 1st Ave SE has sufficient spare capacity for Area 2 to temporarily connect to the system at this point. Or a temporary connection could be made at 4th Ave SE. The limited area to be developed will be based on the proposed density.

If development proceeds in the short term, in advance of the ultimate stormwater facility, an interim stormwater solution would be required by each developer, with each parcel ultimately draining to the overall stormwater management facility. A staged approach of the ultimately facility could also be considered. At this time, the overall management facility is expected to be a collective cost to all the developers within each catchment area.

9.0 Area 3 Servicing

9.1 Ultimate

Please refer to **Figure 9** for the ultimate configuration to service Area 3. The existing contouring of Area 3 are demonstrated in **Figure 10**. The servicing for Area 3 will only apply in Scenario 2.

9.1.1 Sanitary

Similar to the *Joint Growth Servicing Strategy*, it is proposed that Area 3 tie in to the existing Westend sanitary trunk main that discharges to the wastewater lagoon. From the *Westend Regional Sewage Services Commission - Westend Sanitary Trunkmain Relocation Design Report*, it is stated that the system was designed for a total capacity of 280 L/s, 146 L/s of which is allocated for the Town of Black Diamond. At this time, it is proposed that a portion of the Kaiser ASP will contribute 20.2 L/s to the Westend main in future. It is proposed that the entire flow of 35.1 L/s from Area 3 be directed to the Westend main. The proposed tie-in location is sanitary manhole S01 (identified in the Westend Sanitary Trunk Main Relocation drawings).

It is recommended that the process be initiated with WRSSC for Black Diamond to connect to the Westend main.

9.1.2 Water

The water demand of 33.5 L/s for Area 3 can be serviced off the existing system by tying into the existing 250mm main on Willow Ridge Blvd. SW. Additional connections can be made by connecting to the 150mm main on Maple Wood Way. It is recommended to extend the 250mm water main from the tie-in point on 4th Ave SE in Area 2 south along future 6th Street and east along the proposed future roadway. This would strengthen the overall system and provide additional looping.

To further strengthen the system, the developer(s) within Area 3 would also be required to provide a system that loops internally to the quarter section to strengthen the system and provide redundancy.

URBAN systems

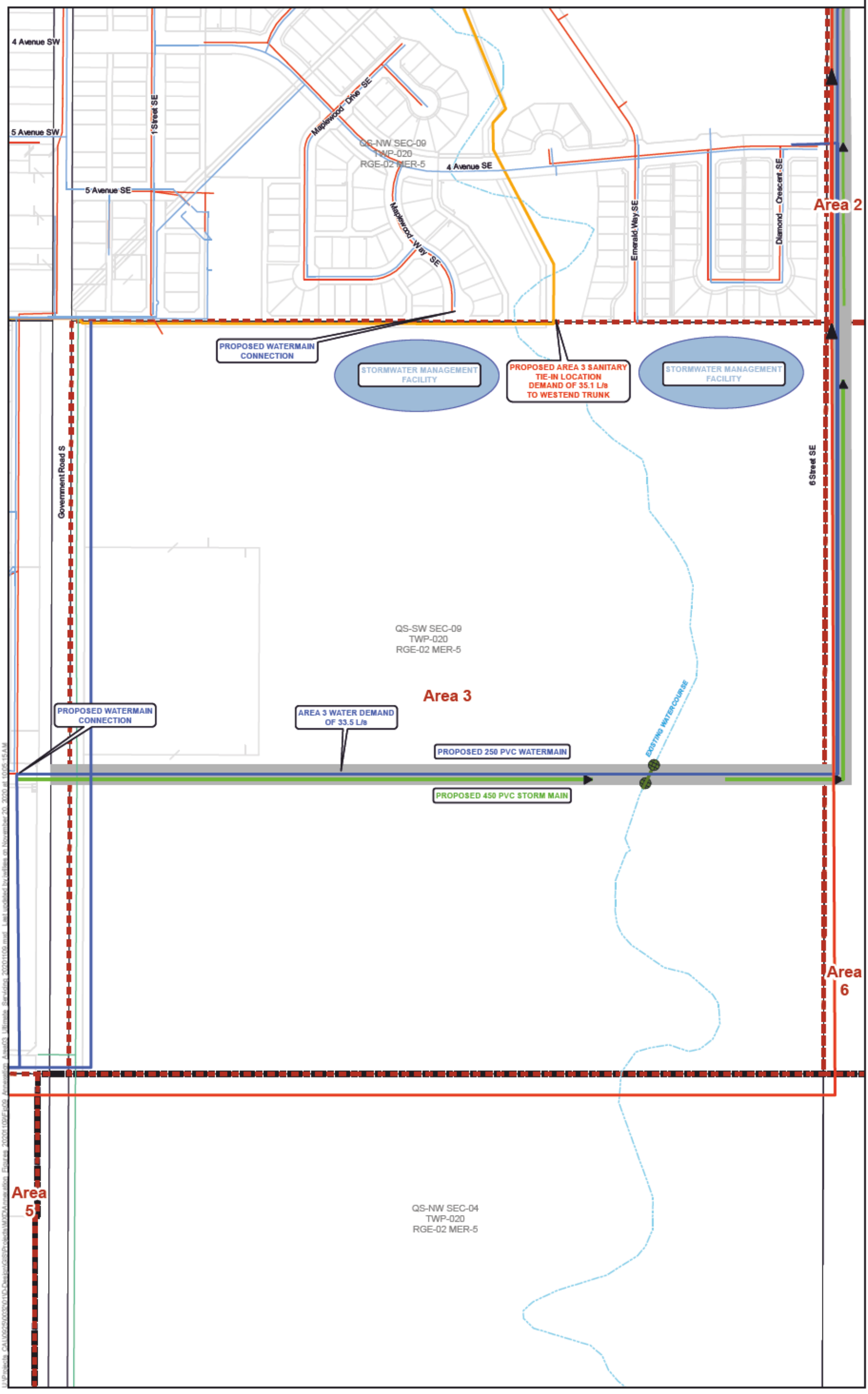
Annexation Lands Servicing Review

Date: 2020 / 11 / 20

Scale: 1:4,000

Legend

- Proposed Watermain
- Proposed Storm Main
- Proposed Ditches
- Proposed Culverts
- Existing Westend Sanitary System
- Existing Sanitary Main
- Existing Watermain
- Quad Regional Water Line
- Stormwater Management Facility
- Proposed Road (25.2m)
- Annexation Areas
- Existing Town Boundary



Area 3 - Ultimate Servicing

FIGURE 9

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

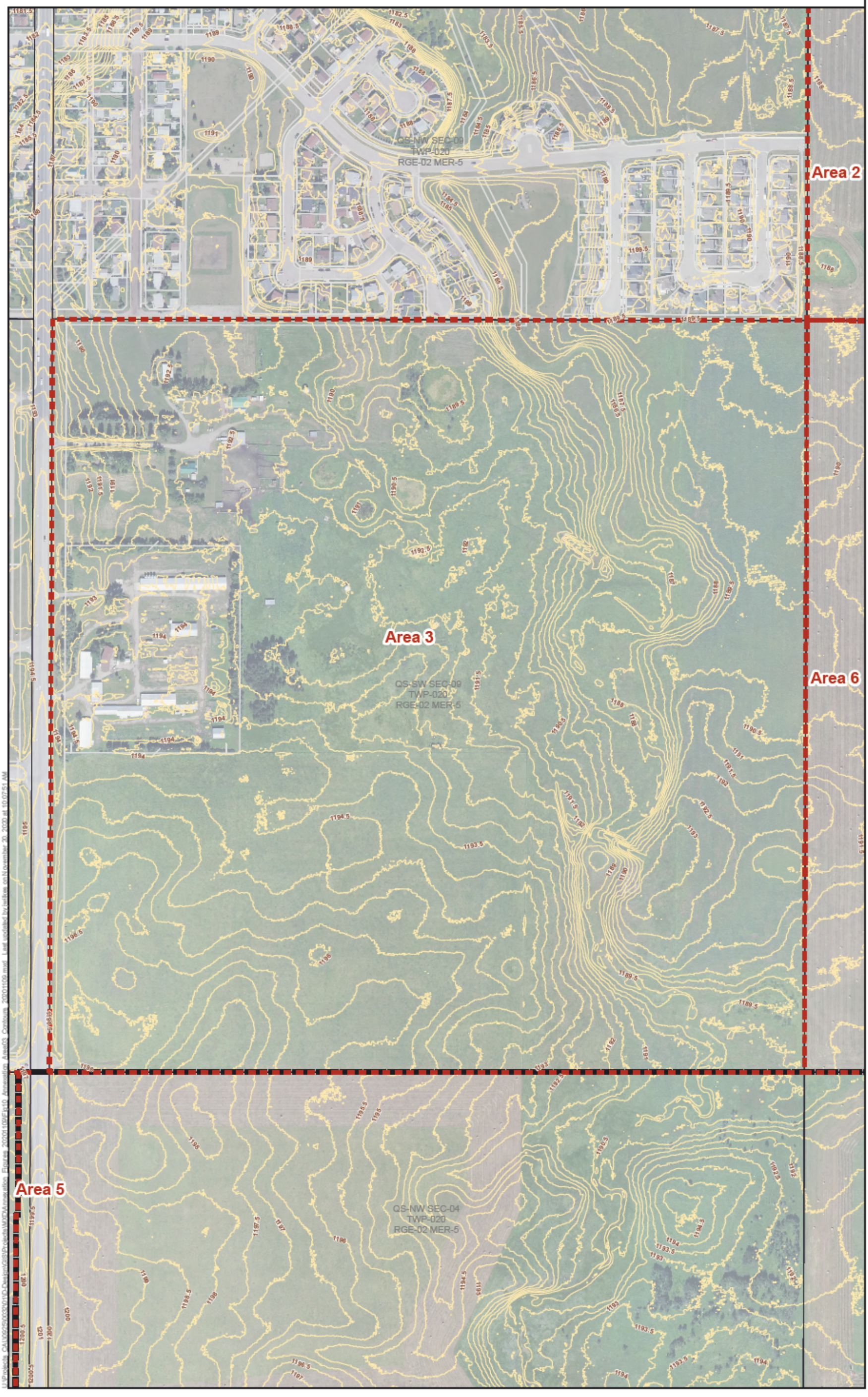
Legend

- Existing Contours (0.5m)
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

TOWN OF BLACK DIAMOND

N

Scale: 1:4,000



Area 3 - Existing Contours

FIGURE 10

9.1.3 Storm

A stormwater management facility is recommended at the north end of the quarter section at the existing low point, west of the existing water course. All stormwater within the quarter section would have to be collected, conveyed, and discharged at the facility. The stormwater facility would then discharge to the existing water course, maintaining the existing drainage pattern.

An additional pond is proposed at the north end east of the existing watercourse to manage all drainage from the east side of the water course. This pond would also discharge to the existing drainage course. If Area 6 were to develop prior to Area 3, the area east of the drainage course could possibly drain east to the Area 6 stormwater management facility to minimize the number of facilities in the area.

It would be the developer's responsibility and cost to develop both systems.

9.2 Short Term

Given the geographic location of Area 3 and its proximity to existing infrastructure, the entire quarter section will be serviced by existing infrastructure, with development starting at the north end of the site. A stormwater management facility will be required to retain stormwater. Similar to Areas 2, if development proceeds in the short term, staged construction of the facility will be considered. An interim stormwater facility could be constructed by each developer that would ultimately drain to the overall stormwater management facility. The overall management facility would be a collective cost to all the developers within the catchment area

10.0 Area 5 Servicing

10.1 Ultimate (Scenario 1)

Please refer to **Figure 11** for the ultimate configuration to service Area 5 for Scenario 1. **Figure 13** in Section 10.2 can be referenced for the existing contouring of the quarter section.

10.1.1 Sanitary

To service the Area 5 demand of 33.6 L/s, it is proposed that a 450mm gravity main be extended west along the south boundary of Area 3. The pipe would be extended south from the proposed stub at Area 2 along future 6th Street to the south east corner of Area 3 and then proceed west along the southern border of Area 3. The pipe would then cross Highway 22 into the NE corner of Area 5. This pipe is sized to service Area 7 and to allow for efficiencies in the system and provide Turner Valley the option of extending the main. Discussions with Turner Valley are recommended to determine the best option in servicing their additional 72 L/s. The Westend forcemain does not have capacity for the additional 72 L/s of projected sanitary flow from their proposed annexed lands.

URBAN systems

Annexation Lands Servicing Review

Date: 2021 / 1 / 27

Scale: 1:4,000

Legend

- Proposed Lift Station
- Proposed Sanitary Main
- Proposed Watermain
- Proposed Storm Main
- Proposed Ditches
- Proposed Culverts
- Existing Westend Sanitary System
- Existing Sanitary Main
- Existing Watermain
- Quad Regional Water Line
- Stormwater Management Facility
- Annexation Areas
- Existing Town Boundary

Area 7

QS-NE SEC-08 TWP-020 RGE-02 MER-5

QS-NW SEC-09 TWP-020 RGE-02 MER-5

QS-SE SEC-08 TWP-020 RGE-02 MER-5

QS-SW SEC-09 TWP-020 RGE-02 MER-5

Area 3

Area 5

QS-NE SEC-05 TWP-020 RGE-02 MER-5

QS-NW SEC-04 TWP-020 RGE-02 MER-5

5 Avenue SE

6 Avenue SW

418 Avenue W

2 Street SW

1 Street SW

1 Street SE

3 Street SW

Government Road S

Riverwood Way SW

Riverwood Crescent SW

Willow Ridge Blvd SW

Willow Ridge Gate SW

Willow Ridge Manor SW

Willow Ridge Crescent SW

Willow Ridge Link SW

Ridgestone Lane SW

Willow Ridge Close SW

Willow Ridge Way SW

PRV

PROPOSED 250 WATERMAIN EXTENSION

PROPOSED WATER CONNECTION

PROPOSED 250 PVC WATERMAIN CONNECTION

PROPOSED 250 PVC WATERMAIN

PROPOSED PVC STORM MAIN

STORMWATER MANAGEMENT FACILITY

PROPOSED SANITARY TIE-IN

PROPOSED 450 PVC GRAVITY MAIN

QUAD REGIONAL WATER LINE

PROPOSED WATER DEMAND = 32.0 L/s
PROPOSED SANITARY DEMAND = 33.6 L/s

Area 5 - Ultimate Servicing (Excluding Area 3)

FIGURE 11

U:\Projects_CAL\065\0030\01\Design\GIS\Projects\MXD\Annexation_Figure_20201209\Fig11_Annexation_Area\05_Ultimate_Servicing_20201209.mxd Last updated by lwilkie on January 27, 2021 at 10:25:22 AM

In the event that the development of Area 5 proceeds before all other annexation areas and that Turner Valley has not reached their need to service for the additional 72 L/s of flow, the possibility of Area 5 tying directly to the Westend main instead of Area 3 could be considered.

It should be noted that the option of tying into the existing Westend forcemain was explored in order to service Area 5. Based on the *Turner Valley/Black Diamond Joint Growth Strategy – Scenario 3 Design Brief* prepared by MPE Engineering, the capacity in the forcemain is allocated to Turner Valley flows from the current town boundary. This option is not recommended as a gravity system is always the preferred option, which will eliminate the need for temporary infrastructure and additional lift stations.

10.1.2 Water

The water demand of 32.0 L/s for Area 5 can be serviced by the existing system in Willow Ridge by tying into existing two water main locations: at the existing 200mm water main on Willow Ridge Manor and at the existing 250mm stub south of 3rd Street SW on Township Road 201 (418 Avenue).

Additionally, a 250mm water main is proposed along the east side of Highway 22 from the existing 250mm water main between Highway 22 and 1st Street SE south until Township Road 201 where the proposed 250mm main will head west to tie-in the existing 250mm main south of 3rd Street SW. This is recommended for redundancy for both Area 5 and for the Willow Ridge/Riverwood community as it was discovered that there is only one water main providing water to the Willow Ridge/Riverwood community. The other water connection into the neighbourhood on 3rd Street SW at the north end of the development has a PRV installed that provides water to the north (i.e. the lower pressure zone). The added redundancy would provide added looping in the case that the water main on Willow Ridge Boulevard was ever need of repair.

To further strengthen the system, the developer(s) within Area 5 would also be required to provide a system that loops internally to the quarter section to strengthen the system and provide redundancy.

It should be noted that although the SRRUC Quad Regional main runs along Highway 22 parallel to the east of Area 5, the quarter section cannot tie into this main, as it is a transmission main that supplies the water to the reservoir.

10.1.3 Storm

A stormwater management facility is recommended at the north-east corner of the quarter section at the existing low point (see Figure 13). All stormwater within the quarter section would be collected, conveyed and discharge to the facility. Currently, the overland flows generally flow to the north-east and ultimately to the watercourse that is located in Area 3. However, given the proximity of the watercourse on the west side of the quarter section, it is recommended that the stormwater facility discharge towards the water course along the western edge of the quarter section via a piped system. It will be the responsibility of the developer to design and construct these systems. This recommendation is the same for both Scenario 1 and 2.

10.2 Ultimate (Scenario 2)

Please refer to **Figure 12** for the ultimate configuration to service Area 5 for including the annexation of

Area 3 (Scenario 2). As previously mentioned, the existing contouring of Area 5 is demonstrated in **Figure 13.**

10.2.1 Sanitary

Similar to what was described for Scenario 1 in Section 10.1.1, it is suggested that the proposed 450mm sanitary main in Area 2 be extended south along the eastern edge of Area 3 and then west along the south border of Area 3 towards Area 5. The proposed 450mm would then cross Highway 22 to service Area 5. The 450mm main is sized to accommodate the projected sanitary flows from Area 5 and 7 as well as the additional flow from Turner Valley. This would also allow for efficiencies in the system and provide Turner Valley the option of extending the main to service their additional 72 L/s of projected sanitary flow from their proposed annexed lands. It is understood that the 72 L/s was not included in the design of the Turner Valley Westend forcemain or gravity main.

In the event that the development of Area 5 proceeds all other annexation areas and that Turner Valley has not reached their need to service for the additional 72 L/s of flow, the possibility of Area 5 tying directly to the Westend main could be explored as there is the 83 L/s of spare capacity as mentioned in Section 3.1.1. In this option, both Areas 3 and 5 could be serviced off the Westend gravity main given the remaining capacity and the sanitary demands for both areas.

URBAN systems

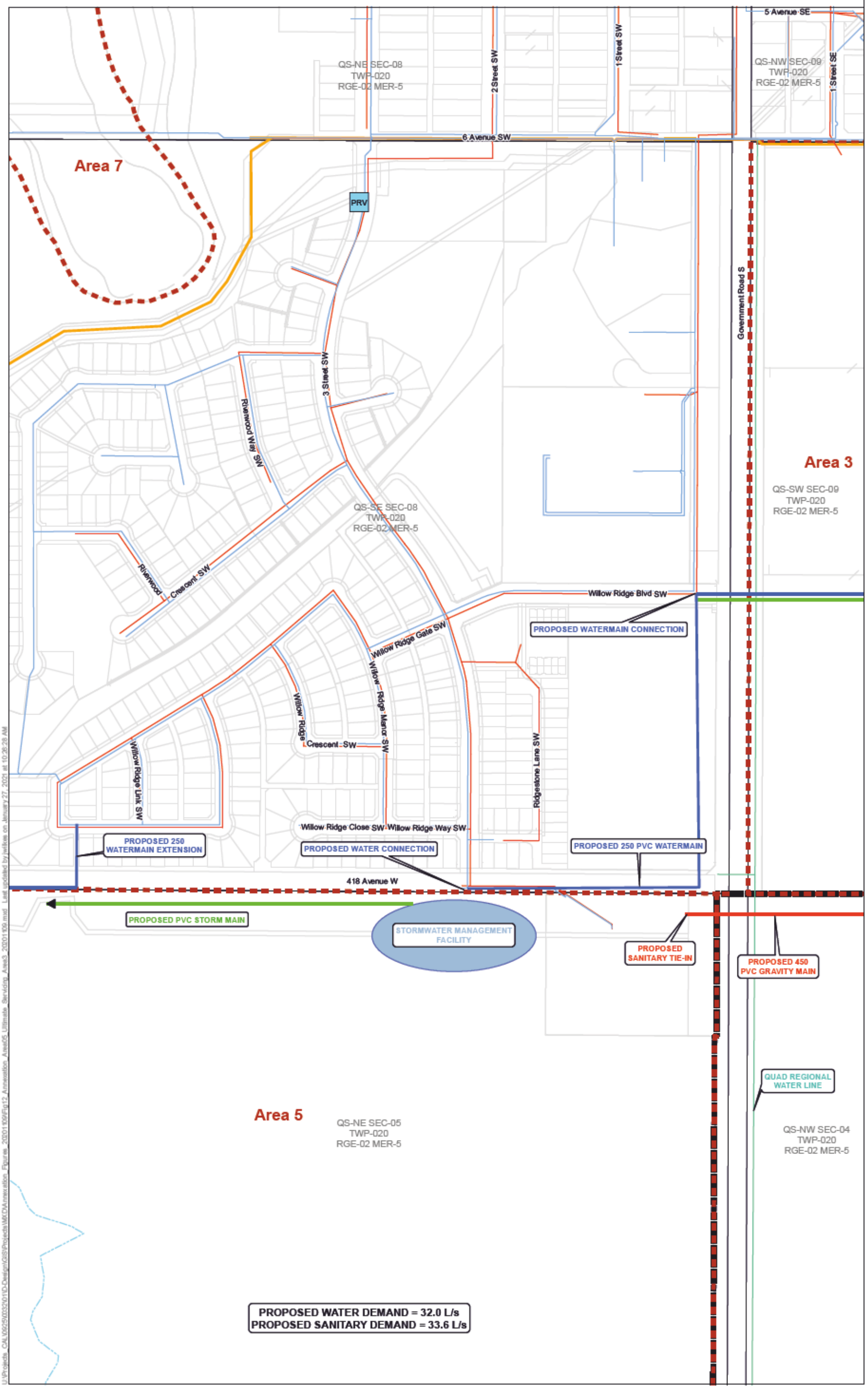
Annexation Lands Servicing Review

Date: 2021 / 1 / 27

Scale: 1:4,000

Legend

- Proposed Lift Station
- Proposed Sanitary Main
- Proposed Watermain
- Proposed Storm Main
- Proposed Ditches
- Proposed Culverts
- Existing Westend Sanitary System
- Existing Sanitary Main
- Existing Watermain
- Quad Regional Water Line
- Stormwater Management Facility
- Annexation Areas
- Existing Town Boundary



Area 5 - Ultimate Servicing (Including Area 3)

FIGURE 12

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

Legend

- Watercourse
- Existing Contours (0.5m)
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

TOWN OF BLACK DIAMOND

N

Scale: 1:4,000

Area 5 - Existing Contours

FIGURE 13

Similar to Scenario 1, the option of tying into the existing Westend forcemain was explored in order to service Area 5. Based on the *Turner Valley/Black Diamond Joint Growth Strategy – Scenario 3 Design Brief* prepared by MPE Engineering, the capacity in the forcemain is allocated to Turner Valley flows from the current town boundary. This option is not recommended as a gravity system is always the preferred option, which will eliminate the need for temporary infrastructure and additional lift stations.

10.2.2 Water

The water servicing strategy for Scenario 2 is the exact same as Scenario 1, Area 5 can be serviced off the existing system in Willow Ridge by extending off the existing 200mm water main on Willow Ridge Manor and tying in to the existing 250mm stub south of 3rd Street SW on Township Road 201 (418 Avenue).

Based on the requirement of a redundant water main as described in the water servicing for Scenario 1, a redundant main will also be required for Scenario 2. However, the location of the redundant main for Scenario 2 will differ from the alignment of Scenario 1. A 250mm water main is still proposed but this water main will extend from the Area 3 water main connection on Willow Ridge Boulevard south across Township Road 201 and then head west to tie in to the existing 250mm stub south of 3rd Street SW. Again, the added redundancy would provide added looping in the case that the water main on Willow Ridge Boulevard was ever need of repair and provide additional flows in the area.

To further strengthen the system, the developer(s) within Area 5 would also be required to provide a system that loops internally to the quarter section to strengthen the system and provide redundancy.

As mentioned in Scenario 1, it should be noted that although the SRRUC Quad Regional main runs along Highway 22 parallel to the east of Area 5, the quarter section cannot tie into this main. This transmission main supplies the water to the reservoir.

10.2.3 Storm

The stormwater servicing for Area 5 is the same regardless of the Scenario. Please refer to Section 10.1.3 for more information.

10.3 Short Term

The Town has identified that it is more likely that developers would develop 10-15 acres parcels at a time compared to one developer developing the entire quarter.

As such, the opportunities for Area 5 to develop in the short term were explored. For the purposes of this short-term review, it is assumed that only Area 5 would be built out in the short term prior to Kaiser or the other annexed lands. This is due to the capacity constraints of the existing sanitary system. The short-term servicing of Area 5 would be the same regardless if it is Scenario 1 or 2.

Given the location of Area 5, it would be able to service water off the existing infrastructure in Willow Ridge as recommended in the overall water servicing. However, the redundant loop on the east side of Highway 22 would still be required.

As stated previously, there is only 10 L/s of remaining capacity in the Black Diamond gravity sanitary system, prior to any connection of the Kaiser area. There is also capacity remaining in the Westend gravity portion with or without Kaiser developing.; Therefore, it is recommended that in the short-term, Area 5 could extend a gravity main along Township Road 201 and connect to the Westend gravity main. Or another option, limited to the remaining capacity of 10 L/s, a possible connection could be made to the existing 250mm sanitary main that is stubbed at the south end of 3rd Street SW. From our estimate of the sanitary flows from the Willow Ridge development, there is enough spare capacity in their sanitary mains to accommodate the 10 L/s. From the *2010 Wastewater Flow Monitoring Study for the Sanitary Trunk Mains*, BSEI Municipal Consulting Engineers, 2011, it was identified that there was sufficient capacity to service the 10 L/s in three downstream manholes that were monitored, even with the full build-out flows of Riverwood. Based on this limited capacity, it is expected that only the residential would proceed as it would limit the need for an additional sanitary main. If the commercial area developed first, a sanitary main draining west would be required to tie in to the existing main where it would ultimately drain the north-east corner of the quarter section. It would be possible to install if the Town preferred to have commercial and depending on the rate of growth, but for the purposes of this short-term review, we will assume only residential will proceed. If the residential portion did tie into the existing system, it would be limited. The limited area of development would be based on proposed density.

If development proceeds in the short term, in advance of the ultimate stormwater facility, an interim stormwater solution would be required by each developer, with each parcel ultimately draining to the overall stormwater management facility. A staged approach of the ultimately facility could also be considered. At this time, the overall management facility is expected to be a collective cost to all the developers.

11.0 Area 6 Servicing

11.1 Ultimate

Please refer to **Figure 9** for the ultimate configuration to service Area 6. Refer to **Figure 15** for existing contours of Area 6.

11.1.1 Sanitary

Given the location of this quarter section between Areas 2 and 3, Area 6 will be serviced by the 450mm sanitary main to be extended south along future 6th Street.

To service the Area 6 demand of 35.4 L/s, it is proposed that a 450mm gravity main from Area 2 be extended south along future 6th Street to the NW corner of Area 6. As the existing contours of the land gently slope to the east, if a gravity system flowing west cannot be achieved, a lift station may be required to pump flows from the east side of the site to the connection in future 6th Street. Considering the timing of

URBAN systems

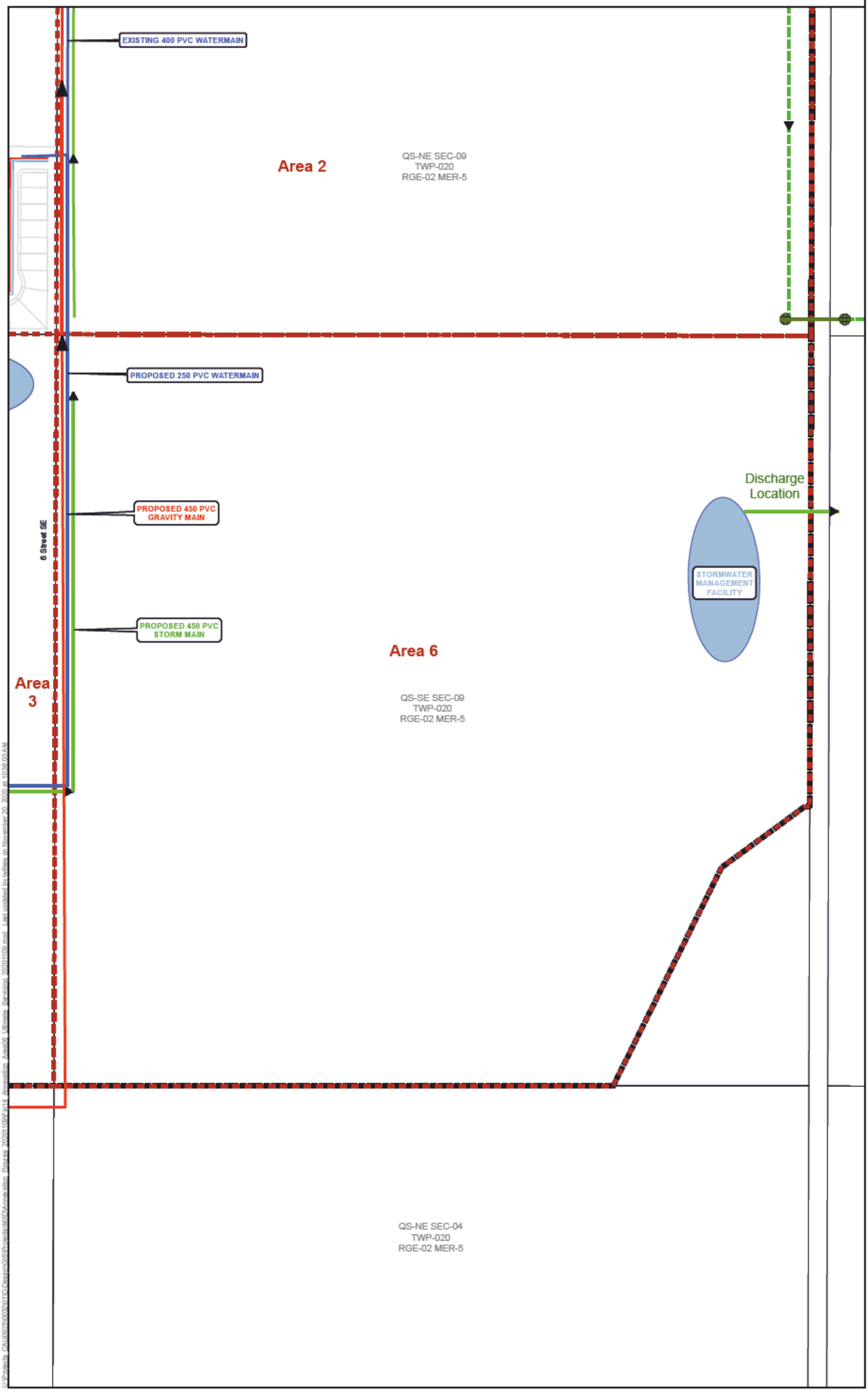
Annexation Lands Servicing Review

Date: 2020 / 11 / 20

Scale: 1:4,000

Legend

- Proposed Lift Station
- Proposed Sanitary Main
- Proposed Watermain
- Proposed Storm Main
- Proposed Ditches
- Proposed Culverts
- Existing Westend Sanitary System
- Existing Sanitary Main
- Existing Watermain
- Quad Regional Water Line
- Stormwater Management Facility
- Annexation Areas
- Existing Town Boundary



Area 6 - Ultimate Servicing

FIGURE 14

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

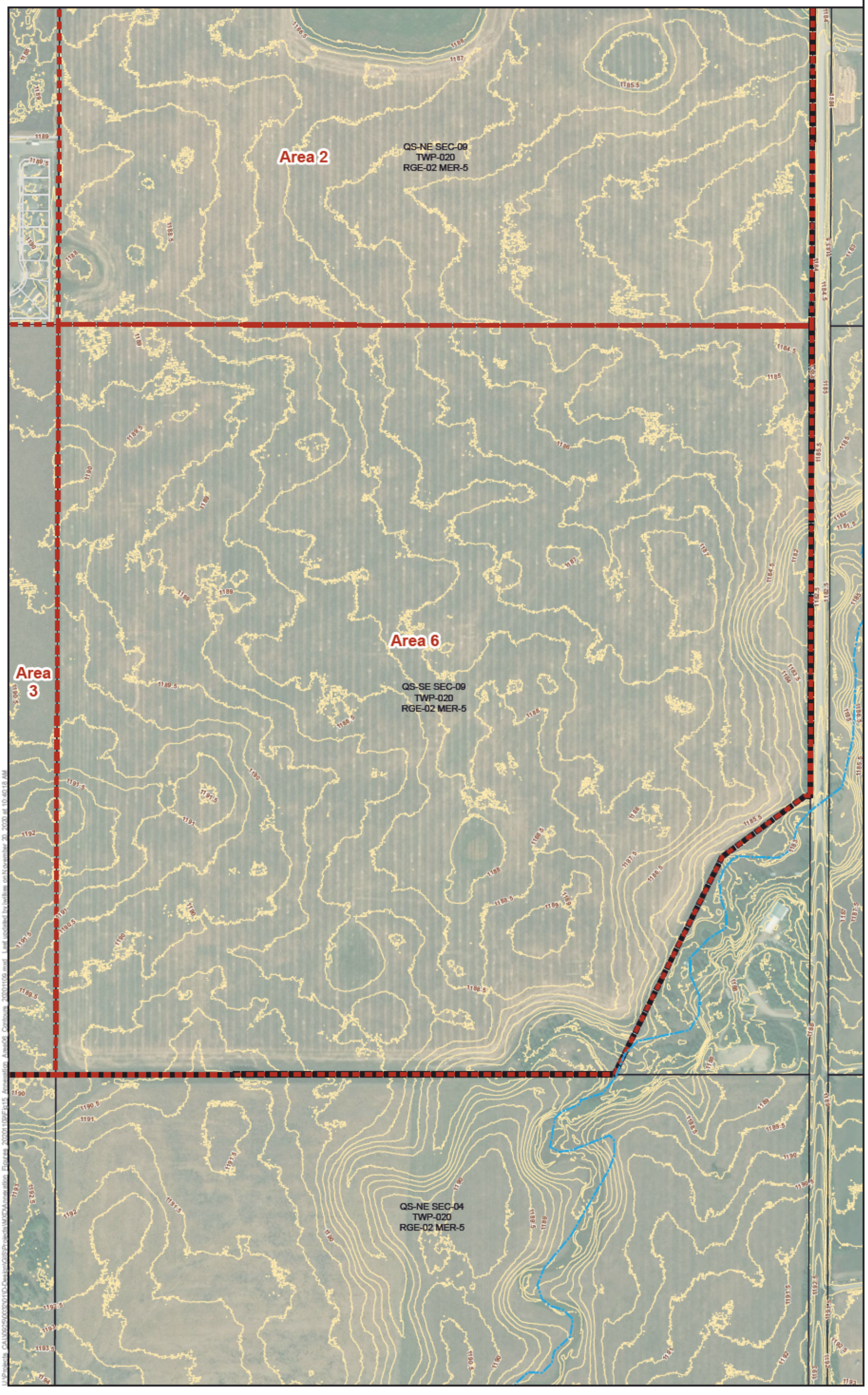
Legend

- Watercourse
- Existing Contours (0.5m)
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

TOWN OF BLACK DIAMOND

N

Scale: 1:4,000



Area 6 - Existing Contours

FIGURE 15

construction relating to Area 2, it may also be possible for Area 6 to flow north through Area 2 and use the same connection as Area 2 to the 6th Street sanitary main. This would require oversizing of the sanitary main within Area 2.

11.1.2 Water

Area 6 will be serviced by the future extension of a 250mm water main along future 6th Street, from the newly constructed 400mm water main stubbed at 4th Street. As such, the developer will tie to the extended main to service the water demand of 33.8 L/s. The developer(s) within Area 6 would also be required to provide a system that loops internally to the quarter section, as well as connect to Area 2 to the north and Area 3 to the west. There will be enough pressure in the area regardless of whether or not the quarter section is looped; however, looping is recommended for redundancy.

11.1.3 Storm

A stormwater management facility is recommended at the east edge of the quarter section at the existing low point as shown in Figure 7 and Figure 8. All stormwater within the quarter section would be collected, conveyed, and discharged at the facility. The stormwater facility would then discharge to the east under 144 Street W towards the existing ravine. It will be the responsibility of the developer to design and construct these systems, and to seek out necessary outfall approvals from Provincial authorities.

As mentioned in Section 9.1.3, it is possible that a portion of Area 3 east of the watercourse could be managed by the stormwater facility in Area 6. In the event that this catchment is developed prior to ultimate servicing in Area 6, it is recommended that temporary facilities be proposed to manage stormwater runoff in the interim. This will be explored in greater detail in the Town's Stormwater Master Drainage Plan.

It would be the developer's responsibility and cost to develop both systems.

11.1.3.1 Wetlands

A brief desktop review of the quarter section identified the possibility of wetlands in the area. It was identified by the Town that preserving wetlands are a priority but to be conservative, for the purpose of this study, the surface areas of the wetlands were not removed from the developable area calculation. As the classes of these wetlands are unknown, the Town preferred to assume all the area is developable, therefore meaning the wetlands could be removed, in order to size infrastructure appropriately.

It is recommended that a further review of the wetlands take place at the time of an ASP to identify the class of the wetlands.

11.2 Short Term

If Area 6 were to develop prior to any other annexed lands, the recently constructed 400mm watermain could be extended south to the Area 6 boundary. A looped connection would be recommended for redundancy purposes and a tie could be considered to Emerald Way.

A temporary connection to the existing sanitary main along 4th Street could be considered. There would be a limited capacity of 10 L/s as previously stated. A connection to the Westend gravity main could also be considered if Area 3 has not connected to this main.

An interim stormwater facility could be constructed by each developer that would ultimately tie to the overall stormwater management facility. The overall management facility would be a collective cost to all the developers.

12.0 Area 7 Servicing

12.1 Ultimate

Please refer to **Figure 16** for the ultimate configuration to service Area 7. Please refer to **Figure 17** for existing contours of Area 7.

12.1.1 Sanitary

It is suggested that Area 7 be serviced by a 375mm gravity sewer main extended west from Area 5 along Township Road 201. This 375mm gravity main is also sized to service the additional 72 l/s from Turner Valley. Based on existing grades of Township Road 201, a lift station may be required to connect to the gravity main.

12.1.2 Water

Area 7 will be serviced by extending a 250mm water main from Area 5 to the east boundary of Area 7 along Township Road 201. As Area 7 is located at the edge of the Town system, if the number of units exceeds 50 lots, a dual water connection is required.

12.1.3 Storm

The majority of Area 7 is impacted by the floodplain of the Sheep River. For portions of land considered to be developable, given the proximity to the Sheep, as well as the lack of adjacent available stormwater infrastructure, development in Area 7 will be required to manage stormwater runoff on-site prior to discharge to the Sheep River. Applicable Provincial guidelines for pre- and post-development flows as well as water quality should be followed. Opportunities exist within development areas and within the flood fringe of the Sheep to apply alternative stormwater management methods such as low impact development, and infiltration in pervious areas.

12.1.3.1 Wetlands

The Town has identified that a wetland may exist within the development cell identified in Area 7. A brief desktop review of the quarter section does not clearly identify the presence of a wetland. It was identified by the Town that preserving wetlands are a priority but to be conservative, for the purpose of this study, the surface areas of the wetlands were not removed from the developable area calculation. As the existence

and classes of these wetlands are unknown, the Town preferred to assume all the area is developable, therefore meaning the wetlands could be removed, in order to size infrastructure appropriately.

It is recommended that a further review of the wetlands take place at the time of an ASP to identify the class of the wetlands.

URBAN systems

Annexation Lands Servicing Review

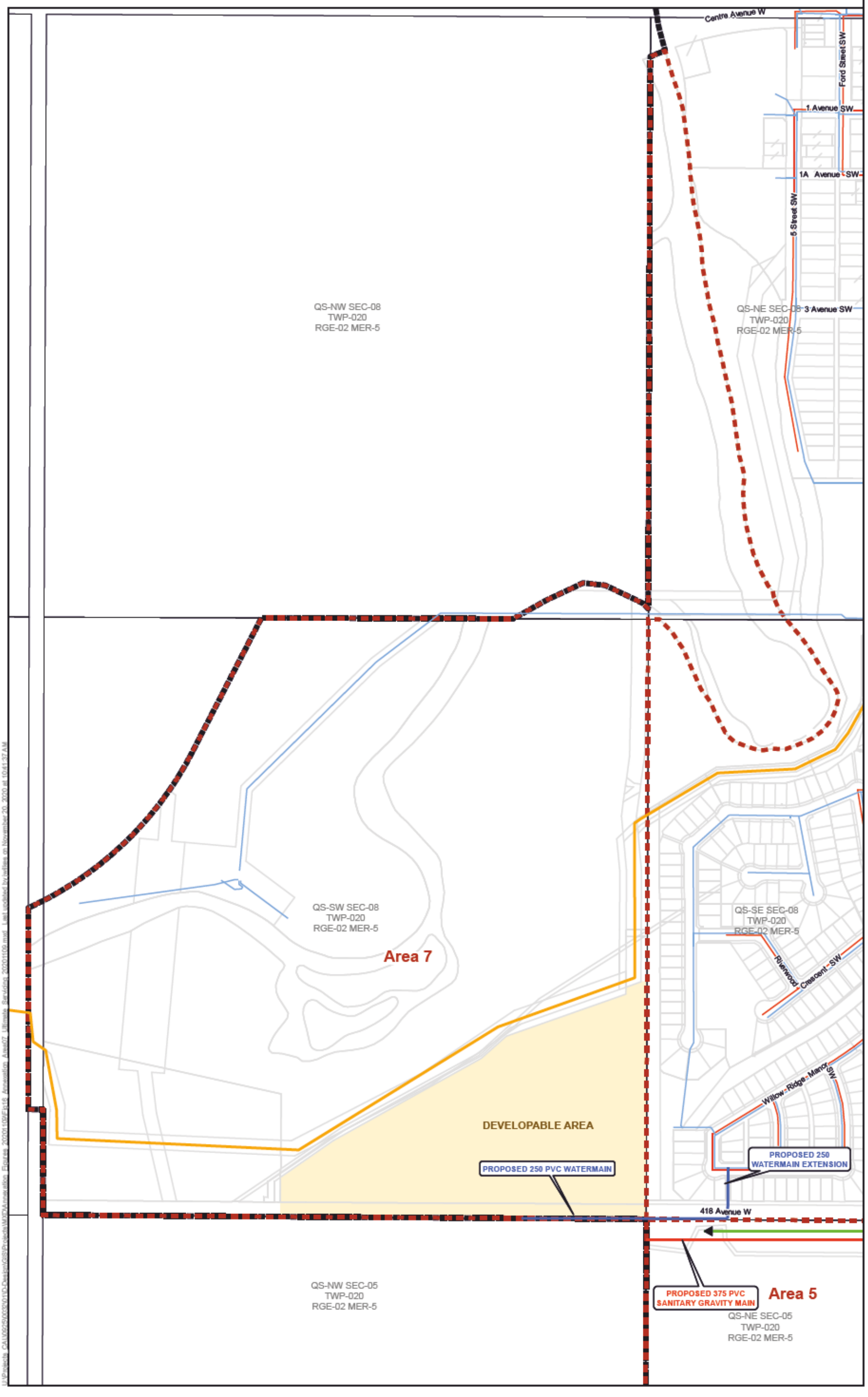
Date: 2020 / 11 / 20

Legend

- LS Proposed Lift Station
- Proposed Sanitary Main
- Proposed Watermain
- Proposed Storm Main
- Proposed Ditches
- Proposed Culverts
- Existing Westend Sanitary System
- Existing Sanitary Main
- Existing Watermain
- Quad Regional Water Line
- Annexation Areas
- Existing Town Boundary

TOWN OF BLACK DIAMOND

Scale: 1:5,000



Area 7 - Ultimate Servicing

FIGURE 16

URBAN systems

Annexation Lands Servicing Review

Date: 2020 / 11 / 20

Legend

- Watercourse
- Existing Contours (0.5m)
- Annexation Areas
- Quarter Sections
- Existing Town Boundary

TOWN OF BLACK DIAMOND

N

Scale: 1:5,000

QS-NW SEC-08 TWP-020 RGE-02 MER-5

QS-NE SEC-08 TWP-020 RGE-02 MER-5

QS-SW SEC-08 TWP-020 RGE-02 MER-5

QS-SE SEC-08 TWP-020 RGE-02 MER-5

Area 7

QS-NW SEC-05 TWP-020 RGE-02 MER-5

QS-NE SEC-05 TWP-020 RGE-02 MER-5

Area 5

Area 7 - Existing Contours

FIGURE 17

priority but to be conservative, for the purpose of this study, the surface areas of the wetlands were not removed from the developable area calculation. As the classes of these wetlands are unknown, the Town preferred to assume all the area is developable, therefore meaning the wetlands could be removed, in order to size infrastructure appropriately.

It is recommended that a further review of the wetlands take place at the time of an ASP/Development permit to identify the class of the wetlands.

12.2 Short Term

It is assumed that Area 5 would develop prior to Area 7 and bring the utilities close to the Phase 7 boundary. In the event that Area 7 is to develop first, it is an option to extend existing utilities from the neighbourhood of Willow Ridge. A 250mm water main can be extended west along Township Road 201 and connect to both the existing 200mm water main on Willow Ridge Manor and the existing 250mm stub south of 3rd Street SW on Township Road 201 (418 Avenue). A sanitary connection could be considered through Willow Ridge also, but capacity would need to be confirmed. As the developable area in Area 7 is minimal, approximately 8.5 ha, the sanitary flow is minimal at 5.1 L/s.

13.0 Transportation

In addition to the civil servicing, the Town existing transportation network was reviewed to determine possible upgrades required to support the potential growth areas. The proposed annexation areas are connected to Highway 7 and Highway 22 that bisects the Downtown Core. Highway 7 transitions to Highway 22 and provides an east-west connection to the Town of Okotoks to the east, High River and Highway 2 to the east and currently carries 5,000 vehicles per day (vpd). Highway 22 provides a north-south connection to Turner Valley to the west and Highway 22X to the north and currently carries between 2,000 and 3,000 vpd.

With the proposed annexation areas, new road connections and accesses will be required to support the full build-out of the lands. The proposed growth areas will require a new north-south connection currently aligned with the future 6 Street SE corridor to alleviate the estimated demand on the existing network. The proposed north-south corridor is approximately 1,200m in length and will provide key connections between Areas 2, 3 and 6. Within Area 3, a new east-west connection (approximately 800m in length) will connect the proposed north-south corridor with Highway 22.

It has been identified by Alberta Transportation and regional stake holders, that Range Road 23 will be a potential future regional roadway. This roadway is currently proposed as a minimum 25.2m Collector roadway, similar to the future 6th Street cross section. The width of this future road right of way will be confirmed in the Town of Black Diamond Master Transportation Plan.

These new corridors provide an additional layer of mobility and connectivity into the existing transportation network. The high-level grid network provides a level of redundancy into the network, will shift demand during the peak period and providing commuters in the area additional routes to and from their destinations.

The analysis and assumptions provided during this stage of the assignment is considered conceptual understanding internal servicing requirements for the annexed areas have not be detailed. Certainty related to phasing and intersection configuration will be further determined at the area structure plan and as potential developers begin to influence the details of these lands.

These proposed road alignment and annexation areas are illustrated in **Figure 18** below.

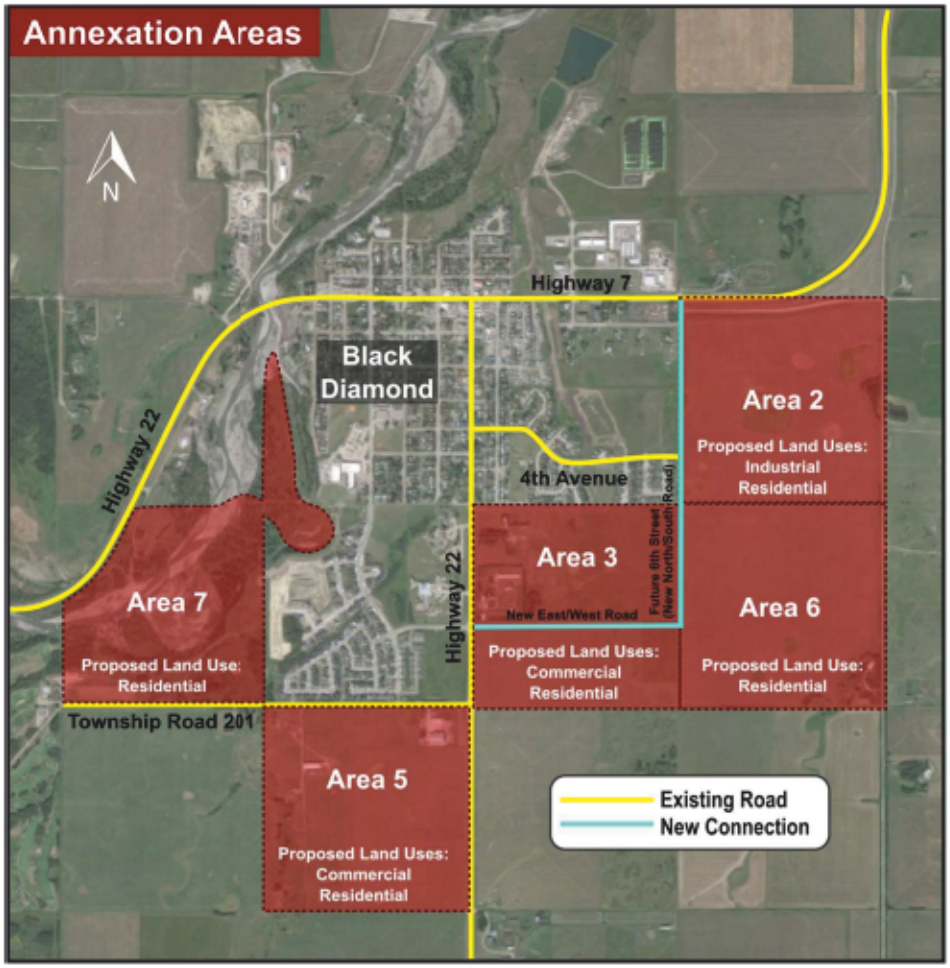


Figure 18: Combined Scenario

13.1 Annexation Assumptions

13.1.1 Trip Generation Assumptions

The Institute of Transportation Engineers (ITE) Trip Generation Manual (10th edition) was used to estimate the number of vehicle trips that can be generated within the proposed annexation areas based on their land uses. It should be noted that to be conservative, the PM peak hour was selected for analysis and 100% of the trips generated will assumed to be personal vehicle trips. Table 17 summarizes the trip generation rates assumed for each of the proposed land uses.

Table 17: ITE Trip Generation Rates (PM Peak Hour) Used for Analysis

Land Use	ITE Code	Description	Trip Generation Rate	Unit
Industrial	130	Industrial Park	0.40	1000 sq. ft. GFA
Commercial	820	Shopping Center	3.81	1000 sq. ft. GFA
Residential	210	Single Family Detached	0.99	Dwelling Unit

Based on the selected trip generation rates, the total number of vehicle trips from each annexation area was determined and shown in **Error! Reference source not found.**. For the industrial and commercial uses, a 0.3 FAR (Floor Area Ratio)[11] was assumed and applied to the total developable lands for the purposes of estimating potential trips.

Table 18: Generated Vehicle Trips (PM Peak Hour) Per Scenario

Area	Land Use	% In	% Out	Generated Trips		
				In	Out	Total
2	Industrial	21%	79%	28	103	131
	Residential	63%	37%	517	303	820
3	Commercial	48%	52%	567	614	1,181
	Residential	63%	37%	449	264	713
5	Commercial	48%	52%	192	208	400
	Residential	63%	37%	521	306	827
6	Residential	63%	37%	602	354	956
7	Residential	63%	37%	86	51	137

13.1.2 Trip Distribution Assumptions

Several assumptions were made within the traffic model to best represent the expected future conditions of the network under each of the scenarios. The assumptions made in estimating the overall proportion of trips originating and ending outside of the study area (trips from out of town) and those that originate and end within the study area (trips from within the town) are describe below. While our study focuses explicitly on areas within Black Diamond, our modeling approach was also influenced by Turner Valley given the proximity and partnerships between the Towns.

- Under Area 2, the proportion of external and internal trips are estimated to be roughly equal (50% each) under the assumption that the mix of residential and industrial land uses would provide job opportunities for residents within the area.
- Under Area 3 and Area 5, it was assumed 60% of the new trips will be internalized between the Town, annexed areas, and the proposed commercial hub. This assumption

[11] Floor Area Ratio refers to the relationship between the total amount of building areas and the size of the land.

is valid for local, specialized small commercial retail unit. Larger scale regional commercial such as large format retail (Costco, Home Depot, etc.) would attract more external trips.

- Under Area 6 and Area 7, it was assumed 60% of the new trips will be internalized between the Town and annexed areas given the proximity and the surround commercial and industrial land uses.

- To be conservative in the loading of the main highways and corridors in the study area, cross-over trips between the annexation areas (i.e. originating in one area and ending in another) were assumed to be negligible. For example, for Area 2, it was assumed that the trips between Area 2 and Area 3, 5, 6 and 7 are negligible and most of the Area 2 trips would travel to the Black Diamond core area, located on the southwest corner of Highway 7 & Highway 22, as well as Turner Valley and externals. This approach is conservative as it feeds most of the trips onto the study corridors and intersections rather than internalizing them.

At the time of this report, these distribution assumptions are based on high level planning principles and the opportunities the adjust these estimates can occur as more information related to travel behaviour (through Future studies) becomes available. .

Table 19 shows a summary of the external and internal trip distributions for each scenario.

Table 19: External and Internal Trip Distribution Percentages

Area (Scenario)	Percentage of External Trips	Percentage of Internal Trips (includes Black Diamond and Turner Valley)
2	50%	50%
3	40%	60%
5	40%	60%
6	40%	60%
7	40%	60%

Furthermore, the external trips are assigned to three major routes leading in and out of the study area. These three routes are the following:

- Eastbound Hwy 7 (East of Black Diamond)
- Southbound Hwy 22 (South of Black Diamond)
- Northbound Hwy 22 (North of Turner Valley)

In terms of internal trips, it was assumed a larger distribution of future trips would be generated from Turner Valley (to/from the west). This assumption is consistent with the previous population forecasts completed for the *Joint Growth Strategy*.

13.2 Scenario Evaluation

Traffic assignment and analysis was performed for the study area under the above-mentioned assumptions using Vistro and Synchro. The key traffic performance indicators for each development scenario are summarized in the sections below. Upgrades to the road network and intersection locations were developed based on the following parameters:

- Daily 2-way corridor volumes (estimated from PM peak volumes using a factor of 10)
- Intersection Level of Service (LOS)
- Intersection volume to capacity ratio (v/c ratio)

The major road corridors considered for traffic analysis are as follows:

- Highway 7
- Highway 22
- 4th Avenue SE
- Proposed north-south connection (Aligned with 6 Street NE/SE)
- Proposed east-west Willow Ridge Road connection (in Area 3)

It should be noted that 4th Avenue SE was selected due to its significance in providing connectivity from Highway 22 to the proposed north-south road connection. Additionally, Township Road 201 was selected under Scenario 3 and Scenario 6 which include Area 7.

As more details evolve from these annexed areas, a better understanding into the type of intersection control (traffic signal, roundabout, all-way stop, etc.), approach layout, upgrade phasing can be determined during the development of the neighbourhood plan stage. Transportation infrastructure required to access and service the annexed lands were considered local and were not included in the analysis. For the purpose

of this assignment, it was determined that an intersection that operates at LOS "E/F" or with a volume-to-capacity ratio (v/c) greater than 0.9 would require intersection improvements.

The background daily volumes for the existing road network are shown in **Figure 19.**

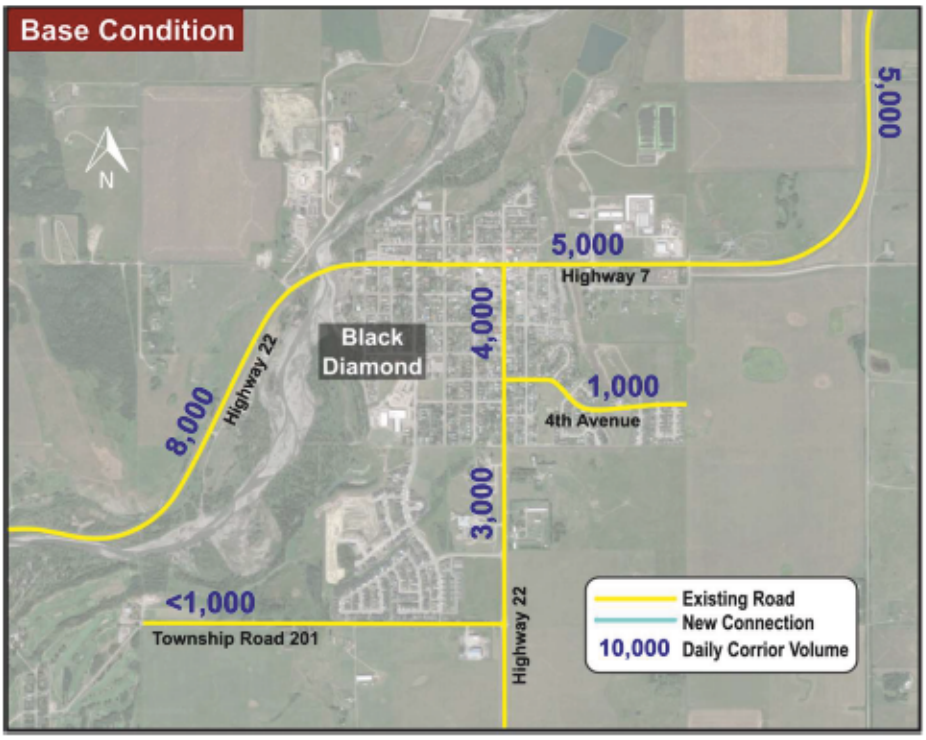


Figure 19: Base Condition Daily Corridor Volumes

13.2.1 Area 2 (Scenario 1)

The estimated daily corridor volumes based on the expected traffic impact from Area 2 are shown in **Figure 20**. The results from Area 2 will be named Scenario 1 within the Transportation section of this report. Under Scenario 1, the main traffic increase is expected to occur along Highway 22/Highway 7 in the east-west direction, notably along the segment leading to and from west of the town. The daily trips on this corridor are expected to grow by roughly 3,000 vehicles. 4th Avenue SE is also expected to see a substantial increase in volume (from 1,000 to 3,000 daily trips).

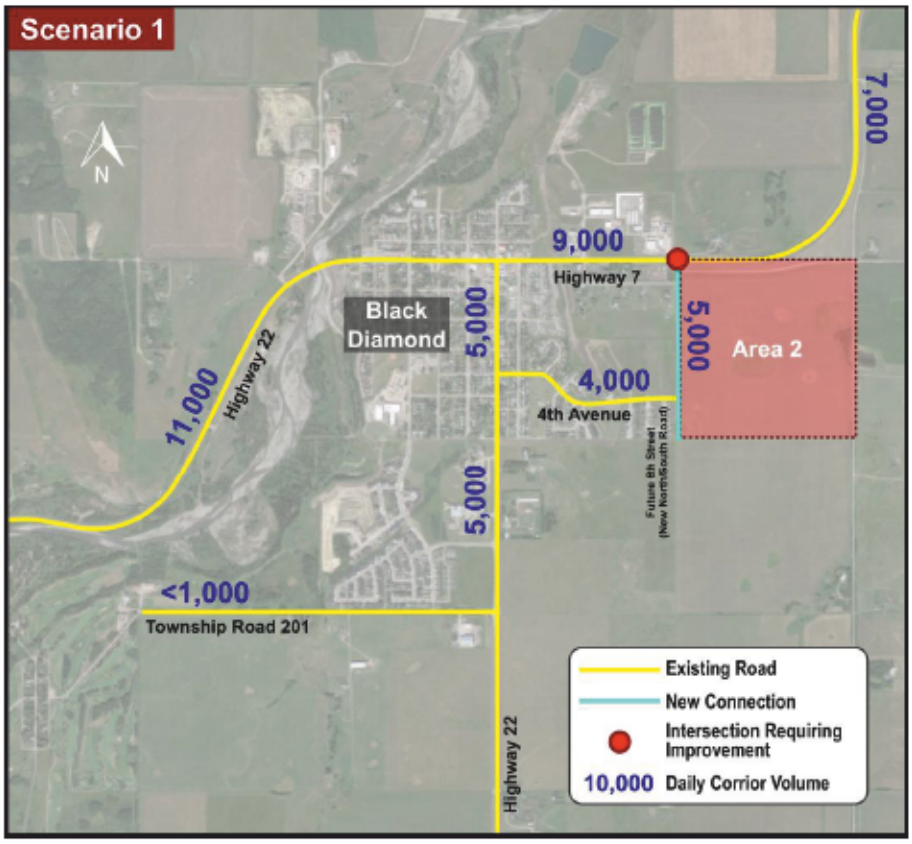


Figure 20: Scenario 1 Daily Corridor Volumes

The intersection analysis reported acceptable performances for all of the intersection locations under Scenario 1 except for the intersection at Highway 7 and 6 Street SE. The intersection results for Scenario 1 are summarized in Table 20.

Intersection upgrades will need to be explored in detail during the ASP to understand property implication.

Table 20: Scenario 1 Intersection Analysis Summary

Intersection	Control Type	Scenario 1		Improvement Required?
		Intersection LOS	v/c[12]	
Highway 22 & 3 St SW/NW	Unsignalized	A	0.28	No
Highway 22 & Highway 7	Signalized	B	0.68	No
Highway 7 & 3 St SE/NE	Unsignalized	A	0.20	No
Highway 7 & 6 St SE	Unsignalized	C	0.94	**Yes**
Highway 7 & Range Road 23	Unsignalized	A	0.16	No
Highway 22 & 4th Ave SE/SW	Unsignalized	A	0.32	No
Highway 22 & Willow Ridge Blvd	Unsignalized	A	0.05	No
4 Ave SE and New North/South Road	Unsignalized	A	0.18	No

13.2.2 Area 3 (Scenario 2)

The estimated daily corridor volumes based on the expected traffic impact from Area 3 are illustrated in Figure 21. The results from Area 3 will be named Scenario 2. As shown in Figure under Scenario 2, the majority of the existing corridors are expected to experience increased daily traffic. It should be noted under this scenario, an assumption was made in the model that half of the trips from Area 3 that travel to and from the west (i.e. Turner Valley and beyond) would opt to use the 4th Avenue connection to access Highway 22, while the remainder would take the new east-west connection at Willow Ridge Boulevard. This assumption resulted in notable increase in daily trips for both 4th Avenue (increased of 3,000 trips) and the new east-west connection (increase of 10,000 trips), in addition to the substantial traffic increase along the major highways.

[12] v/c = Volume to capacity ratio

Figure 21: Scenario 2 Daily Corridor Volumes

Several intersections experience LOS D or worse under Scenario 2. Notably, due to projected high usage of the proposed Willow Ridge connection the intersection at Highway 22 from the new east-west alignment through Area 3 is expected to experience capacity issues. In addition, the intersection of Highway 22 and Highway 7 will potentially be operating near/at capacity under this scenario. To mitigate potential impacts to existing businesses at the intersection from significant intersection upgrades, it was assumed that as demand during the peak period increases, travel patterns would adapt to utilize the new north-south connection on the east side of the Town. By maintaining the current form at Highway 22/Highway 7, travel behaviour is expected to shift to take advantage of the new corridor connecting commuter to Area 3. Intersection results for Scenario 2 are summarized in Table 21.

Table 21: Scenario 2 Intersection Analysis Summary

Intersection	Control Type	Scenario 2		Improvement Required?
		Intersection LOS	v/c[13]	
Highway 22 & 3 St SW/NW	Unsignalized	A	0.61	No
Highway 22 & Highway 7	Signalized	C	1.04	**Yes**
Highway 7 & 3 St SE/NE	Unsignalized	A	0.22	No
Highway 7 & 6 St SE	Unsignalized	D	1.14	**Yes**
Highway 7 & Range Road 23	Unsignalized	A	0.20	No
Highway 22 & 4th Ave SE/SW	Unsignalized	A	0.16	No
Highway 22 & Willow Ridge Blvd	Unsignalized	F	1.55	**Yes**
4 Ave SE and New North/South Road	Unsignalized	A	0	No

13.2.3 Area 7 (Scenario 3)

The illustrated daily corridor volumes based on the expected traffic impact from Area 7 are illustrated in **Figure 22**. The results from Area 7 will be named Scenario 3. As shown in Figure , Highway 22 and Highway 7 are expected to experience moderate increase of daily traffic (up to 2,000 vph for Highway 22 and less than 1,000 vph/hr for Highway 7). Under this scenario, it was assumed that all of the trips from Area 7 would use Township Road 201 as the access road as all of the development will occur south of the river.

[13] v/c = Volume to capacity ratio

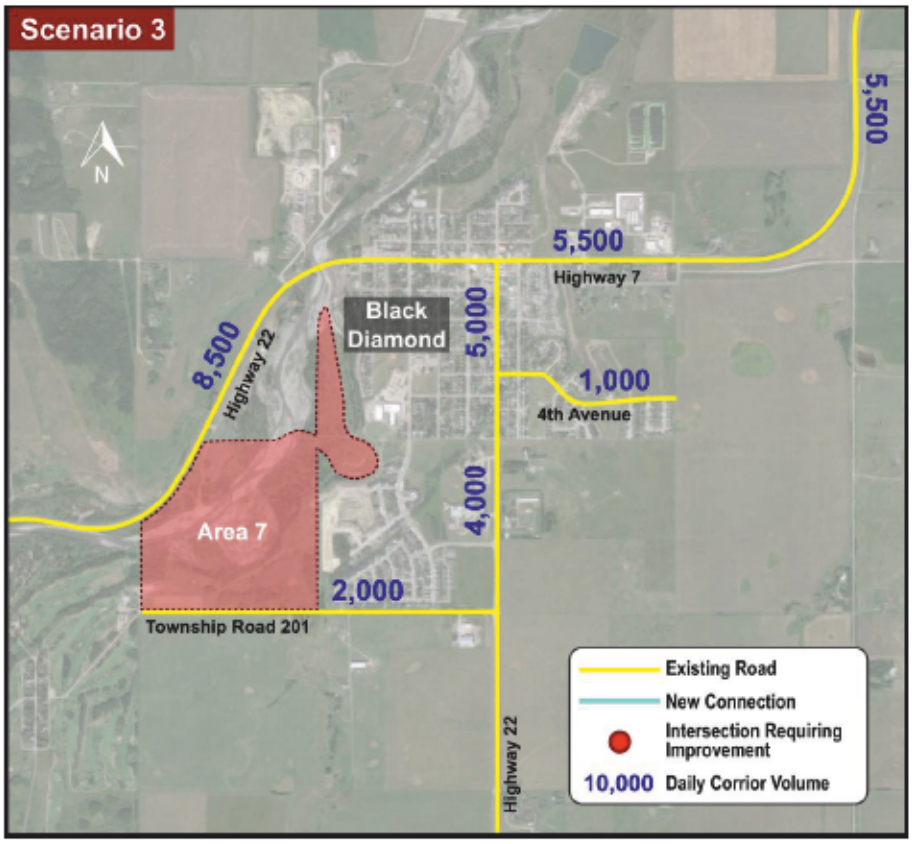


Figure 22: Scenario 3 Daily Corridor Volumes

Based on the Synchro analysis, all of the intersection locations under this scenario are expected to operate at acceptable conditions hence no intersection requirements are required. The intersection results for Scenario 3 are summarized in Table 22.

Table 22: Scenario 3 Intersection Analysis Summary

Intersection	Control Type	Scenario 2		Improvement Required?
		Intersection LOS	v/c[14]	
Highway 22 & 3 St SW/NW	Unsignalized	A	0.16	No
Highway 22 & Highway 7	Signalized	B	0.73	No
Highway 7 & 3 St SE/NE	Unsignalized	A	0.14	No
Highway 7 & 6 St SE	Unsignalized	A	0.03	No
Highway 7 & Range Road 23	Unsignalized	A	0.11	No
Highway 22 & 4th Ave SE/SW	Unsignalized	A	0.04	No
Highway 22 & Willow Ridge Blvd	Unsignalized	A	0.05	No
Highway 22 & Township Road 201	Unsignalized	A	0.13	No

13.2.4 Areas 2,3,6 (Scenario 4)

The estimated daily corridor volumes based on the projected traffic impact from a combination of Areas 2, 3, and 6 are shown in **Figure 23**. This scenario will be referred to as Scenario 4. As expected, the full buildout of these three proposed annexation areas will result in significant increase of traffic volumes throughout the major corridors in the study area.

[14] v/c = Volume to capacity ratio

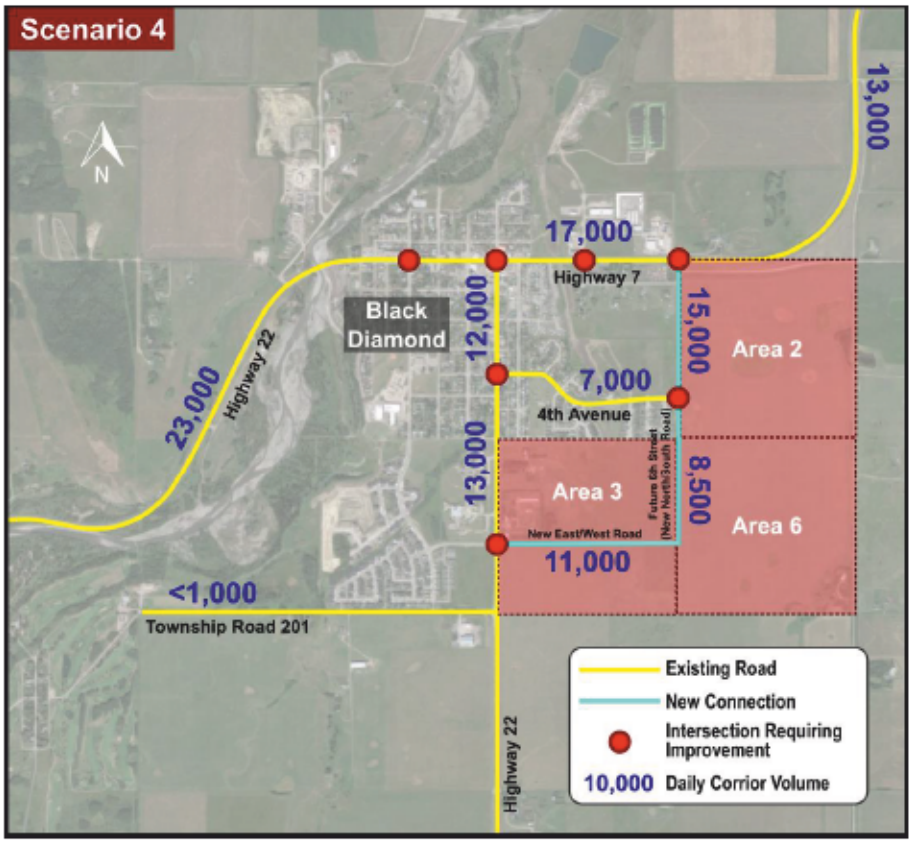


Figure 23: Scenario 4 Daily Corridor Volumes

The intersection analysis results for Scenario 4 are summarized in Table 23. The traffic analysis indicates that most of the existing intersections within the area will not be able to support the proposed annexed area based on its existing layout. The preliminary traffic analysis identified seven intersections (shown in the table below) that will require upgrades to address the future demand. Intersection upgrades will need to be explored in detail during the ASP to understand property implication.

As all three potential areas fully develop within the Town, a need of widening Highway 22 at intersections or throughout the corridor is also anticipated to provide sufficient capacity to accommodate the additional traffic demand. Alternatively, providing additional connections in parallel with Highway 22 may also alleviate the anticipated demand on Highway 22.

Table 23: Scenario 4 Intersection Analysis Summary

Intersection	Control Type	Combined Scenario		Improvement Required?
		Intersection LOS	v/c[15]	
Highway 22 & 3 St SW/NW	Unsignalized	F	Error[16]	**Yes**
Highway 22 & Highway 7	Signalized	E	1.15	**Yes**
Highway 7 & 3 St SE/NE	Unsignalized	C	1.56	**Yes**
Highway 7 & 6 St SE	Unsignalized	F	16.38	**Yes**
Highway 7 & Range Road 23	Unsignalized	A	0.29	No
Highway 22 & 4th Ave SE/SW	Unsignalized	F	Error	**Yes**
Highway 22 & Willow Ridge Blvd	Unsignalized	F	2.65	**Yes**
4 Ave SE and New North/South Road	Unsignalized	F	2.45	**Yes**

13.2.5 Areas 2,5,6 (Scenario 5)

The estimated daily corridor volumes based on the projected traffic impact from a combination of Areas 2, 5, and 6 are shown in **Figure 24**. Similar to Scenario 4, the full buildout of these proposed annexation areas will result in significant increase of traffic volumes throughout the major corridors in the study area. The preliminary traffic analysis identified five intersections (shown in the table below) that will require upgrades to address the future demand. Intersection upgrades will need to be explored in detail during the ASP to understand property implication.

As all three potential areas fully develop within the Town, a need of widening Highway 22 at intersections or throughout the corridor is also anticipated to provide sufficient capacity to accommodate the additional traffic demand.

[15] v/c = Volume to capacity ratio
[16] Error indicates intersection is extremely over capacity

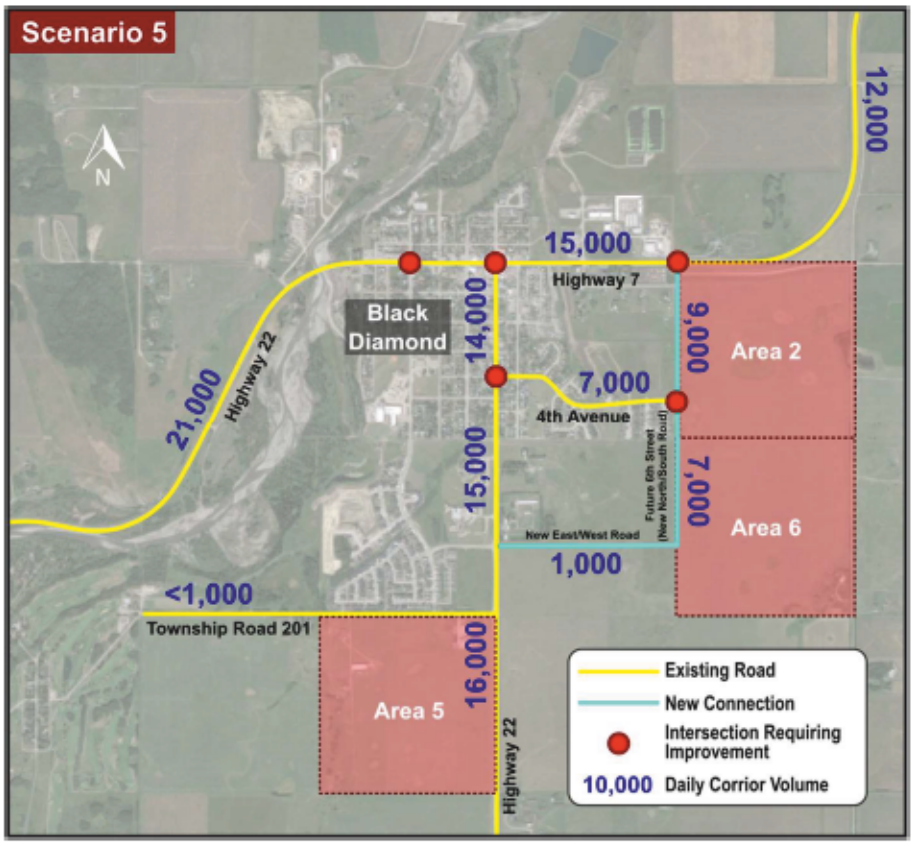


Figure 24: Scenario 5 Daily Corridor Volumes

Table 24: Scenario 5 Intersection Analysis Summary

Intersection	Control Type	Combined Scenario		Improvement Required?
		Intersection LOS	v/c[17]	
Highway 22 & 3 St SW/NW	Unsignalized	F	2.76	**Yes**
Highway 22 & Highway 7	Signalized	F	1.33	**Yes**
Highway 7 & 3 St SE/NE	Unsignalized	A	0.42	No
Highway 7 & 6 St SE	Unsignalized	F	5.07	**Yes**
Highway 7 & Range Road 23	Unsignalized	A	0.25	No
Highway 22 & 4th Ave SE/SW	Unsignalized	F	Error[18]	**Yes**
Highway 22 & Willow Ridge Blvd	Unsignalized	A	0.30	No
4 Ave SE and New North/South Road	Unsignalized	E	1.06	**Yes**

In addition to the five intersections identified in Table 24 above that will be requiring improvements, the intersection at the future access (currently assumed as a single access point on Highway 22) to Area 5 is also expected to require upgrades as the magnitude of the development volumes from Area 5 likely cannot be accommodated by a stop-controlled access.

13.2.6 Areas 2,3,5,6,7 (Scenario 6)

The estimated daily corridor volumes based on the projected traffic impact from all five proposed annexation areas are shown in **Figure 25**. This scenario will be referred to as Scenario 6. As expected, the full buildout of all five proposed annexation areas will result in significant increase of traffic volumes throughout the major corridors in the study area.

[17] v/c = Volume to capacity ratio
[18] Error indicates intersection is extremely over capacity

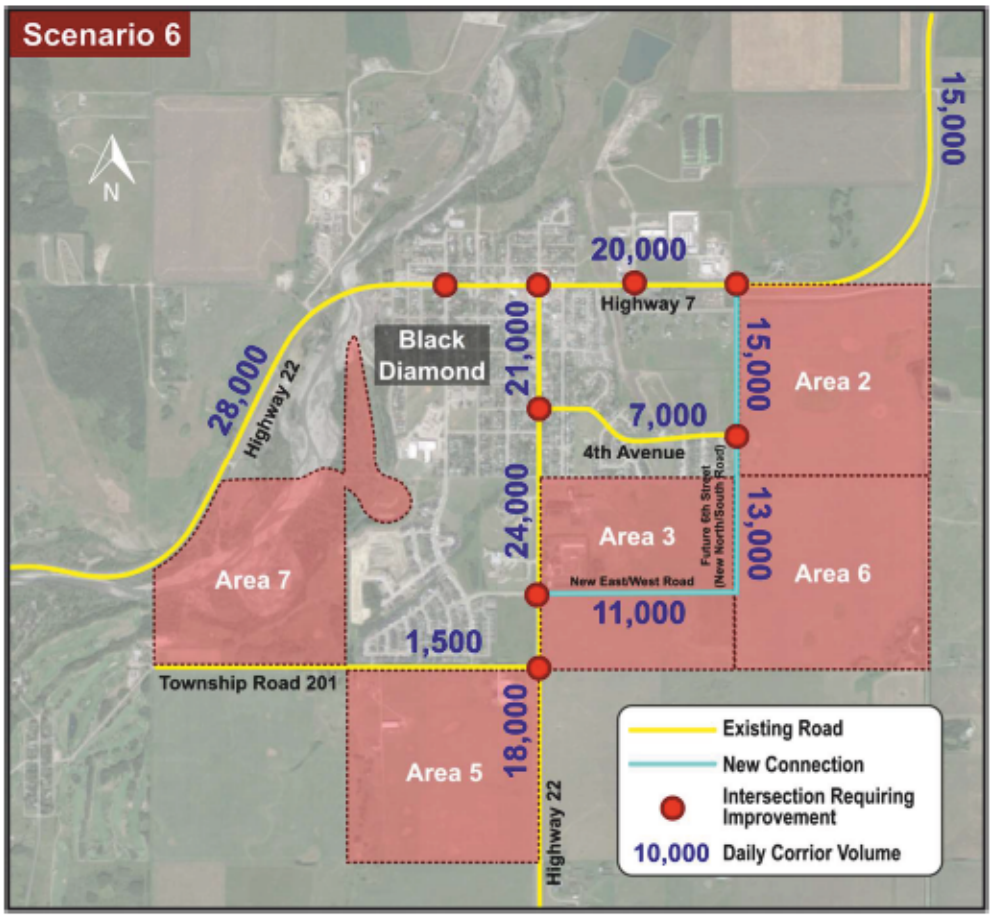


Figure 25: Scenario 6 Daily Corridor Volumes

The intersection analysis results for the Scenario 6 are summarized in Table 25 below. To support all five annexed areas, transportation improvements into the existing and expanded network will be required understanding the substantial growth anticipated from these lands. The preliminary traffic analysis identified eight intersections (shown in the table below), both existing and new, that will require upgrades to address the future demand.

In addition to the seven existing intersections identified in the table above that will be requiring improvements, the intersection at the future access (currently assumed as a single access point on Highway 22) to Area 5 is also expected to require a form of intersection control to accommodate the estimated development growth volumes. It is likely that development of Area 5 cannot be supported by a stop-controlled access. Therefore, a total of eight intersections are identified as requiring improvements under Scenario 6.

As all five potential areas fully develop within the Town, traffic along Highway 22 will increase as a result of growth and it is expected that a need to provide four travel lane to support the future travel demands. The need to widen Highway 7 at intersections or throughout the corridor is also anticipated.

While providing additional lanes on existing corridors can alleviate potential delays, expanding the network to connect to these new areas will likely contribute to a more resilient transportation network. For example,

providing additional connections that are in parallel with Highway 22 may reduce the demand on Highway 22 and reduce trip distances for local travels. As development proceeds for Scenario 6, the connections to Area 5 will need to be revisited. For example, extending the 3rd Street connection can provide a more robust network with less reliance on the Provincial Highways.

Table 25: Scenario 6 Intersection Analysis Summary

Intersection	Control Type	Combined Scenario		Improvement Required?
		Intersection LOS	v/c[19]	
Highway 22 & 3 St SW/NW	Unsignalized	F	Error[20]	**Yes**
Highway 22 & Highway 7	Signalized	F	2.51	**Yes**
Highway 7 & 3 St SE/NE	Unsignalized	F	3.92	**Yes**
Highway 7 & 6 St SE	Unsignalized	F	28.14	**Yes**
Highway 7 & Range Road 23	Unsignalized	A	0.35	No
Highway 22 & 4th Ave SE/SW	Unsignalized	F	Error	**Yes**
Highway 22 & Willow Ridge Blvd	Unsignalized	F	48.48	**Yes**
4 Ave SE and New North/South Road	Unsignalized	F	2.45	**Yes**
Highway 22 & Township Road 201	Unsignalized	A	0.92	**Yes**

13.3 Cross Section and Access

Cross sections for the new road alignments will follow closely with the *City of Calgary Design Guidelines for Subdivision Servicing* (DGSS), 2014, and refer to the customized cross sections developed for the *6th St Watermain Looping (Watermain Looping)*, as per discussions with the Town of Black Diamond. Three potential cross sections can be used for the proposed annexation areas, with possible modifications based on community design requirements.

Table 26 summarizes the required right of way and the recommended vehicle carrying capacities.

[19] v/c = Volume to capacity ratio
[20] Error indicates intersection is extremely over capacity

Table 26: Road Types (DGSS)

Road Type	ROW	Pavement Width	Daily Volumes
Collector Street with Parking on Both Side	25.2m	15.0m	2,000 to 8,000
Collector Street with Parking on One Side	22.5m	12.3m	2,000 to 8,000
Residential Street	16m	9.0m	2,000

Figure 26 illustrates the recommended cross-section for a collector street with parking on both sides, which was developed from the *6th Street Watermain Looping study*,

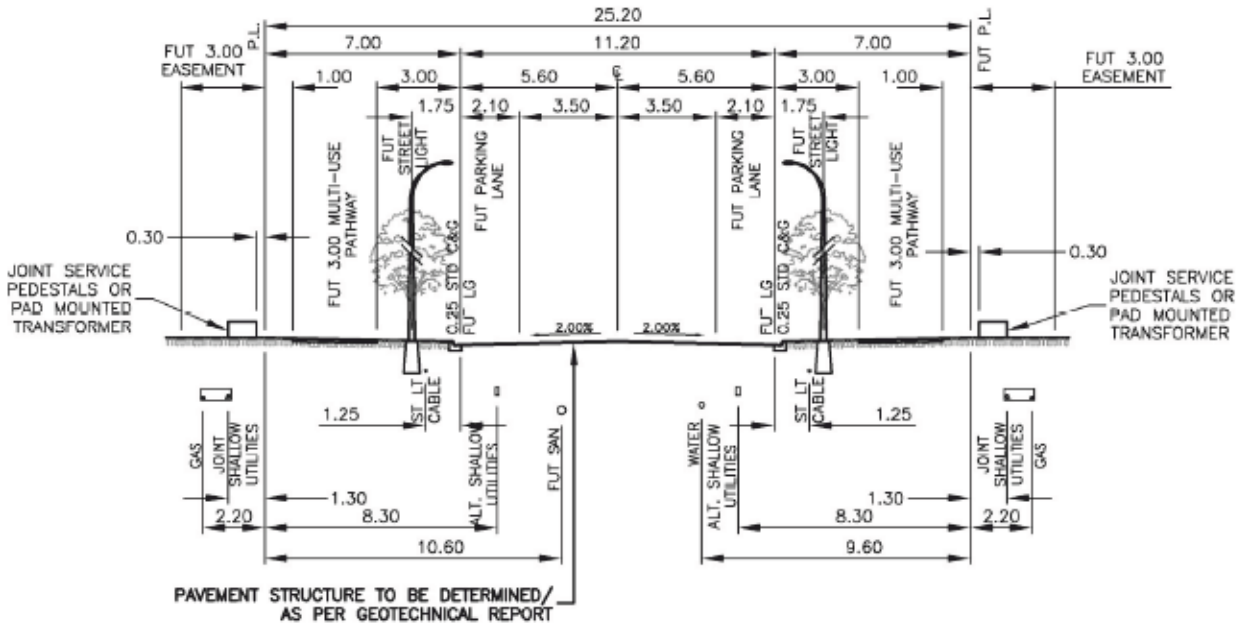


Figure 26. Recommended Cross-Section (Collector Street with Parking on Both Sides)

The potential carrying capacities illustrated in Table 26 were developed with the intention of maintaining a level of service benchmark acceptable to the City of Calgary. Depending on the function of the street, it is acceptable to increase the two-lane street corridor from the 8,000 vpd maximum to 15,000 vpd (i.e., Activity Centre Streets per DGSS). With the increase in vehicles, trade-offs can be expected such as travel times and wait time at intersections.

Minimum access requirements to meet fire and emergency standards are stipulated by the National Fire Protection Association Section 1141 "Standard for Fire Protection Infrastructure for And Development in all Suburban and Rural Areas". Table 27 summarizes the access requirements based on household units.

Table 27: Access Requirements

No. Households	Minimum Access Requirement
Up to 100 units	1 access point
Between 101 to 600 units	2 access points

Over 600 units	3 access points

These access requirements need to be considered along with ensuring the appropriate points of public access onto and from the development sites and the roads will need to be sized accordingly. The Town will likely need to review its long-term strategy on how it can provide a more resilient road network capable of managing peak hour flows and unpredictable conditions. Part of this strategy will involve exploring ways to increase roads within the Town or better connect existing roads to new networks increasing connectivity and redundancy within the system. The intent is to rebalance peak hour demand and better utilize the Town's key intersections.

14.0 Road Right of Way & Utility Corridors

Roadway dedication will be required along the west side of Areas 2 and 6, and the east side of Area 3 to accommodate future utilities and the proposed 25.2m collector roadway (6th Street). A right of way along the east and south borders of Area 3 will also be required to accommodate the proposed sanitary main in both Scenarios 1 and 2. An initial utility right of way may be required prior to roadway dedication if the utilities are required prior to roadway construction.

For areas 2 and 6, which are bordered by Range Road 23 to the east, road widening will be required for the future regional roadway. If these lands proceed with development prior to the completion of the Black Diamond Transportation Master Plan, consultation with both Alberta Transportation and regional partners will be required to finalize the width during the conceptual scheme process.

15.0 Cost Estimates

15.1 Civil & Transportation Cost Estimates

The high-level costs to design and construct the civil and transportation infrastructure for all of the annexation areas were estimated and are presented below in Table 28.

Table 28: Servicing Cost Estimates (Scenario 2 – including all annexed lands)

Infrastructure Type	Estimated Cost
Site Works	$2,823,000
Sanitary	$4,669,000
Wastewater Treatment Plant[21]	$14,890,000
Water	$3,337,000
NE Industrial Water Main Looping - Phase 1[23]	*$1,952,000*

[21] Anticipated costs for the overall upgrade to the Wastewater Treatment Plant that will take place in the next few years. The allocations of these costs have not yet been determined so the overall cost has been included in this table. This price is subject to funding from the government and cost sharing between Black Diamond and Turner Valley.

Remainder of Water Costs	*$1,385,000*
Water Treatment Plant[22]	$69,863,000
Storm	$1,998,000
Transportation	$19,800,000
Total	**$117,380,000**

When reviewing the costs presented above, the following should be noted:

- All of the above prices include 35% contingency and 15% for engineering services.
    - Wastewater Treatment Plant upgrades include 20% contingency, 15 % engineering and 3% for third party testing.
- The water costs include infrastructure to service the annexed land including the 2020 bid price for the water looping constructed in 2020, with the breakdown shown.
- The cost for the storm infrastructure does not include any pricing for a stormwater management facility as this cost will be that of the developer(s).
- The costs above should not be used for budgetary purposes and are provided to inform the Town of the possible scale of costs for this infrastructure.
- A detailed cost estimate for the overall infrastructure costs can be found in Appendix F.

The costs for the water and wastewater treatment plant upgrades provided in Table 28 are the total costs for the regional systems in both scenarios and do not take into consideration the cost sharing requirements between both the Towns of Black Diamond and Turner Valley, nor any additional funding that could be used to pay for the systems. These costs do not break down the individual costs to service each area as all of the infrastructure recommended would strengthen the infrastructure network of the surrounding area compared to benefitting one specific area. As such, it is recommended that the overall cost for the proposed infrastructure be used in further conversation regarding infrastructure cost sharing. In order to understand the benefits and which areas should contribute to certain costs, the matrix below in Table 29 specifies which of the proposed infrastructure costs could relate to a specific area. These areas include all of the annexation areas, as well the Kaiser ASP and the existing Town.

[22] Estimated costs from the *Joint Growth Servicing Strategy* for further upgrades in approximately 20 years time. Similar to the Wastewater Treatment Plant, these costs will be subject to cost sharing and additional funding from the government.
[23] Kidco 2020 Bid Price

Table 29: Infrastructure Cost Matrix

Infrastructure Type	Area 2	Area 3	Area 5	Area 6	Area 7	Kaiser	Town
Site Works	✓	✓	✓	✓	✓	✓	✓
Sanitary	✓		✓	✓	✓		
Water	✓	✓	✓	✓	✓	✓	✓
Storm	✓	✓	✓	✓		✓	
Roads	✓	✓	✓	✓	✓	✓	✓

Given the information presented in this report, it is recommended that further study be performed in order to accurately determine offsite levies, using this report as a supporting document.

15.2 Transportation Cost Estimates

Transportation cost estimates for each scenario provided in Section 13 are included in Appendix E. The total transportation cost for all transportation infrastructure is included in the total estimate above in Section 15.1.

16.0 Recommendations

It is understood that it is important to the Town to comprehend the extents to which the annexation areas can be serviced on the existing infrastructure. Below is a summary of the status and required upgrades of the Town's infrastructure.

- With the hydraulic connection of both the Westend sanitary trunk and the existing gravity system in the Town of Black Diamond, there will be sufficient capacity to handle 80% of the projected flows from the proposed annexation areas in Scenario 1. If Scenario 2 were to proceed 67% of the projected flow could be handled. Upgrades to the gravity system upstream of the wastewater treatment lagoon will be required beyond a total flow of 146 L/s. Tables 6 and 7 identify sanitary capacity overage of 34.7 L/s in Scenario 1 or 69.8 L/s in Scenario 2.
- There are currently proposed upgrades for the Wastewater Treatment Lagoon in Black Diamond (construction anticipated for 2022), which will extend the design life of the treatment facility to 2036. Further upgrades will be required, and additional study will be needed in the next 20 years or if the population in both Black Diamond and Turner Valley approaches 7,989 residents, which is expected between 2030 and 2033.

- The NE Industrial Water Main Looping – 400mm water main was constructed in 2020. The PRV is scheduled for installation in early 2021.
- Additional water license will be required as the combined population (jobs and residents) of Black Diamond approaches 8,304 people, or approximately between years 2056 and 2066.
- The Water Treatment Plant in Turner Valley (where Black Diamond receives its treated water) has recently been upgraded and its design life has been extended to the year 2036 approximately. Review of the system is required prior to that date or if the population approaches the combined population of 7,989 people similarly to the Wastewater Treatment Lagoon.
- Upgrades will be required to the existing water reservoir beyond 2056 for Scenario 2 only
- The Kaiser area is currently undeveloped. Development within the Kaiser ASP can proceed. The north portion will utilize the current sanitary capacity left in the Black Diamond gravity 300mm main. The south portion will utilize the Westend main.
- Assuming Kaiser remains undeveloped, there is approximately 10 L/s remaining in the existing Black Diamond 300mm sanitary gravity main. This indicates that:
    - Assuming Areas 5 or 6 do not proceed, Area 2 can initiate development, limited by the 10 L/s of remaining capacity
    - Assuming Areas 2 and 6 do not proceed, Area 5 can initiate development limited to the 10 L/s of remaining capacity if it were to connect to the gravity system.. If Area 3 does not develop, Area 5 could proceed by connecting to the Westend main. The construction of a redundant water main would be required in both scenarios.
    - Assuming Areas 2 and 5 do not proceed, Area 6 can initiate development, limited by the 10 L/s of remaining capacity.
- Area 3 can be serviced off existing sanitary and water infrastructure.
- Area 7 can proceed with development with the extension of existing utilities in the SW corner of the Town.
- The development of all the annexed lands will require 8 intersection upgrades.

In addition to infrastructure upgrades, it will be beneficial for the Town to undertake additional study to prepare for the development of the proposed annexation areas. The following studies/next steps are recommended:

- Further upgrades to the Wastewater Treatment Lagoon past 2036
- Conversations with WRSSC regarding the proposed Area 3 sanitary tie-in
- Further upgrades to the Water Treatment Plant past 2036
- Conversations with SRUCC to inform on the proposed water servicing strategy
- Overall Stormwater Strategy for the Town – currently underway
- Detailed Wetland Investigation
- Watercourse Investigation in Areas 3 and 5
- Transportation Master Plan
- Functional Road Study
- Traffic Data Collection
- Establish policy for road right of way dedication and/or purchase
- Offsite Levy Bylaw Updates (already approved by the Town)

17.0 Closure

This document, entitled *Annexation Lands Servicing Review – Revised Report*, is prepared by Urban Systems Ltd. for the Town of Black Diamond. This report documents the infrastructure requirements for the Town in order to service three proposed quarter section for annexation. If there are any questions or clarifications regarding information in this report, please contact the undersigned.

Civil Engineering Prepared by:

2021-04-14
Erin Eyre, P.Eng.
Senior Engineer

PERMIT TO PRACTICE
URBAN SYSTEMS LTD.
Signature
Date 2021-04-14
PERMIT NUMBER: P 3836
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Transportation Engineering by:

2021-04-14
Ming Xia,P.Eng.
Transportation Engineer

18.0 References

1. *Black Diamond Proposed Annexation Study,* BSEI Municipal Consulting Engineers, 2012
2. *Quad Regional Water System: Water Treatment Plan and Mechanical Upgrades - Final*, MPE Engineering Ltd., 2012
3. *Quad Regional Water Partnership, Regional Raw Water and Treated Water Transmission Lines Preliminary Design Report, Urban Systems December 2012*
4. *City of Calgary Design Guidelines for Subdivision Servicing* (2014)
5. *Calgary Regional Partnership Water and Wastewater Servicing Masterplan*, 2014,
6. *Westend Regional Sewage Services Commission - Westend Sanitary Trunkmain Relocation Design Report*, Urban Systems Ltd., 2015
7. *WRSSC Revised Plan for Operating Approval*, MPE Engineering Ltd. 2015
8. *Turner Valley & Black Diamond Joint Growth Strategy,* O2 Planning & Design Inc., 2016
9. *Turner Valley/Black Diamond Joint Growth Strategy – Scenario 3 Design Brief*, MPE Engineering, Ltd. 2016
10. *Black Diamond and Turner Valley Joint Growth Strategy – Scenario 3,* Urban Systems Ltd., 2016
11. *Kaiser Area Structure Plan (ASP) Technical Background Report,* Urban Systems Ltd., 2017
12. Town of Black Diamond, 6th Street Water Looping Engineering Drawings, Urban Systems, September 2020
13. *Wastewater Flow Monitoring Memo*, Urban Systems, November 2020

Appendix A

Population Estimation Summary

Appendix A - Population Estimation Summary

November 2020

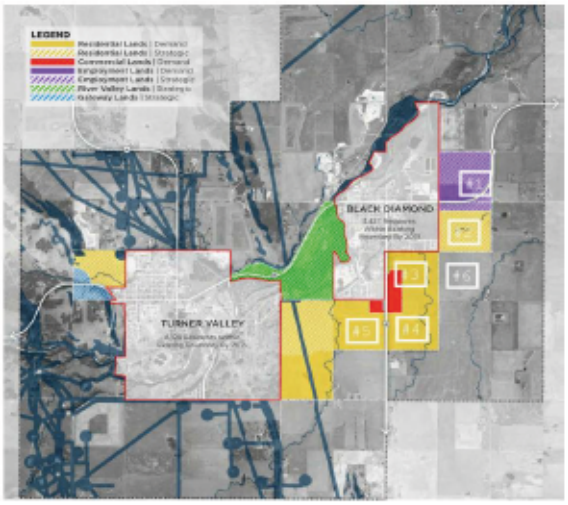
	Study Area - Black Diamond	Total Area (ha)[1]	Developable Area[2]	Units	Developable Area[2]	Units
	Black Diamond - within Town Boundary	-	-	-	-	-
Area 2	Residential	54.54	51.58	Hectares	127.46	Acres
	Industrial	10.21	10.11	Hectares	24.99	Acres
Area 3	Commercial	9.60	9.60	Hectares	23.72	Acres
	Residential	44.80	44.80	Hectares	110.70	Acres
Area 5	Commercial	3.24	3.24	Hectares	8.00	Acres
	Residential	51.98	51.98	Hectares	128.45	Acres
Area 6	Residential	60.90	60.14	Hectares	148.61	Acres
Area 7	Strategic lands - non-developable	50.91		Hectares		Acres
	Residential		8.60	Hectares	21.25	Acres

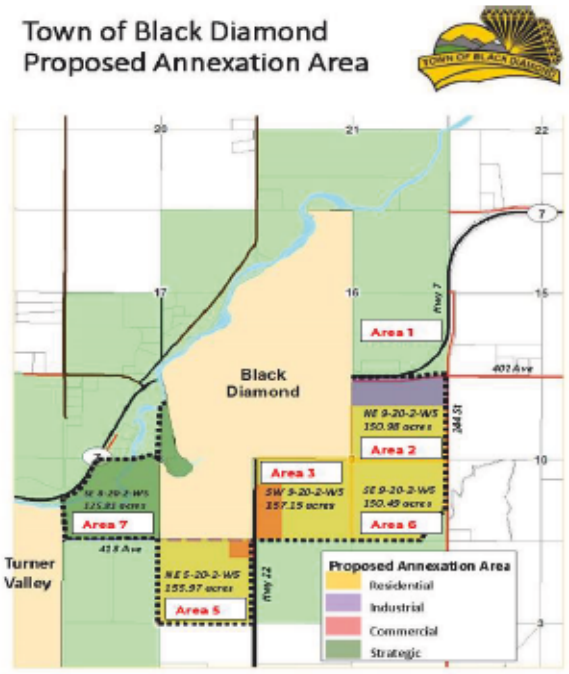
1 = area for the respective landuses for Areas 2, 3 and 5 were estimated from the figure below (Joint Growth Strategy)

area for Areas 6 and 7 are identified in the annexation figure below

2 Assumed certain allocations for wetlands, ROW widenings, etc. and converted to acres

	Study Area - Black Diamond	Residential Population	Service Population	Population Equivalent	
	Black Diamond - within Town Boundary	3,427		3,427	People
Area 2	Residential	1,988		15.6	people/acre
	Industrial	-	237	9.5	people/acre
Area 3	Commercial	-	572	24.1	jobs/acre
	Residential	1,727		15.6	people/acre
Area 5	Commercial	-	193	24.1	jobs/acre
	Residential	2,004		15.6	people/acre
Area 6	Residential	2,318		15.6	people/acre
Area 7	Strategic lands	-			
	Residential	332		15.6	people/acre
	TOTAL	11,796	1,002		





Appendix B

Population Projections Table

Appendix B - Population Projection Table

Year	Black Diamond				Turner Valley			
	Lower Growth Trend	Population	Higher Growth Trend	Population	Lower Growth Trend	Population	Higher Growth Trend	Population
2016*	-	2,700	-	2,700	-	2,559	-	2,559
2017	2.50%	2,768	3.00%	2,781	2.50%	2,623	3.00%	2,636
2018	2.50%	2,838	3.00%	2,865	2.50%	2,689	3.00%	2,716
2019	2.50%	2,909	3.00%	2,951	2.50%	2,757	3.00%	2,798
2020	2.50%	2,982	3.00%	3,040	2.50%	2,826	3.00%	2,882
2021	2.50%	3,057	3.00%	3,132	2.50%	2,897	3.00%	2,969
2022	2.50%	3,134	3.00%	3,226	2.50%	2,970	3.00%	3,059
2023	2.50%	3,213	3.00%	3,323	2.50%	3,045	3.00%	3,151
2024	2.50%	3,294	3.00%	3,423	2.50%	3,122	3.00%	3,246
2025	2.50%	3,377	3.00%	3,526	2.50%	3,201	3.00%	3,344
2026	2.50%	3,462	3.00%	3,632	2.50%	3,282	3.00%	3,445
2027	2.50%	3,549	3.00%	3,741	2.50%	3,365	3.00%	3,549
2028	2.50%	3,638	3.00%	3,854	2.50%	3,450	3.00%	3,656
2029	2.50%	3,729	3.00%	3,970	2.50%	3,537	3.00%	3,766
2030	2.50%	3,823	3.00%	4,090	2.50%	3,626	3.00%	3,879
2031	2.50%	3,919	3.00%	4,213	2.50%	3,717	3.00%	3,996
2032	2.50%	4,017	3.00%	4,340	2.50%	3,810	3.00%	4,116
2033	2.50%	4,118	3.00%	4,471	2.50%	3,906	3.00%	4,240
2034	2.50%	4,221	3.00%	4,606	2.50%	4,004	3.00%	4,368
2035	2.25%	4,316	2.75%	4,733	2.25%	4,095	2.75%	4,489
2036	2.25%	4,414	2.75%	4,864	2.25%	4,188	2.75%	4,613
2037	2.25%	4,514	2.75%	4,998	2.25%	4,283	2.75%	4,740
2038	2.25%	4,616	2.75%	5,136	2.25%	4,380	2.75%	4,871
2039	2.25%	4,720	2.75%	5,278	2.25%	4,479	2.75%	5,005
2040	2.25%	4,827	2.75%	5,424	2.25%	4,580	2.75%	5,143
2041	2.25%	4,936	2.75%	5,574	2.25%	4,684	2.75%	5,285
2042	2.25%	5,048	2.75%	5,728	2.25%	4,790	2.75%	5,431
2043	2.25%	5,162	2.75%	5,886	2.25%	4,898	2.75%	5,581
2044	2.25%	5,279	2.75%	6,048	2.25%	5,009	2.75%	5,735
2045	2.25%	5,398	2.75%	6,215	2.25%	5,122	2.75%	5,893
2046	2.25%	5,520	2.75%	6,386	2.25%	5,238	2.75%	6,056
2047	2.25%	5,645	2.75%	6,562	2.25%	5,356	2.75%	6,223
2048	2.25%	5,773	2.75%	6,743	2.25%	5,477	2.75%	6,395
2049	2.25%	5,903	2.75%	6,929	2.25%	5,601	2.75%	6,571
2050	2.25%	6,036	2.75%	7,120	2.25%	5,728	2.75%	6,752
2051	2.25%	6,172	2.75%	7,316	2.25%	5,857	2.75%	6,938
2052	2.25%	6,311	2.75%	7,518	2.25%	5,989	2.75%	7,129
2053	2.25%	6,453	2.75%	7,725	2.25%	6,124	2.75%	7,326
2054	2.25%	6,599	2.75%	7,938	2.25%	6,262	2.75%	7,528
2055	2.00%	6,731	2.50%	8,137	2.00%	6,388	2.50%	7,717
2056	2.00%	6,866	2.50%	8,341	2.00%	6,516	2.50%	7,910
2057	2.00%	7,004	2.50%	8,550	2.00%	6,647	2.50%	8,108
2058	2.00%	7,145	2.50%	8,764	2.00%	6,780	2.50%	8,311
2059	2.00%	7,288	2.50%	8,984	2.00%	6,916	2.50%	8,519
2060	2.00%	7,434	2.50%	9,209	2.00%	7,055	2.50%	8,732
2061	2.00%	7,583	2.50%	9,440	2.00%	7,197	2.50%	8,951
2062	2.00%	7,735	2.50%	9,676	2.00%	7,341	2.50%	9,175
2063	2.00%	7,890	2.50%	9,918	2.00%	7,488	2.50%	9,405
2064	2.00%	8,048	2.50%	10,166	2.00%	7,638	2.50%	9,641
2065	2.00%	8,209	2.50%	10,421	2.00%	7,791	2.50%	9,883
2066	2.00%	8,374	2.50%	10,682	2.00%	7,947	2.50%	10,131
2067	2.00%	8,542	2.50%	10,950	2.00%	8,106	2.50%	10,385
2068	2.00%	8,713	2.50%	11,224	2.00%	8,269	2.50%	10,645
2069	2.00%	8,888	2.50%	11,505	2.00%	8,435	2.50%	10,912
2070	2.00%	9,066	2.50%	11,793	2.00%	8,604	2.50%	11,185
2071	2.00%	9,248	2.50%	12,088	2.00%	8,777	2.50%	11,465
2072	2.00%	9,433	2.50%	12,391	2.00%	8,953	2.50%	11,752
2073	2.00%	9,622	2.50%	12,701	2.00%	9,133	2.50%	12,046
2074	2.00%	9,815	2.50%	13,019	2.00%	9,316	2.50%	12,348

* Represents population from Canadian 2016 Census

Appendix C

Sanitary Demand Calculations

Appendix C - Sanitary Demand Calculations

1. Sanitary Sewer Flows

Population Flow Equivalents

Total Wastewater Demand	264	L/c/d
MDF:ADF Ratio	2.2	
PHF:ADF Ratio	5.0	
Westend Forcemain TV Capacity	482.40	m3/h
	134.00	L/s

2. Calculate Sanitary Flows for Proposed Annexation Areas

Scenario 1 - Excluding Area 3

		Residential Population	Service Population	ADF (m^3/d)	MDF (m^3/d)	PHF (m3/h)	Catchment
	Black Diamond - within Town Boundary	3,427		904.7	1990.4	188.5	Ex
Area 2	Residential	1,988		524.9	1154.8	109.4	2
	Industrial		237	62.7	137.9	13.1	2
Area 3	Commercial		0	0.0	0.0	0.0	3
	Residential	0		0.0	0.0	0.0	3
Area 5	Commercial		193	50.9	112.0	10.6	5
	Residential	2,004		529.0	1163.8	110.2	5
Area 6	Residential	2,318		612.0	1346.3	127.5	6
Area 7	Strategic						
	Residential	332		87.6	192.8	18.3	7
	TOTAL:	10,069	430	2,772	6,098	577	

Scenario 2 - Including Area 3

		Residential Population	Service Population	ADF (m^3/d)	MDF (m^3/d)	PHF (m3/h)	Catchment
	Black Diamond - within Town Boundary	3,427		904.7	1990.4	188.5	Ex
Area 2	Residential	1,988		524.9	1154.8	109.4	2
	Industrial		237	62.7	137.9	13.1	2
Area 3	Commercial		572	150.9	332.0	31.4	3
	Residential	1,727		455.9	1003.0	95.0	3
Area 5	Commercial		193	50.9	112.0	10.6	5
	Residential	2,004		529.0	1163.8	110.2	5
Area 6	Residential	2,318		612.0	1346.3	127.5	6
Area 7	Strategic						
	Residential	332		87.6	192.8	18.3	7
	TOTAL:	11,796	1,002	3,379	7,433	704	

3. Area Catchment Flows

Scenario 1 - Excluding Area 3

			Flow (L/s)					
Study Area - Black Diamond		Catchment	Ex	2	3	5	6	7
	Black Diamond - within Town Boundary	Ex	52.36					
Area 2	Residential	2		30.38				
	Industrial	2		3.63				
Area 3	Commercial	3			0.00			
	Residential	3			0.00			
Area 5	Commercial	5				2.95		
	Residential	5				30.61		
Area 6	Residential	6					35.41	
Area 7	Strategic	7						
	Residential	7						5.07
		TOTAL:	52.4	34.0	0.0	33.6	35.41	5.07
		Required Sewer Capacity (85% Full)	60.88	39.54	0.00	39.02	41.18	5.90

Scenario 2 - Including Area 3

			Flow (L/s)					
Study Area - Black Diamond		Catchment	Ex	2	3	5	6	7
	Black Diamond - within Town Boundary	Ex	52.36					
Area 2	Residential	2		30.38				
	Industrial	2		3.63				
Area 3	Commercial	3			8.73			
	Residential	3			26.38			
Area 5	Commercial	5				2.95		
	Residential	5				30.61		
Area 6	Residential	6						
Area 7	Strategic	7					35.41	
	Residential	7						5.07
		TOTAL:	52.4	34.0	35.1	33.6	35.4	5.1
		Required Sewer Capacity (85% Full)	60.88	39.54	40.84	39.02	41.18	5.90

Peak Hour Flow per Area

Ex	52	L/s
2	34.0	L/s
3	35.1	L/s
5	33.6	L/s
6	35.4	L/s
7	5.1	L/s
Projected Additional TV Flows	72	L/s
Westend Forcemain - TV Flows	134.0	L/s

Appendix D

Water Demand Calculations

Appendix D - Water Demand Calculations

November 2020

1. Potable Water Demands

Population Equivalent Flow Values

Areas		
Average Consumption	315	l/c/day
Commercial/Employment Ratio	315	l/c/day
MDD:ADD Ratio	2.2	
PHD:ADD Ratio	4.0	

2. Calculate Potable Demands

	Study Area - Black Diamond	Residential Population	Service Population	ADD (MLD)	MDD (MLD)	PHD (L/s)
	Black Diamond - within Town Boundary	3,427	-	1.08	2.375	50.0
Area 2	Residential	1,988	-	0.63	1.378	29.0
	Industrial	-	237	0.07	0.165	3.5
Area 3	Commercial	-	572	0.18	0.396	8.3
	Residential	1,727	-	0.54	1.197	25.2
Area 5	Commercial	-	193	0.06	0.13	2.81
	Residential	2,004	-	0.63	1.39	29.22
Area 6	Residential	2,318		0.73	1.61	33.80
Area 7	Strategic					
	Residential	332		0.10	0.23	4.84
	TOTAL:	**11,796**	**1,002**	**4.03**	**8.87**	
	Ratio Commerical:Residential	0.26				
	Adding System Losses (10%)	10%		0.40	0.89	[AEP Standards and Guidelines for Municipal Waterworks,
	Adding WTP Residuals Wasted (1-5%)	5%		0.20	0.44	Wastewater and Storm Drainage Systems]
	Raw Water Demand		4,031,387 L/day	4.64	10.20	

Peak Hour Flow per Catchment

Ex	50.0	L/s
2	32.5	L/s
3	33.5	L/s
5	32.0	L/s
6	33.8	L/s
7	4.8	L/s
Min. Fire Flow:	197	L/s

[Min. basic fire flow requirement]

3. Required Reservoir Storage

Scenario 1 - Excluding Area 3

T10/T - baffling coefficient	0.4	[Assume average baffling conditions-Baffled Inlet or outlet with some inter-basin baffling]
PHD:ADD	4.0	
MDD:ADD	2.2	

ADD	42.11	l/s	[user demand + pipe losses only (no residuals)]
MDD	92.64	l/s	[user demand + pipe losses only (no residuals)]
PHD	168.43	l/s	[user demand + pipe losses only (no residuals)]

[A-Fire Storage]

	Q (L/min)	Duration (min	Volume (M^3)	
Single family homes	4,091	90	368	[Fire Underwriters Survey for BD]
Commerical & Industrial	10,910	120	1,309	[Fire Underwriters Survey for BD]
Minimum Basic Fire flow	11,820	150	1,773	[2600lgpm; Fire Underwriters Survey for Black Diamond]

STORAGE	Volume	Unit
A - Fire Storage	1,773	m3
B - Equalization Storage	2,001	m3
C - Emergency Storage	546	m3

AEP Standards and Guidelines April 2012

2.5 Potable Water Storage

2.5.1 Sizing

The total water storage requirements for a given water supply system where the treatment plant is only capable of satisfying the maximum daily design flow may be calculated using the following empirical formula:

S = A + B + (the greater of C or D)

where S = Total storage requirement, m^3
A = Fire storage, m^3
B = Equalization storage (approximately 25% of projected maximum daily design flow), m^3
C = Emergency storage (minimum of 15% of projected average daily design flow), m^3
D = Disinfection contact time (T_{10}) storage to meet the CT requirements, m^3, as detailed in 1.10.3.7.

The level of fire protection is the responsibility of the municipality. The level of storage may be further reduced if the water treatment plant is capable of supplying more than the maximum daily design flow or if there is sufficient flow data to support a lower peaking factor than would be normally used for the given population range.

Fire Underwriter's Survey for Fire Flows

REQUIRED DURATION OF FIRE FLOW	
Fire Flow Required (litres per minute)	Duration (hours)
2,000 or less	1.0
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.0
8,000	2.0
10,000	2.0
12,000	2.5
14,000	3.0
16,000	3.5
18,000	4.0
20,000	4.5
22,000	5.0
24,000	5.5
26,000	6.0
28,000	6.5
30,000	7.0
32,000	7.5
34,000	8.0
36,000	8.5
38,000	9.0
40,000 and over	9.5

RVC Servicing Standards (none found for MD Foothills)

Type	Flow***	Duration	Volume
Country Residential*	50 l/s + MDD (3000l/m +MDD)	1.5 hours	270 m^3 + MDD
Single Family Residential	100 l/s + MDD (6,000l/m + MDD)	2.0 hours	720 m^3 + MDD
Multi - Family Residential	166 l/s + MDD (10,000l/m + MDD)	2.0 hours	1200 m^3 + MDD
High Density Residential (Apartments)	250 l/s + MDD (15,000l/m + MDD)	3.5 hours	2700 m^3 + MDD
Commercial	166l/s-250l/s + MDD	2.0 to 3.5	1200-2700 m^3 +
Industrial**	(10,000l/m-15,000l/m + MDD)	hours	MDD

*If the developer proposes a hydrant system or required at the discretion of Council. Country Residential is considered any lot that is 2 acres or greater and have a nominal building separation of 10.1m or greater.

**Range in fire flows depending on scale of project: i.e., "light" industrial commercial versus "regular" industrial commercial.

***Flows shown in chart are independent of MDD

[D-Disinfection Contact Time]

Assume chlorine residual of (mg/l)	1.0	[Assume]
Temperature (oC)	0.5	

CT Tables Converted into Line of best fit to Calculate Required CT for Virus Inactivation by Free Chlorine for temperatures in the range of 0.5 to 15 oC
Refer to table B-1 CT Values for Inactivation of Viruses by Free Chlorine in the Alberta Standards and Guidelines for municipal waterworks, wastewater and Storm Drainage Systems.

Using CT tables provided by AESRD for virus inactivation using Free Chlorine

LOG REDUCTION FOR VIRUSES	CT VALUE
2 log reduction	6
3 log reduction	9
4 log reduction	12

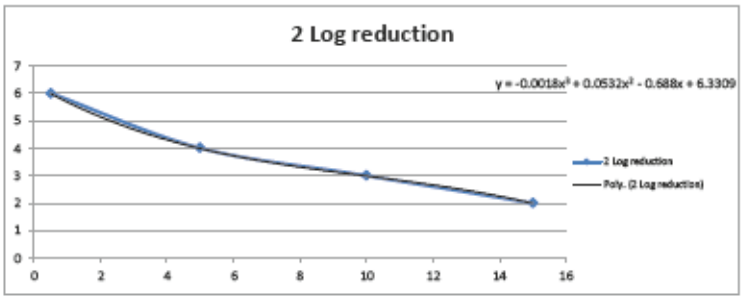
D - Solve for Disinfection Contact Time Storage (m3)

2 log reduction	152	m3
3 log reduction	227	m3
4 log reduction	303	m3

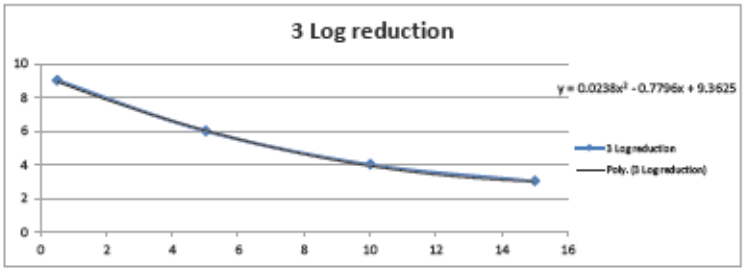
S - Required Reservoir Storage (m3)

2 log reduction	4,320	m3	
3 log reduction	4,320	m3	
4 log reduction	**4,320**	**m3**	4,545 m3

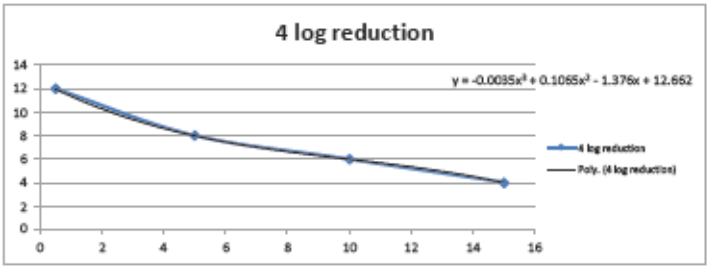
Required Storage	**4,320**	**m3**
Available Storage	**4,545**	**m3**



2 Log reduction	
0.5	6
5	4
10	3
15	2



3 Log reduction	
0.5	9
5	6
10	4
15	3



4 Log reduction	
0.5	12
5	8
10	6
15	4

Required Storage for Black Diamond Growth:	-225	m3	Residential Pop. Eq.	
Triggers upgrade at (ADD):	4	MLD	12,503	Capita

[Assumes Commerical/Employment and Residential Grow at Equal Rates]

Scenario 2 - Including Area 3

T10/T - baffling coefficient	0.4	[Assume average baffling conditions-Baffled Inlet or outlet with some inter-basin baffling]
PHD:ADD	4.0	
MDD:ADD	2.2	

ADD	51.33	l/s	(user demand + pipe losses only (no residuals))
MDD	112.92	l/s	(user demand + pipe losses only (no residuals))
PHD	205.30	l/s	(user demand + pipe losses only (no residuals))

[A-Fire Storage]

	Q (L/min)	Duration (min	Volume (M^3)	
Single family homes	4,091	90	368	[Fire Underwriters Survey for BD]
Commerical & Industrial	10,910	120	1,309	[Fire Underwriters Survey for BD]
Minimum Basic Fire flow	11,820	150	1,773	[2600lgpm; Fire Underwriters Survey for Black Diamond]
	196.9933333			

STORAGE	Volume	Unit
A - Fire Storage	1,773	m3
B - Equalization Storage	2,439	m3
C - Emergency Storage	665	m3

AEP Standards and Guidelines April 2012

2.5 Potable Water Storage

2.5.1 Sizing

The total water storage requirements for a given water supply system where the treatment plant is only capable of satisfying the maximum daily design flow may be calculated using the following empirical formula:

S = A + B + (the greater of C or D)

where S = Total storage requirement, m^3
A = Fire storage, m^3
B = Equalization storage (approximately 25% of projected maximum daily design flow), m^3
C = Emergency storage (minimum of 15% of projected average daily design flow), m^3
D = Disinfection contact time (T_{10}) storage to meet the CT requirements, m^3, as detailed in 1.10.3.7.

The level of fire protection is the responsibility of the municipality. The level of storage may be further reduced if the water treatment plant is capable of supplying more than the maximum daily design flow or if there is sufficient flow data to support a lower peaking factor than would be normally used for the given population range.

Fire Underwriter's Survey for Fire Flows

REQUIRED DURATION OF FIRE FLOW	
Fire Flow Required (litres per minute)	Duration (hours)
2,000 or less	1.0
3,000	1.25
4,000	1.50
5,000	1.75
6,000	2.0
8,000	2.0
10,000	2.5
12,000	2.5
14,000	3.0
16,000	3.5
18,000	4.0
20,000	4.5
22,000	5.0
24,000	5.5
26,000	6.0
28,000	6.5
30,000	7.0
32,000	7.5
34,000	8.0
36,000	8.5
38,000	9.0
40,000 and over	9.5

RVC Servicing Standards (none found for MD Foothills)

Type	Flow***	Duration	Volume
Country Residential*	50 l/s + MDD (3000l/m +MDD)	1.5 hours	270 m^3 + MDD
Single Family Residential	100 l/s + MDD (6,000l/m + MDD)	2.0 hours	720 m^3 + MDD
Multi - Family Residential	166 l/s + MDD (10,000l/m + MDD)	2.0 hours	1200 m^3 + MDD
High Density Residential (Apartments)	250 l/s + MDD (15,000l/m + MDD)	3.5 hours	2700 m^3 + MDD
Commercial	166l/s-250l/s + MDD	2.0 to 3.5	1200-2700 m^3 +
Industrial**	(10,000l/m-15,000l/m + MDD)	hours	MDD

*If the developer proposes a hydrant system or required at the discretion of Council. Country Residential is considered any lot that is 2 acres or greater and have a nominal building separation of 10.1m or greater

**Range in fire flows depending on scale of project i.e., "light" industrial commercial versus "regular" industrial commercial.

***Flows shown in chart are independent of MDD

[D-Disinfection Contact Time]

Assume chlorine residual of (mg/l)	1.0 [Assume]
Temperature (oC)	0.5

CT Tables Converted into Line of best fit to Calculate Required CT for Virus Inactivation by Free Chlorine for temperatures in the range of 0.5 to 15 oC Refer to table B-1 CT Values for Inactivation of Viruses by Free Chlorine in the Alberta Standards and Guidelines for municipal waterworks, wastewater and Storm Drainage Systems.

Using CT tables provided by AESRD for virus inactivation using Free Chlorine

LOG REDUCTION FOR VIRUSES	CT VALUE
2 log reduction	6
3 log reduction	9
4 log reduction	12

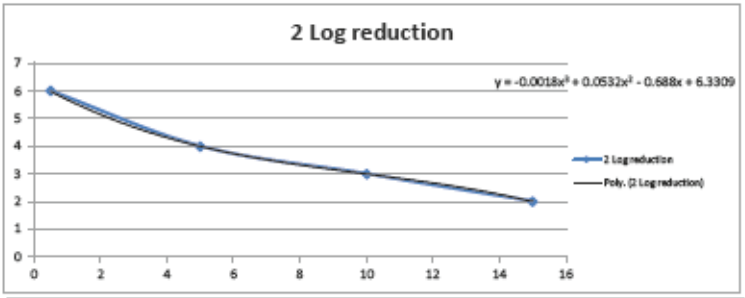
D - Solve for Disinfection Contact Time Storage (m3)

2 log reduction	185	m3
3 log reduction	277	m3
4 log reduction	370	m3

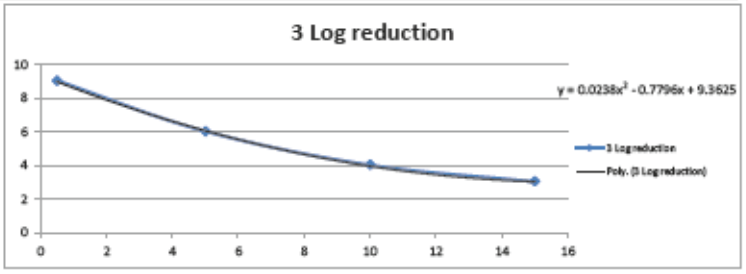
S - Required Reservoir Storage (m3)

2 log reduction	4,877	m3	
3 log reduction	4,877	m3	
4 log reduction	4,877	m3	4,545 m3

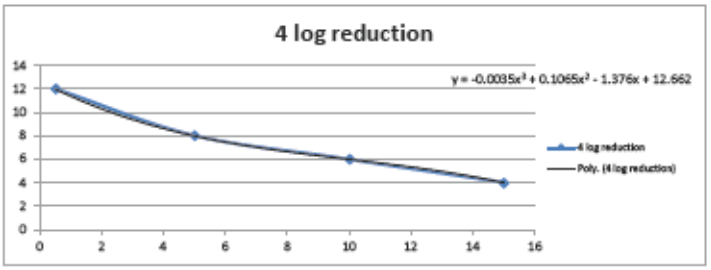
Required Storage	4,877	m3
Available Storage	4,545	m3



2 Log reduction	
0.5	6
5	4
10	3
15	2



3 Log reduction	
0.5	9
5	6
10	4
15	3



4 Log reduction	
0.5	12
5	8
10	6
15	4

Required Storage for Black Diamond Growth:	332	m3	Residential Pop. Eq.		
Triggers upgrade at (ADD):	4	MLD	12,017	Capita	[Assumes Commerical/Employment and Residential Grow at Equal Rates]

4. Water License

Scenario 1 - Excluding Area 3

Black Diamond	934,679	m3/annum
2075 Raw Water Demands	1,388,242	m3/annum
Required additional License -	433,563	m3/annum

Scenario 2 - Including Area 3

Black Diamond	934,679	m3/annum
2075 Raw Water Demands	1,692,175	m3/annum
Required additional License -	737,496	m3/annum

Appendix E

Transportation Summary

Appendix E - Transportation Cost Estimates

A functional evaluation must be completed to provide a more accurate cost estimate for budget purposes. The functional evaluation will also detail the environmental and geotechnical requirements for the study area. The public will also be engaged as part of the functional study to capture the community concerns. In addition, the future functional study will determine the cost required to improve the existing network to support the additional volume and frequency of vehicles operating on the corridors. It will be important to understand the existing road structure and its current life cycle to ensure the corridor can support the additional volume.

Intersections in the study area identified for new construction or upgrades will need to consider the appropriate traffic signal or roundabout treatment through a more detailed traffic impact assessment. These subsequent evaluations will capture the increased details related to the land use characteristics such as, gas station, schools, shopping centre, fast-food restaurants, etc. From there, the appropriate intersection treatment will be selected to ensure operational, safety and property requirements are met.

It should be noted that the cost provided in this study should be used for comparisons purposes only. Using the planning level cost estimate for budgetary or cost to construct is not appropriate. Should cost to construct or detailed cost estimates be required, a functional study or detailed design exercise should be completed as the next stage in the process.

Table 1 summarizes the evaluation for each annexation scenario. The planning level cost estimate should not be used for budgetary purposes or cost to construct.

Table 1: Transportation Cost Estimate Summary

Scenario	New Roads (m)	Intersection Improvements	Cost (Planning Level)
Scenario 1 (Area 2)	820	1	$3,400,000
Scenario 2 (Area 3)	2,130	3	$10,300,000
Scenario 3 (Area 7)	0	0	$0
Scenario 4 (Area 2,3,6)	2,130	7	$18,000,000
Scenario 5 (Area 2,5,6)	2,130	5	$13,900,000
Scenario 6 (Area 2,3,5,6,7)	2,130	8	$19,800,000

Please note that the intersection improvement costs summarized above are for signalized intersections (4-lane or 2-lane depending on the daily traffic volumes). While Township Road 201 does not require additional capacity to support the traffic generated from Area 7, the Town may wish to develop the road to a standard urban road as development takes place. Also, please note that the costs of new roads only include the new north/south connection at 6 Street and the new east/west connection at Willow Ridge Road, costs of internal roads within each area and alternative roads that can alleviate demand from the existing roads are not included in the table above. Costs of highway (Highway 22 and Highway 7) widening (where required) are not included. Property acquisition is not included in the cost estimates.

Additional evaluations will be required to understand the detailed property requirements and capital investments to support the annexation scenarios. These studies include:

- **Transportation Master Plan** – is prepared as a long-term plan to guide the development of transportation infrastructure to support goal and objectives of the Community. The TMP evaluates current travel conditions, forecasts future travel conditions and develops appropriate long-term transportation strategies for the community to consider.

- **Functional Road Study** – this document is prepared to understand the "ground-level" conditions by providing detailed technical analysis and design to support future road alignments ensuring environmental, geotechnical, community and property considerations are evaluated.

- **Traffic Data Collection** – the Communities in the study area should allocate resources for traffic data collection on priority corridor to identify changing travel patterns and demand period. The data can provide useful insights to make traffic management decisions such as when to implement traffic calming measures, road improvements and traffic and parking regulations.

Cost Estimates

Feb. 8, 2021

Assumptions

New road			
Total road length		2250	m
Total Cost	$	3,745,008	
Regional Connector	$	1,664	lm
Intersection Improvement (4lane+sign	$	1,200,000	each
Intersection Improvement (2lane+sign	$	900,000	each
Contingency		35%	
Engineering		15%	

Summary

Scenario	Total Cost (incl. Engineering & Contingency)
Scenario 1 (Area 2)	$ 3,400,000
Scenario 2 (Area 3)	$ 10,300,000
Scenario 3 (Area 7)	$ -
Scenario 4 (Area 2, 3, 6)	$ 18,000,000
Scenario 5 (Area 2, 5, 6)	$ 13,900,000
Scenario 6 (Area 2, 3, 5, 6, 7)	$ 19,800,000

Scenario	New Roads (m)	Intersection Improvements	Cost (Planning Level)
Scenario 1 (Area 2)	820	1	$3,400,000
Scenario 2 (Area 3)	2130	3	$10,300,000
Scenario 3 (Area 7)	0	0	$0
Scenario 4 (Area 2,3,6)	2130	7	$18,000,000
Scenario 5 (Area 2,5,6)	2130	5	$13,900,000
Scenario 6 (Area 2,3,5,6,7)	2130	8	$19,800,000

Calculations

Scenario 1 (Area 2)				
New Road	**Daily Volume**	**Length (m)**	**Unit Cost ($/m)**	**Segment Costs**
Highway 7 to 4th Ave	6000	630	$ 1,664	$ 1,048,602
South of 4th Ave (optional)	0	190	$ 1,664	$ 316,245
Type of Intersection Improvement	**Quantity**		**Unit Cost**	**Intersection Costs**
Signalization (4lane+signal)	0		$ 1,200,000	$ -
Signalization (2lane+signal)	1		$ 900,000	$ 900,000
			Subtotal	$ 2,264,847
Engineering and Contingency				
Engineering				$ 339,727
Contingency				$ 792,697
			Total	$ 3,400,000

Scenario 2 (Area 3)				
New Road	**Daily Volume**	**Length (m)**	**Unit Cost ($/m)**	**Segment Costs**
Highway 7 to 4th Ave (N/S Connection	6000	630	$ 1,664	$ 1,048,602
4th Ave to Willow Ridge Connection (N/S Connection)	6000	680	$ 1,664	$ 1,131,825
Willow Ridge E/W Connection	10000	820	$ 1,664	$ 1,364,847
Type of Intersection Improvement	**Quantity**		**Unit Cost**	**Intersection Costs**
Signalization (4lane+signal)	2		$ 1,200,000	$ 2,400,000
Signalization (2lane+signal)	1		$ 900,000	$ 900,000
			Subtotal	$ 6,845,274
Engineering and Contingency				
Engineering				$ 1,026,791
Contingency				$ 2,395,846
			Total	$ 10,300,000

Scenario 3 (Area 7)				
New Road	**Daily Volume**	**Length (m)**	**Unit Cost ($/m)**	**Segment Costs**
Highway 7 to 4th Ave (N/S Connection)		0	$ 1,664	$ -
4th Ave to Willow Ridge Connection (N/S Connection)		0	$ 1,664	$ -

Willow Ridge E/W Connection		0	$ 1,664	$ -
Type of Intersection Improvement	**Quantity**		**Unit Cost**	**Intersection Costs**
Signalization (4lane+signal)		0	$ 1,200,000	$ -
Signalization (2lane+signal)		0	$ 900,000	$ -
			Subtotal	$ -
Engineering and Contingency				
Engineering				$ -
Contingency				$ -
			Total	$ -

Scenario 4 (Area 2, 3, 6)				
New Road	**Daily Volume**	**Length (m)**	**Unit Cost ($/m)**	**Segment Costs**
Highway 7 to 4th Ave (N/S Connection	15000	630	$ 1,664	$ 1,048,602
4th Ave to Willow Ridge Connection (N/S Connection)	13000	680	$ 1,664	$ 1,131,825
Willow Ridge E/W Connection	11000	820	$ 1,664	$ 1,364,847
Type of Intersection Improvement	**Quantity**		**Unit Cost**	**Intersection Costs**
Signalization (4lane+signal)	7		$ 1,200,000	$ 8,400,000
Signalization (2lane+signal)	0		$ 900,000	$ -
			Subtotal	$ 11,945,274
Engineering and Contingency				
Engineering				$ 1,791,791
Contingency				$ 4,180,846
			Total	$ 18,000,000

Scenario 5 (Area 2, 5, 6)				
New Road	**Daily Volume**	**Length (m)**	**Unit Cost ($/m)**	**Segment Costs**
Highway 7 to 4th Ave (N/S Connection	15000	630	$ 1,664	$ 1,048,602
4th Ave to Willow Ridge Connection (N/S Connection)	13000	680	$ 1,664	$ 1,131,825
Willow Ridge E/W Connection	11000	820	$ 1,664	$ 1,364,847
Area 5 East of Highway 22			$ 1,664	$ -
Type of Intersection Improvement	**Quantity**		**Unit Cost**	**Intersection Costs**
Signalization (4lane+signal)	4		$ 1,200,000	$ 4,800,000
Signalization (2lane+signal)	1		$ 900,000	$ 900,000
			Subtotal	$ 9,245,274
Engineering and Contingency				
Engineering				$ 1,386,791
Contingency				$ 3,235,846
			Total	$ 13,900,000

Scenario 6 (Area 2, 3, 5, 6, 7)				
New Road	**Daily Volume**	**Length (m)**	**Unit Cost ($/m)**	**Segment Costs**
Highway 7 to 4th Ave (N/S Connection	15000	630	$ 1,664	$ 1,048,602
4th Ave to Willow Ridge Connection (N/S Connection)	13000	680	$ 1,664	$ 1,131,825
Willow Ridge E/W Connection	11000	820	$ 1,664	$ 1,364,847
Area 5 East of Highway 22			$ 1,664	$ -
Type of Intersection Improvement	**Quantity**		**Unit Cost**	**Intersection Costs**
Signalization (4lane+signal)	8		$ 1,200,000	$ 9,600,000
Signalization (2lane+signal)	0		$ 900,000	$ -
			Subtotal	$ 13,145,274
Engineering and Contingency				
Engineering				$ 1,971,791
Contingency				$ 4,600,846
			Total	$ 19,800,000

Appendix F

Detailed Cost Estimate

URBAN SYSTEMS

Project: Annexation Lands Servicing Review - Addendum Scenario 2
Project Number: 0925.0032.02
Project Location: Town of Black Diamond

		Unit	Quantity	UNIT $	TOTAL
Combined Areas - Scenario 2 (including Area 3)					
Schedule "A" - Surface Works					
A.1	Mobilization & Demobilization	l.s.	1	100,000.00	100,000.00
A.2	Traffic Accommodation	l.s.	1	20,000.00	20,000.00
A.3	Erosion & Sediment Control	l.s.	1	67,500.00	67,500.00
A.4	Common Excavation to Embankment	cu.m.	23,200	18.00	417,600.00
A.5	Topsoil Stripping to Stockpile	cu.m.	17,952	15.00	269,280.00
A.6	Topsoil Stockpile to Placement	cu.m.	5,257	18.00	94,626.00
A.7	Suitable Fill Import (Optional)	cu.m.	18,650	20.00	373,000.00
A.8	Remove and Replace Swing Gate	ea.	1	1,000.00	1,000.00
A.9	Remove and Replace Wooden Fence	l.m.	60	150.00	9,000.00
A.10	Sawcutting	l.m.	20	10.00	200.00
A.11	Asphalt Removal	s.m.	5,376	10.00	53,760.00
A.12	Full Gravel Removal	s.m.	5,376	10.00	53,760.00
A.13	Subgrade Preparation	s.m.	5,376	5.00	26,880.00
A.14	Prime Coat	s.m.	5,376	1.00	5,376.00
A.15	Gravel Placement	s.m.	5,376	30.00	161,280.00
A.16	Asphalt Placement	s.m.	5,376	30.00	161,280.00
A.17	Remove and Replace Monowalk	l.m.	15	250.00	3,750.00
	Total Schedule "A"				**$ 1,818,292.00**
Schedule "B" - Utilities - Sanitary					
B.1	Install Sanitary Sewer Main				
a)	250 mm PVC SDR 35	l.m.	0	275.00	0.00
b)	300 mm PVC SDR 35	l.m.	0	300.00	0.00
c)	375 mm PVC SDR 35	l.m.	800	300.00	240,000.00
d)	450 mm PVC SDR 35	l.m.	1,850	325.00	601,250.00
	525mm PVC SDR 35	l.m.	1,100	390.00	429,000.00
e)	150 mm Forcemain Installation	l.m.	0	350.00	0.00
	300 mm HDPE	l.m.	250	450.00	112,500.00
	400 mm HDPE	l.m.	400	550.00	220,000.00
f)	450 mm Forcemain Installation	l.m.	0	600.00	0.00
B.2	Sanitary Sewer Main Tie-in	ea.	2	6,500.00	13,000.00
B.3	Sanitary Manhole	ea.	21	6,010.00	126,210.00
B.4	Initial Flushing, Mandrel Testing and Video Inspection at Substantial Performance	l.m.	4,400	17.50	77,000.00
B.5	Final Flushing, Mandrel Testing and Video Inspection at Contract Acceptance	l.m.	4,400	22.50	99,000.00
B.7	Sanitary Lift Station - Area 2	l.s.	1	1,470,000.00	1,470,000.00
	Total Schedule "B"				**$ 3,387,960.00**
Schedule "C" - Utilities - Water					
C.1	Remove Water Main				
a)	150mm PVC DR18	l.m.	75	50.00	3,750.00
b)	200mm PVC DR18	l.m.	90	75.00	6,750.00
C.2	Install Water Main				
a)	200mm PVC DR18	l.m.	0	200.00	0.00
b)	250mm PVC DR18	l.m.	2,325	320.00	744,000.00
C.3	Install Water Valves				
a)	250 mm	ea.	24	3,700.00	89,725.00
C.4	Install Water Fittings	ea.	6	1,600.00	9,600.00
C.5	Water Main Tie-in	ea.	3	12,500.00	37,500.00
	Total Schedule "C"				**$ 891,325.00**
Schedule "D" - Utilities - Storm Sewer					
	Storm for Roads through Area 3 and 6th Street				
D.1	Install Storm Sewer Main				
a)	375 mm PVC SDR 35	l.m.	0	300.00	0.00
b)	450 mm PVC SDR 35	l.m.	1,835	320.00	587,200.00

D.2	Storm MH	ea.	24	6,010.00	144,240.00
D.3	Catchbasins	ea.	48	3,600.00	172,800.00
D.4	Catchbasin Lead	l.m.	1,440	215.00	309,600.00
D.5	Initial Flushing, Mandrel Testing and Video Inspection at Substantial Performance	l.m.	1,835	17.50	32,112.50
D.6	Final Flushing, Mandrel Testing and Video Inspection at Contract Acceptance	l.m.	1,835	22.00	40,370.00
	Total Schedule "D"				**$ 1,286,322.50**

	SUMMARY	
	Schedule "A" - Surface Works	$ 1,818,292.00
	Schedule "B" - Utilities - Sanitary	$ 3,387,980.00
	Schedule "C" - Utilities - Water	$ 891,325.00
	Schedule "D" - Utilities - Storm Sewer	$ 1,286,322.50
	SUBTOTAL	**$ 7,383,899.50**
	CONTINGENCY (35%)	$ 2,451,555.56
	ENGINEERING (15%)	$ 1,446,557.39
	TOTAL	**$ 11,282,012.44**

Cost Estimate Assumptions/Notes

Cost for Lift Stations already includes contingency and engineering. This is not included in the Contigency and engineering totals, only the overall total

- Costs for Reservoir and Water Treatment Plant Upgrades are not included in the above total as the timing is in the far future
- The costs for the Wastewater Treatment Lagoon upgrades are not included in the above costs
- Costs of additional water licenses were not included in the above costs
- The costs of storm ponds and other stormwater infrastructure outside of the proposed roads has not been included in the above costs as we -assume the roads for Area 5 will be built by the developer and have not included costs

The assumption for the above cost estimate is that all of the infrastructure will be built at once and does not consider phasing. A more detailed cost estimate with assumed phasing will be provided as part of the Growth infrastructure Finance Strategy and associated Offsite Levy bylaw update

URBAN SYSTEMS

Project: Annexation Lands Servicing Review Addendum Scenario 2
Project Number: 0925.0032.02
Project Location: Town of Black Diamond

			TOTAL
Summary of Combined Areas - Scenario 2 (including all annexed lands)			
Schedule "A" - Site Works			2,455,000.00
Schedule "B" - Utilities - Sanitary Sewer			4,060,000.00
Schedule "C" - Utilities - Water			1,204,000.00
NE Industrial Water Main Looping			1,697,049.90
Schedule "D" - Utilities - Storm Sewer			1,737,000.00
	Sub-Total	$	11,153,049.90
	Engineering (15%)	$	1,672,957.49
Wastewater Treatment Plant		$	14,890,000.00
Water Treatment Plant		$	69,863,000.00
Transportation		$	19,800,000.00
	TOTAL	**$**	**117,379,007.39**
Note:	Summary prices include 35% Contingency		

Appendix G

2020 Sanitary Flow Monitoring Memo

MEMORANDUM

DATE: November 20, 2020
TO: Sharlene Brown, CAO
CC: Tom Dougall
FROM: Jennifer Whyte
FILE: 0925.0038.01
SUBJECT: 2020 Sanitary Flow Monitoring

This memorandum is intended to outline the background, methodology and findings from analyzing the flow monitoring data that was collected in Black Diamond in 2020. A sanitary sewer model of the trunk was created using current GIS data from Old Man River Regional Services Commission which was used to determine current capacity and limitations in the main.

BACKGROUND

The Town of Black Diamond engaged Urban Systems (USL) and SFE Global to install flow monitoring equipment at 6 locations during the wettest months of the year (May-August). SFE Global's flow monitoring report is included in **Appendix A**. During the monitoring period, flows were measured capturing the entire Town's sanitary flows, flows from the industrial area to the east, and areas along the sanitary trunk main where newly annexed land and future development within the town boundary may occur. Analyzing these flows allowed USL to determine the capacity of the sanitary trunk as part of the Servicing Plan Update. Please see **Figure 1** attached for the flow monitoring locations.

METHODOLOGY

During the monitoring period, dry and wet weather sanitary flows, and volumes of rainfall were captured from Mid May to Mid August. Due to a faulty sensor, rain data was only captured until Mid July. The data from monitoring location #2 did not show any diurnal variation of flow and was considered to be inaccurate. This location is shown but was omitted from the analysis.

Average Dry Weather Flow

As seen in **Figure 1**, Monitoring Station #1 recorded sanitary flows from a catchment that comprises the entire Town. Data from this station was used to establish Average Dry Weather Flows for the Town from a day in the monitoring period where no rainfall occurred for more than a 24-hour period prior. On this basis, an Average Dry Weather Flow rate for the Town was determined to be 0.085 L/s/ha.

Diurnal Patterns

Sanitary flows fluctuate within a 24-hour period, with lower flows occurring in the evenings and early mornings, and higher flows occurring sometime throughout the day, peaking at different times depending on land use. Based on an analysis of the monitoring data, we were able to obtain a typical residential dry weather diurnal pattern (**Figure 2**) from Monitoring Location #1, which had the most prominent dry weather flow diurnal pattern out of the 6 locations monitored. This is considered more accurate for establishing peak dry weather flows than applying an empirical peaking factor such as Harmon's.

Similarly, monitoring location #3 corresponds to a sewershed comprised predominantly of industrial land uses. A typical industrial diurnal pattern was obtained from this monitoring station and applied only to dry weather flows from this catchment. The Industrial diurnal pattern is shown in **Figure 3**.

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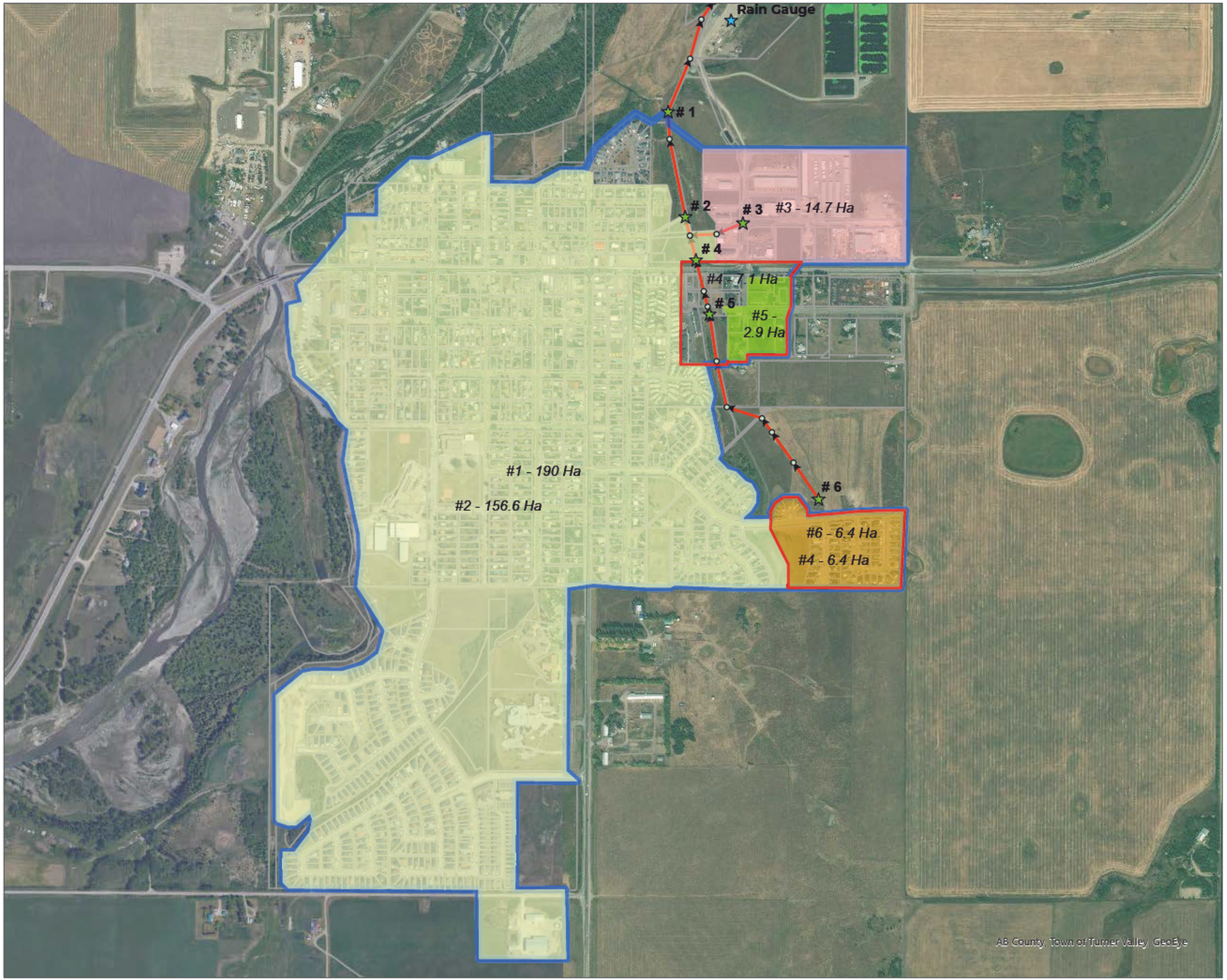
Last printed by squalie on September 17, 2020 9:15 AM



TOWN OF BLACK DIAMOND

2020 Sanitary Flow Monitoring

Flow Monitor Locations & Catchments

- Flow Monitors
- Rain Gauge
- Manhole
- Gravity Trunk Main

Flow Monitor Catchment

- 1
- 2
- 3
- 4
- 5
- 6

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

0 100 200
Meters

Coordinate System:

NAD 1983 3TM 114

Data Sources:

- Town of Black Diamond
- Oldman River Regional Services Commission

Project #:	0925.0038.01	URBAN systems
Author:	SQ	
Checked:	NA	
Date:	2020 / 11 / 20	FIGURE 1

U:\Projects_EDM\6666\Temp Working Projects\Black Diamond San Trunk Model (CAL 0925.0038.01)\GIS\Projects\Pro_Projects\BD Sanitary Trunk Model\BD Sanitary Trunk Model.aprx\Flow Monitors

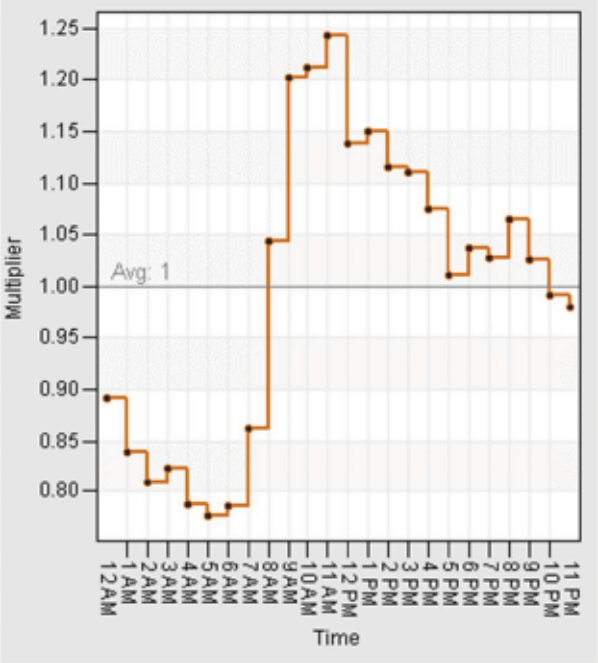


Figure 2: Typical Residential Diurnal Pattern

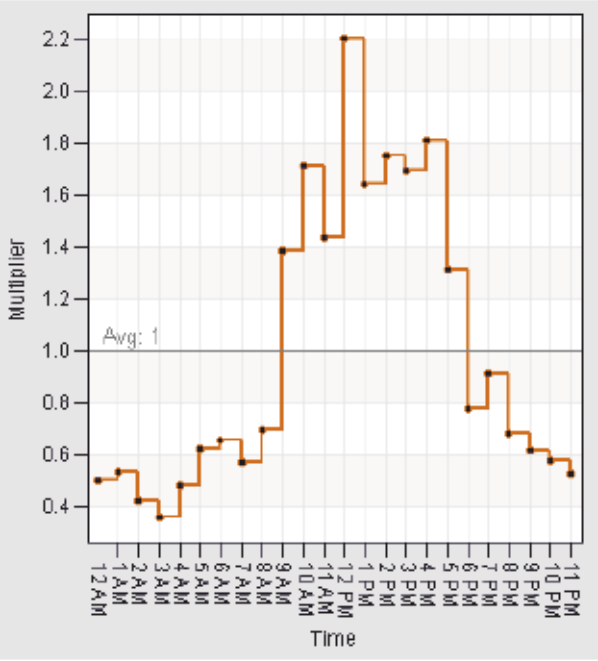


Figure 3: Predominant Industrial Diurnal Curve

Inflow and Infiltration (I&I)

Older systems made of materials such as vitrified clay tile or asbestos cement allow large volumes of infiltration from groundwater through cracks in the pipes and faulty joints. Inflow typically enters the system through manhole covers during rain events, particularly at sag locations. Flow monitoring data and rainfall data for the same period were analyzed to determine if there was a significant response to I&I in the Town's sanitary system. A review of the data collected indicated that on June 21, 2020 a 1:50 year rainfall event occurred in Black Diamond, which resulted in a surge in flow through the sanitary system, likely as a response to I&I. This was more prominently observed at monitoring location #1, as shown in **Figure 4.**

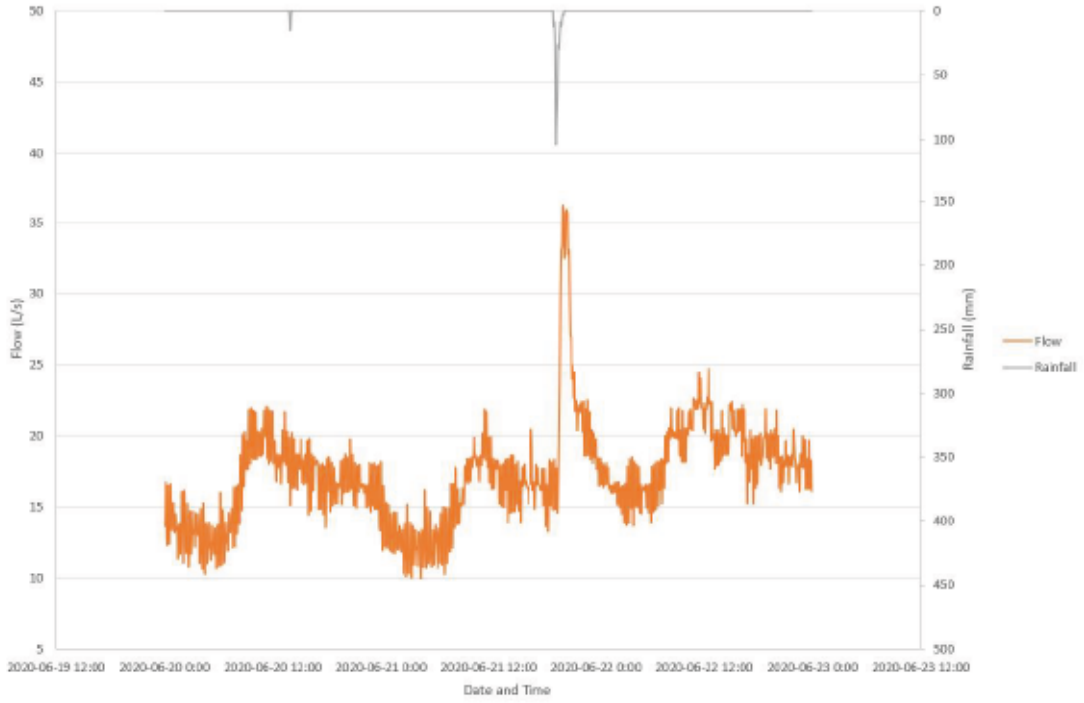


Figure 4 Monitoring Location #1 Flow vs Rainfall Volume

The total volume of I&I for the 1:50 year rainfall event was established by subtracting the dry weather flow from the June 21, 2020 wet weather event recorded at Monitoring Location #1 (**Figure 5**). The total volume of I&I measured after the rain event was 167,448 L. USL converted that volume to flow (5.81 L/s) and divided it by the total area of the town (189.9Ha) to get a baseline I&I rate of 0.0306 L/s/ha.

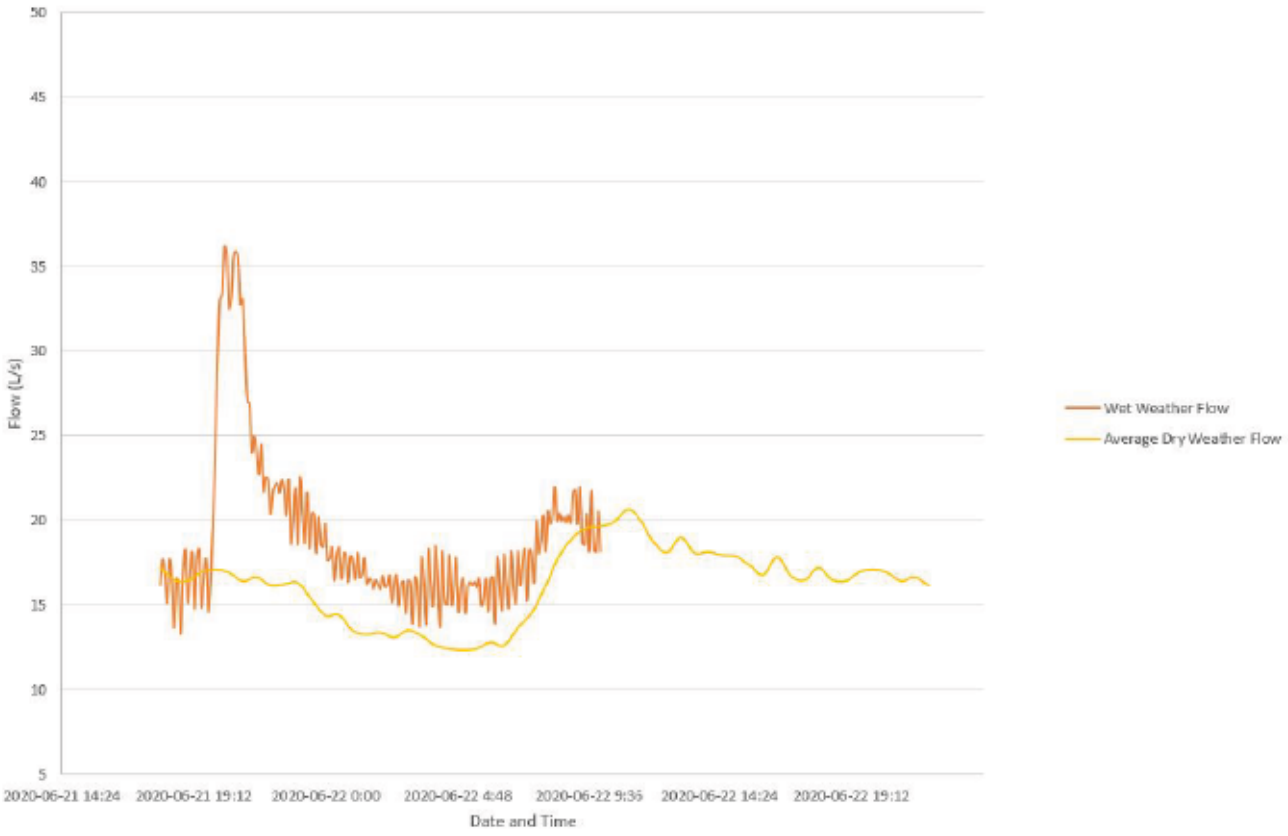


Figure 5: Monitoring Location #1 Wet Weather Flow vs Average Dry Weather Flow

PCSWMM Modelling

A model of the town's sanitary trunk was created in PCSWMM, a hydraulic modeling software developed by Computational Hydraulics International (CHI). PCSWMM combines a GIS interface with the United States Environmental Protection Agency's SWMM5 hydraulics computational engine in order to model rural or urban watersheds and stormwater and sanitary drainage systems. Trunk geometry was obtained from the Town's GIS system and complemented with as-built information.

Average dry weather flows were included at each monitoring location along the trunk by applying the average flow rate established earlier to each contributing area along the trunk. Residential and Industrial diurnal patterns were applied to this average flow in order to obtain peak dry weather flows. Similarly, the established I&I rate was also applied to each contributing area and entered into the model as constant baseline flow at each monitoring location (even though the flow monitoring showed negligible responses to I&I at most monitoring stations – this was done in order to be conservative). It is also worth noting that the average dry weather flow rate was further increased by 38% to achieve a peak flow similar to what was observed in the monitoring data.

A summary of the predominant land uses, contributing areas, baseline flows and average dry weather flows at each monitoring location are outlined in the table below:

Table 1 - Summary of Modelled Flows

Monitoring Location	Predominant Land Use	Contributing Area (Ha)	Baseline Flow (L/s)	Average Dry Weather Flow L/s
1	Residential	5.13	0.16	22.29
3	Industrial	14.72	0.45	1.50
4	Residential	4.22	0.13	1.69
5	Residential	2.87	0.16	0.63
6	Residential	6.42	0.20	1.22

FINDINGS

Industrial Area Capacity

The industrial area saw a negligible and unclear amount of I&I volume due to the system being relatively new (2006) and likely made from PVC. From the model, there is a maximum 3.7 L/s of flow measured from location #3. Infrastructure with the least amount of capacity downstream of the industrial area is a 200 PVC at 0.60% which is using 12.1% of its capacity (25.9 L/s).

Town Sanitary Trunk Capacity

USL has assumed that the sanitary system needs to operate at a maximum of 85% capacity and that no surcharging would be allowed. As shown in **Figure 6**, the 300mm main downstream of monitoring station #1 has the least amount of capacity, currently operating at 66% (35.5L/s out of a possible 45.3L/s). We estimate that only an additional 10L/s should be permitted to be added to this main, either from development within the existing town boundary or from future annexed lands.

As per the BSEI 2010 Wastewater Flow Monitoring Study (**Appendix B**), a recommendation to upsize the 300mm main to a 375mm at a minimum slope of 0.42% would further increase capacity to 107.3 L/s. This would allow an estimated 62 L/s of additional flow to be conveyed to the system without surcharging. Our findings continue to support this recommendation of upsizing from location #2 to the Westend interconnected point.

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Last printed by squalie on September 17, 2020 9:15 AM

TOWN OF BLACK DIAMOND

2020 Sanitary Flow Monitoring

Sanitary Trunk Capacities

- Flow Monitors
- Rain Gauge
- Manhole

Pipe Operating Capacity

- ≤10%
- 10-20%
- 20-30%
- 30-40%
- 40-50%
- 50-60%
- 60-70%
- 70-80%
- 80-90%
- >90%

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

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Meters

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Coordinate System:

NAD 1983 3TM 114

Data Sources:

- Town of Black Diamond
- Oldman River Regional Services Commission

Project #:	0925.0038.01	URBAN systems
Author:	SQ	
Checked:	NA	
Date:	2020 / 11 / 20	FIGURE 6

U:\Projects_EDM\9999\Temp Working Projects\Black Diamond San Trunk Model (CAL 0925.0038.01)\GIS\Projects\Pro_Projects\BD Sanitary Trunk Model\BD Sanitary Trunk Model.aprx\Pipe Capacity

Thank you for giving Urban Systems the opportunity to provide information on this important piece of town infrastructure. Please contact the undersigned should you have any questions.

Sincerely,

URBAN SYSTEMS LTD.

Prepared By: Jennifer Whyte, P.L.(Eng.), C.E.T.
Design Engineer

Reviewed By: Nicolas Abarca, M.Sc., P.Eng.
Water Resources Engineer

PERMIT TO PRACTICE
URBAN SYSTEMS LTD.
Signature
Date 2020-11-20
PERMIT NUMBER: P 3836
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

cc: Meghan Aebig, Urban Systems

/JW

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Appendix H

6th Street Water Looping Drawings
September 2020
Drawing E – Sanitary Catchment Areas

NOTE:
FUTURE FORCE MAIN SIZING TO BE DETERMINED AT TIME OF LIFT STATION DEVELOPMENT. SIZING WILL BE DEPENDENT UPON EXPECTED SANITARY LOADING AND PERMISSIBLE DETENTION TIMES BASED UPON INCOMING FLOWS/POPULATIONS.

FUTURE SANITARY MAIN SIZING BASED UPON ASSUMED CATCHMENTS AND DENSITIES AS PER ANNEXATION REPORTS. AS DEVELOPMENT PROGRESSES, CHECK PROPOSED DENSITIES AGAINST ASSUMPTIONS TO CONFIRM PROPOSED PIPE SIZING.

Catchment	Residential Area (ha)	Residential Area (acres)	Commercial /Industrial Area (ha)	Commercial/ Industrial Area (acres)	Total Area (ha)	Residential Pop Density (People/acre)	Commercial Pop Density (jobs/ac)	Residential Pop	Commercial Pop	Total Pop	Res Unpeaked Flow (L/s)	Commercial Unpeaked Flow (L/s)	Total Flow (Unpeaked)	I&I
2	51.6	127.5	10.1	25.0	61.7	15.6	9.5	1989	237	2226	6.078	0.724	6.802	17.276
3	44.8	110.7	9.6	23.7	54.4	15.6	24.1	1727	572	2299	5.277	1.748	7.025	15.232
5	51.98	128.4	3.24	8.0	55.22	15.6	24.1	2004	193	2197	6.123	0.590	6.713	15.4616
6	51.76	127.9	0	0.0	51.76	15.6	0	1995	0	1995	6.096	0.000	6.096	14.4928
Turner Valley	103.6	256.0	0	0.0	103.6	22.4	0	5740	0	5740	17.539	0.000	17.539	29.008

MANHOLE NUMBER		CATCHMENT AREA #	INCR. AREA	INCR. POP.	INCR. Q	CUMM. AREA	CUMM. POP.	CUMM. Q	HARMON'S PEAKING FACTOR	Q (L/s)	CUMM. INFIL.	**TOTAL Q**	SLOPE (%)	NOMINAL PIPE DIAMETER	PIPE MATERIAL	MANNING'S N	FULL VELOCITY	PIPE CAPACITY	PERCENT FULL CAPACITY
FROM	TO		(ha)		(l/s)	(ha)		(l/s)			(L/s)	**(L/s)**					(m/s)	(L/s)	(%)
TV	SMH F	Turner Valley	86.49	4792	14.64	86.49	4792	14.6	3.26	47.8	24.2	**72.0**	0.320%	375	PVC	0.013	0.88	**93.2**	77.25%
SMH F	SMH E	5	55.22	2197	6.71	141.71	6989	21.4	3.11	66.4	39.7	**106.1**	0.320%	450	PVC	0.013	1.01	**159.2**	66.66%
SMH E	SMH B	6	51.76	1995	6.10	193.47	8984	27.5	3.00	82.4	54.2	**136.6**	0.320%	450	PVC	0.013	1.01	**159.2**	85.82%
SMH B	SMH D	2	61.70	2226	6.80	255.17	11210	34.3	2.91	99.5	71.4	**171.0**	0.320%	525	PVC	0.013	1.14	**253.7**	67.41%
SMH G	Lagoon	1	43.40	1019	3.11	298.57	12229	37.4	2.87	107.1	83.6	**190.8**	0.320%	525	PVC	0.013	1.14	**253.7**	75.22%

ATTENTION

"This drawing was prepared for the sole use of our client. No representations of any kind are made by Urban Systems Ltd. or its employees to any party with whom Urban Systems Ltd. does not have a contract."

WARNING

Utilities or structures shown on this drawing were compiled from information supplied by various parties and may not be complete or accurate. Expose and conclusively confirm the location in the field of all underground utilities and structures indicated on this drawing, all underground utilities in the area of the proposed work and any utilities or structures reasonably apparent from an inspection of the proposed work. Urban Systems Ltd assumes no responsibility for loss or damage caused by third party negligence including failure to comply with the above.

GENERAL NOTES:

1. ALL PIPE SIZES ARE IN mm AND ALL DIMENSIONS IN METERS UNLESS OTHERWISE STATED.
2. ALL MATERIALS AND CONSTRUCTION TO CONFORM TO CITY OF CALGARY AND TOWN OF BLACK DIAMOND STANDARDS AND SPECIFICATIONS IN FORCE AT TIME OF REVISED FINAL APPROVAL.
3. NO CONSTRUCTION SHALL PROCEED UNTIL ALL APPROPRIATE REGULATORY APPROVALS ARE OBTAINED.
4. ALL PLANS SUBJECT TO TERMS OF THE DEVELOPMENT AGREEMENT/PERMIT AND THE CONTRACT DOCUMENTS.
5. ANY ERRORS OR DISCREPANCIES TO BE REPORTED TO THE ENGINEER PRIOR TO COMMENCEMENT OF CONSTRUCTION.
6. ALL CONFINCTION TO BE IN ACCORDANCE WITH SPECIFICATIONS.
7. ALL TRUNCATED RIMS, INVERTS, AND ELEVATIONS ARE GEODETIC, REFERENCED TO 1100.00 IN ELEVATION.
8. CONTRACTOR TO BE RESPONSIBLE FOR LOCATION AND ALIGNMENT OF ALL EXISTING UTILITIES. EXACT LOCATION OF ALL EXISTING INFRASTRUCTURE (HORIZONTAL AND VERTICAL) TO BE CONFIRMED IN THE FIELD BEFOVE CONSTRUCTION BEGINS.
9. CONTRACTOR TO TAKE CARE WHEN WORKING NEAR EXISTING INFRASTRUCTURE.
10. CONTRACTOR TO COORDINATE ALL CONSTRUCTION w/ ASSOCIATED OWNER(S) WHEN WORKING NEAR EXISTING INFRASTRUCTURE.
11. EXISTING SURFACE FEATURES TO BE REINSTATED TO CONDITIONS PREVISTING CONSTRUCTION WHERE EXISTING CONDITIONS WILL BE MAINTAINED.
12. ALL NORTHING-EASTING COORDINATES ARE AT 3TM NAD 83 (GRID) COORDINATES. STATION COMBINED FACTOR APPLIED=0.999719, INVERSE=1.000281078883194.

SANITARY SEWER NOTES:

1. ALL PVC PIPES TO BE SDR35 UNLESS OTHERWISE NOTED. REFER TO PROFILE DRAWINGS.
2. ALL CIRCULAR CONCRETE PIPES TO BE CLASS III UNLESS OTHERWISE NOTED. REFER TO PROFILE DRAWINGS.
3. ALL PIPE BACKFILL SHALL SATISFY A MINIMUM TYPE 3 INSTALLATION SPECIFICATION WITH CLASS 1B BEDDING. REFER TO PROFILE DRAWINGS.
4. SANITARY MANHOLE LIDS MUST BE SEALED WHEN LOCATED IN TRAPPED LOW AREAS WITH PLASTIC PLUGS OR USE A SINGLE VENT COVER.
5. CONTRACTOR TO ENSURE THAT THE SEALS ON ALL PIPE AND MANHOLE SEGMENTS ARE PROPERLY PLACED IN ACCORDANCE WITH INSTALLATION SPECIFICATIONS.
6. ALL EXISTING SANITARY SEWERS ARE OPERATIONAL AND MUST BE MAINTAINED AS SUCH DURING CONSTRUCTION OR SUITABLE ALTERNATE SERVICE CONDITIONS PROVIDED.
7. EXISTING UTILITY INFORMATION SHOWN ON THIS DRAWING IS COMPILED FROM RECORD INFORMATION PROVIDED BY OTHERS.

Professional Seals

#	Date	Issue/Revision	App
1	2020-07-07	ISSUED FOR 90% REVIEW	BD
2	2020-07-15	ISSUED FOR TENDER	BD
3	2020-09-01	ISSUED FOR CONSTRUCTION	BD

TOWN OF BLACK DIAMOND

URBAN systems
101 - 134 11th AVENUE SE
CALGARY, ALBERTA T2G 0X5
urbansystems.ca

Scale 1:5000 (50 0m 50 100)

Designed by	WM
Drawn by	JK/LH/YC
Quality Control by	BD

TOWN OF BLACK DIAMOND
6TH ST WATERMAIN LOOPING
SANITARY CATCHMENT AREAS

Project Number	Drawing Number	Issue/Revision
0925.0035.01	E	3

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