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To: **Town of Okotoks** Date: **April 11, 2024**

Attention: **Richard Boonstra, P.Eng. – Development Engineer** Project No.: **28019**

Cc:

Reference: **Okotoks Sanitary Servicing Study Update**

From: **Sarah Barbosa, P.Eng., ENV SP and Geoffrey Schulmeister, P.Eng., SCPM**

1.0 Introduction

In 2016, ISL Engineering and Land Services Ltd. (ISL) completed the Sanitary Servicing Master Plan (SMP) for the Town of Okotoks. In 2020, ISL was retained to make an amendment/update to the plan based on the Town's updated growth objectives (2020 SMP Update). Staging plans were prepared for existing system upgrades in conjunction with future system expansion, and servicing concepts were provided for the 5-year, 10-year, 25-year, and ultimate servicing horizons.

The growth horizon for the North Point and Trilogy Plains areas has changed, and development will occur sooner than originally anticipated. Table 1.1 and Figure 1.1 provide a summary of the updated staging plan. Figures illustrating the previous staging plan horizons are included in **Appendix A** (Figures 7.3 to 7.5), along with the ultimate horizon which is shown in Figure 5.2 of **Appendix A**.

Table 1.1 Staging Plan Summary

Horizon	Timeframe	Added Population ¹ (Incremental)	Service Areas	Proposed Existing System Upgrades
5-Year Growth	2024 - 2029	6,737	Currently Vacant Parcels; N-1A; N-1A.2; N-1A.3; N-1A.4; N-1A.5; N-1A.6; N-1A.7; N-1A.8; N-1A.9; N-1B; N-1B.2; N-1B.3; N-1B.4; N-1B.5; N-1B.6; N-1B.7; N-1B.8; N-1B.9; N-1B.10; N-1B.11; S-2B; S-2B.2	UPG 1: North Railway Street / Fisher Gate UPG 2: South Railway Street
10-Year Growth	2029 - 2034	7,304	N-2; N-2.2; N-2.3; N-3; N-3.2; N-3.3; N-3.4; N-3.5; N-3.6; N-3.7; N-3.8; N-3.9; N-3.10; N-3.11; N-4B; N-4B.2; N-7.2; N-7.3; N-7.4; N-7.6; N-7.7; S-2B.3	UPG 3: Banister Drive
25-Year Growth	2034 - 2049	13,220	N-5; N-5.2; N-5.3; N-5.4; N-5.5; N-5.6; N-6; N-6.2; N-6.3; N-9; N-9.2; N-9.3; N-15; N-15.2; N-15.3; N-15.4; N-15.5; N-15.6; N-16; N-16.2; N-16.3; N-16.4; N-16.5; N-16.6; N-17.1; N-17.2A; N-17.2B; N-17.3; N-17.4; N-17.5; S-3; S-4; S-7; S-8; S-8.2; S-9; N-2.4; N-2.5; N-2.6; N-2.7; N-2.8; N-2.9; N-2.10; N-14A	
Ultimate	Beyond 2049	33,328	N-8; N-8.2; N-10; N-10.2; N-11A; N-11B; N-11B.2; N-12; N-12.2; N-13; N-13.2; N-14B; N-18; N-18.2; N-18.3; N-18.4; N-19; N-19.2; N-19.3; N-20; N-20.2; N-20.3; N-20.4; S-2A; S-2A.2; S-6; S-11; S-12; S-12.2; S-12.3; S-13; S-13.2; S-13.3; S-14	

¹ Assumes baseline 8 upa population density.

Additionally, the Wedderburn population density may potentially increase. ISL was retained to undertake a study on selected areas and analyze downstream impacts and associated upgrades that need to be made. A new watermain is also being planned for construction along North Railway Street (NRS), prompting upgrades to the sanitary system simultaneously. ISL conducted an analysis into potential sanitary sewer pipe alignments for upgrades required along NRS and downstream to the wastewater treatment plant (WWTP).

2.0 Background

The 2020 SMP Update had development occurring within the North Point and Trilogy Plains areas in 2044. The Town communicated that development is to occur sooner and would like to make use of the existing trunk on 32 Street for these areas in the interim, ultimately with a new twinned sewer on 32 Street to reach full build-out. The Town noted that gravity lines are preferred, so the lift stations proposed in the 2020 amendment required re-evaluation. Additionally, capacity in the sewers downstream of the Wedderburn development needed confirmation, as the Town wanted to consider increasing the density of the residential portions of this development. Beyond this, the Town also wanted to explore alignment options along NRS towards the WWTP. Finally, two specific pipe bottleneck locations were requested to be investigated in greater detail. This project is intended to achieve the following objectives pertaining to the identified study areas. It is noted that an additional analysis for the sewers on South Railway Street (SRS) will be evaluated as a further update and appended to this memo in Spring 2024.

Trilogy Plains and North Point Assessment

- Refine plan to increase the catchment area for the 32 Street trunk main to include everything in the north part of town, including North Point.
- Review options to reduce the size of the future proposed lift stations and optimize a gravity system as much as possible.
- Confirm the hydraulic grade line (HGL) based on further discretization of the development.
- Provide recommendations and associated costs required to improve 32 Street trunk if deemed necessary.
 - It is noted that twinning the existing sanitary infrastructure on 32 Street would be the preferred method of implementation.
- Perform a sensitivity analysis between using an 8 units per acre (upa) density and a 12 upa density.

Wedderburn Assessment

- Confirm proposed pipe sizing within the Wedderburn community to ensure there is sufficient capacity to accommodate a density increase from 8 upa to 10 upa.
- Assess impacts on the system downstream of Wedderburn and look at alternative options to pipe alignments rather than proposing upgrades, if needed (i.e., optimizing one tie-in location as opposed to potentially requiring upgrades at the other).

North Railway Street Assessment

- Consider various alignments along NRS to optimize the system and reduce easement requirements.
- Reduce the number of sewers west of Fisher Gate to one to minimize alignments, reduce conflicts underground for sanitary sewers and improve the overall life span of this infrastructure.
- Consider an alternate connection route to the WWTP to avoid utility conflicts on Fisher Gate, south of NRS.
- Review the potential to relocate the proposed pipe twinning completely to 32 Street rather than directly south through easements within some landowner's properties.
- Check the potential to decommission the Stockton and/or Nexen Lift Stations by reconnecting to the proposed gravity systems to reduce operating costs and the Town's reliance on lift stations.
- Perform a sensitivity analysis between using an 8 units per acre (upa) density and a 12 upa density.

Debottlenecking Scenarios

- Remove the “double dog leg” on Clark Avenue.
 - Determine if capacity improves if the dog legs are removed and replaced with a straight run of pipe.
 - Review existing invert elevations and constraints for reconnections.
 - Identify potential alignment options for the removal of the dog legs.
- Replace the existing 250 mm 1952 vitrified clay tile (VCT) pipe on North Railway Street with 300 mm.
 - This is a project that is planned to go ahead.
 - Determine the effect this will have on freeing up capacity.

3.0 Modelling Approach

3.1 Model Updates

The hydrodynamic MIKE URBAN model was constructed and calibrated for the SMP and updated in 2020. It was updated again for this project to reflect the most recent condition of the sanitary system. The update consisted of incorporating new pipes and manholes that have come online since the previous studies. The sanitary sewer system modelled for this study is illustrated in Figure 3.1 on Page 16 of this memorandum.

In addition to the recent development between 2020 and 2022, the boundary conditions for the Tillotson Development were adjusted to reflect updates to this area and flow projections stipulated in the Sanitary Servicing Letter prepared by Jubilee Engineering Consultants Ltd for Tristar Communities in February 2021. This was done given that the Tillotson development contributes to the downstream portion of the NRS trunk.

3.2 Level of Service (LOS)

A single LOS was applied for both the existing and future system assessments. The chosen LOS is the 50-year 24-hour Q4 Huff Storm, to be consistent with previous assessments and the criteria selected by The City of Calgary. A Huff rainfall distribution replicates a storm with a moderate peak intensity, which is ideal for wastewater system analysis. The initial RDII boundary condition for the root zone storage (L_{ini}) for each catchment was adjusted such that the L/L_{max} ratio is 50% at the beginning of the design storm simulations. This design storm has been implemented as the Town's level of service for wet weather flow due to its proximity to Calgary and the Town's request. The rainfall hyetograph for this event is shown in Chart 3.1.

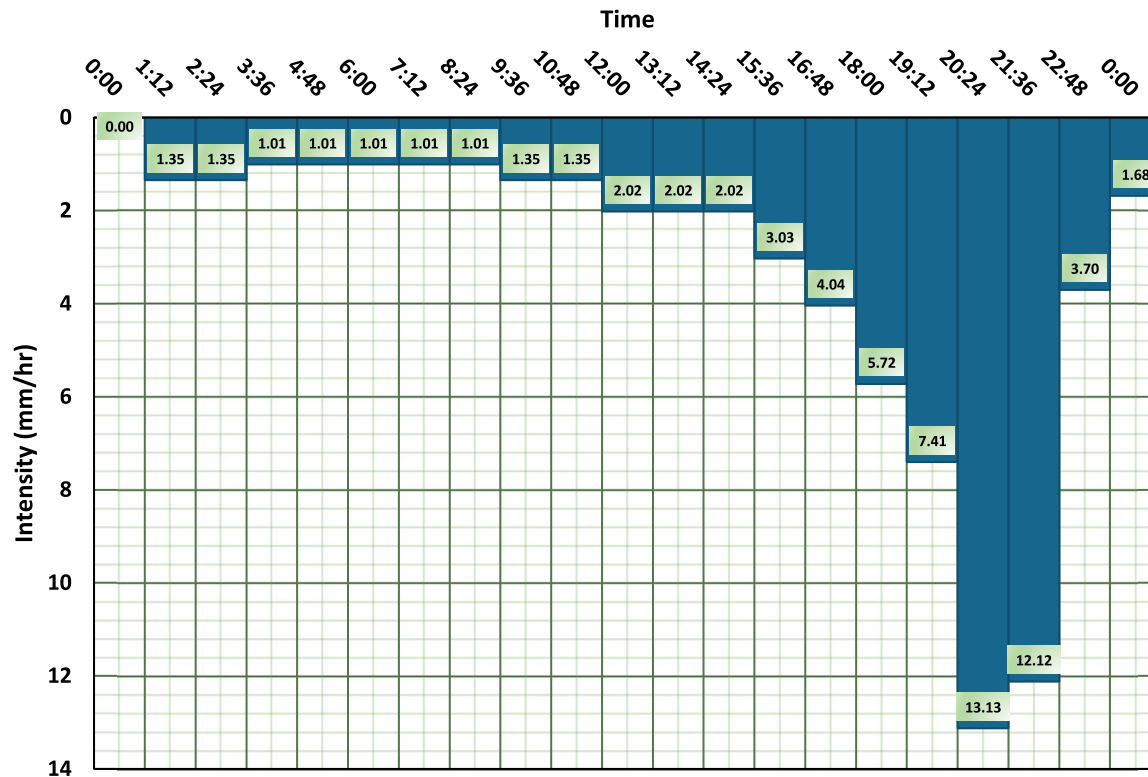


Chart 3.1: 50-Year 24-Hour Q4 Huff Storm Rainfall Hyetograph

3.3 Assessment Criteria

The performance of the sanitary system is ultimately determined based on the available freeboard between the ground elevation and high-water level elevation (represented by the maximum HGL) at each manhole for each assessment design rainfall storm. Based on this, the maximum allowable surcharge in the gravity portion of the sanitary sewer systems must remain at least 2.5 m from the ground surface. A freeboard of 2.5 m adheres to the City of Calgary's allowable surcharge criteria defined in the Design and Asset Performance Objectives for Hydraulic Modelling – Revision 1 memorandum (City of Calgary, 2012).

The following exceptions to this criterion are as follows:

- Catchment areas that have experienced reoccurring basement flooding following less than a 50-year return period rainfall events in the past. In those instances, upgrades may be triggered even if modelling results indicate that a surcharge level is below 2.5 m from the ground surface.
- In gravity pipe sections where there are no service connections and therefore no basement, the freeboard may be less than 2.5 m. For example:
 - Siphon locations at the creek/water body crossing
 - Sewers running within green spaces

Existing forcemains should be analyzed to maintain a minimum velocity of 1.0 m/s however should not exceed a velocity of 3.0 m/s, with the preferred velocity being 2.5 m/s. Existing siphons should be analyzed to maintain a minimum velocity of 1.0 m/s based on average dry weather flow conditions or reach a velocity of 1.0 m/s at least once a day, with two times being preferred.

3.4 Design Criteria

Unless otherwise noted in the assessments described below in Section 4.0, the following design criteria was applied for this study.

3.4.1 Population Density

To be consistent with the methodology applied in the SMP, a density of 55 persons per hectare was applied for single-family residential development types. This is a Town-specified density that provides a conservative engineering estimate for design. An assumption for this study was made such that a density of 8 upa corresponds to a population per area based density of 55 persons per hectare. This resulted in a population per unit density of 2.78, which was used when considering the higher unit per area densities of 10 upa (Wedderburn only) and 12 upa.

3.4.2 Dry Weather Flow (DWF) Generation Rates

Future catchments were assigned the following DWF generation rates:

- Residential Areas – 255 L/p/d
- Non-Residential Areas – 8,525 L/ha/d (based on a density of 55 persons per hectare)

Additionally, a groundwater infiltration (DWF baseflow) rate of 0.033 L/ha/s was incorporated in the model for future infrastructure as per The City of Calgary's modelling guidelines.

3.4.3 Peaking Factors

Servicing Network Design

Peaking factors for the future sanitary system were calculated in accordance with the Alberta Environment and Protected Areas' (AEPA) guidelines. These include the following:

- Peaking factor derived based on Harmon's formula for residential areas:

$$PF = 1 + \left(\frac{14}{4 + p^{\frac{1}{2}}} \right)$$

- p is the design contributing population in thousands
- PF must be at least 2.5
- Peaking factor for non-residential areas

$$PF = 6.659 * (Q_{AVE}^{-0.168})$$

- PF can have a maximum value of 5.0

Assessment of the Impact on the Existing System

The peaking factors derived during the DWF calibration process in the SMP were applied to most build-out growth catchments. As expected, the observed modelled peaking factors tend to be lower than those stipulated by the AEPA's guidelines as they fluctuate between 1.66 and 1.80 for residential areas, and 1.49 to 2.19 for ICI areas.

For the Tillotson development, peak wet weather flows (PWWFs) were determined by Jubilee Engineering using AEPA's more conservative peaking factor approach. These flows were applied to the model for a more conservative analysis of the downstream system, as requested by the Town. The same considerations were made when modelling the Trilogy Plains and North Point developments, given they tie into critical sanitary infrastructure. This impacted both the Trilogy Plains and North Point and the NRS assessments.

3.4.4 Minimum Design Slopes for Sewers

The minimum design slopes for the sanitary sewers were based on The City of Calgary's Design Guidelines for Subdivision Servicing 2014. Minimum slope requirements are as follows in Table 3.1.

Table 3.1 Minimum Design Slopes for Concrete and PVC Sewers ($n = 0.013$)

Nominal Pipe Size	Slope
mm	%
200	0.80
250	0.40
300	0.32
375	0.24
450	0.18
525	0.16
600	0.12
675 and Greater	0.10



4.0 System Analysis

4.1 Trilogy Plains and North Point Assessment

The Trilogy Plains and North Point lands are in the northeast of Okotoks as shown in Figure 4.1. In the 2020 SMP Update, these quarter sections were considered long-term developments, with the anticipated growth horizon between 2044 and ultimate build-out. The Town has identified that growth in these areas is now expected to occur much sooner and must be prioritized. A sanitary assessment to determine how much of these two developments can be serviced completely by a gravity system and the extent that can be diverted to the west to 32 Street was required. This realignment deviates from the previously proposed servicing concept, which had a substantial portion of the infrastructure connecting to gravity tie-in location #13 via new infrastructure in the undeveloped east lands. The tie-in locations from the 2020 SMP Update are included in **Appendix A** for context. The Town also indicated that twinning the existing 32 Street trunk would be preferred rather than upsizing existing infrastructure.

Prior to determining the new alignments for these areas, the proposed service areas were updated to reflect more recent development plans. This also allowed for further discretization of the service areas to provide a more detailed servicing concept. Several planning documents were provided to ISL at the onset of the project. It is noted that these are preliminary documents and could potentially change in the future. The following two documents were used to update the service areas:

- **North Point:** Town of Okotoks North Point ASP – Preliminary Industrial Concept Plan (b&a, August 2021)
- **Trilogy Plains:** East Okotoks Planning Context (b&a, July 2021)

Design criteria remain consistent with previous studies, as detailed in Section 3.4. Residential populations were updated based on the revised development plans, by assigning a density of 55 persons per hectare to residential parcels. A sensitivity analysis was conducted by analyzing densities of 8 upa and 12 upa and applying a unit density of 2.78 people per unit.

The following table (Table 4.1) summarizes the populations in both scenarios.

Table 4.1 Trilogy Plains/North Point Population Statistics for Both Scenarios

Density Scenario	Population Density	Residential Area (ha)	Population ¹
8 upa	2.78 persons per unit	34.23	1,883
12 upa			2,822

¹ Residential population applies only to the Trilogy Plains portion of this analysis as North Point is non-residential.

A servicing concept was developed with the above noted goals:

- Increase the catchment area for the 32 Street trunk main to include everything in the north part of town, including North Point.
- Reduce sewage from proposed development to the 48 Street Trunk.
- Minimize reliance of the Trilogy Plains/North Point developments on pumped infrastructure (i.e., lift stations and forcemains).
- Favour a trunk twinning option on 32 Street rather than pipe upsizing. It is noted that twinning rather than upsizing removes the need of Upgrades 4 and 5 previously noted in the 2020 SMP Update.

The servicing concept was evaluated for the 8 upa and 12 upa density scenarios, as shown in Figures 4.2 and 4.3. Most of Trilogy Plains can be serviced via gravity, and a portion of North Point is also serviceable by gravity. The remaining areas are proposed to be conveyed by gravity to the low point on the Town's eastern border, then pumped back west towards 32 Street.

A benefit of twinning 32 Street rather than upsizing is that the existing alignment on 32 Street can remain. The proposed infrastructure will not be governed by tie-in elevations, so deeper sewers can be used to remove some of the reliance on pumped infrastructure. That said, in the interim some of Trilogy Plains and North Point could connect to the existing system and utilize spare capacity. To meet existing grades, new sewers must tie-in to the existing sewer at 32 Street and Crystal Shores Road (see Figures 4.2 and 4.3). A summary of the cost estimates for the proposed servicing option under both density scenarios is in Table 4.2 below. For a detailed cost breakdown, refer to **Appendix B**.

Table 4.2 Summary of Cost Estimates for Sanitary Servicing within Trilogy Plains and North Point

Items	Total Cost	
	8 upa	12 upa
250 mm Gravity Sewer	\$4,550,000	\$4,500,000
300 mm Gravity Sewer	\$510,000	\$560,000
375 mm Gravity Sewer	\$3,520,000	\$3,330,000
450 mm Gravity Sewer	\$2,780,000	\$860,000
525 mm Gravity Sewer	-	\$2,570,000
600 mm Gravity Sewer	\$930,000	\$220,000
675 mm Gravity Sewer	\$800,000	\$1,580,000
750 mm Gravity Sewer	\$390,000	-
900 mm Gravity Sewer	\$3,970,000	\$440,000
1050 mm Gravity Sewer	\$1,150,000	\$6,040,000
250 mm Forcemain	\$600,000	\$710,000
300 mm Forcemain	\$2,430,000	\$2,430,000
Lift Station (140 L/s)	\$4,280,000	\$4,280,000
Lift Station (75 L/s)	\$2,470,000	-
Lift Station (92 L/s)	-	\$3,020,000
Pavement Rehabilitation (32 Street)	\$2,700,000	\$2,700,000
Pavement Rehabilitation – Alley (South of 32 Street to WWTP)	\$460,000	\$460,000
Grand Total:	\$31,540,000	\$33,700,000

A sensitivity analysis was also performed to determine how much additional sewage the existing system on 32 Street can accommodate prior to requiring upgrades. A constant flow was added at the upstream end of the system and scenarios with incrementally increasing flows were simulated to determine when the existing system would require upgrades, or the twinned pipe proposed in the servicing concept.

This is shown in the longitudinal profiles provided in Figures 4.4 and 4.5; the profiles are split at Milligan Drive. An additional 25 L/s generally reaches the crown of the pipe with some minor surcharging while 65 L/s has an HGL right below surface. Most of the surcharging pipes from these simulations are in Profile 1.

An option could be to consider some interim upgrades in Profile 1 to defer the twinned sewer out further, depending on how quickly the Trilogy Plains and North Point lands progress. Potential upgrades may include adding a 200 mm sewer along 32 Street between the section of existing sewer that is conveyed around on Crystal Green Way,

essentially offloading this section of pipe as shown on Figures 4.2 and 4.3. The cost of this upgrade would be approximately \$550,000 for a length of about 260 m. Longitudinal profiles with this offloading improvement are shown on Figures 4.6 and 4.7.

Though surcharging remains evident in some pipes, it is greatly reduced to allow for additional interim development to occur. Surcharging is below 2.5 m to surface, so could be tolerated given impacts to basements would not be as concerning. A maximum additional flow of 95 L/s would be tolerable.

Tables 4.3 and 4.4 provide a summary of the approximate levels of development that correspond to each incremental flow scenario for both the 8 upa and 12 upa density conditions. As it is unclear how exactly the development would proceed in terms of residential versus non-residential contributions and given the development type is a factor of sewage generation, the following scenarios were assumed:

- Entirely residential
- Entirely non-residential
- 60/40 split between residential and non-residential based on the area ratio at full build-out of the area ultimately tying to the proposed northeast servicing (i.e., includes lands north of Trilogy Plains)

Table 4.3 Levels of Development at 8 upa

Flow Scenario	Upgrade Triggered?	Entirely Residential		Entirely Non-Residential	60/40 Split Residential/Non-Residential		
		Residential Area	Population	Non-Residential Area	Residential Area	Population	Non-Residential Area
		ha		ha	ha		ha
Additional 25 L/s	No	28.59	1,571	32.33	17.69	972	11.79
Additional 35 L/s		40.93	2,249	45.26	25.06	1,377	16.71
Additional 45 L/s		53.61	2,946	58.48	32.53	1,788	21.69
Additional 55 L/s		66.57	3,658	73.20	40.09	2,203	26.73
Additional 65 L/s		79.77	4,384	88.22	47.73	2,623	31.82
Additional 75 L/s	Yes	93.20	5,122	103.49	55.43	3,046	36.96
Additional 85 L/s		106.82	5,870	118.98	63.20	3,473	42.13
Additional 95 L/s		120.62	6,629	134.67	71.00	3,903	47.30

Table 4.4 Levels of Development at 12 upa

Flow Scenario	Upgrade Triggered?	Entirely Residential		Entirely Non-Residential	60/40 Split Residential/Non-Residential		
		Residential Area	Population	Non-Residential Area	Residential Area	Population	Non-Residential Area
		ha		ha	ha		ha
Additional 25 L/s	No	21.51	1,773	32.33	14.65	1,207	9.76
Additional 35 L/s		30.92	2,549	45.26	20.83	1,717	13.89
Additional 45 L/s		40.63	3,349	58.48	27.13	2,236	18.09
Additional 55 L/s		50.60	4,171	73.20	33.53	2,764	22.35
Additional 65 L/s		60.79	5,011	88.22	40.01	3,298	26.67
Additional 75 L/s	Yes	71.18	5,868	103.49	46.57	3,839	31.05
Additional 85 L/s		81.76	6,739	118.98	53.20	4,385	35.47
Additional 95 L/s		92.50	7,625	134.67	59.89	4,937	39.93

4.2 Wedderburn Assessment

The population was scaled up from 8 upa to 10 upa and 12 upa considering the equivalent population per unit density of 2.78 as described in Section 3.4. The 12 upa scenario is provided for context only, as this density is not anticipated west of the gas line. The following table (Table 4.5) summarizes the populations in each scenario.

Table 4.5 Wedderburn Population Statistics for Each Scenario

Density Scenario	Population Density	Area (ha)	Population
8 upa	2.78 persons per unit	72.21	3,969
10 upa			4,961
12 upa			5,953

The population density was increased to 10 upa and 12 upa for the catchments within the Wedderburn development. The tie-in locations for these catchments were left as #5 and #7 based on Figure 5.2 (**Appendix A**) of the 2020 SMP Update to determine if these connection points remain feasible with the increase in flows due to the added population of roughly 1,000 people per density scenario. Note that an approximate population of 1,000 corresponds to an additional average dry weather flow of 2.95 L/s, assuming a generation rate of 255 L/p/d. As the model is applying a diurnal pattern rather than a Harmon's peaking factor, the maximum diurnal multiplier (peaking factor) is 1.83. This provides a peak dry weather flow of 5.40 L/s for an additional population of 1,000, which is divided between the two tie-in locations. It is noted that a density of 12 upa would not be realized west of the gas line, so considerations for the 12 upa scenario downstream of the #5 tie-in are less concerning. It is however noted that the proposed pipe servicing east of the gas line would require upsizing to 300 mm under the 12 upa scenario.

The results from these assessments are shown in Figures 4.8, 4.10, and 4.12 for the peak discharge relative to pipe capacity and maximum HGL relative to surface and Figures 4.9, 4.11, and 4.13 for the spare capacity. Longitudinal profiles are also shown in Figures 4.14 to 4.18. It is noted that these assessments assume that UPG 3 from Figure 6.3 of the 2020 SMP Update (see **Appendix A**) have been completed. These upgrades consider plugging the southwest inverts of two manholes on Banister Drive to divert most flows to the east rather than down Clark Avenue. Clark Avenue was indicated as having capacity constraints in the 2020 SMP Update if these minor upgrades are not performed. Further analysis pertaining to the "double dog leg" on Clark Avenue is provided in Section 4.4, however the minor improvements to the HGL described below are not anticipated to offset the need for the diversion upstream on Bannister Drive. These upgrades are recommended in the 10-year growth horizon, noting they should be prioritized to occur prior to full build-out of the west Wedderburn quarter section to accommodate the additional growth.

Some surcharging already exists with the 8 upa scenario, however the HGL remains at least 2.5 m from surface throughout. In the 10 upa scenario, the surcharging appears more prevalent, however the HGL also remains at least 2.5 m from the surface. The 12 upa scenario (Figure 4.12) indicates that one node (intersection of Banister Drive and Sunset Crescent) would be within 2.5 m from surface, thus could cause concerns of basement flooding during a rainfall event with a similar or greater intensity to the LOS (50-year 24-hour Q4 Huff storm). That said, as noted above the 12 upa scenario is unlikely to occur west of the gas line, therefore this is less of a concern. It is recommended that this area be monitored during wet weather flow periods following the implementation of Wedderburn to determine the extent of surcharging and if water levels exceeding basement levels are observed.

4.3 North Railway Street Assessment

Several options were investigated around NRS to optimize space in the rights-of-way, reduce the number of required upgrades, and couple some upgrades with the watermain installation being proposed along NRS. Some of the key considerations when investigating options included:

- Removing the existing twinned 450 mm and 525 mm pipes on NRS and installing a single pipe
- Having a single sewer versus twinned upgraded sewers from NRS down to the WWTP
- Regrading some sewers to an alternate 32 Street alignment to avoid going down an easement in the landowner's parcel north of NRS
- Eliminating the existing Stockton/Nexen Lift Stations
- Avoid upgrades to the south towards the WWTP due to an already congested easement

Overall, there were eight concepts, which are shown in Figures 4.19 and 4.20. Assessments were completed considering full build-out flows, including those from Trilogy Plains and North Point. Sizing was based on minimum slopes for new infrastructure, or existing inverts/tie-ins if replacing infrastructure. The option evaluation was completed using the 8 upa density scenarios. The preferred option, discussed below, includes sizing for both the 8 upa and 12 upa density scenarios for Wedderburn and Trilogy Plains/North Point.

Options 1A and 1B are both possible but depend on the amount of room available in the utility right-of-way (ROW) (which is understood to be very limited). A single 1200 mm on the north-south line from NRS to the WWTP would limit the amount of required space.

Option 1C has the proposed 32 Street trunk diverted off NRS with an alternate alignment to the WWTP. This option does not meet the minimum slope requirement in the proposed 1050 mm trunk to reroute the 525 mm off the north-south line as the slope is constrained to 0.08%. Even if a flatter pipe is tolerated, the trunk would daylight along the southern portion of 32 Street due to topographical constraints. That coupled with the proposed underground stormwater system in the area which may cause utility conflicts, rule this option as unfeasible.

Option 1D consists of regrading the sewers from the Stockton Lift Station to the new trunk sewer along 32 Street. This option is not feasible in terms of grades as the elevation of the Stockton Lift Station is below the elevation of the WWTP wet well (at Stockton the elevation is 1040.39 m whereas at the WWTP the elevation is 1041.58 m). This would not work by gravity unless considering chasing back the grade further upstream of the lift station. The same topography challenges as Option 1C exist for this option as well.

Option 1E follows the 32 Street alignment like Options 1C and 1D. As mentioned, this option is constrained by the wet well invert at the WWTP and topographical constraints along 32 Street. The issue with the 32 Street alignment is that the topography drops in the area roughly from Stockton Avenue to the WWTP. There is higher terrain to the north and at the WWTP, but in between the grade is a few metres lower than the current alignment through the parcels. Even at a minimum grade, the potential 32 Street trunk would daylight on 32 Street if working from the WWTP invert to upstream sections. This alignment, along with Options 1C and 1D, do not seem feasible unless adding a lift station or completely re-grading the area to provide sufficient depth of cover, neither of which are ideal solutions.

Options 1F and 1G have a new sewer continuing east along NRS past the existing sewers to the WWTP and follow the same route around the recycling center. This route was considered as replacement for the existing sewers along Fisher Gate (i.e., decommission existing sewers on Fisher Gate between the NRS and WWTP), or as an overflow for the existing sewers. Pipe sizing remains the same in both scenarios, given the significant amount of flow that would need to be diverted in the flow split scenario to avoid surcharging in the existing trunks. With the flow split option (Option 1G), the Nexen Forcemain could either stay as is or be reconnected to the new 1200 mm.

In Option 1F, as the existing sewers would be decommissioned, the Nexen Forcemain would need to be reconnected. Option 1G would provide some resiliency, so likely would be the preferred option between the two.

Option H was a variant to the 32 Street alignments but would jog back to the west and continue straight south for the remainder, adjacent to the existing sewer alignment. This was considered to avoid construction through landowner's property. This option is not feasible due to grading constraints on 32 Street and the current elevation of the WWTP wet well.

Based on these iterations, a preferred alignment was determined. The alignment is shown in Figure 4.21, while plan profiles are illustrated in Figures 4.22 and 4.23. This concept includes replacing the existing 450 mm and 525 mm sewers along NRS with a single 900 mm sewer and upsizing the current 450 mm sewer on Fisher Gate with a 1050 mm sewer along the same alignment. The existing 900 mm sewer from Fisher Gate to the WWTP would be twinned with a 900 mm sewer. The preferred alignment avoids any topographical constraints and the fixed wet well elevation at the WWTP, minimizes the number of sewers on NRS, and utilizes the existing alignment on Fisher Gate. The main drawback of this alignment is the potential for utility conflicts on Fisher Gate due to the extent of utilities within this corridor.

For the 12 upa density scenario at full build-out, the populations contributing to the northeast servicing concept (see Figure 4.3) are increased to a population of 38,565 (from 25,731). In this case the ICI contributions are consistent, at an area of 320.7 ha. The single 900 mm sewer along NRS and the twinned 900 mm sewer from Fisher Gate to the WWTP would be upsized to 1050 mm under these conditions, as shown in Figure 4.24.

4.4 Debottlenecking Scenarios

Two additional upgrades were considered to remove bottlenecks in the existing conveyance system: the “double dog leg” on Clark Avenue and the existing 250 mm VCT pipe on NRS. These scenarios are discussed further below. The current sizing and pipe alignments of both bottleneck locations are shown in Figure 4.25.

“Double Dog Leg” on Clark Avenue

On Clark Avenue, between Mountain Street and Knight Street are two parallel pipes. One pipe conveys flows from north to south on the west side of Clark Avenue while the other pipe on the east side of Clark Avenue collects sewage from Mountain Street. Both pipes are 200 mm and do not connect until they reach Knight Street. It is likely that these parallel pipes exist due to invert elevation constraints on Mountain Street during development compared to existing infrastructure. Removing this “double dog leg” is part of the Town's lifecycle replacement and asset management initiative.

Two alignments were investigated to create a straight run of pipe on Clark Avenue and remove the two 90-degree bends on Clark Avenue. The first alignment keeps the pipes along Mountain Street discharging to the east and tying into the north end of the current “double dog leg”. In this option, to ensure grades are adequate in removal of the parallel sewers, the existing sewer on Clark Avenue north of Mountain Street must be lowered by approximately 0.9 m. The second alignment involves rerouting the two sections of sewer on Mountain Street to the west and discharging to the manhole at the intersection of Mountain Street and Patterson Road.

Both options would require about the same replacement length and would adequately convey flows downstream. A preferred option could be selected by the Town depending on the age, condition, and material of existing infrastructure. This will also depend on the Town's preference on replacing sewers either only on Clark Avenue or on Mountain Street and a portion of Clark Avenue. Existing utility conflicts are also a consideration for future investigation. The final consideration would be the location of any service connections, as changes in elevation would likely require relaying part of the services. Though the exact locations of service connections are unknown,



looking at aerial imagery it is likely that there are services along both alignments. It is anticipated that there would be fewer disturbances to services along the entirely Clark Avenue alignment; however this could be investigated further at preliminary design.

Both upgrade options are illustrated in Figure 4.26 while longitudinal profiles are in Figures 4.27 and 4.28. There are minor improvements to the HGL in the pipes on Clark Avenue north of Mountain Street in both options, however nothing significant enough to warrant the removal of the proposed manhole plugs on Bannister Drive (UPG 3 in Figure 6.3 of Appendix A).

NRS Pipe Upsizing

There is currently a bottlenecked section of pipe on NRS between McRae Street and Poplar Avenue. This section consists of 250 mm VCT pipe that is understood to be from the 1950s, so is likely to have degraded over the past 70 years. In addition to this, these pipes are between a 300 mm pipe upstream and a 375 mm pipe downstream, creating a bottleneck in the system. With the revitalization of downtown, the 250 mm sewers are intended to be upsized to 300 mm pipe during the 2025 construction season, as shown in Figure 4.29. This pipe upsizing was also identified in the 2020 SMP Update, in which upsizing this section of pipe was observed to remove surcharging within this section of sewer. This was reconfirmed in this study by running a similar scenario in Mike Urban. The longitudinal profile along this section of pipe is shown in Figure 4.30, while the spare capacity that becomes available with these upgrades is shown in Figure 4.31. These upgrades would effectively alleviate the surcharging in these sewers, provide sufficient capacity to accommodate the LOS, and offer some spare capacity for future system optimization.

5.0 Conclusions

The Town retained ISL to undertake a study on the sanitary system focusing on areas reprioritized for growth, density increases, or imminent capital upgrades. This included a revised concept and prioritization of the North Point and Trilogy Plains lands, densification of the Wedderburn community, conceptual alignment options for sanitary upgrades and new infrastructure along NRS down to the WWTP, and reviewing two debottlenecking scenarios. The sanitary model developed for the SMP in 2016 and further updated in 2020 was used for this project. The level of service, assessment criteria, and design criteria were also consistent with past reporting, except where otherwise noted (i.e., increasing the population density).

The Trilogy Plains and North Point sanitary concept was revised to be conveyed down 32 Street, optimizing gravity sewers wherever possible to limit the number of lift stations needed. The land use concept for these areas was updated and further discretized to determine the anticipated peak wet weather flows for the updated sanitary concept. Two sanitary concepts were ultimately developed, for the 8 upa and 12 upa densities. The two concepts for the 8 upa and 12 upa scenarios are shown in Figures 4.2 and 4.3.

Three density scenarios were modelled for the Wedderburn community: 8 upa, 10 upa, and 12 upa. This corresponded to an additional population of 1,000 between each scenario, which correlates to an approximate additional peak dry weather flow of 5.40 L/s per scenario. The existing sanitary system can generally accommodate the additional flows between the two tie-in locations for the Wedderburn community. There is some minor surcharging in the existing sewers downstream of the tie-in locations, however the freeboard is greater than 2.5 m in most cases. There is one node where the freeboard is less than 2.5 m, however this is with a density of 12 upa, which is unlikely to occur west of the gas line.



Several options were investigated around NRS to optimize existing space in the rights-of-way, reduce the number of required upgrades, and couple some upgrades with the watermain installation being proposed along NRS. Eight preliminary concepts were developed, as shown in Figures 4.19 and 4.20. Many of the concepts would not be feasible due to elevation constraints, particularly on 32 Street where the road alignment begins to curve to the east. The preferred concept, considering the most feasible elements of the analyzed preliminary concepts, is shown in Figure 4.21, with plan profiles illustrated in Figures 4.22 and 4.23. The preferred concept under the 12 upa density scenario is illustrated in Figure 4.24.

Two debottlenecking scenarios were considered to determine the extent that surcharging could be alleviated in the existing system. This included the “double dog leg” on Clark Avenue and the 250 mm VCT pipe along NRS. Two alignments were considered to remove the “double dog leg”, both suggesting grades could be accommodated. Only minor improvements to the HGL were documented from the removal of the “double dog leg”. On NRS, the bottlenecked 250 mm sewer was upsized in the model to 300 mm and simulated once again. Results suggest that upsizing this section of pipe would mitigate surcharging and provide some spare capacity for future consideration.

An overview of the service areas, proposed upgrades, and servicing concept is shown in Figure 5.1. This figure assumes the 12 upa density east of the gas line in Wedderburn is implemented.



6.0 References

Alberta Government. March 2013. Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems – Part 4 Wastewater Systems Guidelines for Design, Operating and Monitoring of a Total of 5 Parts.

The City of Calgary. May 31, 2012. Design and Asset Performance Objectives for Hydraulic Modelling – Revision 1.

ISL Engineering and Land Services Ltd. February 11, 2020. Okotoks Sanitary Servicing Master Plan Update Memorandum.

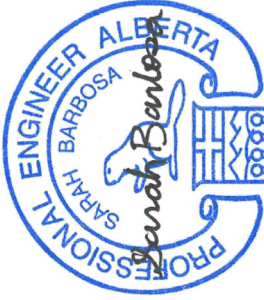
ISL Engineering and Land Services Ltd. July 2016. Town of Okotoks Sanitary Servicing Master Plan Update Final Report.

Jubilee Engineering Consultants Ltd. February 2021. Tilotson Subdivision Sanitary Servicing Letter Prepared for Tristar Communities.

The City of Calgary. October 2020. Design Guidelines for Subdivision Servicing 2020.

7.0 Authorization

This document entitled “Okotoks Sanitary Servicing Study Update” has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of the Town of Okotoks. The information and data provided herein represent ISL’s professional judgment at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from ISL.

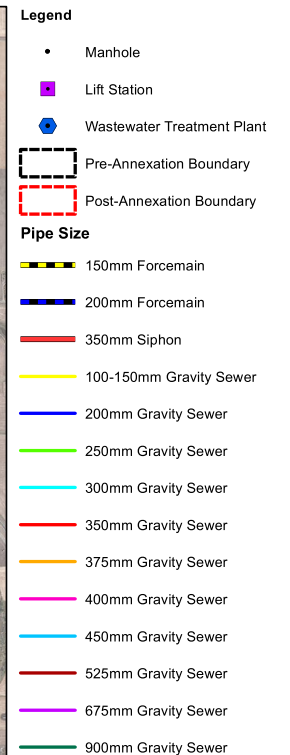
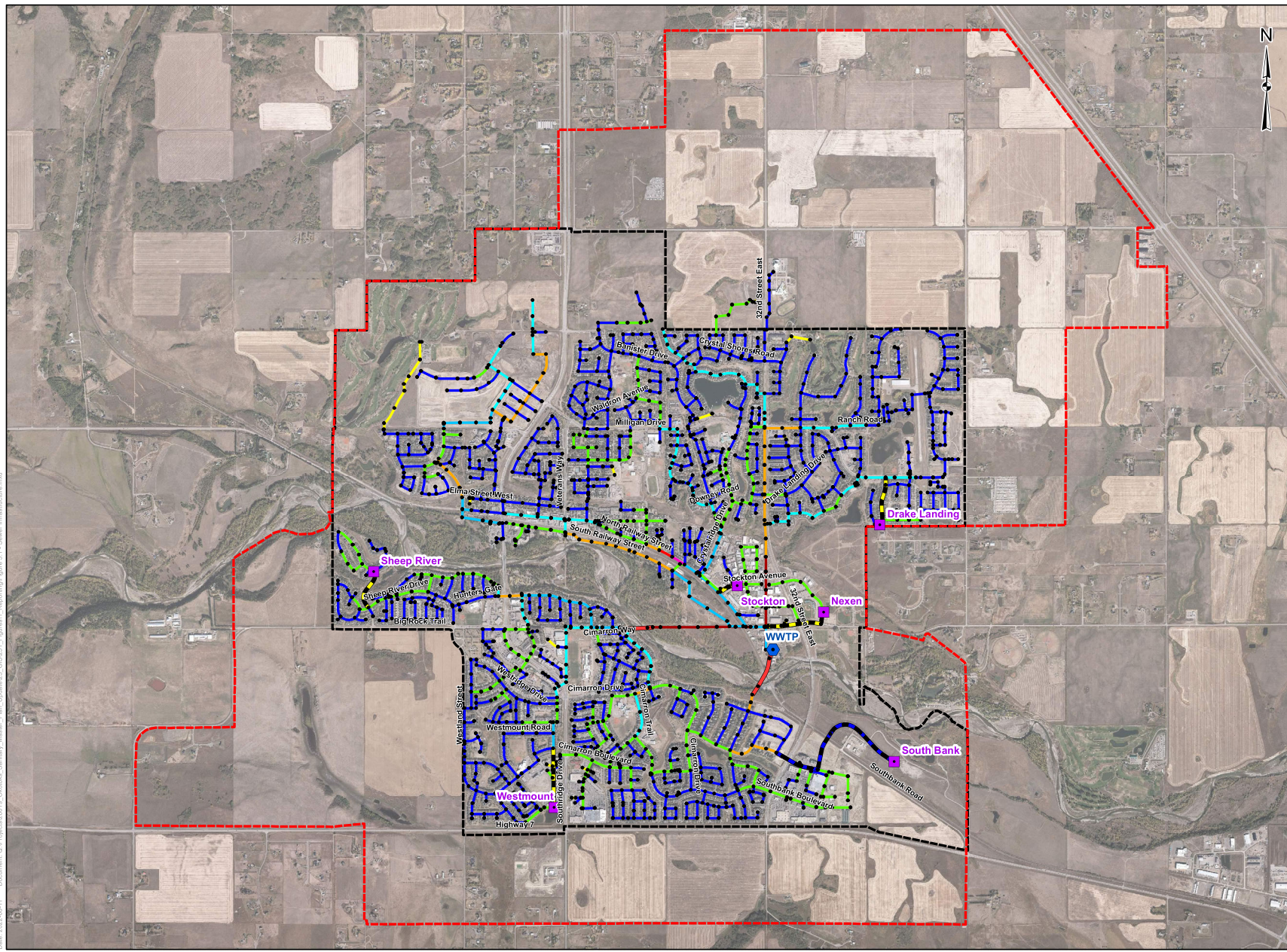


#187386
2024-04-11

Sarah Barbosa, P.Eng., ENV SP
Technical Author

Permit to Practice <i>ISL Engineering and Land Services Ltd.</i>	
RM Signature: 	
RM APEGA ID: 66731	
Date: 12 April 2024	
Permit Number P4741 The Association of Professional Engineers and Geoscientists of Alberta	

Geoffrey Schulmeister, P.Eng., SCPM
Technical Reviewer



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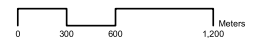
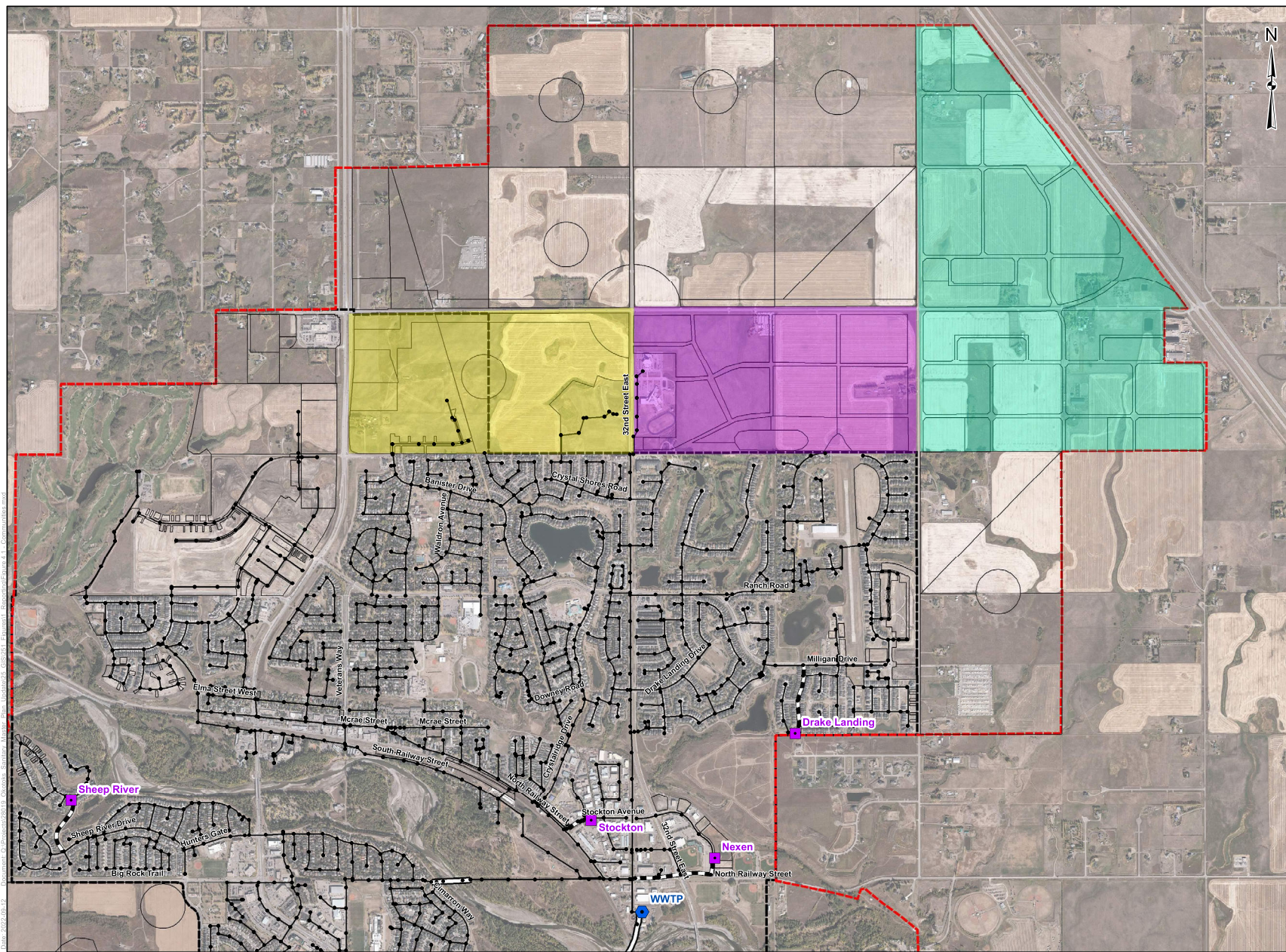


FIGURE 3.1
SANITARY SEWER INFRASTRUCTURE
SANITARY MASTER PLAN UPDATE





Legend

- Manhole
- Lift Station
- Wastewater Treatment Plant
- Sanitary Pipe
- Forcemain
- Siphon
- Land Use Boundary
- Pre-Annexation Boundary
- Post-Annexation Boundary

Future Community

- North Point
- Trilogy Plains
- Wedderburn

Coordinate System:
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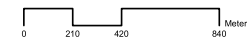
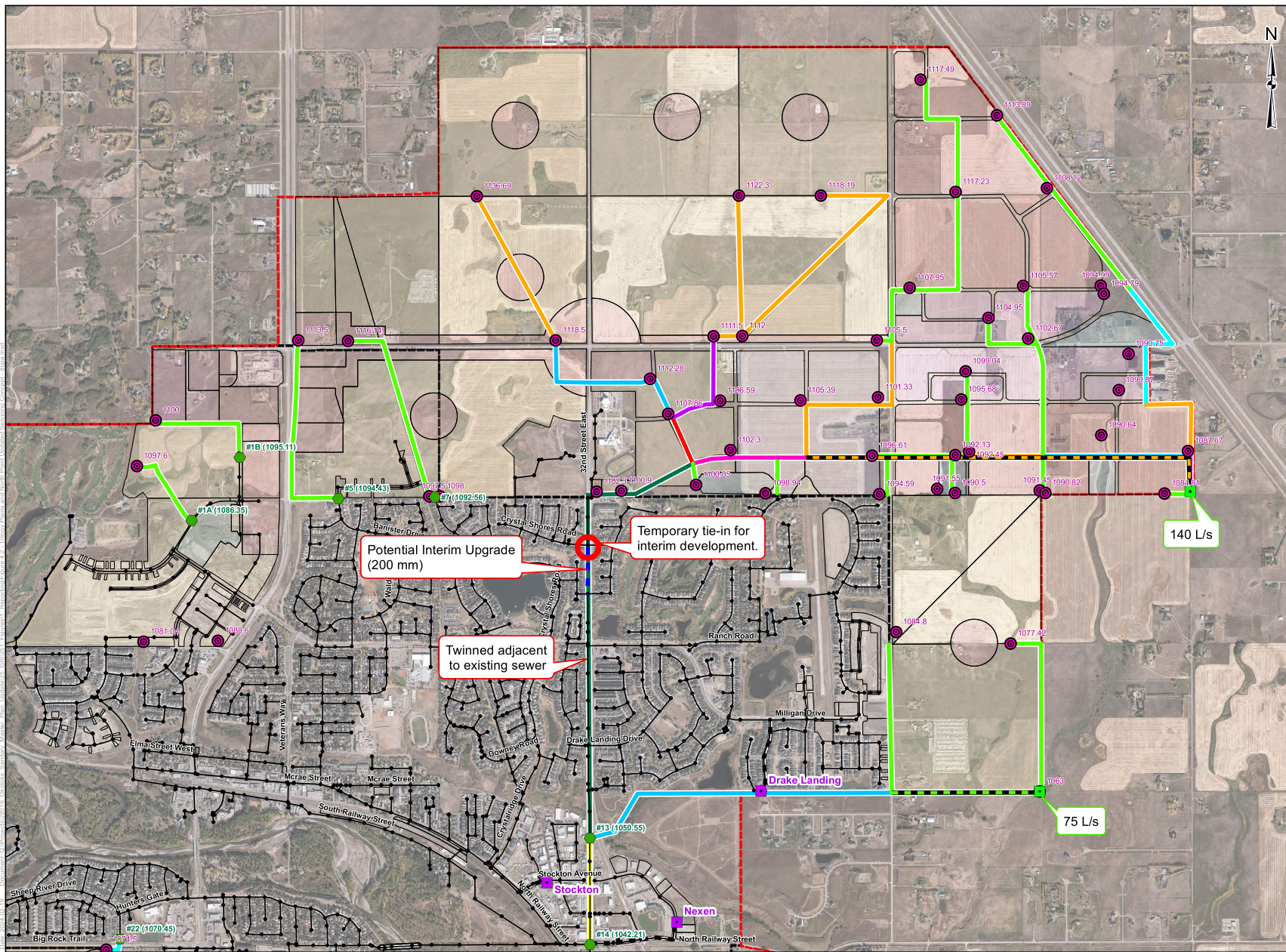


FIGURE 4.1
FUTURE COMMUNITIES
SANITARY MASTER PLAN UPDATE





Legend

- Manhole
- Lift Station
- Proposed Lift Station
- Gravity Tie-in Location
- Lowest Elevation Within Service Area
- Sanitary Pipe
- Forcemain
- Siphon
- Pre-Annexation Boundary
- Post-Annexation Boundary

Service Area by Land Use

- Densification
- Commercial
- Employment
- Green Space (Unserviced)
- Highway Business
- Industrial
- Institutional
- Residential
- SWMP (Unserviced)
- Surplus Industrial

Proposed Pipe Size

- 250mm Gravity Sewer
- 300mm Gravity Sewer
- 375mm Gravity Sewer
- 450mm Gravity Sewer
- 600mm Gravity Sewer
- 675mm Gravity Sewer
- 750mm Gravity Sewer
- 900mm Gravity Sewer
- 1050mm Gravity Sewer
- 250mm Forcemain
- 375mm Forcemain

Coordinate System:
CANADA83-3TM114

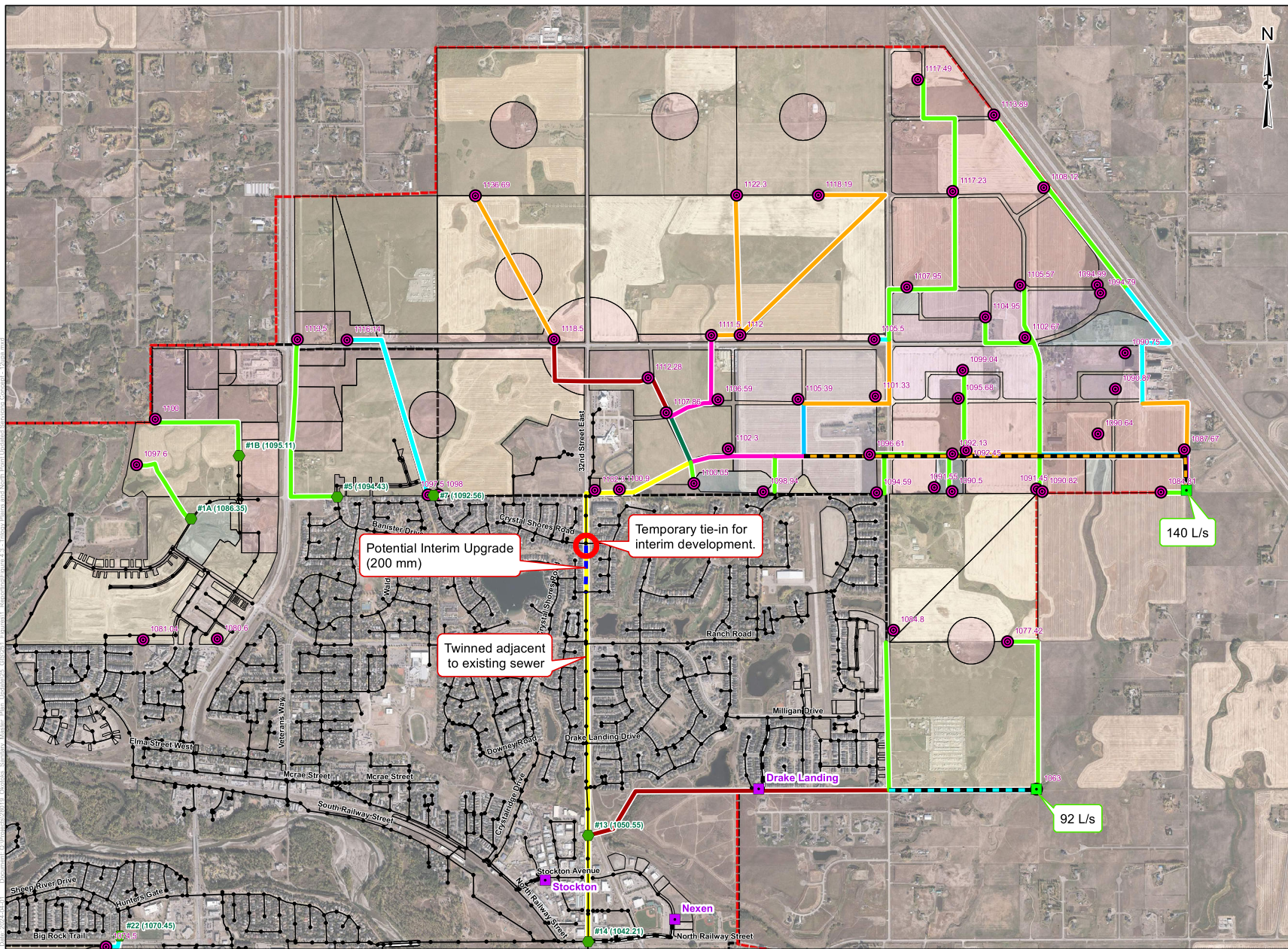
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0 200 400 800 Meters

FIGURE 4.2
TRILOGY PLAINS AND NORTH POINT
UPDATED SERVICING CONCEPT (8 UPA)
SANITARY MASTER PLAN UPDATE

Okotoks
HABITAT FOR HUMANITY

ISL



- Legend**
- Manhole
 - Lift Station
 - Proposed Lift Station
 - Gravity Tie-in Location
 - Lowest Elevation Within Service Area

- Sanitary Pipe
- Forcemain
- Siphon
- Pre-Annexation Boundary
- Post-Annexation Boundary

- Service Area by Land Use**
- Densification
 - Commercial
 - Employment
 - Green Space (Unserviced)
 - Highway Business
 - Industrial
 - Institutional
 - Residential
 - SWMP (Unserviced)
 - Surplus Industrial

- Proposed Pipe Size**
- 250mm Gravity Sewer
 - 300mm Gravity Sewer
 - 375mm Gravity Sewer
 - 450mm Gravity Sewer
 - 525mm Gravity Sewer
 - 600mm Gravity Sewer
 - 675mm Gravity Sewer
 - 900mm Gravity Sewer
 - 1050mm Gravity Sewer
 - 300mm Forcemain
 - 375mm Forcemain

Coordinate System:
CANA83-3TM114

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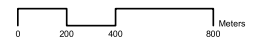
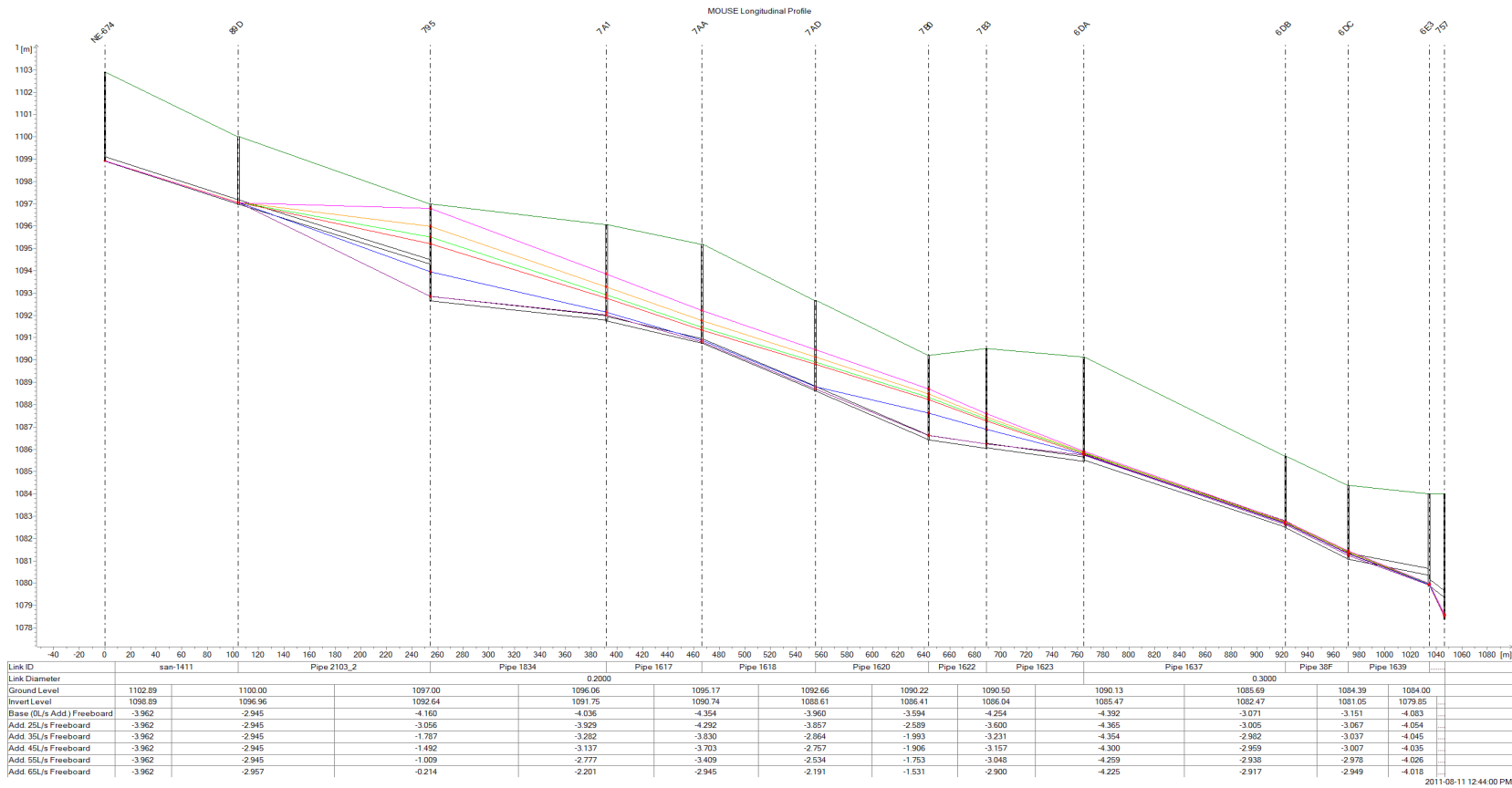


FIGURE 4.3
TRILOGY PLAINS AND NORTH POINT
UPDATED SERVICING CONCEPT (12 UPA)
SANITARY MASTER PLAN UPDATE





Legend

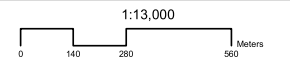
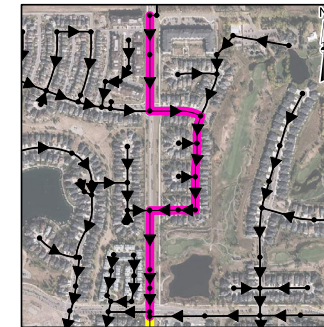
- Wastewater Treatment Plant
- Lift Station
- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Longitudinal Profile

- Trilogy Plains and North Point LP 1
- Trilogy Plains and North Point LP 2

Scenario

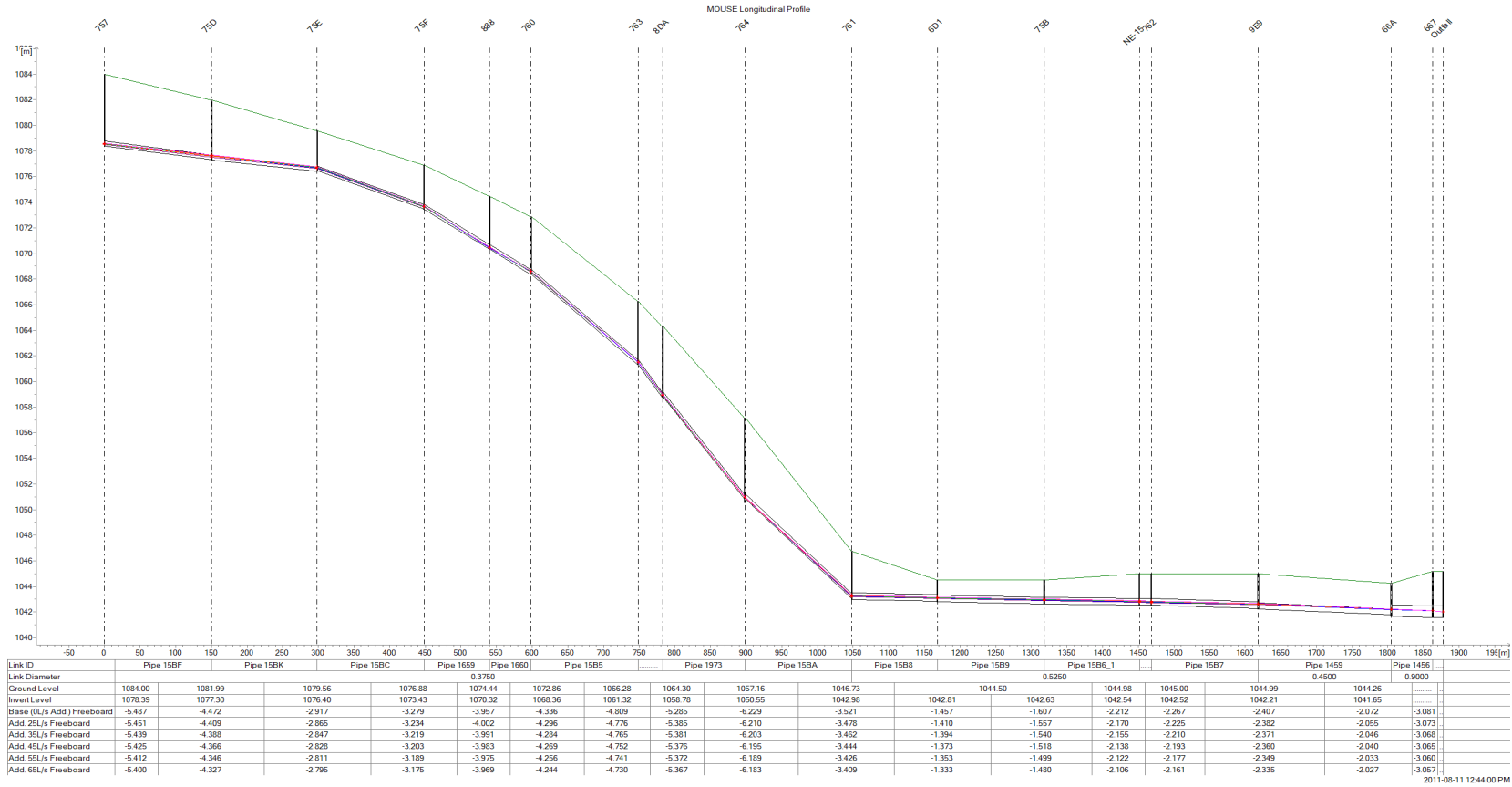
- Base Conditions (0L/s)
- Additional 25L/s
- Additional 35L/s
- Additional 45L/s
- Additional 55L/s
- Additional 65L/s



Coordinate System: CANA83-3TM114

FIGURE 4.4
TRILGY PLAINS AND NORTH POINT
SENSITIVITY ANALYSIS
LONGITUDINAL PROFILE 1
SANITARY MASTER PLAN UPDATE





Legend

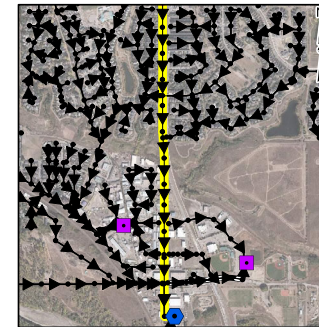
- Wastewater Treatment Plant
- Lift Station
- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Longitudinal Profile

- Trilogy Plains and North Point LP 1
- Trilogy Plains and North Point LP 2

Scenario

- Base Conditions (0L/s)
- Additional 25L/s
- Additional 35L/s
- Additional 45L/s
- Additional 55L/s
- Additional 65L/s

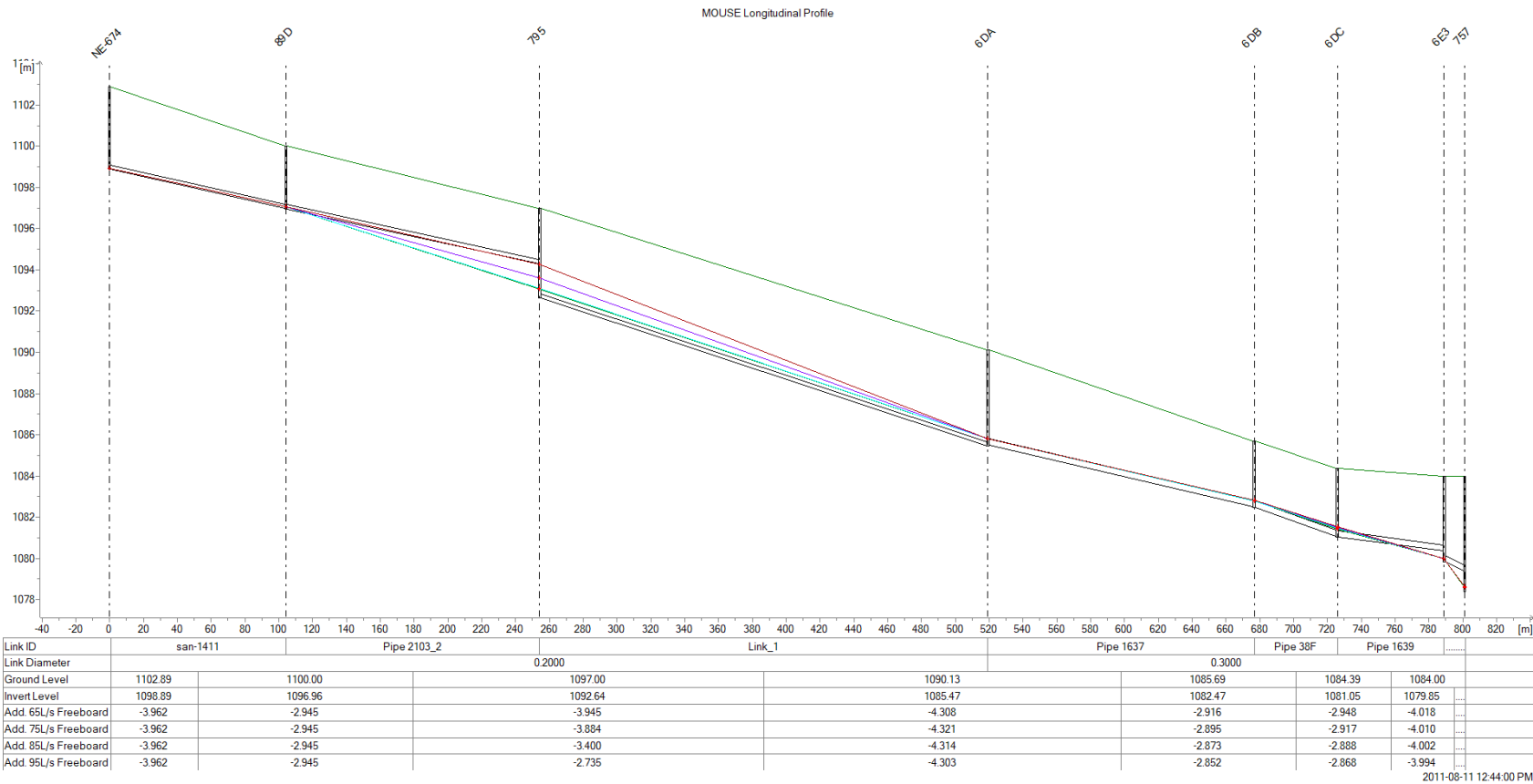


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FIGURE 4.5
TRILGY PLAINS AND NORTH POINT
SENSITIVITY ANALYSIS
LONGITUDINAL PROFILE 2
SANITARY MASTER PLAN UPDATE



Date: 2024-01-19 Document: Q:\Projects\20110 Okotoks, Sanitary Master Plan_Update20110 Okotoks, Sanitary Master Plan_Update20110 Figures1 - Reporting\Figure 4.6 - Trilogy Plains and North Point - Longitudinal Profile 1 - with Upgrades.mxd



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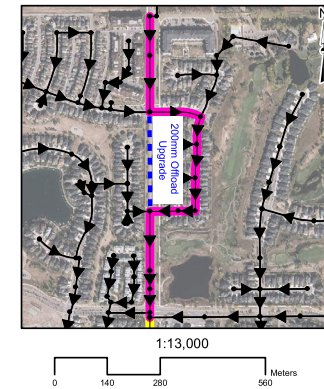
- Wastewater Treatment Plant
- Lift Station
- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Longitudinal Profile

- Trilogy Plains and North Point LP 1
- Trilogy Plains and North Point LP 2

Scenario

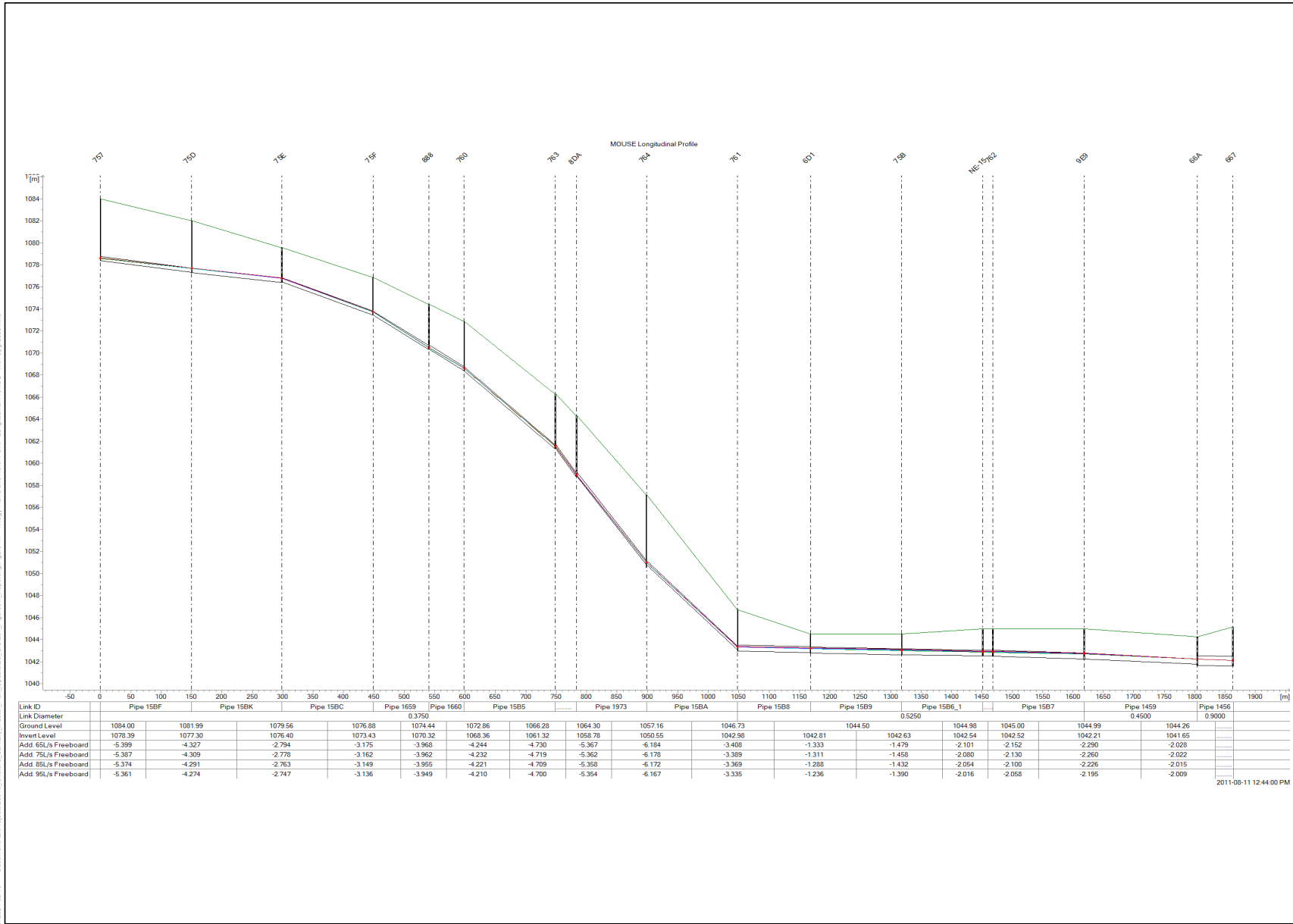
- Additional 65L/s
- Additional 75L/s
- Additional 85L/s
- Additional 95L/s



Coordinate System: CANA83-3TM114

FIGURE 4.6
TRILOGY PLAINS AND NORTH POINT
SENSITIVITY ANALYSIS
WITH INTERIM OFFLOAD UPGRADES
LONGITUDINAL PROFILE 1
SANITARY MASTER PLAN UPDATE





Legend

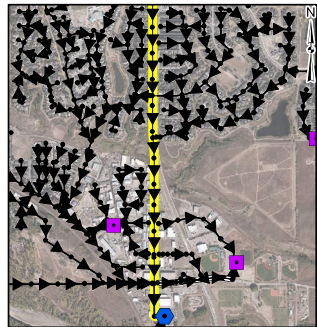
- Wastewater Treatment Plant
- Lift Station
- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Longitudinal Profile

- Trilogy Plains and North Point LP 1
- Trilogy Plains and North Point LP 2

Scenario

- Additional 65L/s
- Additional 75L/s
- Additional 85L/s
- Additional 95L/s

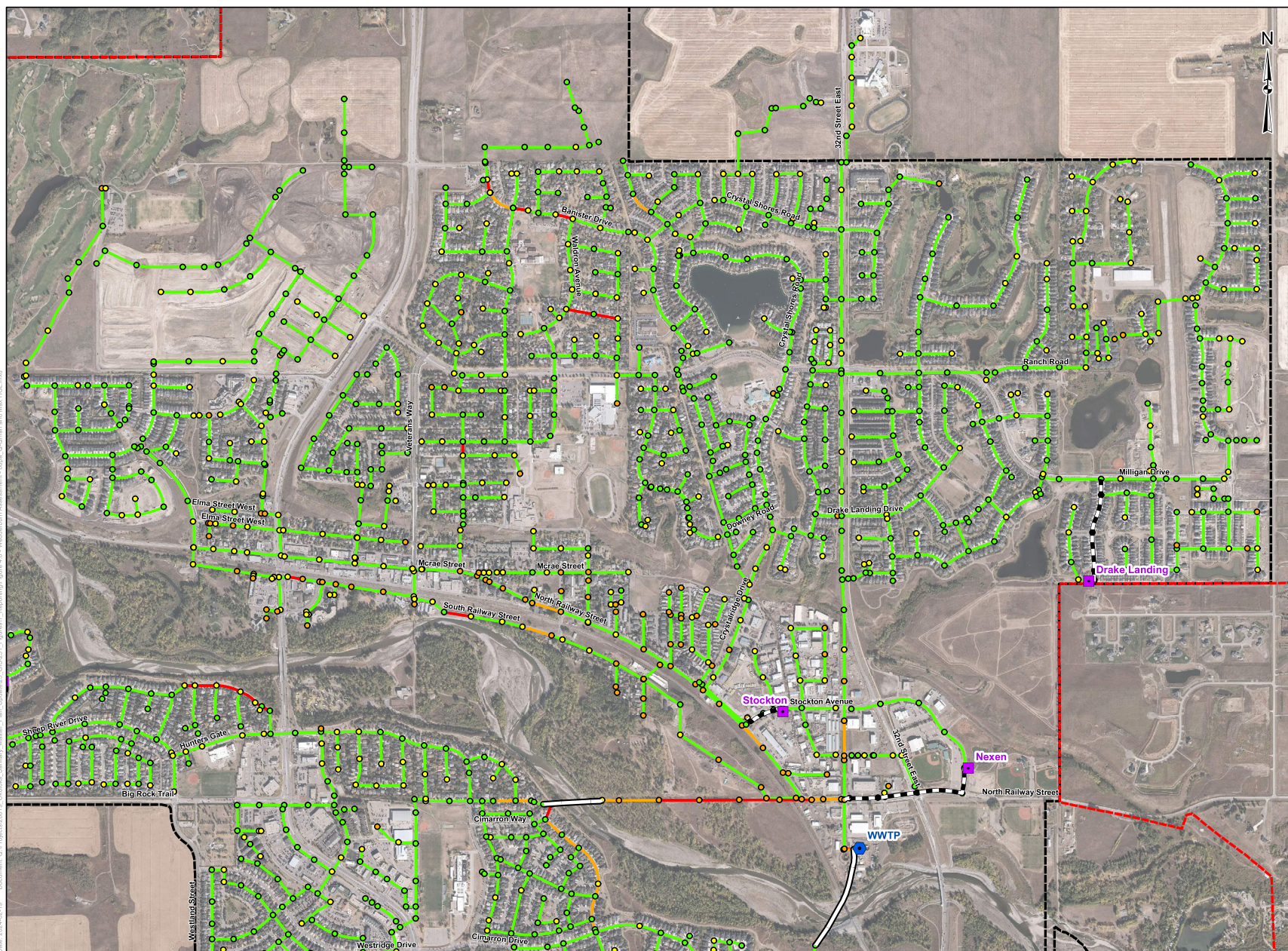


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Coordinate System: CANA83-3TM114

FIGURE 4.7
TRILOGY PLAINS AND NORTH POINT
SENSITIVITY ANALYSIS
WITH INTERIM OFFLOAD UPGRADES
LONGITUDINAL PROFILE 2
SANITARY MASTER PLAN UPDATE



Document: C:\Projects\08119_00000s_Sanitary_Master_Plan_Update\01_GIS\0201_Figures\Figure 4.8 - Wedderburn Assessment - Bupa, O-Qman and Max HGL.mxd
Date: 2024-02-19



Legend

- Lift Station
- Wastewater Treatment Plant
- Forcemain
- Siphon
- Pre-Annexation Boundary
- Post-Annexation Boundary

Maximum HGL Elevation Relative to Ground

- Less than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and 0.00m
- Greater than 0.00m

Peak Discharge Relative to Pipe Capacity

- Greater than 100%
- Between 86% and 100%
- Less than 86%

Coordinate System:
CANA83-3TM114

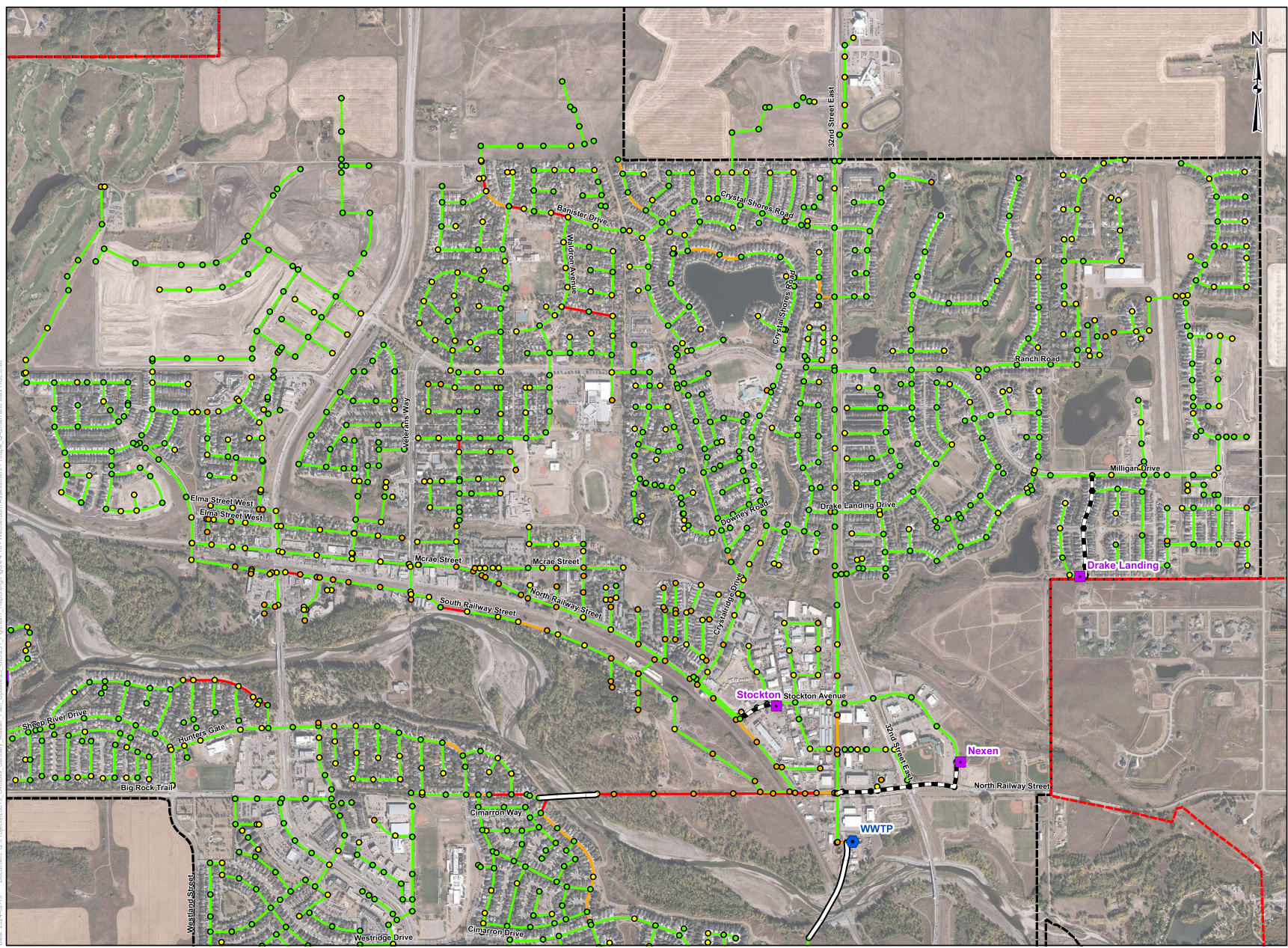
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FIGURE 4.8
WEDDERBURN ASSESSMENT
BUPA SCENARIO
Q/QMAN AND MAX HGL
SANITARY MASTER PLAN UPDATE



Date: 2024-02-19 Document: C:\Projects\08119_Oroville_Sanitary_Master_Plan_Update\21_GIS\2011_Figure1 - Reporting\Figure 4.10 - Wedderburn Assessment - 10UPA, Q/OMAN and Max HGL.mxd



Legend

- Lift Station
- Wastewater Treatment Plant
- Forcemain
- Siphon
- Pre-Annexation Boundary
- Post-Annexation Boundary

Maximum HGL Elevation Relative to Ground

- Less than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and 0.00m
- Greater than 0.00m

Peak Discharge Relative to Pipe Capacity

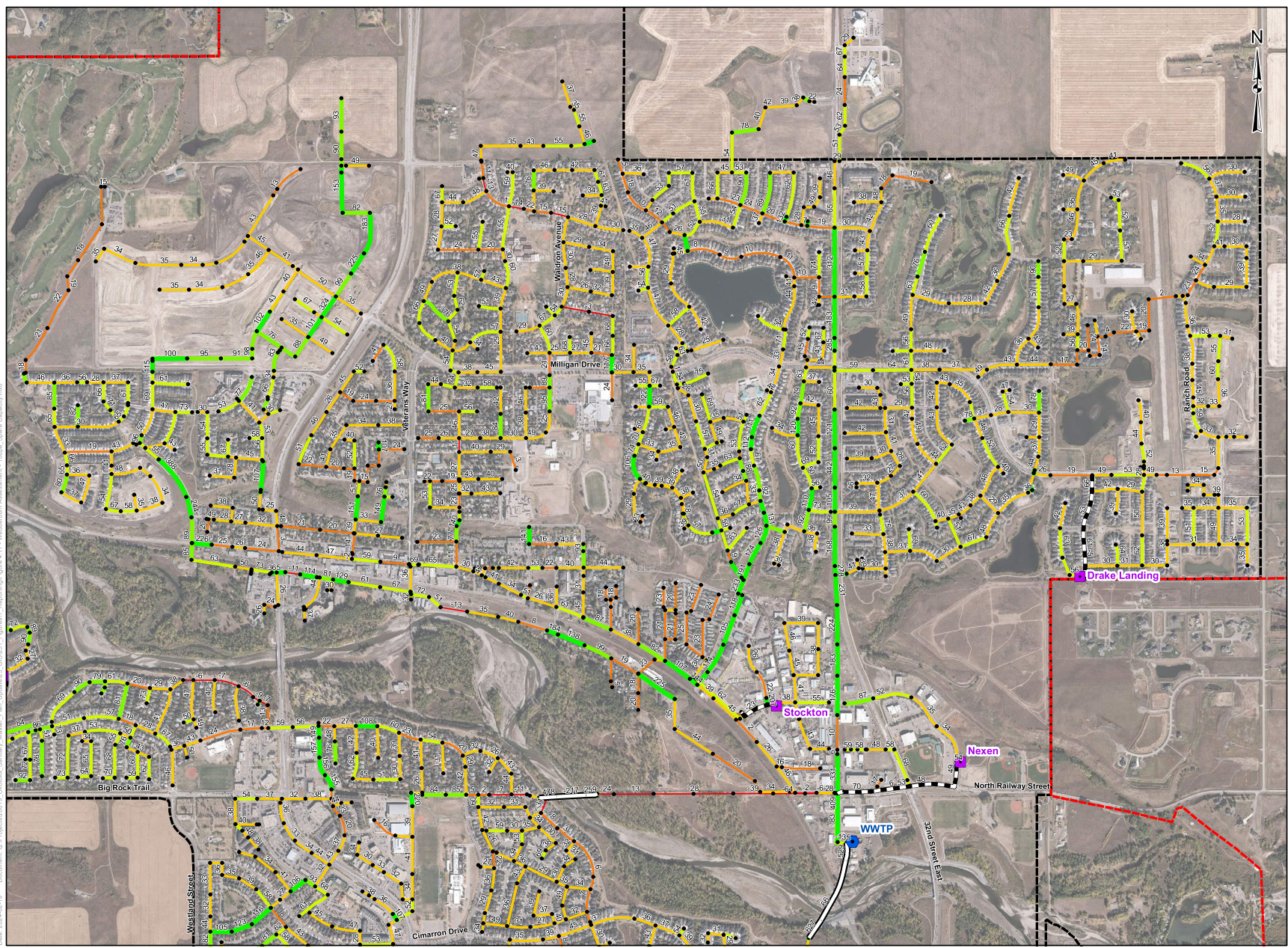
- Greater than 100%
- Between 86% and 100%
- Less than 86%

Coordinate System:
CANA83-3TM114

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FIGURE 4.10
WEDDERBURN ASSESSMENT
10UPA SCENARIO
Q/OMAN AND MAX HGL
SANITARY MASTER PLAN UPDATE

Date: 2024-02-19 Document: C:\Projects\08119_Oroville_Sanitary_Master_Plan_Update\21_GIS\2011_Figures\1_Report\Figure 4.11 - Wedderburn Assessment - 10UPA Spare Capacity.mxd



Legend

- Manhole
- Lift Station
- Wastewater Treatment Plant
- Forcemain
- == Siphon
- - - Pre-Annexation Boundary
- - - Post-Annexation Boundary

Spare Capacity

- Less than 0L/s
- 0 - 25L/s
- 25 - 50L/s
- 50 - 75L/s
- 75 - 100L/s
- Greater than 100L/s

Spare capacity labels are in L/s

Coordinate System:
CANA83-3TM114

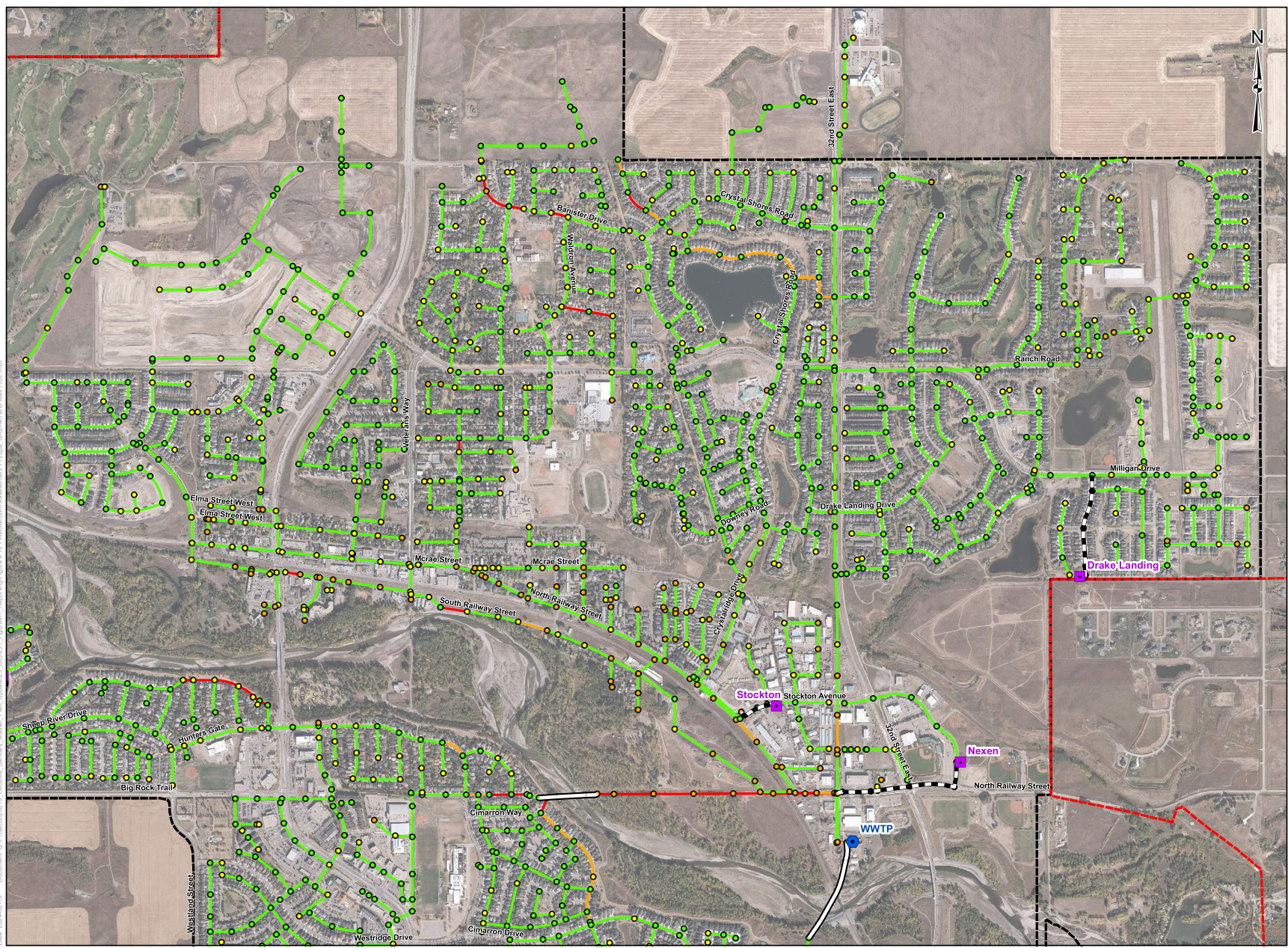
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FIGURE 4.11
WEDDERBURN ASSESSMENT
10UPA SCENARIO
SPARE CAPACITY
SANITARY MASTER PLAN UPDATE



Date: 2024-02-19 Document: C:\Projects\00119_Oroville_Sanitary_Master_Plan_Update\01_GIS\2024_12_Medienum_Assessment - 12upa_O-Draw and Max HGL.mxd



Legend

- Lift Station
- Wastewater Treatment Plant
- Forcemain
- Siphon
- Pre-Annexation Boundary
- Post-Annexation Boundary

Maximum HGL Elevation Relative to Ground

- Less than -3.50m
- Between -3.50m and -2.50m
- Between -2.50m and 0.00m
- Greater than 0.00m

Peak Discharge Relative to Pipe Capacity

- Greater than 100%
- Between 86% and 100%
- Less than 86%

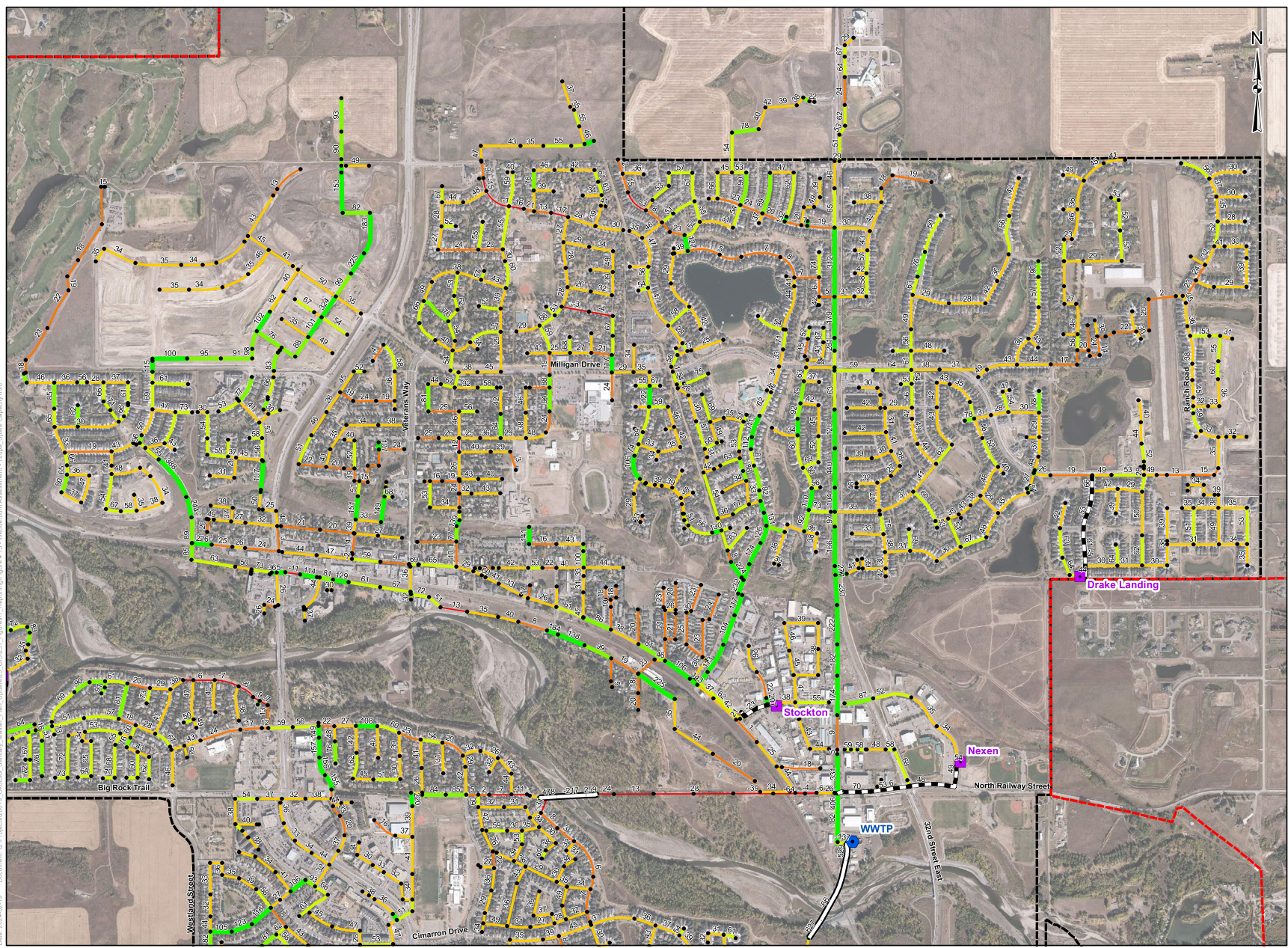
This scenario is unlikely to occur for development in Wedderburn west of the gas line and is provided for information purposes only.

Coordinate System:
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FIGURE 4.12
WEDDERBURN ASSESSMENT
12UPA SCENARIO
Q/OMAN AND MAX HGL
SANITARY MASTER PLAN UPDATE

Date: 2024-02-19 Document: C:\Projects\08119_Oroville_Sanitary_Master_Plan_Update\201_GIS\201_Figures\Figure 4.13 - Wedderburn Assessment - 12upa_Spare Capacity.mxd



- Legend**
- Manhole
 - Lift Station
 - Wastewater Treatment Plan
 - Forcemain
 - == Siphon
 - - - Pre-Annexation Boundary
 - - - Post-Annexation Boundary
- Spare Capacity**
- Less than 0L/s
 - 0 - 25L/s
 - 25 - 50L/s
 - 50 - 75L/s
 - 75 - 100L/s
 - Greater than 100L/s

Spare capacity labels are in L/s

This scenario is unlikely to occur for development in Wedderburn west of the gas line and is provided for information purposes only.

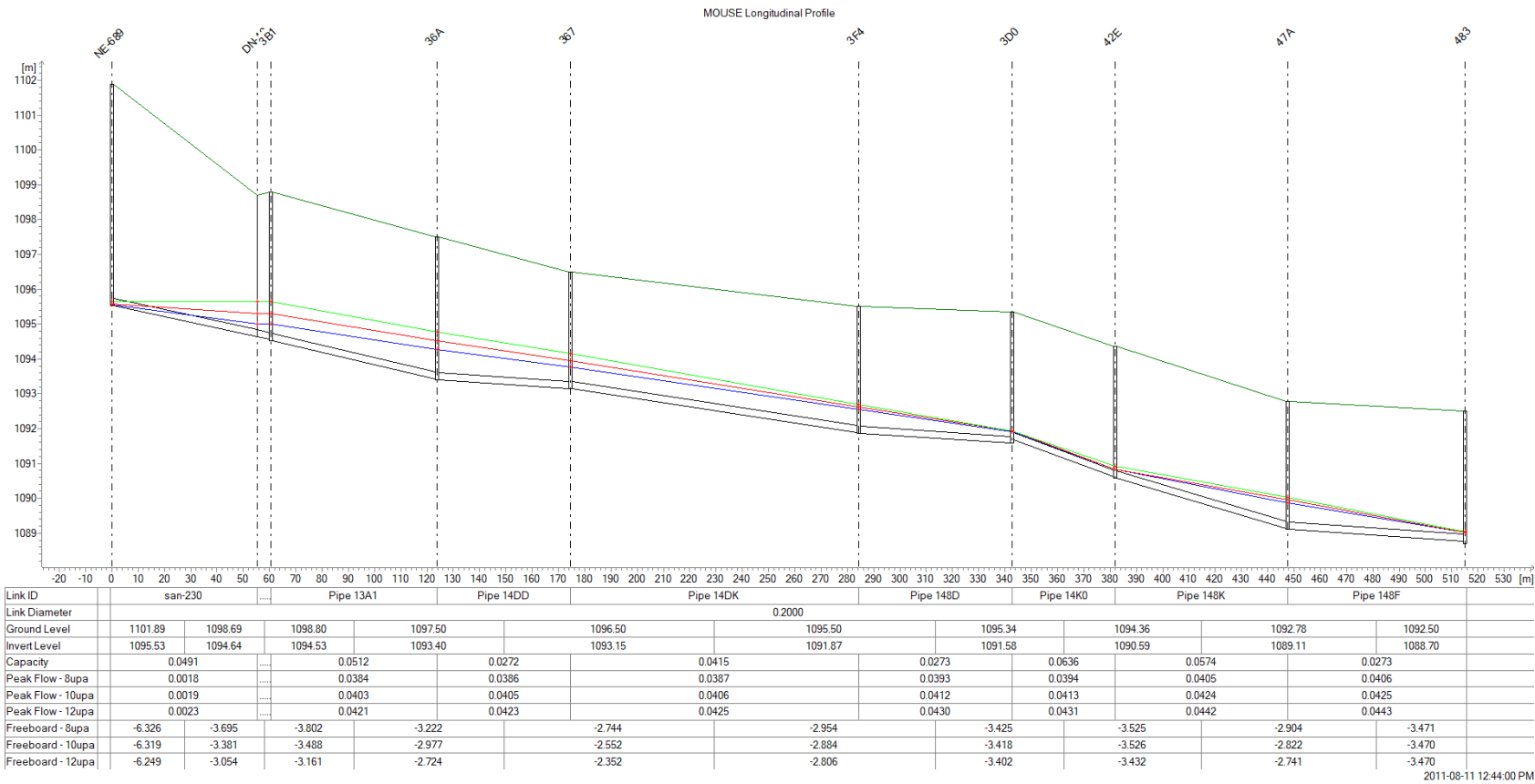
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FIGURE 4.13
WEDDERBURN ASSESSMENT
12UPA SCENARIO
SPARE CAPACITY
SANITARY MASTER PLAN UPDATE

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Date: 2024-02-19
Document: O:\Projects\080119_Ocotoks_Sanitary_Master_Plan_Update\02_GIS\0201_Figures\1 - Wedderburn Assessment - Longitudinal Profile 1.mxd



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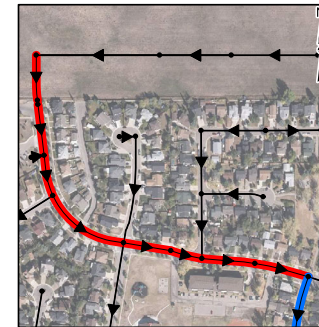
- Wastewater Treatment Plant
- Lift Station
- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Longitudinal Profile

- Wedderburn LP 1
- Wedderburn LP 2
- Wedderburn LP 3
- Wedderburn LP 4
- Wedderburn LP 5

Scenario

- 8upa
- 10upa
- 12upa



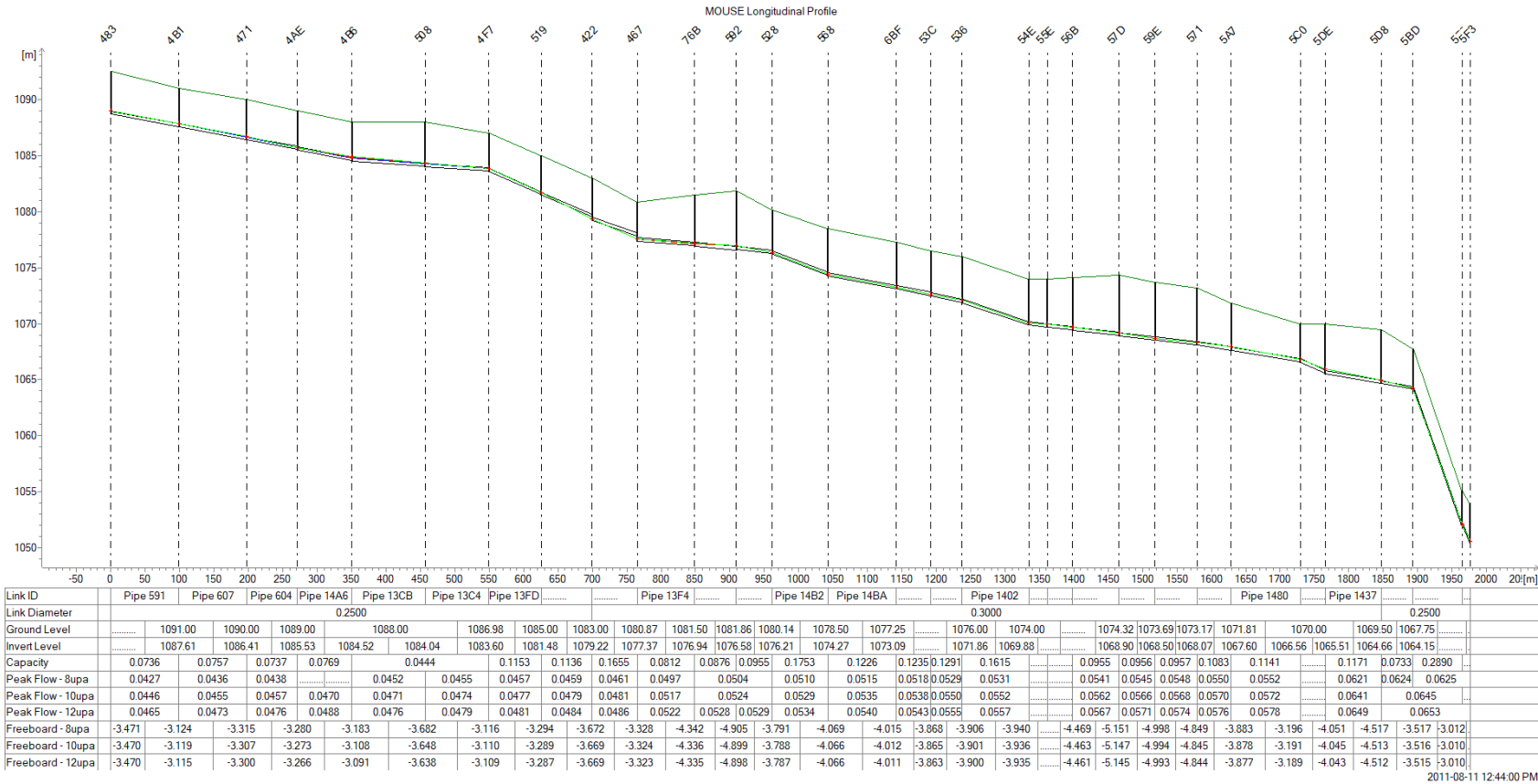
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Coordinate System: CANA83-3TM114

FIGURE 4.14
WEDDERBURN ASSESSMENT
LONGITUDINAL PROFILE 1
SANITARY MASTER PLAN UPDATE



The 12 upa scenario is unlikely to occur for development in Wedderburn west of the gas line and is provided for information purposes only.

Date: 2024-02-19 Document: C:\Projects\08010_Ocotoks_Sanitary_Master_Plan_Update\01_Figures\1_Report\Figure 4.15 - Wedderburn Assessment - Longitudinal Profile 2.mxd



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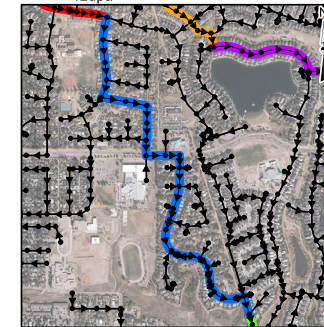
- Wastewater Treatment Plant
- Lift Station
- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Longitudinal Profile

- Wedderburn LP 1
- Wedderburn LP 2
- Wedderburn LP 3
- Wedderburn LP 4
- Wedderburn LP 5

Scenario

- 8upa
- 10upa
- 12upa



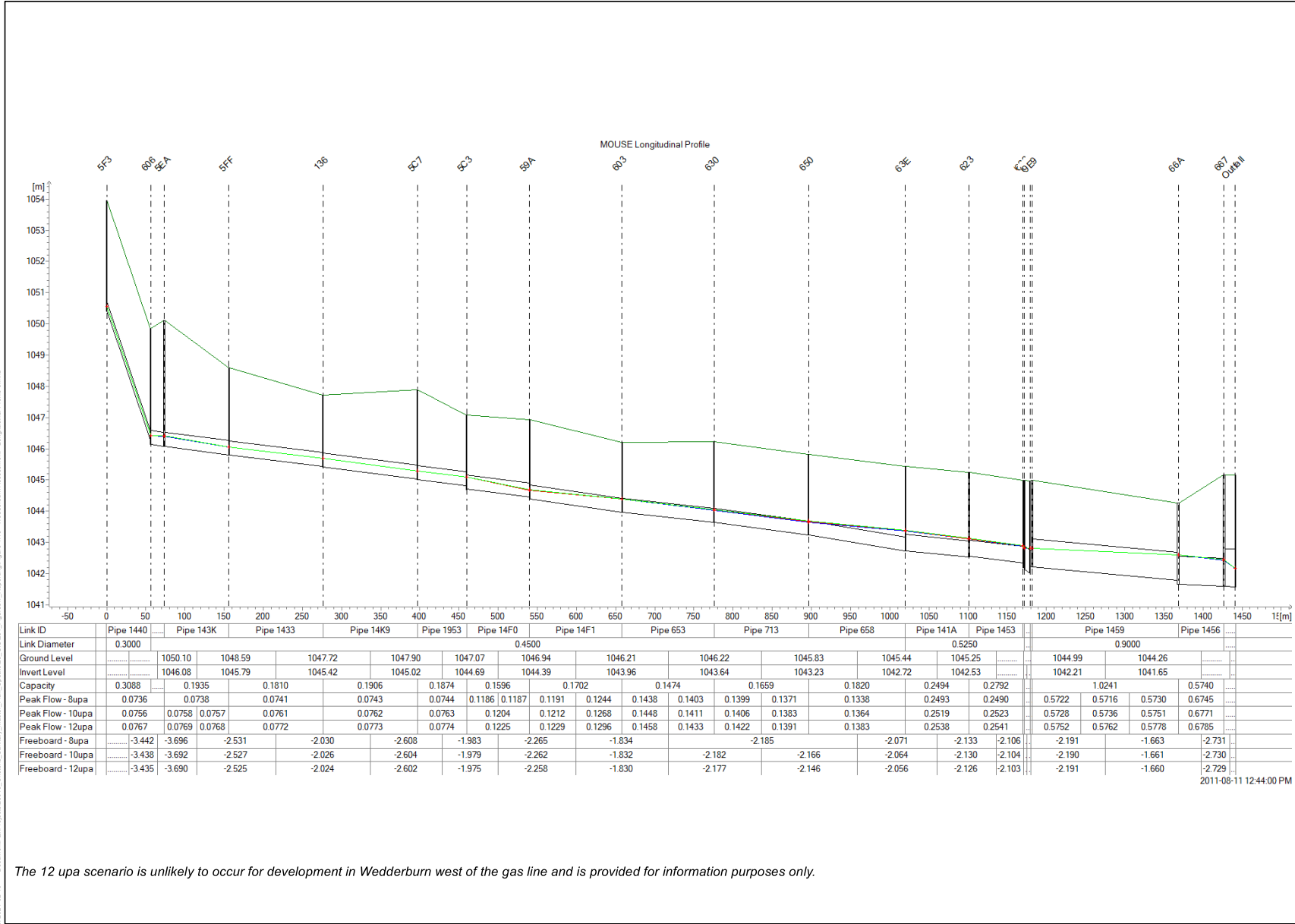
Coordinate System: CANA83-3TM114

FIGURE 4.15
WEDDERBURN ASSESSMENT
LONGITUDINAL PROFILE 2
SANITARY MASTER PLAN UPDATE

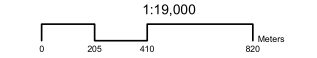
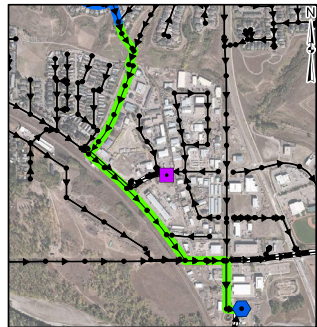


The 12 upa scenario is unlikely to occur for development in Wedderburn west of the gas line and is provided for information purposes only.

Date: 2024-02-19 Document: O:\Projects\08010_ Okotoks Sanitary Master Plan_Update2019_03\08010_Figures\1. Reporting\Figure 4.16 - Wedderburn Assessment - Longitudinal Profile 3.mxd



The 12 upa scenario is unlikely to occur for development in Wedderburn west of the gas line and is provided for information purposes only.

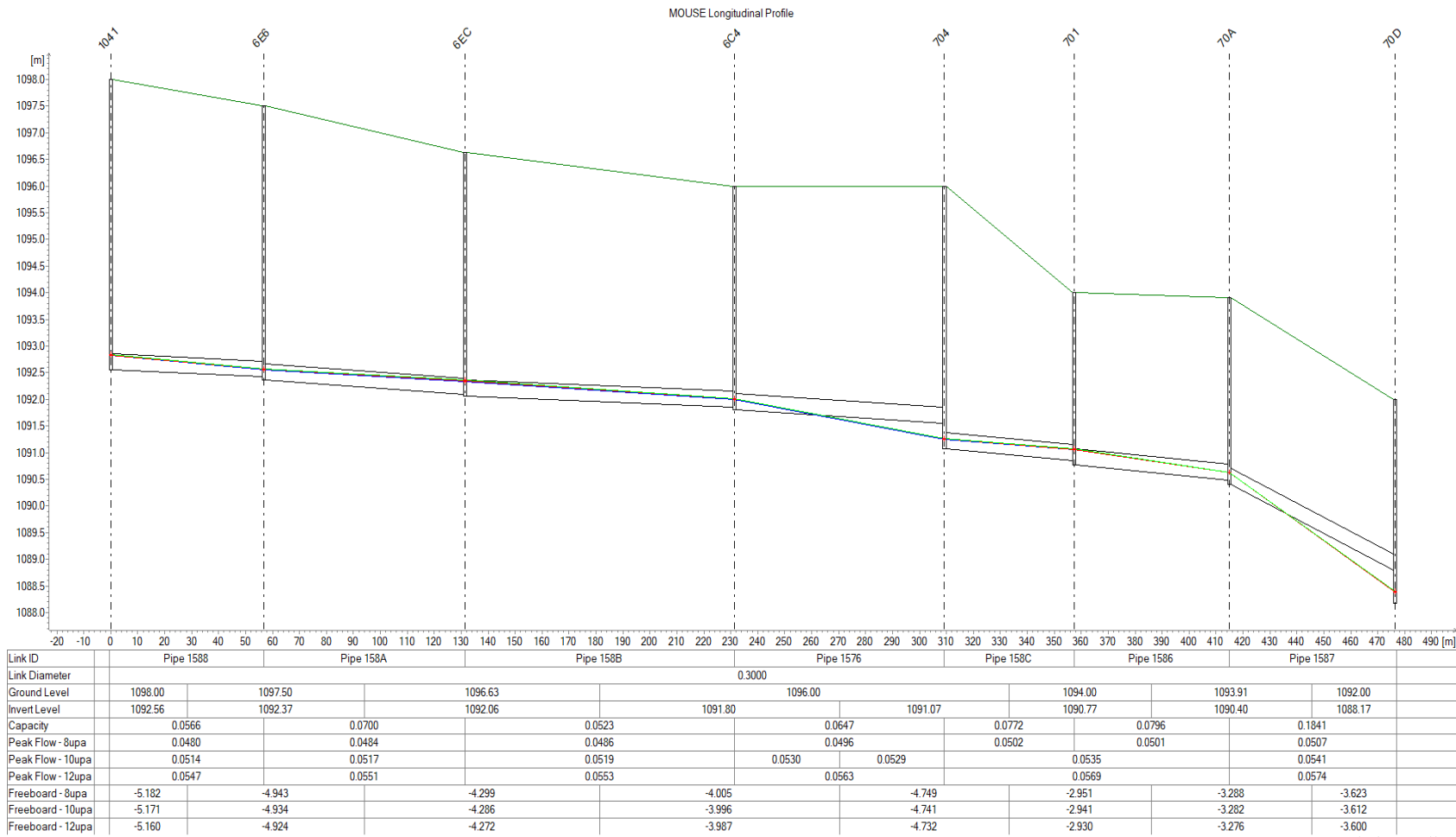


Coordinate System: CANA83-3TM114

FIGURE 4.16
WEDDERBURN ASSESSMENT
LONGITUDINAL PROFILE 3
SANITARY MASTER PLAN UPDATE



Date: 2024-02-19 Document: Q:\Projects\08119_Ocotoks_Sanitary_Master_Plan_Update\02_GIS\2017_Figures\1_Report\Figure 4.17 - Wedderburn Assessment - Longitudinal Profile 4.mxd



The 12 upa scenario is unlikely to occur for development in Wedderburn west of the gas line and is provided for information purposes only.

Legend

- Wastewater Treatment Plant
 - Lift Station
 - Manhole
 - Forcemain
 - Siphon
 - Gravity Sewer
- #### Longitudinal Profile
- Wedderburn LP 1
 - Wedderburn LP 2
 - Wedderburn LP 3
 - Wedderburn LP 4
 - Wedderburn LP 5
- #### Scenario
- 8upa
 - 10upa
 - 12upa



1:6,000
0 65 130 260 Meters

Coordinate System: CANA83-3TM114

FIGURE 4.17
WEDDERBURN ASSESSMENT
LONGITUDINAL PROFILE 4
SANITARY MASTER PLAN UPDATE



Document: C:\Projects\0819_Ocotoks_Sanitary_Master_Plan_Update\05_GIS\051_Figures\Figure1 - Longitudinal Profile 5.mxd
Date: 2024-02-19

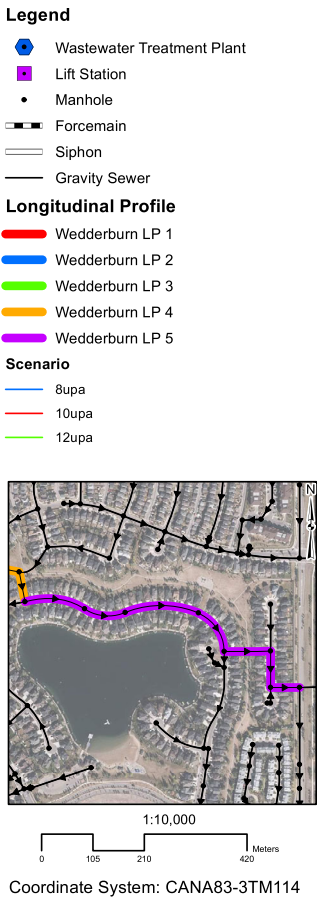
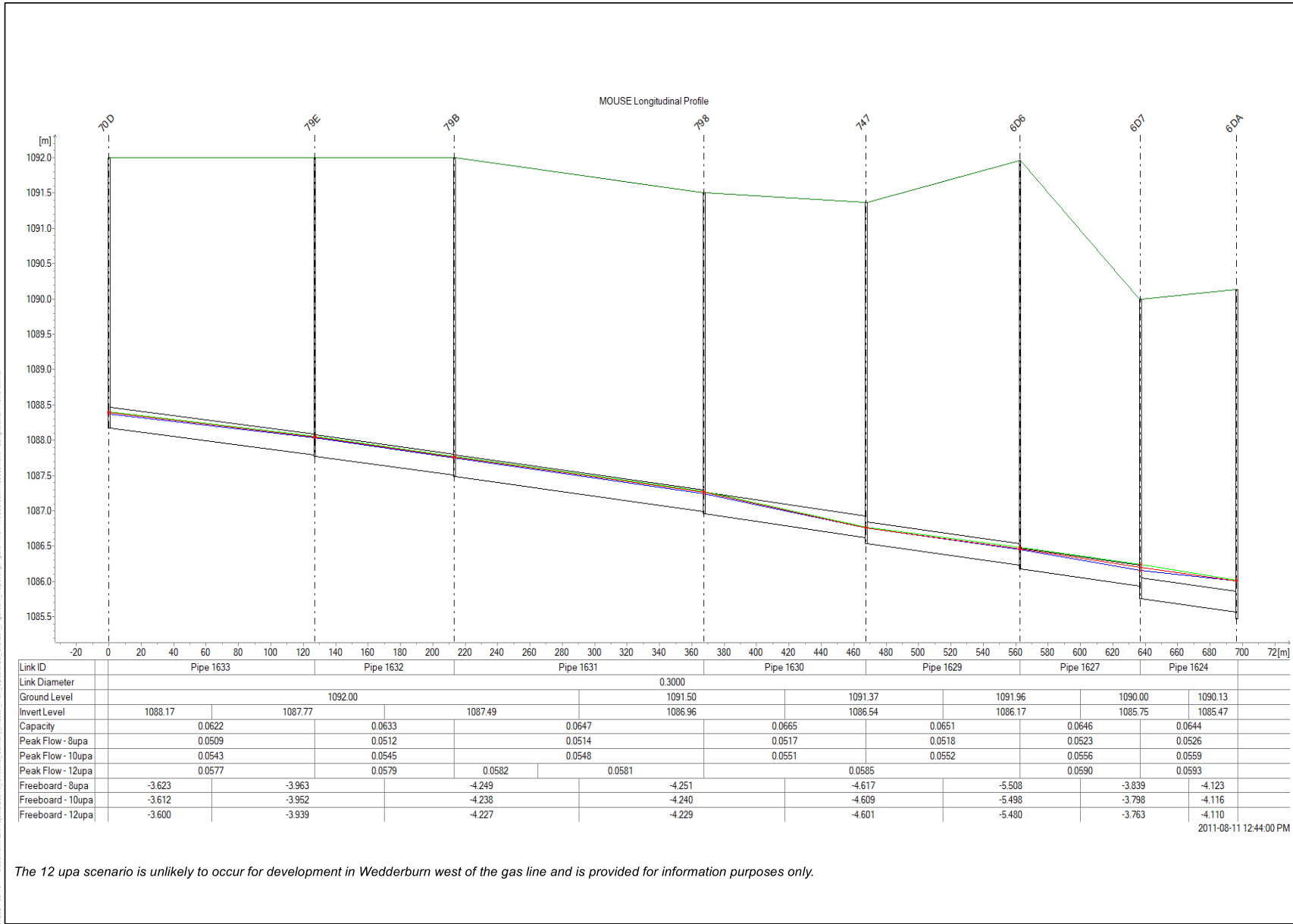
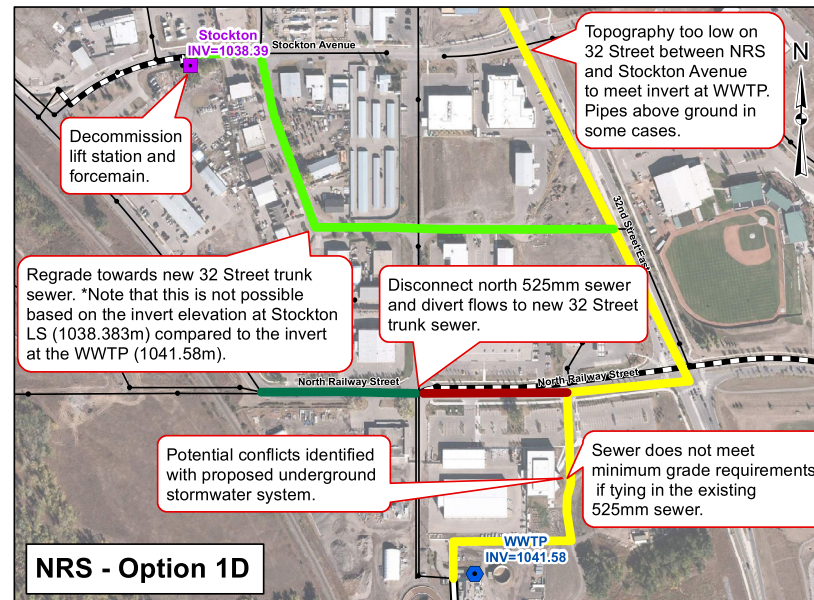
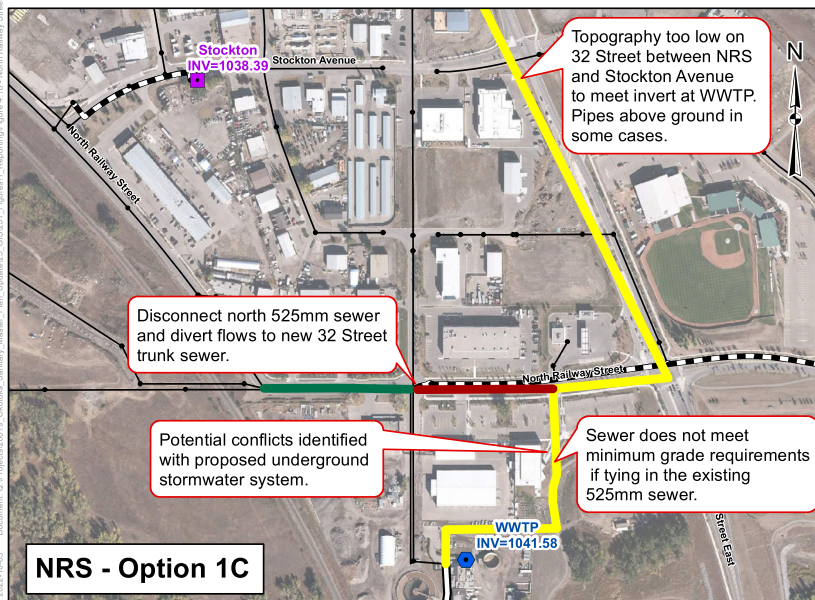
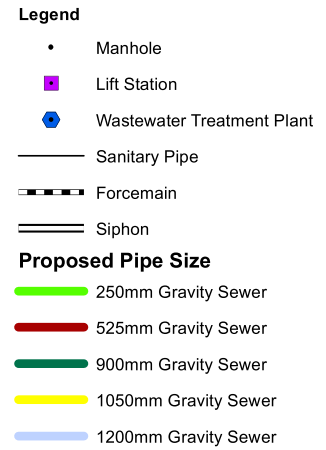
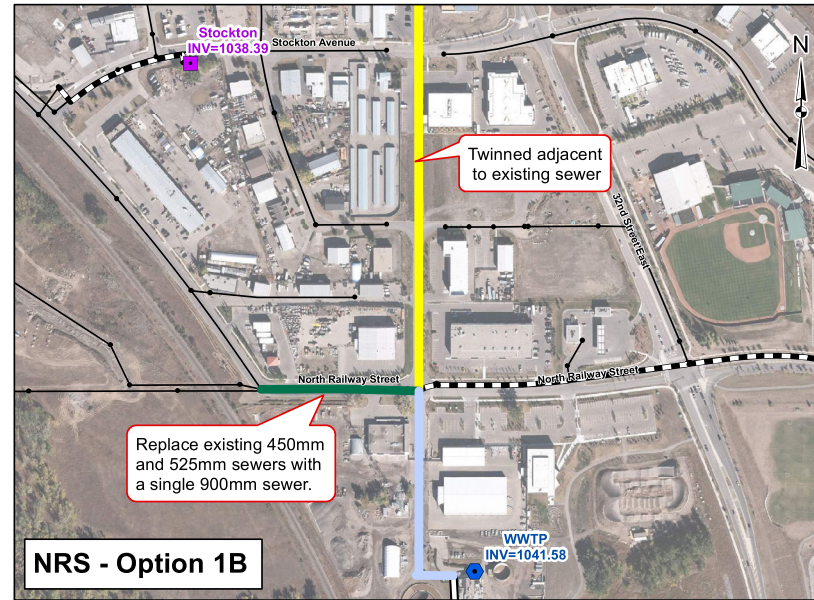
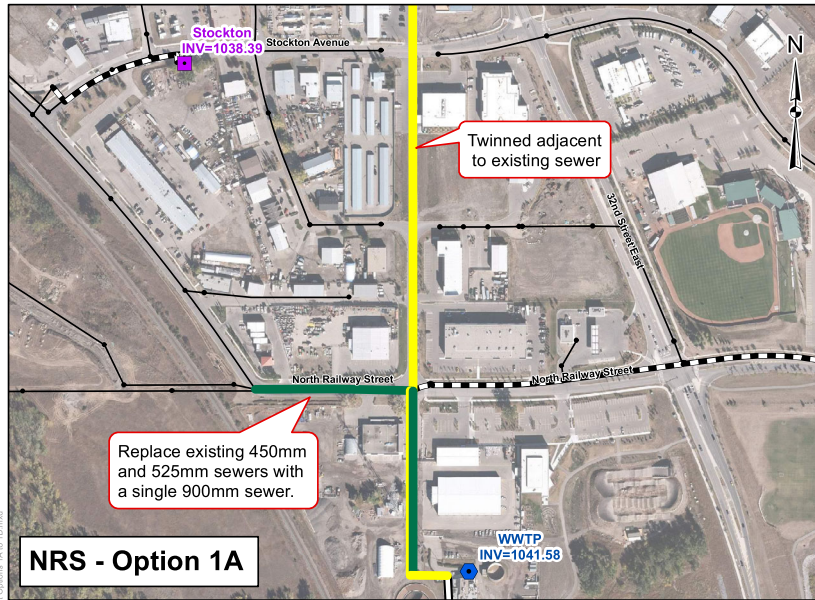


FIGURE 4.18
WEDDERBURN ASSESSMENT
LONGITUDINAL PROFILE 5
SANITARY MASTER PLAN UPDATE





Coordinate System:
CANAD83-3TM114

1:5,000

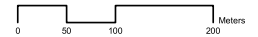
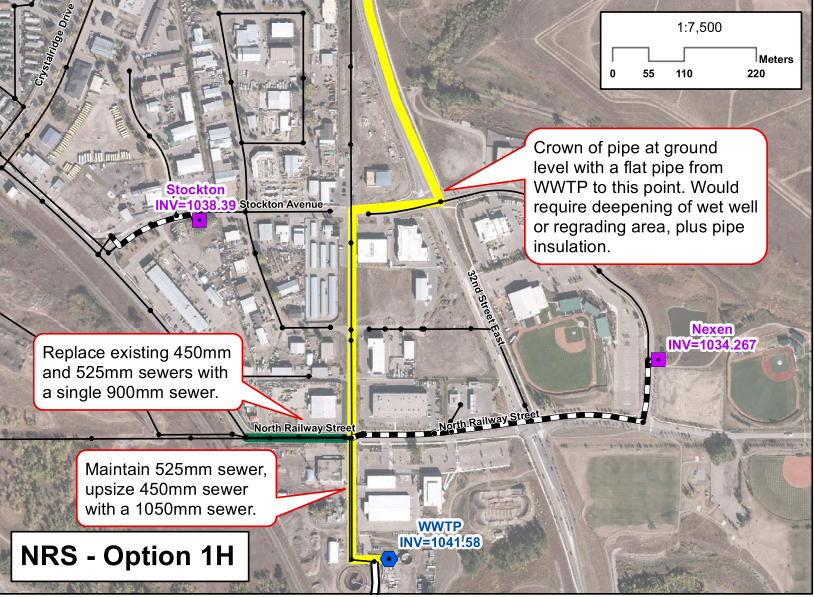
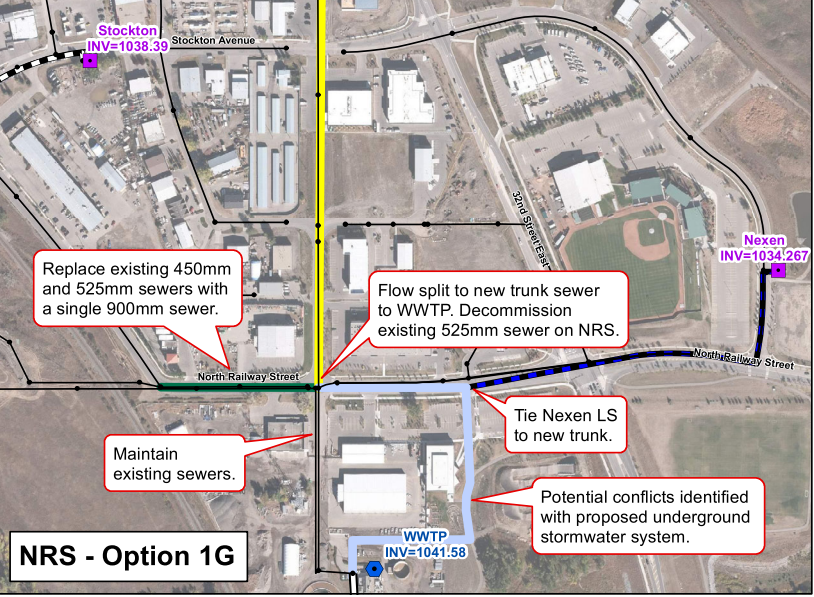
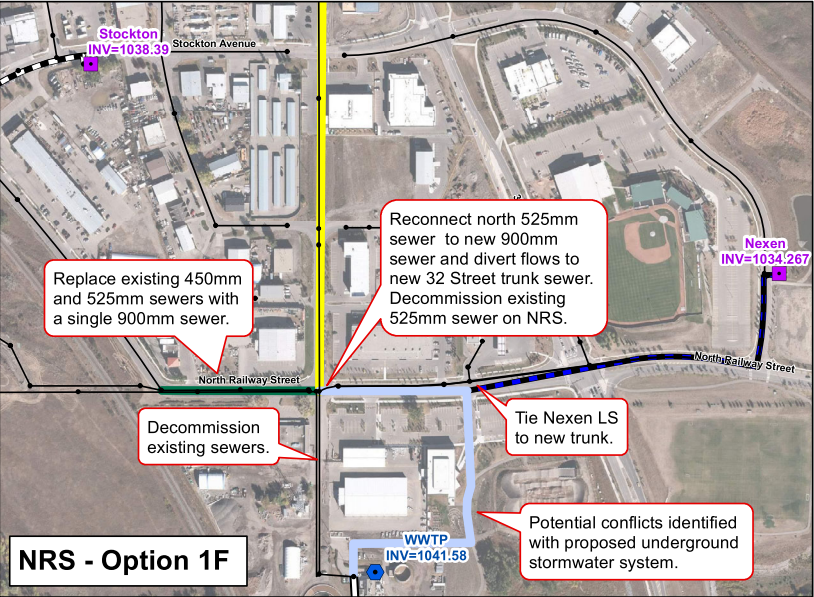
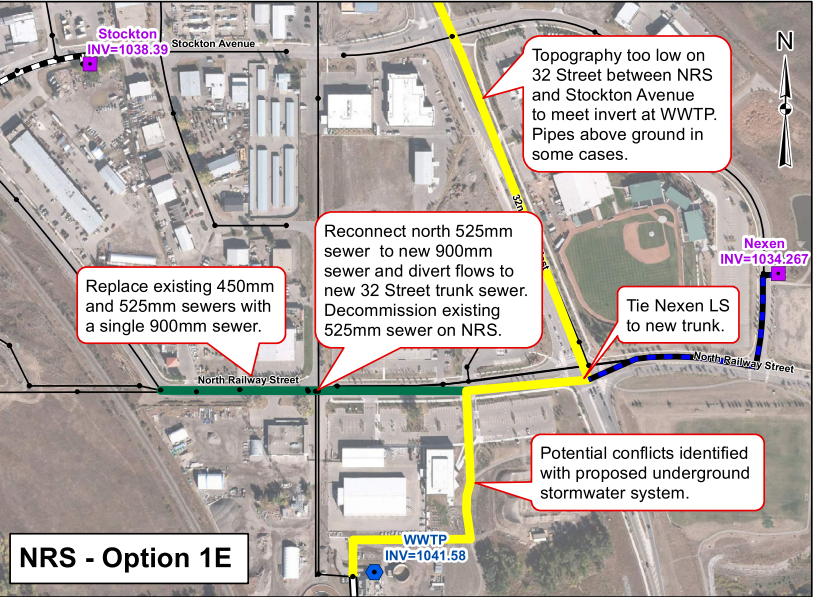


FIGURE 4.19
NRS ALTERNATIVES
OPTIONS 1A TO 1D
SANITARY MASTER PLAN UPDATE



Date: 2022-10-05 Document: C:\projects\0810_00000s_Sanitary_Master_Plan_Update\02_GIS\2021_Figures\Figure 4.20 - North Railway Street Alignment Options 1E to 1H.dwg



Legend

- Manhole
- Lift Station
- Wastewater Treatment Plant
- Sanitary Pipe
- Forcemain
- Siphon

Proposed Pipe Size

- 150mm Forcemain
- 250mm Gravity Sewer
- 900mm Gravity Sewer
- 1050mm Gravity Sewer
- 1200mm Gravity Sewer

Coordinate System:
CANAD83-3TM114

1:5,000

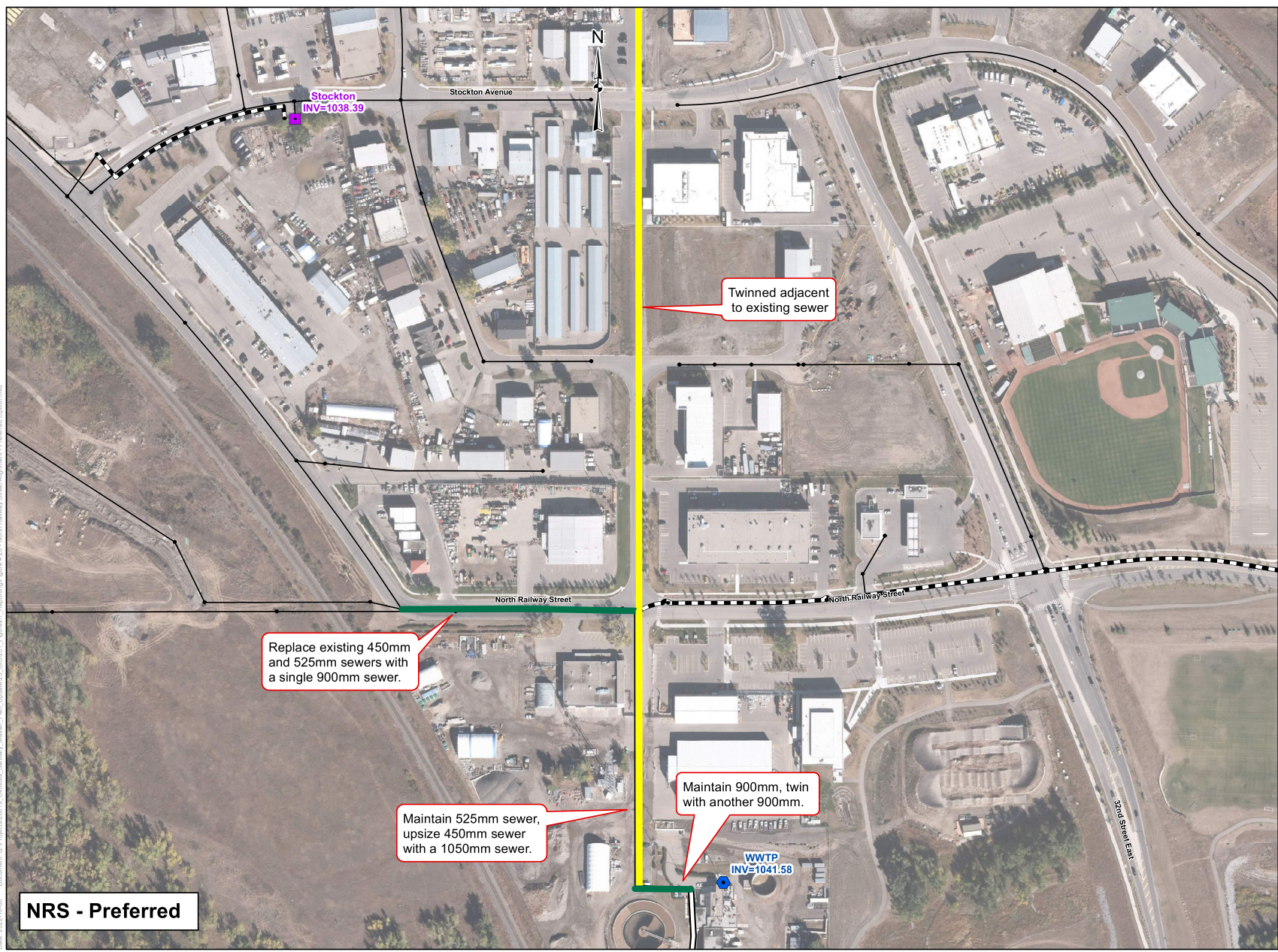
0 50 100 200 Meters

FIGURE 4.20
NRS ALTERNATIVES
OPTIONS 1E TO 1H
SANITARY MASTER PLAN UPDATE

Okotoks
Water & Sewerage Division

ISL

Date: 2022-10-08 Document: C:\projects\08110_Okotoke_Sanitary_Master_Plan_Update\01_GIS\2011_Figure\1_Report\Figure 4.20 - North Railway Street Alignment - Preferred Option.mxd



NRS - Preferred

- Legend**
- Manhole
 - Lift Station
 - Wastewater Treatment Plant
 - Sanitary Pipe
 - - - Forcemain
 - Siphon
- Proposed Pipe Size**
- 525mm Gravity Sewer
 - 675mm Gravity Sewer
 - 750mm Gravity Sewer
 - 900mm Gravity Sewer
 - 1050mm Gravity Sewer

Coordinate System:
CANADA83-UTM114

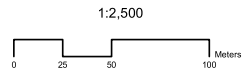
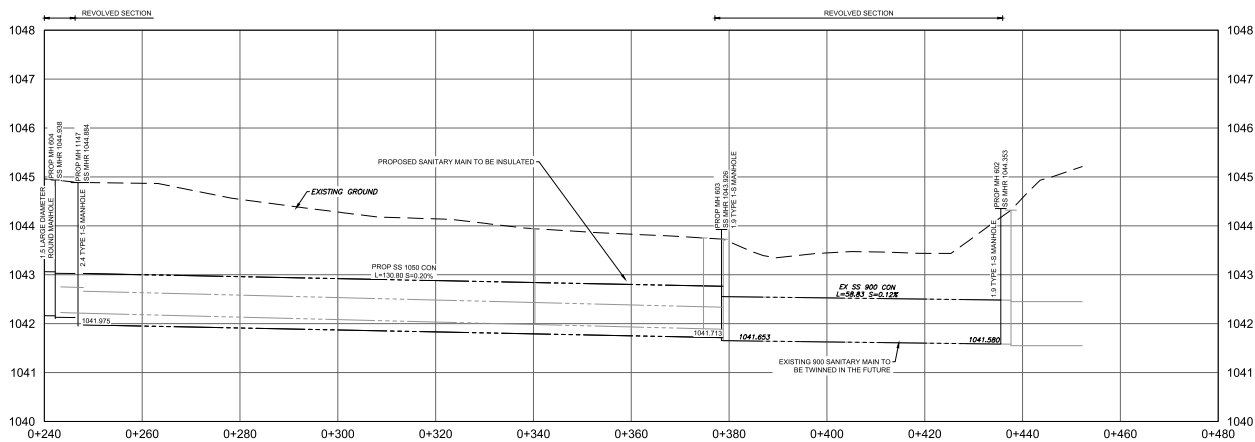
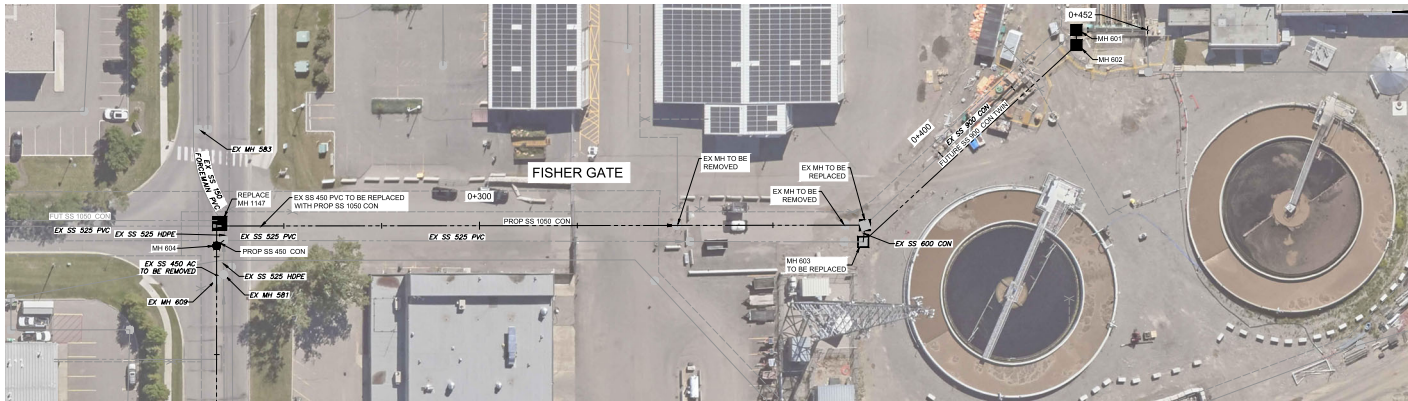


FIGURE 4.21
NRS ALTERNATIVES (8 UPA)
PREFERRED ALIGNMENT OPTION
SANITARY MASTER PLAN UPDATE



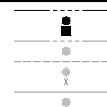


NOTES

1. ALL PIPE SIZES ARE IN MILLIMETRES AND ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. ALL COORDINATES AND DISTANCES ARE BASED ON 3TM COORDINATE SYSTEM (NAD 83).

LEGEND

PROPOSED SANITARY PIPE
PROPOSED SANITARY 1.5 MANHOLE
EXISTING SANITARY PIPE
EXISTING SANITARY MANHOLE
EXISTING WATER PIPE
EXISTING WATER HYDRANT
EXISTING WATER VALVE
EXISTING STORM PIPE
EXISTING STORM MANHOLE



PRELIMINARY
FOR DISCUSSION ONLY
SUBJECT TO REVISION

ALBERTA
ONECALL

NAD 83
COORDINATES

NO.	DESCRIPTION	DATE	BY	APPROVED
1	ISSUED FOR REVIEW	2022.11.23	CC	SB

PERMIT	SEAL
DESIGNED	BY
DRAWN	SB
CHECKED	CC
SCALE	DATE

1:500 (HORIZ.)	1:20 (VERT.)
1:500 (HORIZ.)	1:20 (VERT.)

Okotoks

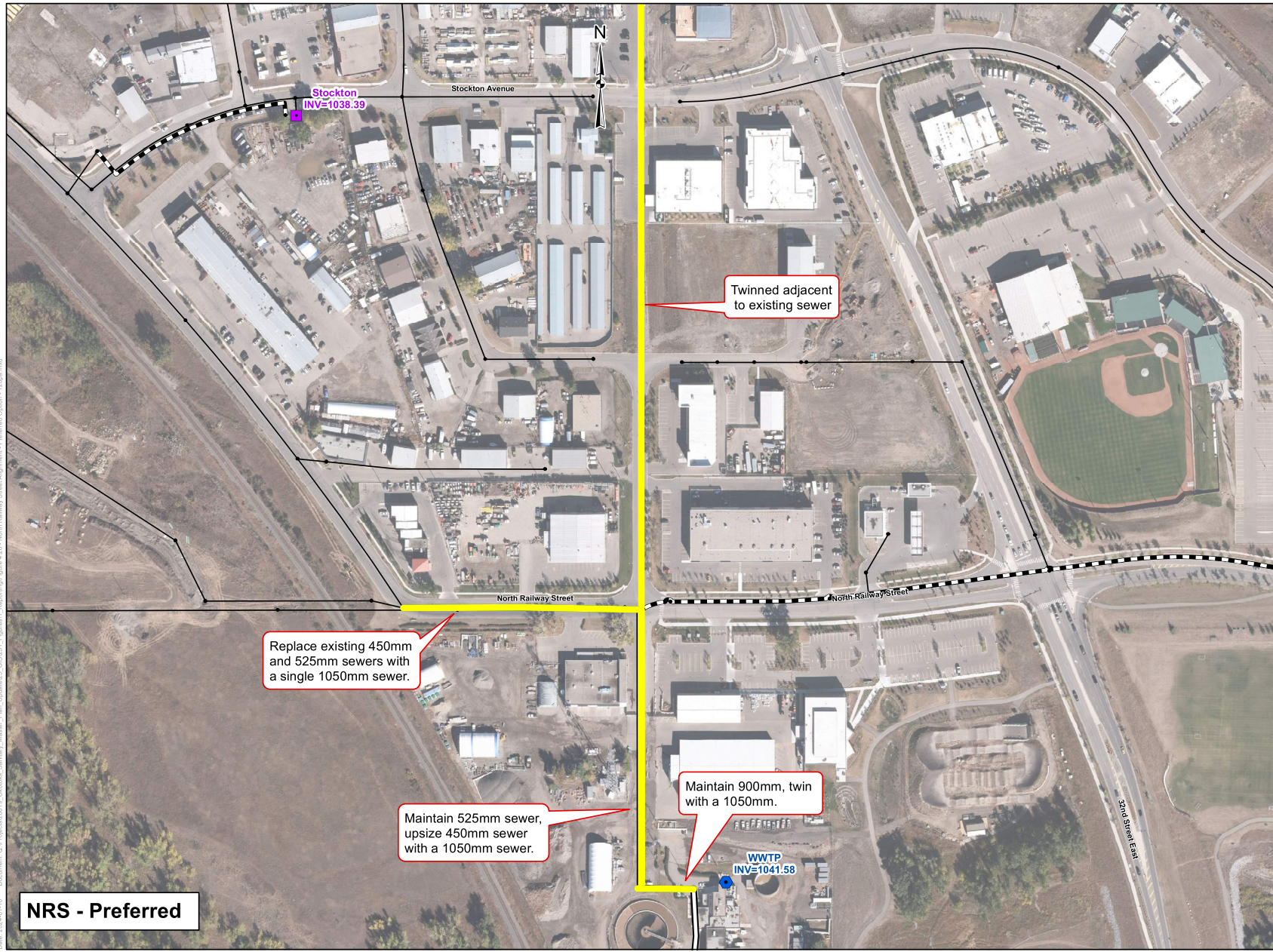
ISL

PROJECT
**TOWN OF OKOTOKS
SANITARY SERVICING STUDY UPDATE**

SHEET TITLE
**PLAN PROFILE
PROPOSED SANITARY UPGRADES
STA 0+0+160 TO STA 0+348**

FILE NO. 28019_PlanProfile_4.23.dwg	ENG. DWG NO.
SHEET ID. CU-102	SHEET NO. 2
BY CC	DATE 2022.11.23
DRAWN CC	PROFILE NO. FIGURE 4.23

ISC: #000 SHEET SIZE ANSI D 25 mm



Legend

- Manhole
- Lift Station
- Wastewater Treatment Plant
- Sanitary Pipe
- Forcemain
- Siphon

Proposed Pipe Size

- 525mm Gravity Sewer
- 675mm Gravity Sewer
- 750mm Gravity Sewer
- 900mm Gravity Sewer
- 1050mm Gravity Sewer

Coordinate System:
CANADA83-3TM114

1:2,500



FIGURE 4.24
NRS ALTERNATIVES
PREFERRED ALIGNMENT OPTION
12UPA ALTERNATIVE
SANITARY MASTER PLAN UPDATE



Date: 2024-02-28 Document: C:\projects\00110 Okotoks, Sanitary Master Plan_Update201, Figures\1, Reporting\Figure 4.25 - Debottlenecking Scenarios - Existing Infrastructure.mxd

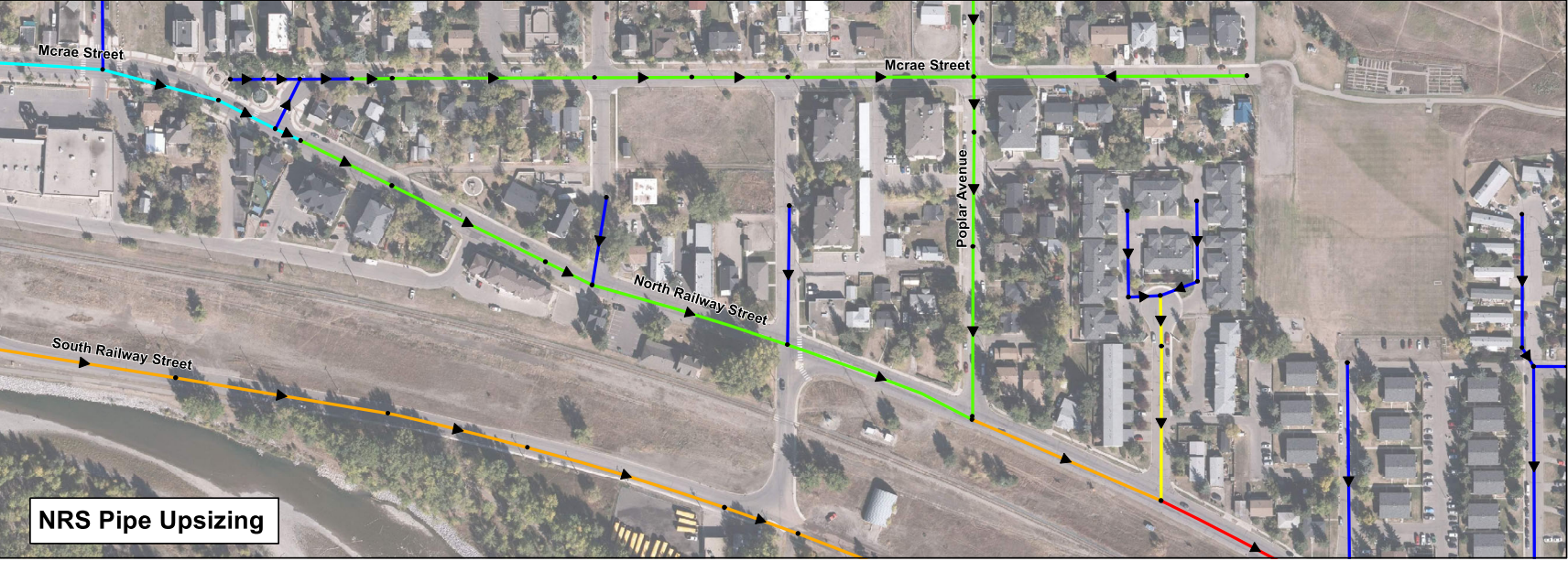


Legend

- Manhole

Pipe Size

- 100-150mm Gravity Sewer
- 200mm Gravity Sewer
- 250mm Gravity Sewer
- 300mm Gravity Sewer
- 350mm Gravity Sewer
- 375mm Gravity Sewer



Coordinate System:
CANADA83-3TM114

1:2,500

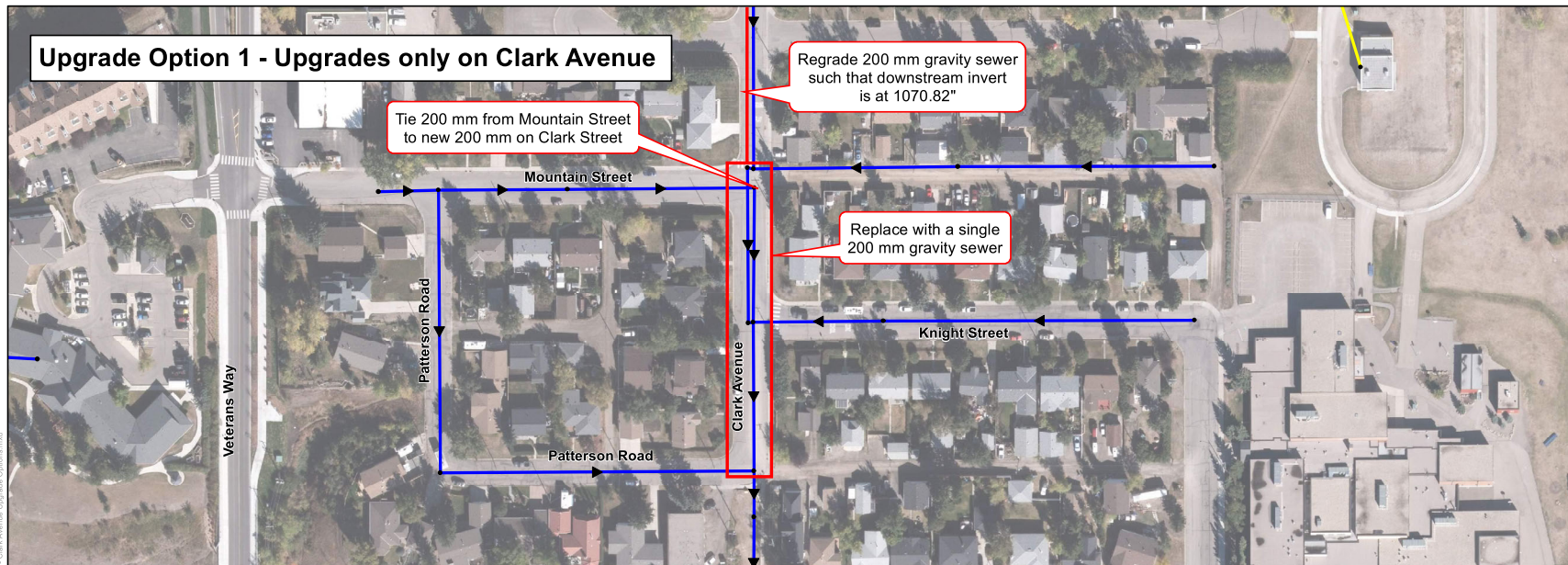
0 25 50 100 Meters

FIGURE 4.25
DEBOTTLENECKING SCENARIOS
EXISTING INFRASTRUCTURE
SANITARY MASTER PLAN UPDATE

Okotoks
HABITAT FOR HUMANITY

ISL

Document: C:\projects\08119_Oroville_Sanitary_Master_Plan_Update\02_GIS\0211_Figures\1_Report\Figure 4.26 - Debottlenecking Scenarios - Clark Avenue Upgrade Options.mxd
Date: 2024-03-01

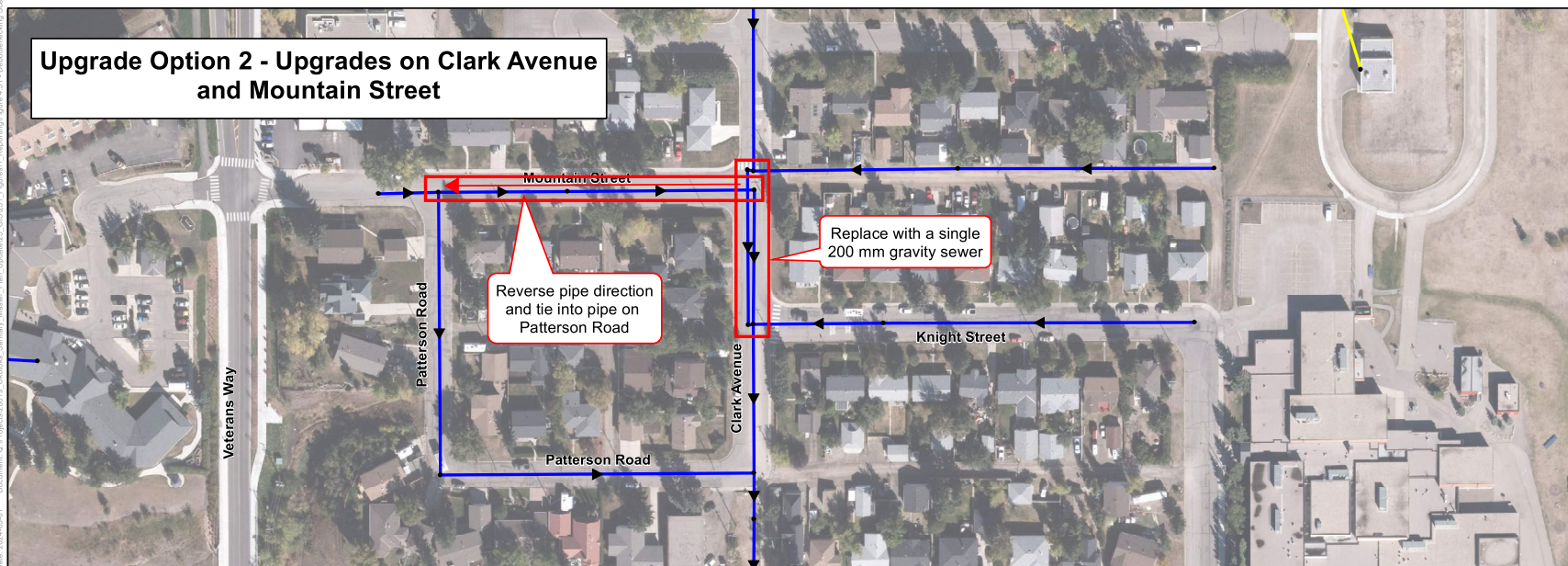


Legend

- Manhole

Pipe Size

- 100-150mm Gravity Sewer
- 200mm Gravity Sewer



Coordinate System:
CANADA83-UTM114

1:1,600

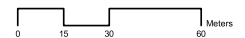
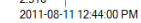


FIGURE 4.26
DEBOTTLENECKING SCENARIOS
CLARK AVENUE UPGRADE OPTIONS
SANITARY MASTER PLAN UPDATE





- Manhole
- Forcemain
- Siphon
- Gravity Sewer

Clark Avenue LP

— Existing
— Upgraded

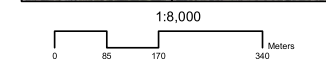
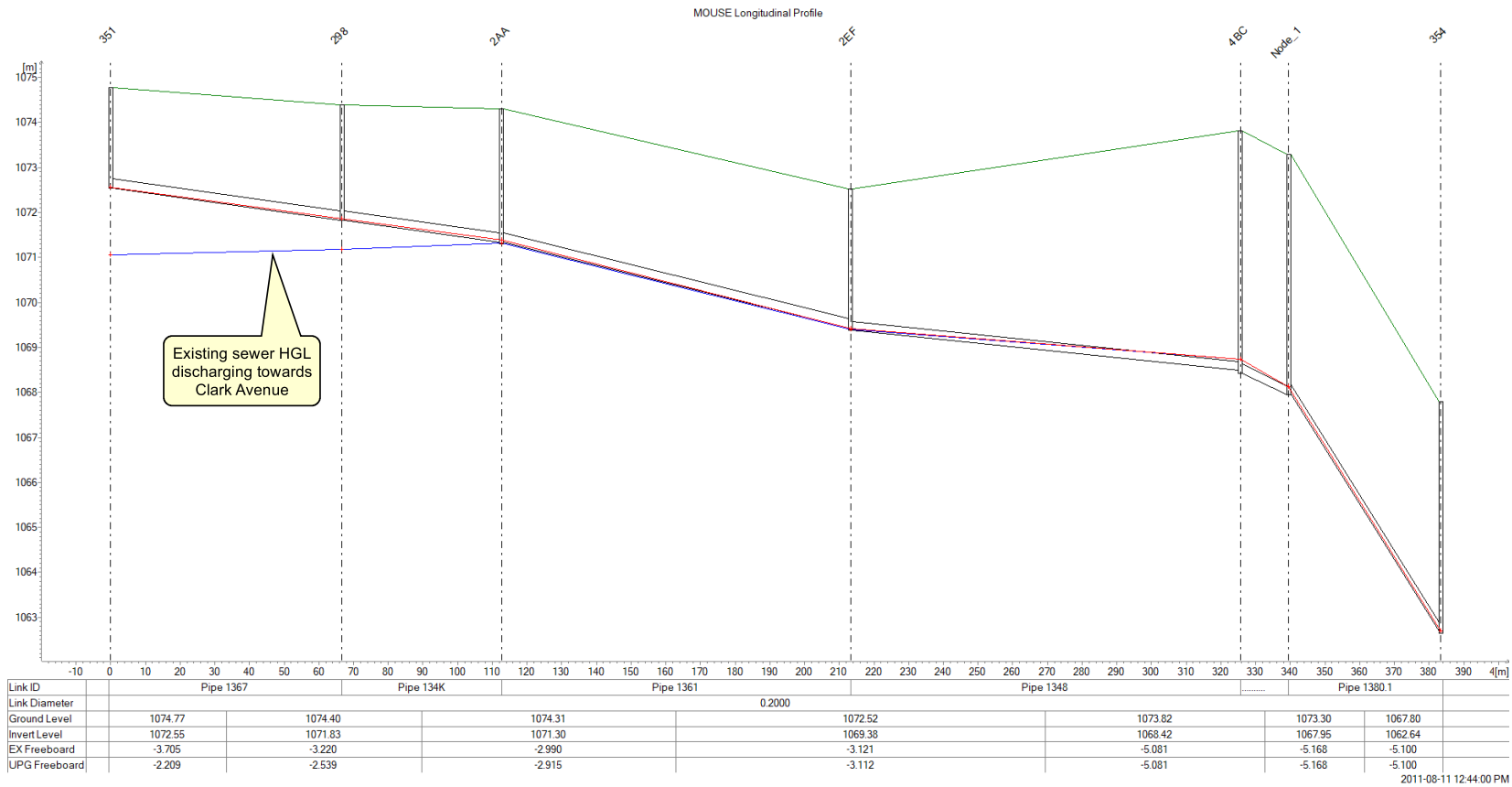


FIGURE 4.27
DEBOTTLENECKING SCENARIOS
CLARK AVENUE LONGITUDINAL PROFILE
SANITARY MASTER PLAN UPDATE

2011-08-11 12:44:00 PM
Date: 2024-02-28 Document: O:\Projects\08019_Okotoke_Sanitary_Master_Plan_Update\08019_Figures\1_Report\Figure 4.28 - Debottlenecking Scenarios - Mountain St and Patterson Road Longitudinal Profile.mxd



Legend

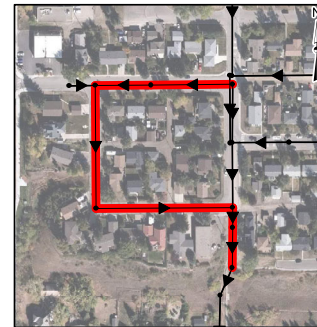
- Manhole
- ▬ Forcemain
- ▬ Siphon
- ▬ Gravity Sewer

Longitudinal Profile

Mountain St and Patterson Rd LP

Scenario

- Existing
- Upgraded



1:4,000
0 40 80 160 Meters

Coordinate System: CANA83-3TM114

FIGURE 4.28
DEBOTTLENECKING SCENARIOS
MOUNTAIN STREET AND PATTERSON ROAD
LONGITUDINAL PROFILE
SANITARY MASTER PLAN UPDATE



Date: 2024-02-28 Document: C:\projects\08016_Orooks_Sanitary_Master_Plan_Update\01_GIS\0201_Figure1 - Report\Figure 4.29 - Debottlenecking Scenarios - North Railway Street Upgrades.mxd



Legend

- Manhole
- ▶ 200mm Gravity Sewer
- ▶ 250mm Gravity Sewer
- ▶ 300mm Gravity Sewer
- ▶ 375mm Gravity Sewer
- North Railway Street Upgrade

Coordinate System:
CANA83-3TM114

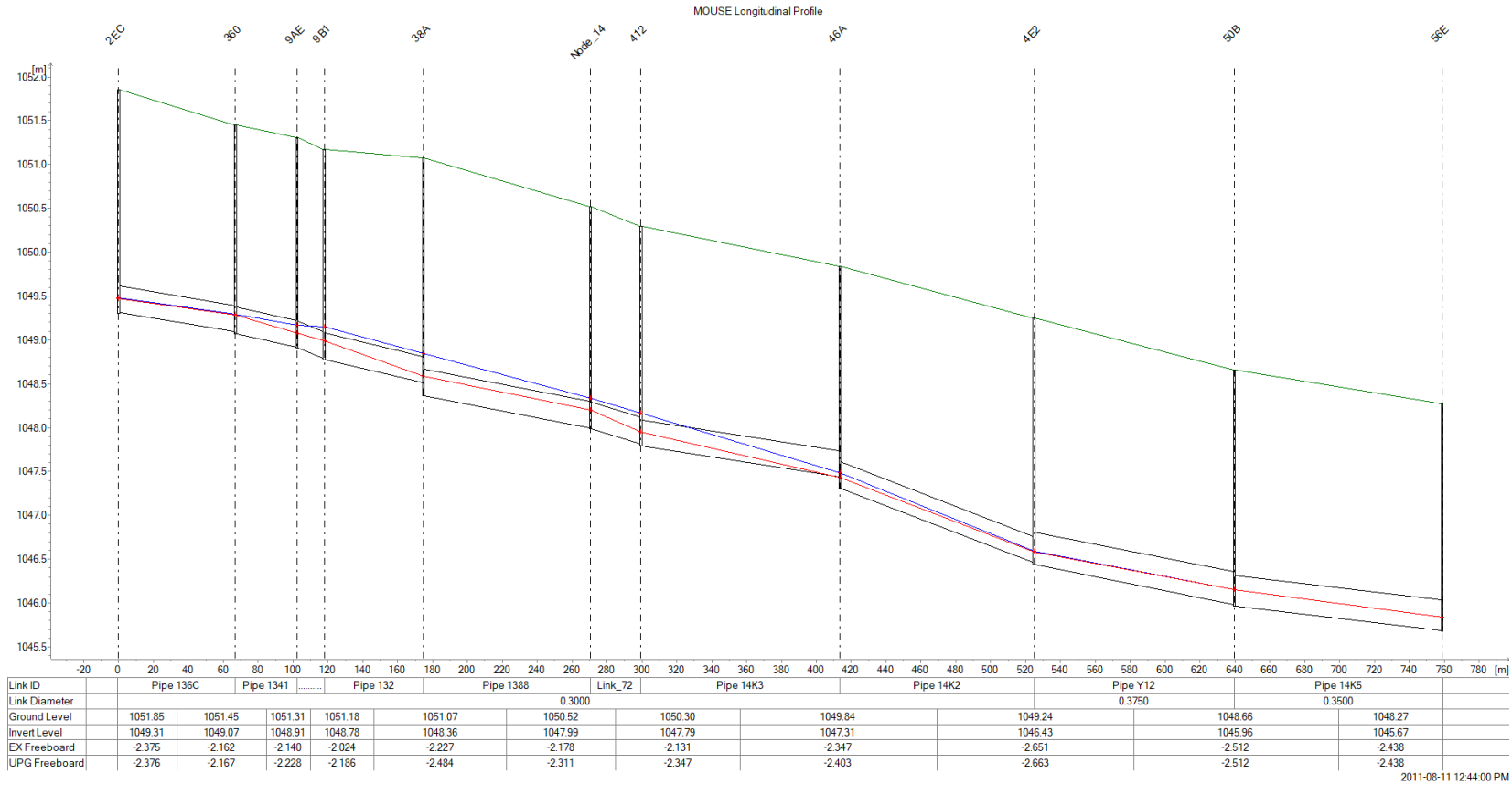
1:1,200

0 10 20 40 Meters

FIGURE 4.29
DEBOTTLENECKING SCENARIOS
NORTH RAILWAY STREET UPGRADES
SANITARY MASTER PLAN UPDATE



Date: 2024-02-28 Document: O:\Projects\00119_Okotoke_Sanitary_Master_Plan_Update\02_GIS\021_Figures\1_Report\Figure 4.30 - Debottlenecking Scenarios - North Railway Street Longitudinal Profile.mxd



Legend

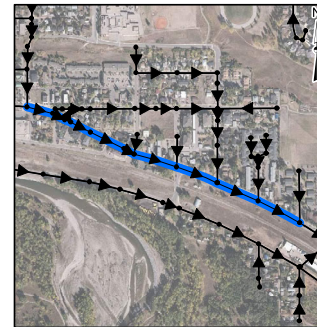
- Manhole
- ▬ Forcemain
- ▬ Siphon
- ▬ Gravity Sewer

Longitudinal Profile

▬ NRS LP

Scenario

- ▬ Existing
- ▬ Upgraded



1:12,500
0 135 270 540 Meters

Coordinate System: CANA83-3TM114

FIGURE 4.30
DEBOTTLENECKING SCENARIOS
NORTH RAILWAY STREET
LONGITUDINAL PROFILE
SANITARY MASTER PLAN UPDATE



Date: 2024-02-28 Document: C:\Projects\00110_Orooks_Sanitary_Master_Plan_Update\02_GIS\0201_Figure1_Reporting\Figure 4.38 - Debottlenecking Scenarios - North Railway Street Spare Capacity.mxd



Legend

- Manhole

Spare Capacity

- Less than 0L/s
- 0 - 25L/s
- 25 - 50L/s
- 50 - 75L/s
- 75 - 100L/s
- Greater than 100L/s

Note: Pipe labels represent spare capacity in L/s.

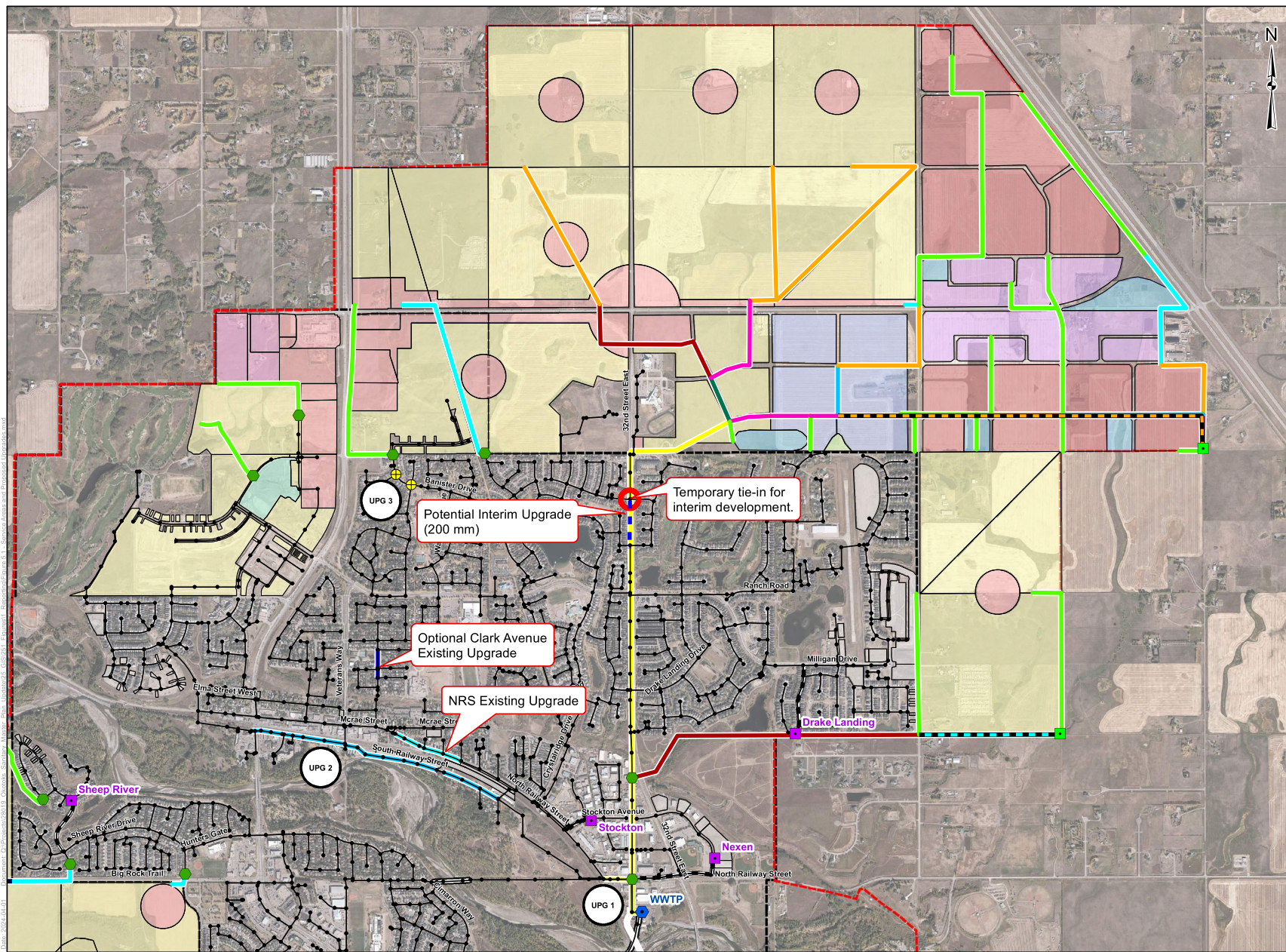
Coordinate System:
CANADA83-3TM114

1:1,200



FIGURE 4.31
DEBOTTLENECKING SCENARIOS
NORTH RAILWAY STREET
SPARE CAPACITY
SANITARY MASTER PLAN UPDATE





Legend

- Lift Station
- Proposed Lift Station
- Gravity Tie-in Location
- Wastewater Treatment Plant
- Proposed Plug To Divert Flows
- Manhole
- Sanitary Pipe
- Pre-Annexation Boundary
- Post-Annexation Boundary

Service Area by Land Use

- Densification
- Commercial
- Employment
- Green Space (Unserviced)
- Highway Business
- Industrial
- Institutional
- Residential
- SWMP (Unserviced)
- Surplus Industrial

Proposed Pipe Size

- 200mm Gravity Sewer
- 250mm Gravity Sewer
- 300mm Gravity Sewer
- 375mm Gravity Sewer
- 450mm Gravity Sewer
- 525mm Gravity Sewer
- 600mm Gravity Sewer
- 675mm Gravity Sewer
- 900mm Gravity Sewer
- 1050mm Gravity Sewer
- 200mm Forcemain
- 300mm Forcemain
- 375mm Forcemain

Coordinate System:
CANA83-3TM114

1:21,000

0 210 420 840 Meters

FIGURE 5.1
SERVICE AREAS AND
PROPOSED UPGRADES (12 UPA)
SANITARY MASTER PLAN UPDATE

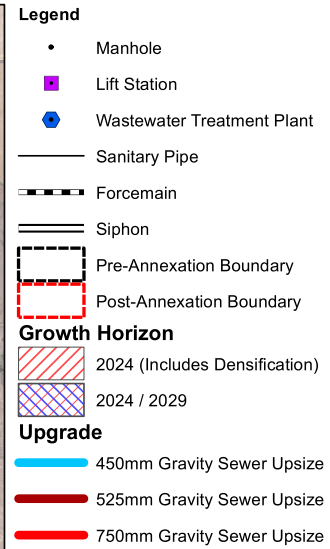
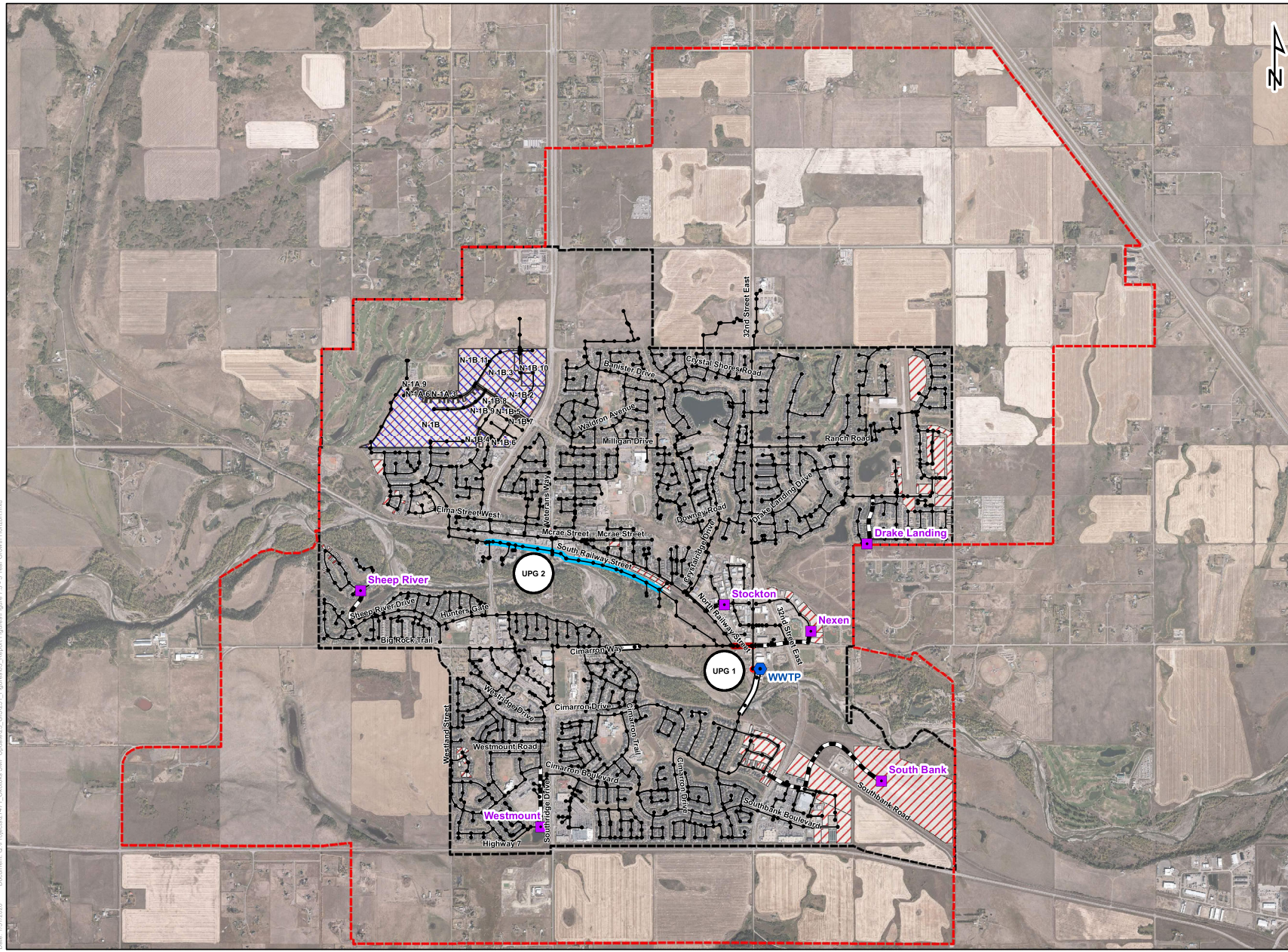




APPENDIX

Figures from Past Studies

A



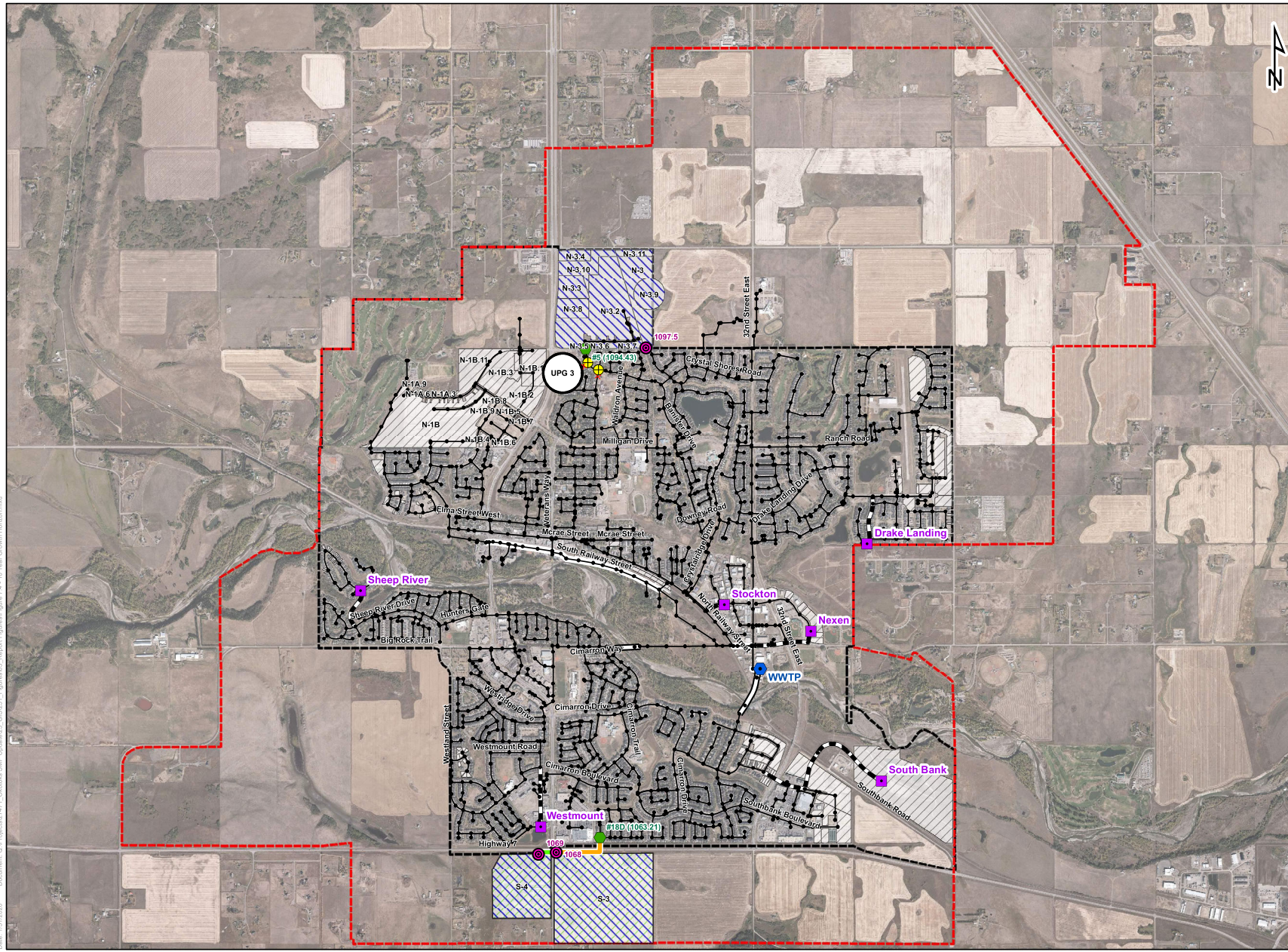
Coordinate System:
CANA83-3TM114

1:30,000



FIGURE 7.3
FIVE YEAR GROWTH HORIZON
SANITARY MASTER PLAN UPDATE





Legend

- Manhole
- Lift Station
- Wastewater Treatment Plant
- Gravity Tie-in Location
- Lowest Elevation Within Service Area
- Proposed Plug To Divert Flows

— Sanitary Pipe

--- Forcemain

— Siphon

--- Pre-Annexation Boundary

--- Post-Annexation Boundary

Growth Horizon

Developed Service Areas Prior to 2029

2029

2029 / 2044

Servicing Concept

250mm Gravity Sewer

375mm Gravity Sewer

*Infrastructure developed prior to the 10 year horizon shown in white.

Coordinate System:
CANA83-3TM114

1:30,000

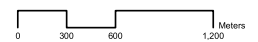


FIGURE 7.4
TEN YEAR GROWTH HORIZON
SANITARY MASTER PLAN UPDATE



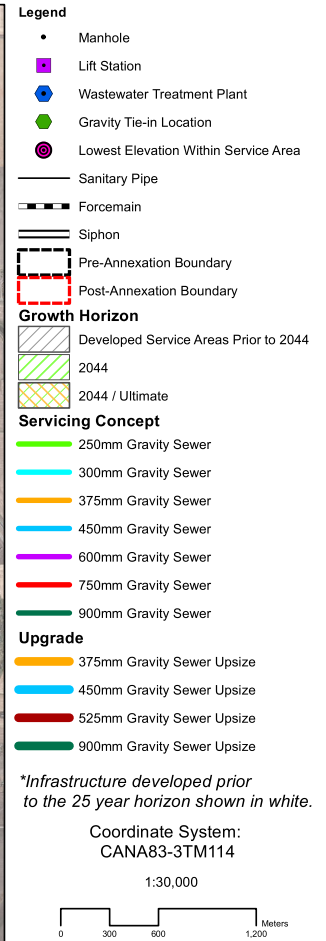
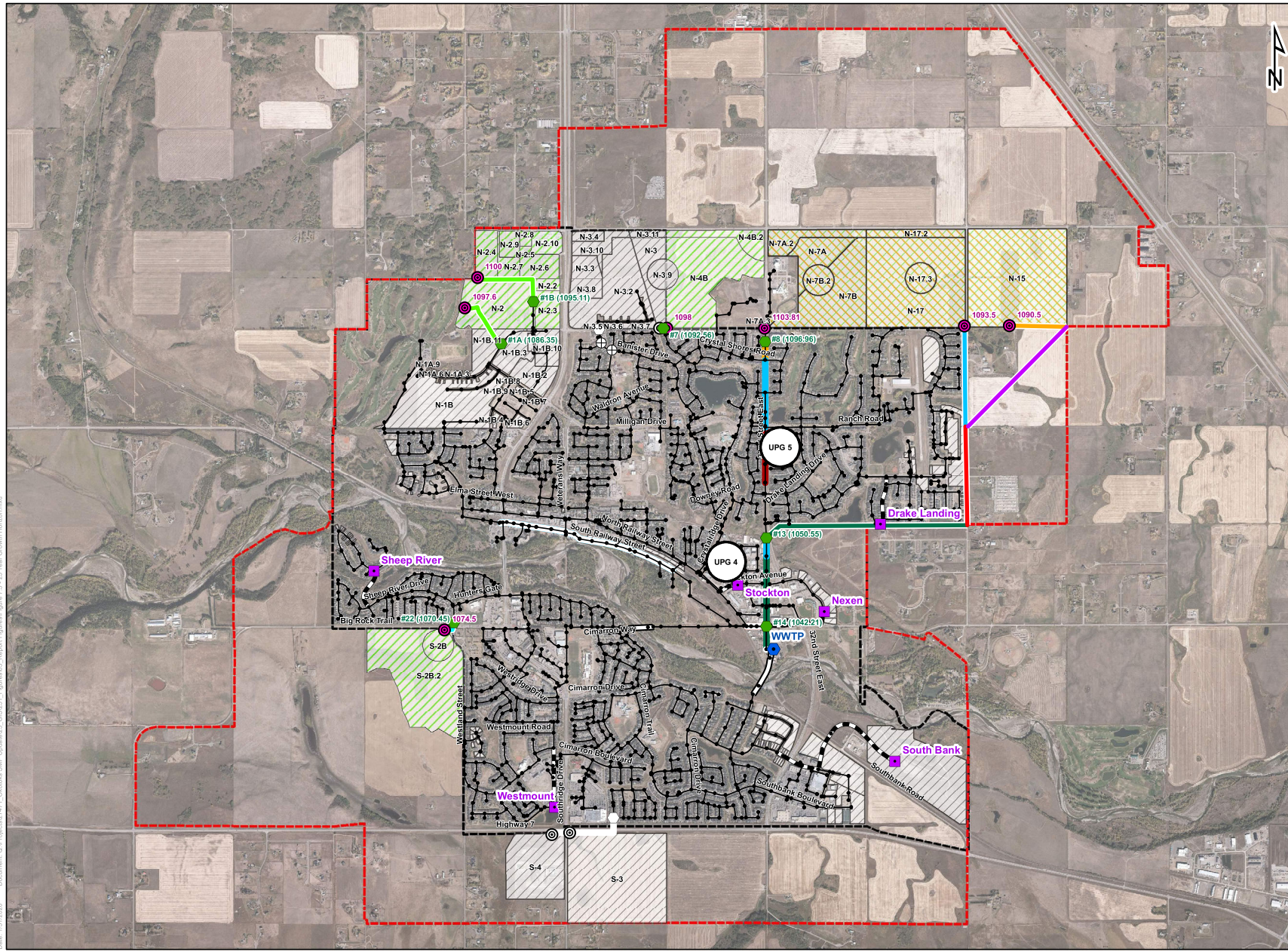


FIGURE 7.5
TWENTY-FIVE YEAR GROWTH HORIZON
SANITARY MASTER PLAN UPDATE



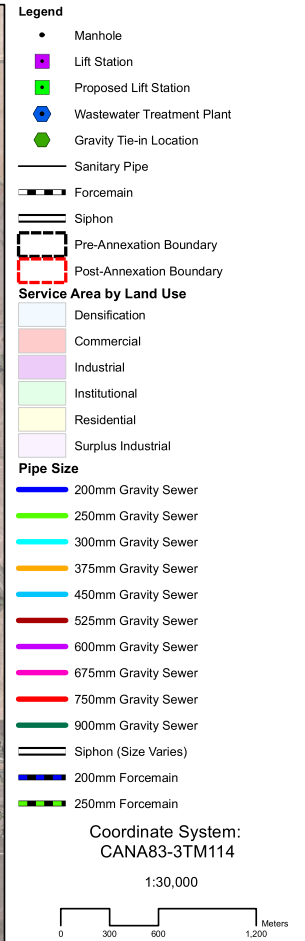
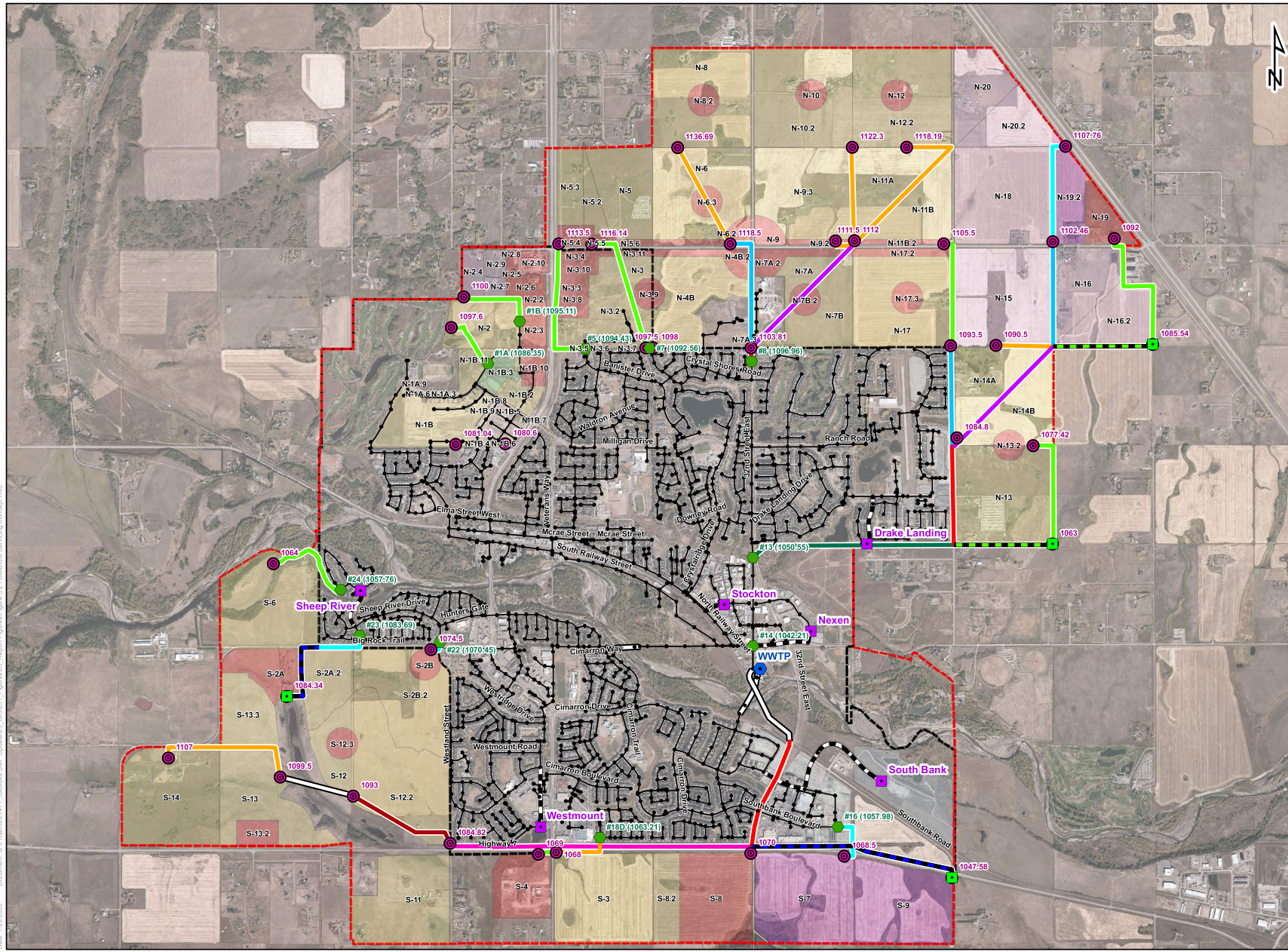
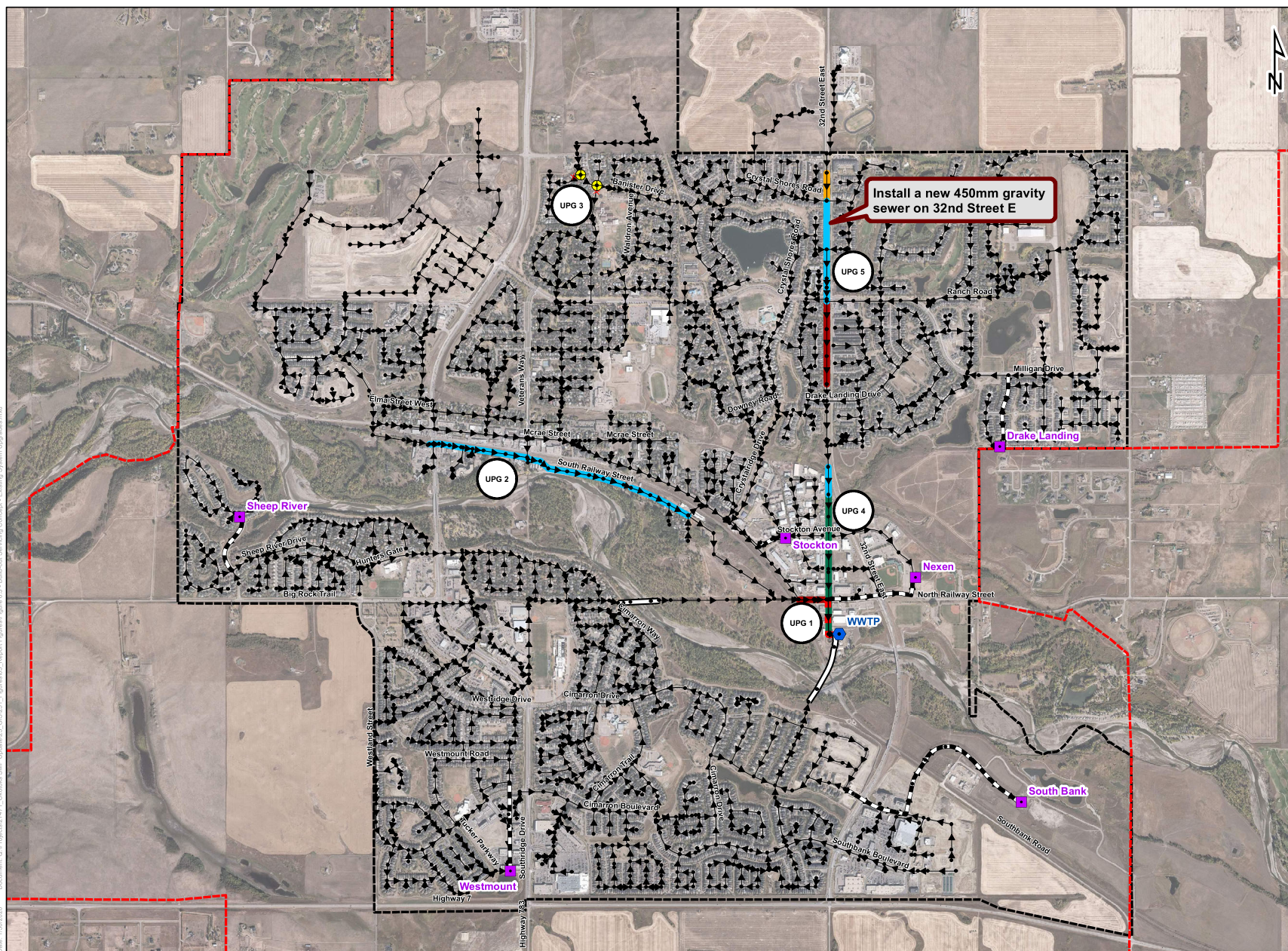


FIGURE 5.2
BUILD-OUT SERVICING CONCEPT
SANITARY MASTER PLAN UPDATE





- Legend**
- Manhole
 - Lift Station
 - ⬡ Wastewater Treatment Plant
 - ⊕ Proposed Plug To Divert Flows
 - Sanitary Pipe
 - Forcemain
 - Siphon
 - - - Pre-Annexation Boundary
 - - - Post-Annexation Boundary
- Upgrade**
- 375mm Gravity Sewer Upsize
 - 450mm Gravity Sewer Upsize
 - 525mm Gravity Sewer Upsize
 - 750mm Gravity Sewer Upsize
 - 900mm Gravity Sewer Upsize

Coordinate System:
 CANA83-3TM114

1:20,000



FIGURE 6.3
 BUILD-OUT GROWTH HORIZON
 RECOMMENDED UPGRADES
 TO EXISTING SYSTEM
 SANITARY MASTER PLAN UPDATE





APPENDIX

Detailed Cost Estimates

B



Items	Material	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
250 mm Gravity Sewer	PVC	8,326	Metres	\$365	\$3,039,105	\$911,732	\$592,626	\$4,550,000
300 mm Gravity Sewer	PVC	843	Metres	\$400	\$337,307	\$101,192	\$65,775	\$510,000
375 mm Gravity Sewer	PVC	5,289	Metres	\$445	\$2,353,812	\$706,144	\$458,993	\$3,520,000
450 mm Gravity Sewer	PVC	3,541	Metres	\$525	\$1,858,852	\$557,656	\$362,476	\$2,780,000
600 mm Gravity Sewer	PVC	792	Metres	\$780	\$617,956	\$185,387	\$120,501	\$930,000
675 mm Gravity Sewer	CONC	618	Metres	\$860	\$531,329	\$159,399	\$103,609	\$800,000
750 mm Gravity Sewer	CONC	271	Metres	\$940	\$254,474	\$76,342	\$49,622	\$390,000
900 mm Gravity Sewer	CONC	2,470	Metres	\$1,075	\$2,654,983	\$796,495	\$517,722	\$3,970,000
1050 mm Gravity Sewer	CONC	577	Metres	\$1,325	\$764,358	\$229,307	\$149,050	\$1,150,000
250 mm Forcemain	PVC	810	Metres	\$495	\$401,013	\$120,304	\$78,198	\$600,000
375 mm Forcemain	PVC	2,257	Metres	\$720	\$1,625,040	\$487,512	\$316,883	\$2,430,000
Lift Station (140 L/s)	N/A	1	Items	\$2,860,000	\$2,860,000	\$858,000	\$557,700	\$4,280,000
Lift Station (75 L/s)	N/A	1	Items	\$1,650,000	\$1,650,000	\$495,000	\$321,750	\$2,470,000
Pavement Rehabilitation (32 nd Street)	N/A	1,800	Metres	\$1,000	\$1,800,000	\$540,000	\$351,000	\$2,700,000
Pavement Rehabilitation - Alley (South of 32 nd Street to WWTP)	N/A	610	Metres	\$500	\$305,000	\$91,500	\$59,475	\$460,000
Grand Total:					\$21,053,230	\$6,315,969	\$4,105,380	\$31,540,000

Assumptions:

Costs herein are comparable to other municipalities.

Costs are representative of 2024 dollars.

Total costs have been rounded to the nearest \$10,000.



Items	Material	Quantity	Units	Unit Cost	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost
250 mm Gravity Sewer	PVC	8,245	Metres	\$365	\$3,009,326	\$902,798	\$586,819	\$4,500,000
300 mm Gravity Sewer	PVC	925	Metres	\$400	\$369,942	\$110,983	\$72,139	\$560,000
375 mm Gravity Sewer	PVC	5,003	Metres	\$445	\$2,226,133	\$667,840	\$434,096	\$3,330,000
450 mm Gravity Sewer	PVC	1,087	Metres	\$525	\$570,583	\$171,175	\$111,264	\$860,000
525 mm Gravity Sewer	PVC	2,741	Metres	\$625	\$1,712,979	\$513,894	\$334,031	\$2,570,000
600 mm Gravity Sewer	PVC	188	Metres	\$780	\$146,934	\$44,080	\$28,652	\$220,000
675 mm Gravity Sewer	CONC	1,222	Metres	\$860	\$1,050,660	\$315,198	\$204,879	\$1,580,000
900 mm Gravity Sewer	CONC	271	Metres	\$1,075	\$291,021	\$87,306	\$56,749	\$440,000
1050 mm Gravity Sewer	CONC	3,047	Metres	\$1,325	\$4,036,779	\$1,211,034	\$787,172	\$6,040,000
300 mm Forcemain	PVC	810	Metres	\$585	\$473,924	\$142,177	\$92,415	\$710,000
375 mm Forcemain	PVC	2,257	Metres	\$720	\$1,625,098	\$487,529	\$316,894	\$2,430,000
Lift Station (140 L/s)	N/A	1	Items	\$2,860,000	\$2,860,000	\$858,000	\$557,700	\$4,280,000
Lift Station (92 L/s)	N/A	1	Items	\$2,020,000	\$2,020,000	\$606,000	\$393,900	\$3,020,000
Pavement Rehabilitation (32 nd Street)	N/A	1,800	Metres	\$1,000	\$1,800,000	\$540,000	\$351,000	\$2,700,000
Pavement Rehabilitation - Alley (South of 32 nd Street to WWTP)	N/A	610	Metres	\$500	\$305,000	\$91,500	\$59,475	\$460,000
Grand Total:					\$22,498,379	\$6,749,514	\$4,387,184	\$33,700,000

Assumptions:

Costs herein are comparable to other municipalities.

Costs are representative of 2024 dollars.

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