City of Lloydminster

Sanitary Sewer Master Plan

Final Report

September 2024

ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

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4015 7 Street SE, Calgary AB T2G 2Y9, T: 403.254.0544 F: 403.254.9186

September 10, 2024

Our Reference: 28114

City of Lloydminster
4420 50 Avenue
Lloydminster, AB/SK
T9V 0W2

Attention: James Rogers, P.Eng., Senior Manager, Capital Infrastructure

Dear J. Rogers:

Reference: City of Lloydminster Sanitary Sewer Master Plan – Final Report

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Enclosed is the Final Report for the City of Lloydmindster's Sanitary Sewer Master Plan. We trust that it meets your needs.

The key objective of the Sanitary Sewer Master Plan is to complete a review of the City's existing sanitary sewer collection system and assess its capacity to convey the current and future growth sanitary flow volumes effectively.

The Sanitary Sewer Master Plan will provide the City of Lloydminster with direction on infrastructure implementation and associated timelines to service future growth, while ensuring infrastructure remains fully functional in providing an appropriate level of service. This information will aid in making informed decisions on capital projects and will provide solutions for efficient, economic, and sustainable municipal services to residents and businesses.

We sincerely appreciate the opportunity to undertake this project on behalf of the City of Lloydminster. Should you have any questions or concerns, please do not hesitate to contact the undersigned at 403.254.5044

Sincerely,

Geoffrey Schulmeister, P.Eng., SCPM
General Manager, Water and Environment

Corporate Authorization

This document entitled “Sanitary Sewer Master Plan” has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of City of Lloydminster. 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.

November 22 2024

Sarah Barbosa, P.Eng., ENV SP
Project Lead

Permit to Practice
ISL Engineering and Land Services Ltd.

RM Signature: _____
RM APEGA ID: 66731
Date: 2024 November 26

Permit Number P4741
The Association of Professional Engineers and Geoscientists of Alberta

Geoffrey Schulmeister, P.Eng., SCPM
Project Manager

Territory Acknowledgement

City of Lloydminster

The City of Lloydminster acknowledges that we are located on Treaty 6 Territory, and the City of Lloydminster respects the histories, languages, and cultures of First Nations, Metis, Inuit, and all First Peoples of Canada, whose presence continues to enrich our vibrant community.

ISL Engineering and Land Services Ltd.

ISL Engineering and Land Services Ltd. acknowledges that our Calgary office and work takes place on the ancestral, traditional, and present-day territory of the Treaty 7 Nations of Southern Alberta. The confluence of the Bow and Elbow Rivers has been an important meeting place for Indigenous peoples since time immemorial, and we honour the Siksika, Piikani, and Kainai Nations of the Blackfoot Confederacy, the Bearspaw, Chiniki, and Goodstoney First Nations of the Stoney Nakoda Nations, and the Tsuut'ina Nation. We also acknowledge that this is the homeland of the Métis Nation of Alberta, Region 3.

Executive Summary

E1.0 Introduction

The City of Lloydminster (City) retained ISL Engineering and Land Services Ltd. (ISL) to complete a review of its existing sanitary sewer collection system and assess its capacity to convey the current and future growth sanitary flow volumes effectively. A review and assessment of both the condition and capacity of the sanitary sewer collection system was conducted to generate an updated Sanitary Sewer Master Plan (SSMP).

E2.0 Report Summary

The overall SSMP is summarized as follows:

- **Purpose and scope of the Sanitary Sewer Master Plan (SSMP):** The SSMP is a comprehensive review and assessment of the existing and future sanitary sewer collection system in the City of Lloydminster. It aims to inventory and analyze the existing infrastructure, calibrate and update the hydraulic model, prepare capacity assessments, develop servicing plans, and provide a framework for future capital planning.
- **Study area:** The study area covers 24 neighbourhoods and approximately 23.5 quarter sections of recently annexed land, with a total area of about 5,870 ha. The study area is divided by the Alberta/Saskatchewan border and is located within the North Saskatchewan River Basin. The development type is classified by several land use districts, such as residential, commercial, industrial, and public service.
- **Population horizons and growth projections:** The SSMP considers six population horizons for the existing and future sanitary sewer collection system assessment, ranging from 2021 to 2051. The growth populations are based on an annual growth rate of 2.2%, a target population allocation of 70% to Alberta and 30% to Saskatchewan, and the anticipated development timelines for each area. The growth projections also account for residential densification, employment population, and land use densities.
- **Design criteria and level of service:** The SSMP uses the existing Sanitary Sewer Master Plan (AECOM, 2016), the City's Municipal Development Standards, and typical municipal servicing standards as the sources for the design criteria. The level of service for the sanitary sewer collection system is based on a Type 4 Huff design storm with a 1:25 year 24-hour return period. The performance of the sanitary sewer collection system is assessed in terms of peak discharge relative to pipe capacity and maximum hydraulic grade line elevation relative to ground.
- **Existing sanitary sewer collection system and hydraulic model development:** The existing sanitary sewer collection system consists of approximately 193 km of sanitary sewers, mostly made of PVC or VCT, with diameters ranging from 100 mm to 1350 mm. The sanitary sewer collection system has several trunk sewers that convey flows to the Wastewater Treatment Plant. The hydraulic model was constructed from scratch using the City's GIS data, record drawings, and assumptions as necessary. The model was calibrated using flow monitoring and rainfall data for both dry and wet weather conditions.
- **Existing sanitary sewer collection system assessment and proposed capacity upgrades:** The existing sanitary sewer collection system assessment identified areas of concern where the sanitary sewer collection system is surcharged or over capacity under different design storm scenarios. The assessment also estimated the inflow and infiltration rates based on the monitored and modelled data.

The proposed capacity upgrades include pipe upsizing, slope adjustments, and flow redirections at thirteen (13) locations in the system. The upgrades aim to resolve the capacity constraints and provide a sufficient level of service for the existing population. Seven (7) upgrades related to condition of pipes are also recommended.

- **Future sanitary sewer collection system assessment and proposed concepts:** Two future servicing concepts are developed, with a recommendation provided as to a preferred concept. System assessments were completed to ensure performance of existing sewers under future development conditions. Costing is also provided for future concepts as well as existing system upgrades as well as proposed staging.
- **Capital Planning:** Based upon recommended upgrades and provided staging, a proposed capital planning table is included noting upgrades and recommended timelines for implementation for consideration in the City's overall capital plan.

E3.0 SSMP Conclusions

Conclusions for the sanitary sewer collection system are as follows:

- Significant inflow and infiltration was identified at Sites 7, 9, 12, and 14. Most other sites were within typical design guidelines of 0.28 L/s/ha or less.
- Flow monitoring and rain gauge data collected in 2022 indicated that no major rainfall events occurred during the monitoring period, as all storms were less than a 1:2 year return period.
- DWF and WWF calibration was undertaken for the 2022 monitoring period. Successful calibration was achieved based on agreement between the observed and modelled data.
- The sanitary sewer collection system was evaluated in terms of various return period events, with the level of service event identified as the 1:25 year design storm event.
- Thirteen (13) locations were flagged as areas of concern under the level of service event.
- A CCTV inspection program was undertaken in various areas of the city, covering a range of sewer installation years, materials, and pipe diameters. Pipe conditions were documented and flagged for repairs or maintenance depending on their condition rating.
- A risk assessment was undertaken to prioritize the capacity and condition upgrades recommended under existing sanitary sewer collection system conditions.
- The proposed sanitary sewer collection system is comprised of gravity sewers, lift stations, and forcemains to service future growth areas.
  - Two concepts were evaluated to service future areas: Concept 1 and Concept 2. The main difference between the two concepts is the ultimate tie-in point of one single-family quarter section on the west side of the city.
  - In Concept 1 it is tied-into the existing sanitary infrastructure and in Concept 2 it is routed to the proposed South Trunk.
  - Concept 1 was selected as the recommended option as it allows greater flexibility regarding staging of the quarter section.
- Under Ultimate Boundary Growth conditions, the existing sanitary sewer collection system was generally found to perform adequately.
  - Some surcharging was noted in seven (7) areas across the two concepts, however, in many cases the surcharging was minor.
  - Upgrades for three (3) of the seven (7) noted areas were recommended.

- The future network assumes all the recommended existing sanitary sewer collection upgrades are implemented. Therefore, these upgrades should be completed prior to any substantial densification or future development.

- Hydraulic assessment of the proposed sanitary sewer collection system is sufficient in managing sewage generated from the future development areas given that all proposed upgrades are implemented.

E4.0 SSMP Recommendations

Recommendations for the sanitary sewer collection system are as follows:

- Prioritize upgrades to the existing sanitary sewer collection system based on the order documented in Table 6.11.
  - To mitigate surcharging in the existing sanitary sewer collection system, implement the necessary upgrades recommended under the LOS design storm scenario.
  - Remediate the pipes flagged as being in poor condition from the CCTV inspections.
- Continue condition assessments and flow monitoring and aligning infrastructure upgrades with development and roadworks programs to minimize costs.
- Conduct an inflow-infiltration field investigation program to pinpoint the sources of I-I. Field investigation could consist of smoke testing, micro flow monitoring, dye testing and CCTV inspections.
  - Once the field investigation is completed and areas of sources of I-I have been identified, these issues should be mitigated.
  - Additional flow monitoring and WWF calibration would be required following the program to update the runoff and I-I model parameters.
- Preferred servicing future concept recommended is Concept 1. Recommended staging of Concept 1 for the 5-, 10-, and 20-Year Growth Horizons are shown in Figures 7.12 to 7.14, respectively.
  - The future sanitary sewer collection system should be designed based on the City's Municipal Development Standards (City of Lloydminster, 2020).
- The SSMP should be reviewed and updated after significant periods of growth or every five years to update the hydrodynamic model and analysis with any capital upgrades completed by the City, and the most up-to-date growth plans. This could provide clarity on the planned location of development, the density of the proposed development, and the potential corresponding upgrades. This will ensure capacity is maintained and staging upgrades are advancing as needed.

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APPENDICES

TABLES

FIGURES

ACRONYMS

Acronym	Description
AEPA	Alberta Environment and Protected Areas
ASP	Area Structure Plan
CCTV	closed-circuit television
City	City of Lloydminster
CIWEM	Chartered Institution of Water and Environmental Management
CN	Canadian National
CONC	concrete
CPR	Canadian Pacific Railway
DWF	dry weather flow
GIS	geographic information system
HGL	hydraulic grade line
ICI	industrial, commercial, institutional
IDF	intensity duration frequency
I-I	inflow and infiltration
ISL	ISL Engineering and Land Services Ltd.
LiDAR	light detection and ranging
LOS	level of service
LP	longitudinal profile
McGill's	McGill's Industrial Services
No.	number
PVC	polyvinyl chloride
Q/Q_{man}	peak discharge relative to sewer capacity
QA/QC	quality assurance/quality control
RDII	rainfall dependent inflow-infiltration
SSMP	Sanitary Sewer Master Plan
STL	steel
VCT	vitrified clay tile
WaPUG	Wastewater Planning Users Group
WWF	wet weather flow
WWTP	Wastewater Treatment Plant

UNITS

Unit	Description
$	dollars
%	percentage
ha	hectares
hr	hour
km	kilometre
L/ha/d	litres per hectare per day
L/p/d	litres per person per day
L/s	litres per second
L/s/ha	litres per second per hectare
m	metre
m/s	metres per second
mm	millimetre
mm/hr	millimetre per hour

1.0 Introduction

1.1 Authorization

The City of Lloydminster (City) retained ISL Engineering and Land Services Ltd. (ISL) to complete a review of its existing sanitary sewer collection system and assess its capacity to convey the current and future growth sanitary flow volumes effectively. A review and assessment of both the condition and capacity of the sanitary sewer collection system was conducted to generate an updated Sanitary Sewer Master Plan (SSMP).

1.2 Background

The SSMP was most recently updated in 2016. Since then, the city limits have been expanded via the 2022 Annexation Lands along with various sanitary sewer collection system upgrades or replacements being completed. The expected additional sanitary flows driven by expansion through annexation and population growth of the city, in conjunction with the normal deterioration of pipe condition and system upgrades that have occurred since 2016, are sufficient reasons to require this updated SSMP.

The updated SSMP will help the City understand the implications of servicing new developments by understanding each area's servicing approach and constraints. By completing a comprehensive review of the available background data and sanitary sewer collection system hydraulic model, maintaining consistent approaches to issues, and using sound engineering principles, while all the time protecting the natural and human environment, the updated SSMP will guide effective infrastructure improvement and expansion. The updated SSMP will also examine the capacity of the sanitary sewer collection system to determine the extent of upgrades required to maintain an appropriate level of service for existing and future residents and businesses.

1.3 Purpose of Study

The purpose of developing an updated SSMP is outlined as follows:

- Inventory and analyze the existing infrastructure under existing conditions;
- Convert and update the City's existing hydraulic model;
- Calibrate the City's hydraulic model under dry weather flow (DWF) and wet weather flow (WWF) conditions to accurately represent the flow conditions within the City's existing sanitary sewer collection system;
- Use the calibrated hydraulic model to prepare capacity assessments of the existing sanitary sewer collection system under current and future growth conditions;
- Develop servicing plans for future growth. Locations and timing may be dependent on the following:
  - Availability of sufficient servicing needs;
  - Annexed land locations; and
  - Community planning;
- Determine what upgrades are required to the existing sanitary sewer collection system based on condition and capacity assessments and recommend future servicing options; and
- Provide a framework for future sanitary sewer collection system capital planning, including cost estimates and possible staging of infrastructure installations.

2.0 Study Area

2.1 Location

The city is divided by the Alberta/Saskatchewan border and is located approximately 250 km east of the City of Edmonton. The city is bordered by the County of Vermilion River No. 24 on the Alberta side and both the Rural Municipalities of Britannia No. 502 and Wilton No. 472 on the Saskatchewan side. The Yellowhead Highway (Highway 16) is an interprovincial highway that connects Manitoba to British Columbia through Lloydminster and is known as 44 Street/Ray Nelson Drive within city limits. Highway 17 runs north/south through Lloydminster along the Alberta/Saskatchewan border and is known as 50 Avenue within city limits. The study area is shown in Figure 2.1.

The study area encompasses 24 neighbourhoods, as well as approximately 23.5 quarter sections of recently annexed land (shown in Figure 2.2). Not all existing neighbourhoods are fully developed; therefore, future growth is anticipated both within these neighbourhoods and within the recently annexed land. The study area encompasses a total area of approximately 5,870 ha.

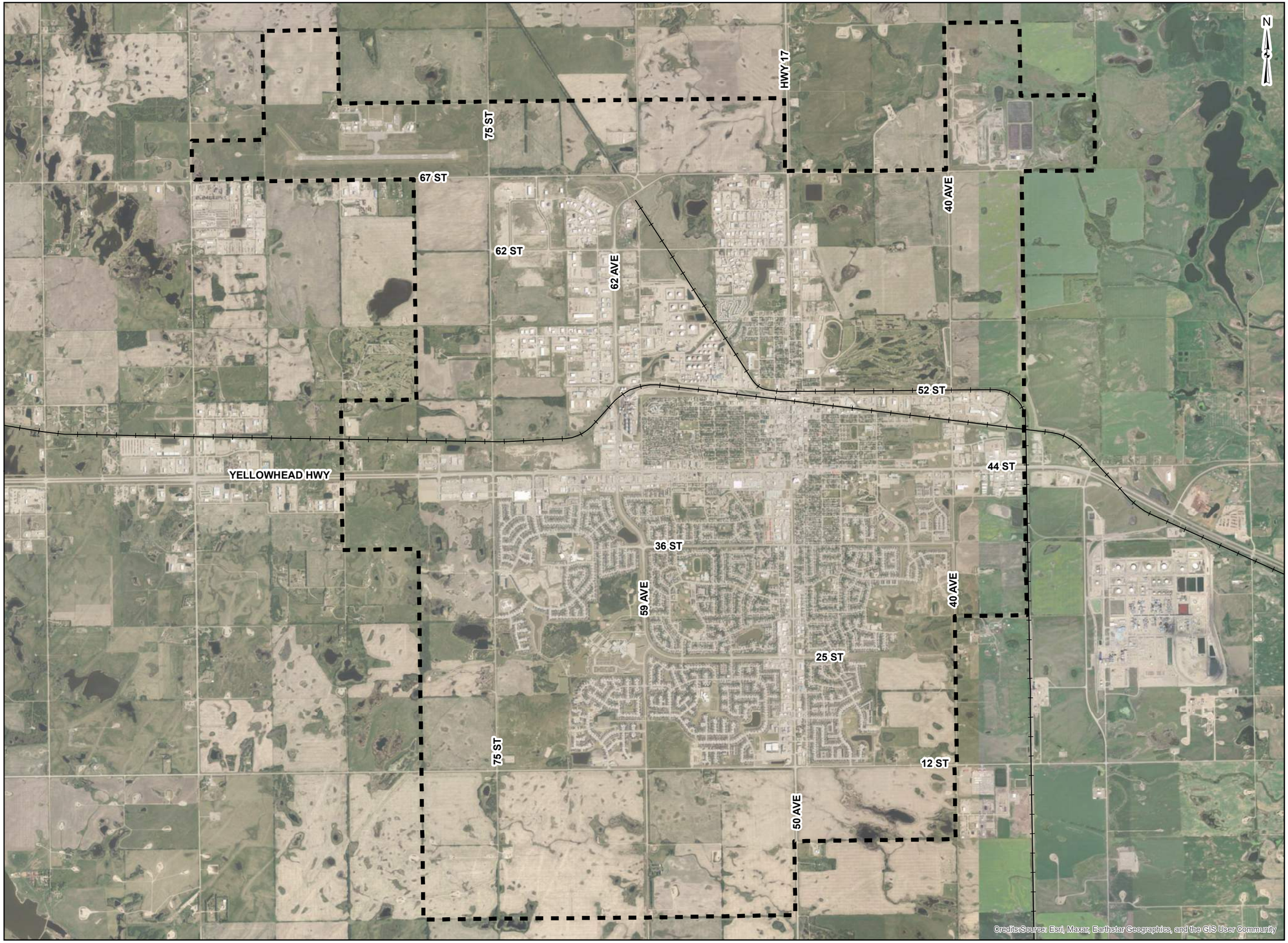
The highest elevation areas within city limits are approximately 670 m in elevation and located within the northwest and southwest corners of the city. The lowest elevation area within city limits is the northeast corner of the city at an elevation of approximately 615 m. The topography of the study area is shown in Figure 2.3.

The study area is located almost entirely within the Central North Saskatchewan River Watershed with the southwest corner of the study area adjacent to the boundary of the Battle River Watershed. Both watersheds are part of the North Saskatchewan River Basin, which is part of the Nelson-Churchill (Hudson Bay) Continental Drainage Basin. A map of the watershed boundaries is shown in Figure 2.4.

2.2 Development Type

The development type influences sanitary effluent generation rates and diurnal patterns; therefore, obtaining an appropriate classification was vital in ensuring that an accurate representation of the City's sanitary sewer collection system could be achieved. When determining development classifications for existing areas within the city, a land use district shapefile provided by the City was used.

A land use district map for existing development is illustrated in Figure 2.5, while Table 2.1 summarizes all land use district codes and their corresponding descriptions. The land uses were compared to aerial maps and Google Street View to confirm that parcels were properly categorized. For the purposes of the project, many of these land use districts were grouped together to form an overall land use. In this manner, the City was classified more broadly by several unique development types, including residential, commercial, industrial, and public service.



Legend

Railway

Study Area

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 2.1
STUDY AREA
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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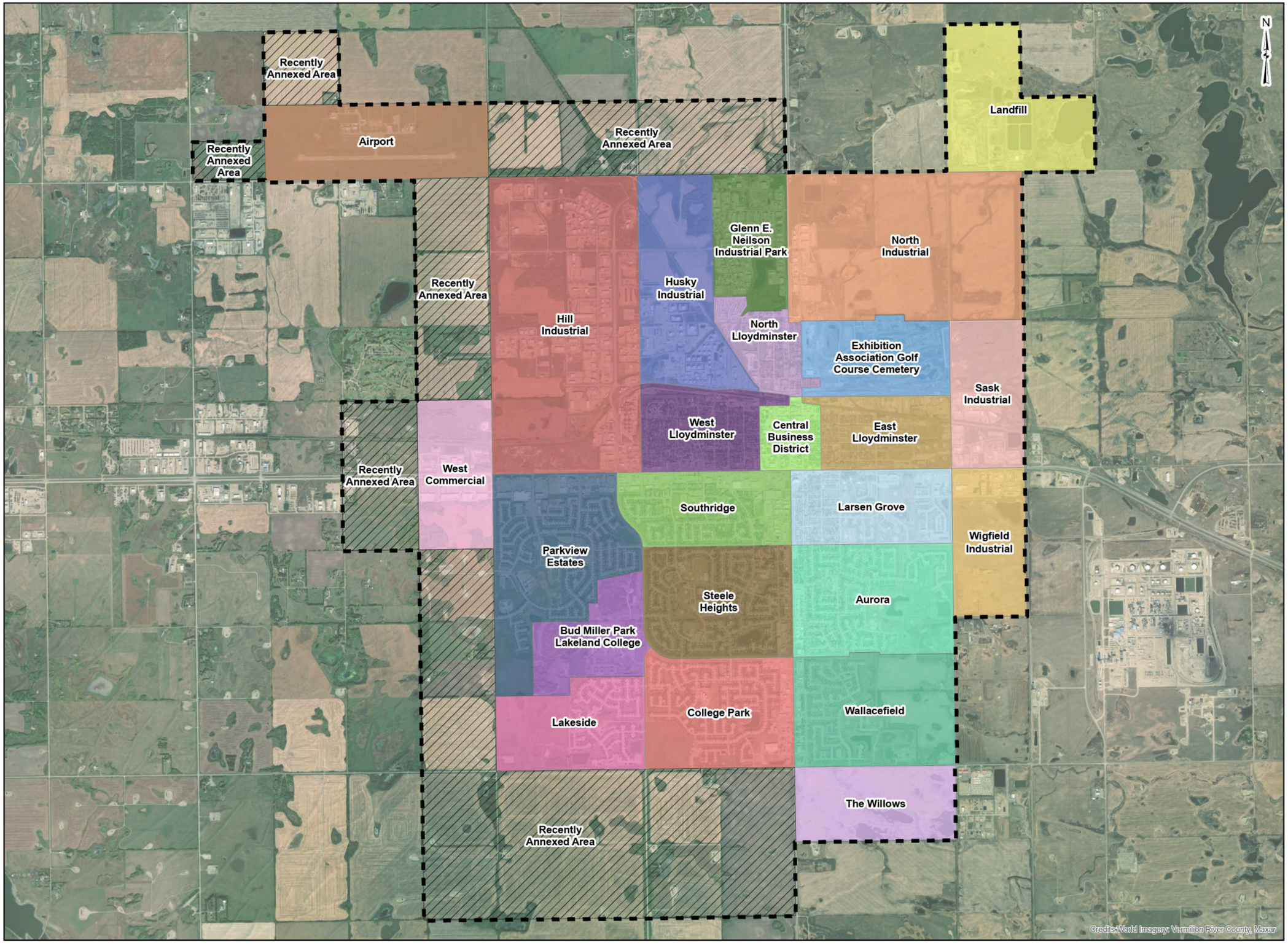

Legend

- Study Area

Neighbourhood

- Airport
- Aurora
- Bud Miller Park Lakeland College
- Central Business District
- College Park
- East Lloydminster
- Exhibition Association Golf Course Cemetery
- Glenn E. Neilson Industrial Park
- Hill Industrial
- Husky Industrial
- Lakeside
- Landfill
- Larsen Grove
- North Industrial
- North Lloydminster
- Parkview Estates
- Sask Industrial
- Southridge
- Steele Heights
- The Willows
- Wallacefield
- West Commercial
- West Lloydminster
- Wigfield Industrial
- Recently Annexed

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 2.2
EXISTING NEIGHBOURHOODS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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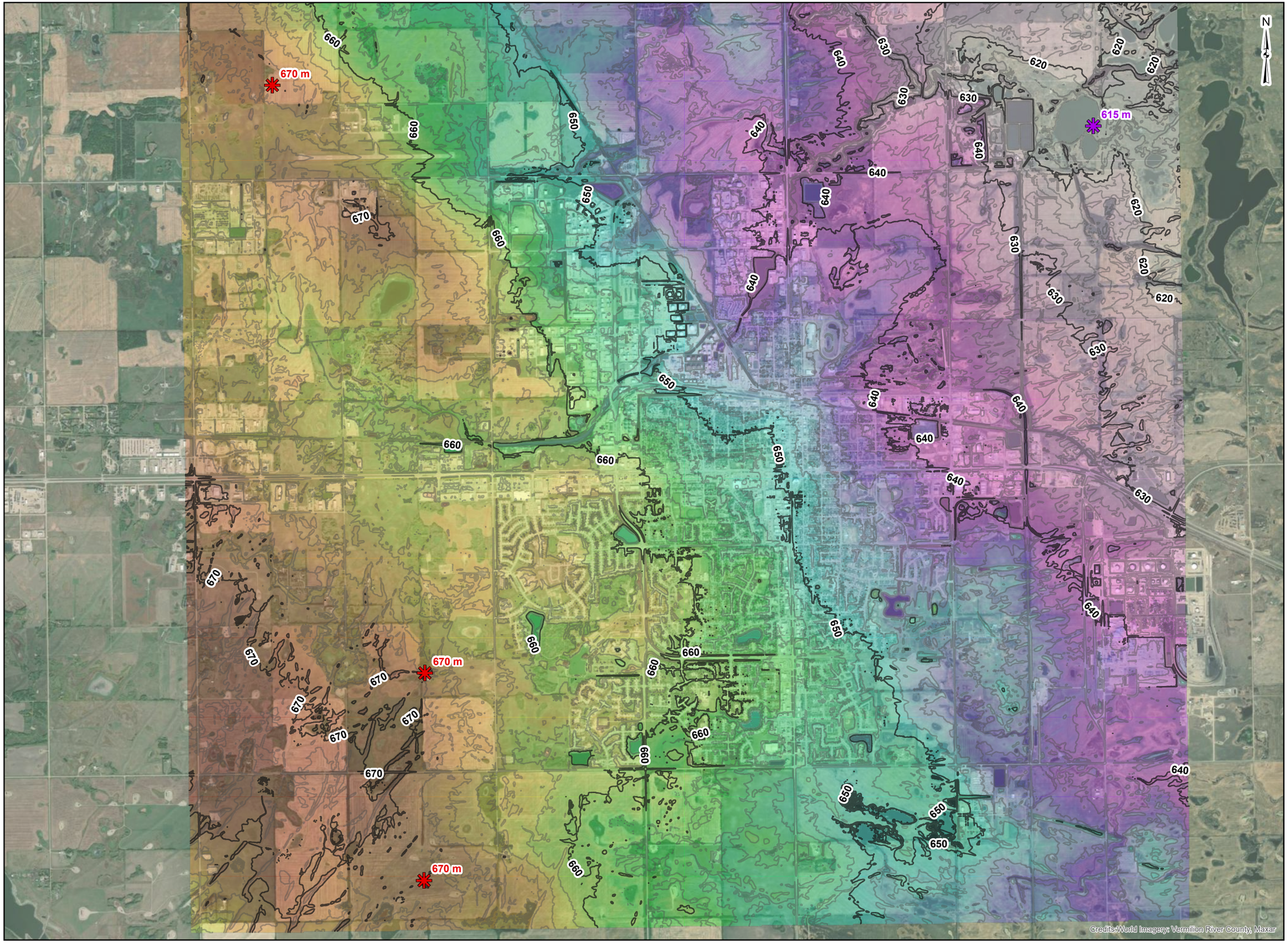

Legend

- Maximum Elevation Point
- Minimum Elevation Point
- Major Contour - 10m Interval
- Minor Contour - 2m Interval
- Study Area

Elevation (m)

High : 676.38

Low : 615.174

Note: LiDAR data was acquired on 2019-04-18

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 2.3
TOPOGRAPHY
LLOYDMINSTER SANITARY SEWER MASTER PLAN

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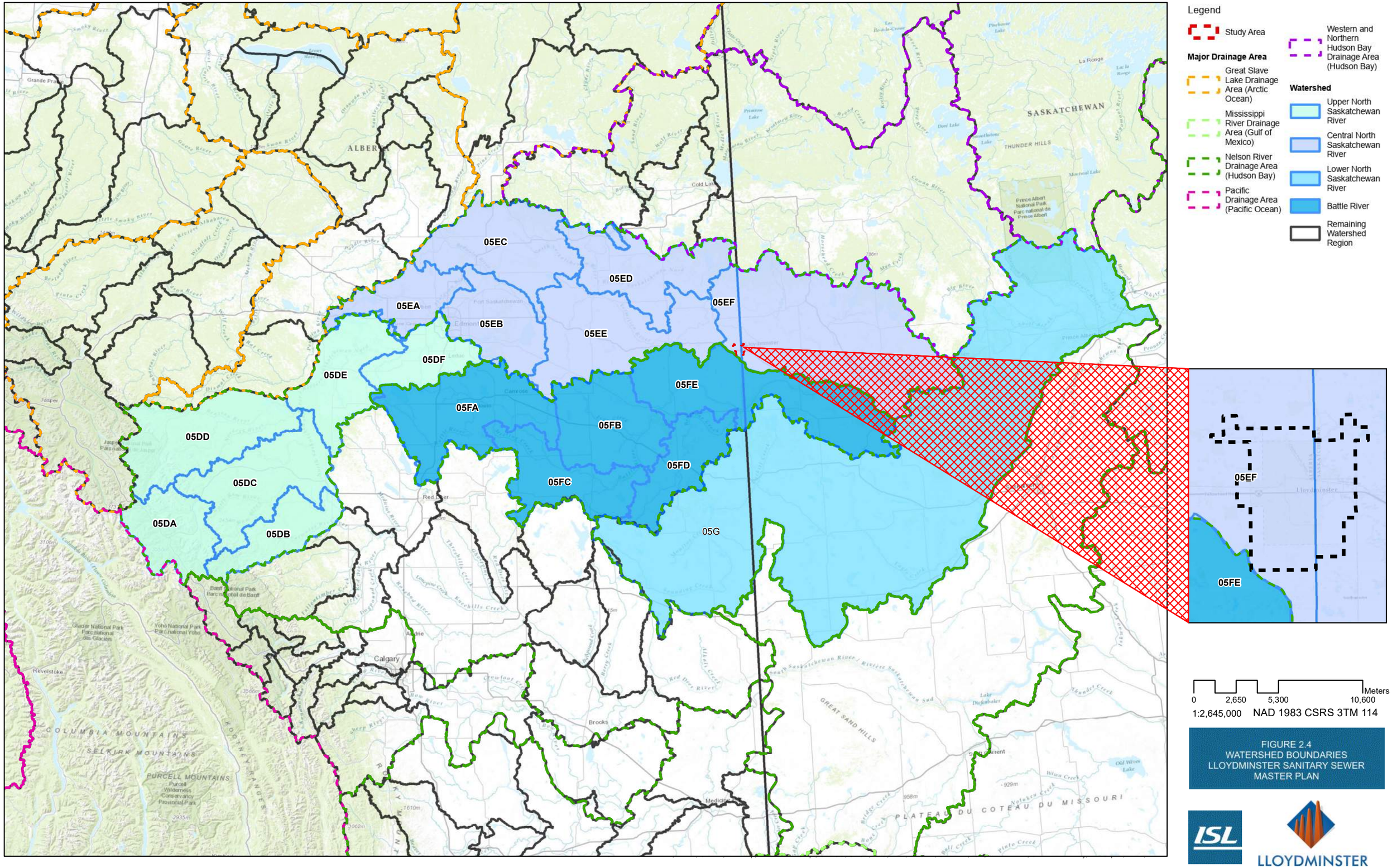

FIGURE 2.4
WATERSHED BOUNDARIES
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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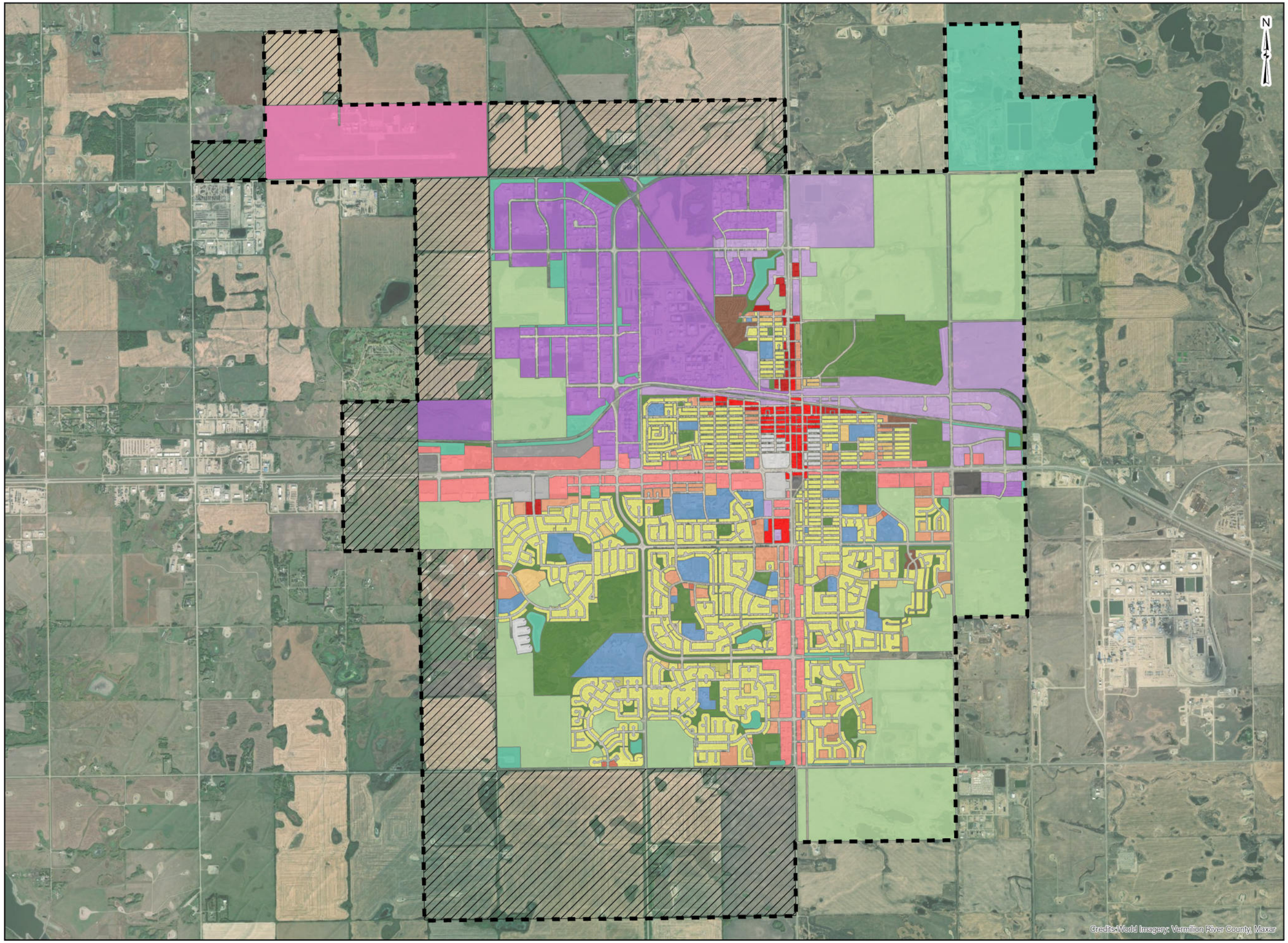

Legend

Study Area

Existing Land Use

- R1: Single-Detached Residential
- R2: Semi-Detached Residential
- R3: Row House Residential
- R4: Medium-Density Residential
- R5: High-Density Residential
- RMH: Residential Manufactured Home
- C1: Central Commercial
- C2: Highway Corridor Commercial
- C3: Neighbourhood Commercial
- C5: Service Commercial
- I1: Light Industrial
- I2: Medium Industrial
- PS: Public Services
- PU: Public Utility
- UP: Urban Park
- MA1: Municipal Airport Airside
- UT: Urban Transition
- DC1: Direct Control 1
- DC2: Direct Control 2
- DC3: Direct Control 3
- DC4: Direct Control 4
- DC5: Direct Control 5
- DC6: Direct Control 6
- DC7: Direct Control 7
- Annexed Area-Urban Transition

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 2.5
EXISTING LAND USE
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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Table 2.1: Land Use District Descriptions

District Code	District Description	District Code	District Description
R1	Single-Detached Residential	C5	Service Commercial
R2	Semi-Detached Residential	I1	Light Industrial
R3	Row House Residential	I2	Medium Industrial
R4	Medium-Density Residential	PS	Public Services
R5	High-Density Residential	PU	Public Utility
RMH	Residential Manufactured Home	Up	Urban Park
C1	Central Commercial	MA1	Municipal Airport Airside
C2	Highway Corridor Commercial	UT	Urban Transition
C3	Neighbourhood Commercial	DC (1-7)	Direct Control (1-7)

2.3 Population Horizons

The City's sanitary sewer collection system was assessed for six (6) scenarios as summarized in Table 2.2.

Table 2.2: Population Horizon Assessment Scenarios

Scenario[1]	Year	Cumulative Population		
		Alberta	Saskatchewan	Total
Existing Conditions[2]	2021	19,739	11,843	31,582
3-Year Growth	2025	22,081	12,570	34,651
5-Year Growth	2027	22,475	13,658	36,132
10-Year Growth	2032	23,564	17,584	41,148
20-Year Growth	2042	37,085	20,185	57,271
Ultimate Boundary	**2051**	**46,461**	**20,688**	**67,149**

[1] The growth year scenarios are based on the year at the start of the project, which is 2022.
[2] The population for the existing conditions scenario is based on the 2021 Census (Statistics Canada, 2022).

The growth populations were initially determined by applying an annual growth rate of 2.2%. This growth rate was kept consistent with that applied within the design of the City's Wastewater Treatment Plant (WWTP). This was based on the City of Lloydminster and County of Vermilion River Joint Regional Growth Study (Applications Management, et.al, 2019). The target population allocation of 70% to the Alberta side of the city and 30% to the Saskatchewan side of the city was used to scale the populations for the future development areas.

Staging of growth areas was then refined by the City to align with the anticipated growth horizon for each future development area. This results in a non-linear growth rate that deviates from the annual growth rate of 2.2% that was initially applied across the city.

Additionally, the 3-Year Growth Horizon incorporates a densification population of 1,579. This population is based on a densification rate of 5% applied to the existing population obtained from the 2021 Census. This densification rate is also outlined within the Joint Regional Growth Study as part of the 2016 Draft Land Demand Generators Summary (Applications Management, et.al, 2019).

Growth did not occur at the rate anticipated within the 2019 Joint Regional Growth Study between 2019 and 2021; therefore, the population growth assumptions were reset to reflect the actual 2021 Census population (Statistics Canada, 2022). A comparison of these population projections is shown in Figure 2.6.

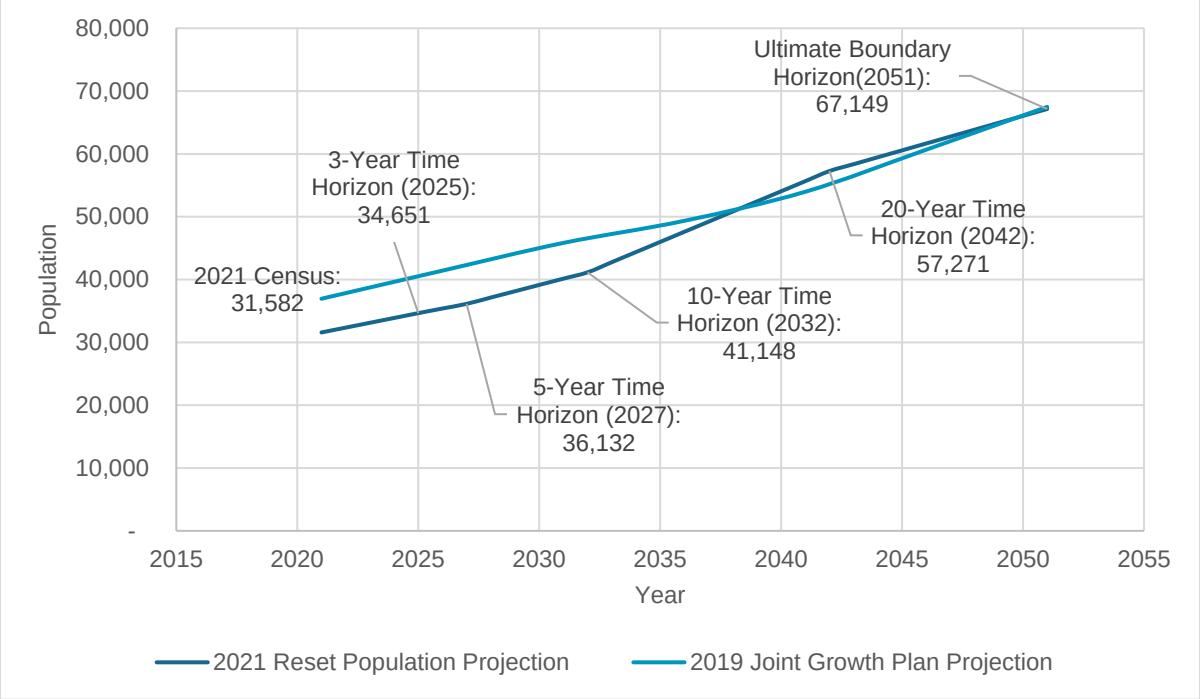


Figure 2.6: 2021 Population Projection Comparison

2.4 Growth Projections

Residential population estimates were generated based on the 2021 reset population projections, as well as net developable areas stipulated within local Area Structure Plans (ASPs), the 2013 Comprehensive Growth Strategy, the 2019 Joint Regional Growth Study, and the 2020 Annexation Application. These were applied on a persons/ha basis for the residential future development areas.

Approximately one and a half (1.5) quarter sections of future residential area were added to the anticipated growth areas between 75 Avenue and the city's west limit. The densities for these areas were based on the equivalent populations specified within the City's Municipal Development Standards for low-density and medium-density residential. It should be noted that this results in a deviation from the target population allocation of 70% to the Alberta side of the city and 30% to the Saskatchewan side of the city.

Employment population estimates were generated based on the 2019 Joint Regional Growth Study and interpolated for each of the population horizon assessment scenarios. These were applied on an employees/ha basis for the non-residential future development areas. Future development areas and land use classifications are shown in Figure 2.7.

As previously noted, staging of the City's future development areas was refined by the City to align with the anticipated development timelines for each area.

The growth considered in the City's development areas is summarized incrementally in Tables 2.3 to 2.7 for each of the growth horizons. Staging of the development areas by growth horizon is presented in Figure 2.8.

Table 2.3: Incremental 3-Year Horizon (2025) Development Areas and Populations

District Code	District Description	Area	Population	
		ha	Residential	Employment
RES-SF	Single-Family Residential	52.29	1,402	0
RES-MF	Multi-Family Residential	1.45	88	0
CBD	Commercial Business District	25.38	0	309
IND	Industrial	137.17	0	1,668
PS	Public Services	7.74	0	98
Total		**224.03**	**1,490**	**2,074**

As noted above, the 3-Year Growth Horizon also incorporates residential densification based on a densification rate of 5% applied to the existing population within existing residential areas. This is equal to a densification population of 1,579 in addition to the growth population in the future development areas noted in Table 2.4.

Table 2.4: Incremental 5-Year Horizon (2027) Development Areas and Populations

District Code	District Description	Area	Population	
		ha	Residential	Employment
RES-SF	Single-Family Residential	40.80	1,158	0
RES-MF	Multi-Family Residential	2.12	324	0
CBD	Commercial Business District	44.52	0	544
IND	Industrial	45.25	0	545
PS	Public Services	21.90	0	288
Total		**154.59**	**1,481**	**1,376**

Table 2.5: Incremental 10-Year Horizon (2032) Development Areas and Populations

District Code	District Description	Area	Population	
		ha	Residential	Employment
RES-SF	Single-Family Residential	156.26	4,250	0
RES-MF	Multi-Family Residential	13.69	614	0
CBD	Commercial Business District	53.95	60	709
IND	Industrial	148.40	0	1,992
PS	Public Services	2.65	92	0
Total		**374.95**	**5,016**	**2,700**

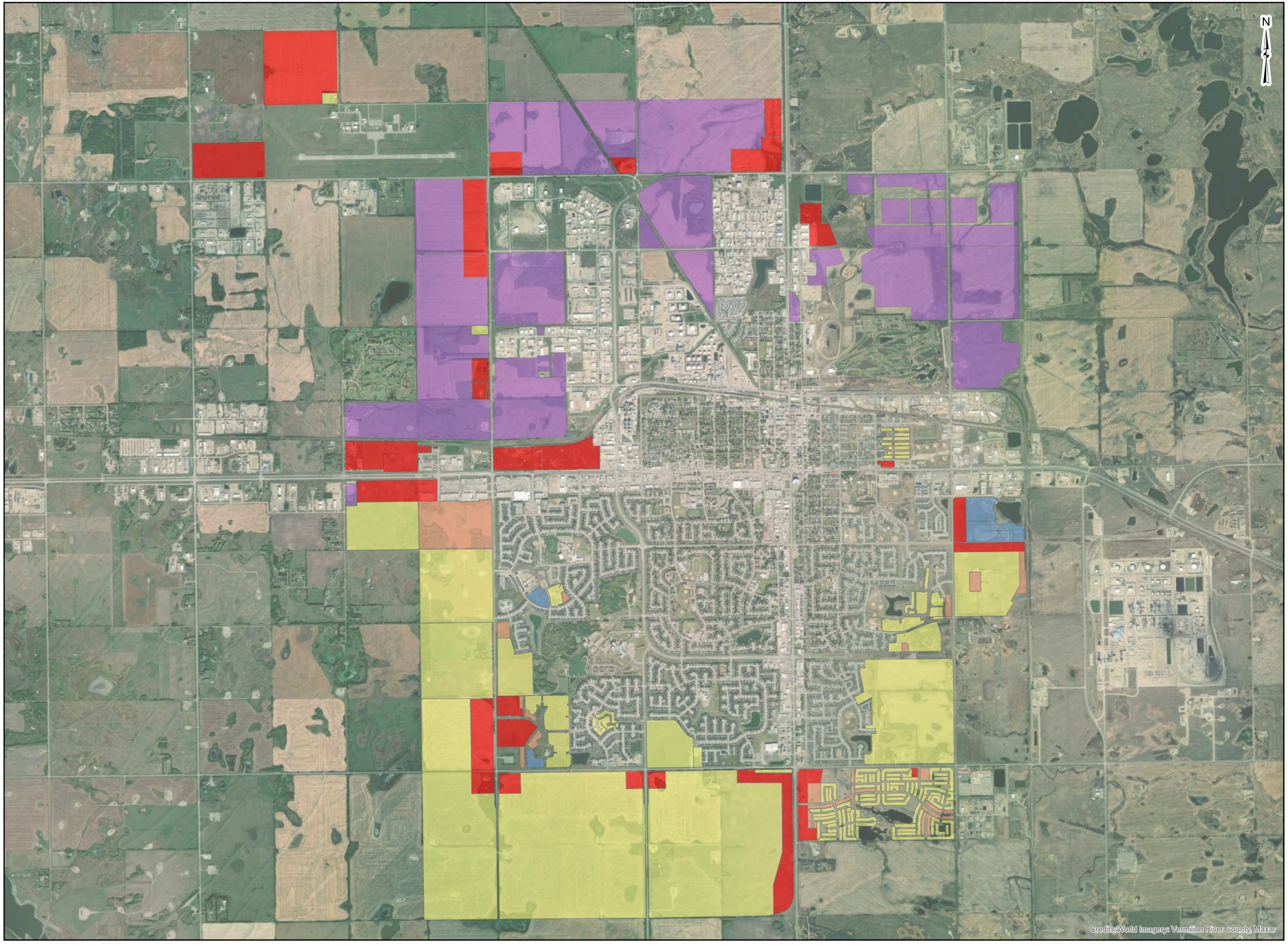
Table 2.6: Incremental 20-Year Horizon (2042) Development Areas and Populations

District Code	District Description	Area	Population	
		ha	Residential	Employment
RES-SF	Single-Family Residential	434.48	11,770	0
RES-MF	Multi-Family Residential	53.29	4,353	0
CBD	Commercial Business District	69.63	0	957
IND	Industrial	247.05	0	3,453
PS	Public Services	0.00	0	0
Total		**804.45**	**16,123**	**4,410**

Table 2.7: Incremental Ultimate Boundary Horizon (2051) Development Areas and Populations

District Code	District Description	Area	Population	
		Ha	Residential	Employment
RES-SF	Single-Family Residential	399.19	9,878	0
RES-MF	Multi-Family Residential	0.00	0	0
CBD	Commercial Business District	175.70	0	2,137
IND	Industrial	378.30	0	4,578
PS	Public Services	0.00	0	0
Total		**953.19**	**9,878**	**6,715**

The Municipal Development Plan only specifies residential areas, not the density of those areas. In the 2042 to 2051 timeframe to reach the Ultimate Horizon, there is not any other detailed information on the differentiation between single-family and multi-family residential parcels, so all were assigned as single-family residential. Though the increase in population density would result in a higher sewage generation, this is offset by a decrease in inflow and infiltration, as there are fewer services to multi-family residential properties compared to single-family residential properties. Therefore, as the exact split is unknown between single-family and multi-family residential parcels, it is assumed that the difference between dry weather and wet weather flows would be negated for this purpose.



Legend

Study Area

Future Land Use

- Commercial Business District
- Industrial
- Public Service
- Medium Density Residential
- Low Density Residential

Note: Parcels shown are those to be serviced.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 2.7
FUTURE LAND USE
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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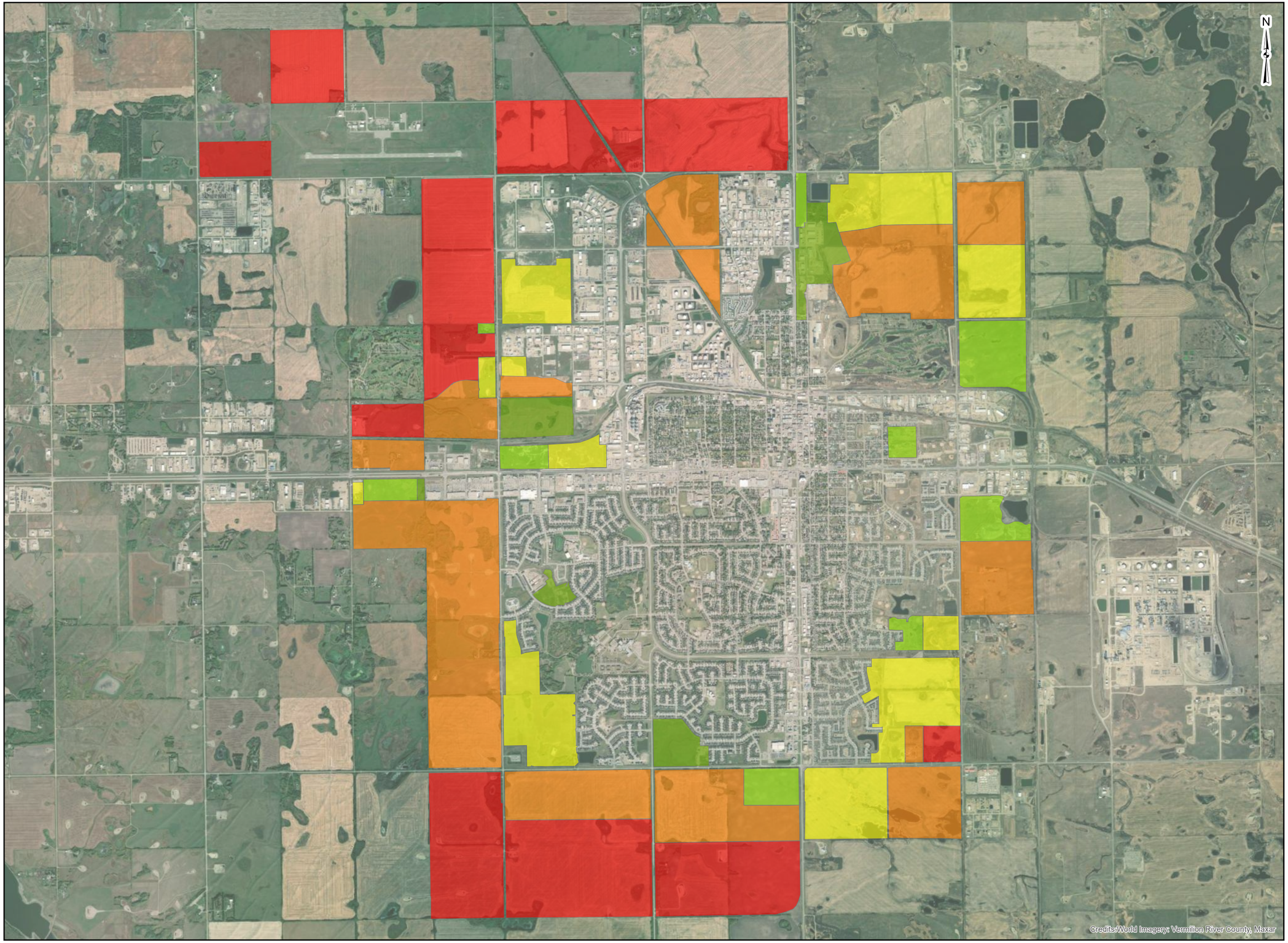

Legend

Study Area

Staging

- 3-Years
- 5-Years
- 10-Years
- 20-Years
- Ultimate

Note: Map does not include any vacant parcels under existing conditions that would be developed in the future, or densification to existing development.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 2.8
FUTURE DEVELOPMENT AREA STAGING
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3.0 Design Criteria

The design criteria used to assess the City's sanitary sewer collection system were derived from the existing Sanitary Sewer Master Plan (AECOM, 2016), the City's Municipal Development Standards, and typical municipal servicing standards in the Province of Alberta and the Province of Saskatchewan. In addition, sanitary effluent generation rates were derived based on the City's population rates, service areas, and historic sanitary influent at the City's WWTP.

3.1 Level of Service

To properly consider level of service (LOS), it was necessary to consider what the required LOS is in terms of Wet Weather Flow (WWF) in the City's sanitary sewer collection system. The LOS that was applied when assessing the sanitary sewer collection system for existing and future system assessments is summarized below.

The existing and future sanitary sewer collection system capacity was assessed based on a Type 4 Huff design storm with a 1:25 year 24-hour return period. A Huff rainfall distribution replicates a storm with a moderate peak intensity following an initial wetting period to ensure system response to the peak, which is ideal for sanitary sewer collection system analysis. In the case of the 1:25 year 24-hour Q4 Huff storm, the peak intensity is 10.96 mm/hr for a duration of 1.2 hours or 72 minutes, while the total rainfall depth produced over the entire duration is 67.44 mm. The rainfall hyetograph for this event is shown in Figure 3.1.

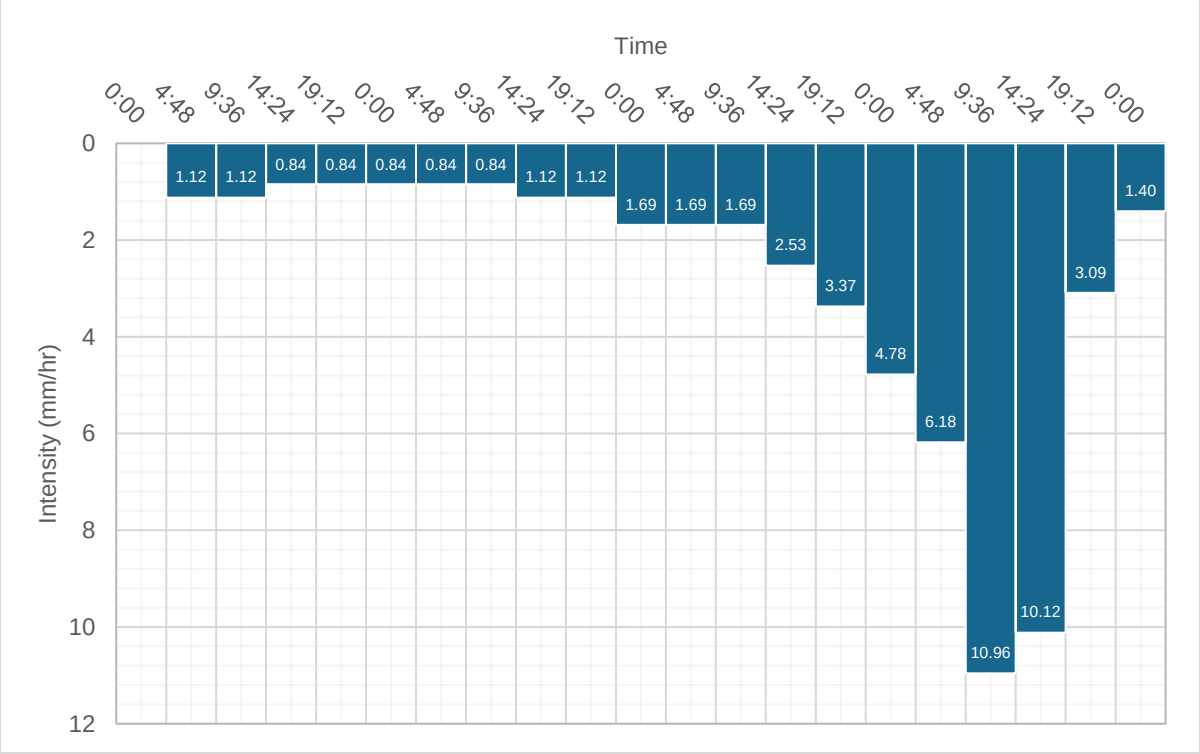


Figure 3.1: 1:25 Year 24-Hour Q4 Huff Storm Rainfall Hyetograph

A comparison of the 1:5 year and 1:10 year 24-hour Q4 Huff design storm events is shown below in Figure 3.2 for reference on scale. The 1:50 year storm is also shown in Figure 3.2 for comparison as this is a common storm frequency used to determine existing and future sanitary sewer collection system capacity.

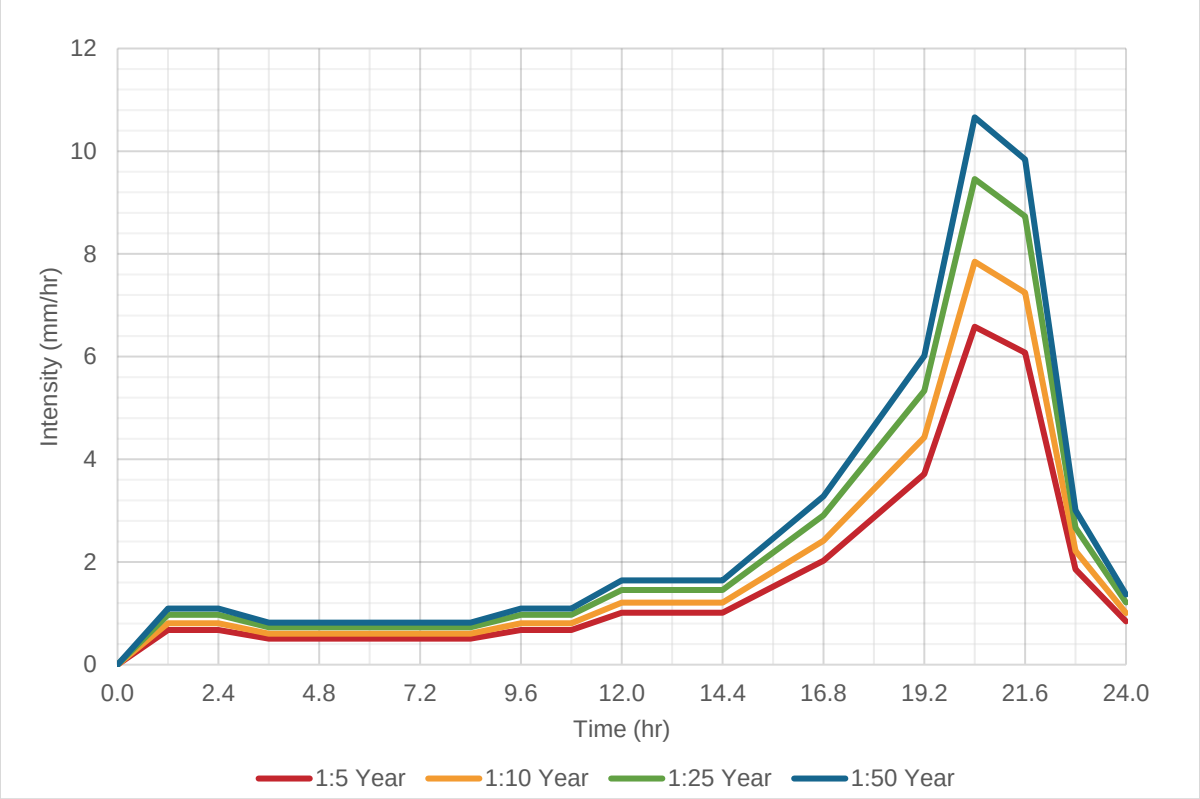


Figure 3.2: Comparison of 24-hour Q4 Huff Storm Return Periods

3.2 Assessment Criteria

The performance of the sanitary sewer collection system under existing conditions is ultimately determined based on the available freeboard between the ground elevation and the high-water level elevation, which is represented by the maximum hydraulic grade line (HGL) at each manhole for each assessment design storm. Based on this, the maximum allowable surcharge in the gravity portion of the sanitary sewer collection system must remain at least 2.5 m from the ground surface during a design storm scenario. The exception to this is in the case of shallow sewers with less than 2.5 m of cover. In these instances, the allowable surcharge should not exceed the obvert/crown of the pipe. The performance of the sanitary sewer collection system was assessed in terms of two (2) relationships: the Maximum HGL Elevation Relative to the Ground and the Peak Discharge Relative to Sewer Pipe Capacity as follows:

3.2.1 Maximum HGL Elevation Relative to the Ground

Maximum HGL elevation relative to the ground elevation is the amount of freeboard between the maximum water elevation and the ground elevation at each manhole when maximum flow passes through.

Hence, the maximum HGL elevation relative to the ground elevation with a value of:

- Greater than 0.00 m is denoted as a red dot, indicating surcharge/back-up to surface;
- Between -2.40 m and 0.00 m is denoted as an orange dot (maximum HGL peaks within 2.4 m below the ground elevation, indicating possible basement back-ups);
- Between -3.50 m and -2.40 m is denoted as a yellow dot (maximum HGL peaks within 2.4 m and 3.5 m below the ground elevation, indicating no basement back-ups but possibly an elevated HGL); and
- Less than -3.50 m is denoted as a green dot (maximum HGL peaks 3.5 m below the ground elevation).

3.2.2 Peak Discharge Relative to Sewer Pipe Capacity

Peak discharge relative to pipe capacity indicates the ratio of peak flow to pipe capacity in wet weather conditions; as a corollary to this, the data can be interpreted to indicate the amount of spare capacity during peak flows. This is calculated by taking the ratio of the modelled flow in a pipe and its corresponding capacity. Pipes with ratios higher than 1.00 are considered to have no spare capacity, thus indicating a section of pipe that may require upgrading, particularly where the length of the section is long enough to cause surcharge conditions immediately in the upstream reach.

Hence, the peak discharge relative to sewer capacity with a ratio of:

- Greater than 1.20 is denoted with a red line (significantly over capacity);
- Between 1.00 and 1.20 is denoted as an orange line (over capacity, or in another words the capacity is diminishing as the maximum flow theoretically occurs at roughly 93% of the pipe's diameter. This means that in principle, sewers with a Q/Q_{man} [peak discharge relative to pipe capacity] ratio equal to or less than 1.05 have their flow still contained within the pipe's diameter);
- Between 0.86 and 1.00 is denoted as a yellow line (less than 14% of spare capacity available); and
- Less than 0.86 is denoted as a green line (spare capacity available).

Both relationships should be evaluated in conjunction to pinpoint any potential capacity deficiencies in the system. For example:

- The maximum HGL elevation relative to the ground elevation with a value that is between -2.40 m and 0.00 m (an orange dot) may indicate a location with a possible basement back-up; however, the peak discharge relative to pipe capacity ratio at the same location could have a value of less than 0.86 (a green line), indicating the pipe is not surcharged. This could suggest a relatively shallow pipe.
- The ratio of peak discharge relative to pipe capacity for forcemains is always above 1.00, as these operate under pressurized conditions by nature. This should not be of any concern, as this color coding for gravity sanitary sewers is not intended for this application.

In addition to these two (2) scenarios, the spare capacity of each pipe was determined. This indicates the amount of additional flow each pipe can convey before it becomes completely utilized. The amount of spare capacity ranges from less than 0 L/s to over 100 L/s, with the least capacity illustrated in red and the most capacity illustrated in green. In determining the spare capacity, it becomes evident which pipes are available to convey any additional flows due to future development and which pipes should remain untouched.

Existing sanitary sewer forcemains should be analyzed, and should be sized in the future to maintain a minimum velocity of 1.0 m/s or reaching 1.0 m/s at least two (2) times daily. The velocity should not exceed a velocity of 3.0 m/s, with the preferred velocity being 2.5 m/s.

3.3 Future System Design Criteria

3.3.1 Dry Weather Flow Generation Rates

The Dry Weather Flow (DWF) generation rates applied to the growth scenarios were employed from the City's Municipal Development Standards (2020) as follows:

- Residential Areas – 320 L/p/d; and
- Non-Residential Areas – 0.2 L/s/ha or 17,280 L/ha/d.

Although actual generation rates in the existing sanitary sewer collection system may be less than those outlined above for some areas, the use of these rates is a more conservative approach for future design over adopting historic generation trends, which are subject to change.

It should be noted that the employment population was provided in Sections 2.3 and 2.4 for reference; however, the non-residential sanitary effluent generation rates are applied on an area basis in keeping with the City's Municipal Development Standards.

3.3.2 Peaking Factors

Peaking factors for the future sanitary sewer collection system were calculated in accordance with the City's Municipal Development Standards. These include the following:

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

$$PF = 1 + \frac{14}{4 + P^{\frac{1}{2}}}$$

  - Where, P is the design contributing population in thousands; and
  - PF must be at least 2.5; and
- Peaking factor for non-residential areas is 3.0.

Although actual peaking factors in the existing sanitary sewer collection system may be less than those outlined above for some areas, the use of these rates is a more conservative approach for future design over adopting historic peaking trends, which are subject to change.

3.4 Wet Weather Flow Component

A constant inflow and infiltration (I-I) allowance of 0.28 L/s/ha per the City's Municipal Development Standards (2020) was applied to each growth catchment to simulate the wet weather response. This is in alignment with the Alberta Environment and Protected Areas (AEPA) Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems for new development.

For modelling purposes, the average variable hydrograph was obtained by adjusting the RTK parameters on top of the WWF calibrated model such that the ensuing average modelled I-I rate of 0.28 L/s/ha was obtained for the future sanitary sewer collection system. The RTK method is discussed in detail in Section 5.5.

4.0 Existing Sanitary System

4.1 Sanitary Collection System

Lloydminster is currently serviced by approximately 187 km of sanitary sewers. The sanitary sewer collection system details with regards to pipe diameter, material, and installation period are shown in Figures 4.1, 4.2, and 4.3, respectively. The sanitary sewers are predominantly made of polyvinyl chloride (PVC) or vitrified clay tile (VCT). Pipe diameters range from 100 mm to 1,350 mm, with most being between 200 mm and 250 mm. Tables 4.1 to 4.3 below summarize the sanitary sewer collection system based on diameter, material, and installation year, respectively.

Table 4.1: Existing System Diameter Summary

Diameter	Total Length	Percentage of Total
mm	m	%
100	195	0.10
150	882	0.47
200	93,995	50.33
250	23,771	12.73
300	12,462	6.67
375	13,578	7.27
400	453	0.24
450	11,938	6.39
500	206	0.11
525	3,867	2.07
600	6,322	3.39
675	850	0.46
750	4,833	2.59
900	3,087	1.65
1050	6,621	3.54
1200	2,773	1.48
1350	356	0.19
Unknown	578	0.31
Total	**186,768**	**100.00**

Table 4.2: Existing System Material Summary

Material	Total Length	Percentage of Total
	m	%
Concrete (CONC)	31,475	16.85
Polyvinyl Chloride (PVC)	75,537	40.44
Steel (STL)	7	0.00
Vitrified Clay Tile (VCT)	78,939	42.27
Polyethylene (PE)	459	0.25
Unknown	351	0.19
Total	**186,768**	**100.00**

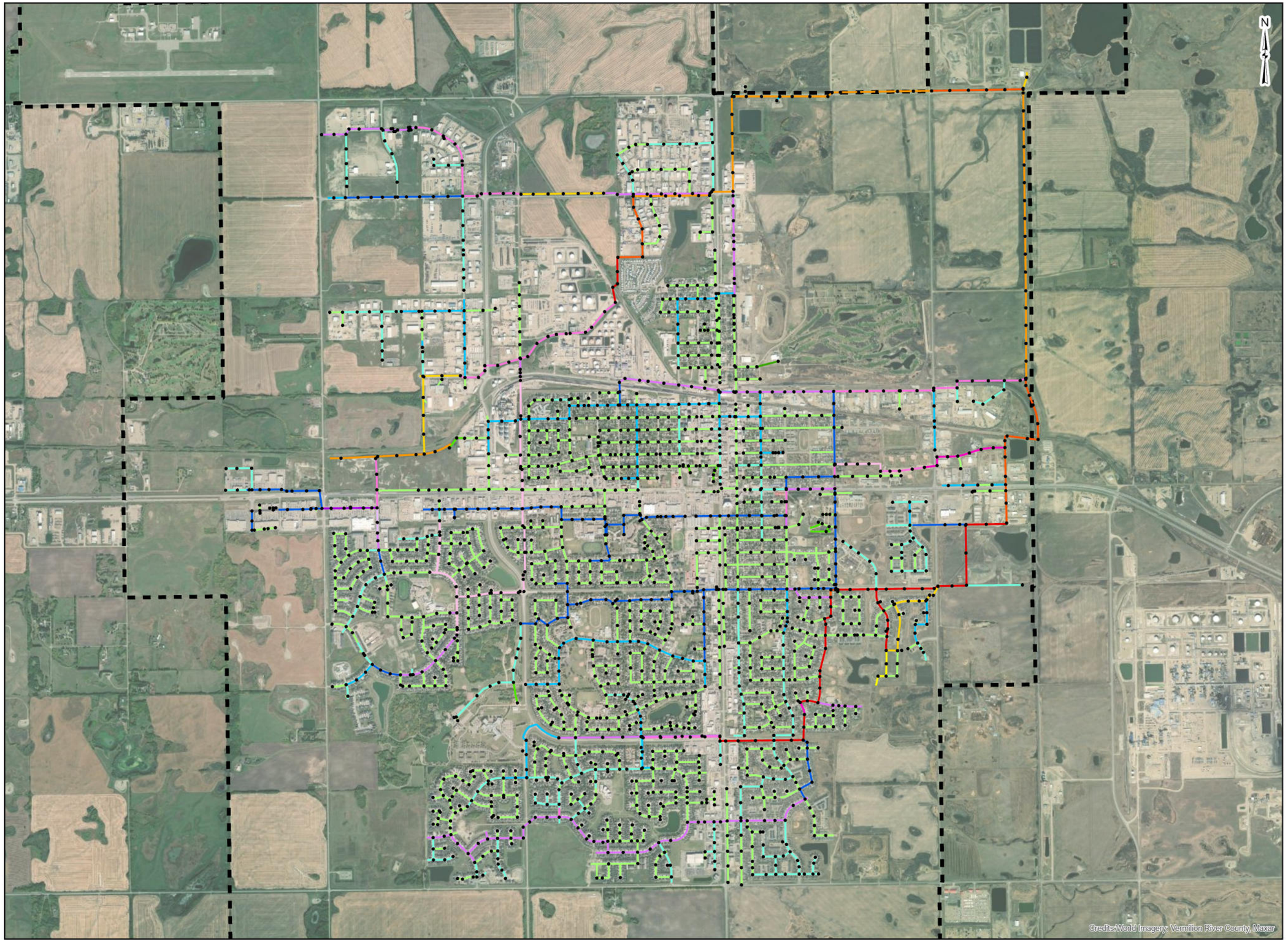
Table 4.3: Existing System Installation Period Summary

Installation Period	Total Length	Percentage of Total
	m	%
1940-1949	8,478	4.54
1950-1959	5,916	3.17
1960-1969	17,895	9.58
1970-1979	37,339	19.99
1980-1989	37,350	20.00
1990-1999	14,075	7.54
2000-2009	36,866	19.74
2010-2021	28,775	15.41
Unknown	74	0.04
Total	**186,768**	**100.00**

The existing sanitary sewer collection system's primary trunk sewers are shown in Figure 4.4 and summarized below:

- **25 Street Trunk:**
  - This trunk is along 25 Street from 59 Avenue to 47 Avenue, conveying flows from the 25 Street Trunk collection area to the Southeast Trunk.
- **36 Street Trunk:**
  - This trunk is along 36 Street from 52 Avenue to 40 Avenue, conveying flows from the 25 Street Trunk, 36 Street Trunk, and Southeast Trunk collection areas to the East Trunk.
- **47 Street Trunk:**
  - This trunk is along 46 Street from 45 Avenue to 43 Avenue, crosses the Legion Ball Park, then is along 47 Street from 40 Avenue to 37 Avenue, conveying flows from the 47 Street Trunk collection area to the East Trunk.
- **52 Street Trunk:**
  - This trunk is along 52 Street from 50 Avenue to east of 37 Avenue, conveying flows from the 52 Street Trunk collection area to the East Trunk.
- **62 Street Trunk:**
  - This trunk is along 62 Street from 63 Avenue to 53 Avenue, conveying flows from the 62 Street Trunk collection area to the West Trunk.

- **East Trunk:**
  - This trunk is along 36 Street, 39 Avenue, 41 Street, 37 Avenue, and 44 Street, and follows the alignment of the East Drainage Channel from 40 Avenue and 36 Street to 67 Street.
  - This trunk conveys flows from the 25 Street Trunk, 36 Street Trunk, 52 Street Trunk, Southeast, and East Trunk collection areas to the City's WWTP.
- **North Trunk:**
  - This trunk is along 49 Avenue and 67 Street from 62 Street to the East Trunk, conveying flows from the 62 Street Trunk and West Trunk collection areas to the East Trunk.
  - It should be noted that there is no existing collection area for the North Trunk, as these lands are currently undeveloped.
- **Southeast Trunk:**
  - This trunk is along 18 Street, 47A Avenue, 19 Street, 47 Avenue, 20 Street, 46 Avenue, 27 Street, 45 Avenue, and 33 Street from 52 Avenue and 18 Street to 45 Avenue and 36 Street.
  - This trunk conveys flows from the 25 Street Trunk and Southeast Trunk collection areas to the 36 Street Trunk.
- **West Trunk:**
  - This trunk is along 70 Avenue, 59 Street, 53 Avenue, and 62 Street, and follows the alignment of the Northwest Drainage Channel from 70 Avenue and 43 Street to 49 Avenue and 62 Street.
  - This trunk conveys flows from the 62 Street and West Trunk collection areas to the North Trunk.



Legend

Study Area

Manhole

Pipe Diameter

- 100 mm
- 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 400 mm
- 450 mm
- 500 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1050 mm
- 1200 mm
- 1350 mm
- Unknown

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 4.1
EXISTING PIPE DIAMETER
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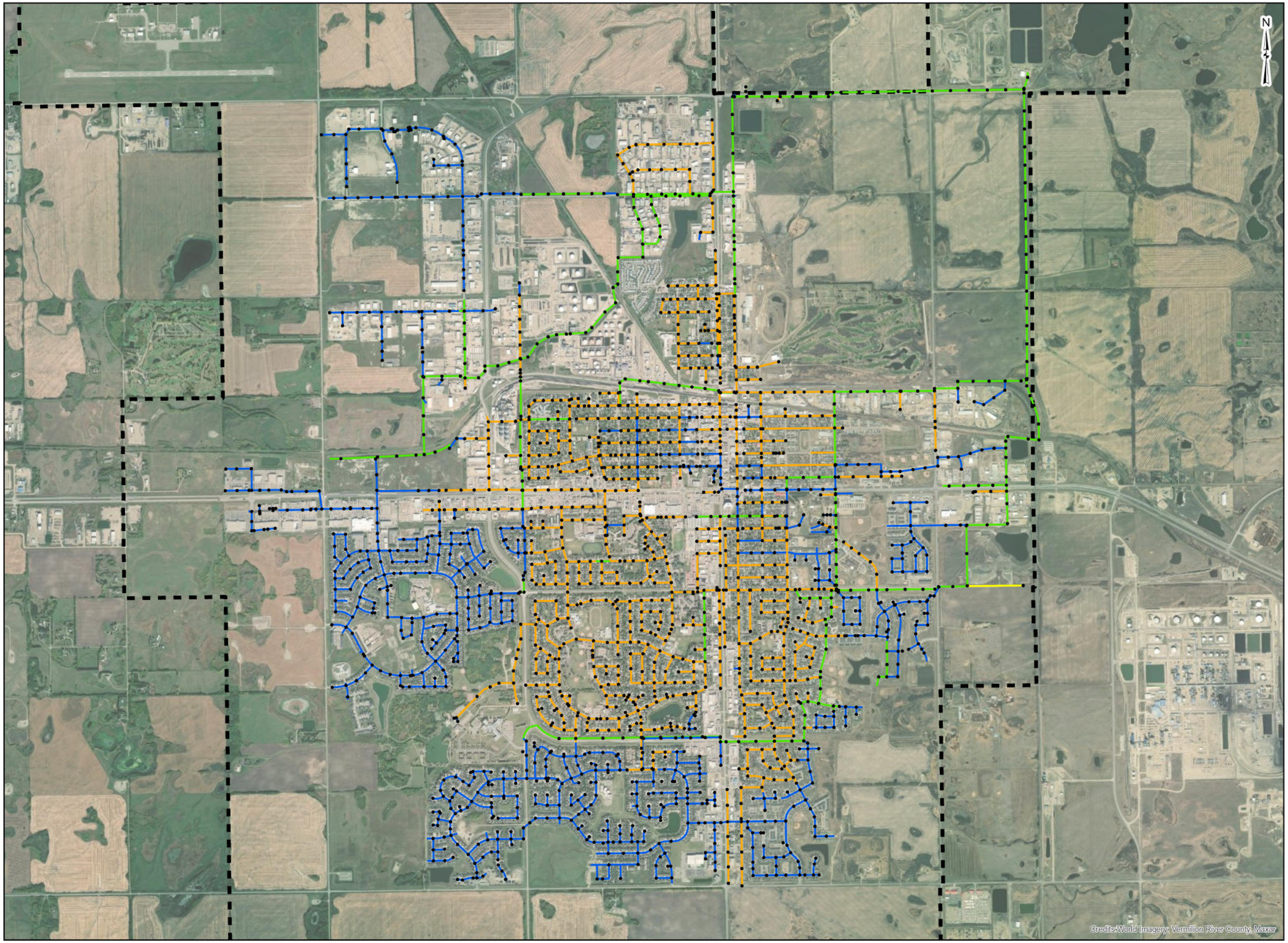

Legend

- Study Area
- Manhole

Pipe Material

- Concrete (CONC)
- Polyvinyl Chloride (PVC)
- Steel (STL)
- Vitrified Clay Tile (VCT)
- Polyethylene (PE)
- Unknown

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 4.2
EXISTING PIPE MATERIAL
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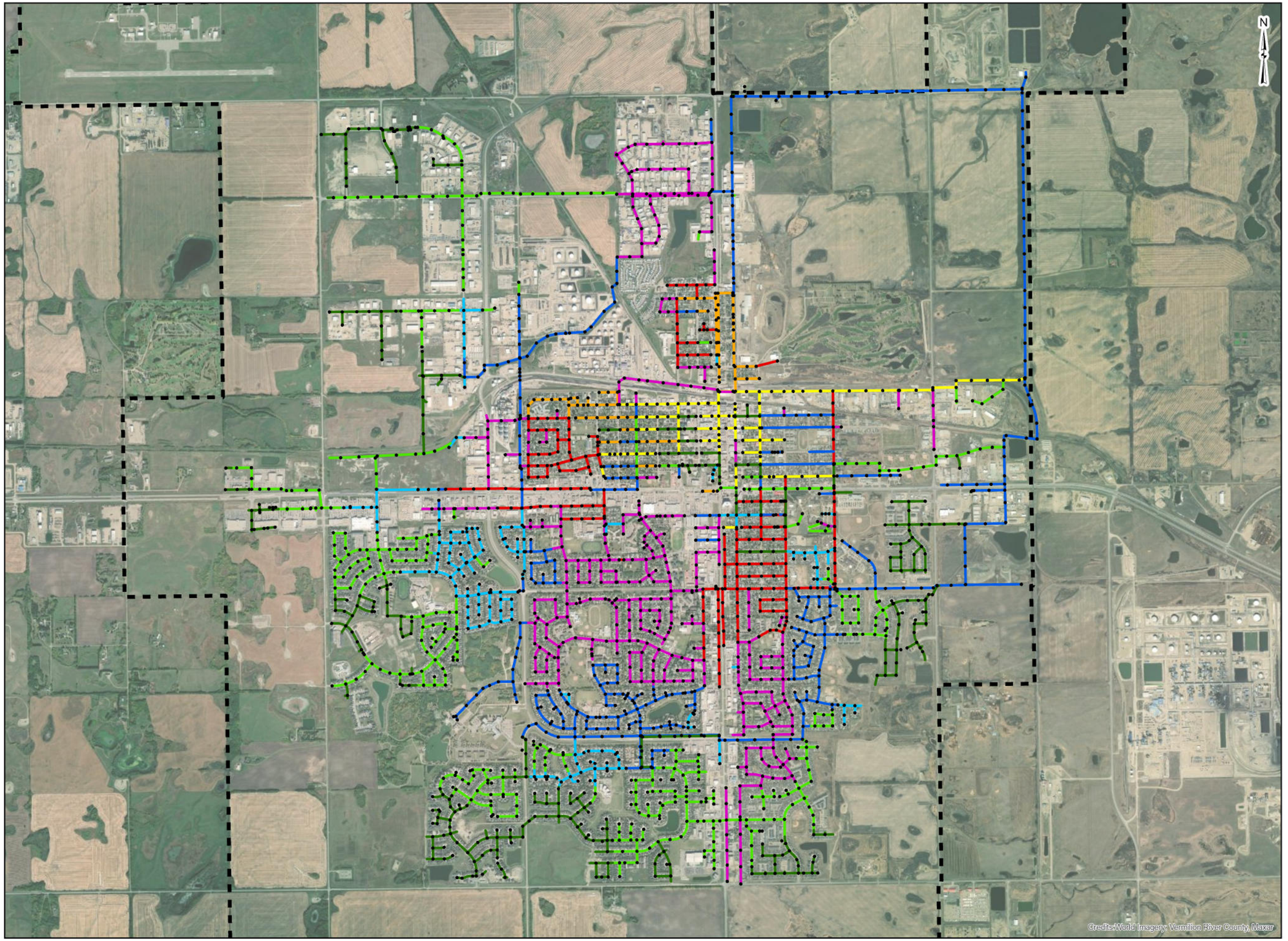

Legend

Study Area

Manhole

Installation Period

1940-1949
1950-1959
1960-1969
1970-1979
1980-1989
1990-1999
2000-2009
2010-2021
Unkown

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 4.3
PIPE INSTALLATION PERIOD
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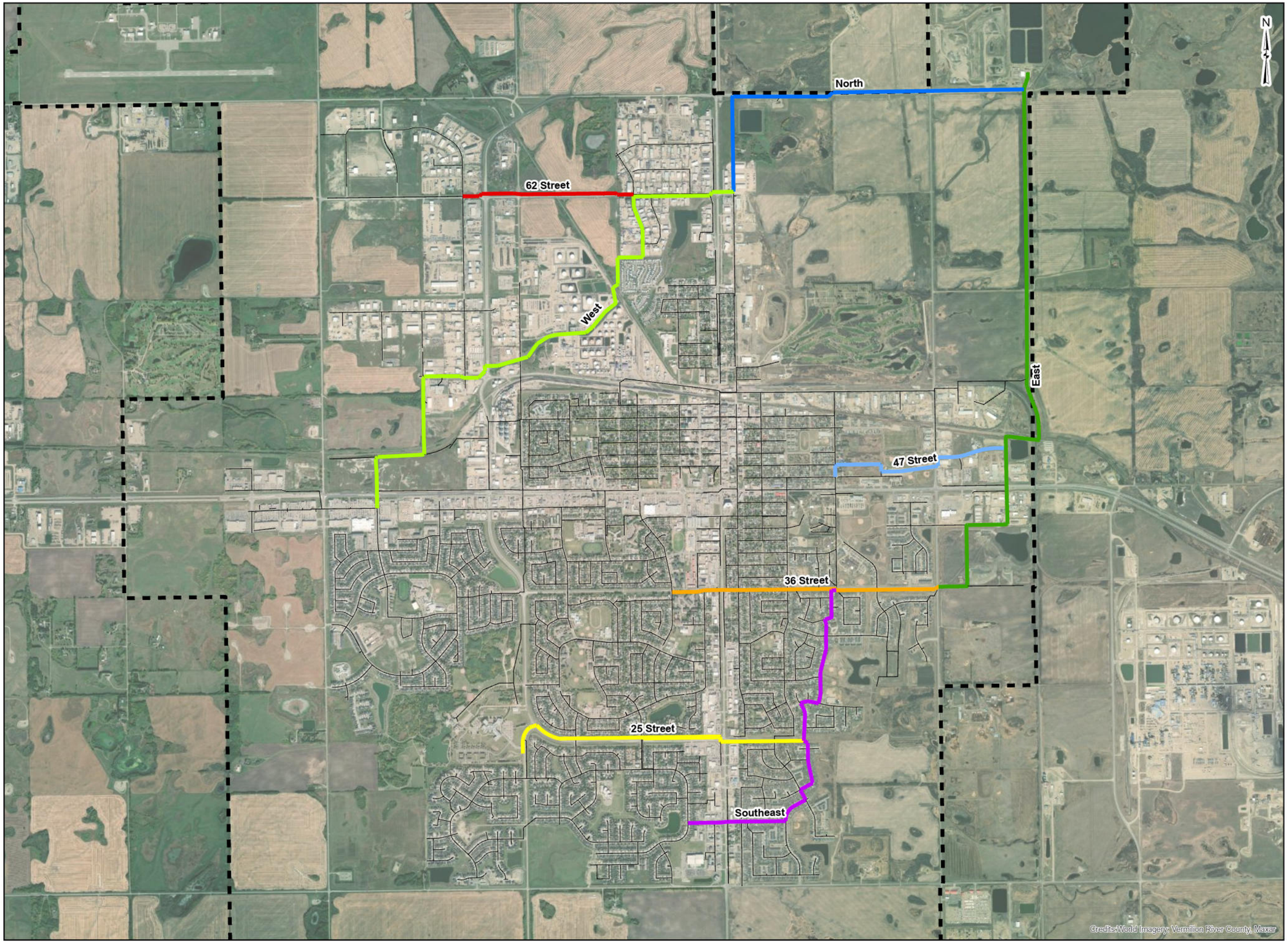

Legend

- Study Area
- Manhole
- Gravity Sewer

Trunk Sewer

- 25 Street Trunk
- 36 Street Trunk
- 47 Street Trunk
- 52 Street Trunk
- 62 Street Trunk
- East Trunk
- North Trunk
- Southeast Trunk
- West Trunk

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 4.4
TRUNK SEWERS
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5.0 Hydraulic Model Development

5.1 Computer Model

The computer model used to assess the City's sanitary sewer collection system was InfoWorks ICM by Autodesk. InfoWorks ICM is a powerful analysis tool that computes inflow from sewage generation rates and rainfall dependent inflow-infiltration and routes these sanitary flows through the hydraulic system network. Based on the hydraulic simulation, the model can be used to evaluate locations with surcharge or flooding conditions under various rainfall events. Sanitary sewer flows are also determined to identify over-capacity pipes based on peak flows and pipe capacities. The InfoWorks ICM software is significantly integrated with the ArcGIS platform, which was used to assist in the construction of the model.

5.2 Model Set-Up

The InfoWorks ICM model was built from scratch using the City's geographic information system (GIS) data, supplemented by record drawings, references to the previous XPSWMM model, and necessary assumptions. The model pipe network was developed from scratch to ensure the most up-to-date system data, consistent with the City's GIS information, was incorporated and all revisions or assumptions tracked for the City's reference. This was also done to ensure new or upgraded infrastructure not previously included was accounted for, while eliminating duplicate network elements.

The pipe network data was first processed in ArcGIS to remove duplicate entries and combine pipe segments with matching NAMENUM shapefile fields to simplify the pipe network for importing into InfoWorks ICM. This also reduces the number of artificial nodes required in the model. Any abandoned or inactive network elements were filtered out as these would not be needed in the model. Once this process was complete, the pipe network and associated infrastructure was imported into InfoWorks ICM for verification.

One of the critical steps as part of this project was to ensure proper connectivity of the system, and review elevations, diameters, and slopes to determine if the inputted data appeared accurate. This process was completed by producing longitudinal profiles (LPs) of every pipe network in the city. For the purposes of system verification, the LPs were used to identify:

- Missing data:
  - Connectivity errors;
  - Missing pipes or nodes; and
  - Reversed pipe direction;
- Potentially erroneous pipe gradients:
  - Flat slopes;
  - Steep slopes; and
  - Adverse slopes;
- Inconsistent profiles:
  - Upstream invert of downstream pipe above downstream invert of upstream pipe;
  - Two (2) pipes with identical elevations in series; and
  - Suspicious pipe drops.

Identified issues were remediated though the request and review of the available record drawings. Survey was undertaken in the fall of 2022 for flow split locations that were not located in most upstream manholes in the system and where record drawings were not available to prioritize downstream flow splits for model calibration purposes. All flow split and survey locations are shown in Figure 5.1. Where record drawings were not available or did not provide the required information, additional survey was undertaken at prioritized locations in the network or assumptions were applied when no other information was available. Any updates to the pipe network information, including the sources of new data and any assumptions made, were tracked in the network element properties. The network element status was flagged as 'modified' in the model's user text fields. Missing information and pipe assumptions included:

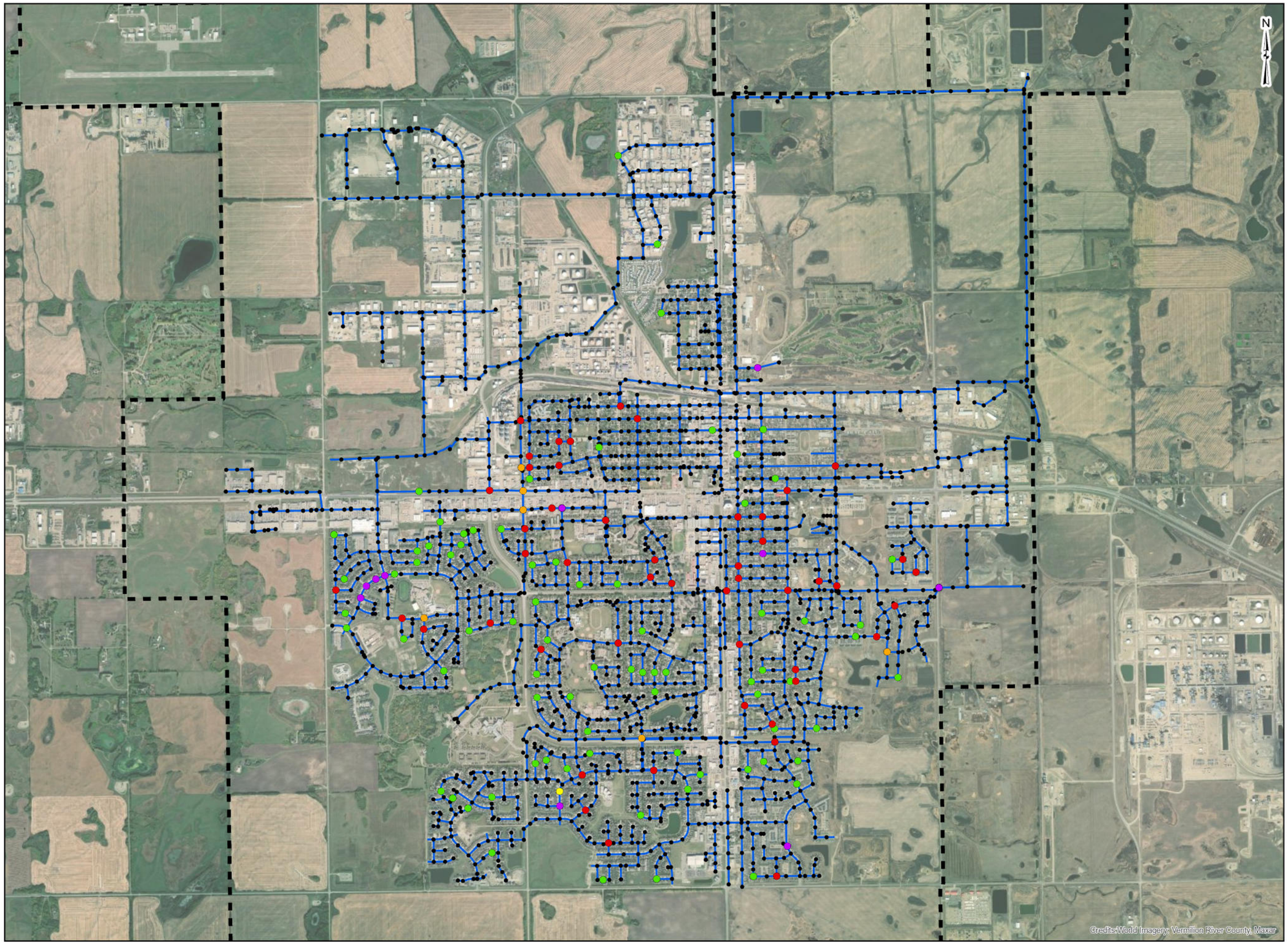
- Missing downstream invert information was taken from the downstream neighbouring pipes; and
- Missing upstream invert information was calculated based on the City's minimum design slope for each pipe size, as stipulated in Table 5.1.

Table 5.1: Minimum Design Slopes for Sewers

Nominal Pipe Diameter	Minimum Design Slope
mm	%
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525	0.10
≥ 600	0.10

Where manhole rim elevations were missing from the City's GIS information, the rim elevation was extracted from the City's 2019 Light Detection and Ranging (LiDAR) surface. Many of the manholes were missing sump elevation data; therefore, the minimum neighbouring pipe invert was assumed as the manhole sump elevation. Like the pipe network elements, the node status was set to "modified" where any assumptions were applied. For those manholes that did not have a manhole diameter provided, a manhole area was applied based on the diameter of the connecting pipes. All manholes with missing diameters have connecting pipes of diameter less than or equal to 675 mm; therefore, a manhole diameter of 1.2 m was assumed for all manholes with missing diameters.

Artificial nodes were added as needed, primarily where connections exist along the pipe rather than at the manhole. Additional artificial nodes and artificial links or pipes were added mainly at the lift stations as needed. Artificial nodes were considered to have zero area.



Legend

- Study Area
- Existing Pipe
- Existing Manhole - Not Surveyed (1,893)
- Existing Manhole - Surveyed (12)
- Existing Flow Split - Surveyed (49)
- Existing Flow Split - Not Surveyed (6)
- Existing Upstream Flow Split - Surveyed (1)
- Existing Upstream Flow Split - Not Surveyed (78)

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 5.1
FLOW SPLIT AND SURVEY LOCATIONS
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Manning's coefficients for pipe roughness were assigned as outlined in Table 5.2.

Table 5.2: Manning's 'n' Roughness Coefficient

Material	Manning's 'n' Coefficient
Concrete	0.013
Corrugated Steel Pipe	0.024
Polyvinyl Chloride	0.011
Steel	0.016
Vitrified Clay Tile[1]	0.017
Unknown	0.013

[1] This roughness coefficient assumes that the pipe's integrity remains and that broken pieces are not laying in the flow channel.

5.3 Catchment Delineation

Following the set-up of the physical sanitary sewer collection system model, it was necessary to delineate the City into sub-catchments for the purpose of generating DWFs and WWFs. The sub-catchments were delineated based on a lot-by-lot basis and land use classification.

The legal shapefile provided by the City was used as a baseline to derive the sub-catchments. A working copy of the shapefile was clipped such that only the parcels that are serviced by the City's sanitary sewer collection system are included. This generally required removing parcels outside of the city boundary as well as undeveloped land parcels.

The remaining parcels underwent a visual inspection to remove any parcels not requiring sanitary service. This included parcels such as utility easements, parks, transportation corridors, and vacant land. Visual inspection was completed through a combination of reviewing the available aerial imagery, the base mapping provided within ArcGIS, Google Maps, and Google Street View.

The existing land use is based on the zoning shapefile provided by the City and was used to assign land use classifications to the sub-catchments developed from the legal shapefile. The inspection process noted above also involved reviewing parcels with unclassified land uses, such as Direct Control parcels. Using Google Maps and its pinned location tags, these parcels were also classified.

To assign residential populations to each parcel, densities and unit densities were assigned based on the existing land use shapefile provided by the City. All Single-Detached Residential and Semi-Detached Residential parcels were assumed to have one unit per lot. The unit count for all other residential classification parcels greater than 0.5 ha in area varies by land use. Unit counts were either based on available unit information for buildings, determined from aerial imagery, or based on the calculation of design populations as outlined in the City's Municipal Development Standards (2020). The parameters used to calculate the populations for each sub-catchment by land use classification are summarized in Table 5.3.

Table 5.3: Sub-Catchment Population Calculation Parameters

Land Use Type	Density	Unit Density	Population Density
	units/ha	capita/unit	capita/ha
Single-Detached Residential	-	3.5	-
Semi-Detached Residential	-	3.5	-
Row House Residential	37.5	2.4	90.0
Medium-Density Residential	25.0	2.4	60.0
High-Density Residential	74.0	2.4	177.6
Residential Manufactured Home	-	2.4	-
Direct Control 1[1]	-	3.5	-

[1] Direct Control 1 is included as it is the only Direct Control land use classification that includes dwellings as a permitted use.

These populations were scaled to match the 2021 Census populations (Statistics Canada, 2022). A summary of the sub-catchment areas and populations by land use type is provided in Table 5.4.

Table 5.4: Sub-Catchment Summary

Land Use Type	Area	Calculated Population	Scaled Population
	ha	capita	capita
Single-Detached Residential	506.90	27,675	21,641
Semi-Detached Residential	16.26	1,092	862
Row House Residential	16.34	1,366	1,108
Medium-Density Residential	71.09	8,259	6,509
High-Density Residential	2.92	473	382
Residential Manufactured Home	18.56	744	582
Central Commercial	28.24	0	0
Highway Corridor Commercial	126.66	0	0
Neighbourhood Commercial	2.49	0	0
Service Commercial	15.62	0	0
Light Industrial	167.92	0	0
Medium Industrial	376.04	0	0
Public Services	113.29	0	0
Urban Park	99.67	0	0
Urban Transition	24.36	0	0
Direct Control 1	17.65	654	500
Direct Control 2	6.53	0	0
Direct Control 3	14.18	0	0
Direct Control 5	3.74	0	0
Direct Control 6	1.31	0	0
Direct Control 7	7.29	0	0
Total	**1,637.04**	**40,261**	**31,586[1]**

[1] The scaled population is slightly larger than the existing population of 31,582 noted in Table 2.2 in Section 2.3, obtained from the 2021 Census (Statistics Canada, 2022), due to rounding of the scaled population for each parcel.

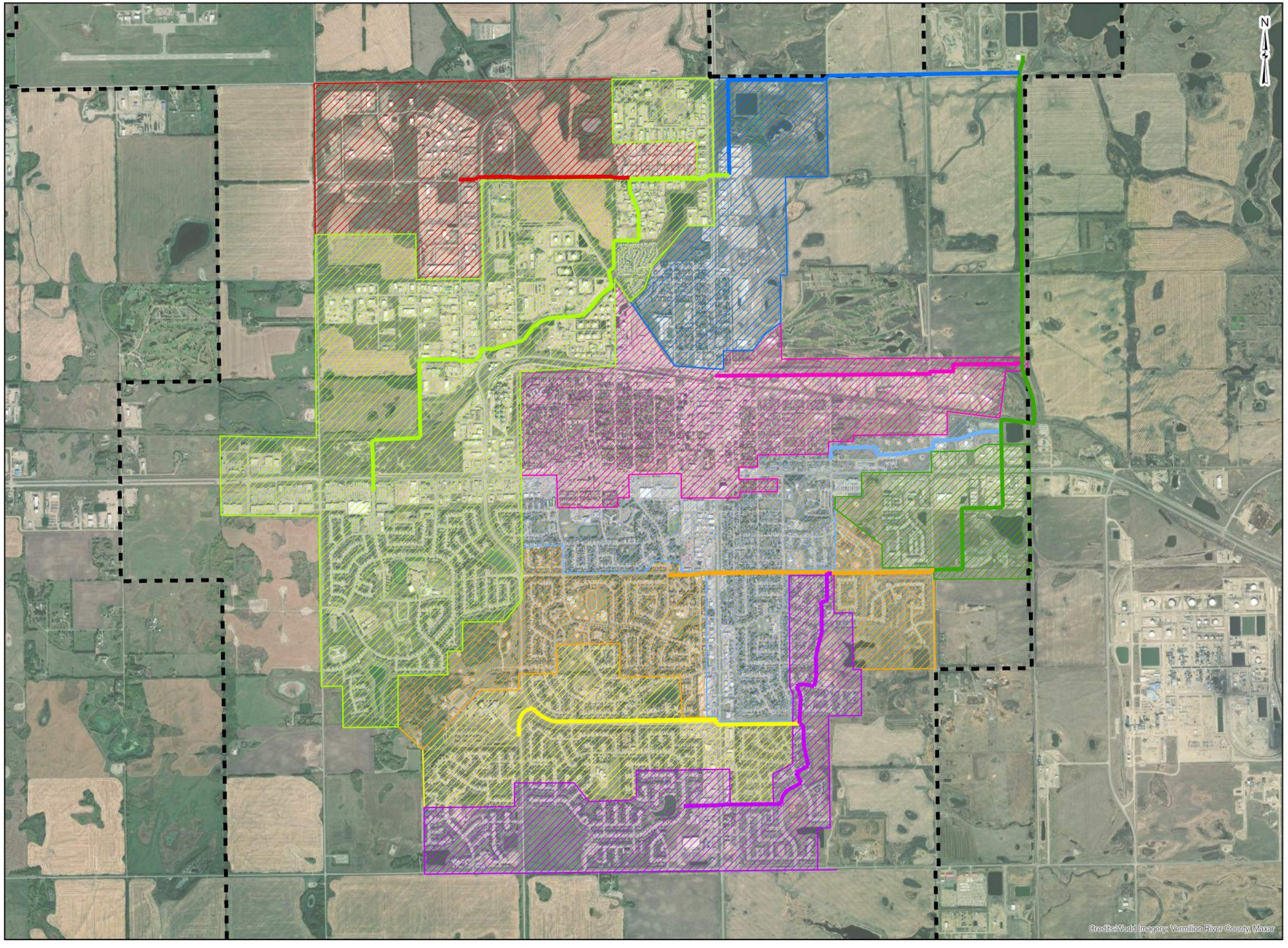
Sub-catchments were also digitized to represent road polygons. Including roads was necessary to account for I-I for WWF calibration. To accomplish this, polygons of the road networks were created by using the void space of the existing land use shapefile provided by the City. A validation process was undertaken to remove any green spaces or utility easements. This shapefile was then clipped such that only roads with sanitary sewers buried underneath were accounted for, as these would be the sections contributing to I-I. Finally, the shapefile was divided into Thiessen polygons for each manhole within the City.

Sub-catchment connections to the pipe network were primarily preprocessed in ArcGIS based on the sanitary service/lateral information provided by the City. Each sub-catchment that intersected a service connection was then spatially joined to the closest pipe to that service connection. As each pipe stipulates the upstream and downstream manhole IDs, this information was then transferred back into each sub-catchment.

The sub-catchments were assumed to tie-into the upstream node, as this provides a slightly more conservative modelling approach. The exception to this was at critical flow split locations, where the flow split within the manhole defined the catchment areas for each flow monitoring location. At these locations, sub-catchments were assigned to the downstream node to ensure flow contributions were properly allocated within each flow monitor catchment. If sub-catchments were assigned to upstream nodes at critical flow split locations, the flows might be inaccurately routed in the wrong direction, potentially leading to either overestimation or underestimation of flows in each flow monitoring catchment, depending on invert elevations.

Sub-catchment connections were imported into the model following the preprocessing step. A visual inspection of the sub-catchment connections was then undertaken for quality assurance/quality control (QA/QC) to correct any connections that appeared erroneous due to automating the process in ArcGIS. Any sub-catchments that were not assigned a tie-in node as part of the preprocessing due to missing services were also connected to the network at this point.

Collection areas for the City's existing sanitary sewer trunks are shown in Figure 5.2. These trunks and their corresponding upstream collection areas are summarized in Table 5.5.



Legend

- Study Area
- Manhole
- Gravity Sewer

Trunk Sewer

- 25 Street Trunk
- 36 Street Trunk
- 47 Street Trunk
- 52 Street Trunk
- 62 Street Trunk
- East Trunk
- North Trunk
- Southeast Trunk
- West Trunk

Trunk Net Collection Area

- 25 Street Trunk Collection Area
- 36 Street Trunk Collection Area
- 47 Street Trunk Collection Area
- 52 Street Trunk Collection Area
- 62 Street Trunk Collection Area
- East Trunk Collection Area
- North Trunk Collection Area
- Southeast Trunk Collection Area
- West Trunk Collection Area

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 5.2
TRUNK SEWER COLLECTION AREAS
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Table 5.5: Existing Sanitary Trunks and Upstream Collection Areas

Trunk	Upstream Collection Area								
	25 Street	36 Street	47 Street	52 Street	62 Street	East	North	Southeast	West
25 Street	Yes								
36 Street	Yes	Yes						Yes	
47 Street			Yes						
52 Street				Yes					
62 Street					Yes				
East	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
North					Yes		Yes		Yes
Southeast	Yes							Yes	
West					Yes				Yes

Note: The upstream collection areas encompass all areas that are located upstream of any portion of the trunk. For example, the most downstream section of the East Trunk is downstream of all collection areas.

5.4 Flow Monitoring

BotCorp was engaged to install 15 flow monitors at strategic locations within city limits to assist in developing realistic sewer flows in the model. Flow monitoring occurred between the beginning of June and the end of July 2022.

The flow monitoring data was used in conjunction with the City's rain gauge data from two (2) active locations during the flow monitoring period in the area to allow model calibration for both dry and wet weather conditions based on flows and rainfall. The flow monitoring sites and catchment areas are illustrated in Figure 5.3, noting that catchment areas include roadways and green spaces in addition to residential and non-residential parcels, including some areas that would not be contributing DWFs. The flow monitoring sites and catchments are summarized in Table 5.6.

Table 5.6: Flow Monitoring Sites and Catchment Summary

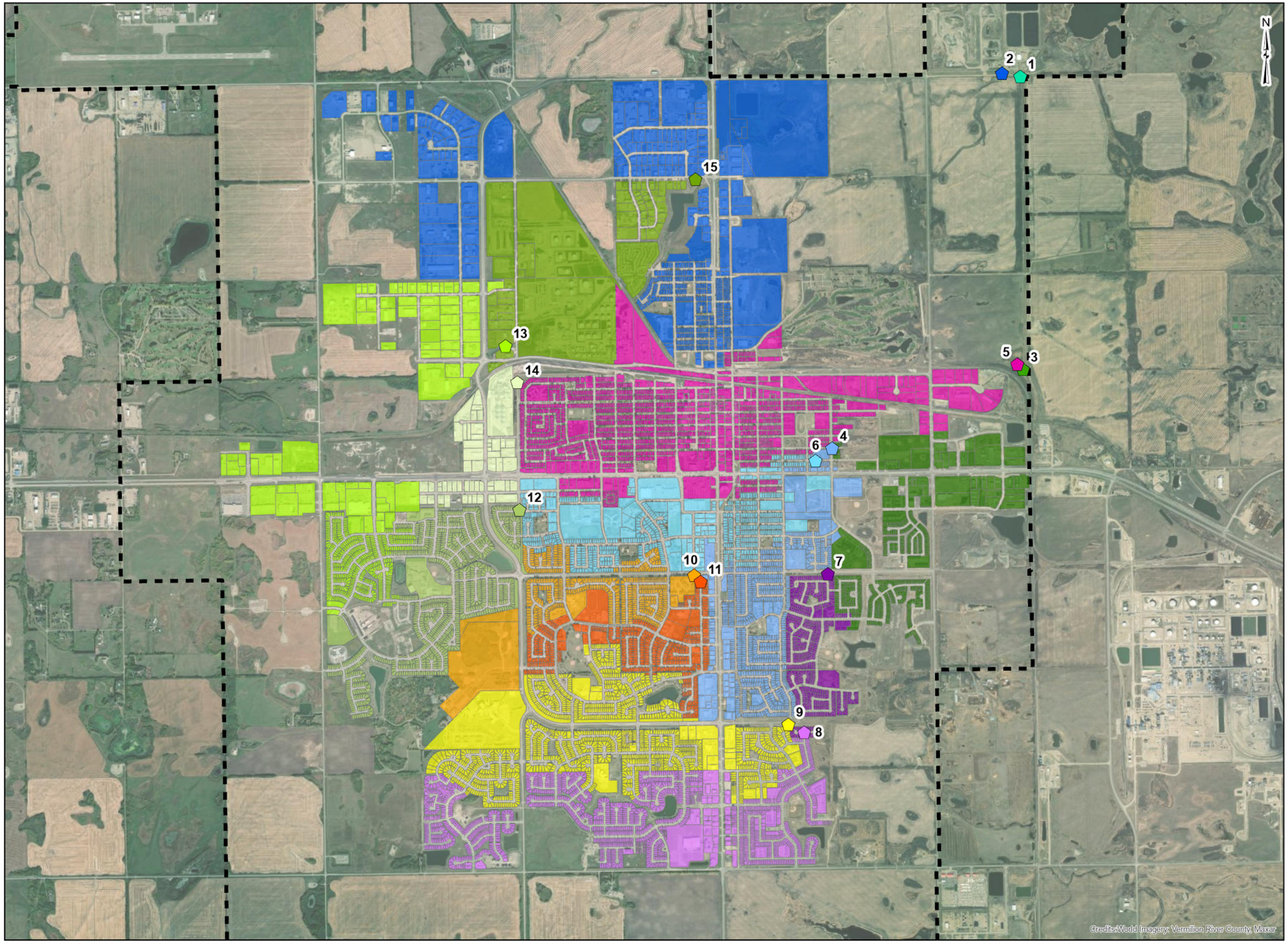
Site	Upstream Sites	Trunk Location	Net Catchment Area	Catchment Population
1	3, 4, 5, 6, 7, 8, 9, 10, 11	East	24.98	0
2	12, 13, 14, 15	North	301.31	835
3	4, 6, 7, 8, 9, 10, 11	East	89.31	1,982
4	6,10, 11	47 Street	88.97	2,525
5	N/A	52 Street	200.15	3,897
6	N/A	N/A	99.48	2,161
7	8, 9	Southeast	33.53	1,645
8	N/A	Southeast	121.56	5,184
9	N/A	25 Street	153.96	4,403
10	N/A	36 Street	77.71	1,821
11	N/A	N/A	49.49	1,778
12	N/A	N/A	80.43	3,236
13	N/A	West	145.43	1,794
14	12	N/A	40.63	0
15	12, 13, 14	West	155.22	327

Flow monitoring and rainfall data was compiled for calibration of the InfoWorks ICM model.

5.5 Model Calibration

Dry Weather Flow Calibration

Following the hydraulic model construction and compilation of the flow monitoring data, calibration of the wastewater model was then initiated. Calibration was a crucial part of the project, to accurately represent flows under both dry and wet weather conditions.



Legend

- Study Area
- Node
- Gravity Sewer

Flow Monitor Locations

- Site 1
- Site 2
- Site 3
- Site 4
- Site 5
- Site 6
- Site 7
- Site 8
- Site 9
- Site 10
- Site 11
- Site 12
- Site 13
- Site 14
- Site 15

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 5.3
FLOW MONITOR SITES AND CATCHMENTS
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The first step in calibration is DWF calibration, where a period with minimal or no rainfall influence on the network was identified for each flow monitoring site. The weeks that were chosen to represent the sanitary sewer collection system under DWF conditions are summarized in Table 5.7.

Table 5.7: Dry Weather Flow Calibration Period Summary

DWF Period	Flow Monitor
June 3-10, 2022	1
	2
	3
	5
	7
	8
	9
	10
June 4-11, 2022	11
	13
	14
	15
July 11-18, 2022	4
	6
July 21-28, 2022	12

Most of the sites were installed on June 3, 2022; therefore, the DWF period begins on this day. However, some sites were not installed until June 4, 2022; therefore, the DWF period for these sites starts one day later. Different weeks needed to be used for three (3) sites due to missing or erroneous data recorded during the flow monitoring period.

After the dry weather flow dates were deduced, it was necessary to establish residential and non-residential diurnals. This first involved determining baseflows that generally represent infiltration to the sanitary sewer collection system. These baseflows are derived independently from the sanitary generation rates, providing a more conservative overall estimate to the sanitary flows in the sanitary sewer collection system. Baseflows were initially assumed to be 80% of minimum flows (typically nighttime flows) and were adjusted as needed to derive accurate diurnals.

Following the establishment of baseflows, to further proceed towards DWF calibration, diurnals were developed. Diurnals were derived by taking the difference between recorded flow rates and the determined baseflow, dividing this value by the average flow from each day, and deducing the average per hour. With this, weekday, Saturday, and Sunday diurnals were produced for all flow monitoring sites. Residential diurnals were developed for each site with non-residential diurnals developed for Sites 2, 5, 13, 14, and 15. Diurnals were adjusted slightly to meet the peak flows that were observed in the monitored data. A total of 20 diurnals were created; graphical representations of the diurnals can be found in Appendix A.

Once the baseflows and diurnals were defined, a combination of determination and adjustment of diurnals as well as identification and adjustment of dry weather sewage flow generation rates was undertaken. Dry weather flow sewage generation rates were estimated by considering the difference between the average flow rates and the defined baseflows, then taking the difference and dividing it by upstream residential populations and non-residential (commercial, industrial, institutional) areas based on anticipated flow rates.

Successful calibration results will produce volume and peak flow errors less than ±10%, based on the Chartered Institution of Water and Environmental Management (CIWEM), formerly the Wastewater Planning Users Group (WaPUG), Code of Practice. Table 5.8 indicates that the recommended values were met at all sites. Graphical representations of the sites also indicate that there is good agreement between the observed and modelled data, and that the calibration results are sufficient.

A generalized peak flow for the monitored data was applied for many of the sites. This was done to remove any irregularities in the data that cannot be replicated in the model. These irregularities may be due to lift stations turning on/off at certain times, short periods of rainfall, or unusual increases in discharge from parcels at various times. One of the more notable occurrences of this is on June 5, 2022, at Site 5, where there was an approximately 20 L/s spike in flow recorded. Since this spike appears to be inconsistent with the rest of the flow monitoring data at this site, it was excluded for the purposes of calibrating the model. Otherwise, there is a solid agreement between modelled and monitored flow data under DWF conditions.

Final DWF comparison plots are provided in Appendix B and the final dry weather flow generation rates employed for the study are shown in Figure 5.4.

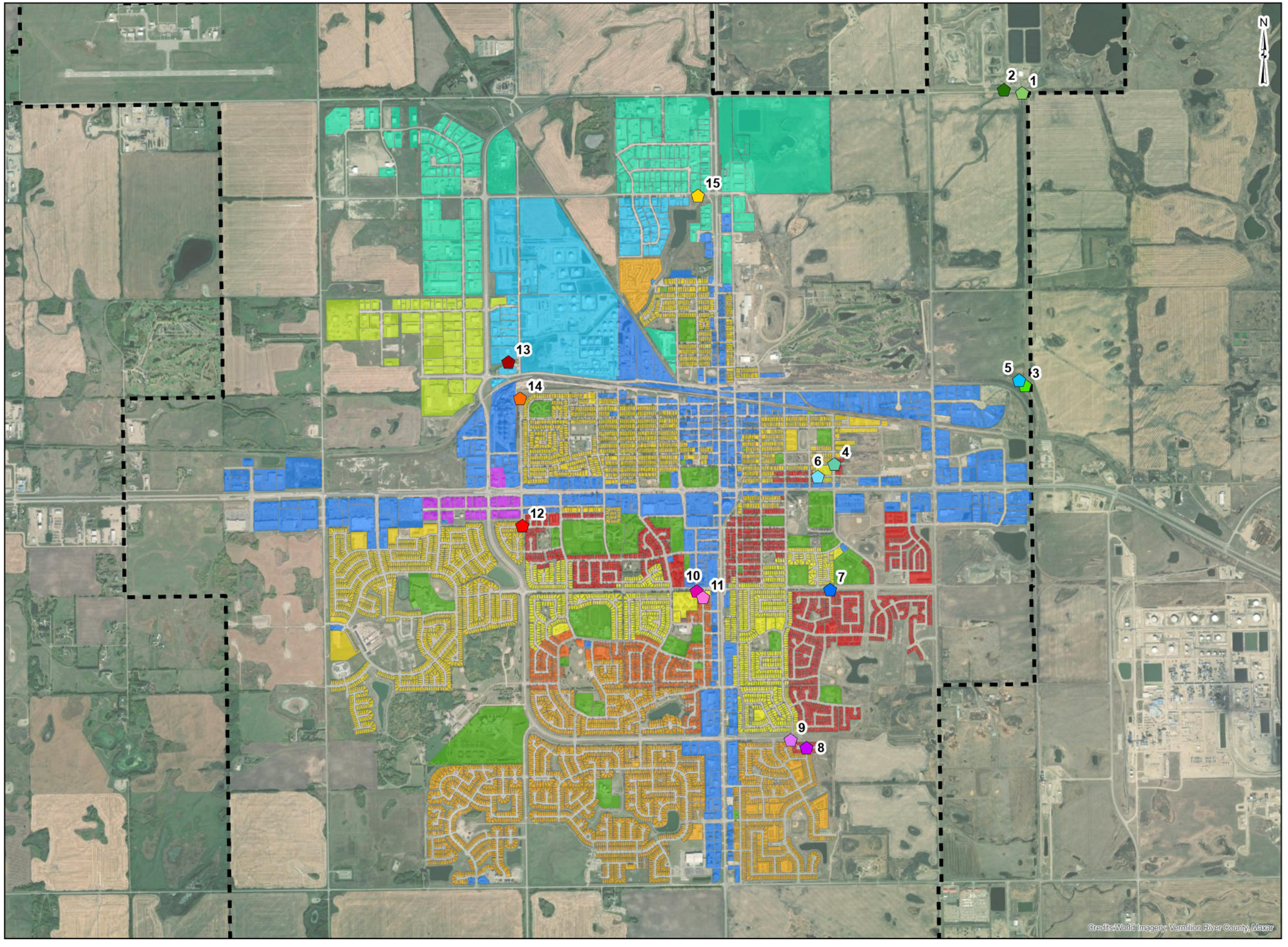
Table 5.8: Dry Weather Flow Calibration Results

Flow Monitor	DWF Period	Generalized Minimum Flow	Baseflow	Baseflow Flow Rate	Upstream Total Contributing Area	Upstream Total Contributing Population	Residential Rate	Commercial Rate	Industrial Rate	Public Services Rate	Peak Flow			Volume		
											Monitored	Modelled	Difference	Monitored	Modelled	Difference
		L/s	L/s	L/s/ha	ha		L/p/d	m^3/ha/day	m^3/ha/day	m^3/ha/day	L/s	L/s	%	m^3	m^3	%
1	June 3 - 10	75.00	22.00	0.88088	24.98	-	-	-	-	-	200.00	181.99	-9.90	84,056.6	81,129	-3.61
2	June 3 - 10	22.00	4.40	0.01460	301.31	835	200.00	5.00	3.00	1.00	70.00	65.27	-7.24	27,840.5	30,336	8.23
3	June 3 - 10	36.00	3.20	0.03577	89.31	1,982	150.00	5.00	5.00	1.00	120.70	111.91	-7.85	46,651.1	47,366	1.51
4	July 11 - 18	11.00	0.60	0.00674	88.97	2,525	325.00	5.00	-	1.00	23.61	22.08	-6.94	9,700.0	9,573	-1.33
5	June 3 - 10	17.00	13.60	0.06796	200.15	3,897	125.00	5.00	5.00	1.00	42.50	43.15	1.51	18,861.8	18721	-0.75
6	July 11 - 18	6.00	2.10	0.02111	99.48	2,161	165.00	5.00	5.00	1.00	17.00	15.79	-7.64	6,876.2	6,676	-3.00
7	June 3 - 10	21.00	5.70	0.17105	33.53	1,645	335.00	-	-	1.00	78.89	75.89	-3.96	28,035.9	30,851	9.13
8	June 3 - 10	5.50	3.30	0.02689	121.56	5,184	300.00	5.00	-	-	30.99	28.91	-7.18	9,397.4	10,352	9.22
9	June 3 - 10	6.00	3.60	0.02338	153.96	4,403	215.00	5.00	-	1.00	23.09	22.09	-4.53	8,287.5	8,946	7.36
10	June 3 - 10	3.00	2.40	0.03149	77.71	1,821	200.00	-	-	1.00	8.00	8.65	7.56	3,422.3	3,420	-0.07
11	June 4 - 11	3.00	2.40	0.04849	49.49	1,778	110.00	5.00	-	1.00	10.50	9.99	-5.14	3,625.8	3,686	1.64
12	July 21 - 28	3.75	2.06	0.02685	80.43	3,236	250.00	5.00	-	1.00	13.15	12.44	-5.70	4,929.1	5,367	8.15
13	June 4 - 11	2.00	0.60	0.00413	145.43	1,794	180.00	5.00	2.00	-	15.00	14.31	-4.84	4,512.0	4,940	8.66
14	June 4 - 11	6.50	0.69	0.01692	40.63	-	-	10.00	5.00	-	25.00	24.27	-3.01	8,921.9	9,906	9.93
15	June 4 - 11	13.50	1.25	0.00805	155.22	327	200.00	5.00	4.00	-	48.00	44.22	-8.55	18,747	18,797	0.27

Legend:

Generalized Peak Flows

Within +/- 10% Error Margin



Legend

Study Area

Manhole

Gravity Sewer

Flow Monitor Locations

- Site 1
- Site 2
- Site 3
- Site 4
- Site 5
- Site 6
- Site 7
- Site 8
- Site 9
- Site 10
- Site 11
- Site 12
- Site 13
- Site 14
- Site 15

Residential Generation Rate

- 100 - 149 L/p/d
- 150 - 199 L/p/d
- 200 - 249 L/p/d
- 250 - 299 L/p/d
- 300 - 350 L/p/d

Non-Residential Generation Rate

- 1 m^3/ha/d
- 2 m^3/ha/d
- 3 m^3/ha/d
- 4 m^3/ha/d
- 5 m^3/ha/d
- 10 m^3/ha/d

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 5.4
DWF GENERATION RATES
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Wet Weather Flow Calibration

WWF calibration was undertaken to ensure the model was accurately representing the amount of inflow and infiltration (I-I) to the sanitary sewer collection system during wet weather events. To do so, wet weather periods, during which a response to wet weather was observed in the flow monitoring data, were established. The weeks that were chosen to represent the sanitary sewer collection system under WWF conditions are summarized in Table 5.9.

Table 5.9: Wet Weather Flow Calibration Period Summary

Primary WWF Period	Validation WWF Period	Flow Monitor
June 13-18, 2022	June 23-28, 2022	11
June 23-28, 2022	June 14-19, 2022	1
		2
		3
		5
		7
		8
		9
		10
		12
		13
		14
		15
July 5-10, 2022	June 14-19, 2022	4
July 5-10, 2022	June 28-July 3, 2022	6

For WWF, a primary event was selected for each site as the event that exhibited the most significant rainfall response. This was June 23, 2022, for most sites, except for three (3) sites – Sites 4, 6, and 11. Site 4 is missing data during this period and has Site 6 located upstream. The only other storm that works well for both sites is the peaky one on July 6, 2022, which is why this event was selected for these two (2) sites. For Site 11, the baseflow alignment between the DWF week and the June 23, 2022, event is not ideal. The event on June 15, 2022, has better alignment; therefore, this event was selected for this site.

It should be noted that all events captured during the flow monitoring period are considered less than a 1:2 year storm event based on the City's Intensity Duration Frequency (IDF) curve. The City's IDF curve with major events captured during the 2022 flow monitoring period superimposed shown in Figure 5.5.

Lloyminster Intensity-Duration Frequency (IDF) Curve - 2022

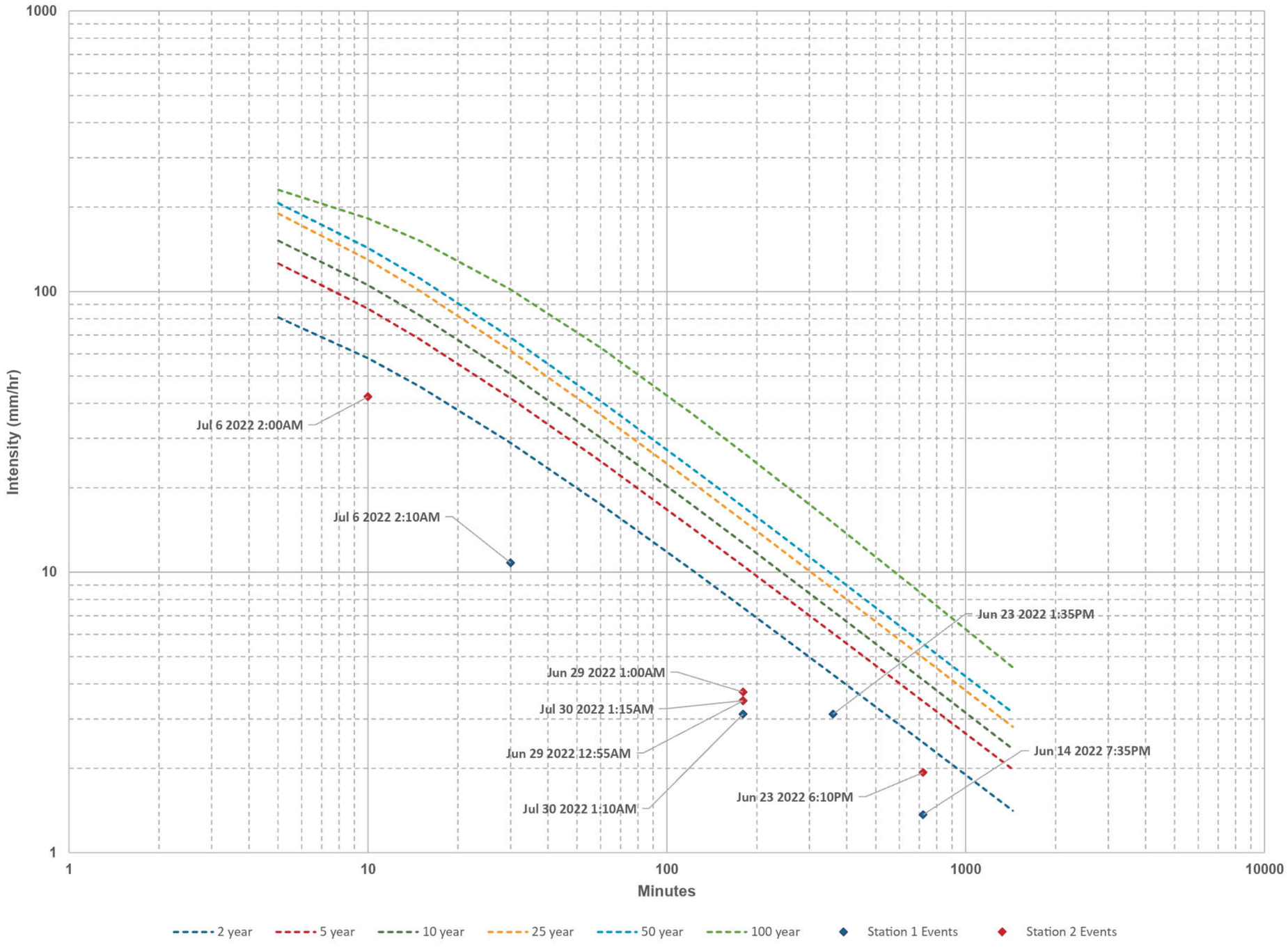

FIGURE 5.5
2022 IDF CURVE WITH
MAJOR EVENTS SUPERIMPOSED
LLOYDMINSTER SANITARY SEWER
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Calibrating the WWF in InfoWorks ICM was best achieved by using the RTK method. This method accounts for the effects of rainfall derived infiltration and inflow (RDII) entering the network. The RTK method assumes that there are three (3) hydrographs, each attributing to the RDII seeping into the sanitary sewer collection system. Each hydrograph consists of three (3) parameters, including:

- R – Area under the graph representing the proportion of rainfall that enters the sanitary sewer collection system
- T – The time it takes the rainfall to reach the peak of the hydrograph
- K – The ratio between time to recession and time to peak

Three (3) sets of RTK parameters were defined for each site, representing short-, medium-, and long-term rainfall responses to aid in the calibration of the model under WWF conditions.

Following successful calibration of the primary event, the validation event was used to assess the accuracy of the calibration. The calibration's RTK parameters were adjusted to better align with the validation event; however, the primary event calibration was still favoured. Tables 5.10 and 5.11 provide a summary of the primary and validation event calibration results, respectively. The RTK parameters for each site are also outlined in Tables 5.10 and 5.11.

There were two (2) sites (Sites 12 and 13) where the error margin was minimally exceeded for the primary event. Increasing the volume to achieve the CIWEM criteria would throw off the validation results further, given the volume errors for these two (2) sites are on the high end for the validation event. Since they are marginally exceeded for the primary event, they were left as is so that the validation event is better matched. Additionally, the monitoring data for Site 13 on June 27, 2022, does not follow the anticipated flow pattern. This may be a result of a temporary blockage, which is not replicated in the model results.

Final WWF comparison plots for the primary and validation event calibrations are provided in Appendix C.

Table 5.10: Wet Weather Flow Calibration Results – Primary Event

Parameter		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
R1		0.03	0.012	0.001	0.011	0.018	0.0105	0.0575	0.019	0.037	0.01	0.005	0.035	0.005	0.02	0.001
T1		10	5	3	0.5	0.5	0.5	0.35	1.5	2	1	2	0.25	0.1	4	0.5
K1		2	1	2	2	1.5	2	1	2	2	1	1.5	0.5	3	2	1
R2		0.25	0.015	0.001	0.001	0.009	0.025	0.115	0.009	0.007	0.005	0.025	0.018	0.006	0.043	0.001
T2		5	4	3	5	5	5	1.5	5	5	0.5	3	3	2.5	3	4
K2		2	2	2	3	2	3	1	3	3	1	2	2	2	2.75	2
R3		0.15	0.001	0.001	0.007	0.03	0.045	0.03	0.04	0.04	0.015	0.03	0.05	0.013	0.037	0.001
T3		15	12.5	10	15	15	15	15	15	15	9	10	15	15	12.5	12.5
K3		7	5	3	7	3	7	7	7	7	6	3	7	7	7	5
Monitored Peak Flow	L/s	472.42	176.21	284.76	39.26	101.15	24.58	255.18	50.58	98.15	27.55	15.00	83.95	29.51	100.14	116.60
Modelled Peak Flow	L/s	467.63	191.54	319.84	38.60	103.85	26.16	257.79	50.12	99.11	27.29	14.84	81.45	30.27	99.82	133.02
Difference	%	-1.03	8.00	10.97	-1.72	2.60	6.03	1.01	-0.92	0.97	-0.94	-1.06	-3.07	2.51	-0.31	12.34
Monitored Volume	m^3	80,330	25,845	42,810	7,986	16,223	5,293	28,625	9,730	10,294	3,094	3,294	6,982	5,298	10,576	17,148
Modelled Volume	m^3	76,969	29,560	45,926	8,215	17,437	5,747	31,221	9,495	10,157	3,329	3,619	6,298	4,714	11,024	18,660
Difference	%	-4.37	12.57	6.79	2.78	6.96	7.89	8.32	-2.47	-1.35	7.04	8.98	-10.86	-12.39	4.06	8.10

Legend:

- Generalized Peak Flows
- Within Error Margin
- Outside of Error Margin

Table 5.11: Wet Weather Flow Calibration Results – Validation Event

Parameter		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15
R1		0.03	0.012	0.001	0.011	0.018	0.0105	0.0575	0.019	0.037	0.01	0.005	0.035	0.005	0.02	0.001
T1		10	5	3	0.5	0.5	0.5	0.35	1.5	2	1	2	0.25	0.1	4	0.5
K1		2	1	2	2	1.5	2	1	2	2	1	1.5	0.5	3	2	1
R2		0.25	0.015	0.001	0.001	0.009	0.025	0.115	0.009	0.007	0.005	0.025	0.018	0.006	0.043	0.001
T2		5	4	3	5	5	5	1.5	5	5	0.5	3	3	2.5	3	4
K2		2	2	2	3	2	3	1	3	3	1	2	2	2	2.75	2
R3		0.15	0.001	0.001	0.007	0.03	0.045	0.03	0.04	0.04	0.015	0.03	0.05	0.013	0.037	0.001
T3		15	12.5	10	15	15	15	15	15	15	9	10	15	15	12.5	12.5
K3		7	5	3	7	3	7	7	7	7	6	3	7	7	7	5
Monitored Peak Flow	L/s	367.57	170.20	170.20	32.50	64.03	24.13	141.68	36.05	51.63	15.06	17.07	37.48	22.77	59.51	79.14
Modelled Peak Flow	L/s	347.95	153.82	226.58	47.49	81.06	22.18	179.41	38.91	62.54	17.76	19.05	54.47	23.00	73.26	99.11
Difference	%	-5.64	-10.65	24.88	31.56	21.01	-8.82	21.03	7.34	17.44	15.22	10.42	31.20	0.99	18.77	20.14
Monitored Volume	m^3	73,432	25,218	42,401	7,570	17,144	6,327	28,428	8,934	9,359	3,404	3,300	5,173	4,098	9,770	17,539
Modelled Volume	m^3	83,252	31,914	50,009	10,730	18,634	5,726	34,244	10,432	11,535	3,568	3,336	7,081	5,028	12,258	20,240
Difference	%	11.80	20.98	15.21	29.45	8.00	-10.49	16.98	14.36	18.87	4.59	1.07	26.94	18.50	20.30	13.35

Legend:

- Generalized Peak Flows
- Within Error Margin
- Outside of Error Margin

6.0 Existing System Assessment

6.1 Inflow and Infiltration Review

To estimate the I-I rate based on the monitored sewage flows in the sanitary sewer collection system, a review of the flow monitoring data was undertaken. The rates observed through flow monitoring are summarized in Table 6.1 below. The monitored I-I rates represent the measured peak WWF minus the measured peak DWF divided by the corresponding gross total upstream catchment area.

Table 6.1: Observed I-I Rates Based on 2022 Flow Monitoring Data

Flow Monitor Site	Peak DWF	Peak WWF	Difference	WWF/DWF Ratio	Gross Upstream Area	I-I Rate
	L/s	L/s	L/s		ha	L/s/ha
1	200	472	272	2.36	1,319.26	0.21
2	70	176	106	2.52	759.15	0.14
3	120	285	165	2.37	1,034.45	0.16
4	22	33	10	1.47	509.80	0.02
5	42	101	59	2.41	259.84	0.23
6	17	24	7	1.42	392.51	0.02
7	79	255	176	3.23	406.99	0.43
8	30	51	21	1.69	159.86	0.13
9	23	98	75	4.25	201.14	0.37
10	9	28	19	3.06	89.92	0.21
11	10	19	9	1.87	66.12	0.13
12	14	84	70	6.09	107.97	0.65
13	14	30	16	2.11	187.00	0.08
14	25	100	75	4.01	54.74	1.37
15	47	117	70	2.48	404.40	0.17

The AEPA Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems (2012) recommends accommodating an I-I rate of no larger than 0.28 L/s/ha (design criterion for new development). Based on Table 6.1, it is apparent that this criterion was exceeded at Sites 7, 9, 12, and 14, which is not uncommon in older areas due to degraded pipes or connections that would no longer be permitted (e.g. weeping tiles or sump pumps discharging into the sanitary sewer collection system, as well as storm cross connections). For example, Sites 7 and 9 both have similar pipe installation years, so there could be a commonality there.

Table 6.2 summarizes the I-I rates established in the calibrated model for the 1:5, 1:10, 1:25, and 1:50 year design storm events. An I-I rate comparison of the monitored and modelled rates is illustrated in Figure 6.1.

Table 6.2: Modelled I-I Rates Based on Huff Design Storm Model Simulations

Flow Monitor Site	Average Peak I-I Rate			
	1:5 Year	1:10 Year	1:25 Year	1:50 Year
	L/s/ha	L/s/ha	L/s/ha	L/s/ha
1	0.58	0.68	0.82	0.92
2	0.34	0.40	0.48	0.55
3	0.56	0.66	0.79	0.89
4	0.35	0.42	0.50	0.56
5	0.47	0.55	0.66	0.74
6	0.38	0.46	0.55	0.61
7	0.91	1.08	1.29	1.45
8	0.43	0.52	0.61	0.69
9	0.70	0.83	1.00	1.12
10	0.33	0.40	0.48	0.53
11	0.53	0.62	0.74	0.83
12	0.92	1.09	1.31	1.47
13	0.22	0.26	0.31	0.36
14	0.87	1.03	1.24	1.39
15	0.37	0.43	0.52	0.59
Average	**0.53**	**0.63**	**0.75**	**0.85**

The average monitored I-I rate calculated from the fifteen (15) flow monitoring sites in Table 6.1 is 0.29 L/s/ha, which is considerably lower than the modelled I-I rates. The I-I rates observed during flow monitoring are lower than the design storm assessment scenarios for all sites except for Site 14. When comparing the City's IDF curve with the major events observed during the flow monitoring period, it is noted that there was not a rainfall event with a significant return period. As previously mentioned, all the monitored events were less than a 2-year return period storm as shown in Figure 5.5. Therefore, it was expected that the monitored rates would be lower than the modelled rates because of the minimal rainfall during the flow monitoring period.

Site 14 is nearest to Rain Gauge 1 in the northwest; however, since rainfall is typically quite spatially variable, the rain gauge may not have captured more intense rain in the Site 14 catchment area. This could be one reason for the discrepancy between the monitored and modelled rates.

Another factor is the catchment area that is used to calculate these rates. Due to the large number of flow splits in the city, the catchment areas are based on using the lower pipe invert at flow split locations. This works well for low flow scenarios such as dry weather flows where the majority of flow is likely conveyed through the lower invert pipes. Under wet weather flow conditions, the flows are likely being split more significantly between any downstream pipes. This could skew the catchment areas for the flow monitoring sites and in turn skew the rate calculations. Therefore, it is recommended that these be used only to get a general sense of the I-I in the sanitary sewer collection system.

The rates generally highlight that the I-I for Sites 7, 9, 12, and 14 is particularly high, especially compared to AEPA's guideline of 0.28 L/s/ha. This presents a potentially significant risk to the existing sanitary sewer collection system if the city were to get a larger rainfall event in the future. This should provide guidance on where future I-I reduction programs may be focused on in the future and supports the need for these programs in the city.

Inflow and Infiltration Reduction

Remediation measures in the existing sanitary sewer collection system could reduce some of the capacity constraints by minimizing I-I. This could potentially resolve some of the capacity constraints without additional upgrades completed to the existing sanitary sewer collection system. A detailed I-I program could be undertaken to pinpoint areas with extreme I-I, which could involve several field tests and inspections, including the following.

Visual Inspections: Interior and exterior visual inspections of sanitary manholes are a quick and inexpensive way to identify obvious defects and assess the condition of joints, seals, and other possible I-I sources.

Smoke Tests: Non-toxic, odourless smoke is injected into sanitary sewer manholes. The locations of exiting smoke can indicate where I-I might enter the sanitary sewer collection system. Smoke will typically appear from roof drains, catchbasins or yard drains connected to the sanitary sewer collection system. The smoke may also appear from cracks in the pavement above the sewer, around homes with foundation drains connected to the sewer or in basements through sump pumps, floor drains or other direct openings to the sanitary sewer collection system.

Dye Tests: A non-toxic dye is added to a stormwater source upstream of suspected I-I locations. The stormwater can then be traced through the sanitary sewer collection system to confirm locations where stormwater is entering the sanitary sewer collection system. This tends to be most useful in locating cross connections, where smoke testing may not provide evidence of them.

Targeted Closed-Circuit TV (CCTV) Inspections: A video camera is sent through sections of the sanitary sewer collection system recording the condition of the pipes. The video footage can help identify I-I problem areas, such as cracks, root intrusions, leaks, and stormwater cross-connections.

Through this program, recommendations for mitigation measures would be proposed to establish an I-I reduction program. Following the completion of the I-I reduction program, additional flow monitoring and recalibration would be needed to determine if the mitigation measures were sufficient alone in alleviating capacity constraints, or if upgrades are still needed. Overall, this could potentially reduce the capital costs of upgrades. It should be noted that City is already planning to implement an I-I reduction program as a separate project from the SSMP.

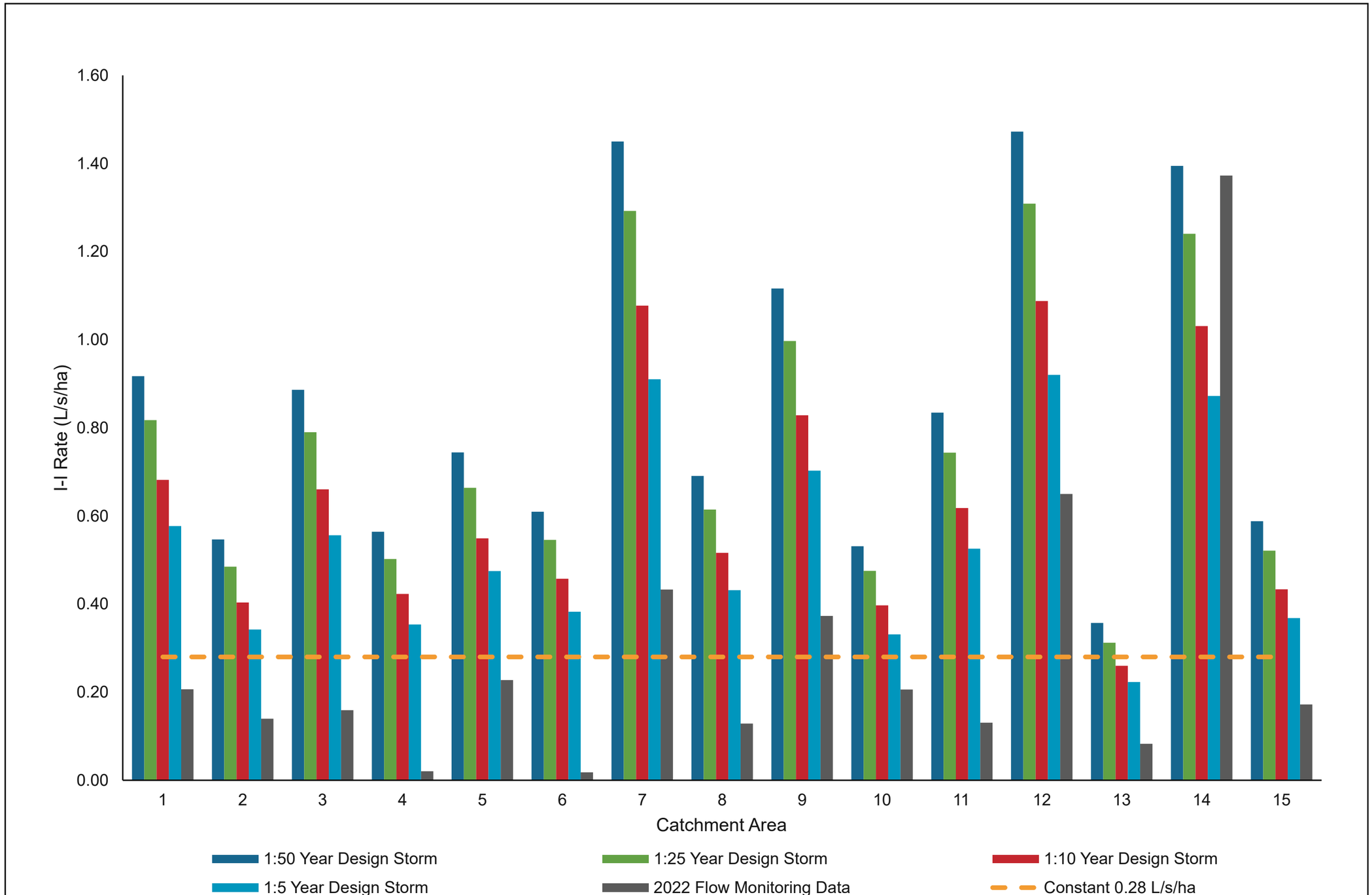

FIGURE 6.1
INFLOW-INFILTRATION RATE SUMMARY
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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6.2 Capacity Assessment

The capacity assessment results for the 1:5 year 24-hour Q4 Huff storm are illustrated in Figures 6.2 and 6.3 for peak discharge relative to pipe capacity (Q/Q_{man}) and maximum HGL elevation relative to ground (Max HGL) and spare capacity, respectively. The capacity assessment results for the 1:10 year storm are illustrated in Figures 6.4 and 6.5. The capacity assessment results of the LOS rainfall event, i.e., the 1:25 year storm, are illustrated in Figures 6.6 and 6.7. Longitudinal profiles (LP) and corresponding numbers (No.) of the major trunks outlined in Figure 4.4 and areas with significant surcharge under the LOS rainfall event have also been provided in Appendix D. A longitudinal profile key plan for the surcharging areas is shown in Figure 6.8.

6.2.1 Existing System Capacity Upgrades

Based on the existing sanitary sewer collection system capacity assessment upgrades to improve areas of concern were developed. The identified upgrades are summarized in Table 6.3 and shown in Figure 6.9.

Table 6.3: Existing System Proposed Capacity Upgrades

Upgrade No.	Name	Description	LP No.
1	Aurora Sewer Upgrades	Upgrade from 200 mm sewer to 300 mm sewer along 32 Street from 45 Avenue to 46 Avenue.	1
		Upgrade from 200 mm sewer to 250 mm sewer along 46 Avenue from 31 Street close to 32 Street.	2
		Upgrade of 200 mm sewer to 250 mm sewer along 31 Street from 45A Avenue to 46 Avenue.	3
2	44 Street Sewer Upgrade	Upgrade from 200 mm sewer to 250 mm sewer along 44 Street from 54 Avenue to 56 Avenue.	5
3	51 Street Sewer Upgrade	Upgrade from 300 mm sewer to 375 mm sewer along 51 Street from 52 Avenue to 54 Avenue including pipe slope adjustments. New 375 mm sewer from 51 Street to 52 Street crossing the Canadian National (CN) Rail property and tracks along 52 Avenue.	6
4	52 Street Trunk Upgrade	Upgrade from 450 mm sewer to 525 mm sewer along 52 Street from 45 Avenue to 49 Avenue. Connection of 300 mm sewer along 50 Avenue to the existing 450 mm sewer along 52 Street.	7
5	48 Avenue Sewer Upgrade	Upgrade from 300 mm sewer to 375 mm sewer along 48 Avenue from 49 Street to 52 Street crossing the CN Rail tracks. Replacement of 375 mm pipe segments for slope adjustments.	8
6	36 Street Trunk Upgrade West	Upgrade from 375 mm sewer to 450 mm sewer along 36 Street from 47 Avenue to 49 Avenue.	9
7	36 Street Trunk Upgrade East	Upgrade from 750 mm sewer to 900 mm sewer along 36 Street from 40 Avenue to 45 Avenue.	10
8	East Trunk Upgrade	Upgrade from 750 mm sewer to 900 mm sewer along 36 Street and 41 Street as well as through the undeveloped land from 37 Avenue to 40 Avenue.	11

Upgrade No.	Name	Description	LP No.
9	Southeast Trunk Upgrade	Upgrade from 375 mm and 450 mm sewer to 525 mm sewer along 46 Avenue/20 Street, 47 Avenue, and 47A Avenue/19 Street from 18 Street to 25 Street.	12
10	47 Avenue Sewer Upgrade	Upgrade from 250 mm sewer to 300 mm sewer along 47 Avenue from 23 Street to 25 Street.	13
11	53 Avenue Sewer Upgrade	Upgrade from 300 mm sewer to 375 mm sewer along 53 Avenue from 25 Street to 27 Street.	14
12	25 Street Trunk Upgrade	Upgrade from 300 mm sewer to 375 mm sewer along 59 Avenue and 25 Street from College Drive to 57B Avenue.	15
13	59 Avenue Sewer Upgrade	Upgrade from 450 mm and 525 mm sewer to 600 mm sewer along 59 Avenue from 50 Street to south of 55 Street crossing the CN Rail tracks.	16

The Aurora Sewer Upgrades (Upgrade 1) are proposed based on the elevated HGL highlighted in the model results. However, City Operations staff have not had any concerns reported in this area to date. Therefore, it is recommended that this location be monitored for operational issues and upgrades prioritized as needed.

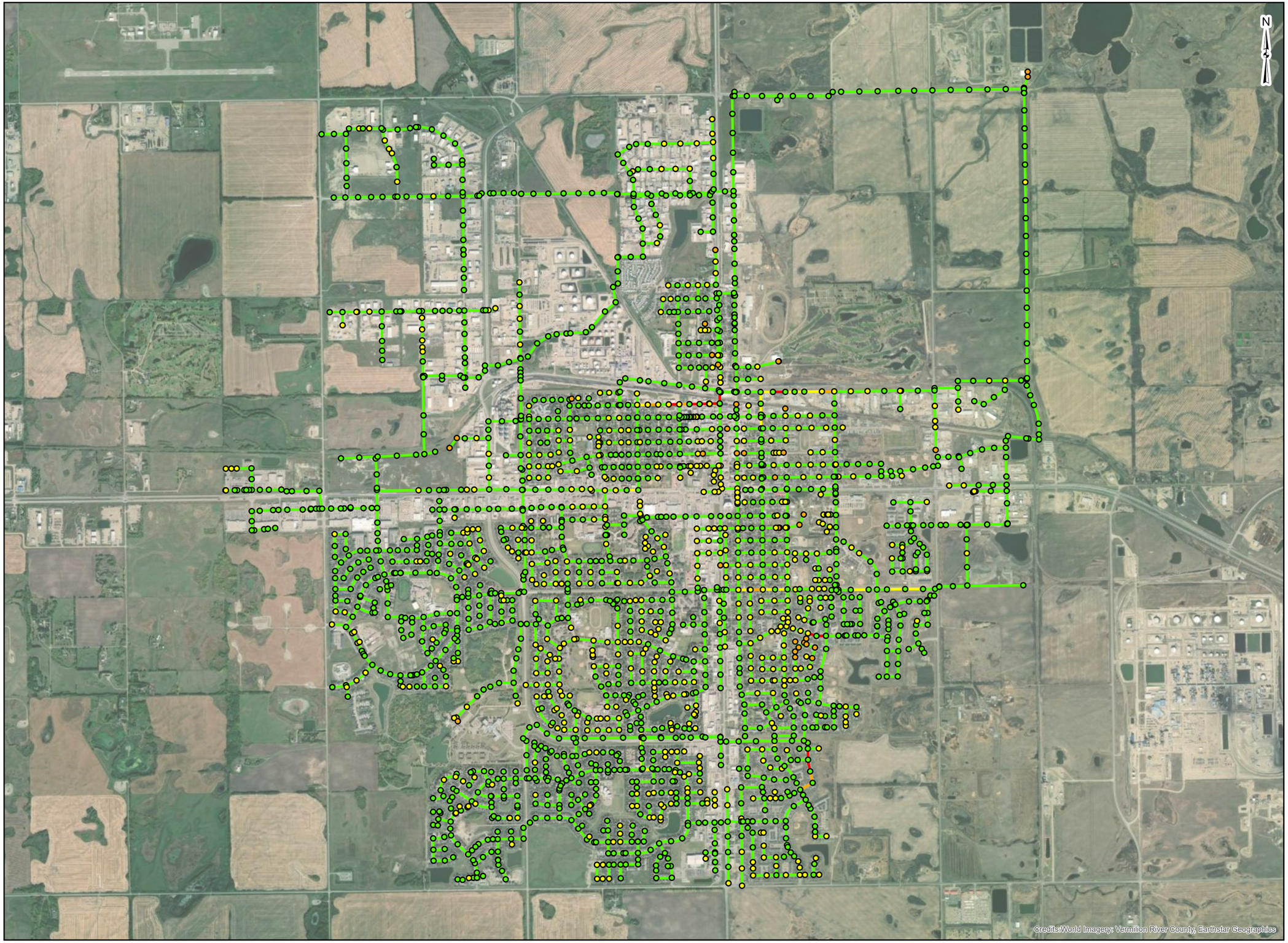
The final alignment of the proposed 44 Street Sewer Upgrade (Upgrade 2) is to be determined during Detailed Design as there may be the option to redirect these sewer flows north along 55 Avenue and east along 45 Street as part of a potential Water and Sewer Replacement Program.

An alternative to the Southeast Trunk Upgrade (Upgrade 9) may be to redirect sanitary sewer flows northeast along 19 Street and through the undeveloped portion of Wallacefield. This has been considered as part of the future sanitary sewer collection system and is discussed in Section 7.1.

Although the results highlight capacity issues in the existing 250 mm pipe along 53 Avenue from 23 Street to 25 Street, no upgrades are proposed at this location. There is minimal surcharging occurring in this section based on the model results and the sewer depth is a minimum of 4 m below the ground surface. Additionally, the City installed a sewer overflow in this area in 2014 to reduce capacity issues. That said, the City noted that there may be a flow split upstream that is not captured in the City's as-built information, which may result in less flow being directed to the sewer overflow in the model than in reality. It is recommended that this be surveyed in the future for the City's records and to improve modelling accuracy in the area.

It should be noted that the 59 Avenue Sewer Upgrade (Upgrade 13) should be undertaken off-line to maintain the use of the existing sanitary sewer collection system during construction. Once this is complete, the existing pipe is to be abandoned or removed following the installation of the new sanitary sewer pipe as requested by the City.

Results from the existing sanitary sewer collection system assessment for the 1:25 year storm LOS event, including the upgrades noted above, are shown in Figures 6.10 and 6.11 with longitudinal profiles provided in Appendix D.



Legend

Study Area

Maximum HGL Elevation Relative to Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m
- Greater than 0.0m

Peak Discharge Relative to Pipe Capacity

- Less than 86%
- Between 86% and 100%
- Between 100% and 120%
- Greater than 120%

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.2
EXISTING SANITARY SYSTEM
1:5 YR 24-HR RESULTS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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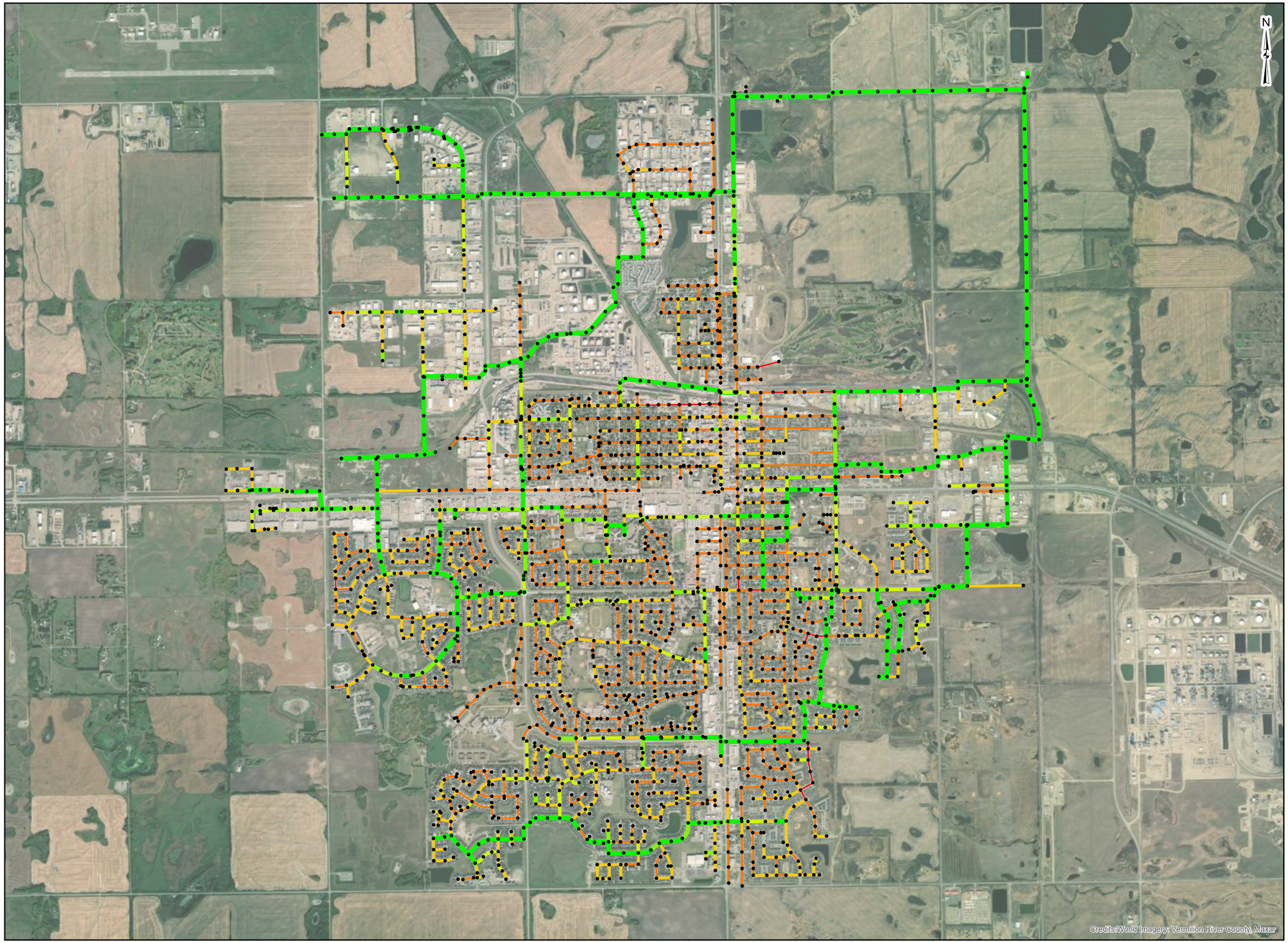

Legend

- Study Area
- Manhole

Pipe Spare Capacity

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

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.3
EXISTING SANITARY SYSTEM
1:5 YR 24-HR SPARE CAPACITY
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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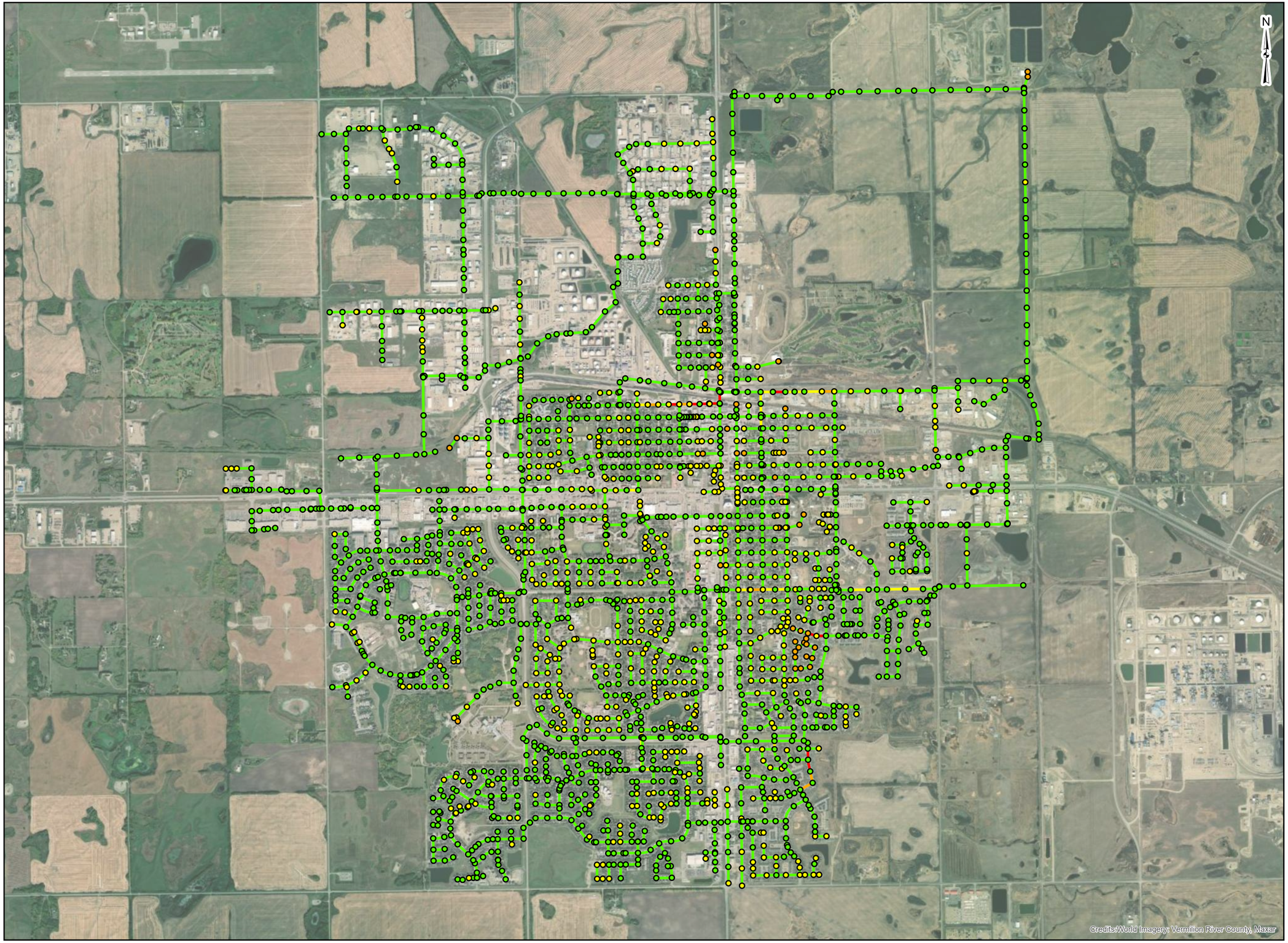

Legend

Study Area

Maximum HGL Elevation Relative to Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m
- Greater than 0.0m

Peak Discharge Relative to Pipe Capacity

- Less than 86%
- Between 86% and 100%
- Between 100% and 120%
- Greater than 120%

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.4
EXISTING SANITARY SYSTEM
1:10 YR 24-HR RESULTS
LLOYDMINSTER SANITARY SEWER
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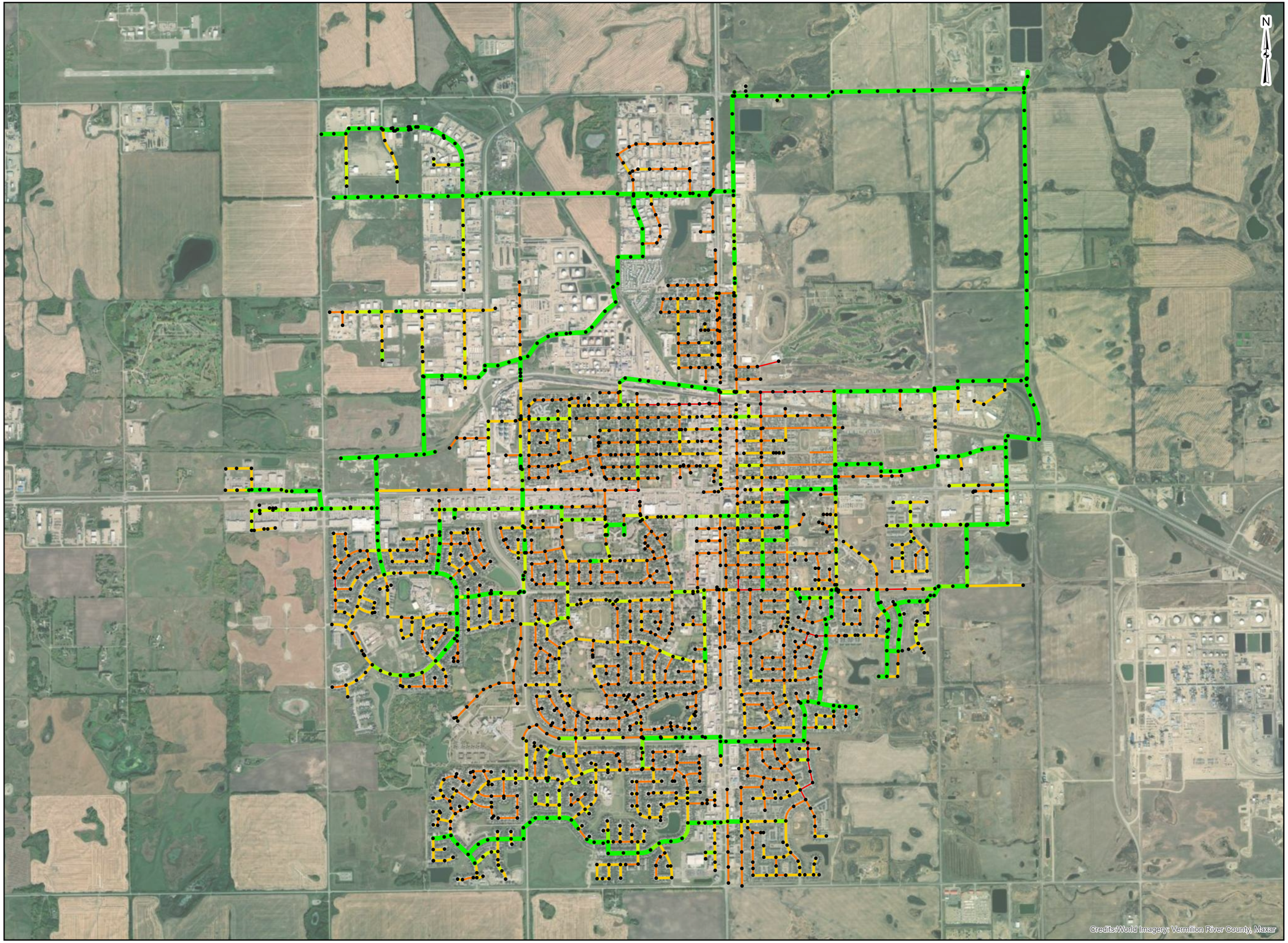

Legend

- Study Area
- Manhole

Pipe Spare Capacity

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

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.5
EXISTING SANITARY SYSTEM
1:10 YR 24-HR SPARE CAPACITY
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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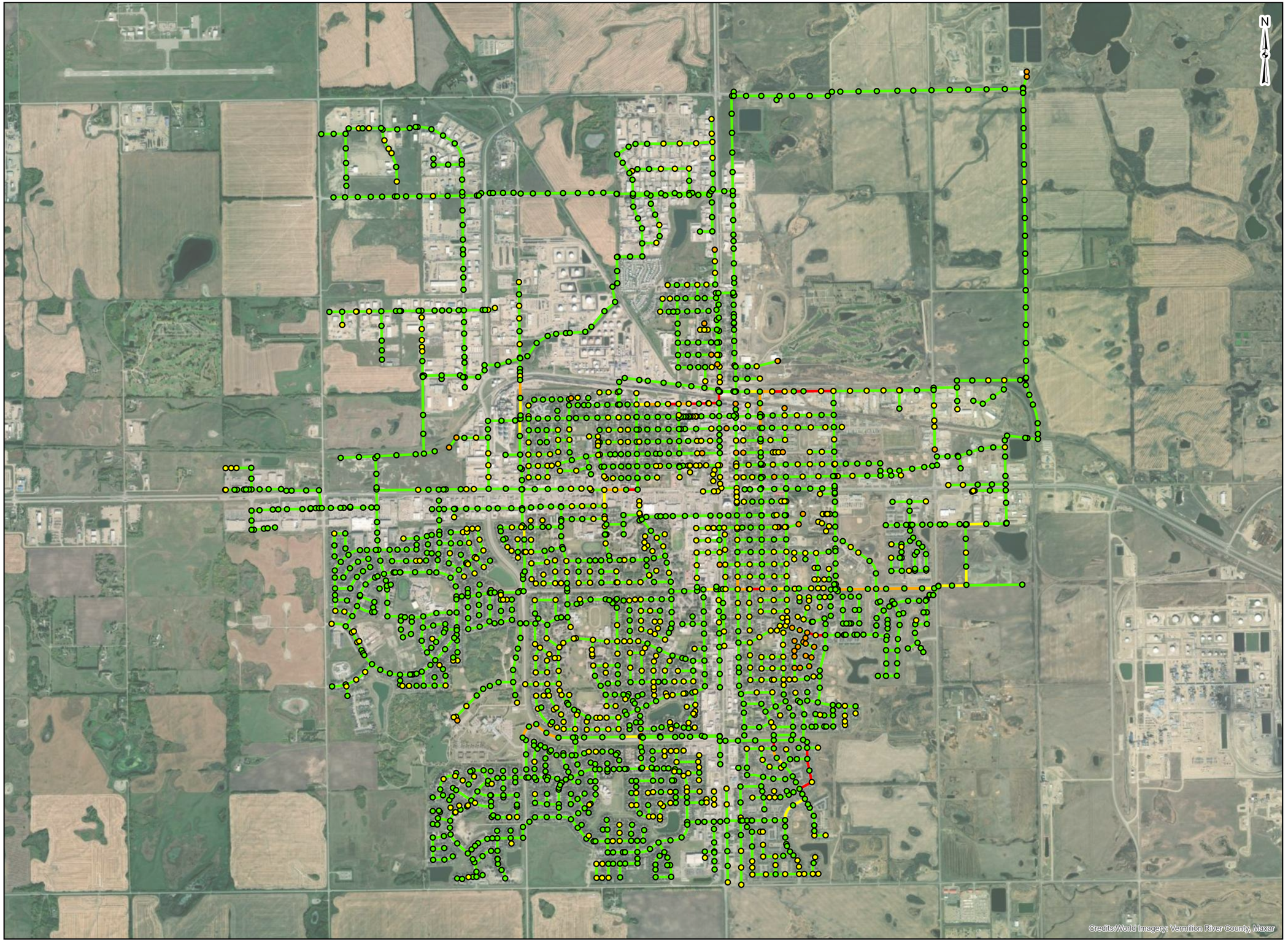

Legend

Study Area

Maximum HGL Elevation Relative to Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m
- Greater than 0.0m

Peak Discharge Relative to Pipe Capacity

- Less than 86%
- Between 86% and 100%
- Between 100% and 120%
- Greater than 120%

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.6
EXISTING SANITARY SYSTEM
1:25 YR 24-HR RESULTS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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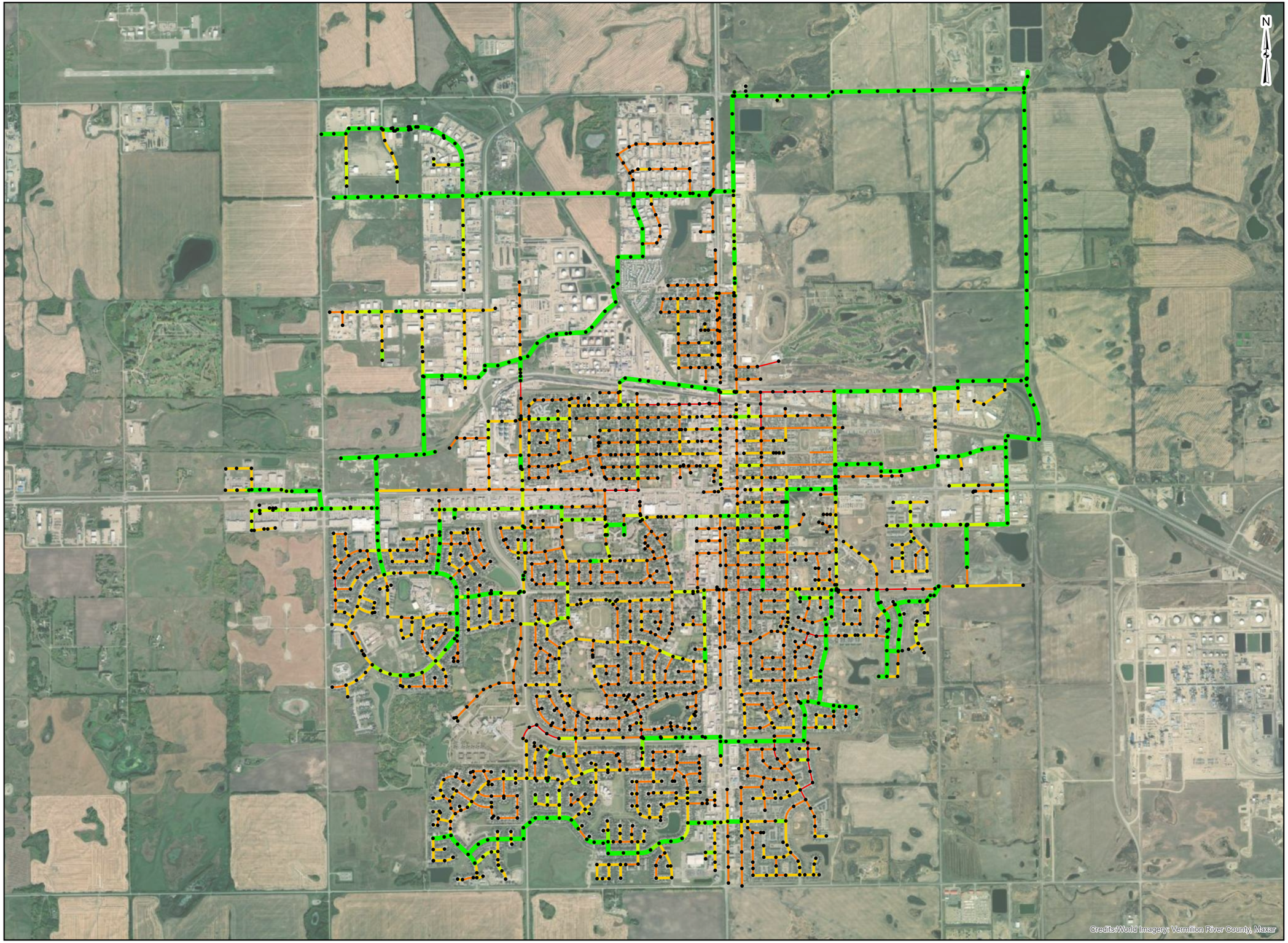

Legend

- Study Area
- Manhole

Pipe Spare Capacity

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

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.7
EXISTING SANITARY SYSTEM
1:25 YR 24-HR SPARE CAPACITY
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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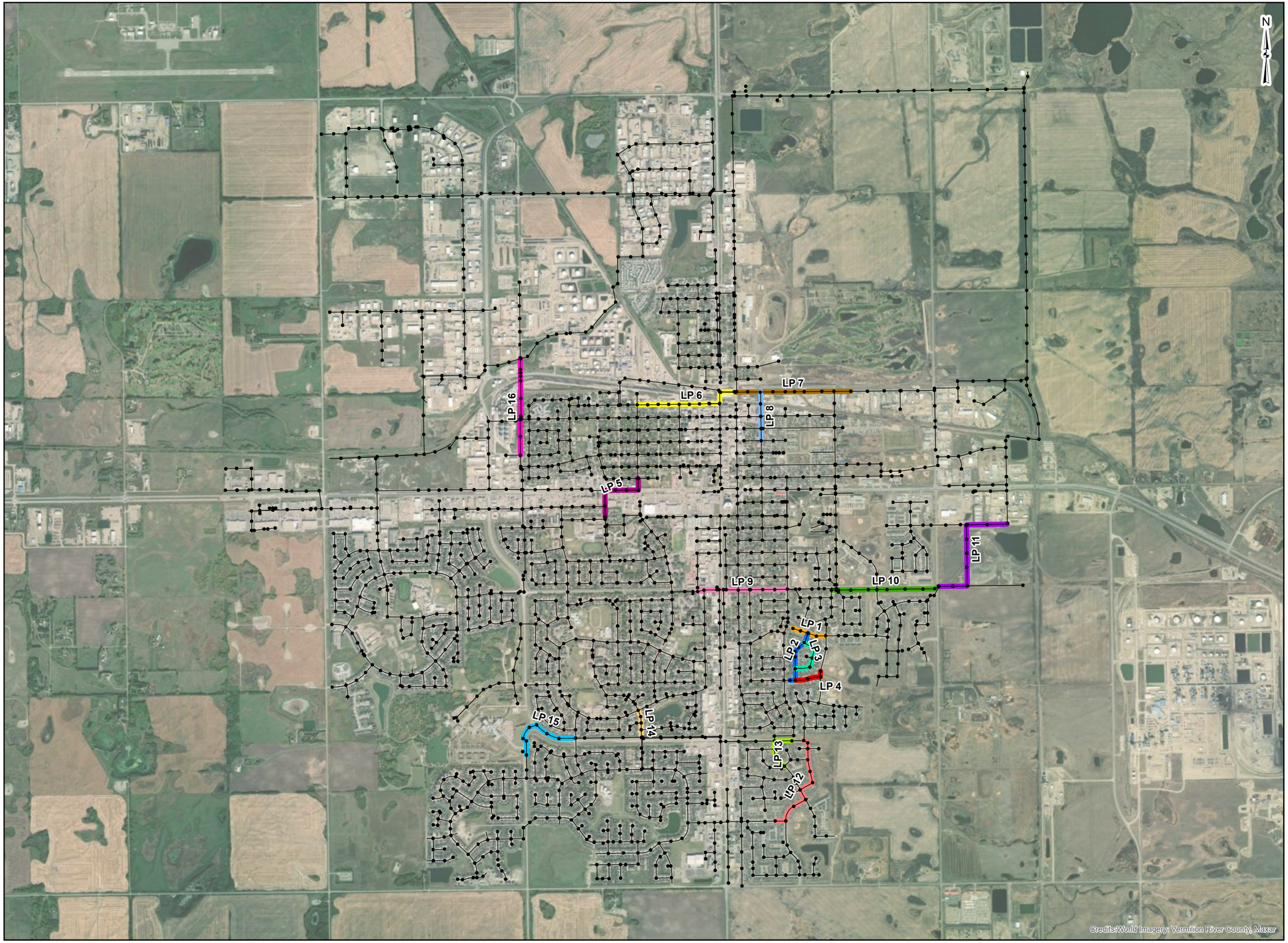

Legend

- Study Area
- Manhole
- Gravity Sewer

Longitudinal Profile

- LP 1
- LP 2
- LP 3
- LP 4
- LP 5
- LP 6
- LP 7
- LP 8
- LP 9
- LP 10
- LP 11
- LP 12
- LP 13
- LP 14
- LP 15
- LP 16

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.8
LONGIDTUDINAL PROFILE
KEY PLAN
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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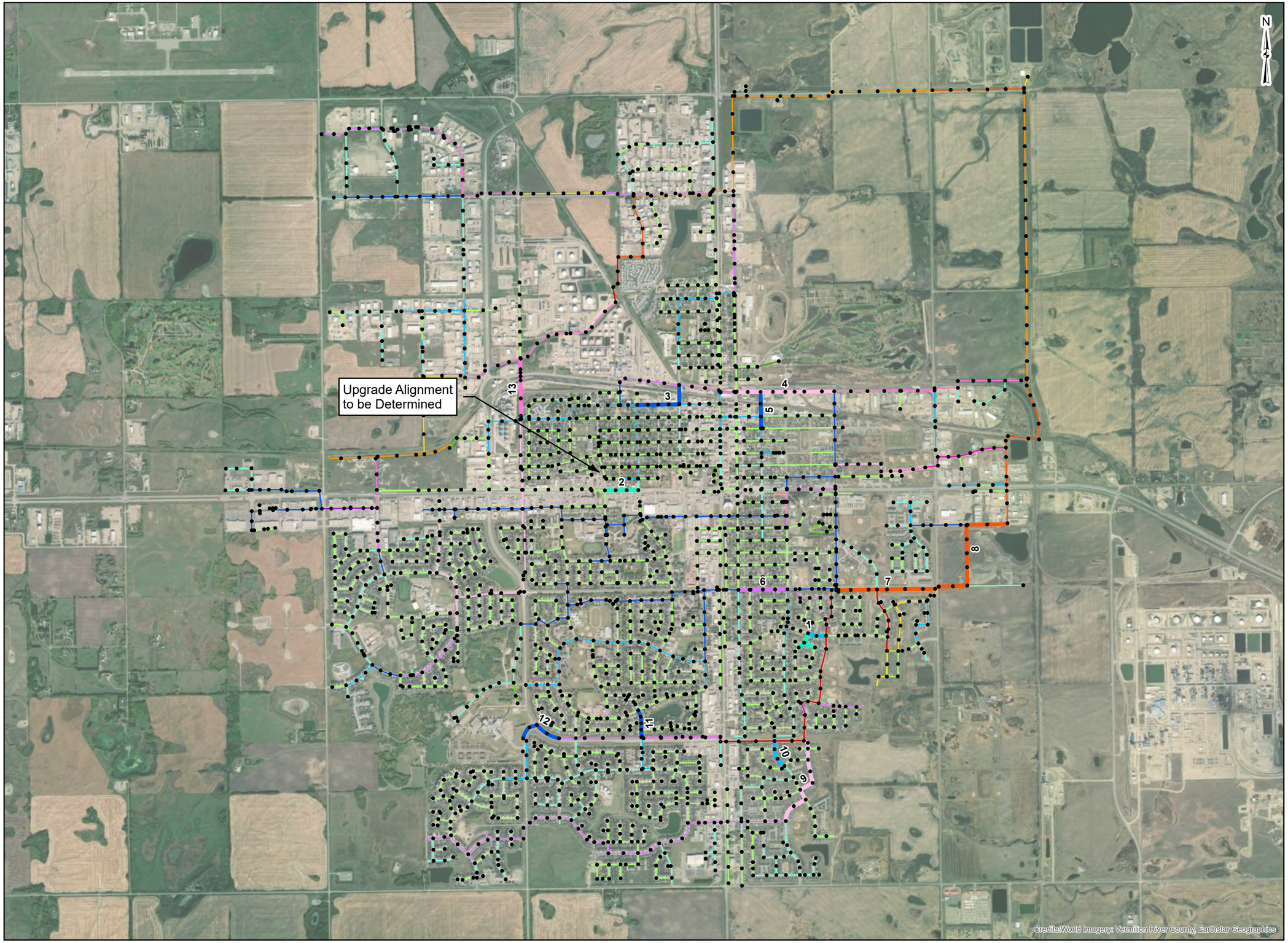

Legend

- Study Area
- Existing Manhole

Existing Pipe Diameter

- 100 mm
- 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 400 mm
- 450 mm
- 500 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1050 mm
- 1200 mm
- 1350 mm
- Unknown

Proposed Pipe Upgrade Diameter

- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- 900 mm

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.9
PROPOSED PIPE CAPACITY UPGRADES
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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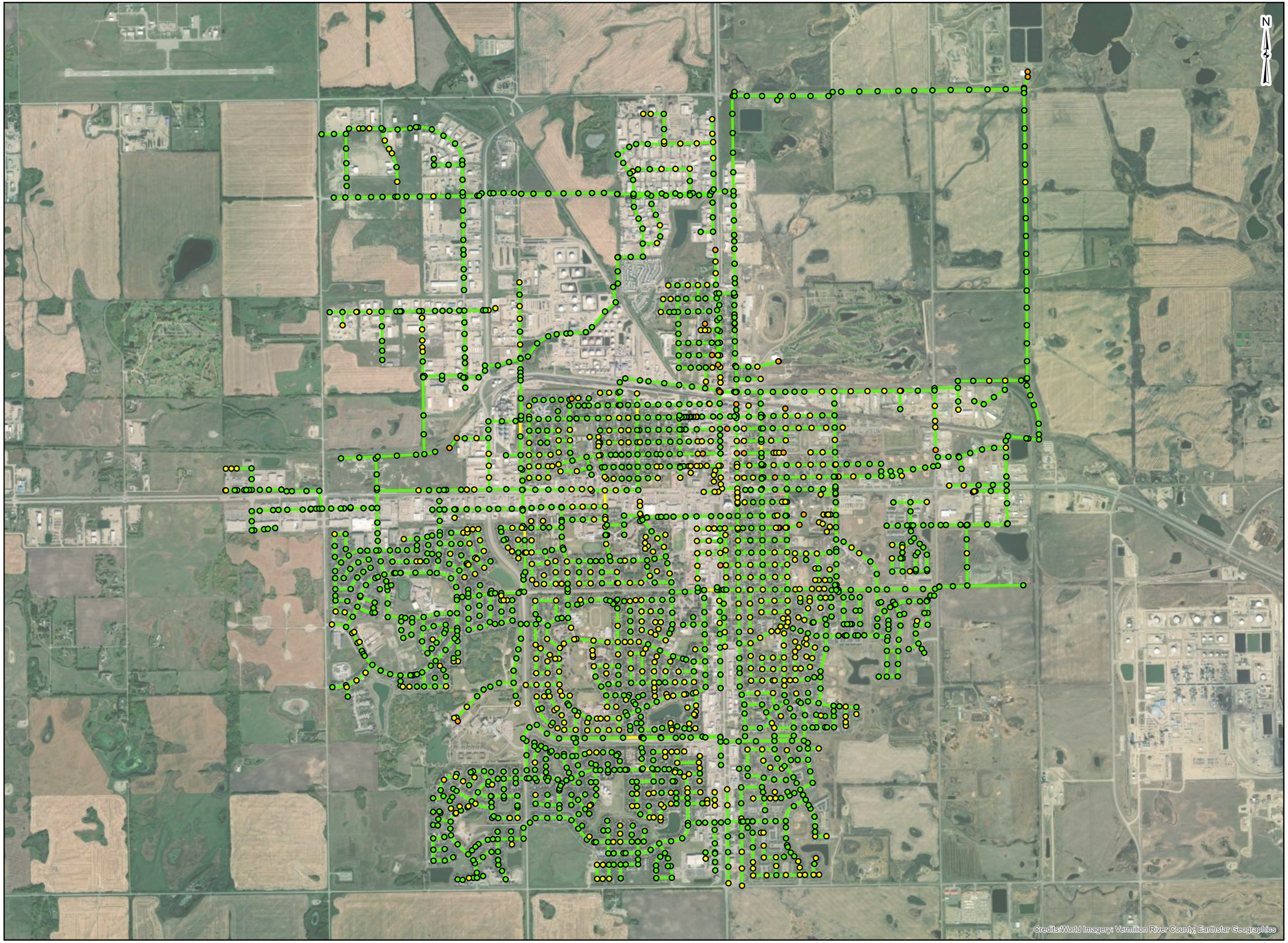

Legend

Study Area

Maximum HGL Elevation Relative To Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m
- Greater than 0.0m

Peak Discharge Relative to Pipe Capacity

- Less than 86%
- Between 86% and 100%
- Between 100% and 120%
- Greater than 120%

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.10
EXISTING UPGRADES
1:25 YR 24-HR RESULTS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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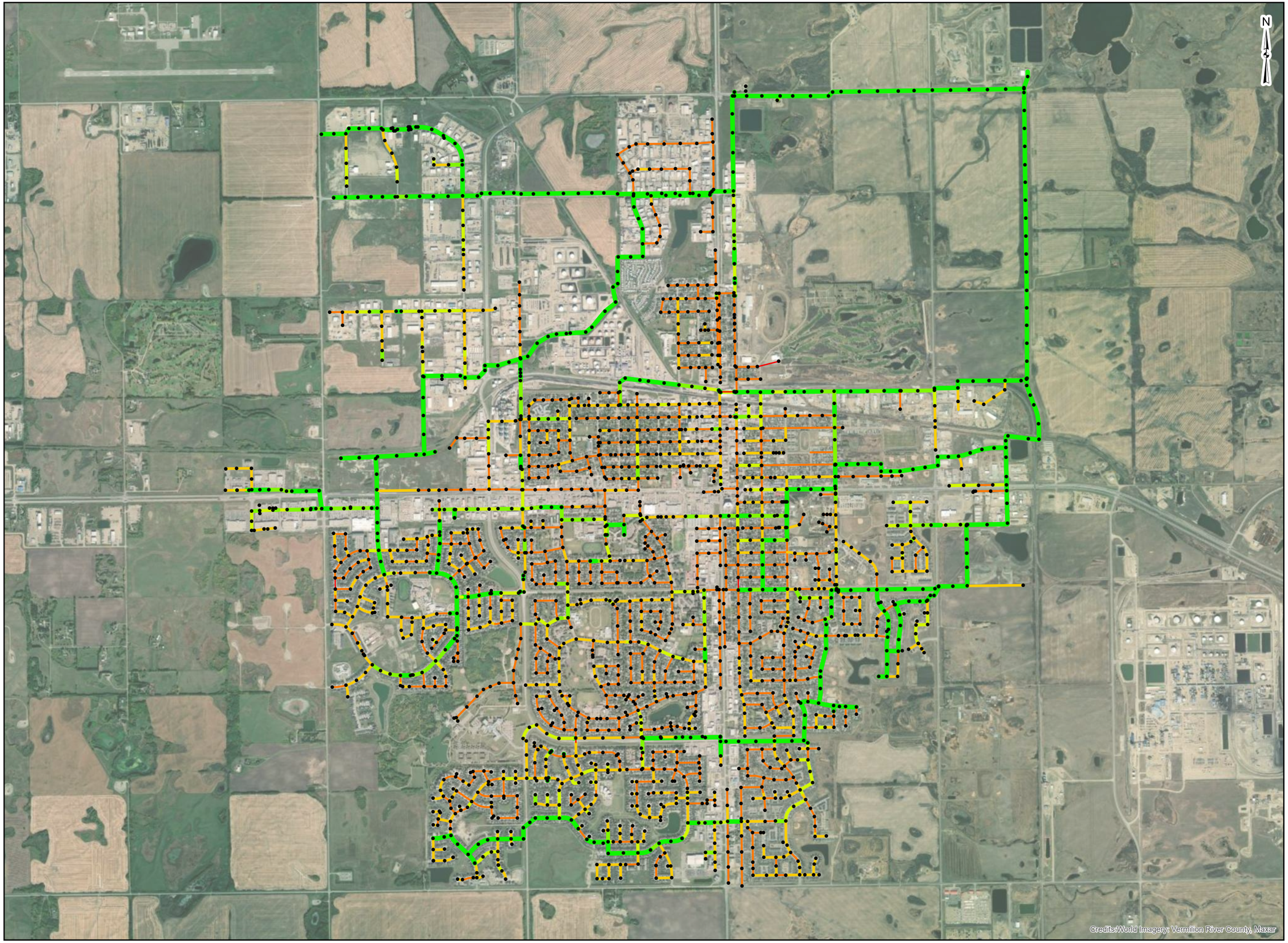

Legend

- Study Area
- Manhole

Pipe Spare Capacity

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

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.11
EXISTING UPGRADES
1:25 YR 24-HR SPARE CAPACITY
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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6.3 Condition Assessment

The City's Sanitary Sewer Condition Assessment and Management Strategy (AECOM, 2016) identified categories for the City's sanitary sewer infrastructure based on consequence of structural failure of the pipe and associated cost-benefit ratio. These categories were then separated into strategic and non-strategic sub-categories based on the critical operation of the overall sanitary sewer collection system to recommend condition assessment priority areas.

The City provided flooding records for parcels and roads for two (2) significant rainfall events in the city: one in June 2017 and the other in June 2018. The 2016 condition assessment recommendations as well as the two (2) sets of flooding records are shown in Figure 6.12. It should be noted that the A-Strategic category was also separated into sub-categories based on the pipe diameter being less or greater than 600 mm, pipe material not being PVC, and the installation year being before 1990 to aid in the prioritization of proposed condition assessment locations.

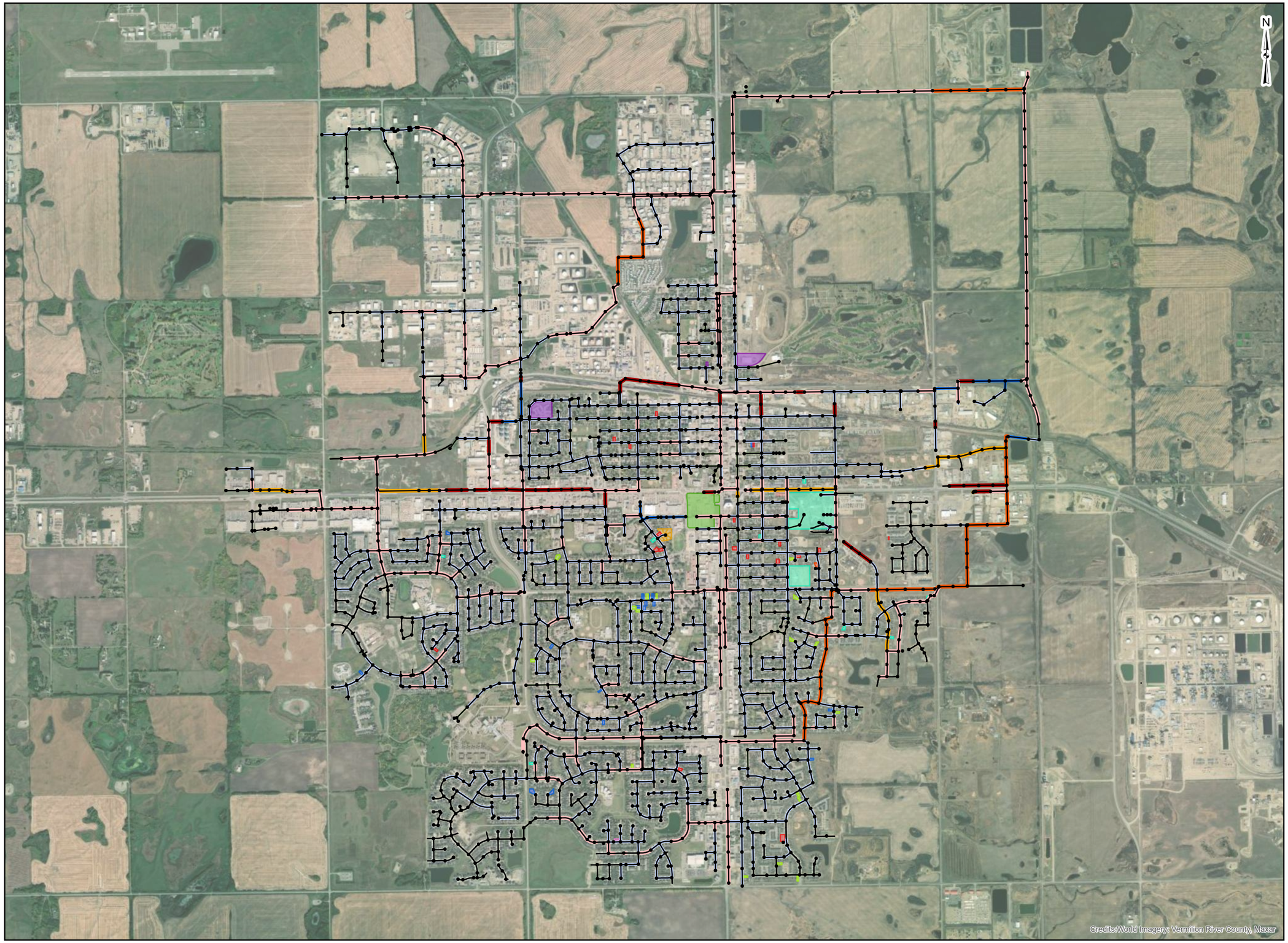
The recommended condition assessment areas outlined in the Sanitary Sewer Condition Assessment and Management Strategy (AECOM, 2016) were used in conjunction with the flooding records provided by the City to propose a condition assessment plan as part of this SSMP. This was further refined, with input from the City, to collect condition information for various pipe materials of varying ages to provide an estimate of the condition of the City's overall sanitary sewer collection system. The proposed condition assessment locations are shown in Figure 6.13.

McGill's Industrial Services (McGill's) undertook closed-circuit television (CCTV) inspections of the proposed assessment pipes based on priority. The CCTV reports and videos provided by McGill's are included in Appendix E and Appendix F, respectively.

ISL reviewed the videos and inspection reports, which provided a general condition rating for each section of inspected pipe as well as each overall assessment segment. These ratings are summarized in Table 6.4.

Table 6.4: Pipe Condition Rating Summary

Rating	Condition	Description
1	Excellent	No further action required.
2	Good	Maintenance is recommended. This category was applied to pipe sections with service connection intrusions into the sewer, attached deposits or debris in the pipes, and root intrusions.
3	Fair	Repairs are recommended in the next ten (10) to 20 years. This category was applied to pipe sections with visible ponding due to sags in the pipes or at the joints and pipe surface damage.
4	Poor	Repairs are recommended in the next five (5) to ten (10) years. This rating was applied to pipe sections with visible cracks, breakage, and displacement at joints.
5	Failing	Repairs are recommended immediately. This category was applied to pipe sections that have collapsed or when pipes have produced a hole with a visible void.



Legend

- Study Area
- Manhole
- Gravity Sewer

June 2017 Parcel Flooding

- Complaints
- FB Images
- Insurance Claims
- June 10 Sewer Backups
- June 9 Sewer Backups
- June 9 Surface Flooding

June 2018 Parcel Flooding

- Complaints
- Insurance Claims

2016 Condition

- A - Strategic (<600mm, Not PVC, installed before 1990)
- A - Strategic (>600mm, Not PVC, installed before 1990)
- A - Strategic (3 km)
- A - Non-Strategic (39.6 km)
- B - Strategic (1.8 km)
- B - Non-Strategic (98.8 km)
- C - Non-Strategic (7.4 km)
- N/A

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.12
2016 CONDITION ASSESSMENT RECOMMENDATIONS
LLOYDMINSTER SANITARY SEWER MASTER PLAN

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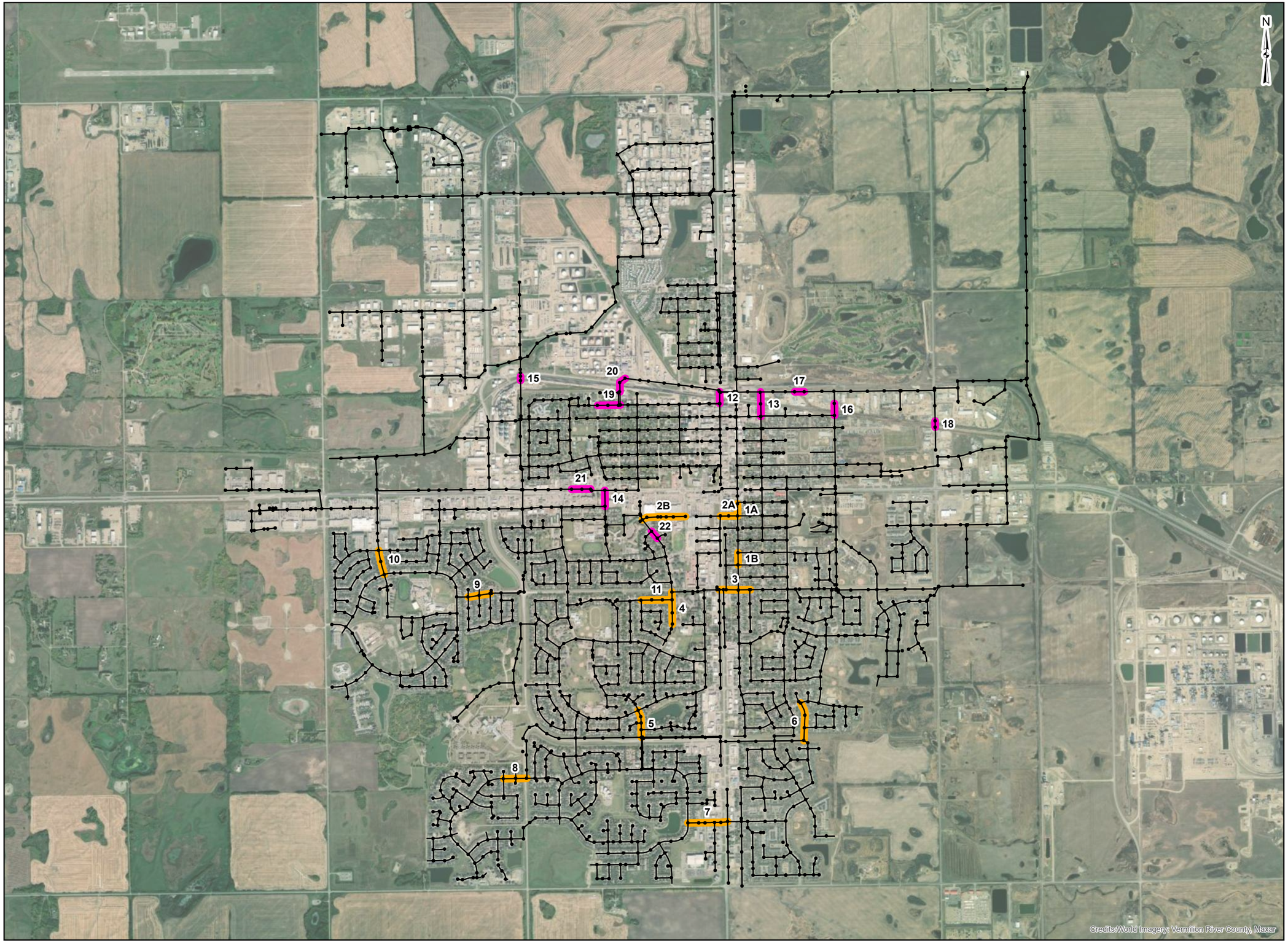

Legend

- Study Area
- Manhole
- Gravity Sewer

2023 Condition Assessment

- Priority 1
- Priority 2

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.13
2023 CONDITION ASSESSMENT
PROPOSED LOCATIONS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

ISL

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ISL also compared the pipe age based on the data provided by the City to the expected useful life of the pipe based on material. The expected useful life of pipe materials, based on normal practice, is summarized in Table 6.5.

Table 6.5: Pipe Material Expected Useful Life

Material	Abbreviation	Ideal Expected Useful Life[1]
		Years
Concrete	CONC	60
Polyvinyl Chloride	PVC	60
Steel	STL	50
Vitrified Clay Tile	VCT	60

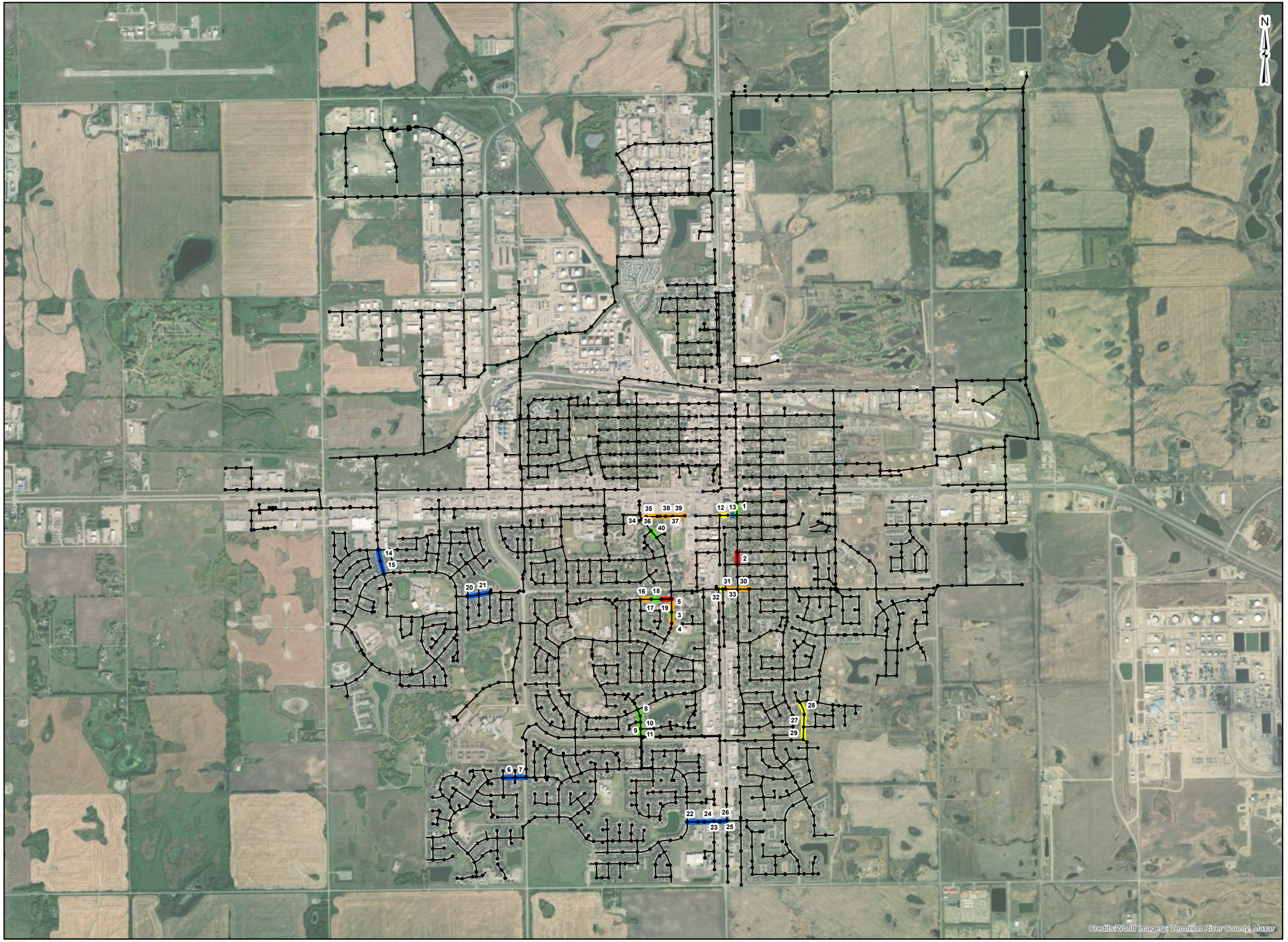
[1] Installation means and the methods as well as pipe application may impact the estimate of expected useful life.

The results of the condition assessment are summarized in Table 6.6 and shown in Figure 6.14.

Table 6.6: Condition Assessment Summary

Segment No.	Report No.	Start MH	End MH	Surveyed Length	Diameter	Material	Installation Year	Pipe Age	Ideal Remaining Expected Life[1]	Condition Rating	Condition Rating Number	Weighted Calculation	Weighted Rating Number	Segment Condition Rating
				m	mm									
1A	1	2882	2881	99.6	200	PVC	2010	13	47	Good	2	199.2	2.00	Good
1B	2	85	84	100.2	200	VCT	1965	58	2	Failing	5	501	5.00	Failing
2A	12	357	356	68.5	375	CONC	1990	33	27	Fair	3	205.5	1.99	Good
	13	356	2882	70.4	375	CONC	1990	33	27	Excellent	1	70.4		
2B	34	561	544	58.1	375	VCT	1974	49	11	Poor	4	232.4	4.00	Poor
	35	544	655	72.7	375	VCT	1974	49	11	Poor	4	290.8		
	36	655	543	26.8	375	VCT	1974	49	11	Poor	4	107.2		
	37	543	656	41.4	375	VCT	1974	49	11	Poor	4	165.6		
	38	656	542	58.8	375	VCT	1974	49	11	Poor	4	235.2		
	39	542	461	47.5	375	VCT	1974	49	11	Poor	4	190		
3	30	389	388	99.3	375	CONC	1966	57	3	Poor	4	397.2	3.46	Fair
	31	390	389	94.9	375	CONC	1966	57	3	Fair	3	284.7		
	32	429	390	21.2	375	CONC	1967	56	4	Fair	3	63.6		
	33	429	434	8.0	375	CMP	1968	55	-5	Poor	4	32	4.00	Poor
4	3	528	UNK	41.3	200	VCT	1973	50	10	Good	2	82.6	3.58	Poor
	4	UNK	527	55.6	200	VCT	1973	50	10	Poor	4	222.4		
	5	527	512	101.7	200	VCT	1973	50	10	Poor	4	406.8		
5	8	896	897	56.6	300	VCT	1980	43	17	Good	2	113.2	2.00	Good
	9	897	996	52.5	300	VCT	1980	43	17	Good	2	105		
	10	996	889	53.4	300	VCT	1980	43	17	Good	2	106.8		
	11	889	857	61.0	300	VCT	1980	43	17	Good	2	122		
6	27	691	690	103.1	750	CONC	1980	43	17	Fair	3	309.3	3.00	Fair
	28	690	689	105.6	750	CONC	1980	43	17	Fair	3	316.8		
	29	691	692	105.0	750	CONC	1980	43	17	Fair	3	315		
7	22	1641	1273	88.1	450	PVC	2004	19	41	Excellent	1	88.1	1.00	Excellent
	23	1273	1642	51.9	450	PVC	2004	19	41	Excellent	1	51.9		
	24	1642	1644	77.2	450	PVC	2004	19	41	Excellent	1	77.2		
	25	1644	1643	53.3	450	PVC	2004	19	41	Excellent	1	53.3		
	26	1643	838	54.6	450	PVC	2004	19	41	Excellent	1	54.6		
8	6	1492	842	98.4	300	PVC	2002	21	39	Excellent	1	98.4	1.00	Excellent
	7	842	5420	91.0	300	PVC	2002	21	39	Excellent	1	91		
9	20	1351	1352	89.7	525	PVC	1997	26	34	Excellent	1	89.7	1.00	Excellent
	21	1352	1344	91.5	525	PVC	1997	26	34	Excellent	1	91.5		
10	14	1662	1663	110.6	375	PVC	2005	18	42	Excellent	1	110.6	1.00	Excellent
	15	1662	1661	89.5	375	PVC	2005	18	42	Excellent	1	89.5		
11	16	515	514	66	375	VCT	1973	50	10	Poor	4	264	3.49	Fair
	17	514	515	18.4	375	VCT	1973	50	10	Good	2	36.8		
	18	514	513	82.6	375	VCT	1973	50	10	Good	2	165.2		
	19	513	512	77.9	375	VCT	1973	50	10	Failing	5	389.5		
22	40	613	614	75.8	200	VCT	1976	47	13	Good	2	151.6	2.00	Good

[1] The remaining expected life of the pipe is based on the pipe age and material only with the condition rating recommending the timeline for replacement as needed.



Legend

- Study Area
- Manhole
- Gravity Sewer

Condition Rating

- Excellent
- Good
- Fair
- Poor
- Failing

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.14
2023 CONDITION ASSESSMENT RESULTS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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An estimated condition rating was developed for the City's entire sanitary sewer collection system based on the condition assessment results. These results were combined with the pipe installation year and material information from the City to estimate each pipe section's relative condition rating. A summary of the generalized condition assessment results by decade is provided in Table 6.7 with the estimated pipe condition for the existing sanitary sewer collection system shown in Figure 6.15. This can aid the City in identifying future locations for inspections, as well as combining potential replacement opportunities with other upgrades in the area.

Table 6.7: Generalized Condition Assessment Summary by Decade

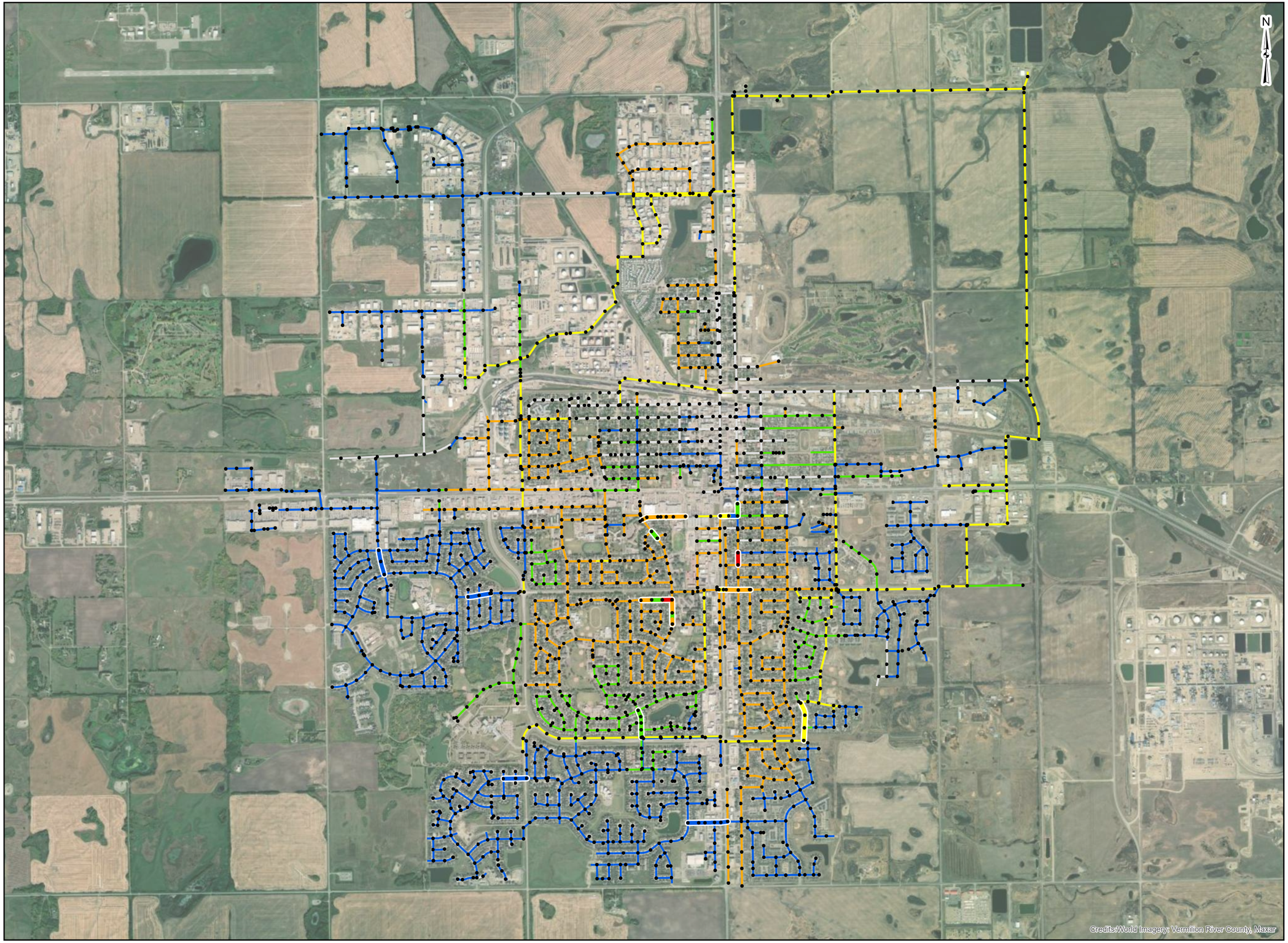
Installation Year	Material	Condition Rating[1]
1940-1949	All	Inconclusive
1950-1959	All	Inconclusive
1960-1969	CONC	Fair
	VCT	Poor
1970-1979	VCT	Poor
1980-1989	CONC	Fair
	VCT	Good
	PE	Good
1990-1999	CONC	Good
	PVC	Excellent
2000-2009	PVC	Excellent
2010-2021	PVC	Excellent

[1] Any pipes noted as inconclusive did not have a comparative sample pipe segment assessed as part of the 2023 Condition Assessment.

It should be noted that these results are only an estimate based on the sections of pipe that were inspected as part of the condition assessment. Therefore, there may be notable deviations from the generalizations outlined in Table 6.7 when looking at the overall sanitary sewer collection system. For example, the condition rating for the pipe sections that were inspected for the 1980 to 1989 installation years are a potential outlier as it is not expected that VCT pipe is in better condition than CONC pipe from the same decade.

Approximately 20% of the city's existing sanitary sewer collection system was installed in the 1970s with a generalized condition rating of poor as noted in Table 6.7. However, as this is only a generalized condition rating based on the sections of pipe that were included within the condition assessment completed in 2023, it is not recommended that all pipes installed within this timeframe be replaced. Rather, it is recommended that monitoring and/or inspection of pipes with lower generalized condition ratings be undertaken to determine specific conditions and prioritize replacement needs.

Additionally, no pipes installed before 1960 were inspected as part of the condition assessment. Therefore, it is recommended that these pipes be monitored and/or inspected as these pipes are beyond their ideal expected life.



Legend

- Study Area
- Manhole

2023 Condition Assessment Rating

- Excellent
- Good
- Fair
- Poor
- Failing

Estimated Condition Rating by Installation Year and Material

- Excellent
- Good
- Fair
- Poor
- Inconclusive

Any pipes noted as inconclusive did not have a comparative sample pipe segment assessed as part of the 2023 Condition Assessment.

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.15
ESTIMATED PIPE CONDITION
BY INSTALLATION YEAR AND MATERIAL
LLOYDMINSTER SANITARY SEWER
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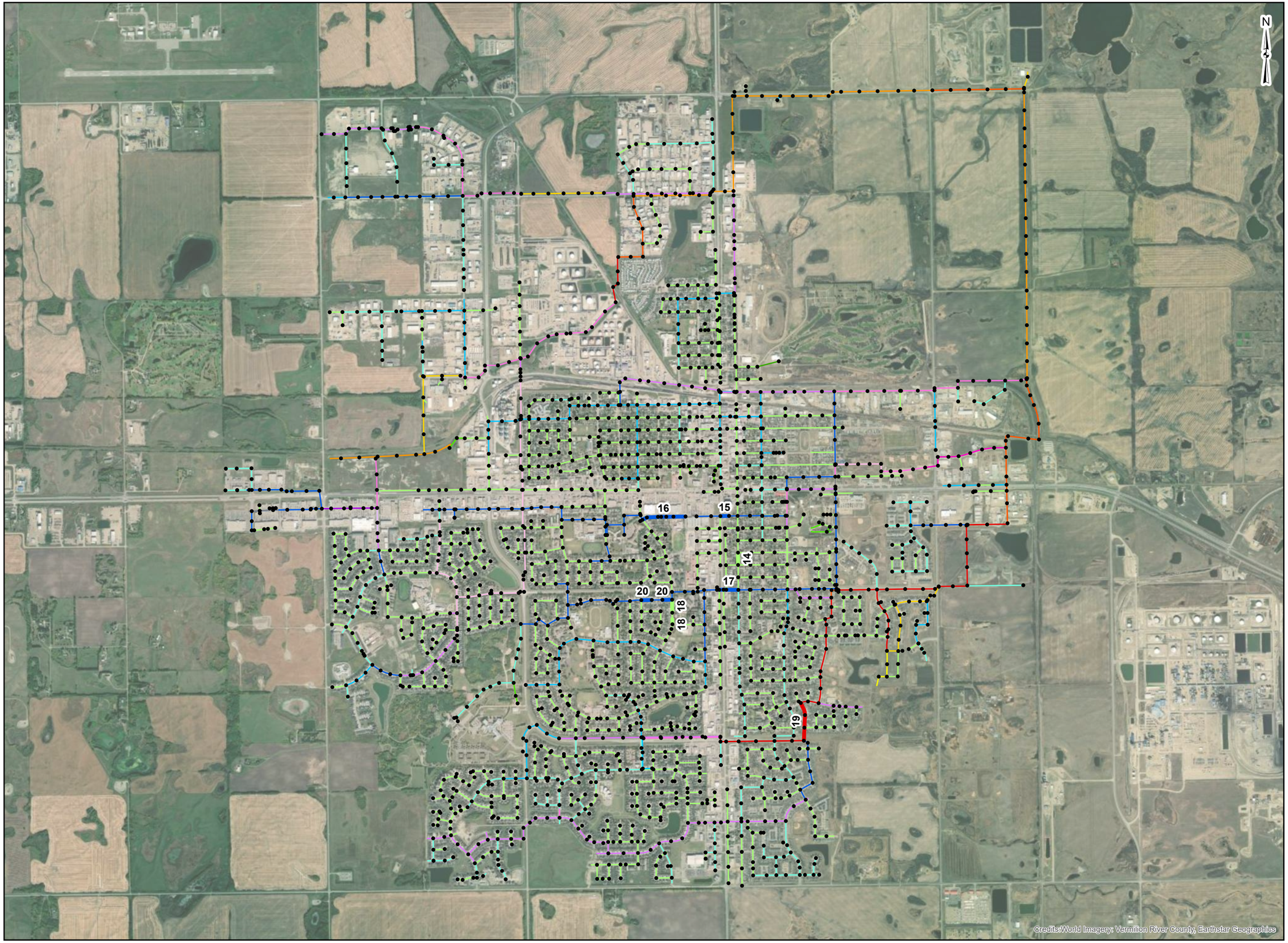
6.3.1 Existing System Condition Recommendations

Based on the existing sanitary sewer collection system condition assessment, upgrades were developed to improve areas of concern where the pipe condition rating was considered either fair, poor or failing. The identified upgrades are summarized in Table 6.8 and shown in Figure 6.16 with the segment numbers identified in Figure 6.13 and the report numbers identified in Figure 6.14.

Table 6.8: Existing System Proposed Condition Upgrades

Upgrade No.	Name	Description	Condition Rating	Segment No.	Report No.
14	49 Avenue Sewer Replacement	Replacement of 200 mm sewer along 49 Avenue from 38 Street to 39 Street.	Failing	1B	2
15	42 Street East Sewer Replacement	Replacement of 375 mm sewer along 42 Street from west of 49 Avenue to 50 Avenue.	Fair	2A	12
16	42 Street West Sewer Replacement	Replacement of 375 mm sewer along 42 Street from 52 Avenue to 54 Avenue.	Poor	2B	34-39
17	36 Street Sewer Replacement	Replacement of 375 mm sewer along 36 Street from 48 Avenue to 50 Avenue.	Poor/Fair	3	30-33
18	52 Avenue Sewer Replacement	Replacement of 200 mm sewer along 52 Avenue from 34 Street to 35 Street.	Poor	4	4-5
19	46 Avenue Sewer Replacement	Replacement of 750 mm sewer along 46 Avenue from 25 Street to 27 Street.	Fair	6	27-29
20	35 Street Sewer Replacement	Replacement of 375 mm sewer along 35 Street from 52 Avenue to 54 Avenue.	Poor/Failing	11	16-19



Legend

Study Area

Existing Manhole

Existing Pipe Diameter

- 100 mm
- 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 400 mm
- 450 mm
- 500 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1050 mm
- 1200 mm
- 1350 mm
- Unknown

Proposed Pipe Replacement

- 200 mm
- 375 mm
- 750 mm

0 375 750 1,500 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 6.16
PROPOSED PIPE CONDITION UPGRADES
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6.4 Risk Assessment

ISL prepared a risk assessment of the recommended upgrades to aid the City in prioritizing potential infrastructure projects. This risk assessment was based on the following criteria, which is described in detail in Table 6.9:

- Average Change in HGL;
- HGL Impacts;
- Existing Upstream Impact;
- Future Upstream Impact;
- Generalized Pipe Condition; and
- Road Condition Upgrade Potential.

Table 6.9: Existing System Upgrades Risk Assessment – Risk Criteria and Scoring

Criteria			Scoring	
ID	Name	Definition	Scale	Description
C.1	Average Change in HGL	Average change in HGL between existing conditions and proposed upgrade conditions based on model results	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal
C.2	HGL Impact (2.4 m)	Number of basements and populations connected to a manhole surcharging to basement level within 2.4 m of the surface based on model results	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal
C.3	HGL Impact (3.0 m)	Number of basements and populations connected to a manhole surcharging to basement level within 3.0 m of the surface based on model results	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal
C.4	HGL Impact (3.5 m)	Number of basements and populations connected to a manhole surcharging to basement level within 3.5 m of the surface based on model results	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal

Criteria			Scoring	
C.5	HGL Impact (4.0 m)	Number of basements and populations connected to a manhole surcharging to basement level within 4.0 m of the surface based on model results	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal
C.6	Existing Upstream Impact	Number of parcels and catchment area upstream of upgrade under existing conditions	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal
C.7	Future Upstream Impact	Number of parcels and catchment area upstream of upgrade under future conditions	5	Significant
			4	
			3	Moderate
			2	
			1	Minimal
C.8	Generalized Pipe Condition	General condition of existing pipe based on condition assessment and generalized pipe condition rating	5	Failing
			4	Poor
			3	Fair
			2	Good
			1	Excellent
C.9	Road Condition Upgrade Potential	Potential for upgrades to be coupled with roadworks or future development that is likely to incorporate road improvements based on road condition from Google Street View	5	Excellent
			4	Good
			3	Fair
			2	Poor
			1	Negligible

A pairwise comparison was used to allocate a weighting to each criterion as shown in Table 6.10.

Table 6.10: Existing System Upgrades Risk Assessment – Criteria Ranking

Risk Criteria Pairwise Comparison										Count	Weighting	Criteria Ranking		
	C.1	C.2	C.3	C.4	C.5	C.6	C.7	C.8	C.9			Rank	ID	Description
C.1	C.1	C.1	C.1	C.1	C.1	C.1	C.1	C.1	C.1	9	20.0%	1	C.1	Average Change in HGL
C.2		C.2	C.2	C.2	C.2	C.2	C.2	C.2	C.2	8	17.8%	2	C.2	HGL Impact (2.4m)
C.3			C.3	C.3	C.3	C.3	C.3	C.3	C.3	7	15.6%	3	C.3	HGL Impact (3.0m)
C.4				C.4	C.4	C.4	C.4	C.4	C.4	6	13.3%	4	C.4	HGL Impact (3.5m)
C.5					C.5	C.5	C.5	C.5	C.5	5	11.1%	5	C.5	HGL Impact (4.0m)
C.6						C.6	C.6	C.6	C.6	4	8.9%	6	C.6	Existing Upstream Impact
C.7							C.7	C.7	C.7	3	6.7%	7	C.7	Future Upstream Impact
C.8								C.8	C.8	2	4.4%	8	C.8	Generalized Pipe Condition
C.9									C.9	1	2.2%	9	C.9	Road Condition Upgrade Potential
									Total	45	100%			

A summary of the prioritization results of the risk assessment is provided in Table 6.11 with the risk assessment details and calculations provided in Appendix G.

Table 6.11: Existing System Upgrades Risk Assessment Priority Summary

Priority	Upgrade No.	Name	Category	Length (m)	Overall Score
1	6	36 Street Trunk Upgrade - West	Capacity	402.17	2.64
2	9	Southeast Trunk Upgrade	Capacity	833.93	2.38
3	4	52 Street Trunk Upgrade	Capacity	807.62	1.76
4	3	51 Street Sewer Upgrade	Capacity	916.34	2.31
5	10	47 Avenue Sewer Upgrade	Capacity	234.14	2.24
6	2	44 Street Sewer Upgrade	Capacity	273.47	1.71
7	5	48 Avenue Sewer Upgrade	Capacity	297.77	1.69
8	7	36 Street Trunk Upgrade - East	Capacity	851.11	1.47
9	8	East Trunk Upgrade	Capacity	1060.35	1.42
10	12	25 Street Trunk Upgrade	Capacity	386.00	1.38
11	11	53 Avenue Sewer Upgrade	Capacity	487.69	1.36
12	13	59 Avenue Sewer Upgrade	Capacity	502.16	1.13
13	19	46 Avenue Sewer Replacement	Condition	315.60	0.89
14	17	36 Street Sewer Replacement	Condition	156.80	0.47
15	14	49 Avenue Sewer Replacement	Condition	100.93	0.36
16	18	52 Avenue Sewer Replacement	Condition	148.15	0.36
17	20	35 Street Sewer Replacement	Condition	164.92	0.36
18	16	42 Street West Sewer Replacement	Condition	358.06	0.33
19	15	42 Street East Sewer Replacement	Condition	71.02	0.31

As previously discussed, the Aurora Sewer Upgrades (Upgrade 1) are not included in the prioritization due to a lack of operational issues to date. It is recommended that this location be monitored in the future and added to the prioritization if required.

Despite the lower overall score, the 52 Street Trunk Upgrade (Upgrade 4) has been placed above the 51 Street Sewer Upgrade (Upgrade 3) due to the constructability of the improvements. Completing Upgrade 4 prior to Upgrade 3 ensures that downstream infrastructure is upgraded prior to the infrastructure upstream of it.

6.5 Existing Sanitary System Upgrades Cost Estimates

A summary of the costs associated with the recommended existing sanitary sewer collection system upgrades are detailed below in Table 6.12. The list is ordered based on upgrade IDs, while priorities are included for reference. A full breakdown of the costs has been provided in Appendix H.

Table 6.12: Cost Estimates for Recommended Existing System Upgrades

Category	Upgrade No.	Priority	Total Cost[1]
Capacity	1	N/A	$1,020,000
	2	6	$700,000
	3	4	$1,410,000
	4	3	$2,530,000
	5	7	$4,990,000
	6	1	$1,220,000
	7	8	$2,950,000
	8	9	$4,110,000
	9	2	$2,570,000
	10	5	$630,000
	11	11	$1,350,000
	12	10	$1,110,000
	13	12	$1,920,000
Capacity Upgrades Sub-Total			**$26,510,000**
Condition	14	15	$270,000
	15	19	$220,000
	16	18	$1,040,000
	17	14	$470,000
	18	16	$370,000
	19	13	$1,220,000
	20	17	$480,000
Condition Upgrades Sub-Total			**$4,070,000**
Total			**$30,580,000**

[1] The total cost has been rounded to the nearest $10,000 and includes a 30% contingency as well as 15% for engineering.

As previously discussed, the Aurora Sewer Upgrades (Upgrade 1) is not included in the prioritization due to a lack of operational issues to date; the cost estimate has been included for the City's reference in the overall picture. It is recommended that this location be monitored in the future and added to the prioritization if required.

7.0 Future Sanitary System

7.1 Future System Concept Development

The future network assumes that all the recommended existing sanitary sewer collection system upgrades are implemented. Thus, it is recommended that these upgrades are completed prior to any substantial densification or future development. A spreadsheet approach for infrastructure sizing was adopted, based on the DWF residential and industrial, commercial, institutional (ICI) generation rates, peaking factors, and the I-I allowance rate outlined in Section 3.3.

The specified pipe diameters are the smallest possible determined based on the minimum design slope to provide a self-cleansing full-sewer velocity of greater than 0.60 m/s as presented in Table 7.1. This was calculated under the derived peak WWFs, based on a roughness coefficient of 0.013.

Table 7.1: Minimum Design Slopes for Sewers

Nominal Sewer Size	Minimum Design Slope		Full-Sewer Velocity	Full-Sewer Capacity
mm	%	m/m	m/s	L/s
200	0.40	0.0040	0.66	20.7
250	0.28	0.0028	0.64	31.5
300	0.22	0.0022	0.64	45.4
375	0.15	0.0015	0.62	67.9
450	0.12	0.0012	0.62	98.8
525	0.10	0.0010	0.63	136.0
600 (and larger)	0.10	0.0010	0.69[1]	194.2[1]

[1] Reflects a sewer diameter of 600 mm, noting that anything larger will have increased full-sewer velocities and capacities.

If flatter slopes are preferred or required at the detailed design stages, this can be reviewed on a case-by-case basis, though it would have negative repercussions (i.e., reduced capacities). If this was acceptable, the determined pipe diameters would need to be increased to meet the specified flow designs. Contrarily, steeper slopes could potentially be achieved depending on topography and how the developments are ultimately graded. This could result in a potentially smaller pipe diameter, which again, should be reviewed during detailed design.

With regards to pumped flows, a new forcemain is typically designed to operate at a preferred velocity range of 0.76 m/s to 1.5 m/s. This approach was used to size new forcemains for the purpose of developing a future servicing concept that minimizes head losses, in turn yielding savings on the energy consumption front. Ensuring that forcemains are sized for a minimum velocity of 0.76 m/s helps to keep materials suspended, thus decreasing sediment build-up in the sewer. Each future forcemain was specified as a single pipe. To provide a degree of redundancy, as well as staging of flows, twinned pipes with an equivalent capacity could be considered.

The servicing schemes of the proposed sanitary sewer collection system are conceptual. Ultimately, it will be up to the developer to fulfill the intent of the servicing concept presented herein. Therefore, a developer may choose to adjust the alignment of the specified trunks as needed, to accommodate the sanitary sewer collection system within future developments. A developer may also choose to connect services directly to the future sanitary trunks if found beneficial, provided the designed sanitary sewer collection system does not result in any negative impacts on the directly connected developments.

Specifically, surcharge conditions within the sanitary sewer collection system resulting in basement back-ups is of concern.

Figures 7.1 and 7.2 show the proposed sanitary sewer collection system under the Ultimate Boundary Horizon (2051) for two (2) concepts, respectively. Both figures illustrate the proposed sanitary servicing concept and pipe diameter, direction of flow to each minimum parcel elevation along with the minimum parcel elevations, and locations and manhole IDs of any ties to the existing sanitary sewer collection system.

One lift station and forcemain are proposed in the north to service approximately half a quarter section adjacent to the Canadian Pacific Railway (CPR). There is also one area north of the airport that is proposed to remain disconnected from the City's sanitary sewer collection system due to the distance. Septic tanks are recommended for properties in this quarter section; otherwise, a second lift station and forcemain will be needed.

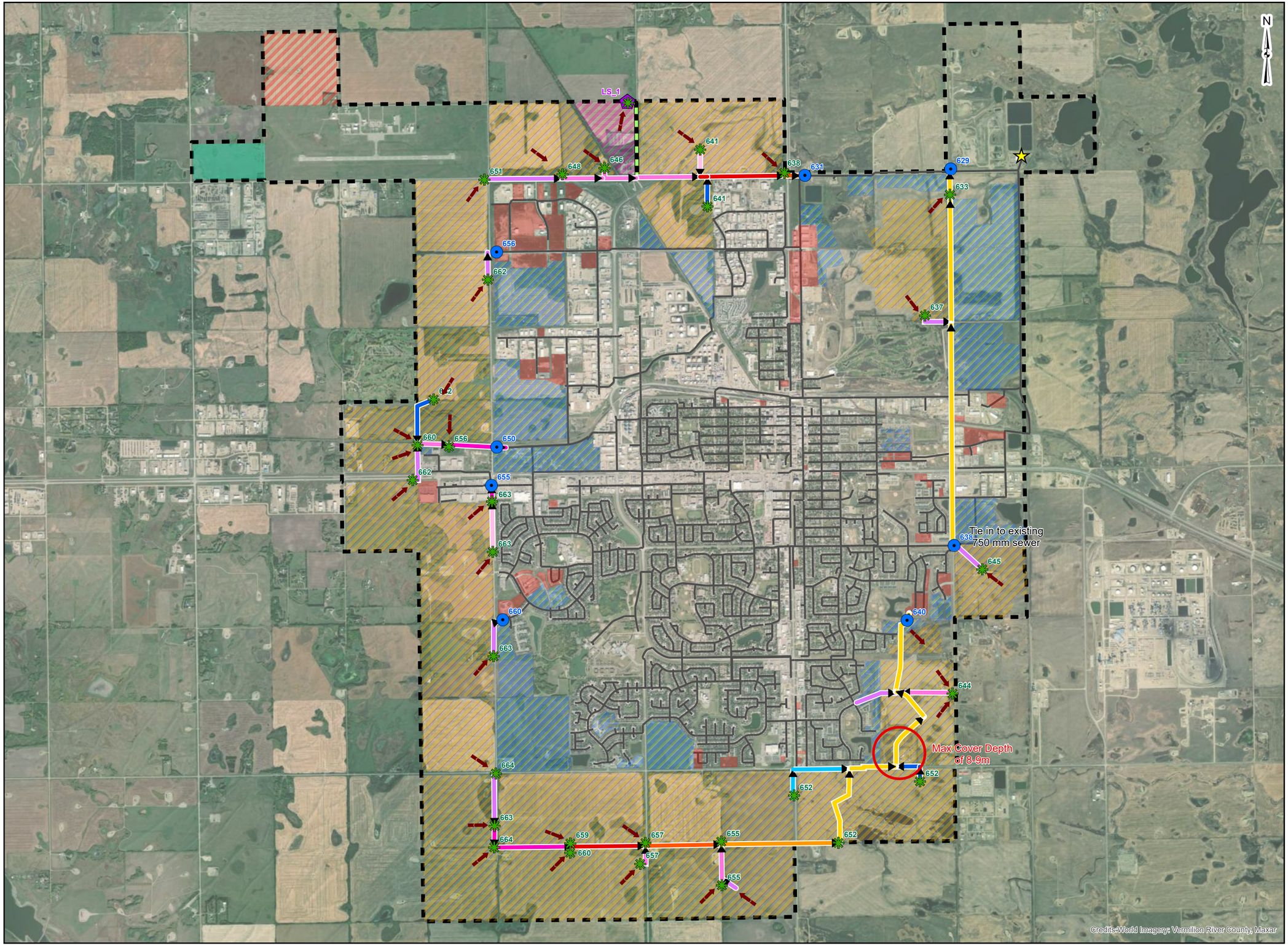
One area is flagged as having a maximum cover depth of 8 to 9 m based on current surface data. This is at the upper limit of the City's tolerance for gravity sewers before a lift station is triggered and should be closely monitored as this section of trunk sewer is built. Re-grading 12 Street to reduce the cover, though likely much more costly upfront, could have longer term savings with reduced operational and maintenance costs. This could be considered as an alternate solution. The City could also consider revising the alignment slightly to an easement within the development, if there is the potential to re-grade the easement with the intent of reducing cover.

Servicing through The Willows is intended to follow the proposed alignment of the South Trunk in The Willows ASP (Select Engineering Consultants Ltd., 2016). The alignment directly downstream through Wallacefield is approximate, based on the Wallacefield Concept Plan (Musgrave Agencies Ltd., et.al., 2014). Overflow from Wallacefield due to pipe constraints, as discussed in Section 6.2.1, are considered in both concepts. The South Trunk ultimately ties into MH 640 in the Aurora neighbourhood, where upgrades to the existing sanitary sewer collection system have already been completed in anticipation of this trunk. A new south-to-north trunk (the East Trunk) then conveys flows ultimately to the WWTP.

The Willows ASP indicates a proposed sanitary servicing pipe that terminates just east of 50 Avenue between two (2) proposed commercial parcels. The servicing concept recommended in this SSMP has the quarter section west of 50 Avenue and south of 12 Street being routed through a 300 mm sewer north on 50 Avenue and east on 12 Street. Depending on the ultimate size of the pipe that terminates east of 50 Avenue, there is the potential to route the quarter section through The Willows rather than around. This could reduce the overall cost of the servicing concept and avoid a major construction project along two (2) major roadways.

The notable differences between the two (2) concepts are as follows:

- **Concept 1**: peak WWF from the single-family residential quarter section adjacent to Parkview Estates ties into the existing sanitary sewer collection system at tie-in point #660 shown in Figure 7.1. This could be an ideal solution if this development progresses at a quicker pace than the parcels south of 12 Street; however, this concept relies more on the capacity of the existing infrastructure.
- **Concept 2**: peak WWF from the single-family residential quarter section adjacent to Parkview Estates is routed south and ties into the servicing concept proposed for the parcels south of 12 Street as shown in Figure 7.2. Though this concept may require fewer upgrades to the existing sanitary sewer collection system, it is reliant on installation of proposed infrastructure to the south (South Trunk), thus making timelines more challenging to manage.



Legend

- Gravity Tie-In Location
- Servicing Area Minimum Elevation
- Proposed Lift Station
- Wastewater Treatment Plant
- Existing Sewer
- Study Area

Future Parcel Tie-In

- New Service
- Existing Service
- Lift Station Required
- Septic Tanks
- Serviced But Vacant
- Airport Expansion

Proposed Pipe Diameter

- 200 mm Forcemain
- 300 mm Sewer
- 375 mm Sewer
- 450 mm Sewer
- 525 mm Sewer
- 600 mm Sewer
- 675 mm Sewer
- 750 mm Sewer
- 900 mm Sewer
- 1050 mm Sewer
- 1200 mm Sewer

Service area minimum points (green) and tie-in elevations at the upstream invert of the existing pipe (blue) are in m.

Maximum cover depths provided are approximate ranges.

Sizing assumes single forcemains. Twinned forcemains can be considered for optimal redundancy if an equivalent capacity is accomplished.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.1
FUTURE SERVICING CONCEPT 1
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

ISL LLOYDMINSTER

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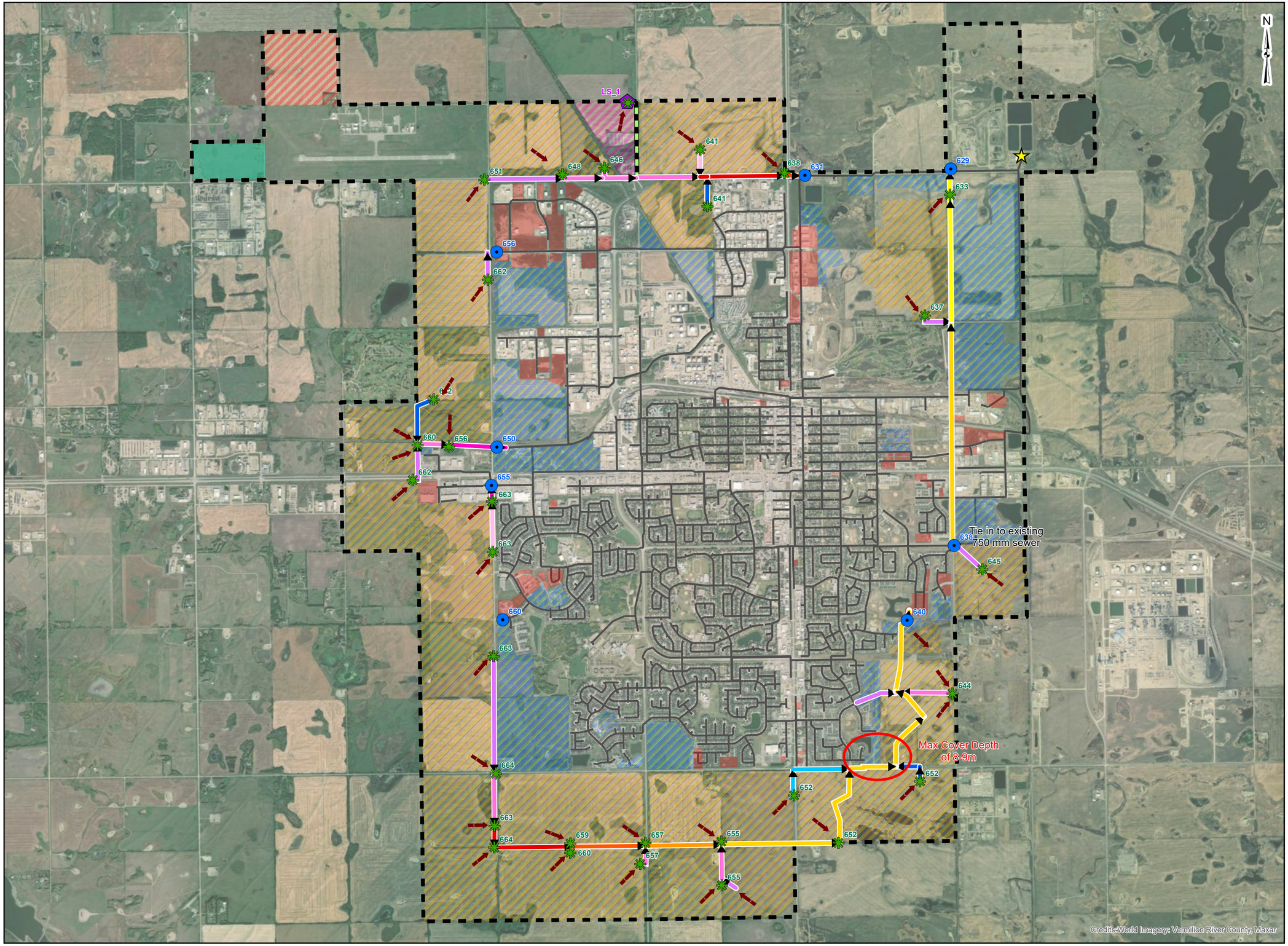

Legend

- Wastewater Treatment Plant
- Existing Sewer
- Study Area

Future Parcel Tie-In

- New Service
- Existing Service
- Lift Station Required
- Septic Tanks
- Serviced But Vacant
- Airport Expansion

Proposed Pipe Diameter

- 200 mm Forcemain
- 300 mm Sewer
- 375 mm Sewer
- 450 mm Sewer
- 525 mm Sewer
- 600 mm Sewer
- 675 mm Sewer
- 750 mm Sewer
- 900 mm Sewer
- 1050 mm Sewer
- 1200 mm Sewer
- 1350 mm Sewer

Service area minimum points (green) and tie-in elevations at the upstream invert of the existing pipe (blue) are in m.

Maximum cover depths provided are approximate ranges.

Sizing assumes single forcemains. Twinned forcemains can be considered for optimal redundancy if an equivalent capacity is accomplished.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.2
FUTURE SERVICING CONCEPT 2
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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7.2 Future System Concept Cost Estimates

The cost estimate summary for both servicing concepts are summarized below in Table 7.2. For a detailed cost breakdown, please refer to Appendix H. The costs are stipulated for the infrastructure necessary for the proposed concept only. An assessment of the servicing concept and required upgrades follows. The items included in Table 7.2 are only for new infrastructure required for the two (2) servicing concepts, and do not include any upgrades to the existing sanitary sewer collection system.

Table 7.2: Cost Estimates for Recommended Future Sanitary Servicing Concepts

Category	Item	Total Cost[1]
Concept 1	200 mm Forcemain	$740,000
	300 mm Gravity Sewer	$870,000
	375 mm Gravity Sewer	$1,560,000
	450 mm Gravity Sewer	$5,220,000
	525 mm Gravity Sewer	$1,160,000
	600 mm Gravity Sewer	$4,450,000
	675 mm Gravity Sewer	$3,280,000
	750 mm Gravity Sewer	$3,480,000
	900 mm Gravity Sewer	$3,110,000
	1050 mm Gravity Sewer	$4,350,000
	1200 mm Gravity Sewer	$26,720,000
	Lift Station 1 (31 L/s)	$1,050,000
Future Concept 1 Total		**$55,990,000**
Concept 2	200 mm Forcemain	$740,000
	300 mm Gravity Sewer	$870,000
	375 mm Gravity Sewer	$1,560,000
	450 mm Gravity Sewer	$5,570,000
	525 mm Gravity Sewer	$1,160,000
	600 mm Gravity Sewer	$5,250,000
	675 mm Gravity Sewer	$1,380,000
	750 mm Gravity Sewer	$4,080,000
	900 mm Gravity Sewer	$3,010,000
	1050 mm Gravity Sewer	$2,790,000
	1200 mm Gravity Sewer	$25,580,000
	1350 mm Gravity Sewer	$6,280,000
	Lift Station 1 (31 L/s)	$1,050,000
Future Concept 2 Total		**$59,320,000**

[1] The total cost has been rounded to the nearest $10,000 and includes a 30% contingency as well as 15% for engineering.

7.3 Future System Assessment

The future sanitary sewer collection system was assessed for the LOS rainfall event (i.e., the 1:25 year storm) for both concepts to determine what, if any, upgrades to the existing sanitary sewer collection are required. Both concepts were assessed under the Ultimate Boundary, while the preferred option was carried forward for staging under the interim growth horizons discussed in Section 2.3 as follows, noting that all development in the 3-Year Growth Horizon ties to existing:

- 3-Year Growth (2025) – Population of 34,651;
- 5-Year Growth (2027) – Population of 36,132;
- 10-Year Growth (2032) – Population of 41,148;
- 20-Year Growth (2042) – Population of 57,271; and
- Ultimate Boundary (2051) – Population of 67,149.

7.3.1 Concept Assessments and Recommended Upgrades to Existing Infrastructure

The performance of the existing sanitary sewer collection system under the build-out to the Ultimate Boundary Horizon was assessed using the criteria discussed in Section 3.2. The calibrated existing sanitary sewer collection system model was run under the 1:25 year 24-hour Huff design storm under this horizon. The purpose of this assessment was to ensure that the proposed servicing concept is effective and that the trunks that tie-into the existing sanitary sewer collection system do not undermine the downstream pipes. The results of this analysis are shown in Figures 7.3 to 7.6 for Concepts 1 and 2, illustrating the maximum HGL and peak discharge relative to pipe capacity and spare capacity, respectively. The results are summarized for both concepts below. Future sanitary sewer collection system assessment longitudinal profiles for both concepts are shown in Appendix D.

Regarding the existing sanitary sewer collection system, there were a total of seven (7) notable locations between the two (2) concepts (many overlapping) where the additional tie-ins caused surcharging in the downstream pipes. These locations, along with a description of any upgrades that would be required to alleviate any constraints, are shown in Table 7.3.

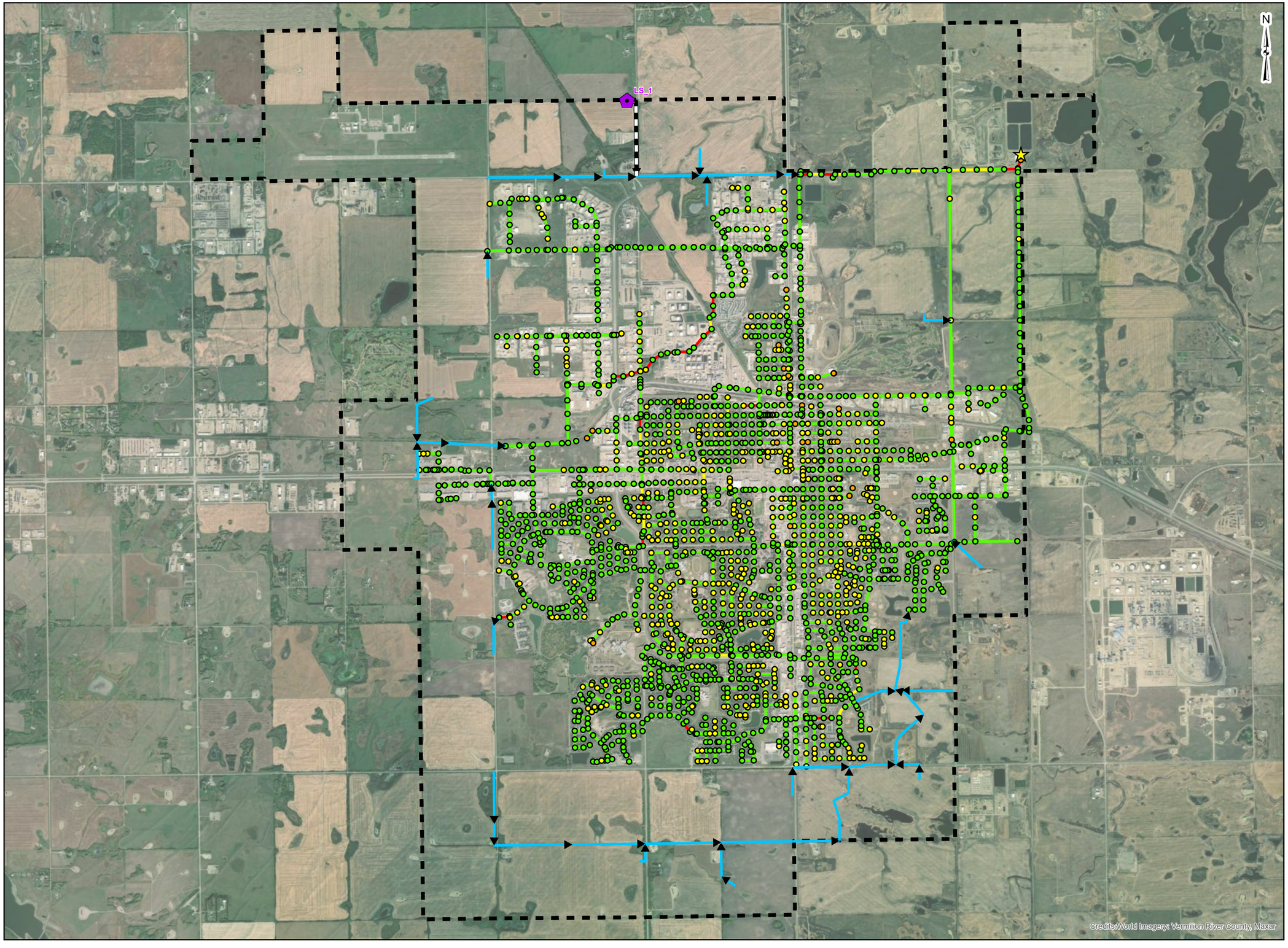
Table 7.3: Areas of Concern and Recommended Upgrades

ID	LP No.	Concept Triggered	Description	Upgrade?
1	1	1 and 2	Very minor surcharging with some sections of pipe illustrating an HGL above the crown of the pipe. This is a flatter and downsized section of pipe, thus the reduced capacity. Recommend replacement to a 1,200 mm with next roadworks in the vicinity.	With Roadworks
2	2	1 and 2	Apparent surcharging, HGL above crown of the pipe therefore upgrades triggered. Recommend replacement with a 675 mm sewer.	Yes
3	3	1 and 2	Very minor surcharging, HGL remains within the pipe; therefore, no upgrades triggered.	No
4	4	1 and 2	Very minor surcharging, HGL remains within the pipe; therefore, no upgrades triggered.	No
5	5	1	Some surcharging in localized section of pipe. Recommend replacement with a 300 mm sewer.	Yes
6	6/7	1	Very minor surcharging, HGL remains within the pipe; therefore, no upgrades triggered.	No
7	6/7	1	Very minor surcharging, HGL remains within the pipe; therefore, no upgrades triggered.	No

The upgrades recommended in this SSMP consider pipe upsizing along the same alignment as current deficiencies. Alternatives may include pipe twinning, new pipe alignments, or offloading to existing sanitary sewers with spare capacity. The City may wish to consider these alternatives to pipe upsizing during preliminary design, as long as the ultimate intent of the upgrades are achieved.

The three (3) upgrades (full upgrades or during roadworks, aka Upgrades 1, 2, and 5) described in Table 7.3 are illustrated in Figure 7.7. Assessment results under the 1:25 year 24-Hour Huff design storm are shown in Figures 7.8 to 7.11 for maximum HGL relative to surface and peak discharge relative to pipe capacity and spare capacity, respectively, for both concepts. Results indicate that surcharging is alleviated in the sewers that were recommended for upgrades. Longitudinal profiles of these three (3) upgrade locations are included in Appendix D.

The 600 mm sewer upstream of Upgrade 2, between 59 Avenue and 63 Avenue, shows some minor surcharging after the upgrades are implemented. The HGLs for both concepts are 2.5 m below the ground and were not flagged for upgrades. Based on the City's risk tolerance, this section could potentially be upsized to a 675 mm sewer to completely mitigate surcharging. It is recommended that this section of sewer is monitored as development proceeds in the west to monitor its performance. Upgrades could be completed if the capacity and condition of the sewer worsens and exceeds the assessment criteria of maintaining a freeboard of at least 2.5 m to the surface.



Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Maximum HGL Elevation Relative To Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m

Peak Discharge Relative To Pipe Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.3
FUTURE 25-YR 24-HR RESULTS
SERVICING CONCEPT 1
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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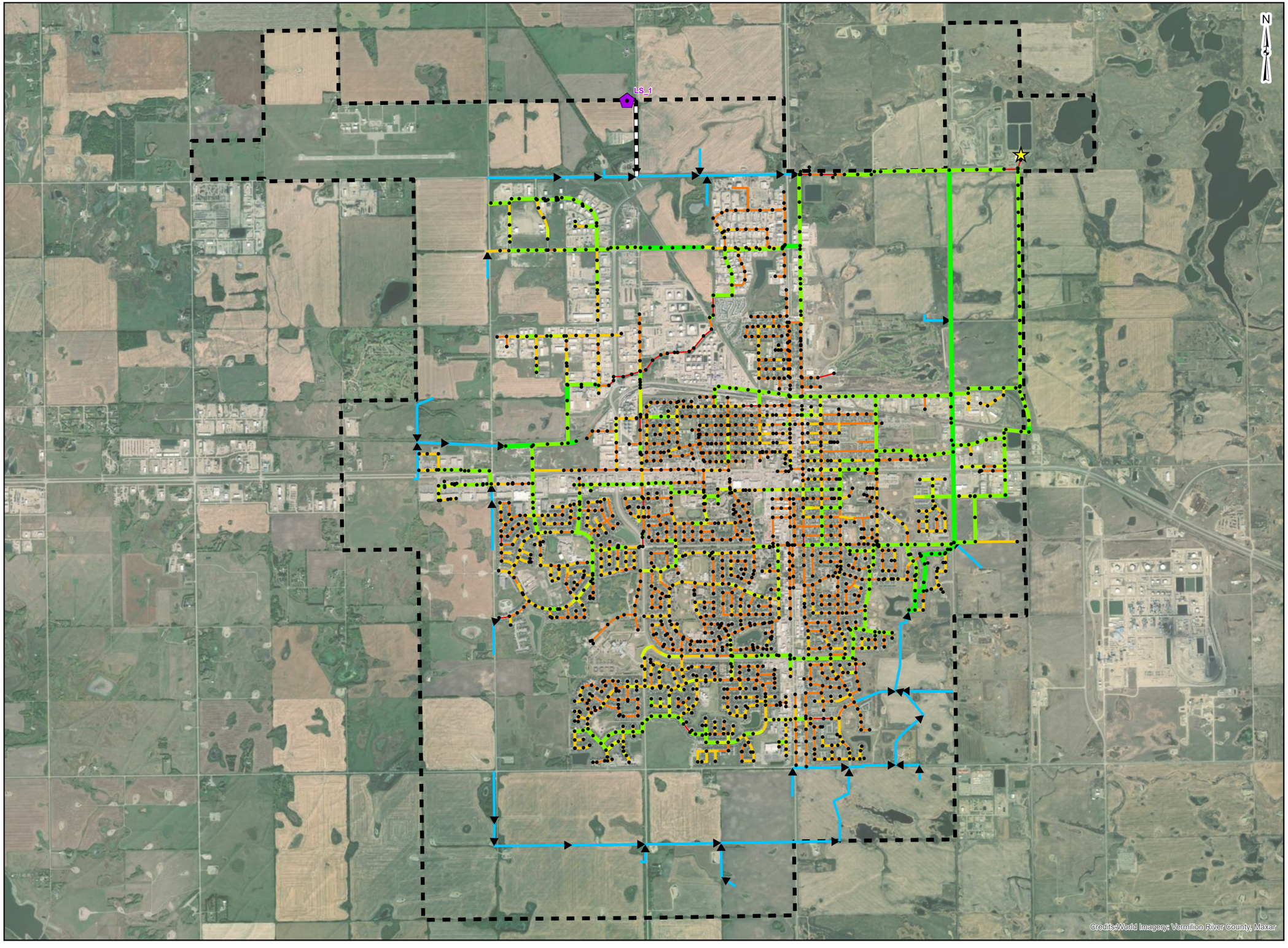

Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Spare Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.4
FUTURE 25-YR 24-HR SPARE CAPACITY
SERVICING CONCEPT 1
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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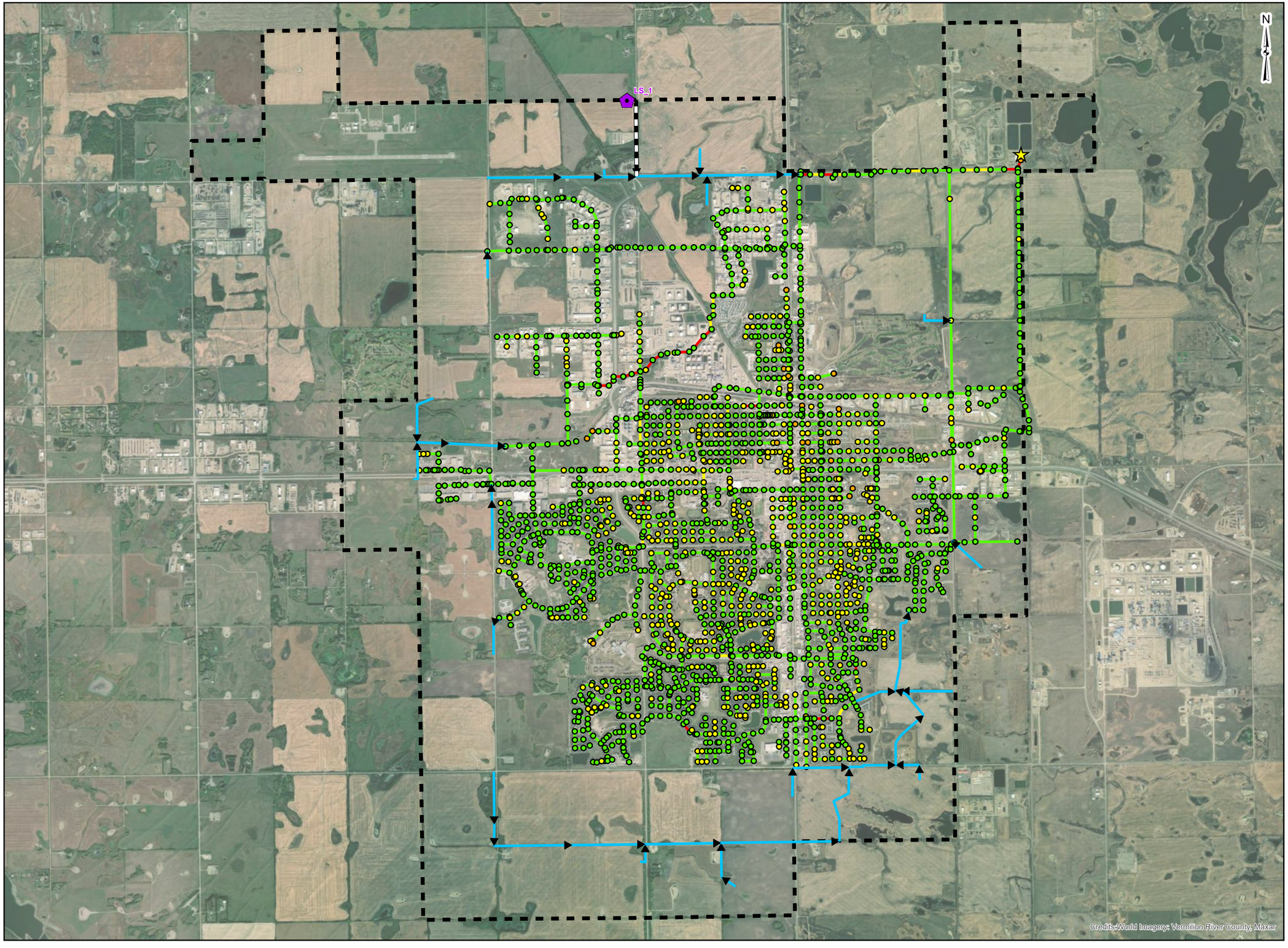

Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Maximum HGL Elevation Relative To Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m

Peak Discharge Relative To Pipe Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.5
FUTURE 25-YR 24-HR RESULTS
SERVICING CONCEPT 2
LLOYDMINSTER SANITARY MASTER PLAN

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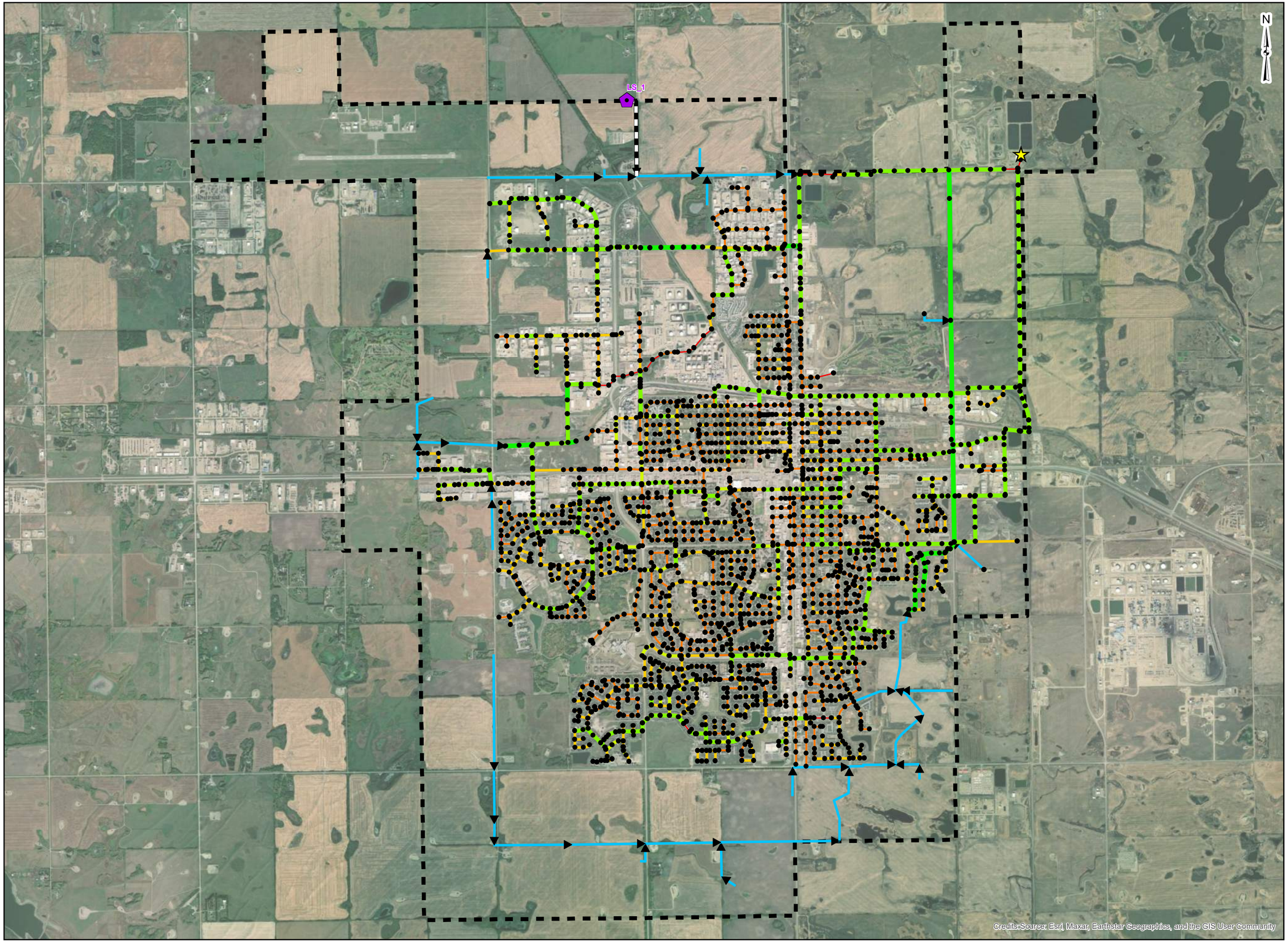

Legend

- Manhole
- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Spare Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.6
FUTURE 25-YR 24-HR SPARE CAPACITY
SERVICING CONCEPT 2
LLOYDMINSTER SANITARY MASTER PLAN

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Date: 2024-05-30 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure 7.6_Future Servicing Concept 2_25-yr 24-hr Huff Results - Spare Capacity.mxd

Upgrade 1
Triggered in Concepts 1 and 2

Upgrade 2
Triggered in Concepts 1 and 2

Upgrade 5
Triggered in Concept 1

1

2

5

N

Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Wastewater Treatment Plant
- Study Area
- Existing Manhole

Existing Pipe Diameter

- 100 mm
- 150 mm
- 200 mm
- 250 mm
- 300 mm
- 375 mm
- 400 mm
- 450 mm
- 500 mm
- 525 mm
- 600 mm
- 675 mm
- 750 mm
- 900 mm
- 1050 mm
- 1200 mm
- 1350 mm
- Unknown
- Private

Proposed Future Pipe Upgrade Diameter

- 300 mm
- 675 mm
- 1200 mm

0 385 770 1,540 Meters

1:30,000 NAD 1983 UTM Zone 12N

FIGURE 7.7
PROPOSED PIPE CAPACITY UPGRADES TRIGGERED UNDER FUTURE CONDITIONS
SANITARY SEWER MASTER PLAN

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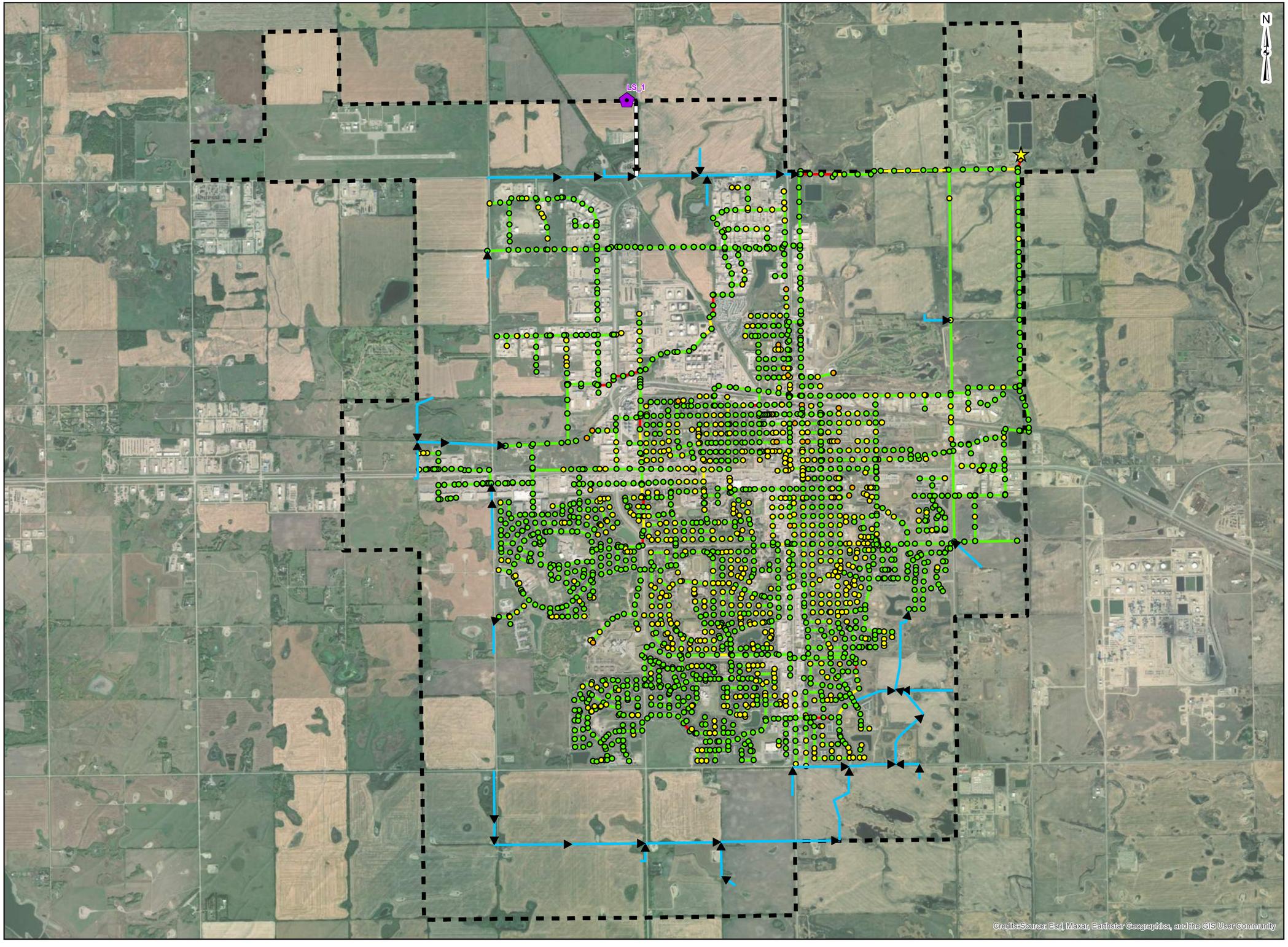
Date: 2024-05-30 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure 7.7_Future 25-yr Capacity Upgrades.mxd



Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Maximum HGL Elevation Relative To Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m

Peak Discharge Relative To Pipe Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.8
FUTURE 25-YR 24-HR RESULTS
SERVICING CONCEPT 1
UPGRADES TO EXISTING SYSTEM
LLOYDMINSTER SANITARY MASTER PLAN

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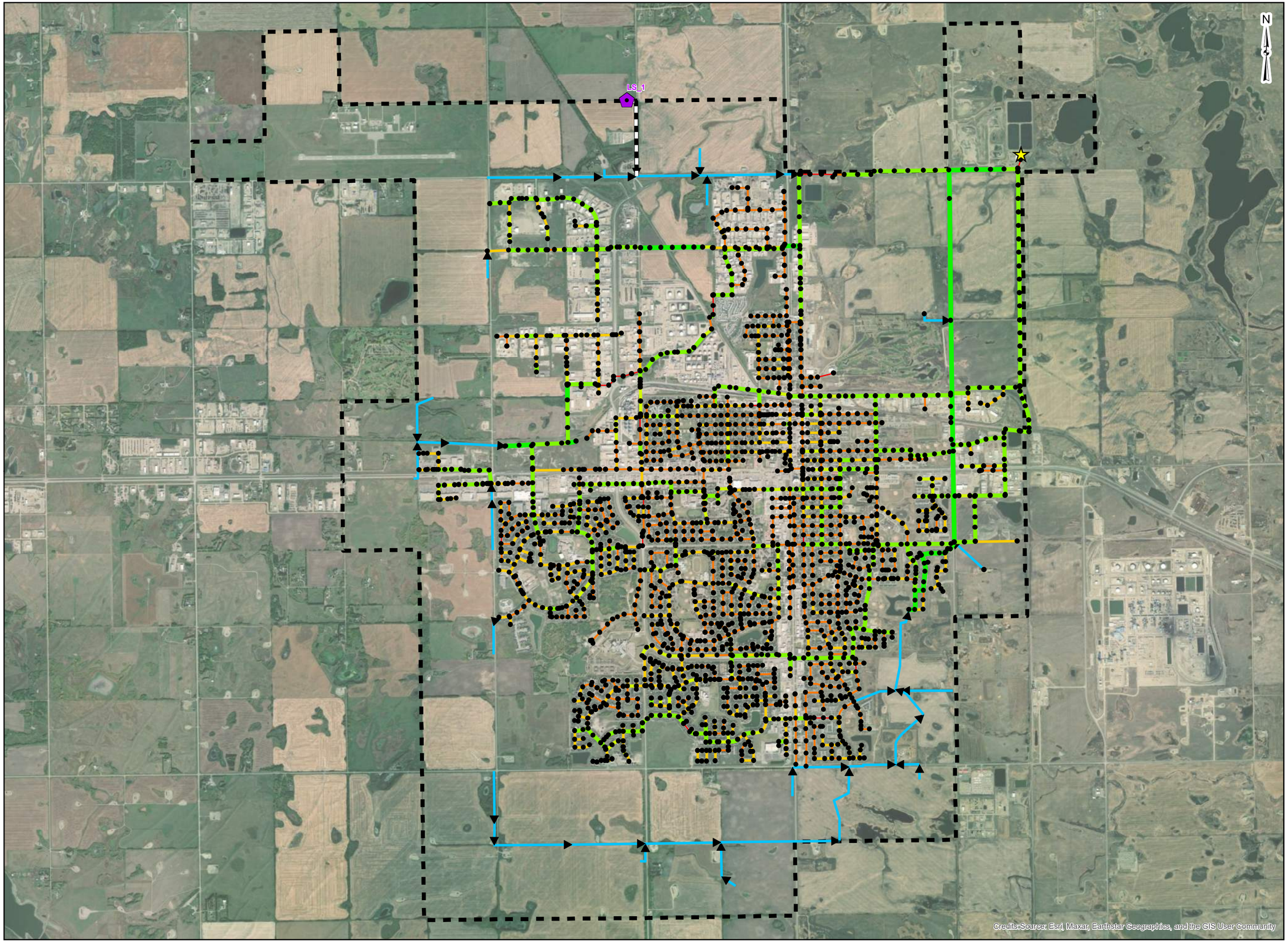

Legend

- Manhole
- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Spare Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.9
FUTURE 25-YR 24-HR SPARE CAPACITY
SERVICING CONCEPT 1
UPGRADES TO EXISTING SYSTEM
LLOYDMINSTER SANITARY MASTER PLAN

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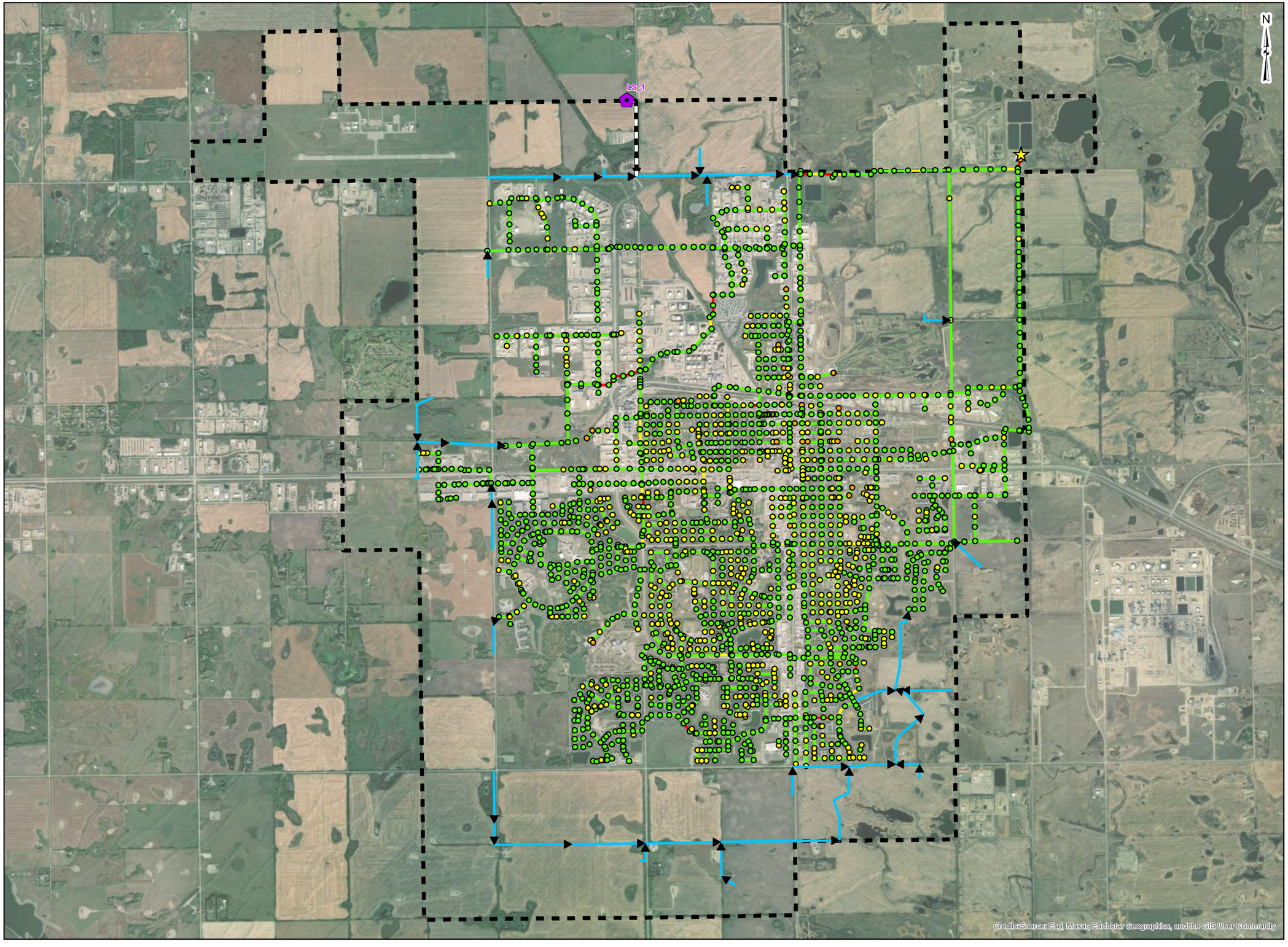

Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Maximum HGL Elevation Relative To Ground

- Less than -3.5m
- Between -3.5m and -2.4m
- Between -2.4m and 0.0m

Peak Discharge Relative To Pipe Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.10
FUTURE 25-YR 24-HR RESULTS
SERVICING CONCEPT 2
UPGRADES TO EXISTING SYSTEM
LLOYDMINSTER SANITARY MASTER PLAN

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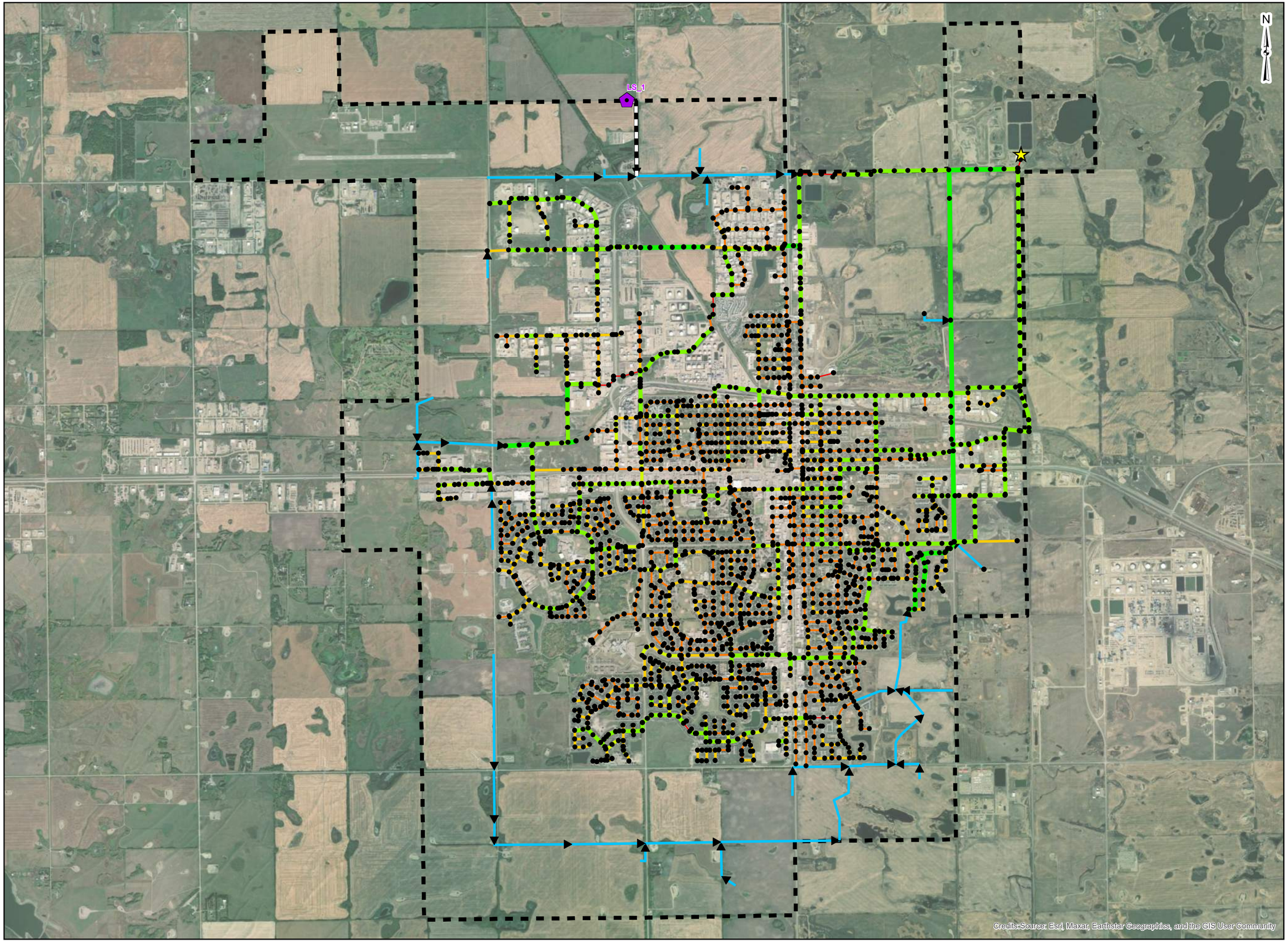

Legend

- Manhole
- Wastewater Treatment Plant
- Proposed Lift Station
- Proposed Pipe
- Proposed Forcemain
- Study Area

Spare Capacity

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

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.11
FUTURE 25-YR 24-HR SPARE CAPACITY
SERVICING CONCEPT 2
UPGRADES TO EXISTING SYSTEM
LLOYDMINSTER SANITARY MASTER PLAN

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Date: 2024-05-30 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure 7.11_Future Servicing Concept 2 Upgrades_25-yr 24-hr Huff Results - Spare Capacity.mxd

7.4 Existing System Upgrades under Growth Conditions Cost Estimates

Cost estimates are provided in Table 7.4 for both servicing concepts, while detailed breakdowns of the cost estimates are provided in Appendix H.

Table 7.4: Cost Estimates for Recommended Upgrades under Growth Conditions

Category	Upgrade No.	Item	Total Cost
Concept 1	1	900 mm Gravity Sewer Removal	$250,000
		1,200 mm Gravity Sewer	$2,700,000
		Pavement Rehabilitation	$1,160,000
		Upgrade 1 Sub-Total	**$4,110,000**
	2	600 mm Gravity Sewer Removal	$190,000
		675 mm Gravity Sewer	$1,670,000
		Upgrade 2 Sub-Total	**$1,860,000**
	6	200 mm Gravity Sewer Removal	$20,000
		300 mm Gravity Sewer	$110,000
		Pavement Rehabilitation	$180,000
		Upgrade 3 Sub-Total	**$310,000**
		Future Upgrades Concept 1 Total	**$6,280,000**
Concept 2	1	900 mm Gravity Sewer Removal	$250,000
		1,200 mm Gravity Sewer	$2,700,000
		Pavement Rehabilitation	$1,160,000
		Upgrade 1 Sub-Total	**$4,110,000**
	2	600 mm Gravity Sewer Removal	$190,000
		675 mm Gravity Sewer	$1,670,000
		Upgrade 2 Sub-Total	**$1,860,000**
		Future Upgrades Concept 2 Total	**$5,970,000**

The estimated cost of extending the Upgrade 2 recommendation of upsizing to a 675 mm sewer west, between 59 Avenue and 63 Avenue is $1,840,000 (note this includes pavement rehabilitation costs whereas the costs in Upgrade 2 above do not, as no roadways are impacted by development). This is provided for reference only if monitoring indicates that capacity significantly worsens with development, to the extent that the maximum HGL relative to the surface no longer meets the 2.5 m criteria.

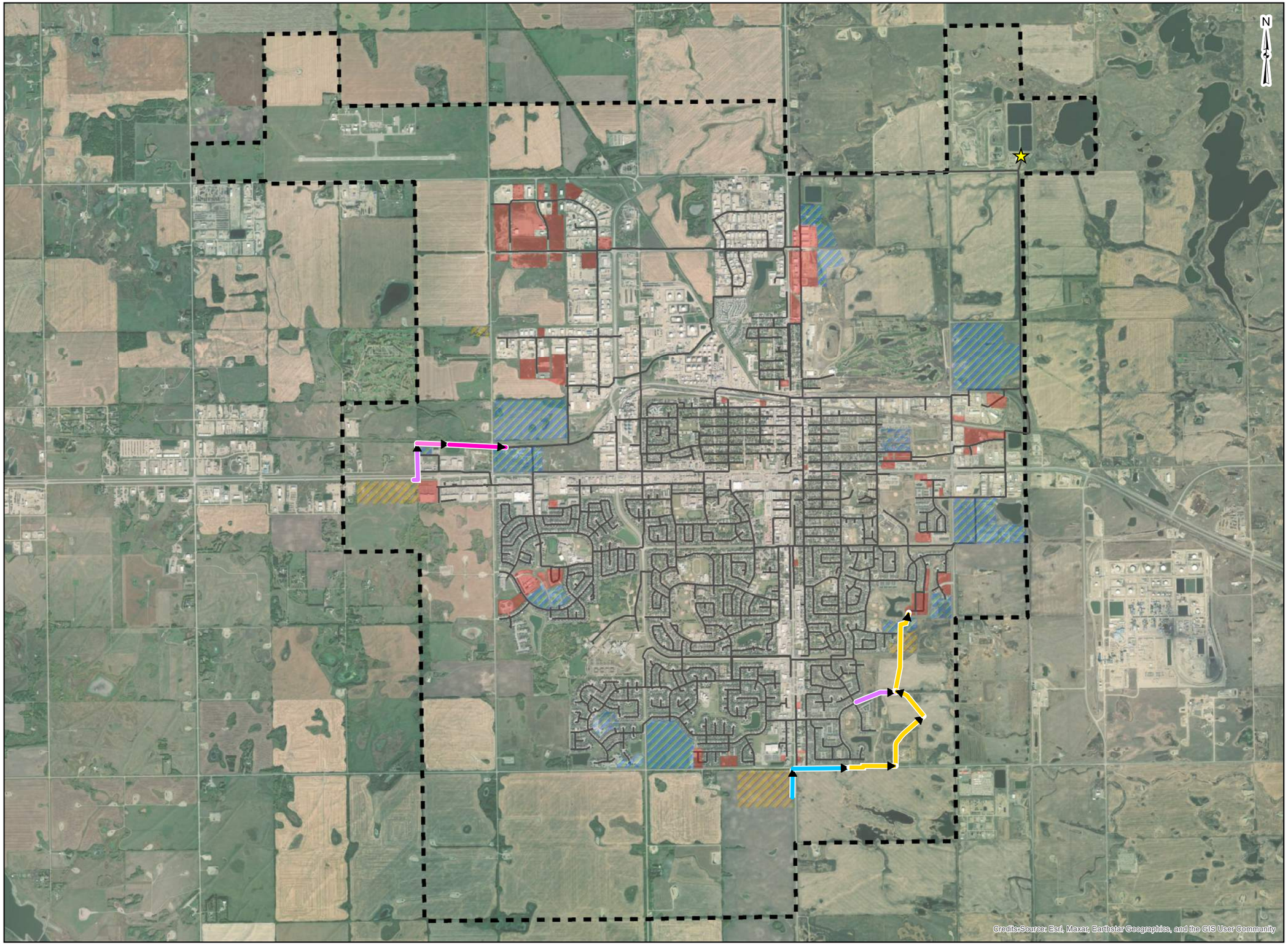
As the cost estimates do not vary significantly between the two (2) concepts, it is recommended that the City proceeds with Concept 1. Though some pipes do show elevated HGLs downstream of the additional tie-in point to the existing sanitary sewer collection system, excessive surcharging is generally limited to one additional section of pipe. Concept 1 would allow for greater flexibility of the affected quarter section, as it does not rely on implementation of the South Trunk infrastructure.

7.5 Staging of Preferred Servicing Concept

Staging of the preferred servicing concept (Concept 1) for the 5-, 10-, and 20-Year Growth Horizons are shown in Figures 7.12 to 7.14, respectively. The concepts assume that overflow from Wallacefield (additional 60 L/s) is triggered in the 5-Year Growth Horizon.

The proposed servicing concept staging has been oversized to account for future development up to the Ultimate Boundary (2051) based on an approximate sewer service life of 60 years. Oversizing sewer upgrades for future scenarios is seen as more cost-effective since the difference in pipe cost will be marginal compared to the costs of excavating and rehabilitating roadways multiple times. Oversizing existing sanitary sewer collection system upgrades to account for ultimate development may introduce operational and maintenance concerns, such as odour and sedimentation within upgraded sewer sections due to low velocities. It is worth noting that detailed design of sewer upgrades may wish to consider additional sewer flushing programs or alternative upgrading concepts, such as staged infrastructure, twinned sewers, or interim smaller diameter sewers housed within the ultimate sewer.

The new 1,200 mm East Trunk sewer is triggered when the spare capacity in the existing 900 mm East Trunk is exhausted, at a limiting spare capacity of approximately 125 L/s under the LOS event. This capacity is exceeded prior to the 10-Year Growth Horizon, suggesting the East Trunk is required within the next ten (10) years. It is recommended that the timing for the East Trunk is revisited in 5-years to confirm the exact timing of this upgrade.



Legend

- Wastewater Treatment Plant
- Existing Sewer
- Study Area

Future Parcel Tie-In

- New Service
- Existing Service
- Lift Station Required
- Septic Tanks
- Serviced But Vacant
- Airport Expansion

Proposed Pipe Diameter

- 300 mm Sewer
- 450 mm Sewer
- 600 mm Sewer
- 675 mm Sewer
- 1200 mm Sewer

Assumes Ultimate Boundary pipe sizes to avoid multiple construction projects.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.12
FUTURE SERVICING CONCEPT 1
5 YEAR STAGING PLAN
LLOYDMINSTER SANITARY MASTER PLAN

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Date: 2024-05-30 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure 7.12_Future Servicing Concept_1 - 5 Year Staging.mxd

Legend

- Wastewater Treatment Plant
- Existing Sewer
- Study Area

Future Parcel Tie-In

- New Service
- Existing Service
- Lift Station Required
- Septic Tanks
- Serviced But Vacant
- Airport Expansion

Proposed Pipe Diameter

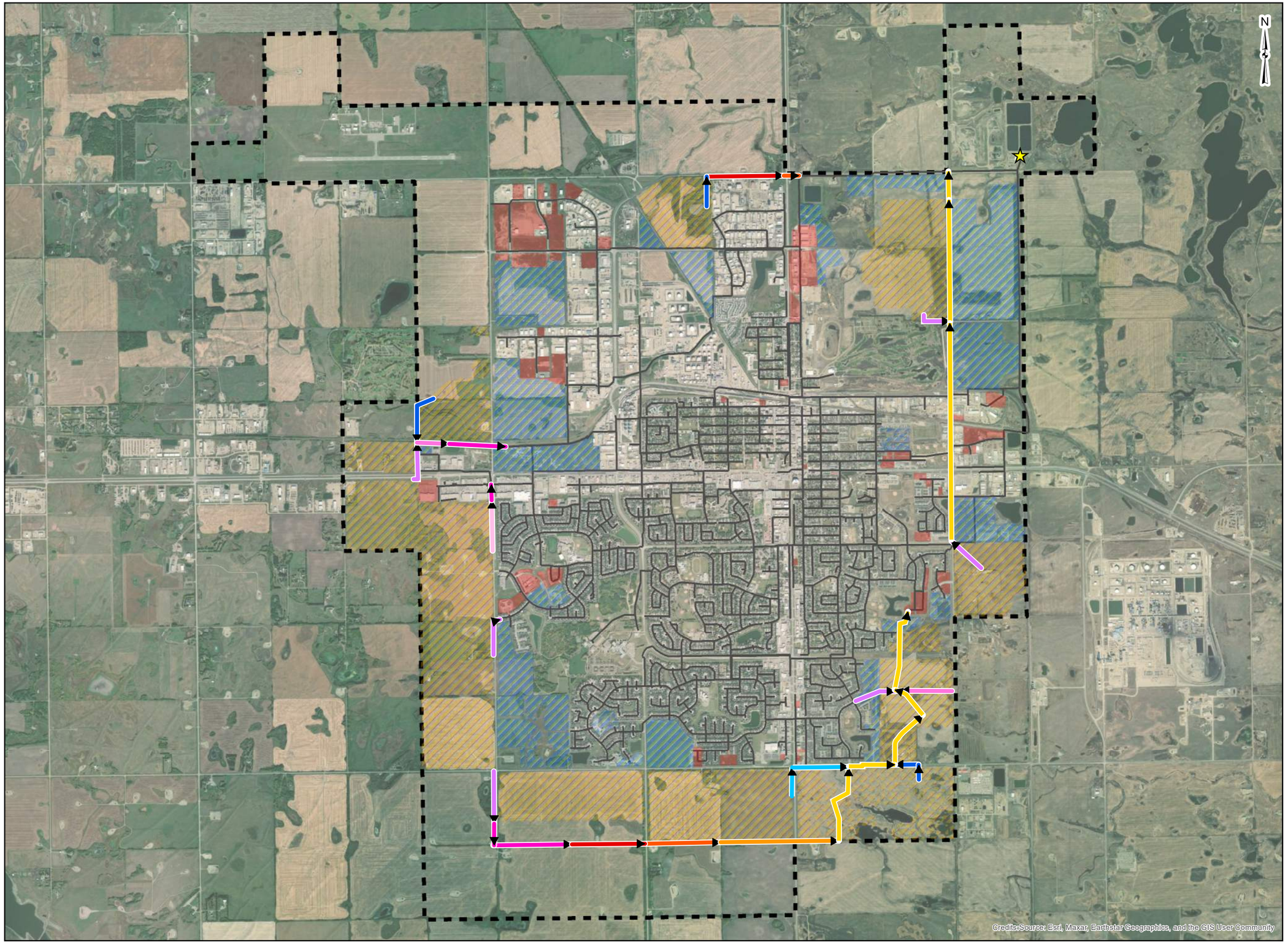
- 300 mm Sewer
- 375 mm Sewer
- 450 mm Sewer
- 600 mm Sewer
- 675 mm Sewer
- 1200 mm Sewer

Assumes Ultimate Boundary pipe sizes to avoid multiple construction projects.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.13
FUTURE SERVICING CONCEPT 1
10 YEAR STAGING PLAN
LLOYDMINSTER SANITARY MASTER PLAN



Legend

- Wastewater Treatment Plant
- Existing Sewer
- Study Area

Future Parcel Tie-In

- New Service
- Existing Service
- Lift Station Required
- Septic Tanks
- Serviced But Vacant
- Airport Expansion

Proposed Pipe Diameter

- 300 mm Sewer
- 375 mm Sewer
- 450 mm Sewer
- 525 mm Sewer
- 600 mm Sewer
- 675 mm Sewer
- 750 mm Sewer
- 900 mm Sewer
- 1050 mm Sewer
- 1200 mm Sewer

Assumes Ultimate Boundary pipe sizes to avoid multiple construction projects.

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 7.14
FUTURE SERVICING CONCEPT 1
20 YEAR STAGING PLAN
LLOYDMINSTER SANITARY MASTER PLAN

ISL

LLOYDMINSTER

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8.0 Capital Plan

A Capital Plan staged to the Ultimate Boundary has been developed from the recommendations made by this SSMP. An overview of the capital plan, including all upgrades required to the sanitary sewer collection system by full build-out, the servicing scheme proposed, and the servicing type are illustrated in Figure 8.1 (note that this is reflective of the recommended servicing Concept 1). The following should be considered when reviewing this information:

- A 2.0% inflation increase per year should be considered to the base costs;
- The annual capital budget allowance is meant to hold funding each year for maintenance and "one off" instances where repairs are required;
- The horizon in which the upgrade is suggested is based on discussion between the City and ISL on when development could occur based on a full build-out scenario; and
- High level cost estimates provided are a Class 4 with an accuracy of +75% to -40%.

To provide interim measures to ensure that areas of the city are growth ready, the following staging plan is recommended to align with the capital plan:

- Complete the capacity upgrades recommended to the existing sanitary sewer collection system based on the priority noted in Table 6.12.
- Complete the condition upgrades recommended to the existing sanitary sewer collection system based on the priority noted in Table 6.12. It is noted that upgrades to this infrastructure could also be completed in conjunction with the City's roadworks program to minimize costs.
- Continue with the condition assessment program to identify additional sewers in poor or failing condition.
- Conduct periodic flow monitoring programs to assess the degree of I-I in certain neighbourhoods. Consider pinpointing smaller catchments that are likely to be more susceptible to I-I.
- Progress the future servicing concept as development proceeds, prioritizing infrastructure required to service development in the short-term.
- Monitor the three (3) areas flagged for upgrades due to future development, and target upgrades when the existing spare capacity is exceeded due to additional development. As a corollary, consider the repercussions of I-I and the potential for increased spare capacity if I-I mitigation measures are implemented.

This generalized staging plan is shown in relation to triggered growth horizon in Figure 8.2 and in Table 8.1 below. Cost breakdowns per growth horizon are included in Appendix H. These recommended upgrades are being provided as a staging plan with the intent that the SSMP will be integrated into an overall capital plan and budget. These upgrades are meant to align with the City's roadworks program and would be implemented in conjunction with the road upgrades to reduce capital costs.

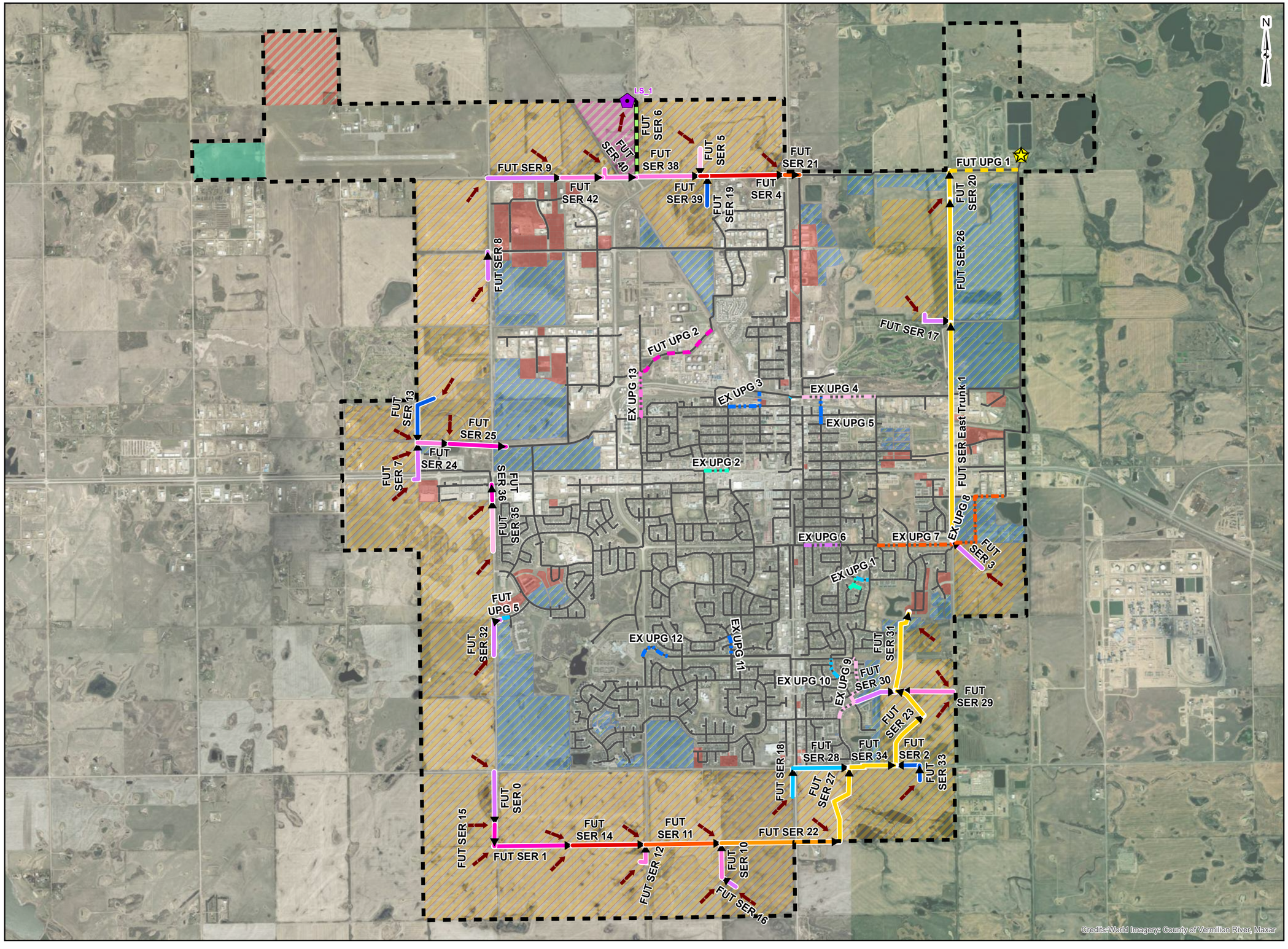
Table 8.1: Capital Planning Horizons

ID[1]	Type	Description	Cost
3 Years (2024 to 2027)			
EX UPG 1	Existing Upgrade	Removal of 200 mm gravity sewer and installation of 250 mm and 300 mm gravity sewer, along with pavement rehabilitation.	$1,020,000
EX UPG 2	Existing Upgrade	Removal of 200 mm gravity sewer and installation of 250 mm gravity sewer, along with pavement rehabilitation along Yellowhead Highway.	$700,000
EX UPG 3	Existing Upgrade	Removal of 300 mm gravity sewer and installation of 375 mm gravity sewer, along with pavement rehabilitation and railway crossing.	$1,410,000
EX UPG 4	Existing Upgrade	Removal of 450 mm gravity sewer and installation of 300 mm and 525 mm gravity sewer, along with pavement rehabilitation along 52 Street.	$2,530,000
EX UPG 5	Existing Upgrade	Removal of 300 mm and 375 mm gravity sewer and installation of 375 mm gravity sewer, along with pavement rehabilitation and railway crossing along 48 Avenue.	$4,990,000
EX UPG 6	Existing Upgrade	Removal of 375 mm gravity sewer and installation of 450 mm gravity sewer, along with pavement rehabilitation along 36 Street.	$1,220,000
EX UPG 7	Existing Upgrade	Removal of 750 mm gravity sewer and installation of 900 mm gravity sewer, along with pavement rehabilitation along 36 Street.	$2,950,000
EX UPG 8	Existing Upgrade	Removal of 750 mm gravity sewer and installation of 900 mm gravity sewer, along with pavement rehabilitation along 41 Street.	$4,110,000
EX UPG 9	Existing Upgrade	Removal of 450 mm and 375 mm gravity sewer and installation of 525 mm gravity sewer, along with pavement rehabilitation along 46 Avenue, 47 Avenue, and 19 Street.	$2,570,000
EX UPG 10	Existing Upgrade	Removal of 250 mm gravity sewer and installation of 300 mm gravity sewer, along with pavement rehabilitation along 47 Avenue.	$630,000
EX UPG 11	Existing Upgrade	Removal of 250 mm and 300 mm gravity sewer and installation of 300 mm and 375 mm gravity sewer, along with pavement rehabilitation along 53 Avenue.	$1,350,000
EX UPG 12	Existing Upgrade	Removal of 300 mm gravity sewer and installation of 375 mm gravity sewer, along with pavement rehabilitation along 59 Avenue and 25 Street.	$1,110,000
EX UPG 13	Existing Upgrade	Removal of 450 mm and 525 mm gravity sewer and installation of 600 mm gravity sewer, along with pavement rehabilitation and railway crossing along 59 Avenue.	$1,920,000
5 Years (2027 to 2029)			
FUT SER 7, 24, 25	Future Servicing	Installation of new 450 mm, 600 mm, and 675 mm gravity sewers on the northern side of the West Commercial neighbourhood to existing sanitary sewer collection system.	$2,180,000
FUT SER 18,23,28,34,41	Future Servicing	Installation of new 300 mm and 1,200 mm gravity sewers in eastern Wallacefield.	$6,690,000
FUT SER 30	Future Servicing	Installation of new 450 mm gravity sewer connecting existing sanitary sewer collection system in Wallacefield to the proposed new installations in eastern Wallacefield.	$590,000

ID[1]	Type	Description	Cost
FUT SER 31	Future Servicing	Installation of a new 1,200 mm gravity sewer connecting new eastern Wallacefield installations to existing sanitary sewer collection system in Aurora.	$3,280,000
10 Years (2029 to 2034)			
FUT SER 13	Future Servicing	Installation of 375 mm gravity sewer on the northern side of West Commercial connecting to the 5-year proposed installations there from the north.	$700,000
FUT SER 27	Future Servicing	Installation of 1,200 mm gravity sewer in The Willows to connect to the 5-year proposed installations in eastern Wallacefield.	$3,250,000
FUT SER 29	Future Servicing	Installation of 600 mm gravity sewer in eastern Wallacefield connecting to 5-year proposed installations in eastern Wallacefield from the eastern city limits.	$810,000
FUT SER 20, 26, East Trunk 1	Future Servicing	Installation of 1,200 mm East Trunk 1 connecting the existing sanitary sewer collection system from Wigfield Industrial to the WWTP northward.	$14,390,000
20 Years (2034 to 2044)			
FUT UPG 1	Future Upgrade	Once triggered, removal of 900 mm gravity sewer and installation of 1,200 mm gravity sewer, along with pavement rehabilitation along 67 Street to the WWTP.	$4,110,000
FUT UPG 2	Future Upgrade	Once triggered, removal of 600 mm gravity sewer and installation of 675 mm gravity sewer through the Husky Oil Refinery land.	$1,860,000
FUT UPG 5	Future Upgrade	Once triggered, removal of 200 mm gravity sewer and installation of 300 mm gravity sewer, along with pavement rehabilitation along 29 Street.	$310,000
FUT SER 4, 19, 21	Future Servicing	Installation of 375 mm, 750 mm, and 900 mm gravity sewer in Glenn E. Neilson Industrial Park, which connects to an existing sanitary sewer collection system in North Industrial.	$2,610,000
FUT SER 17	Future Servicing	Installation of 450 mm gravity sewer from southern part of North Industrial connecting to the proposed East Trunk 1.	$470,000
FUT SER 3	Future Servicing	Installation of 450 mm gravity sewer from southern half of Wigfield Industrial connecting to the proposed East Trunk 1.	$580,000
FUT SER 35, 36	Future Servicing	Installation of 525 mm and 675 mm gravity sewer on southern side of West Commercial along 75 Avenue connecting northward to existing sanitary sewer collection system in West Commercial.	$1,060,000
FUT SER 32	Future Servicing	Installation of 450 mm gravity sewer along 75 Avenue connecting to existing sanitary sewer collection system along 29 Street.	$580,000
FUT SER 2, 33	Future Servicing	Installation of 375 mm gravity sewer connecting eastern side of The Willows to the proposed 5-year installations in Wallacefield.	$490,000
FUT SER 0, 1, 11, 14, 15, 22	Future Servicing	Installation of 450 mm, 675 mm, 750 mm, 900 mm, and 1,050 mm gravity sewers connecting and running west to east through the Southern Recently Annexed Area to the proposed 10-year installations in The Willows.	$11,220,000

ID[1]	Type	Description	Cost
Ultimate (2044 to Full Build-out)			
FUT SER Lift Station 1	Future Servicing	New lift station to be built on the city boundary beside Range Road 11 in the Northern Recently Annexed Area east to the airport.	$1,050,000
FUT SER 6	Future Servicing	Installation of 200 mm forcemain along Range Road 11 southward connecting the proposed Lift Station 1 to the proposed Ultimate gravity sewer running along Township Road 502 and 67 Street.	$730,000
FUT SER 8	Future Servicing	Installation of 450 mm gravity sewer in Hill Industrial along 75 Avenue connecting to the existing sanitary sewer collection system along 62 Street.	$390,000
FUT SER 5	Future Servicing	Installation of 525 mm gravity sewer connecting the Northern Recently Annexed Area to the existing sanitary sewer collection system in Glenn E. Neilson Industrial Park.	$410,000
FUT SER 9, 38, 39, 40, 42	Future Servicing	Installation of 450 mm, 600 mm, and 750 mm gravity sewer along Township Road 502 and 67 Street connecting to the existing sanitary sewer collection system in Glenn E. Neilson Industrial Park.	$3,480,000
FUT SER 12	Future Servicing	Installation of 600 mm gravity sewer in the Southern Recently Annexed Area connecting to the proposed 20-year installations in the same area.	$370,000
FUT SER 10, 16	Future Servicing	Installation of 450 mm and 600 mm gravity sewer in the Southern Recently Annexed Area connecting to the proposed 20-year installations in the same area.	$780,000

[1] The ID numbers for servicing represent pipe ID.



Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Existing Sewer
- Study Area

Proposed Existing Pipe Upgrade Diameter

- 250 mm
- 300 mm
- 375 mm
- 450 mm
- 525 mm
- 600 mm
- 900 mm

Proposed Future Pipe Upgrade Diameter

- 300 mm
- 675 mm
- 1200 mm

Proposed Future Pipe Servicing Diameter

- 200 mm Forcemain
- 300 mm Sewer
- 375 mm Sewer
- 450 mm Sewer
- 525 mm Sewer
- 600 mm Sewer
- 675 mm Sewer
- 750 mm Sewer
- 900 mm Sewer
- 1050 mm Sewer
- 1200 mm Sewer

Future Parcel Tie-In

- New Service
- Existing Service
- Lift Station Required
- Septic Tanks
- Serviced But Vacant
- Airport Expansion

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 8.1
CAPITAL PLANNING OVERVIEW
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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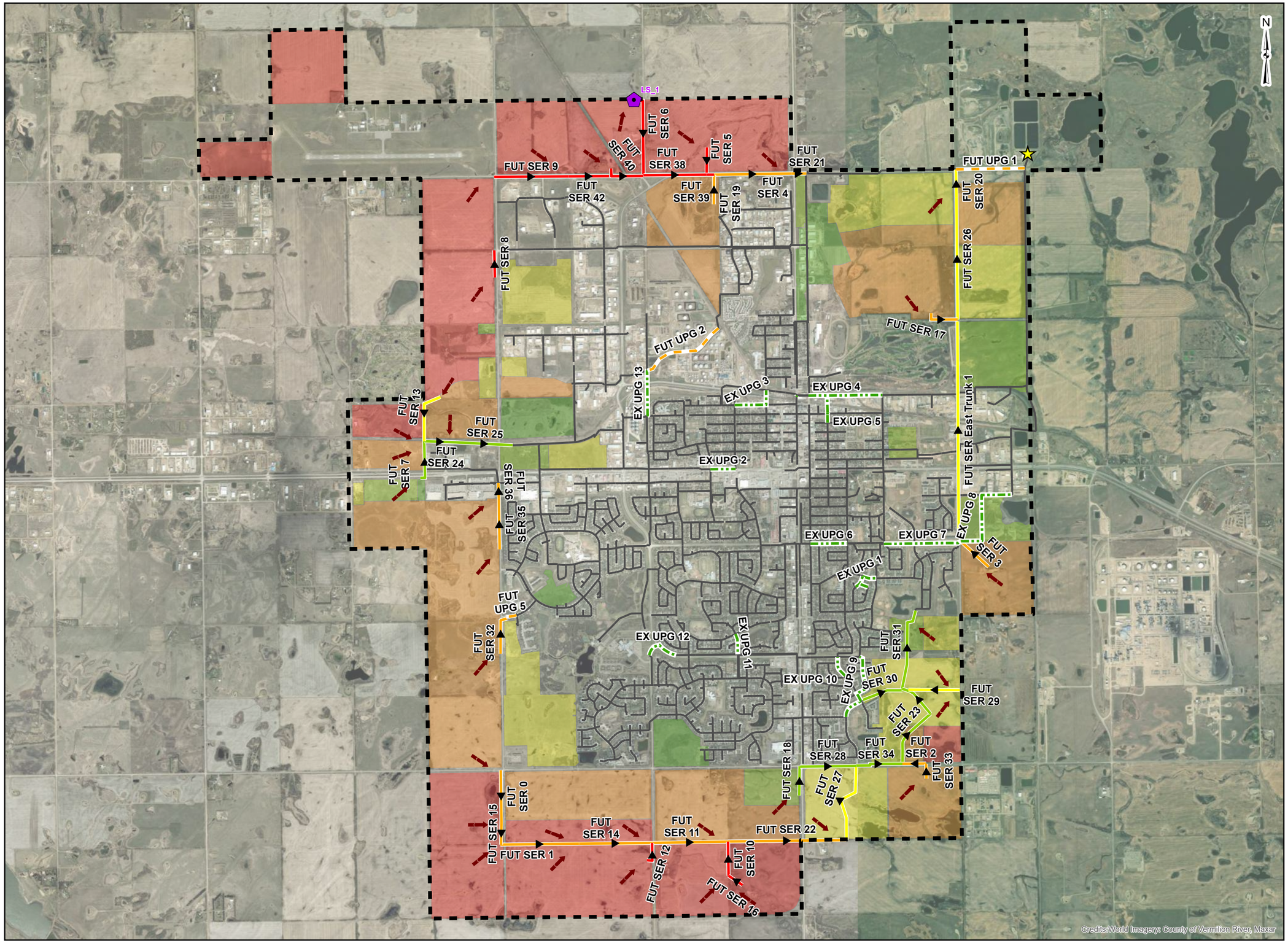

Legend

- Wastewater Treatment Plant
- Proposed Lift Station
- Existing Sewer
- Study Area

Staging

- Existing Upgrades
- Future Upgrades
- 5-Year Growth
- 10-Year Growth
- 20-Year Growth
- Ultimate Boundary

Development Timing

- 3-Years
- 5-Years
- 10-Years
- 20-Years
- Ultimate Boundary

0 500 1,000 2,000 Meters

1:40,000 NAD 1983 UTM Zone 12N

FIGURE 8.2
CAPITAL PLANNING HORIZONS
LLOYDMINSTER SANITARY SEWER
MASTER PLAN

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9.0 Conclusions and Recommendations

ISL was retained by the City to provide engineering services to generate an updated SSMP. The SSMP evaluated the current and future performance and capacity of the sanitary sewer collection system in the city, and assessed any additional servicing required to meet the needs of future populations.

Since the last update to the SSMP in 2016, the City has undergone significant changes, including expansion through the 2022 Annexation Lands and various sanitary sewer collection system upgrades. These changes, along with the anticipated increase in sanitary flows from annexation and population growth and the ongoing deterioration of the sanitary sewer collection system, necessitate an updated SSMP. This updated plan will help the City understand and manage the servicing implications of new developments, ensuring effective infrastructure improvements and future expansion while maintaining service levels for residents and businesses.

The purpose of the SSMP is generally summarized below:

- Inventory and analyze the existing infrastructure under existing conditions;
- Convert and update the City's existing hydraulic model;
- Calibrate the City's hydraulic model under dry weather flow (DWF) and wet weather flow (WWF) conditions to accurately represent the flow conditions within the City's existing sanitary sewer collection system;
- Use the calibrated hydraulic model to prepare capacity assessments of the existing sanitary sewer collection system under current and future growth conditions;
- Develop servicing plans for future growth. Locations and timing may be dependent on the following:
  - Availability of sufficient servicing needs;
  - Annexed land locations; and
  - Community planning;
- Determine what upgrades are required to the existing sanitary sewer collection system based on condition and capacity assessments and recommend future servicing options; and
- Provide a framework for future sanitary sewer collection system capital planning, including cost estimates and possible staging of infrastructure installations.

Conclusions and recommendations from the updated SSMP are provided in Sections 9.1 and 9.2 below for the sanitary sewer collection system.

9.1 Sanitary System Conclusions

Conclusions for the sanitary sewer collection system are as follows:

- Significant inflow and infiltration were identified at Sites 7, 9, 12, and 14. Most other sites were within typical design guidelines of 0.28 L/s/ha or less.
- Flow monitoring and rain gauge data collected in 2022 indicated that no major rainfall events occurred during the monitoring period, as all storms were less than a 1:2 year return period.
- DWF and WWF calibration was undertaken for the 2022 monitoring period. Successful calibration was achieved based on agreement between the observed and modelled data.
- The sanitary sewer collection system was evaluated in terms of various return period events, with the level of service event identified as the 1:25 year design storm event.
- 13 locations were flagged as areas of concern under the level of service event.
- A CCTV inspection program was undertaken in various areas of the city, covering a range of sewer installation years, materials, and pipe diameters. Pipe conditions were documented and flagged for repairs or maintenance depending on their condition rating.
- A risk assessment was undertaken to prioritize the capacity and condition upgrades recommended under existing sanitary sewer collection system conditions.
- The proposed sanitary sewer collection system is comprised of gravity sewers, lift stations, and forcemains to service future growth areas:
  - Two (2) concepts were evaluated to service future areas: Concept 1 and Concept 2. The main difference between the two (2) concepts is the ultimate tie-in point of one single-family quarter section on the west side of the city;
  - In Concept 1 it is tied-into the existing sanitary infrastructure and in Concept 2 it is routed to the proposed South Trunk; and
  - Concept 1 was selected as the recommended option as it allows greater flexibility regarding staging of the quarter section.
- Under Ultimate Boundary Growth conditions, the existing sanitary sewer collection system was generally found to perform adequately.
  - Some surcharging was noted in seven (7) areas across the two (2) concepts; however, in many cases the surcharging was minor;
  - Upgrades for three (3) of the seven (7) noted areas were recommended; and
  - The future network assumes all the recommended existing sanitary upgrades are implemented. These upgrades should be completed prior to any substantial densification or future development.
- Hydraulic assessment of the proposed sanitary sewer collection system is sufficient in managing sewage generated from the future development areas given that all proposed upgrades are implemented.

9.2 Sanitary System Recommendations

Recommendations for the sanitary sewer collection system are as follows:

- Prioritize upgrades to the existing sanitary sewer collection system based on the order documented in Table 6.11:
  - To mitigate surcharging in the existing sanitary sewer collection system, implement the necessary upgrades recommended under the LOS design storm scenario; and
  - Remediate the pipes flagged as being in poor condition from the CCTV inspections.
- Continue condition assessments and flow monitoring and aligning infrastructure upgrades with development and roadworks programs to minimize costs.
- Conduct an inflow-infiltration field investigation program to pinpoint the sources of I-I. Field investigation could consist of smoke testing, micro flow monitoring, dye testing and CCTV inspections:
  - Once the field investigation is completed and areas of sources of I-I have been identified, these issues should be mitigated; and
  - Additional flow monitoring and WWF calibration would be required following the program to update the runoff and I-I model parameters.
- Preferred servicing future concept recommended is Concept 1. Recommended staging of Concept 1 for the 5-, 10-, and 20-Year Growth Horizons are shown in Figures 7.12 to 7.14, respectively:
  - The future sanitary sewer collection system should be designed based on the City's Municipal Development Standards.
- The SSMP should be reviewed and updated after significant periods of growth or every five (5) years to update the hydrodynamic model and analysis with any capital upgrades completed by the City, and the most up-to-date growth plans. This could provide clarity on the planned location of development, the density of the proposed development, and the potential corresponding upgrades. This will ensure capacity is maintained and staging upgrades are advancing as needed.

10.0 References

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APPENDIX A
Dry Weather Flow Diurnals

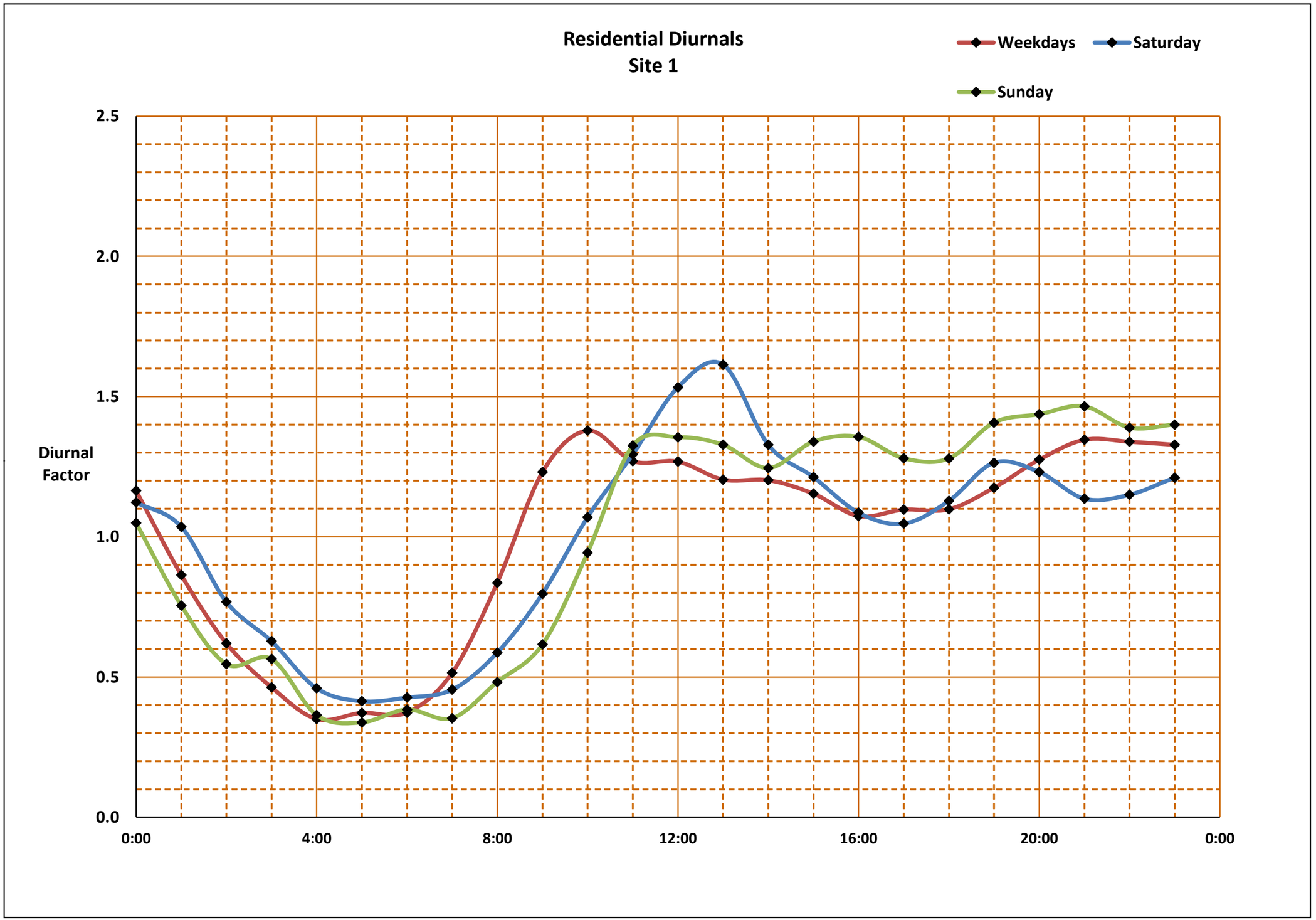

FIGURE A.1
DIURNAL PLOT
SITE 1 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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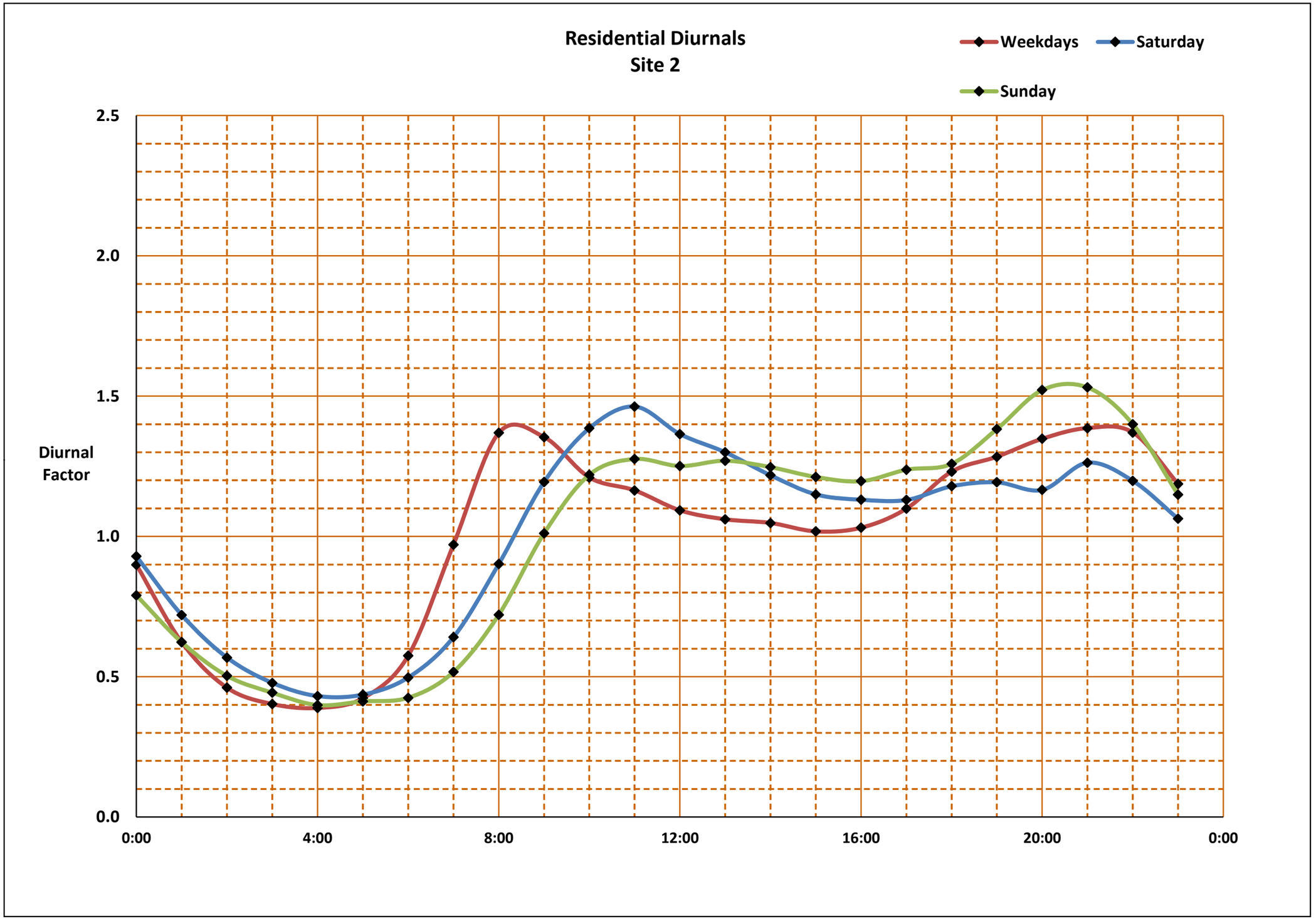

FIGURE A.2
DIURNAL PLOT
SITE 2 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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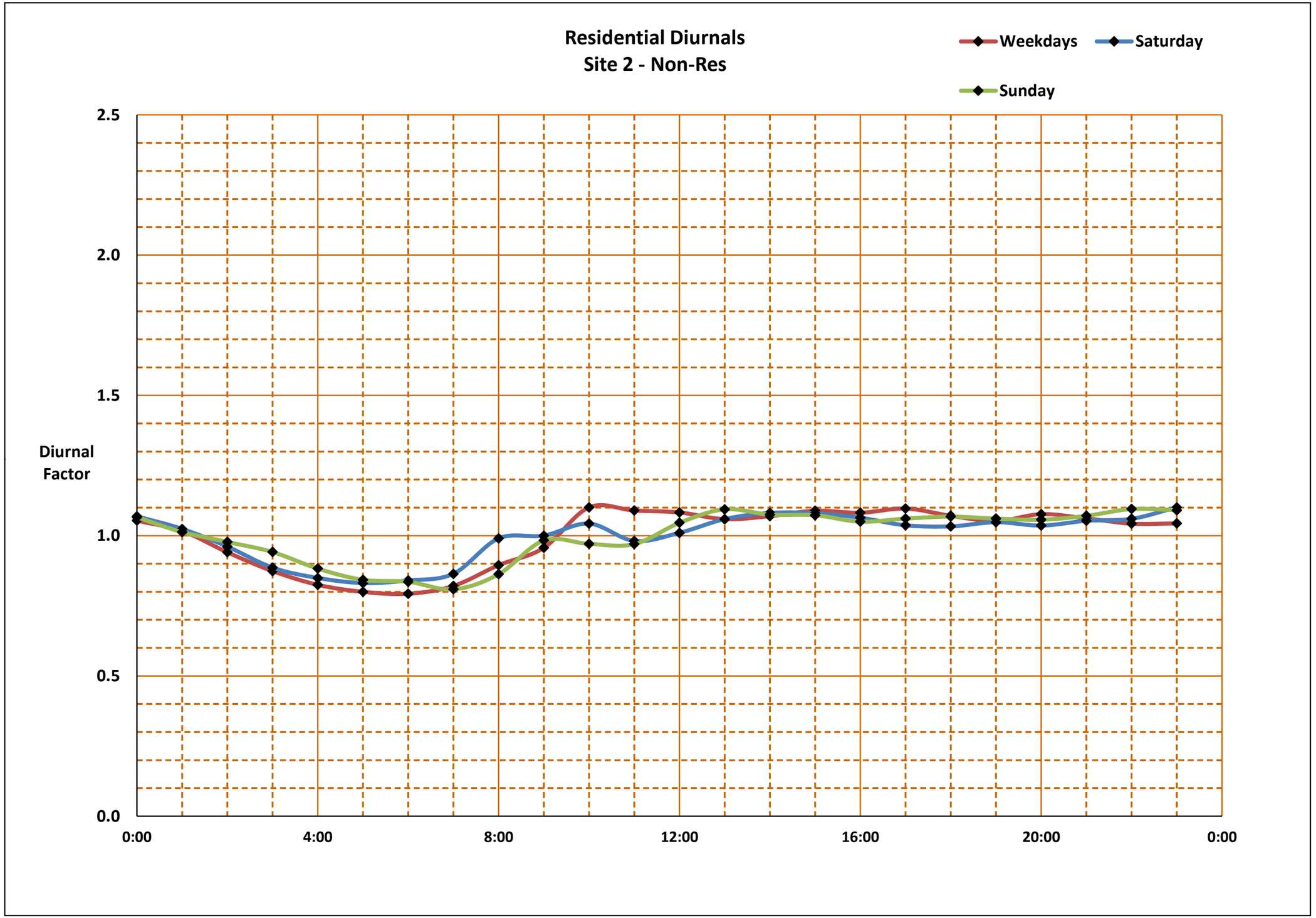

FIGURE A.3
DIURNAL PLOT
SITE 2 - NON-RESIDENTIAL
SANITARY SEWER MASTER PLAN

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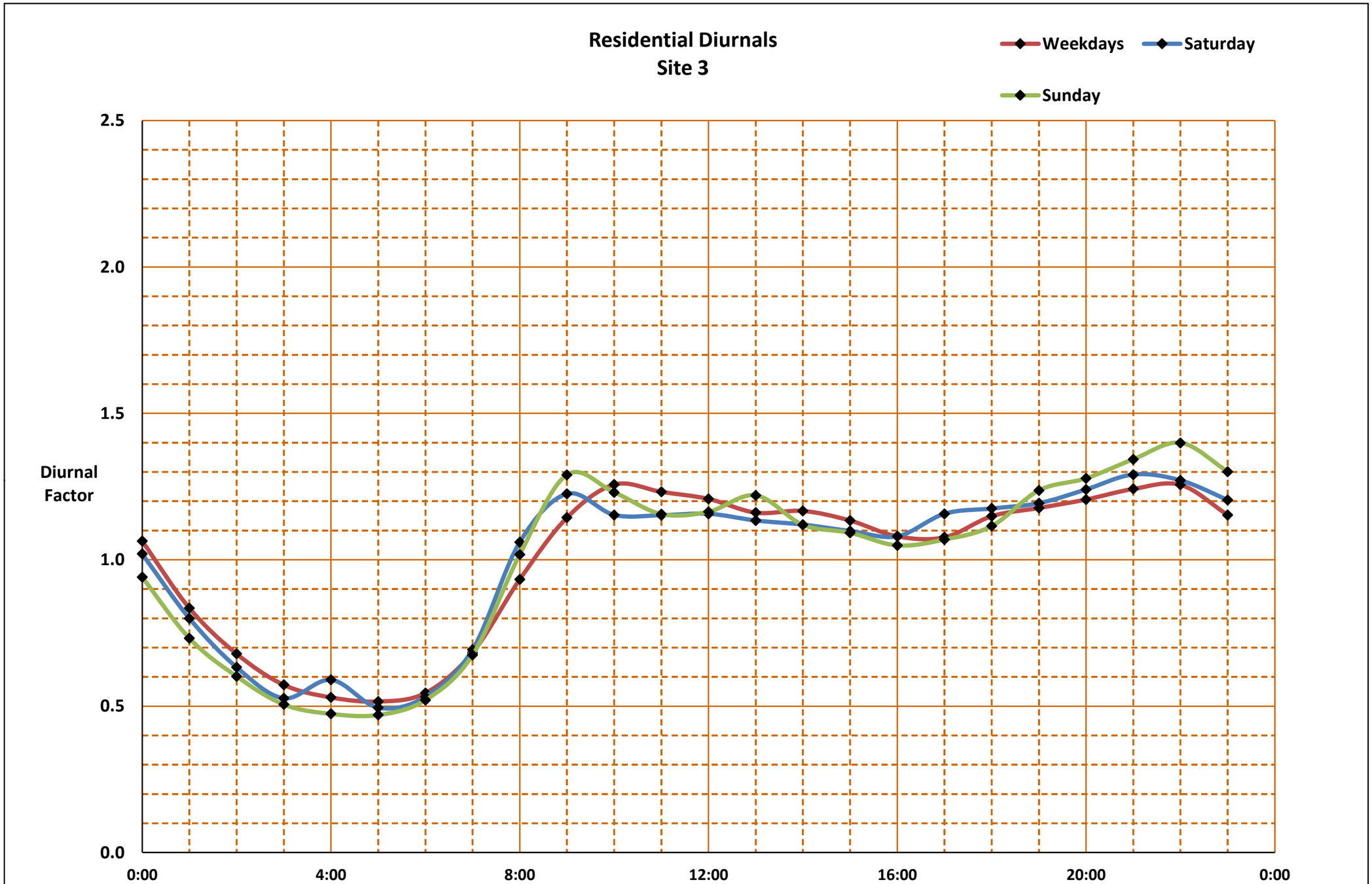

FIGURE A.4
DIURNAL PLOT
SITE 3 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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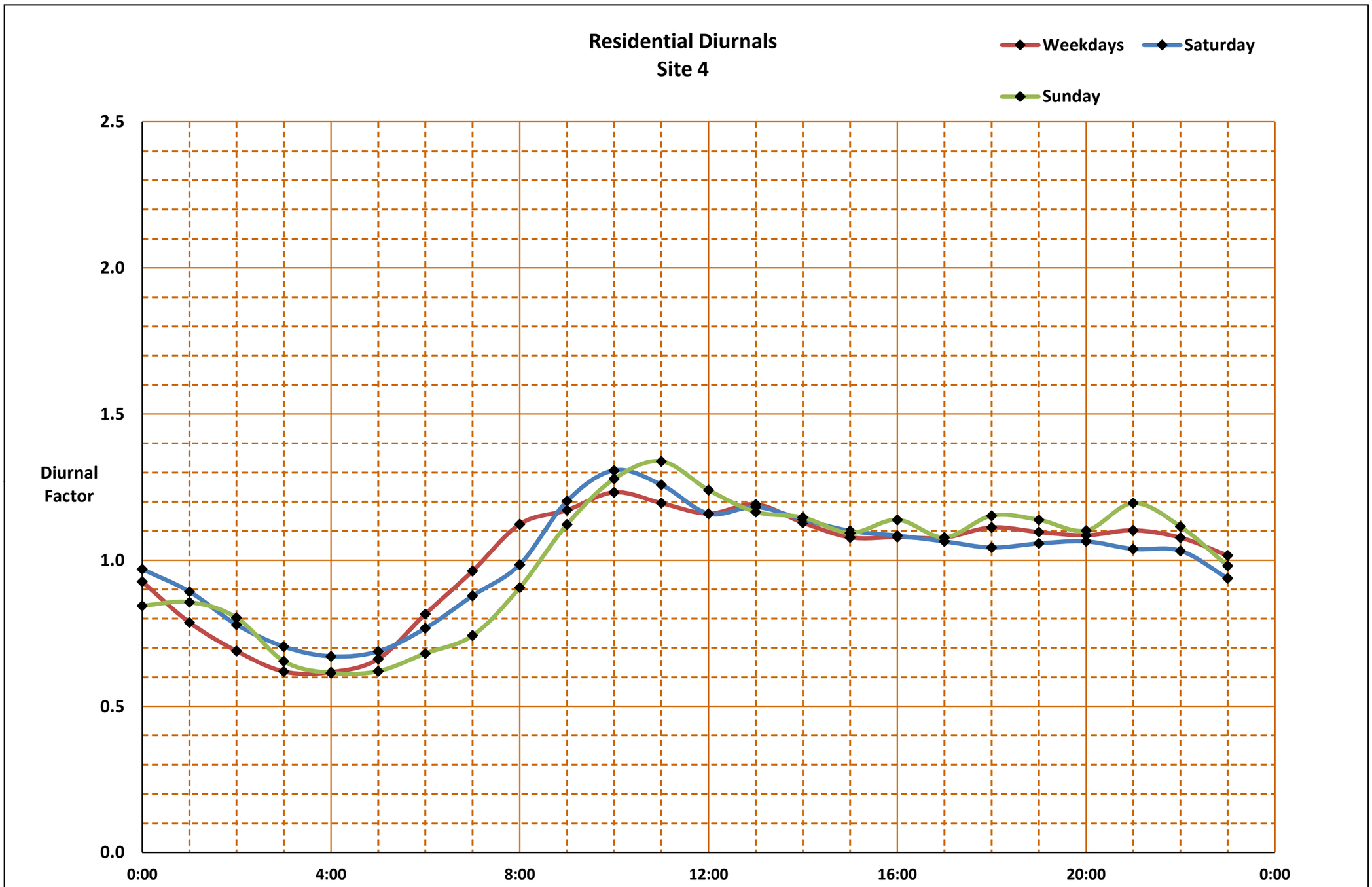

FIGURE A.5
DIURNAL PLOT
SITE 4 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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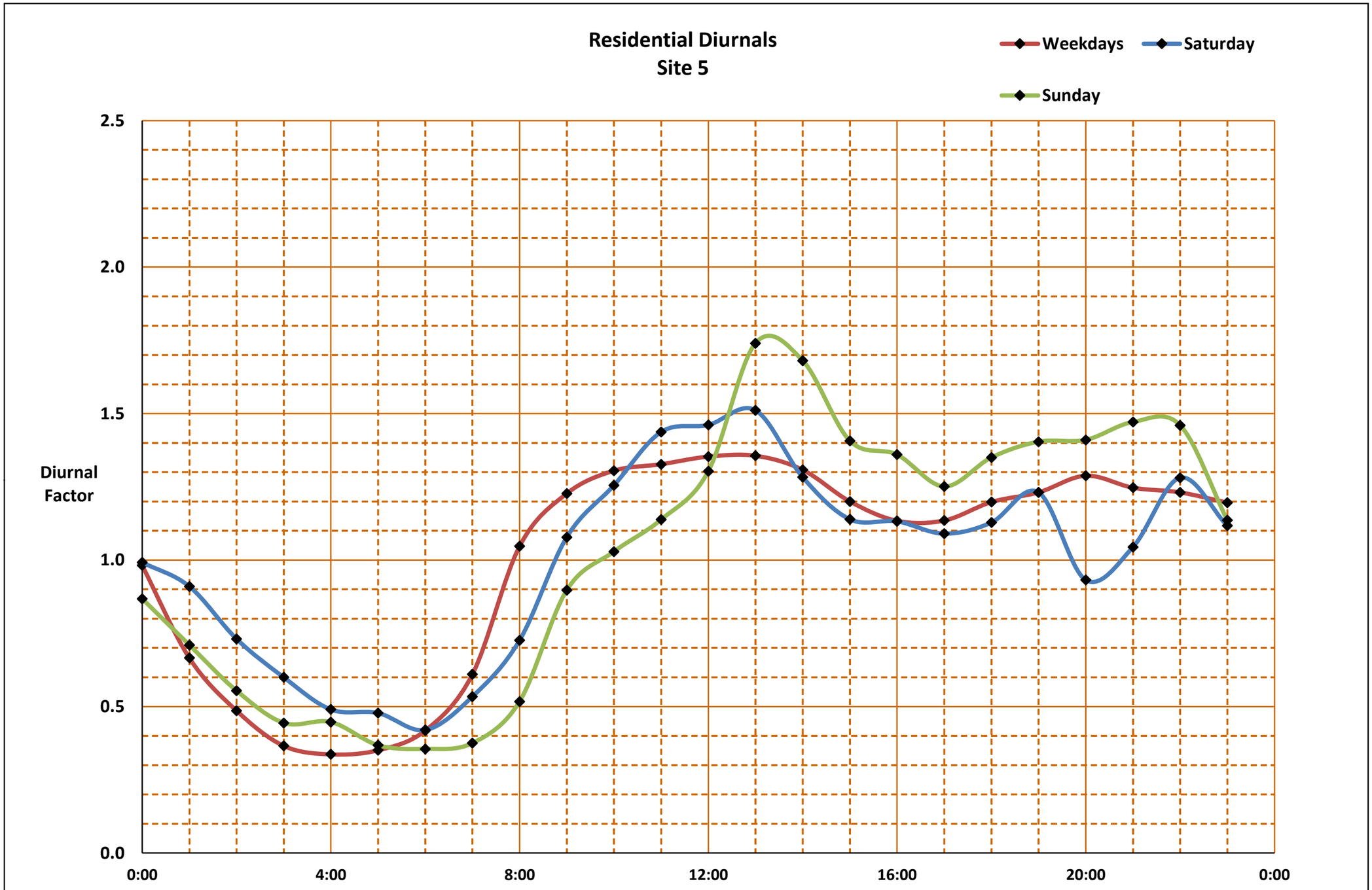

FIGURE A.6
DIURNAL PLOT
SITE 5 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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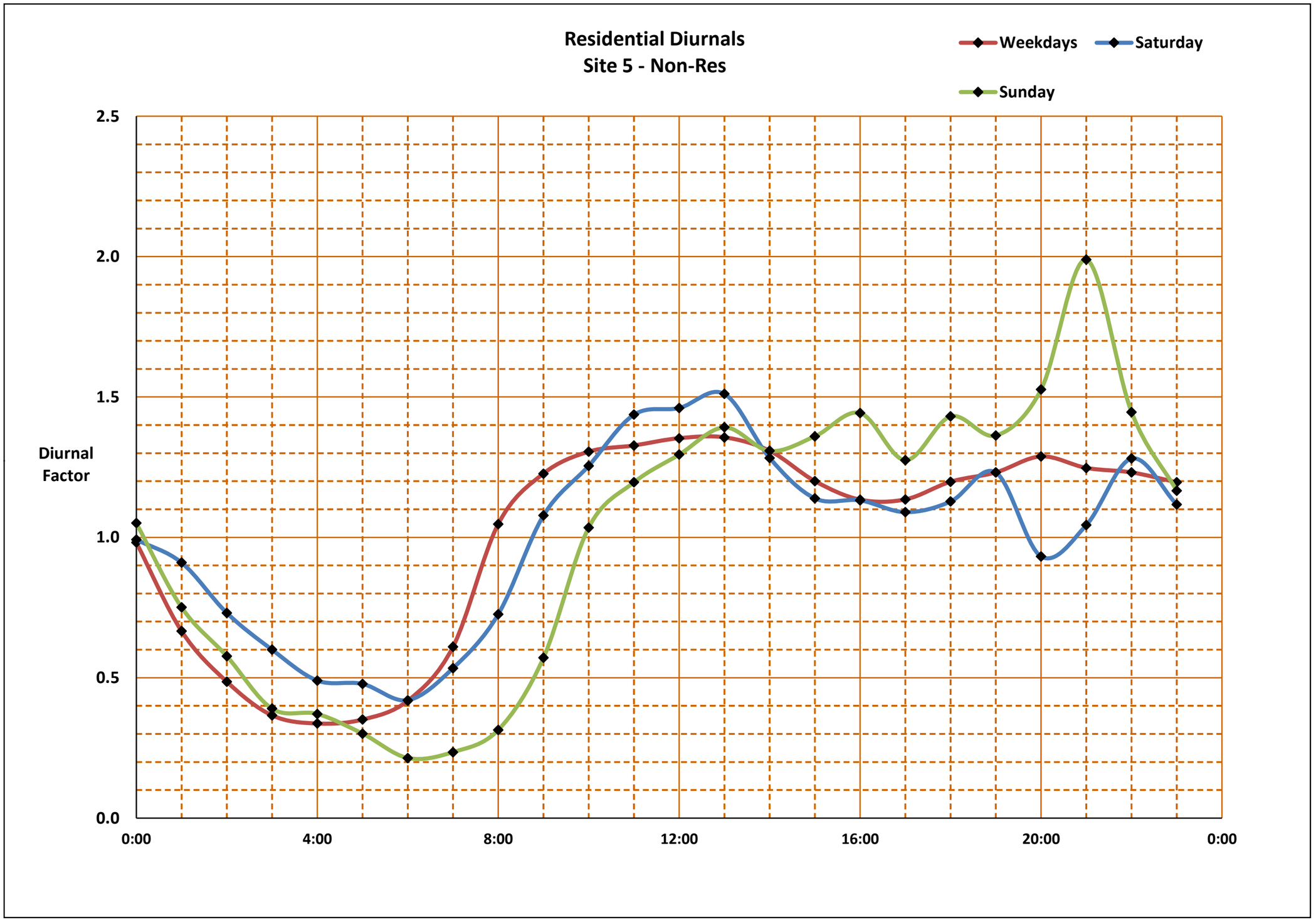

FIGURE A.7
DIURNAL PLOT
SITE 5 - NON-RESIDENTIAL
SANITARY SEWER MASTER PLAN

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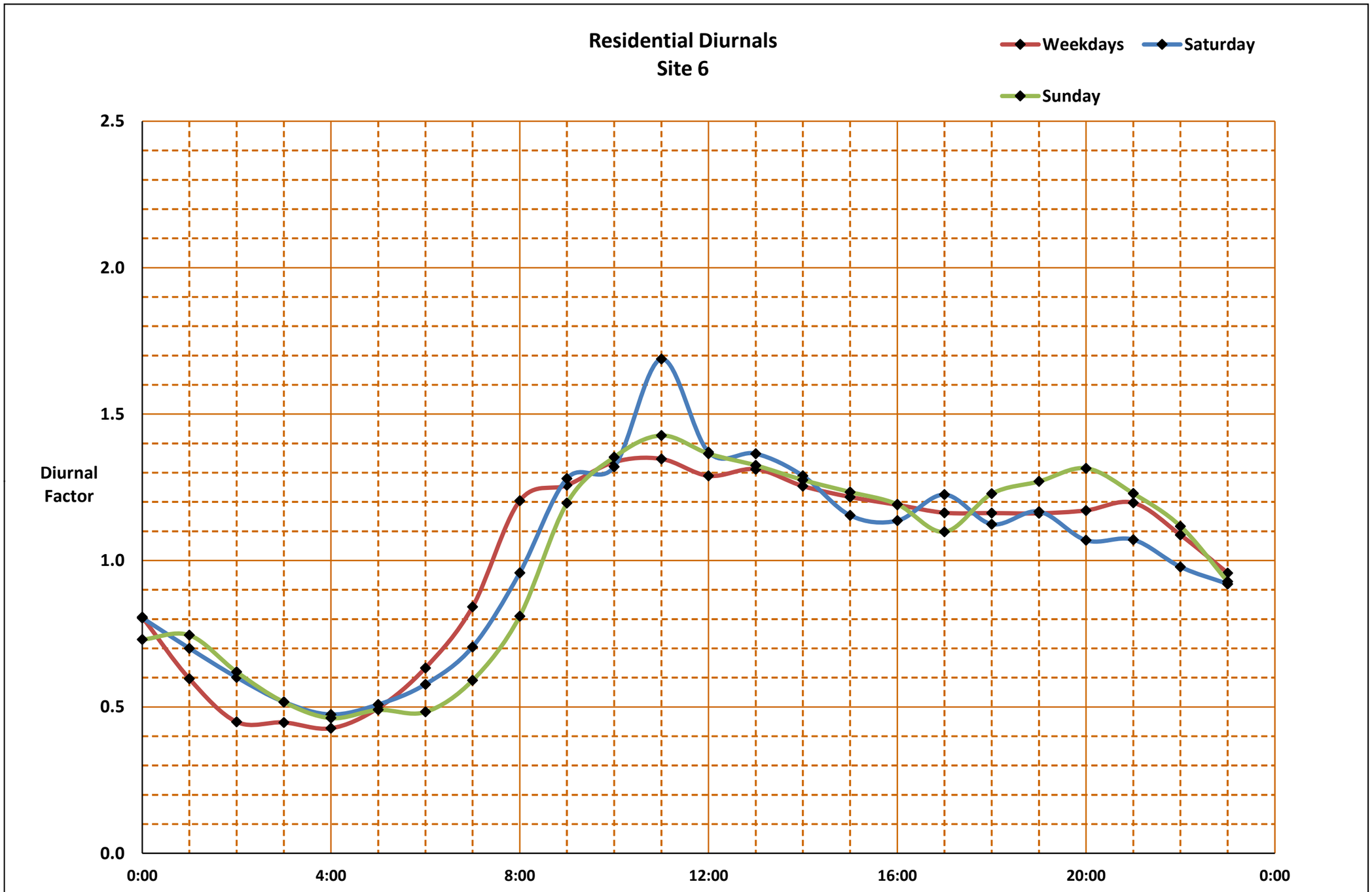

FIGURE A.8
DIURNAL PLOT
SITE 6 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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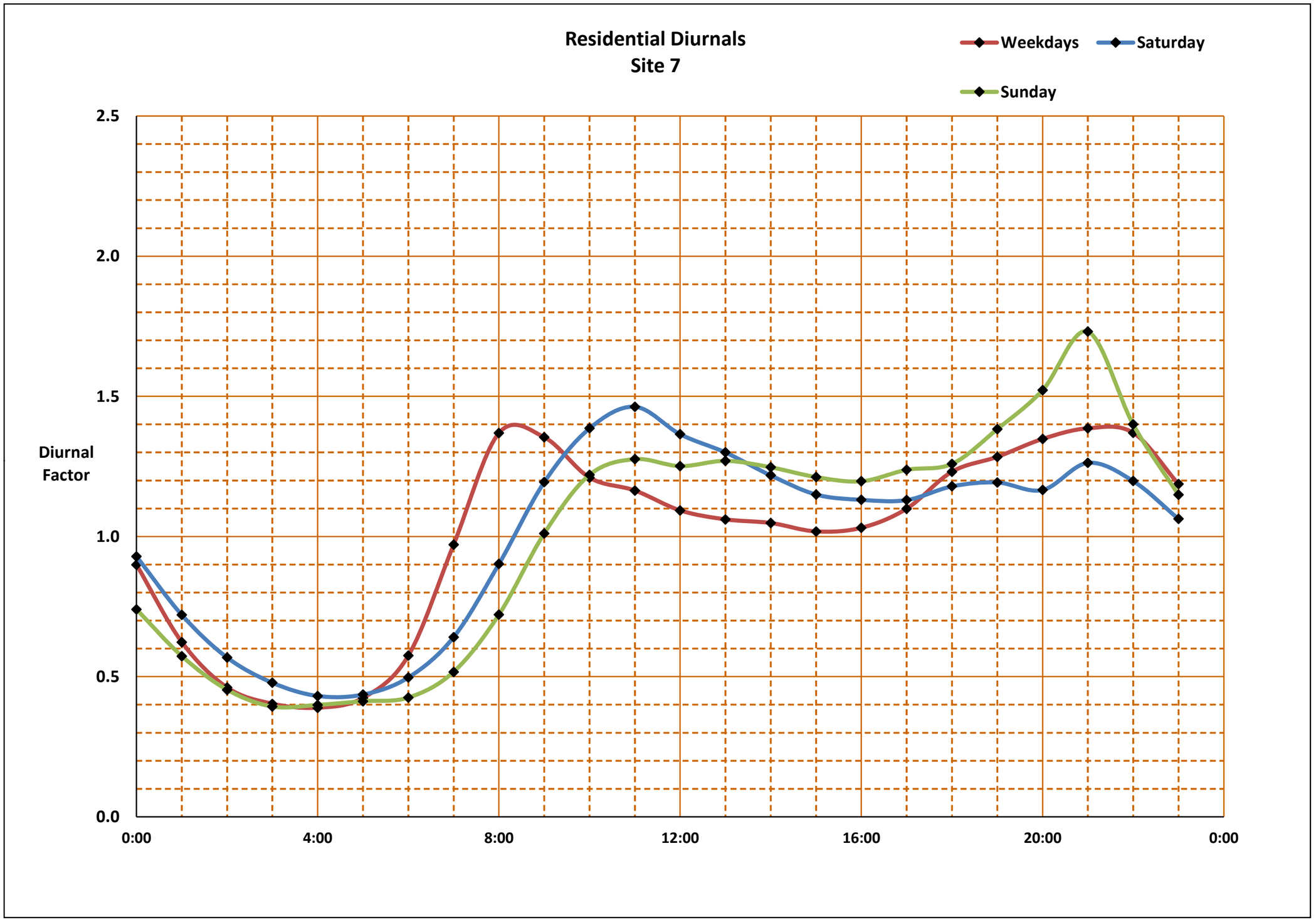

FIGURE A.9
DIURNAL PLOT
SITE 7 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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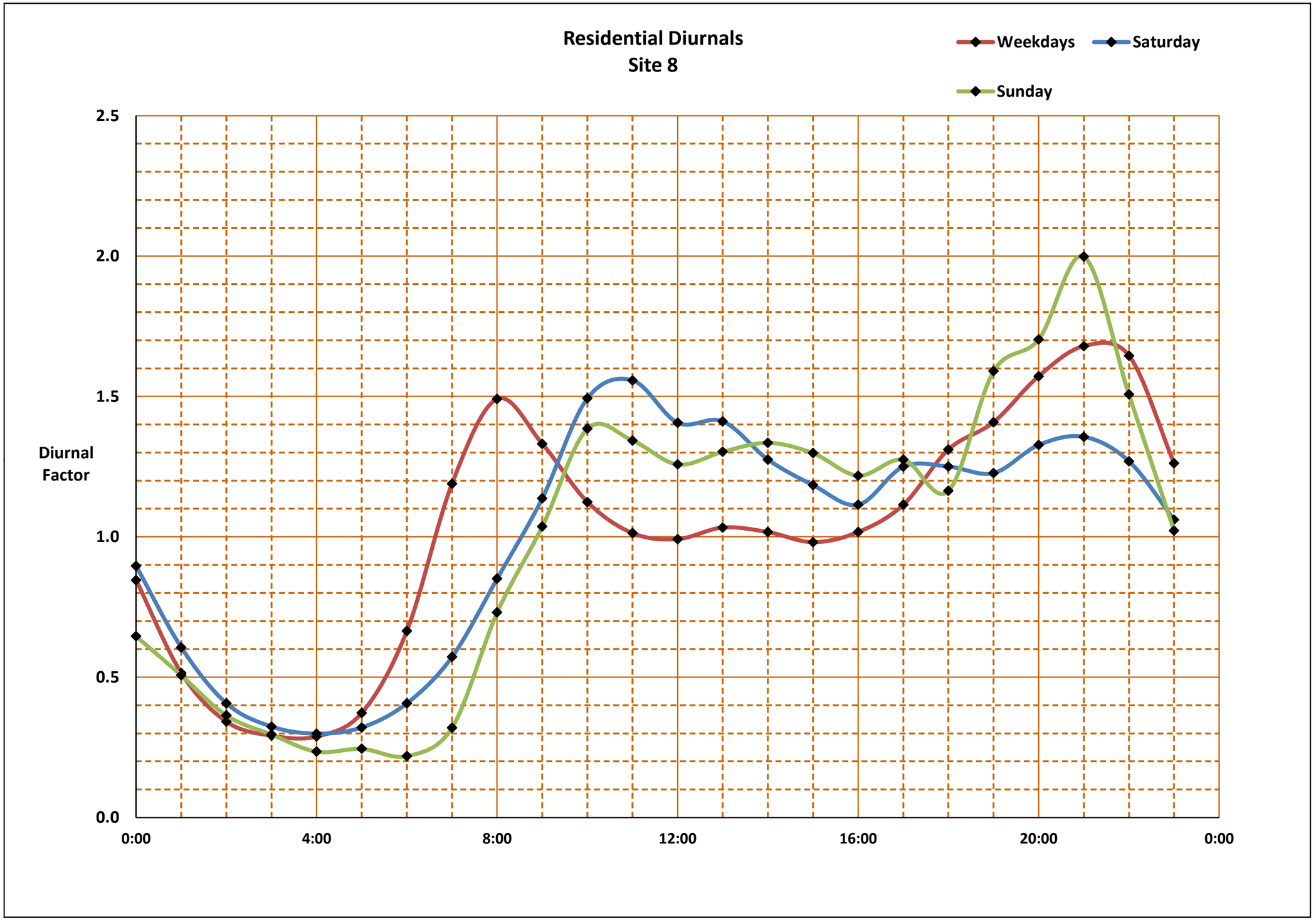

FIGURE A.10
DIURNAL PLOT
SITE 8 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

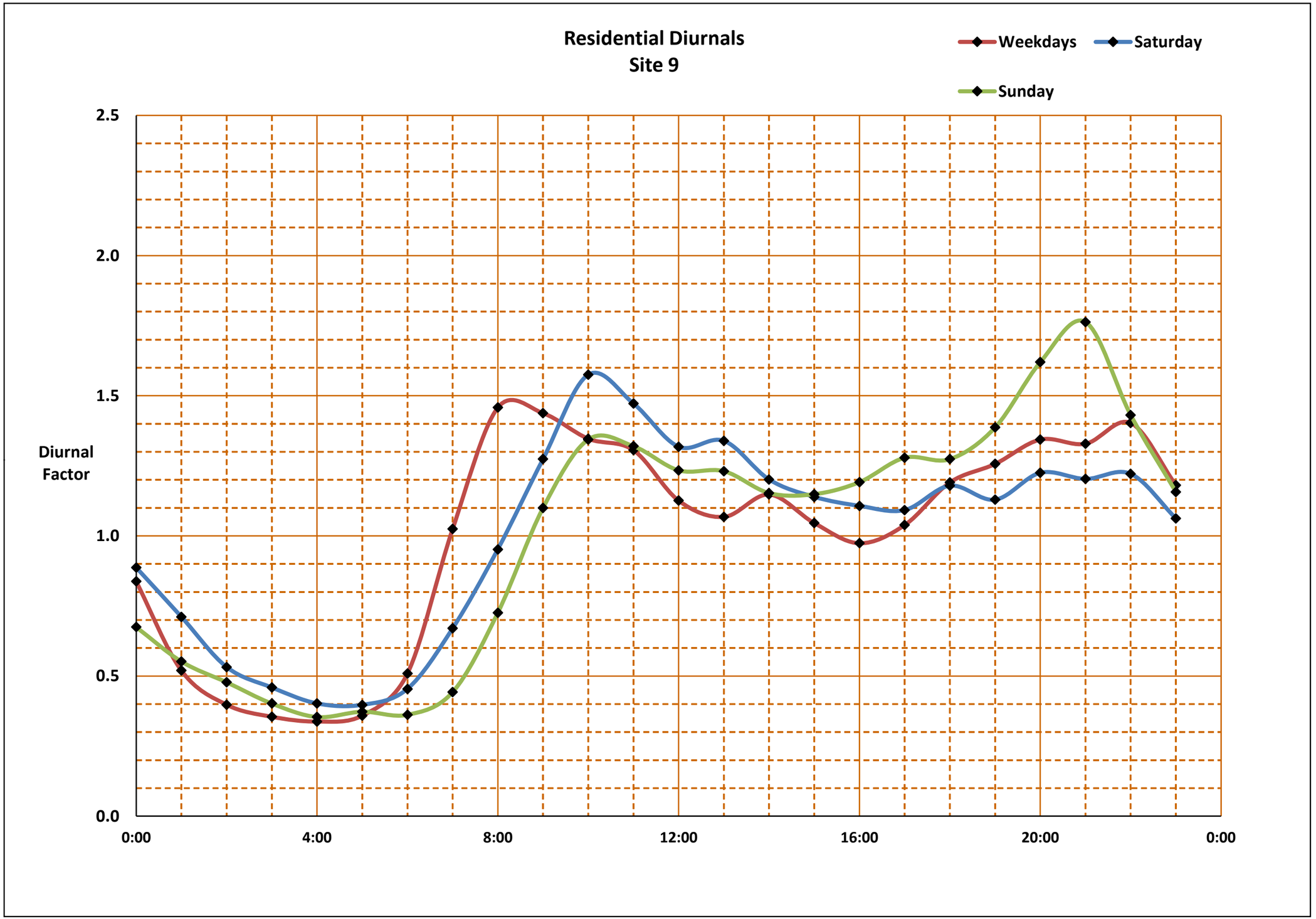

FIGURE A.11
DIURNAL PLOT
SITE 9 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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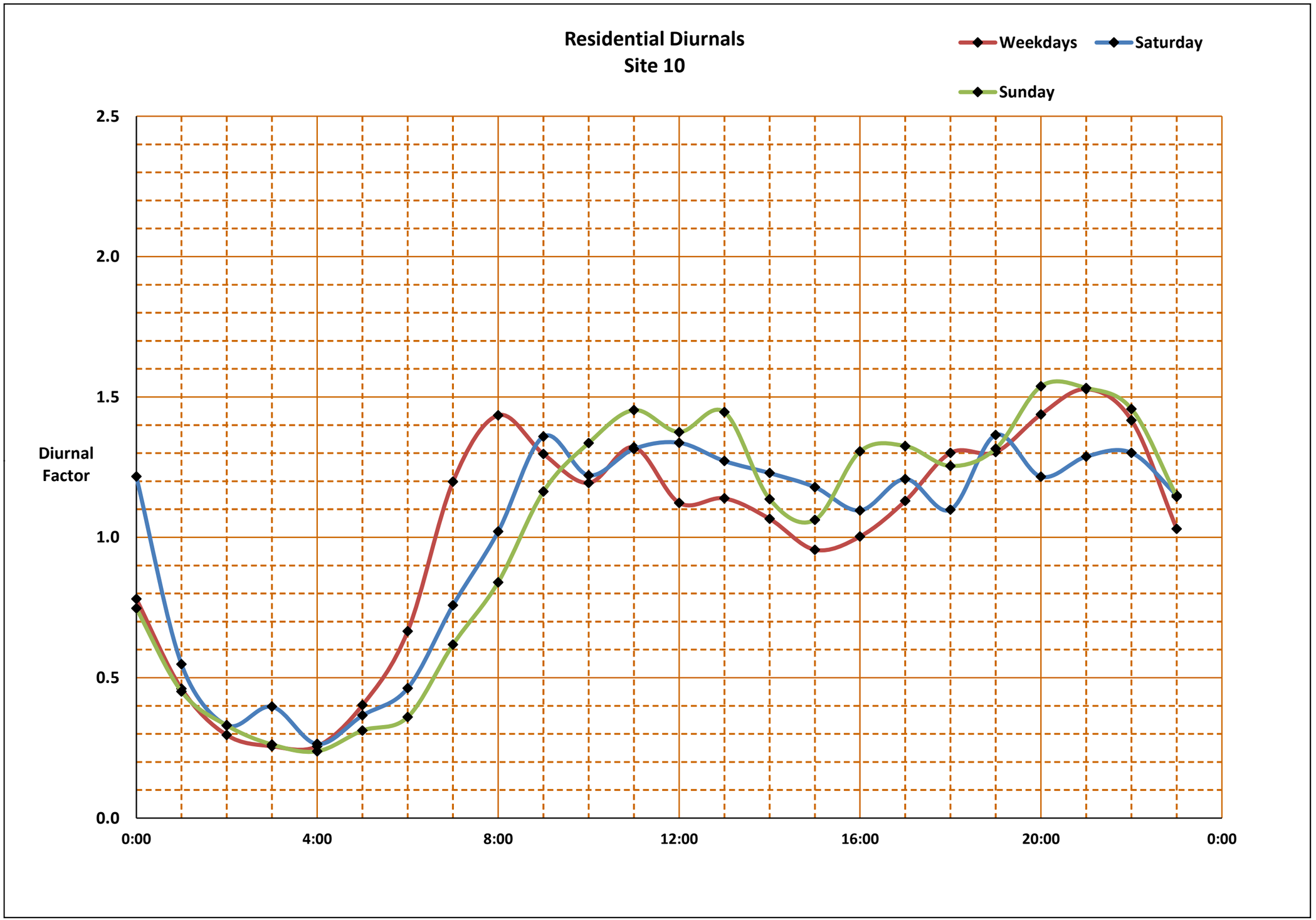

FIGURE A.12
DIURNAL PLOT
SITE 10 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure A.12_Diurnal Plot_Site 10.mxd

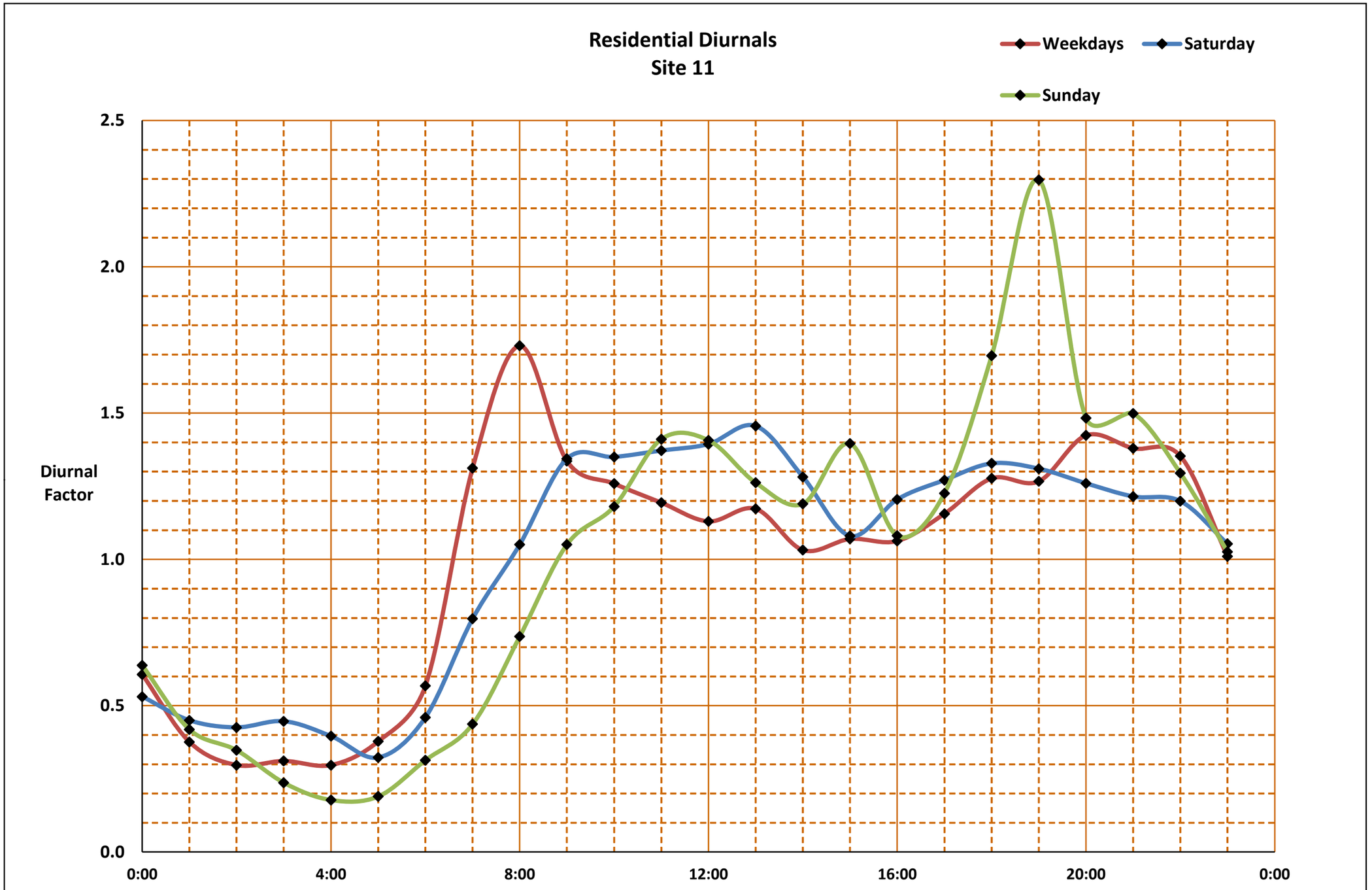

FIGURE A.13
DIURNAL PLOT
SITE 11 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

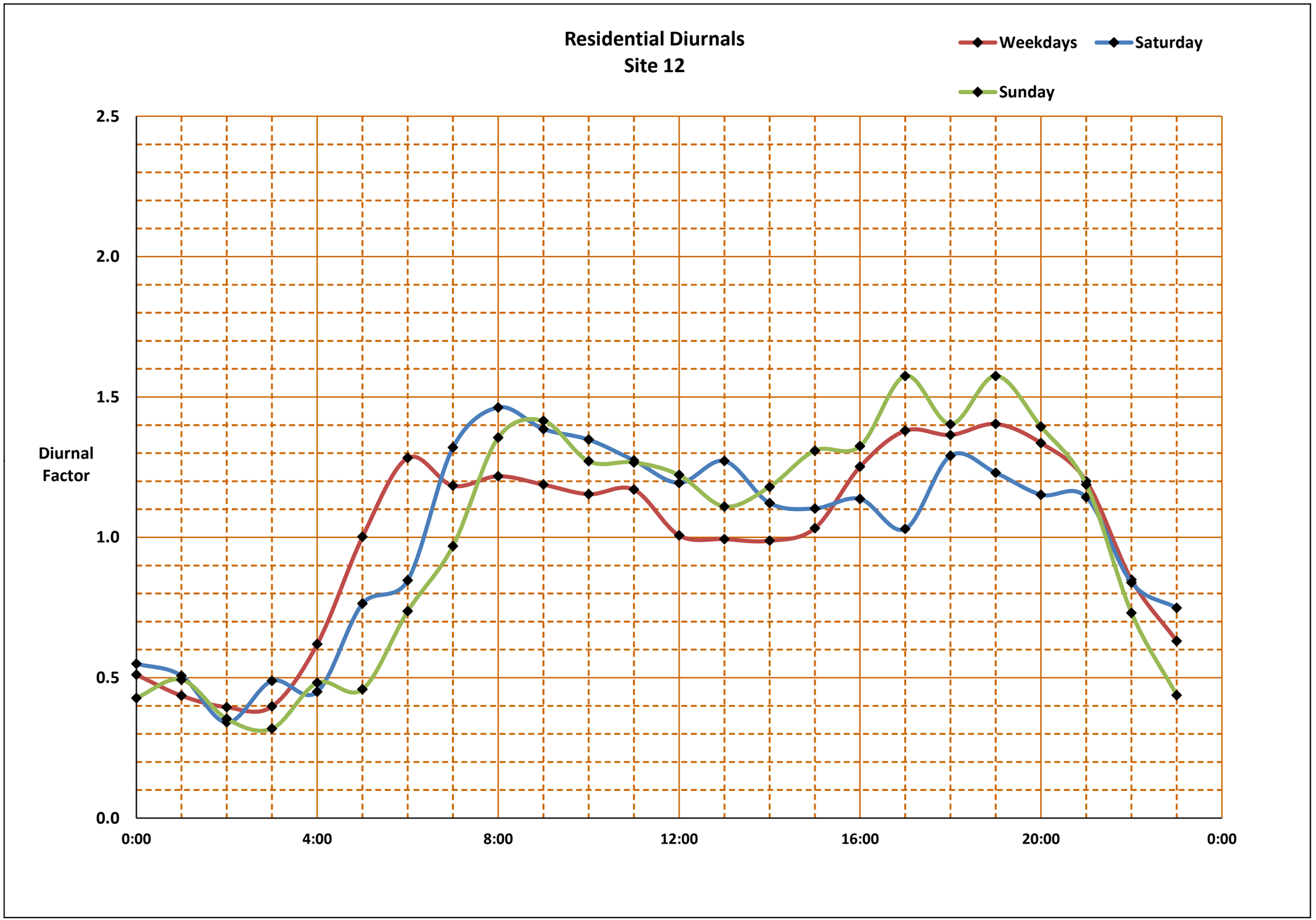

FIGURE A.14
DIURNAL PLOT
SITE 12 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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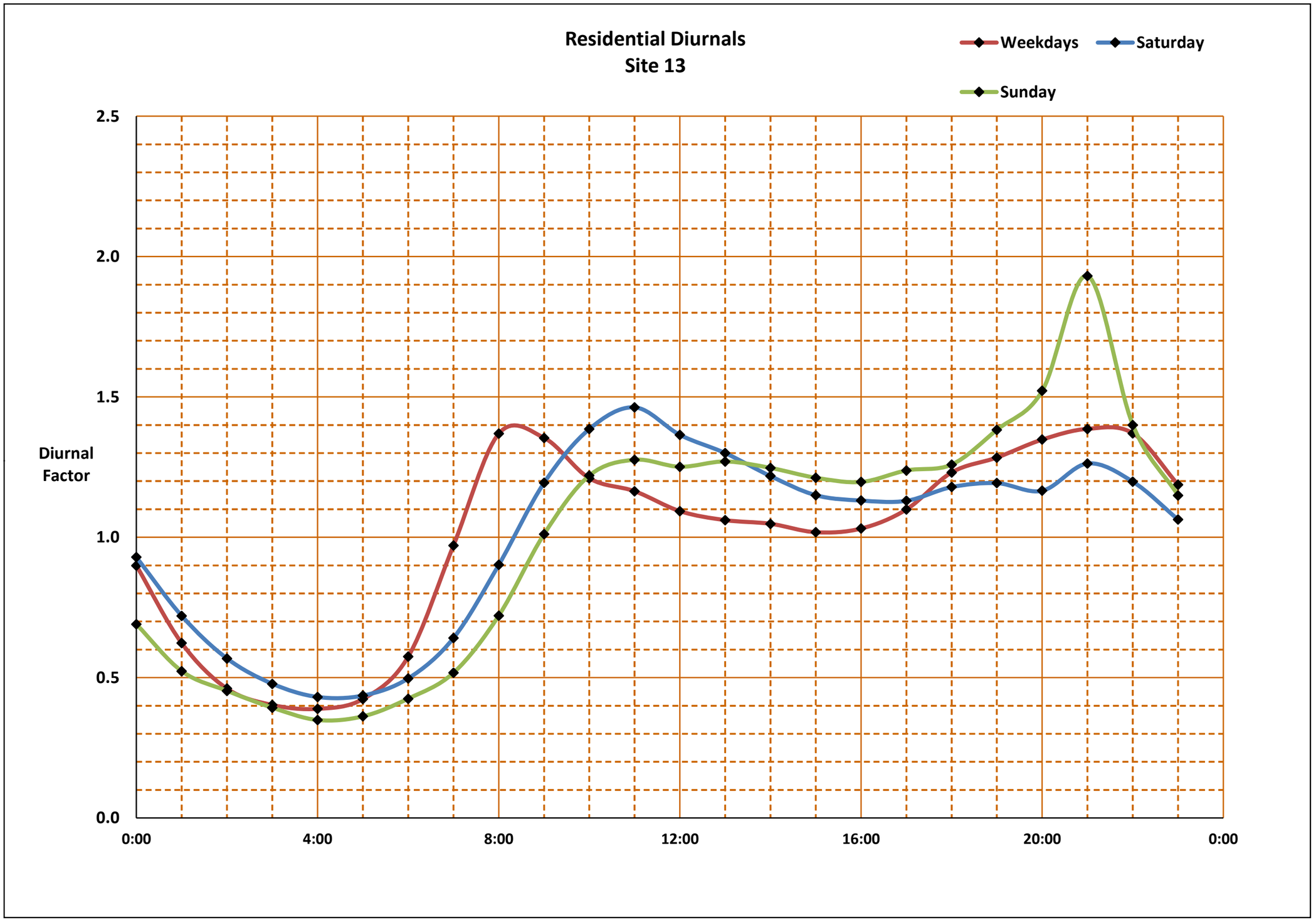

FIGURE A.15
DIURNAL PLOT
SITE 13 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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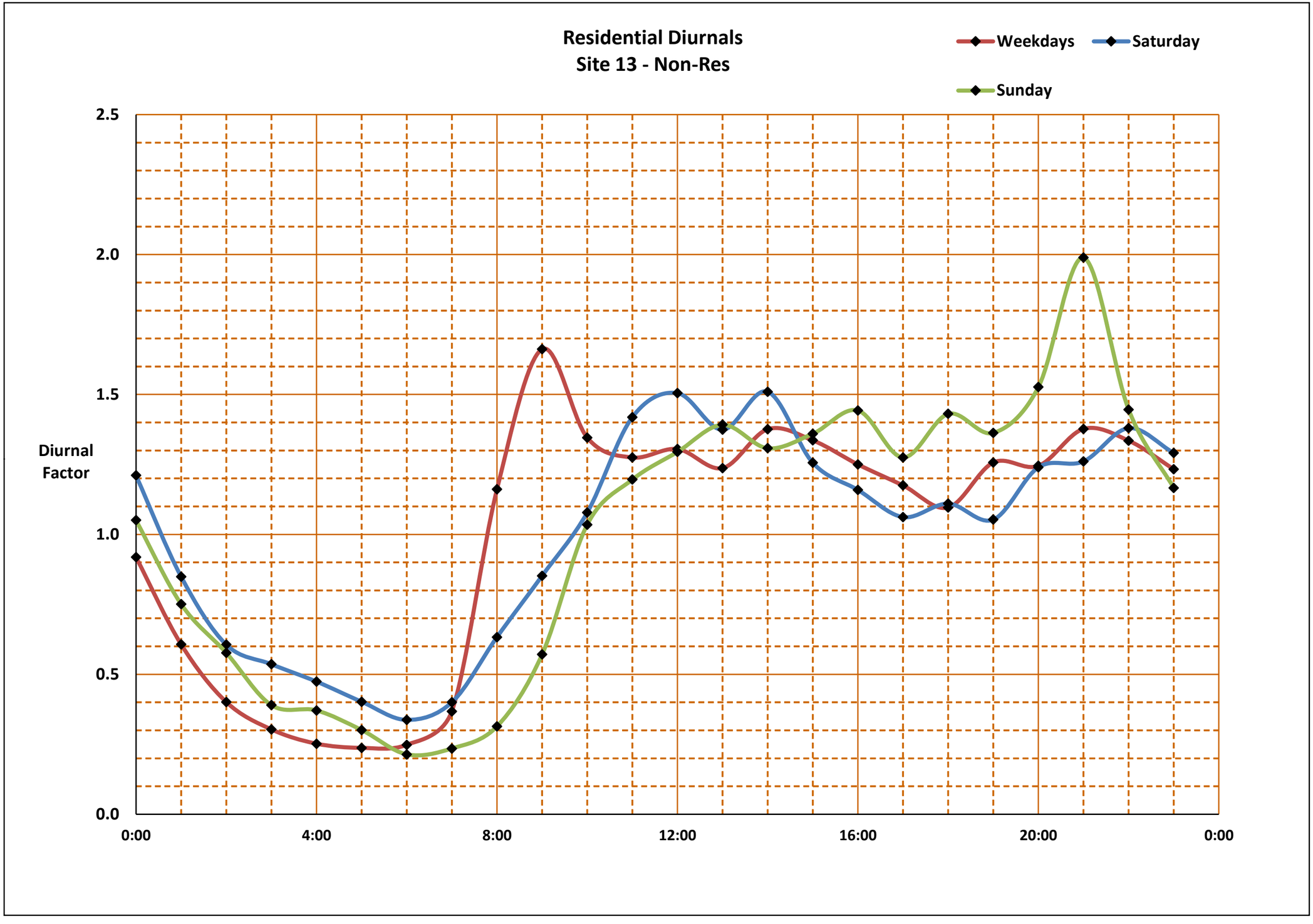

FIGURE A.16
DIURNAL PLOT
SITE 13 - NON-RESIDENTIAL
SANITARY SEWER MASTER PLAN

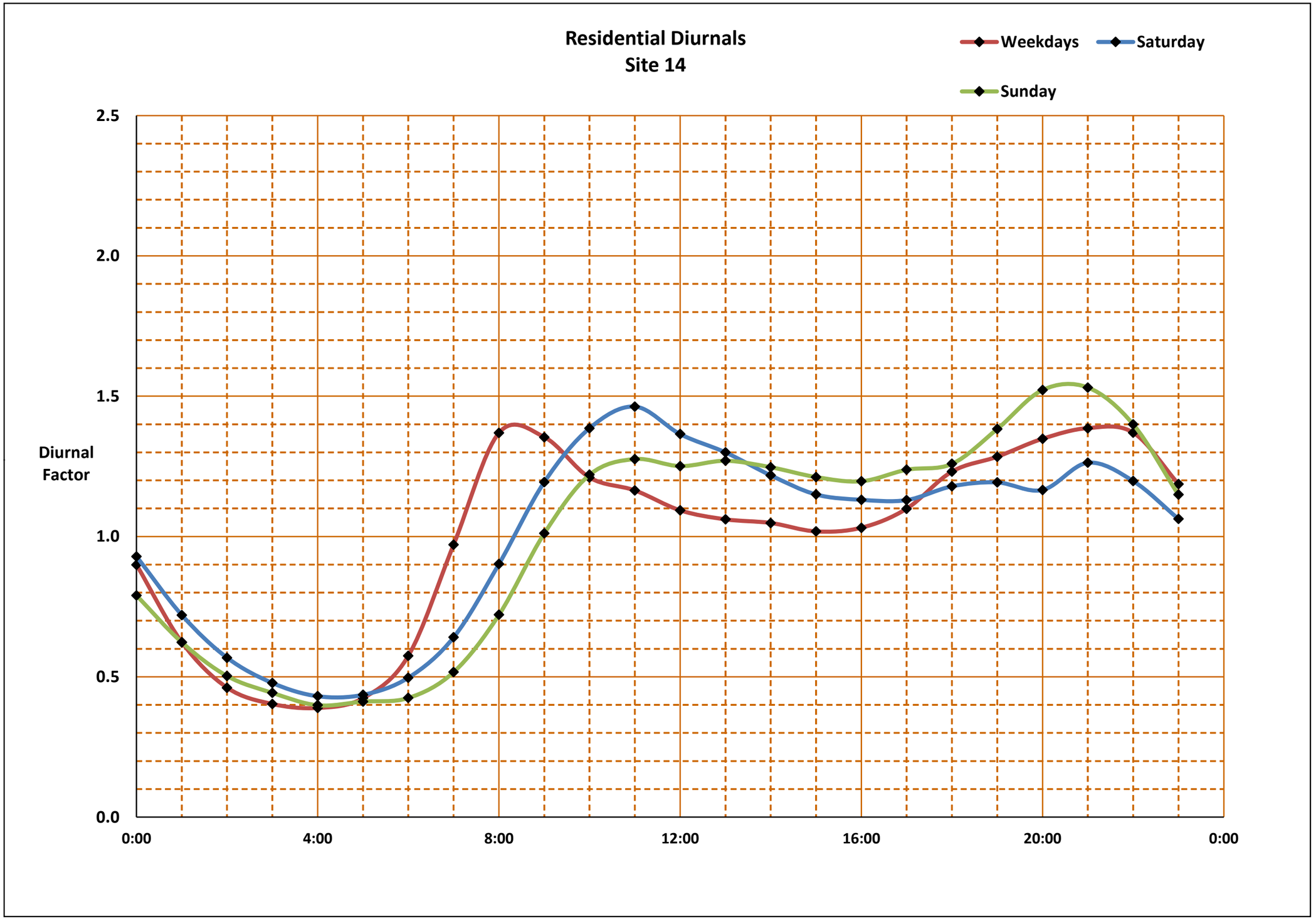

FIGURE A.17
DIURNAL PLOT
SITE 14 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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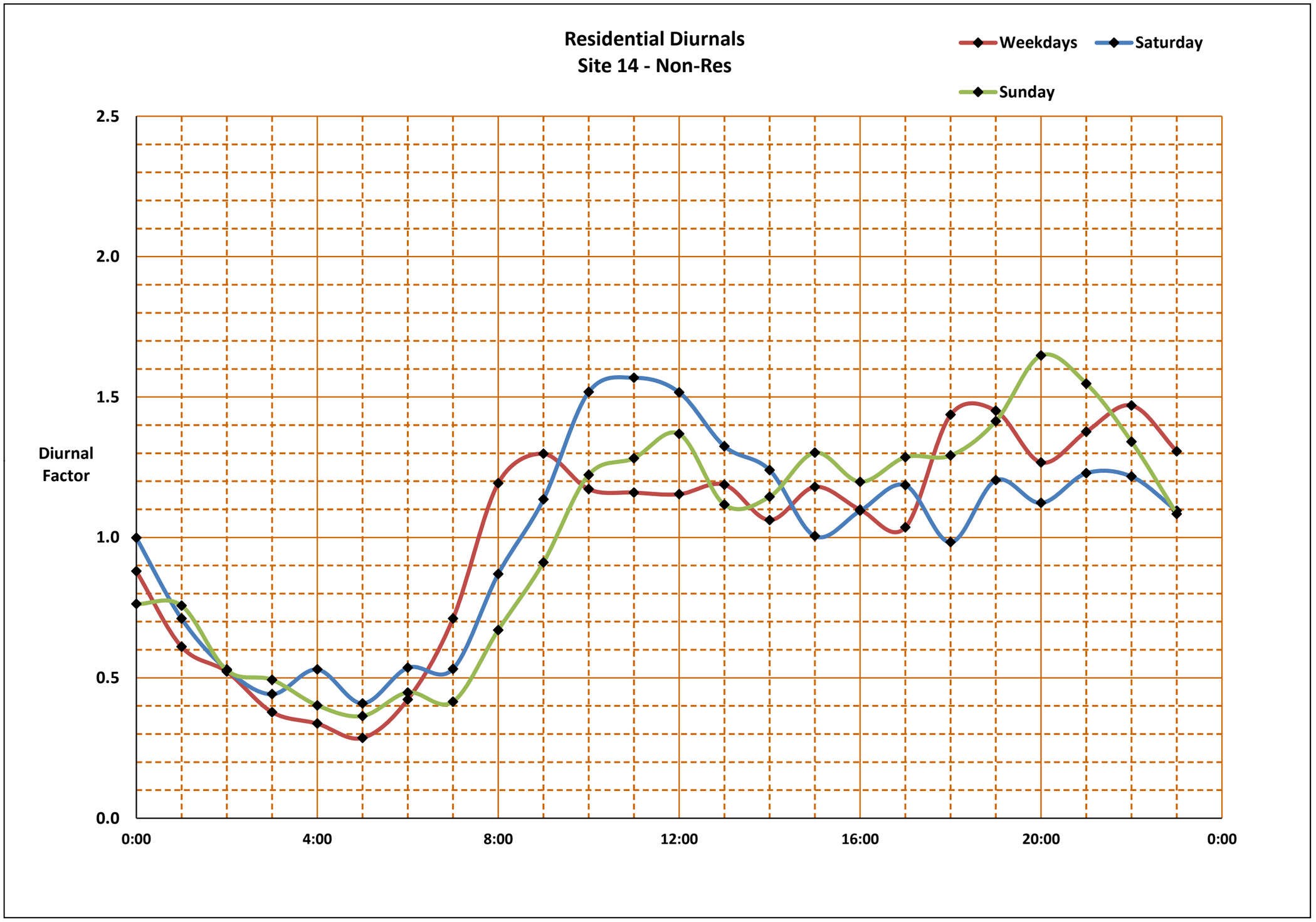

FIGURE A.18
DIURNAL PLOT
SITE 14 - NON-RESIDENTIAL
SANITARY SEWER MASTER PLAN

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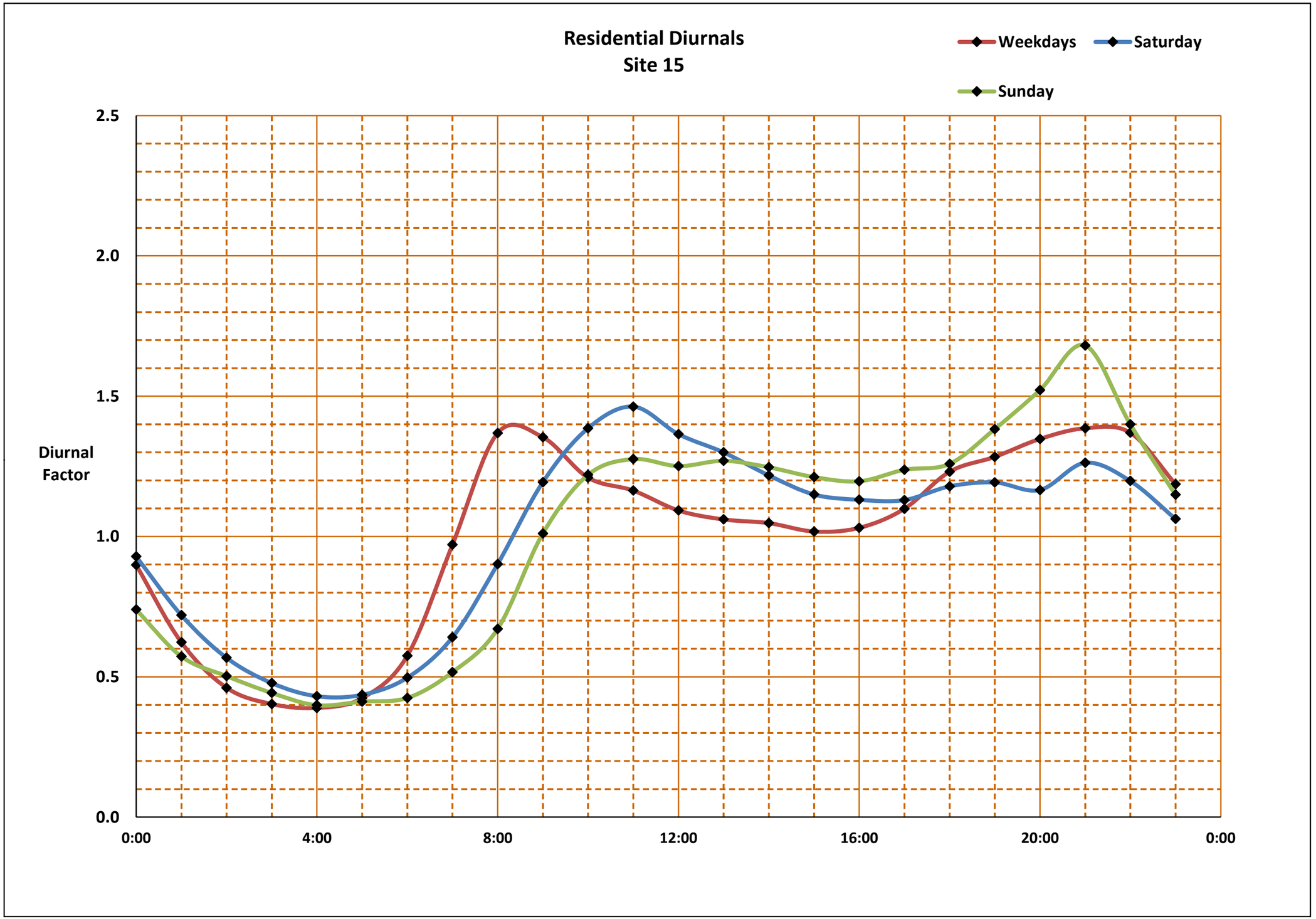

FIGURE A.19
DIURNAL PLOT
SITE 15 - RESIDENTIAL
SANITARY SEWER MASTER PLAN

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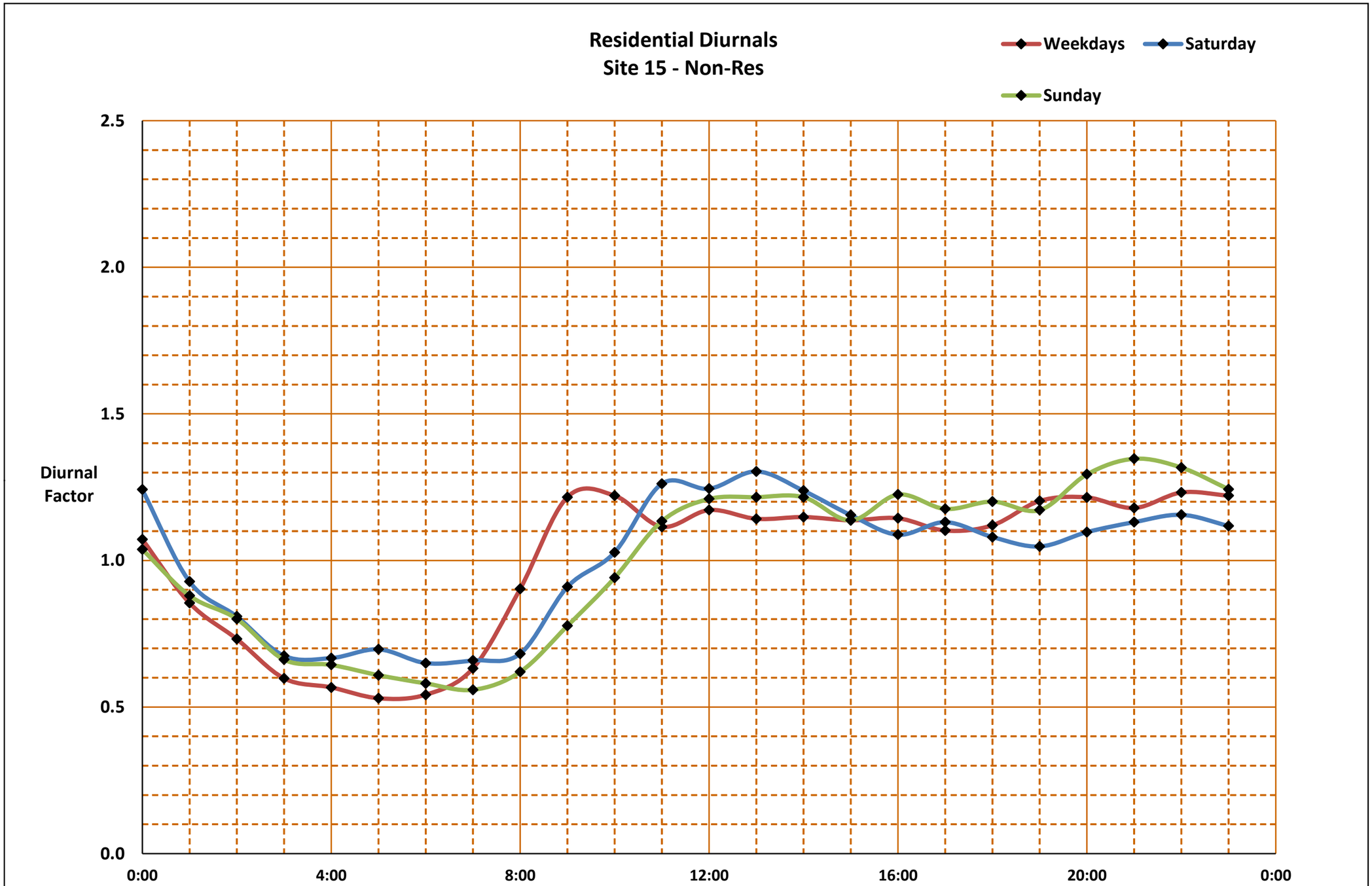

FIGURE A.20
DIURNAL PLOT
SITE 15 - NON-RESIDENTIAL
SANITARY SEWER MASTER PLAN

APPENDIX B
Dry Weather Flow Calibration Graphs

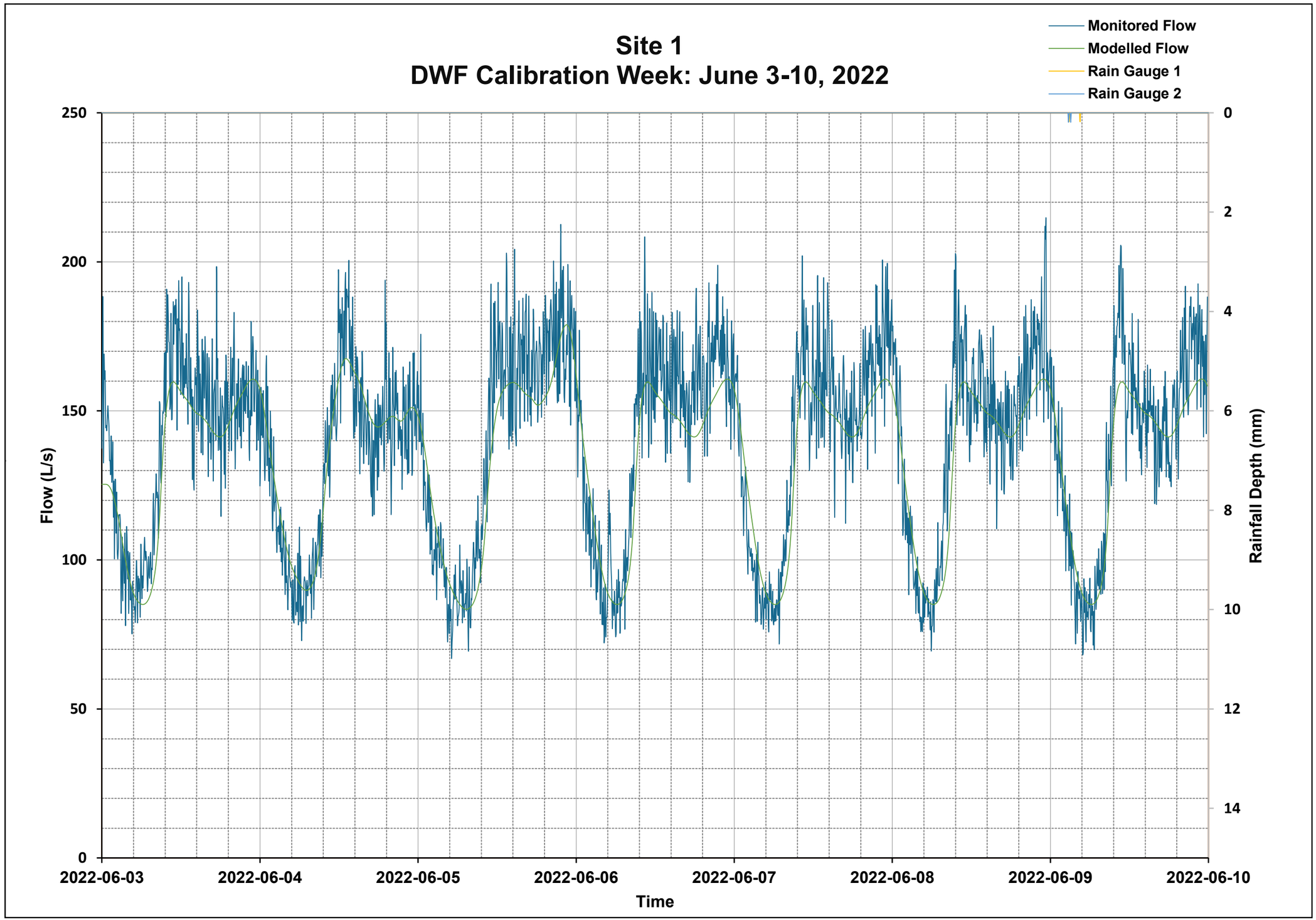

FIGURE B.1
DWF CALIBRATION
SITE 1
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 2
DWF Calibration Week: June 3-10, 2022

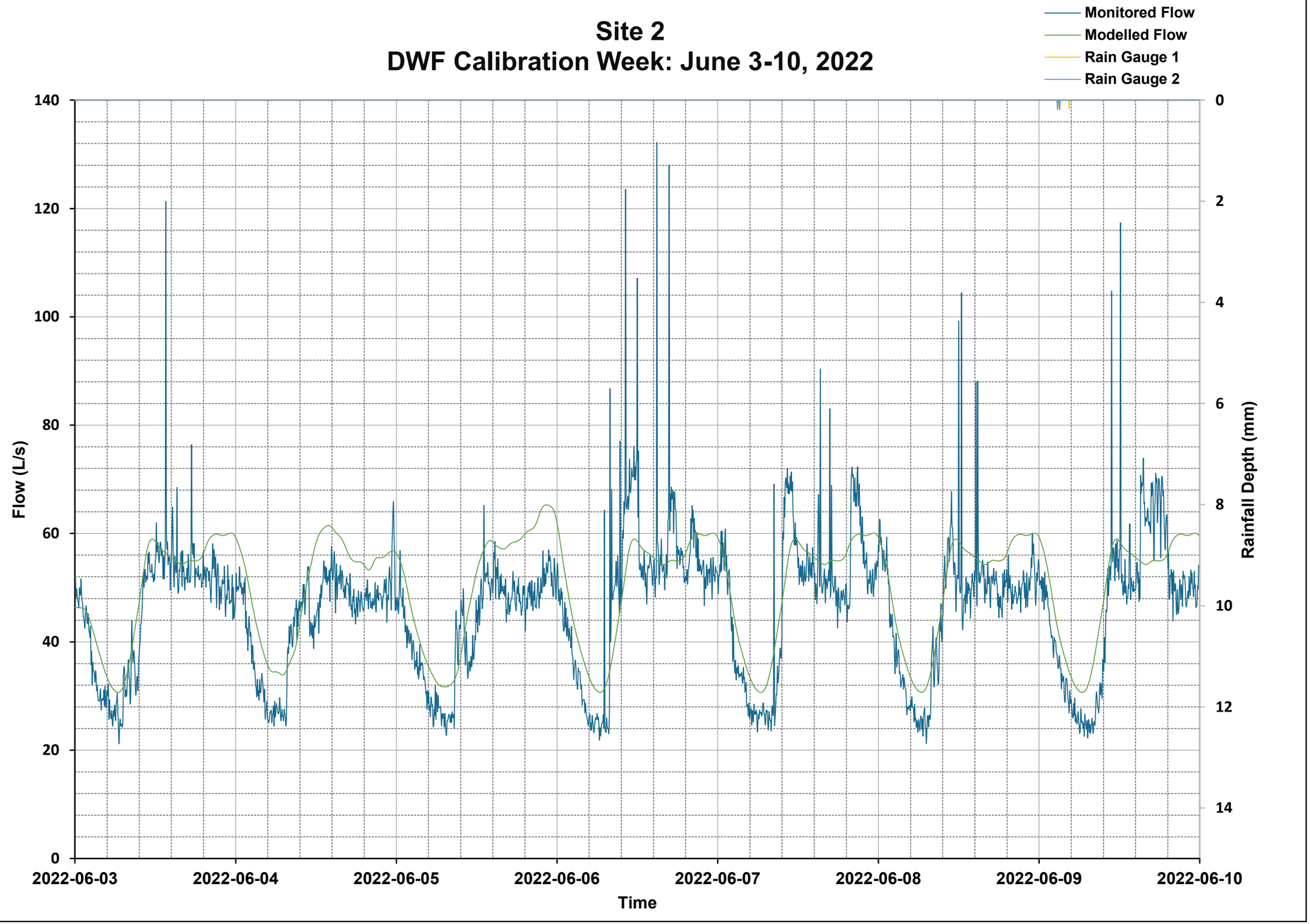

FIGURE B.2
DWF CALIBRATION
SITE 2
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.2_DWF Calibration_Site 2.mxd

Site 3
DWF Calibration Week: June 3-10, 2022

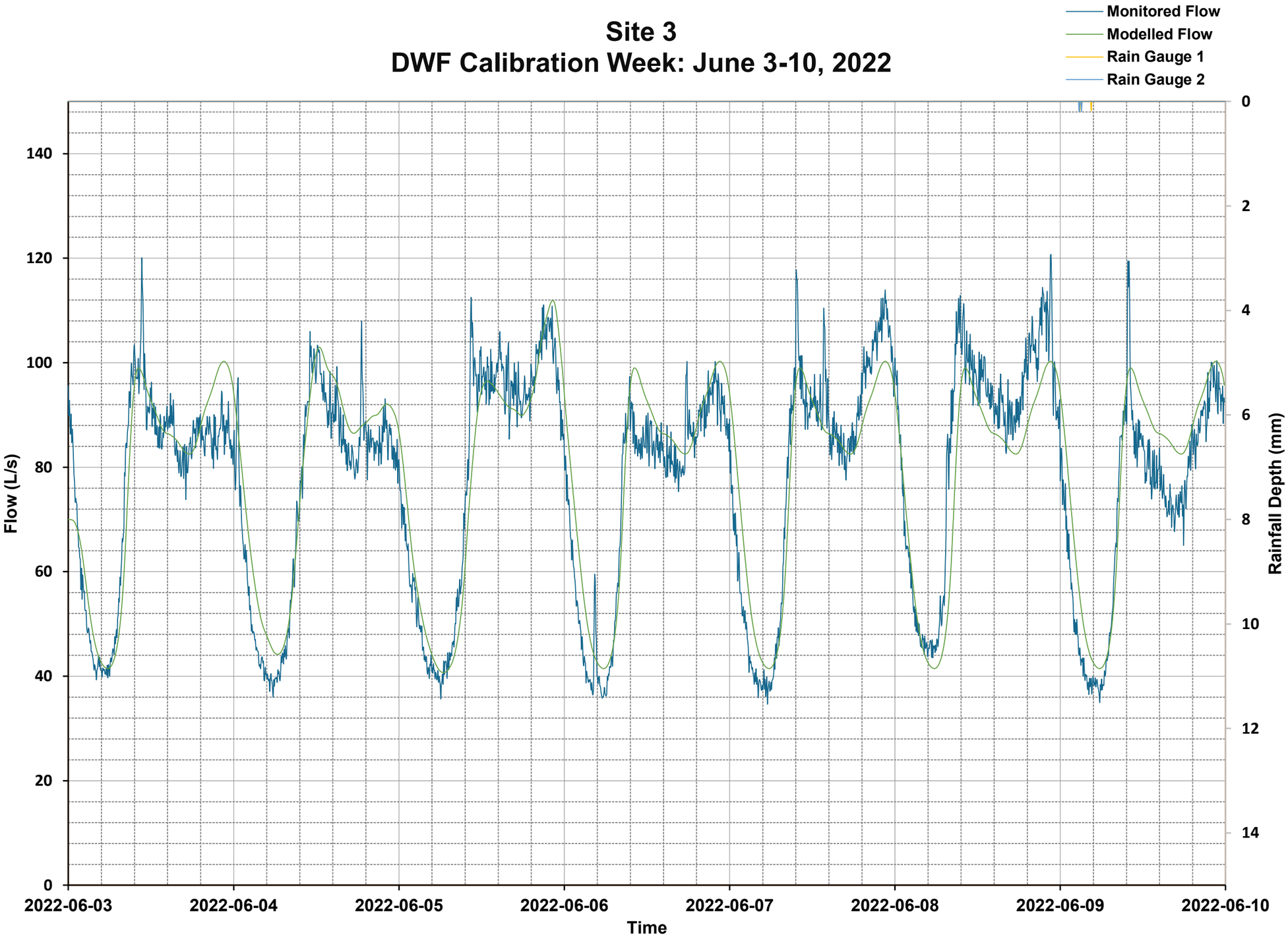

FIGURE B.3
DWF CALIBRATION
SITE 3
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

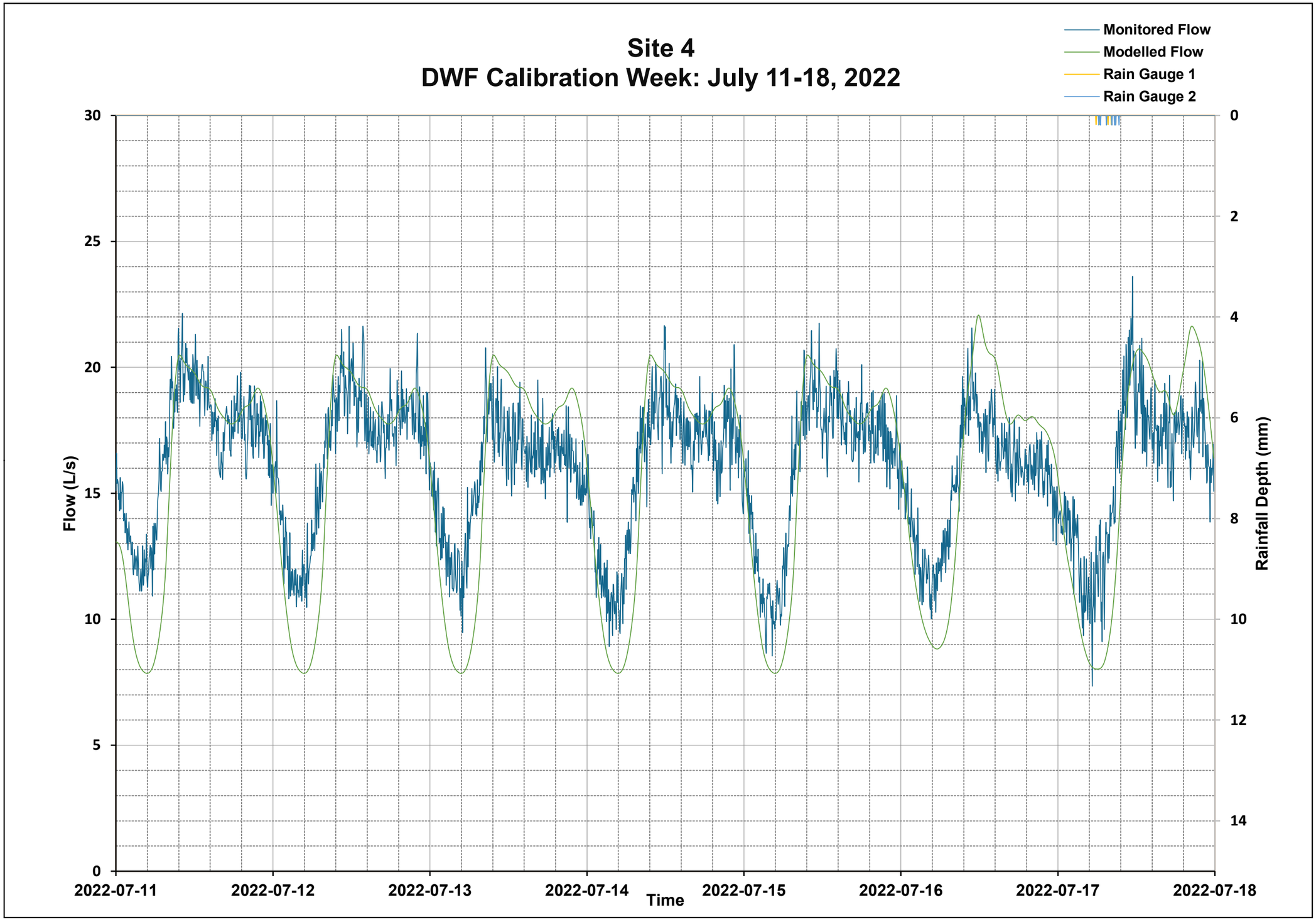

FIGURE B.4
DWF CALIBRATION
SITE 4
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.4_DWF Calibration_Site 4.mxd

Site 5
DWF Calibration Week: June 3-10, 2022

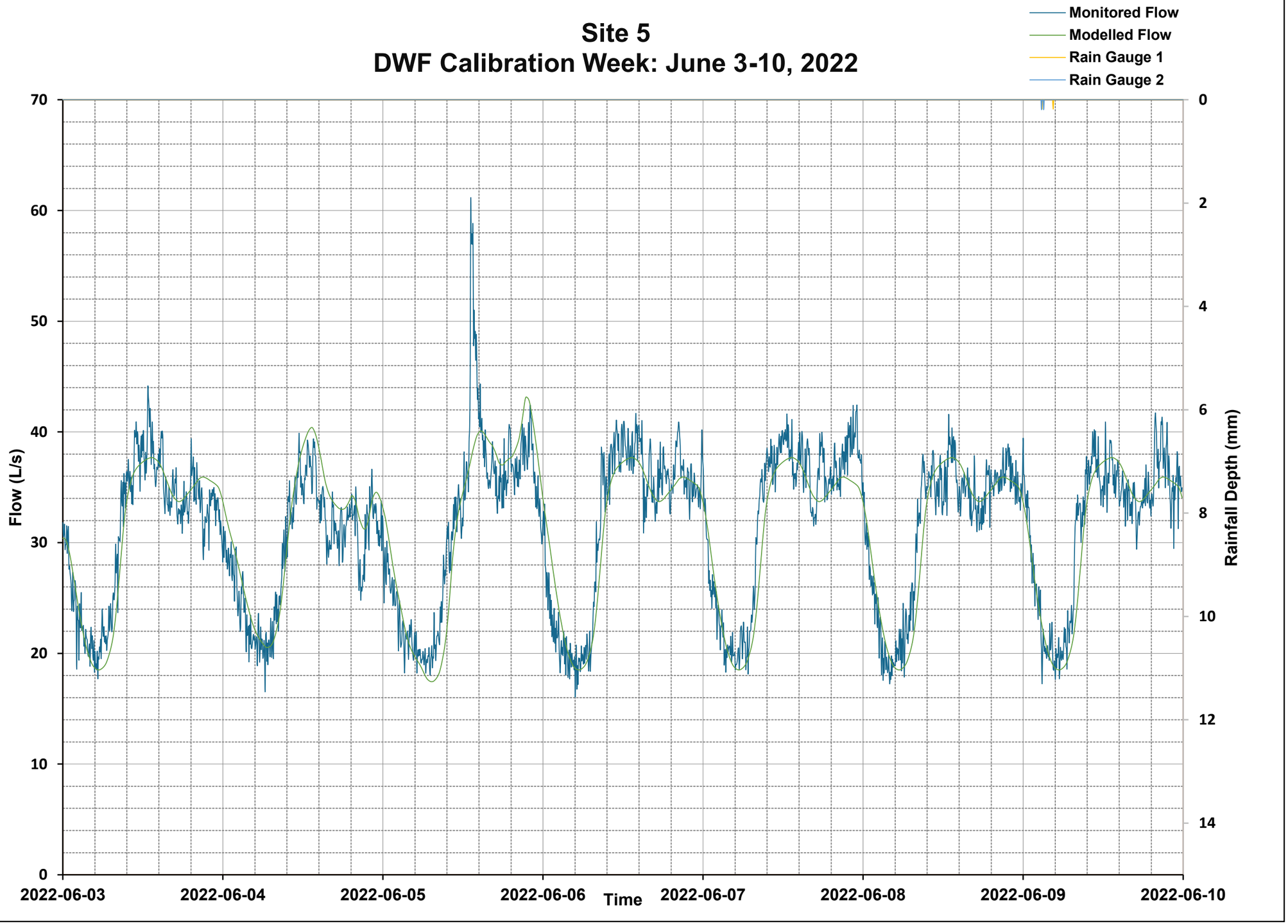

FIGURE B.5
DWF CALIBRATION
SITE 5
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.5_DWF Calibration_Site 5.mxd

Site 6
DWF Calibration Week: July 11-18, 2022

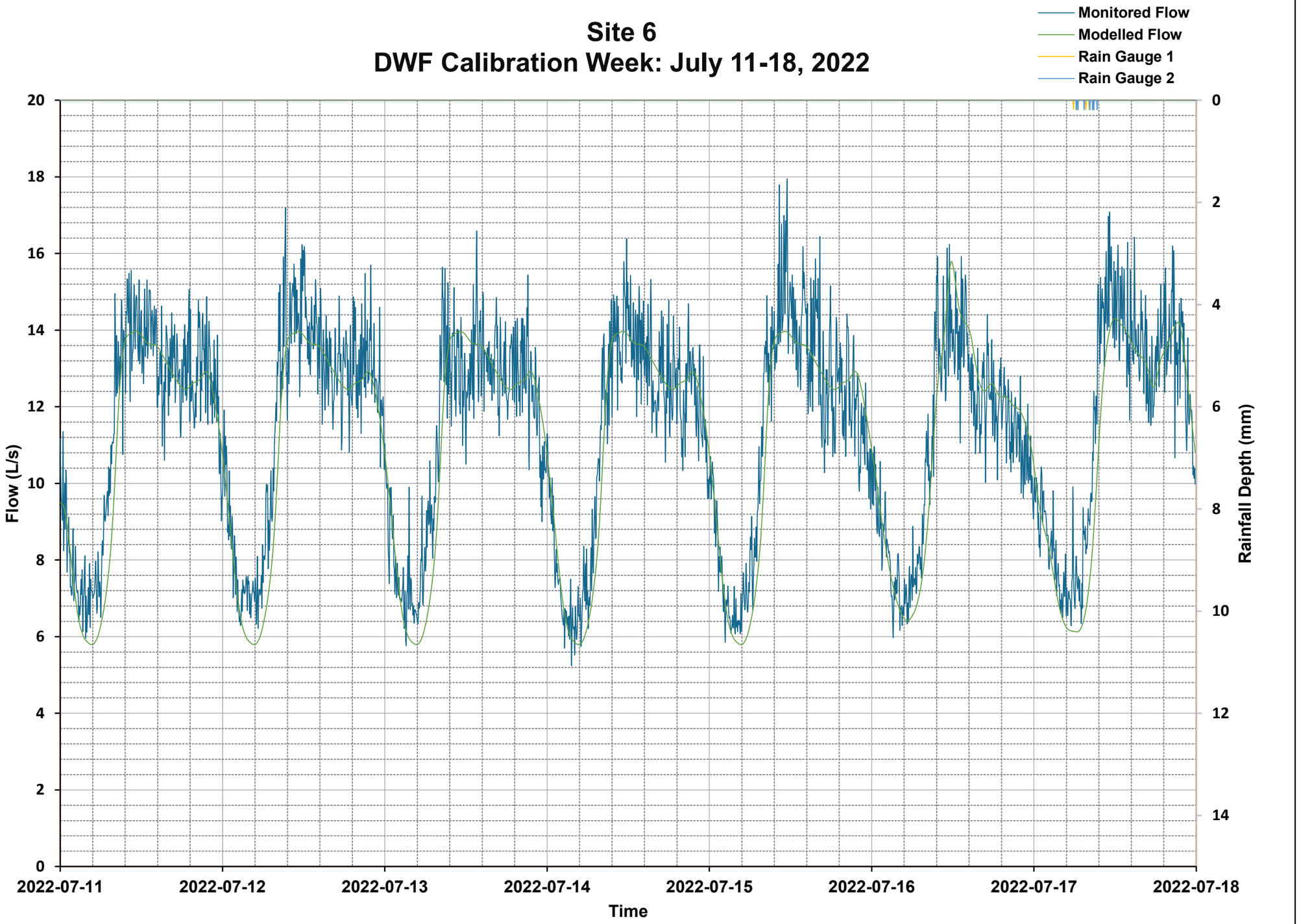

FIGURE B.6
DWF CALIBRATION
SITE 6
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 7
DWF Calibration Week: June 3-10, 2022

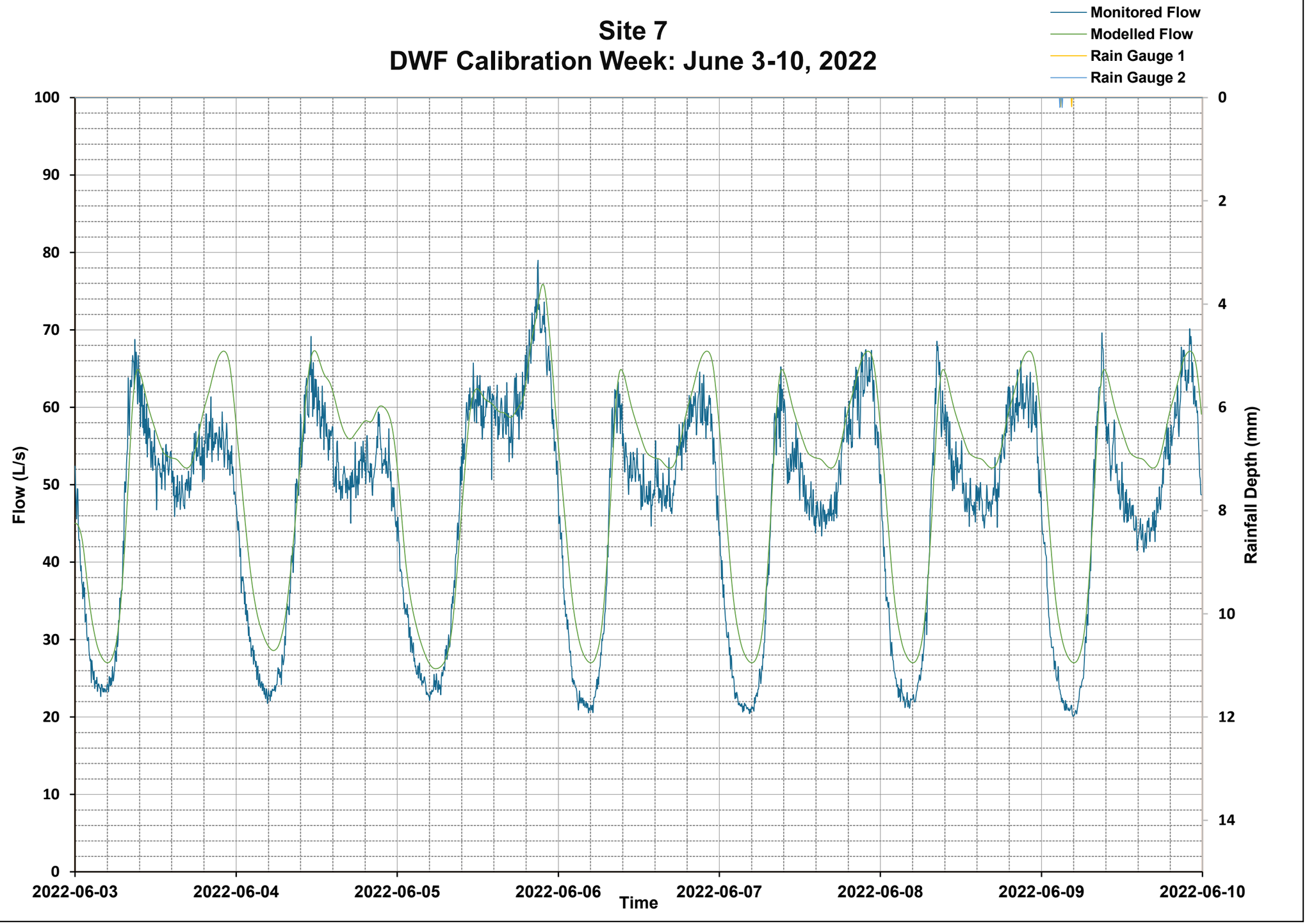

FIGURE B.7
DWF CALIBRATION
SITE 7
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.7_DWF Calibration_Site 7.mxd

Site 8
DWF Calibration Week: June 3-10, 2022

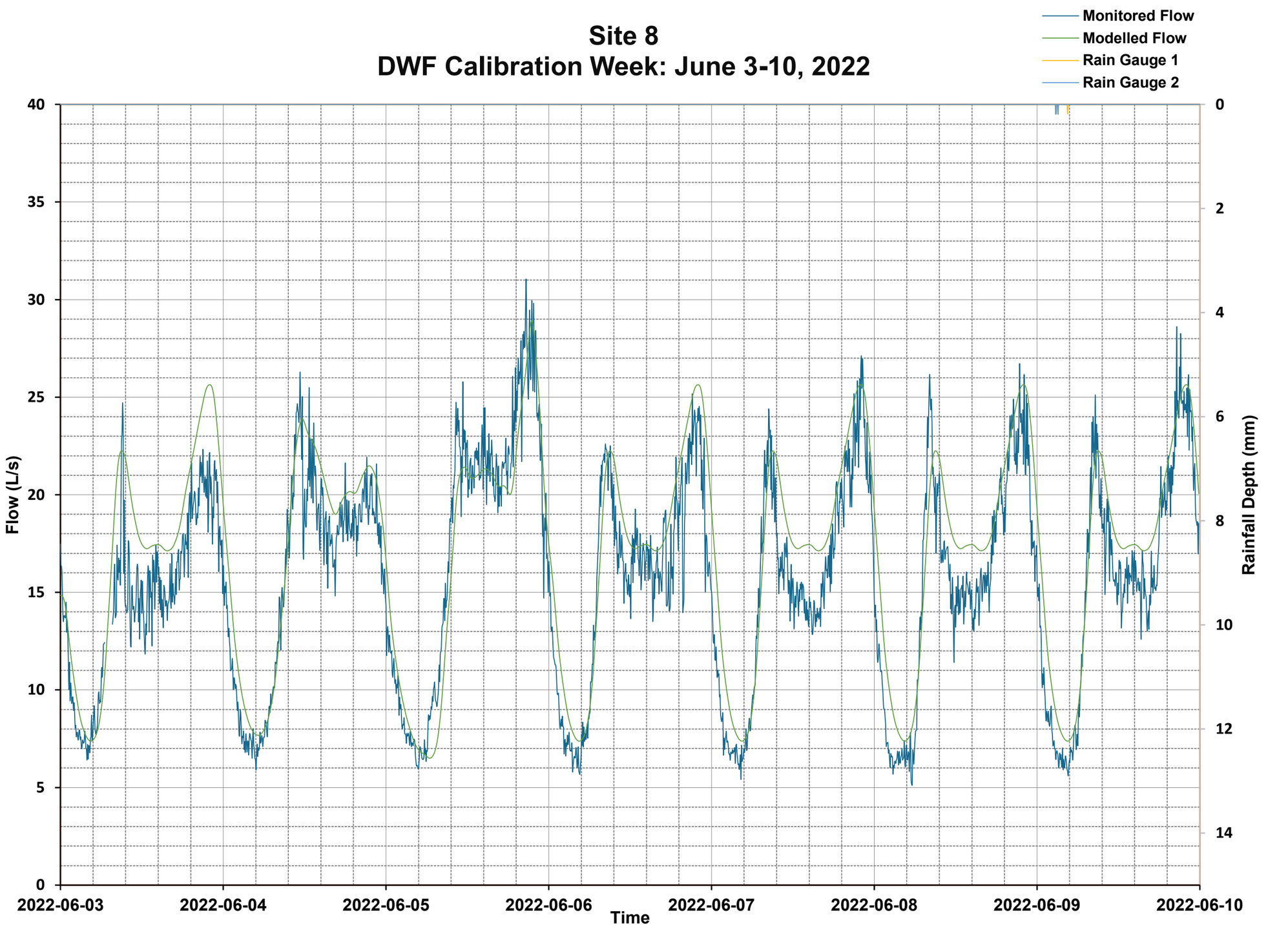

FIGURE B.8
DWF CALIBRATION
SITE 8
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.8_DWF Calibration_Site 8.mxd

Site 9
DWF Calibration Week: June 3-10, 2022

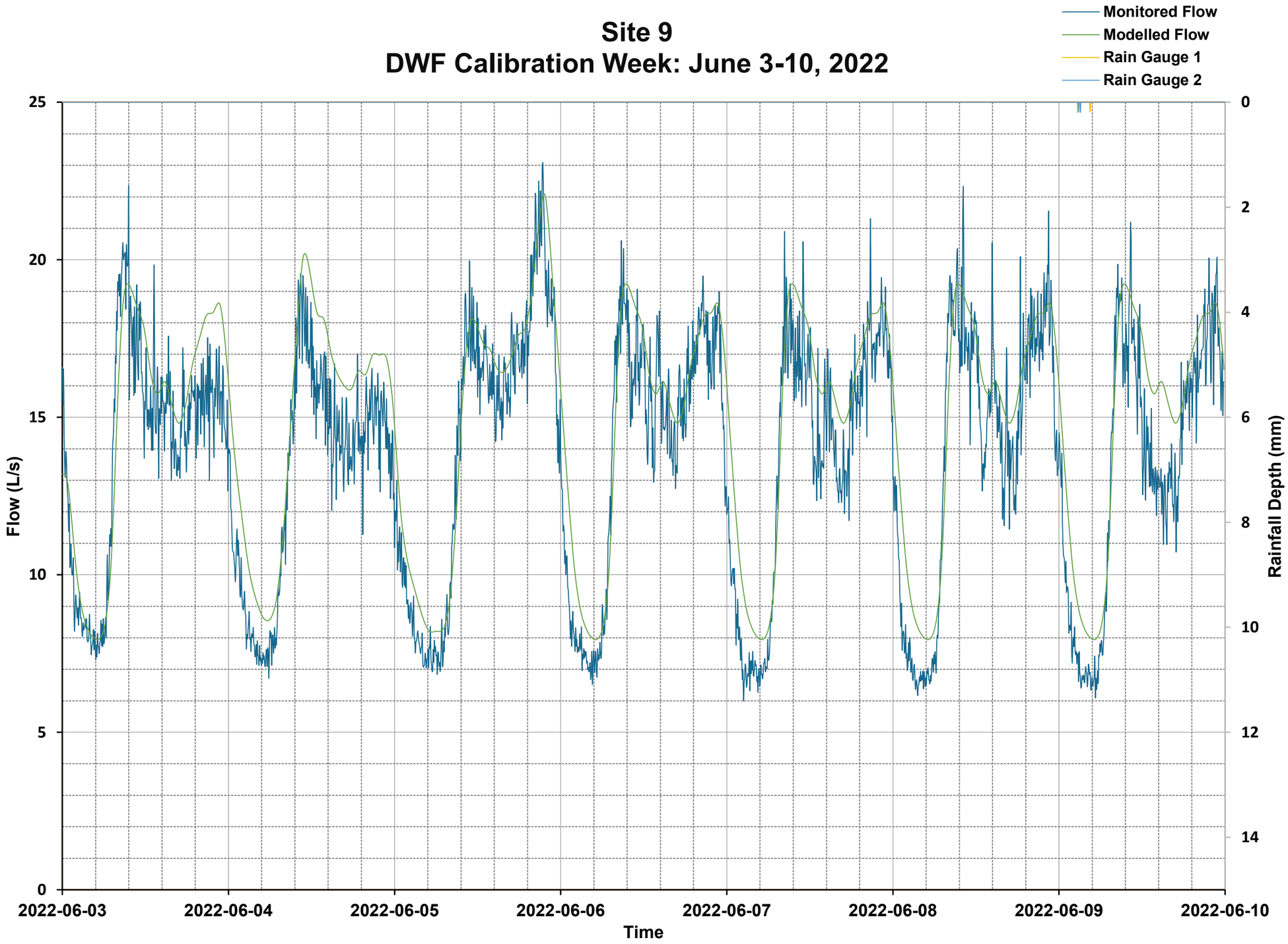

FIGURE B.9
DWF CALIBRATION
SITE 9
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 10
DWF Calibration Week: June 3-10, 2022

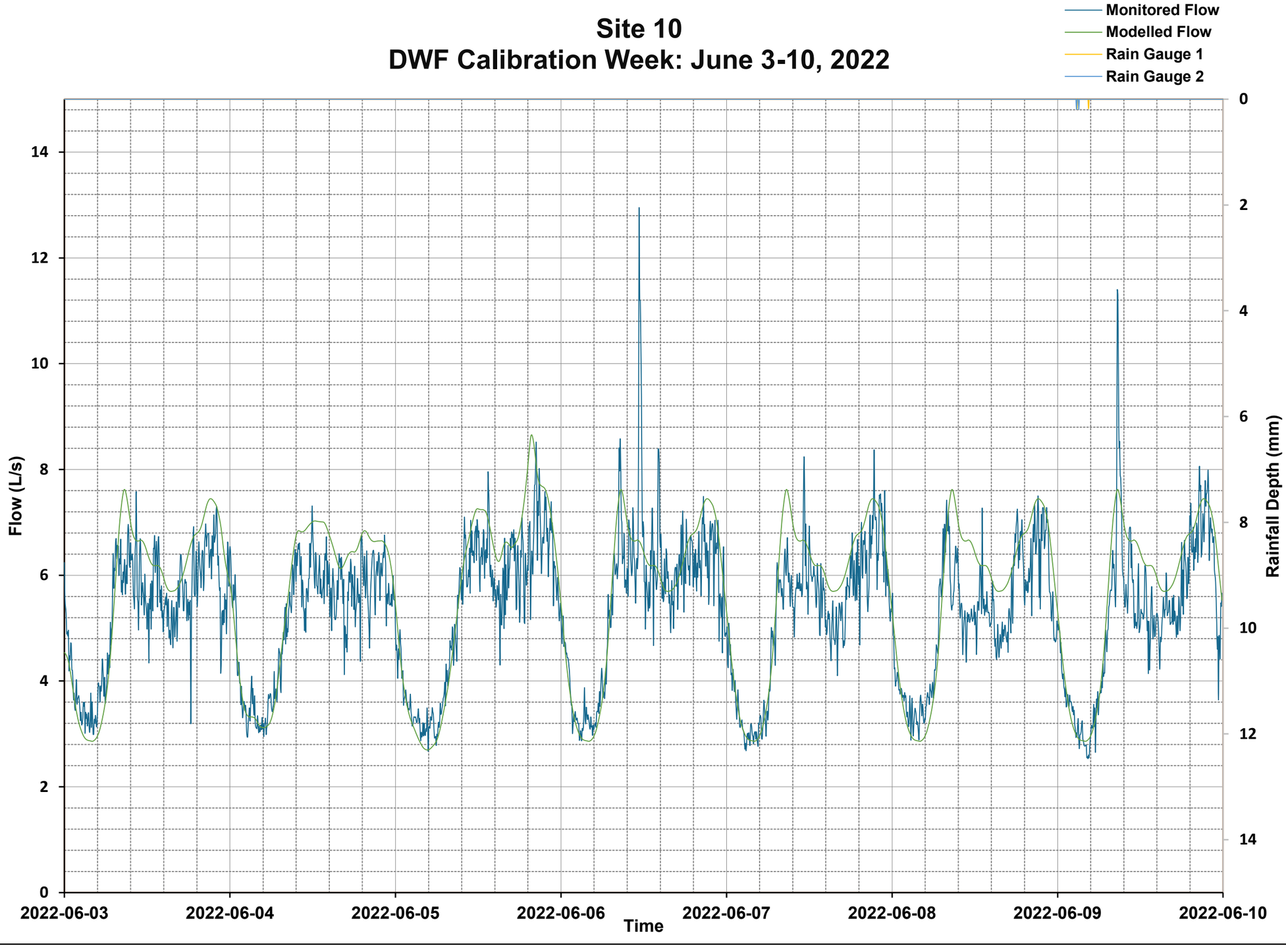

FIGURE B.10
DWF CALIBRATION
SITE 10
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 11
DWF Calibration Week: June 4-11, 2022

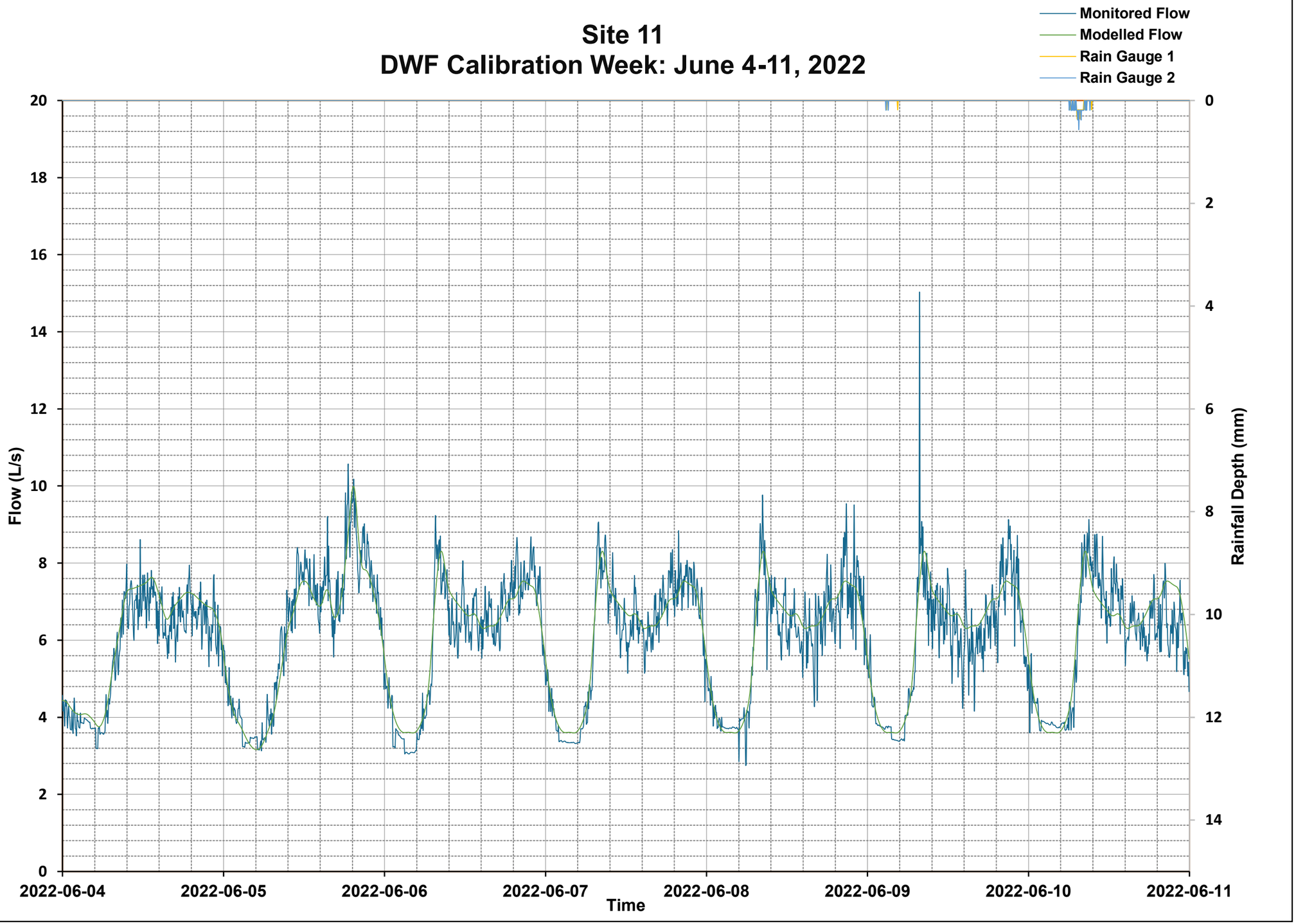

FIGURE B.11
DWF CALIBRATION
SITE 11
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 12
DWF Calibration Week: July 21-28, 2022

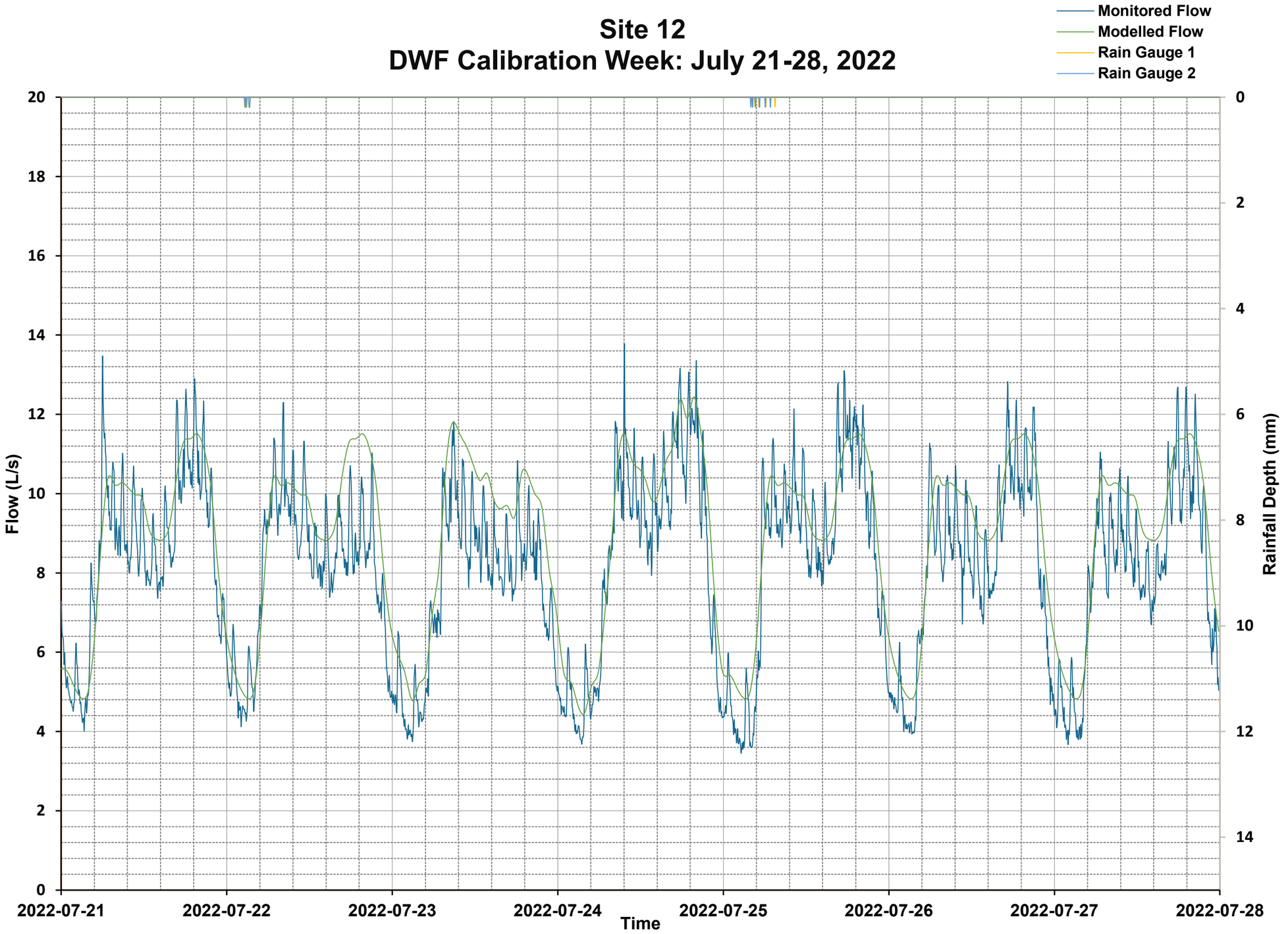

FIGURE B.12
DWF CALIBRATION
SITE 12
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.12_DWF Calibration_Site 12.mxd

Site 13
DWF Calibration Week: June 4-11, 2022

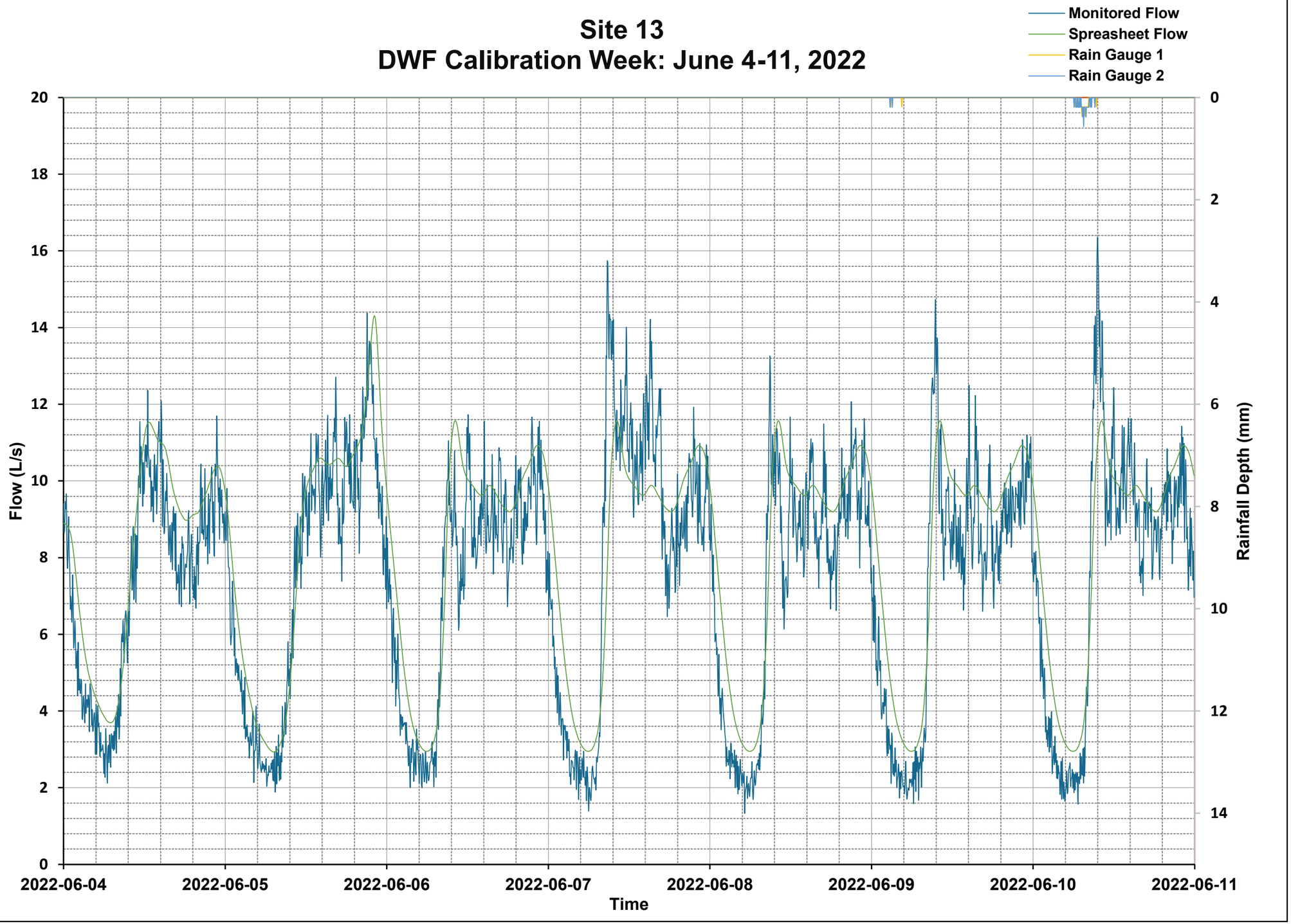

FIGURE B.13
DWF CALIBRATION
SITE 13
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.13_DWF Calibration_Site 13.mxd

Site 14
DWF Calibration Week: June 4-11, 2022

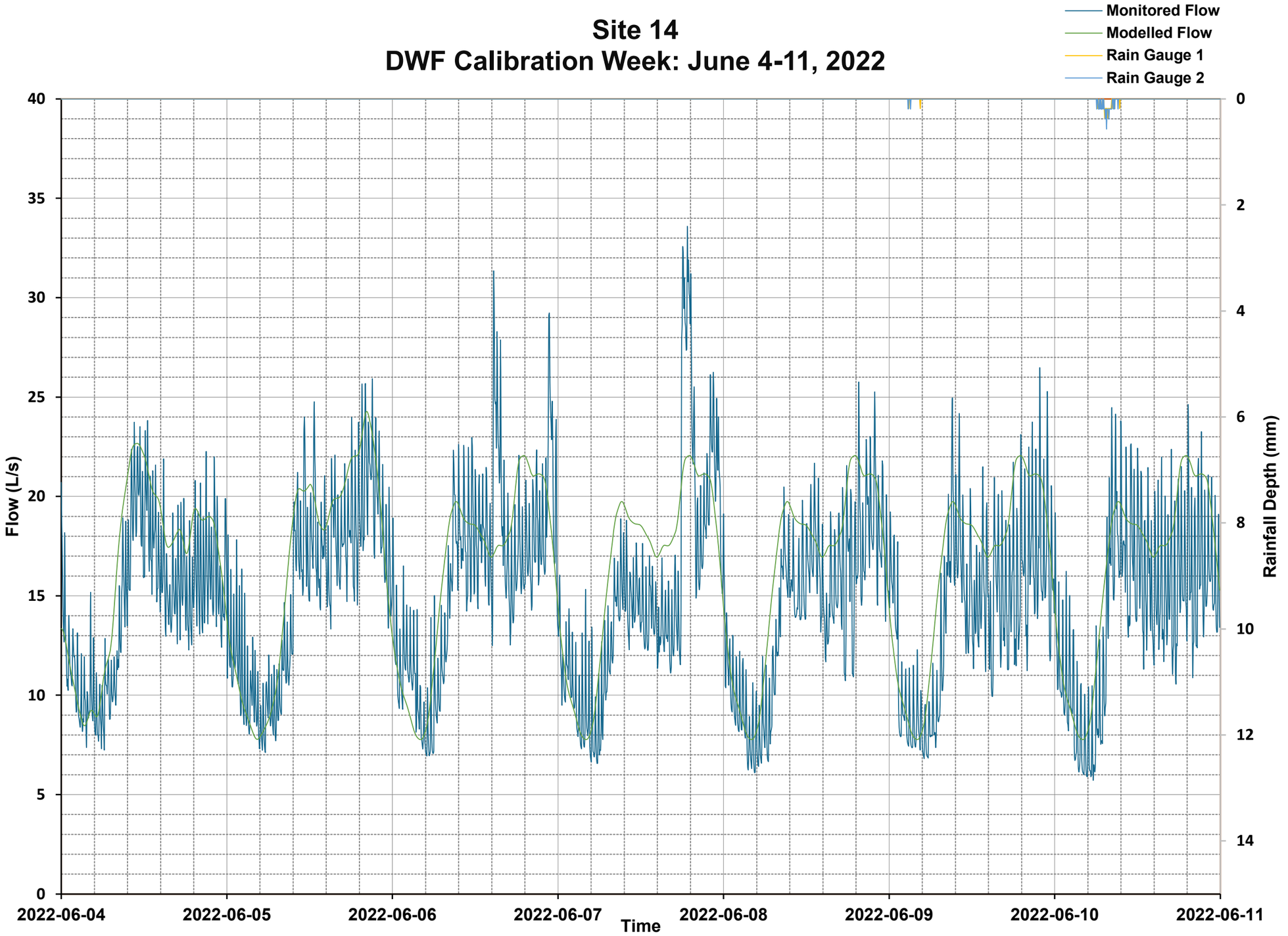

FIGURE B.14
DWF CALIBRATION
SITE 14
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure B.14_DWF Calibration_Site 14.mxd

Site 15
DWF Calibration Week: June 4-11, 2022

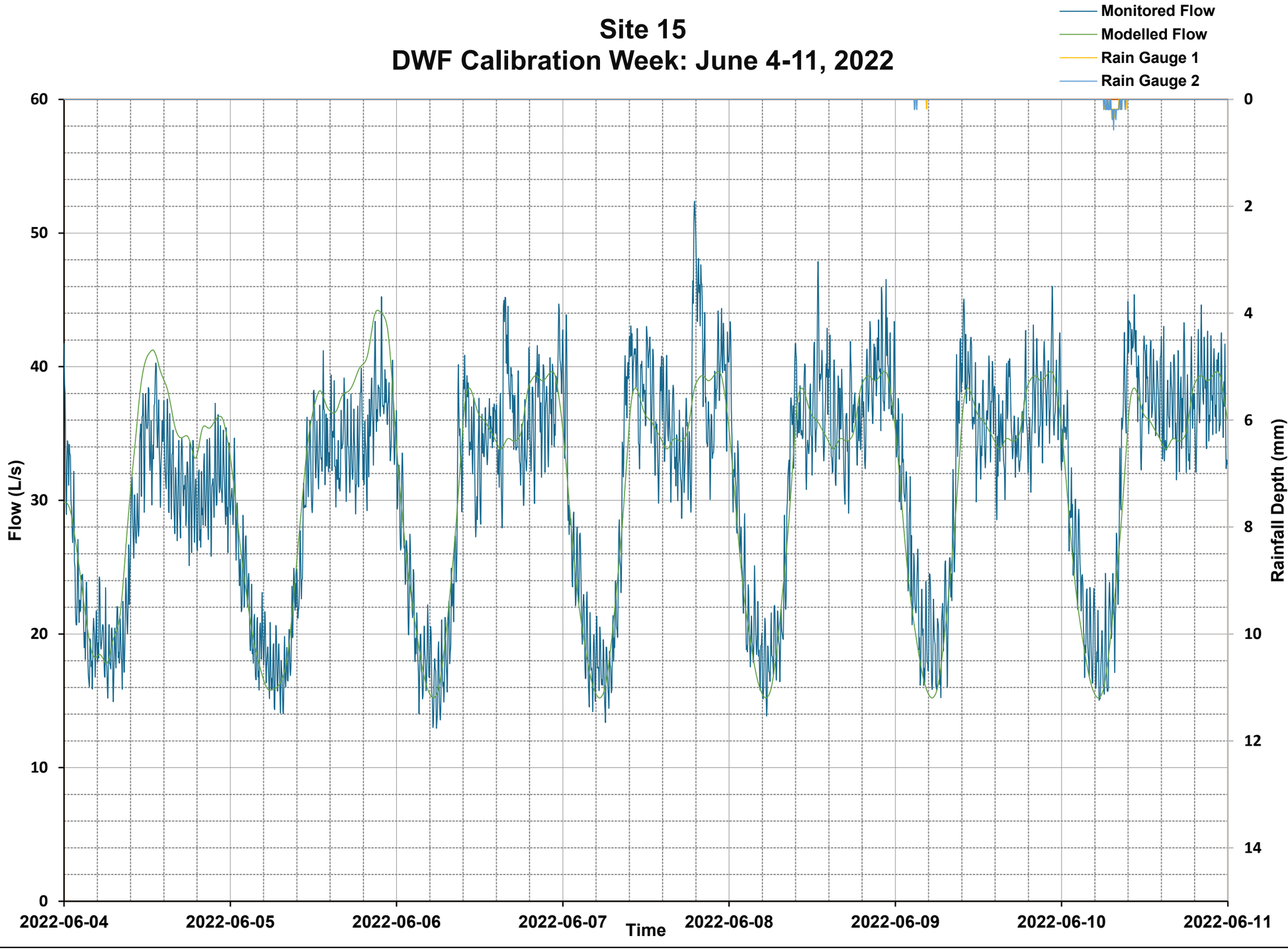

FIGURE B.15
DWF CALIBRATION
SITE 15
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

APPENDIX C
Wet Weather Flow Calibration Graphs

Site 1
WWF Calibration Primary Event: June 23-28, 2022

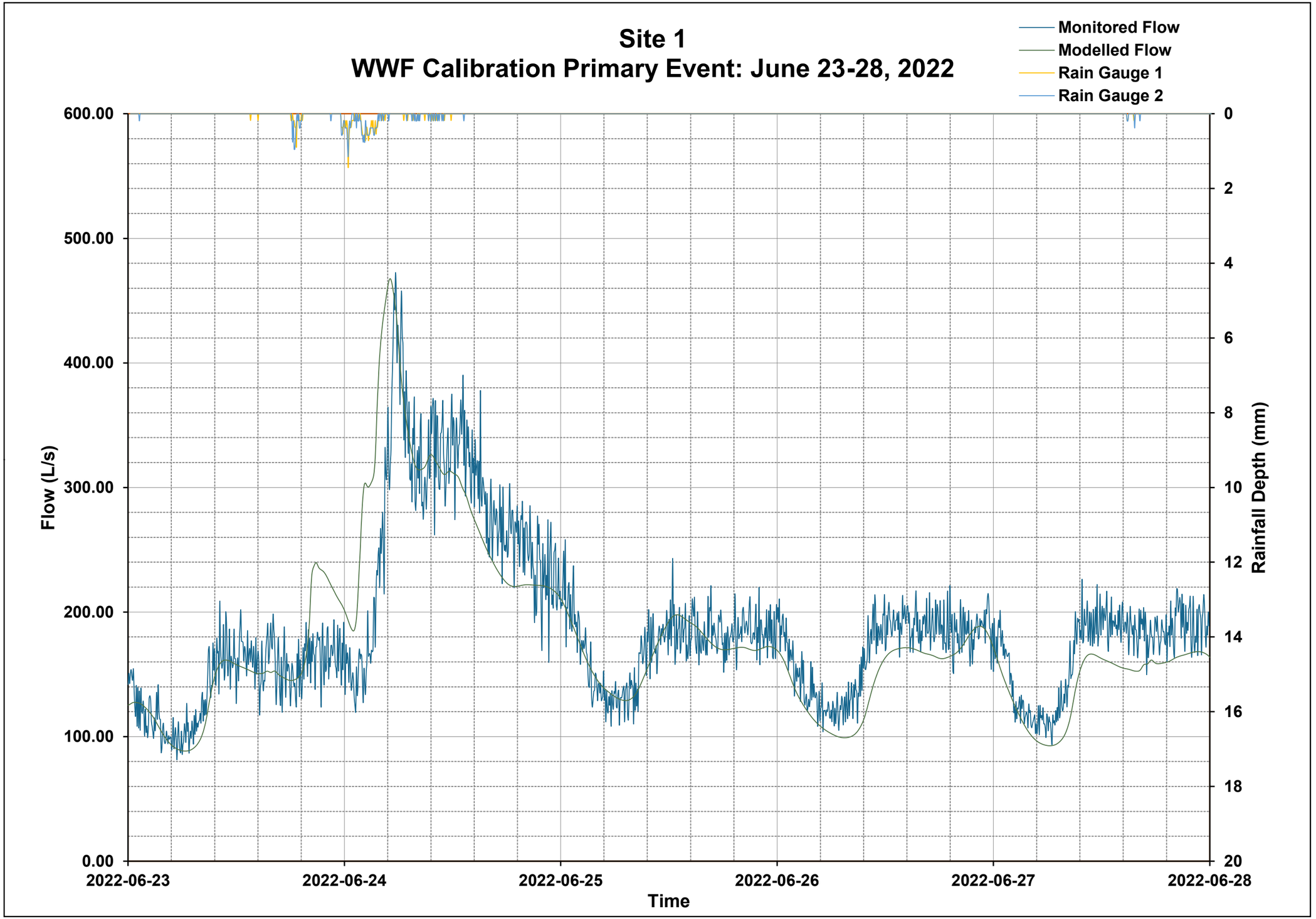

FIGURE C.1
WWF CALIBRATION - PRIMARY EVENT
SITE 1
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.1_WWF Calibration_Site 1_Primary.mxd

Site 2
WWF Calibration Primary Event: June 23-28, 2022

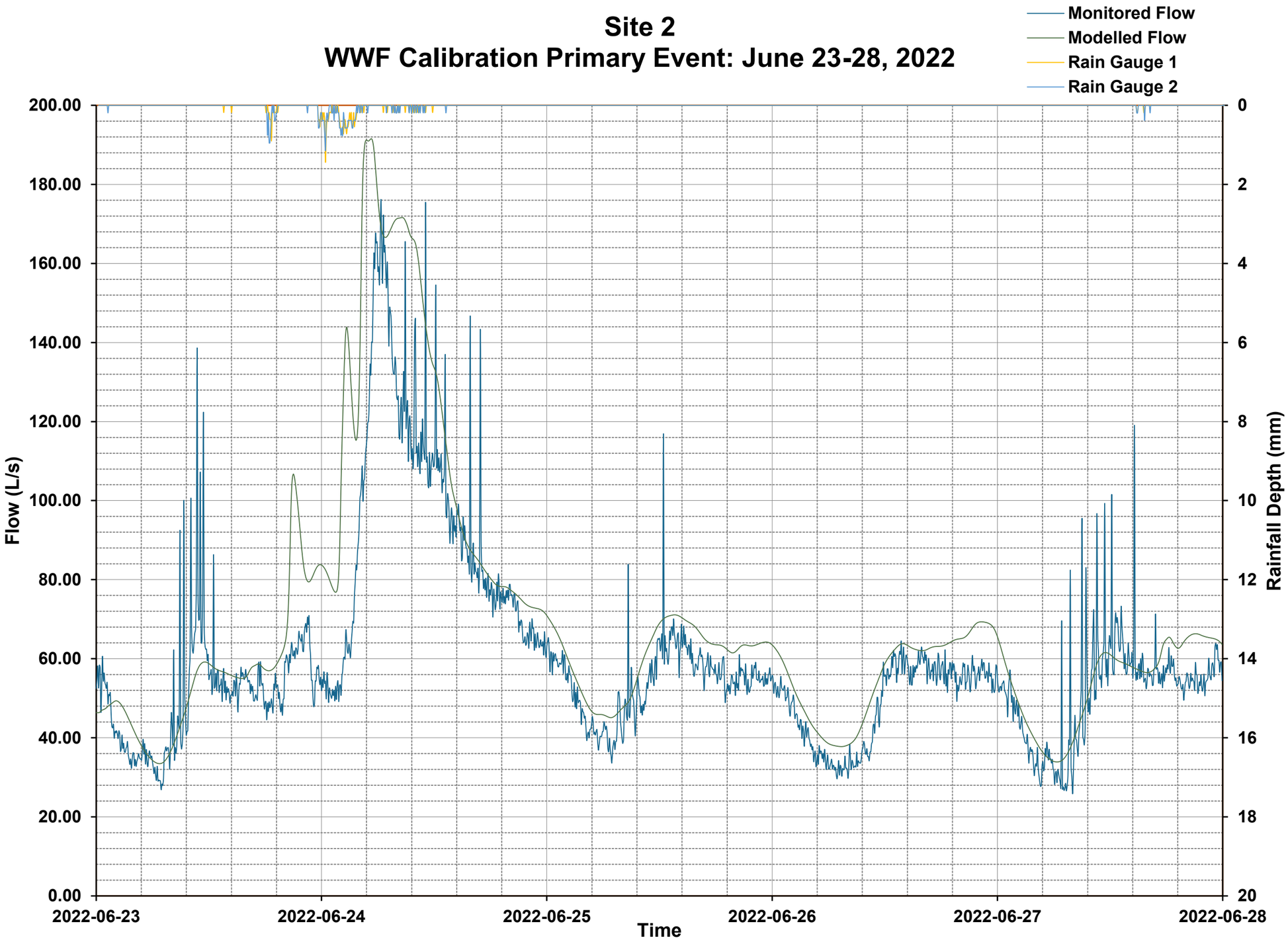

FIGURE C.2
WWF CALIBRATION - PRIMARY EVENT
SITE 2
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.2_WWF Calibration_Site 2_Primary.mxd

Site 3
WWF Calibration Primary Event: June 23-28, 2022

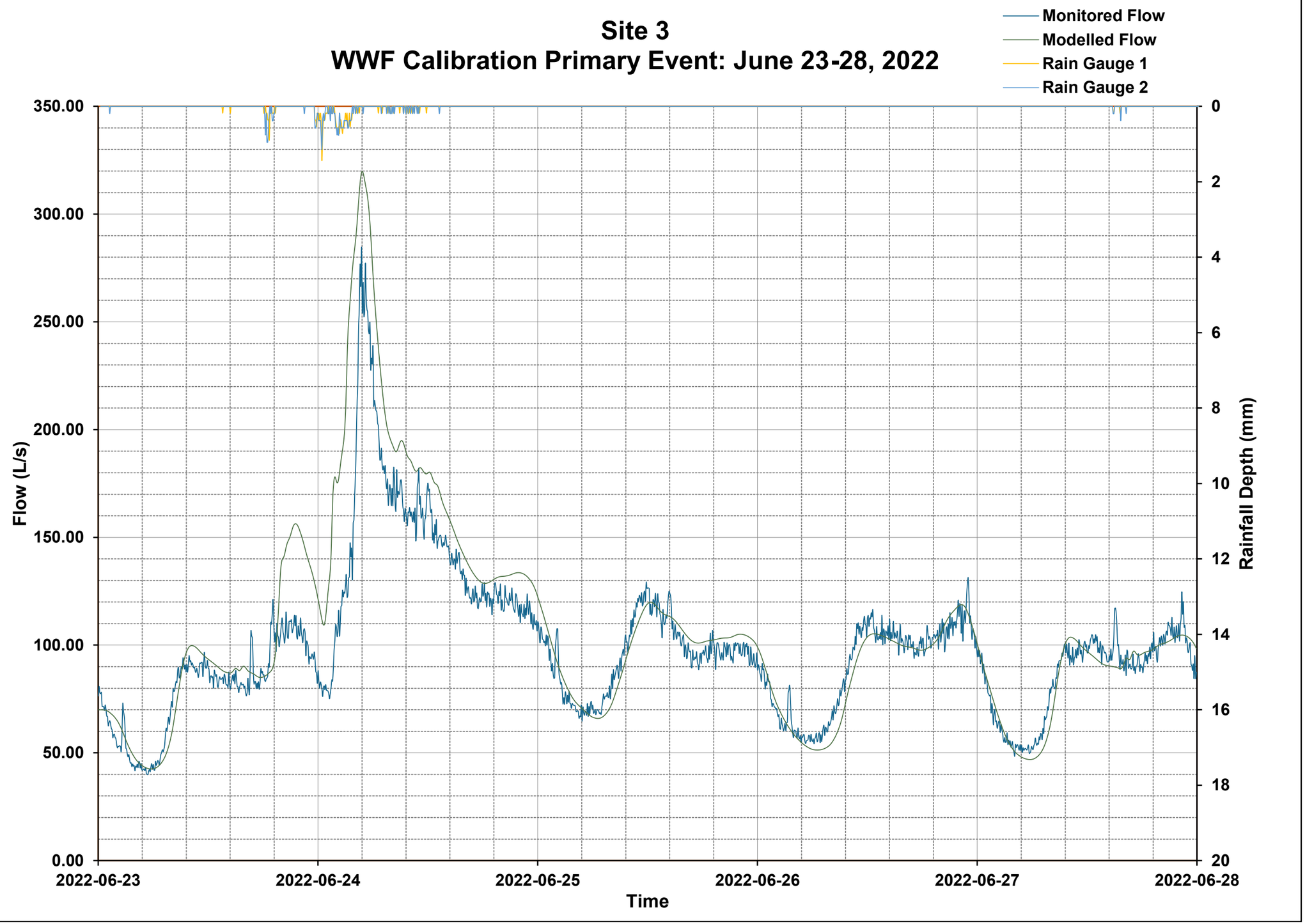

FIGURE C.3
WWF CALIBRATION - PRIMARY EVENT
SITE 3
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.3_WWF Calibration_Site 3_Primary.mxd

Site 4
WWF Calibration Primary Event: July 5-10, 2022

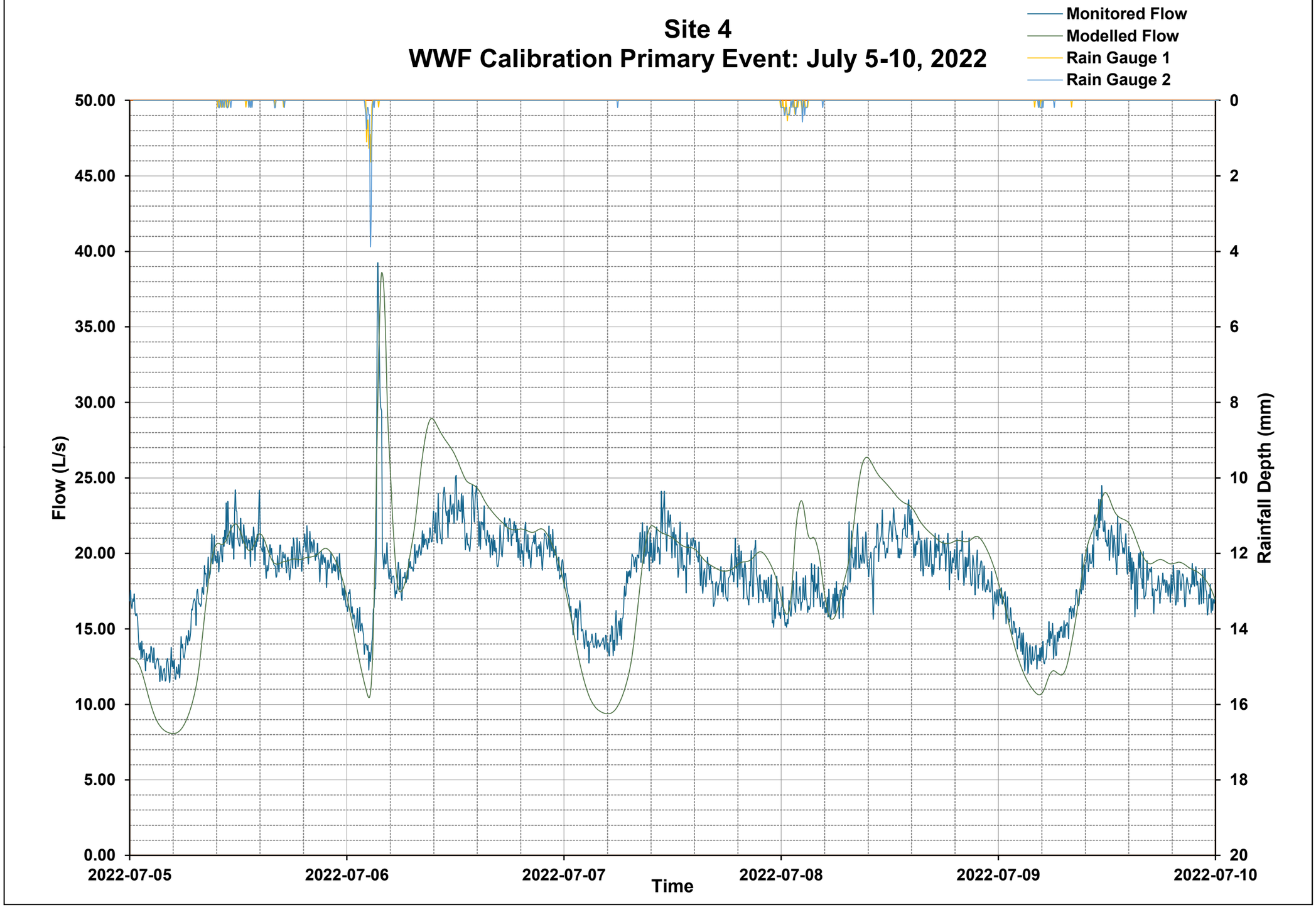

FIGURE C.4
WWF CALIBRATION - PRIMARY EVENT
SITE 4
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 5
WWF Calibration Primary Event: June 23-28, 2022

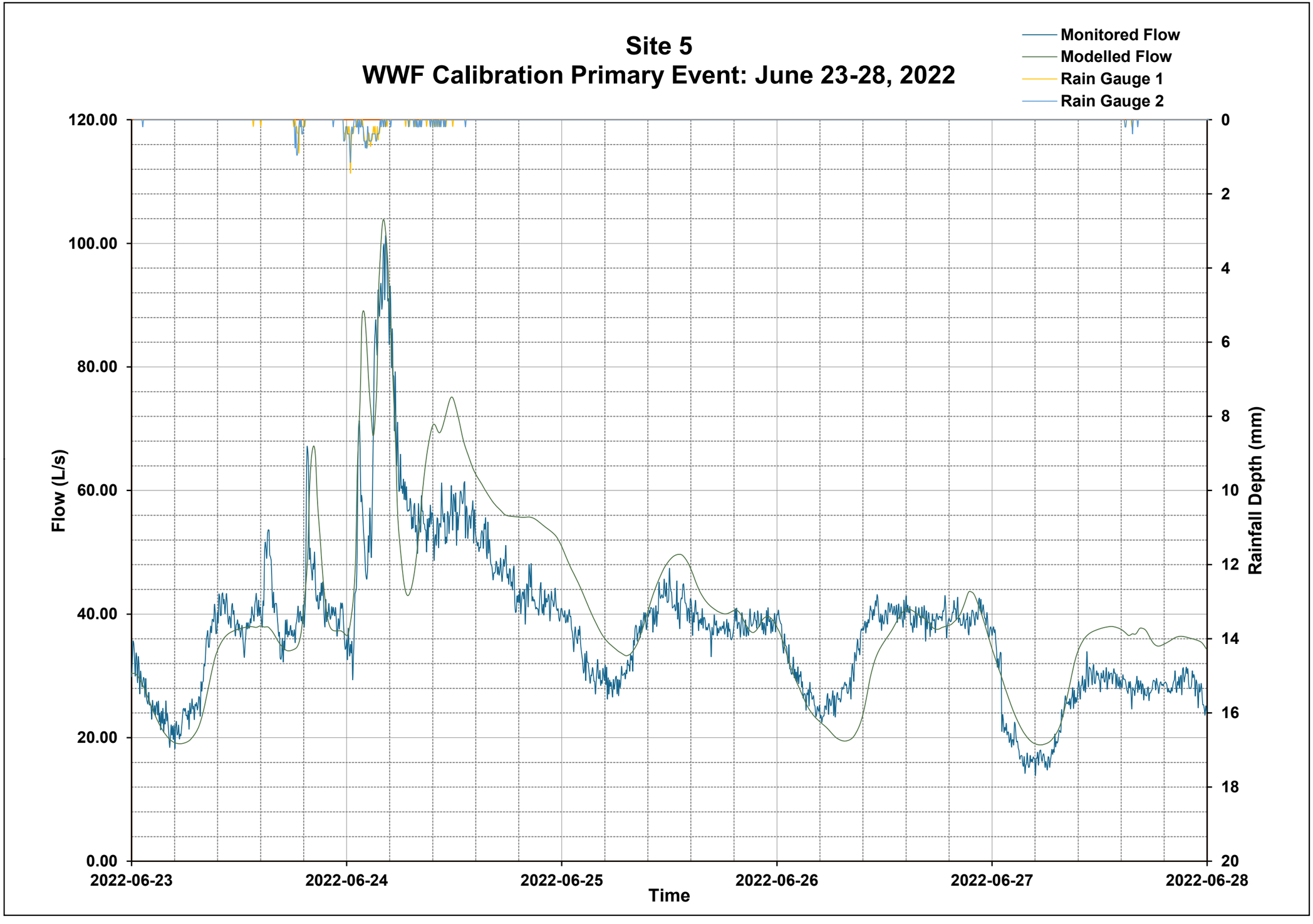

FIGURE C.5
WWF CALIBRATION - PRIMARY EVENT
SITE 5
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.5_WWF Calibration_Site 5_Primary.mxd

Site 6
WWF Calibration Primary Event: July 5-10, 2022

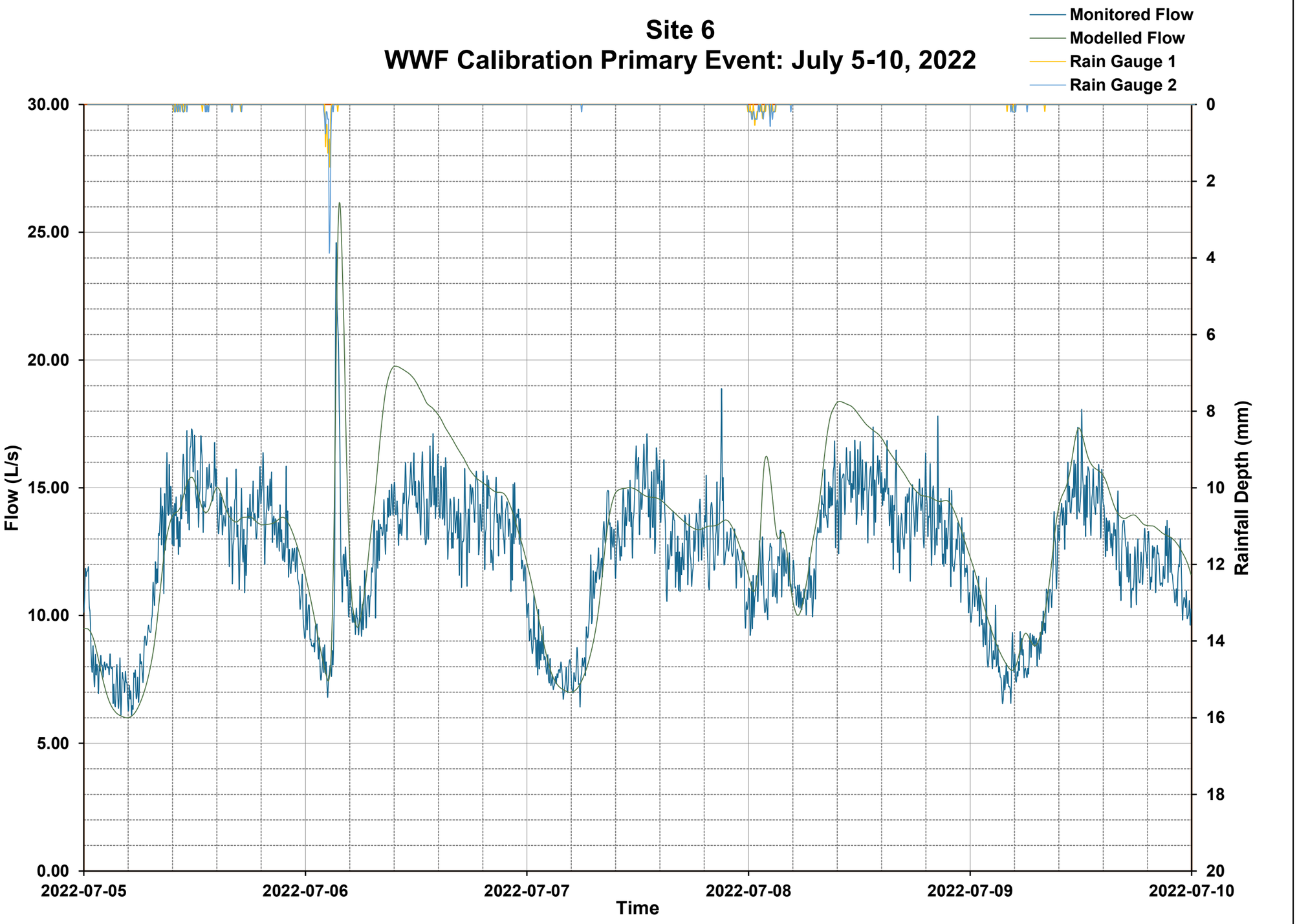

FIGURE C.6
WWF CALIBRATION - PRIMARY EVENT
SITE 6
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.6_WWF Calibration_Site 6_Primary.mxd

Site 7
WWF Calibration Primary Event: June 23-28, 2022

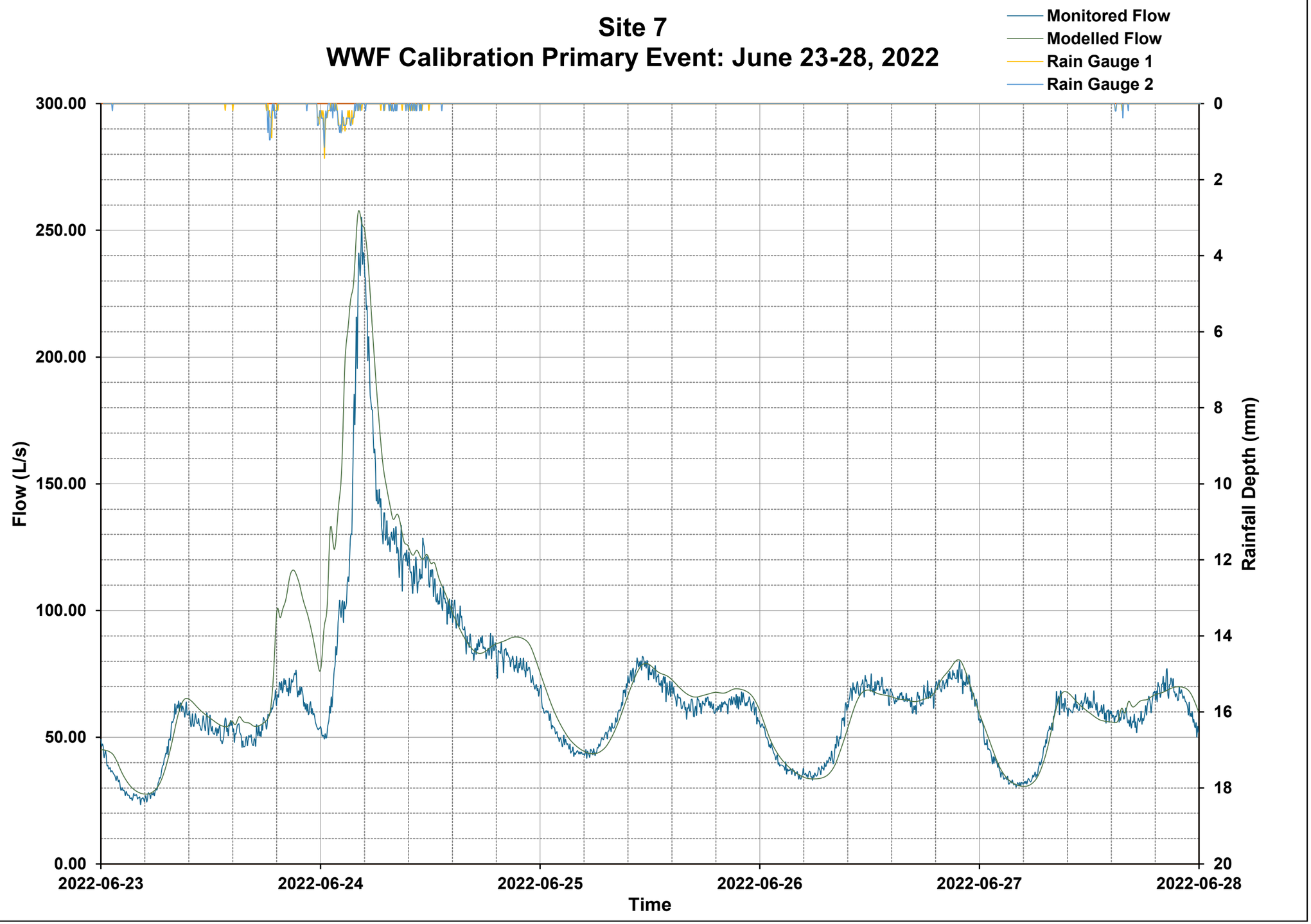

FIGURE C.7
WWF CALIBRATION - PRIMARY EVENT
SITE 7
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.7_WWF Calibration_Site 7_Primary.mxd

Site 8
WWF Calibration Primary Event: June 23-28, 2022

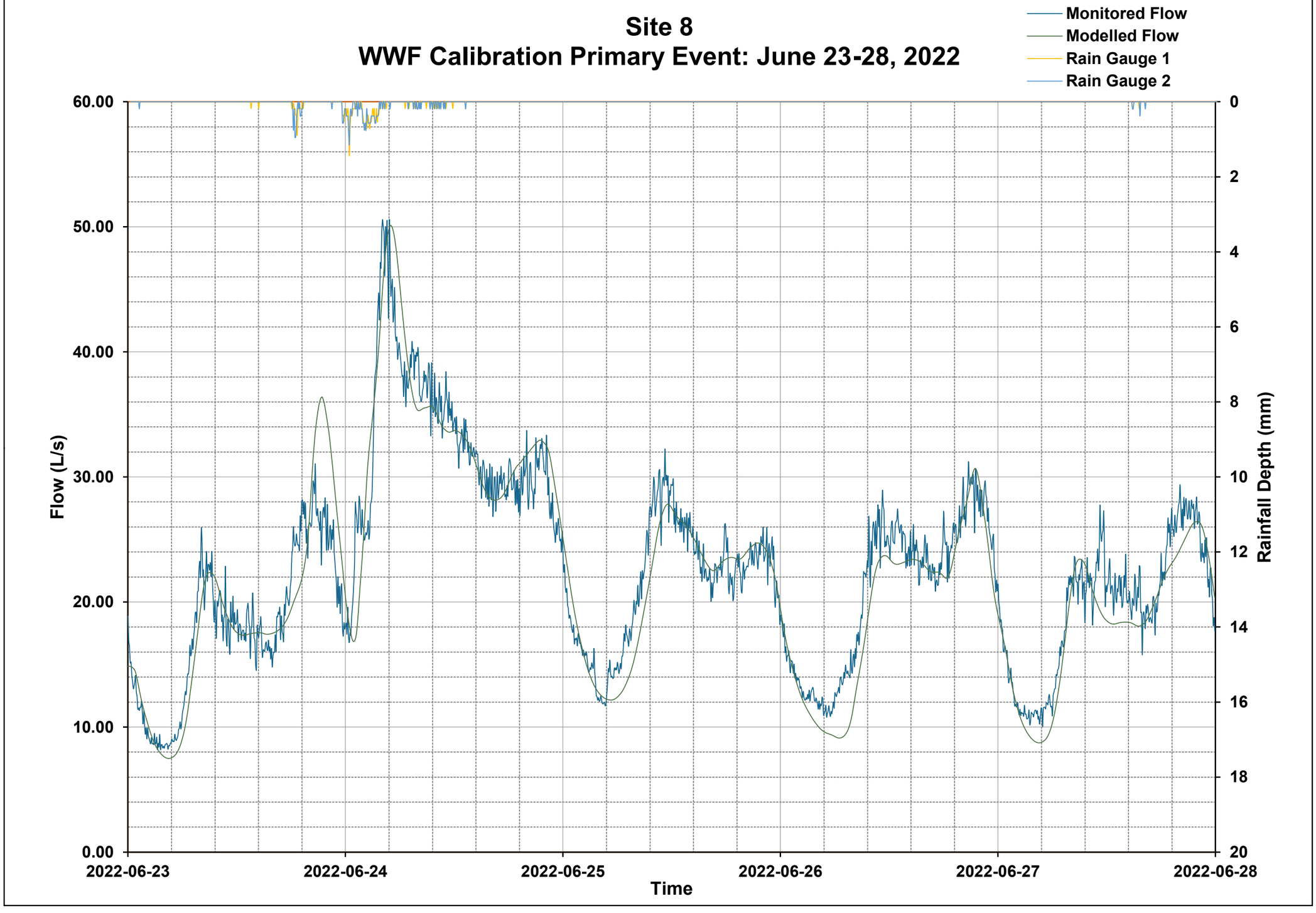

FIGURE C.8
WWF CALIBRATION - PRIMARY EVENT
SITE 8
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 9
WWF Calibration Primary Event: June 23-28, 2022

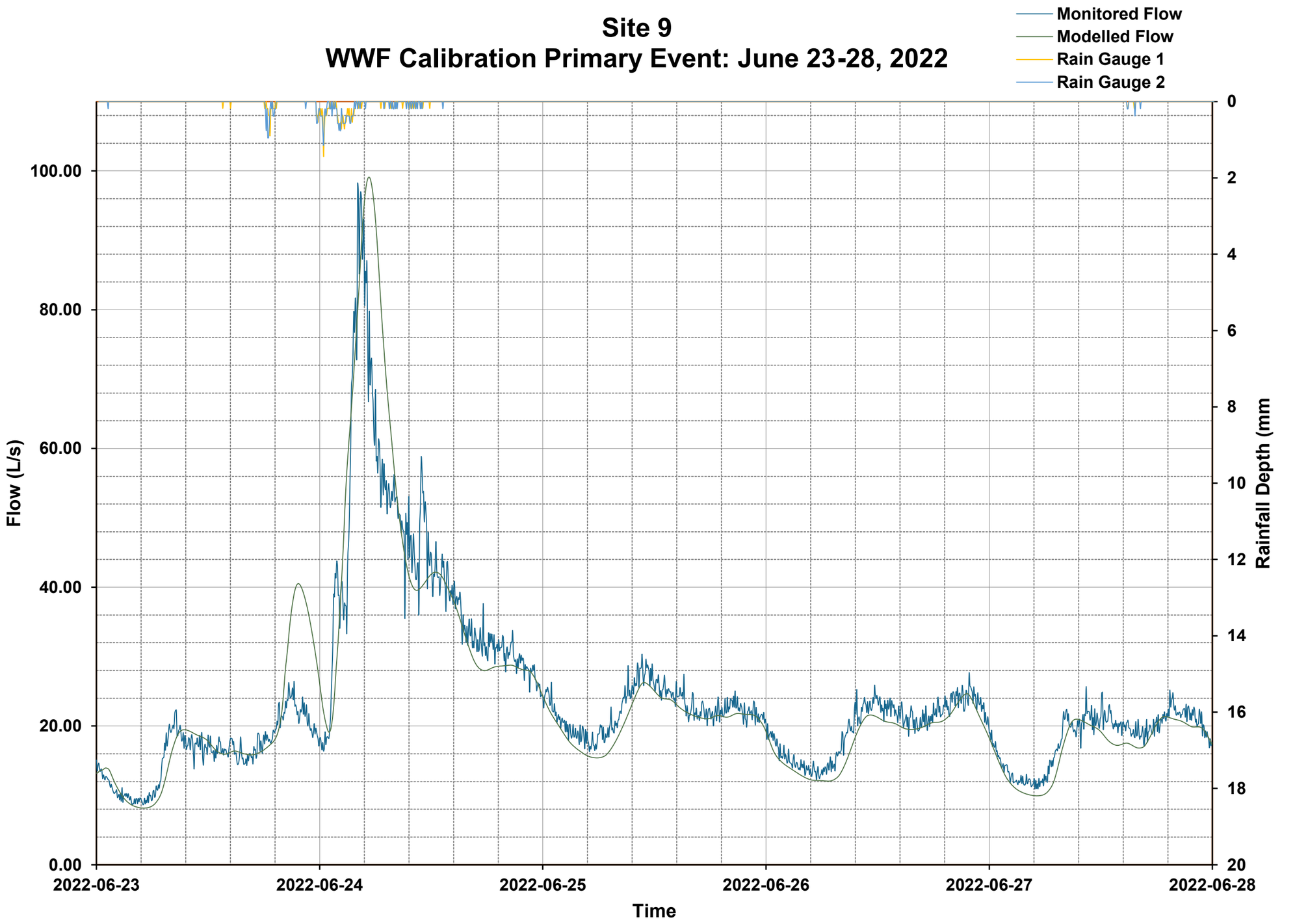

FIGURE C.9
WWF CALIBRATION - PRIMARY EVENT
SITE 9
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.9_WWF Calibration_Site 9_Primary.mxd

Site 10
WWF Calibration Primary Event: June 23-28, 2022

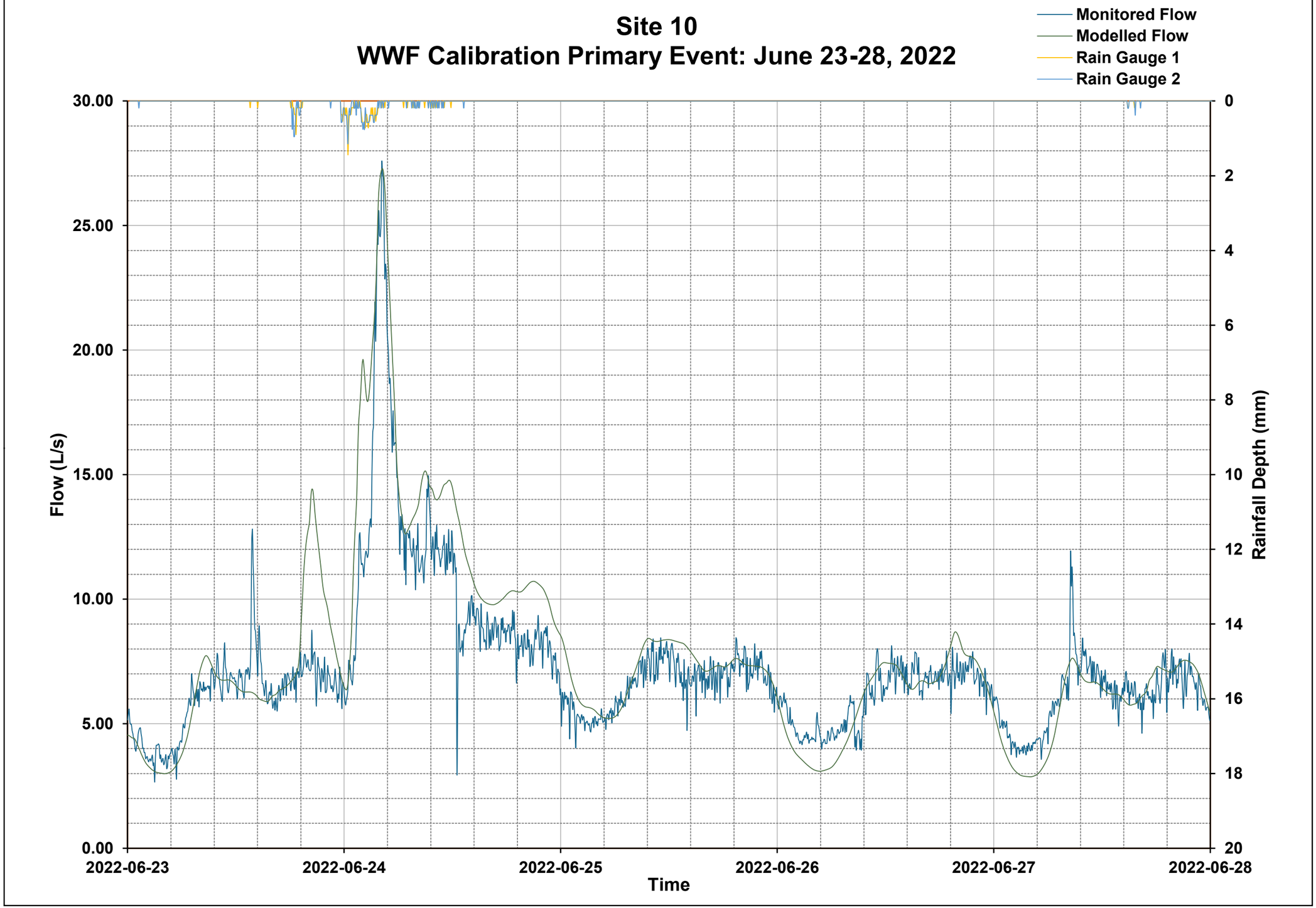

FIGURE C.10
WWF CALIBRATION - PRIMARY EVENT
SITE 10
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 11
WWF Calibration Primary Event: June 13-18, 2022

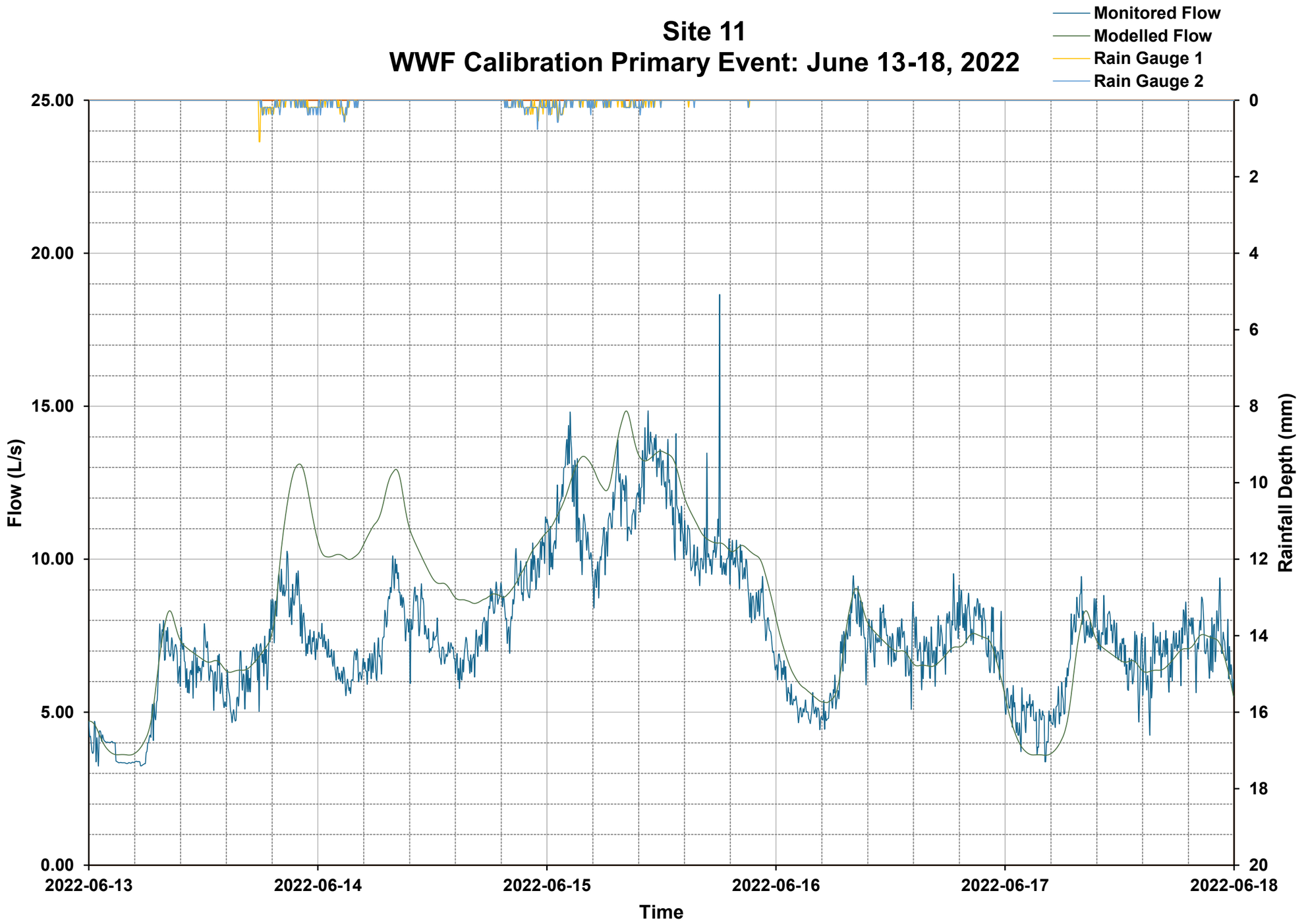

FIGURE C.11
WWF CALIBRATION - PRIMARY EVENT
SITE 11
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.11_WWF Calibration_Site 11_Primary.mxd

Site 12
WWF Calibration Primary Event: June 23-28, 2022

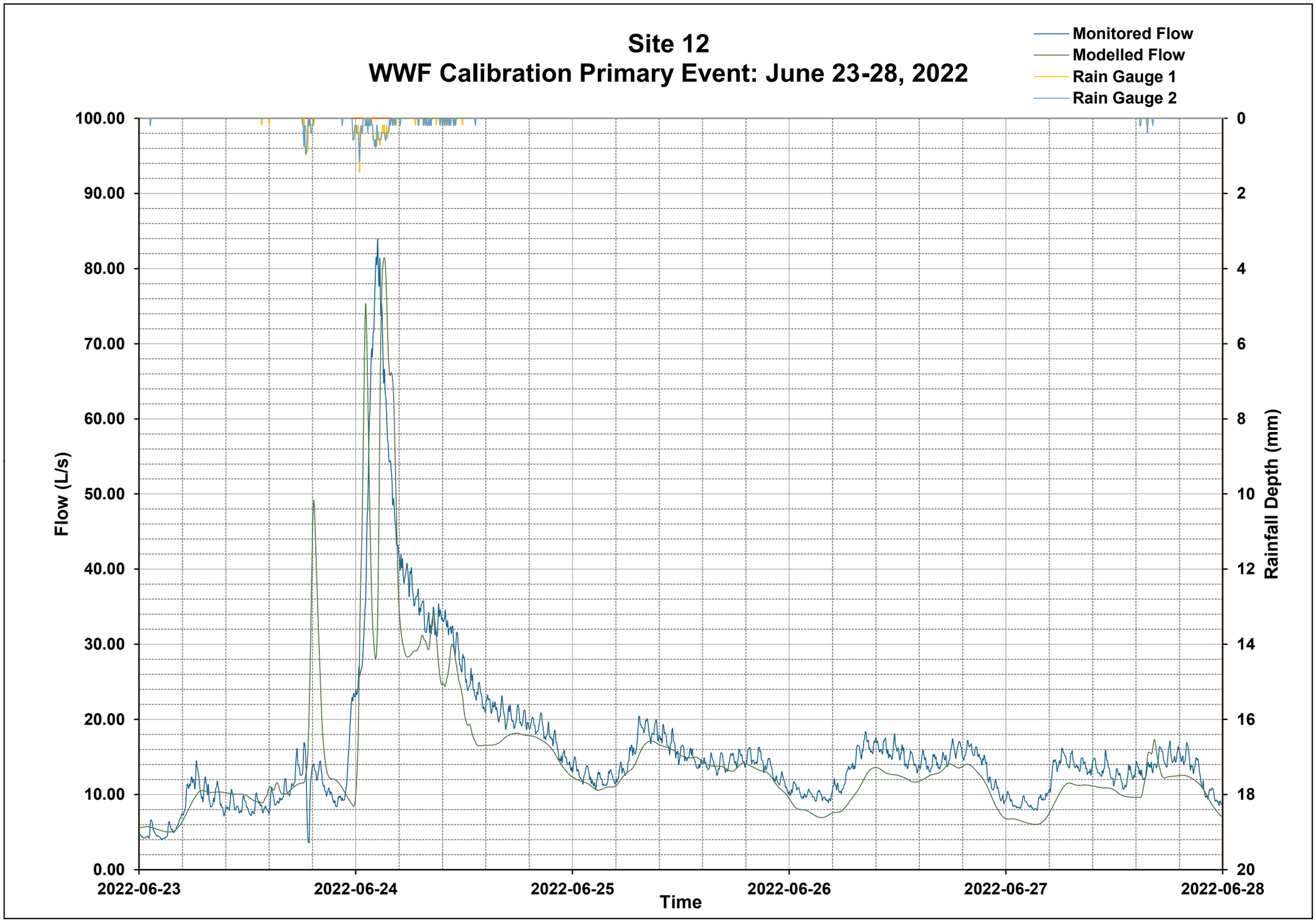

FIGURE C.12
WWF CALIBRATION - PRIMARY EVENT
SITE 12
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.12_WWF Calibration_Site 12_Primary.mxd

Site 13
WWF Calibration Primary Event: June 23-28, 2022

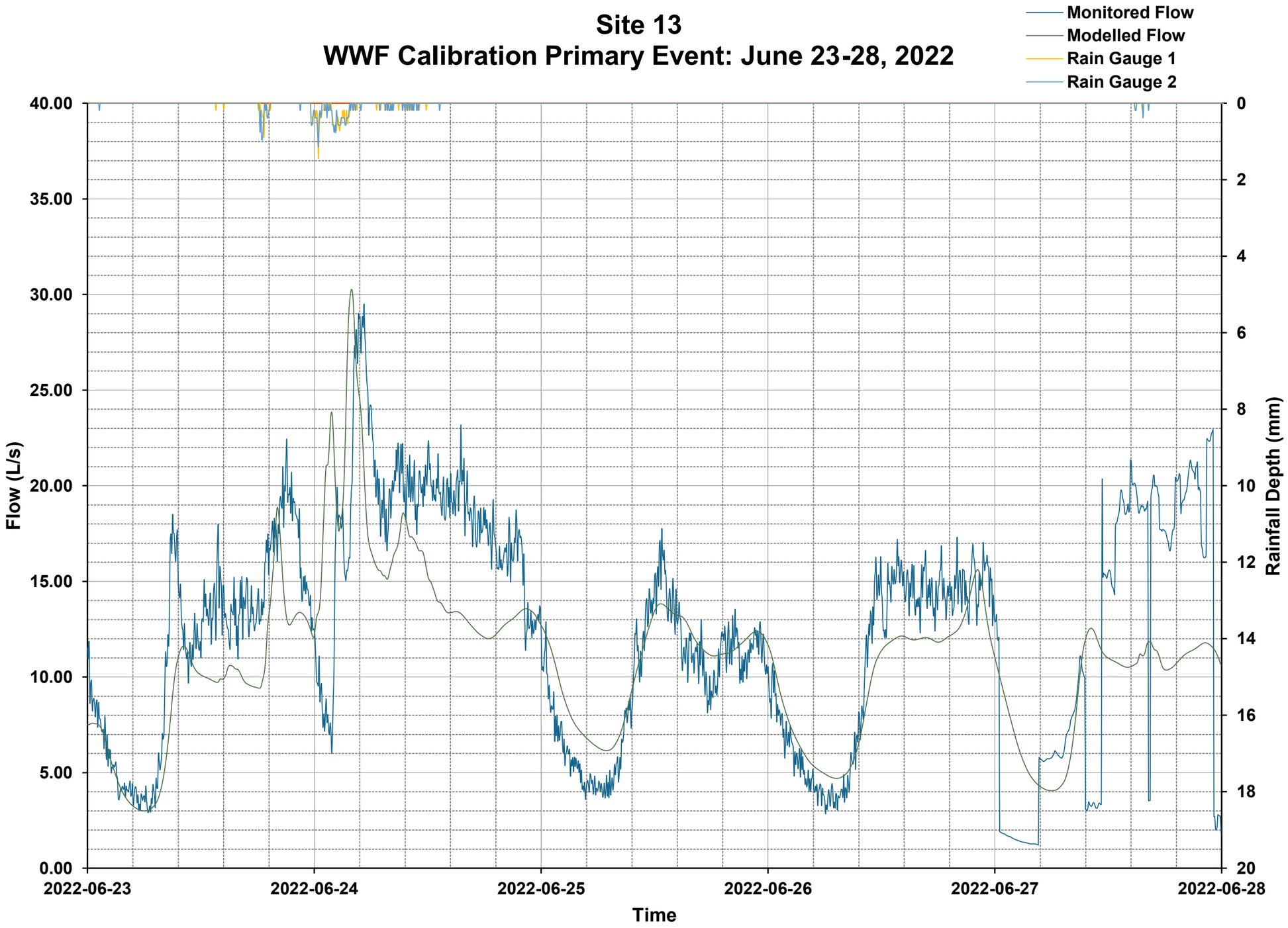

FIGURE C.13
WWF CALIBRATION - PRIMARY EVENT
SITE 13
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 14
WWF Calibration Primary Event: June 23-28, 2022

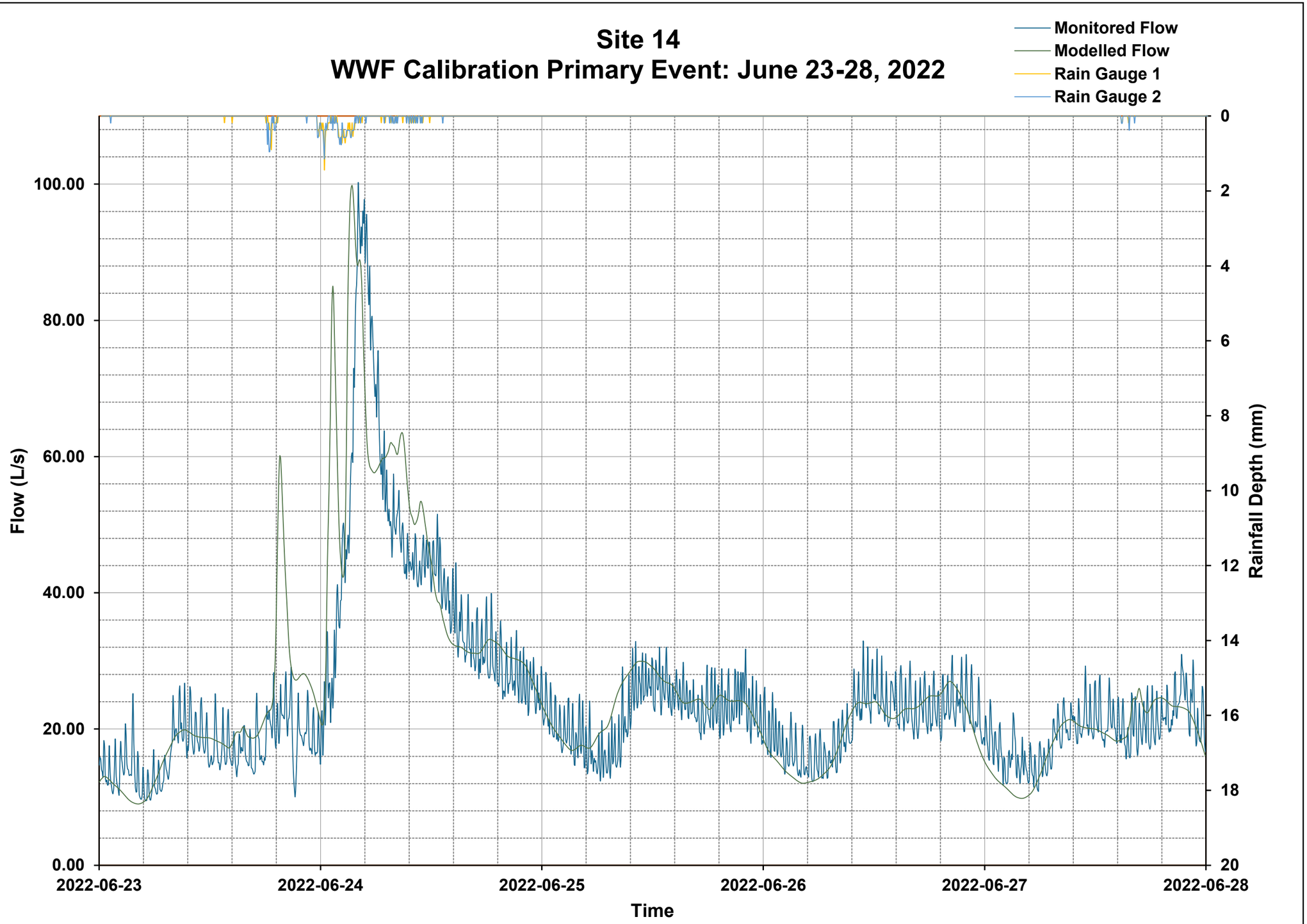

FIGURE C.14
WWF CALIBRATION - PRIMARY EVENT
SITE 14
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 15
WWF Calibration Primary Event: June 23-28, 2022

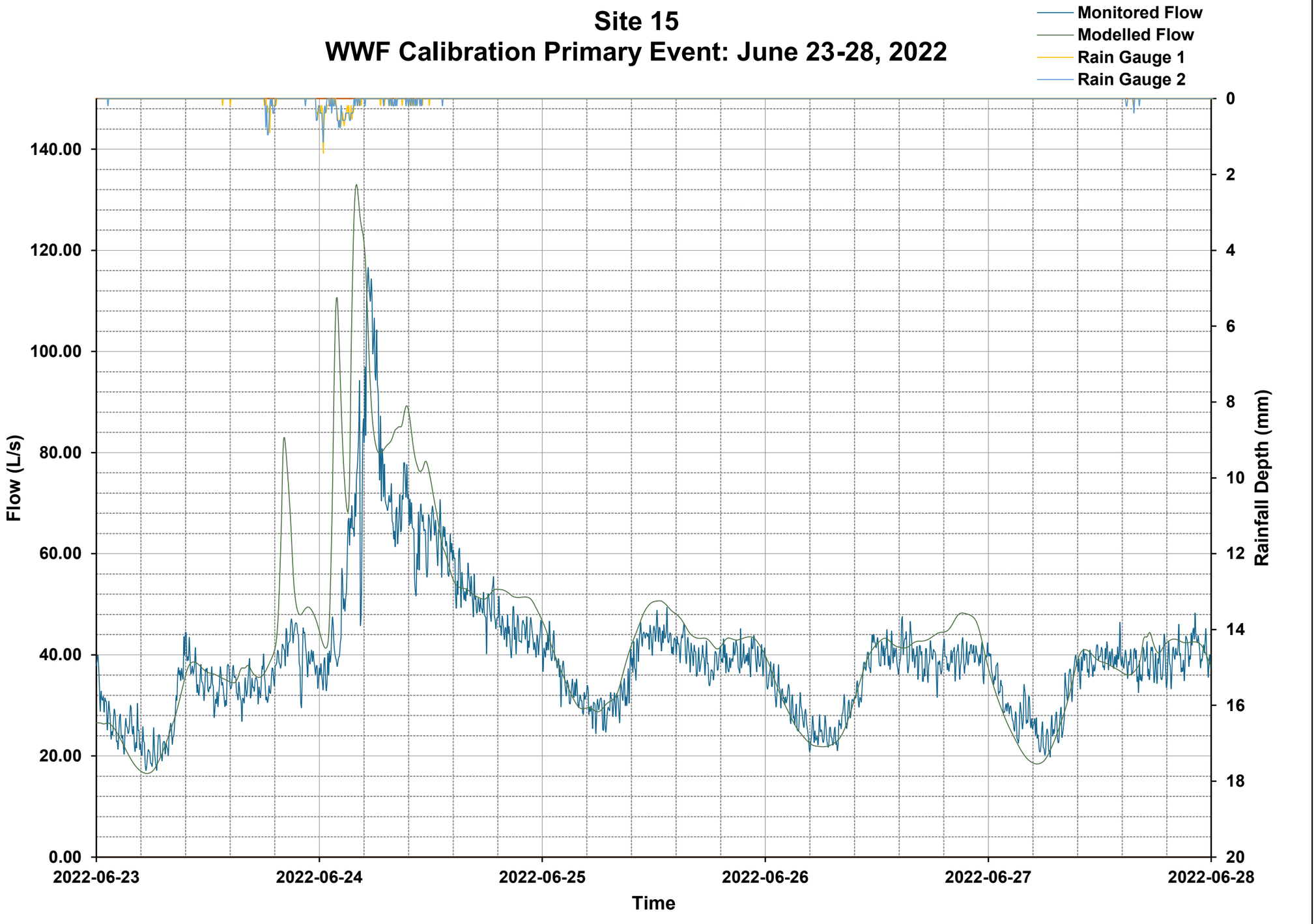

FIGURE C.15
WWF CALIBRATION - PRIMARY EVENT
SITE 15
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 1
WWF Calibration Validation Event: June 14-19, 2022

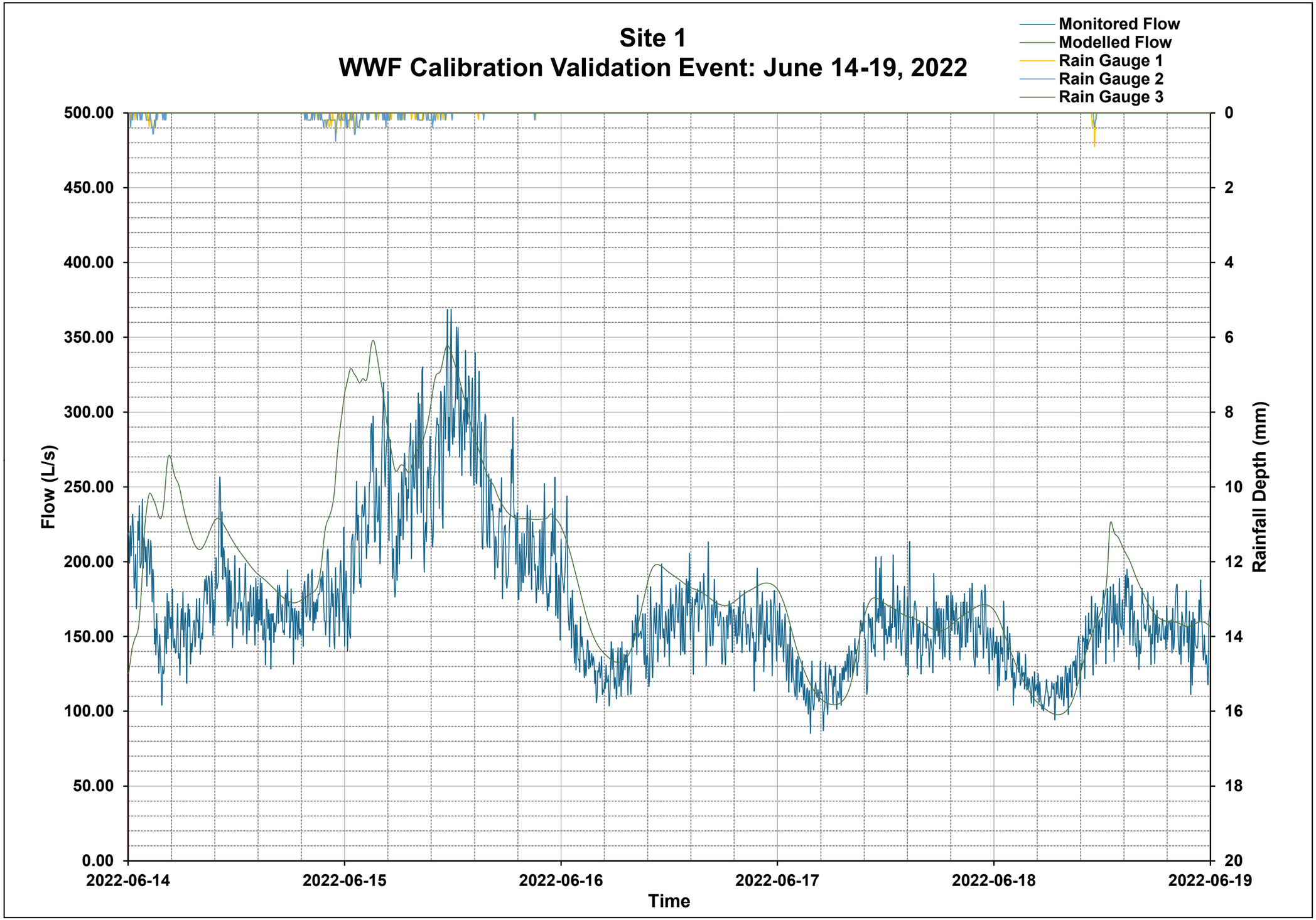

FIGURE C.16
WWF CALIBRATION - VALIDATION EVENT
SITE 1
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Site 2
WWF Calibration Validation Event: June 14-19, 2022

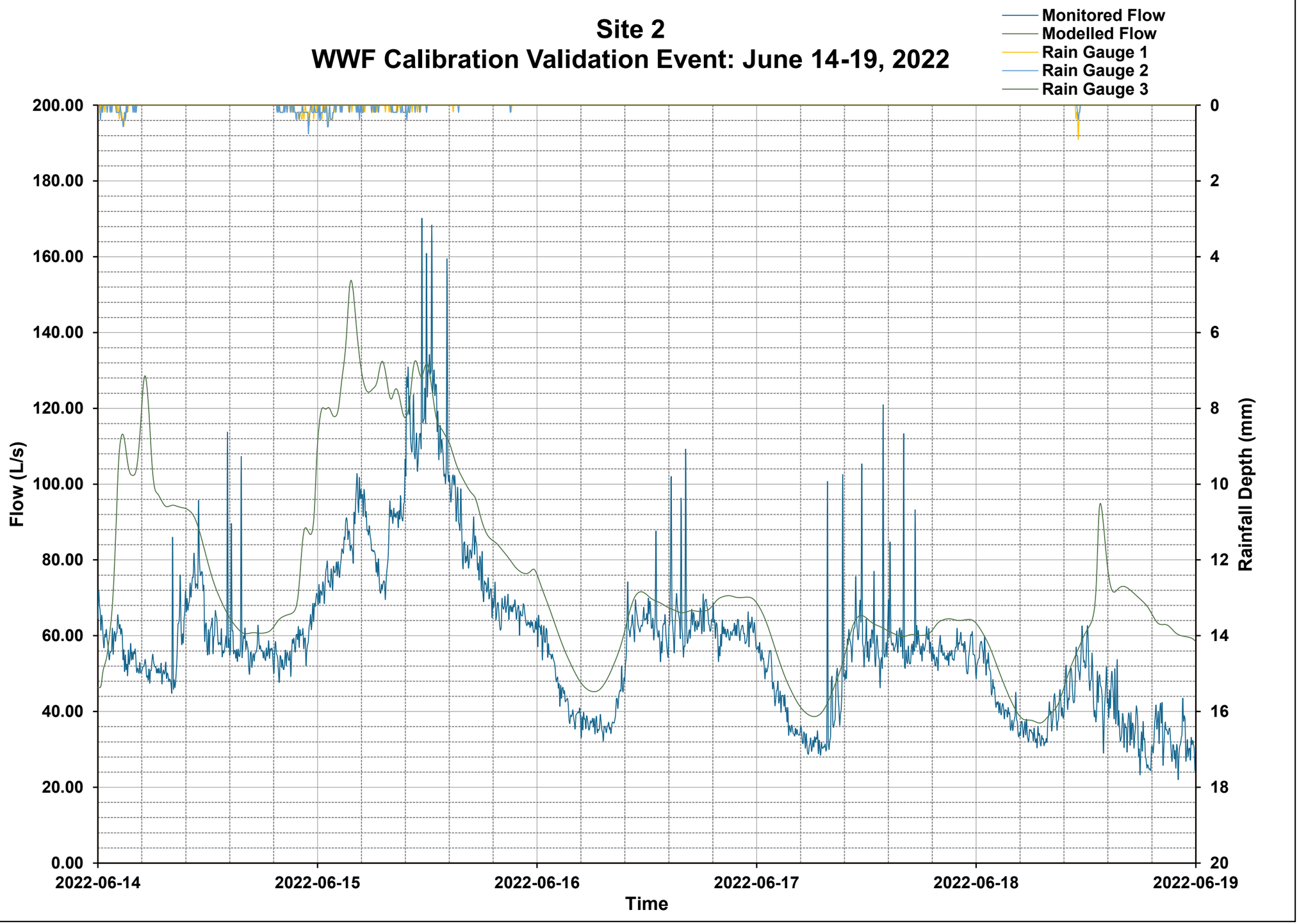

FIGURE C.17
WWF CALIBRATION - VALIDATION EVENT
SITE 2
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.17_WWF Calibration_Site 2_Validation.mxd

Site 3
WWF Calibration Validation Event: June 14-19, 2022

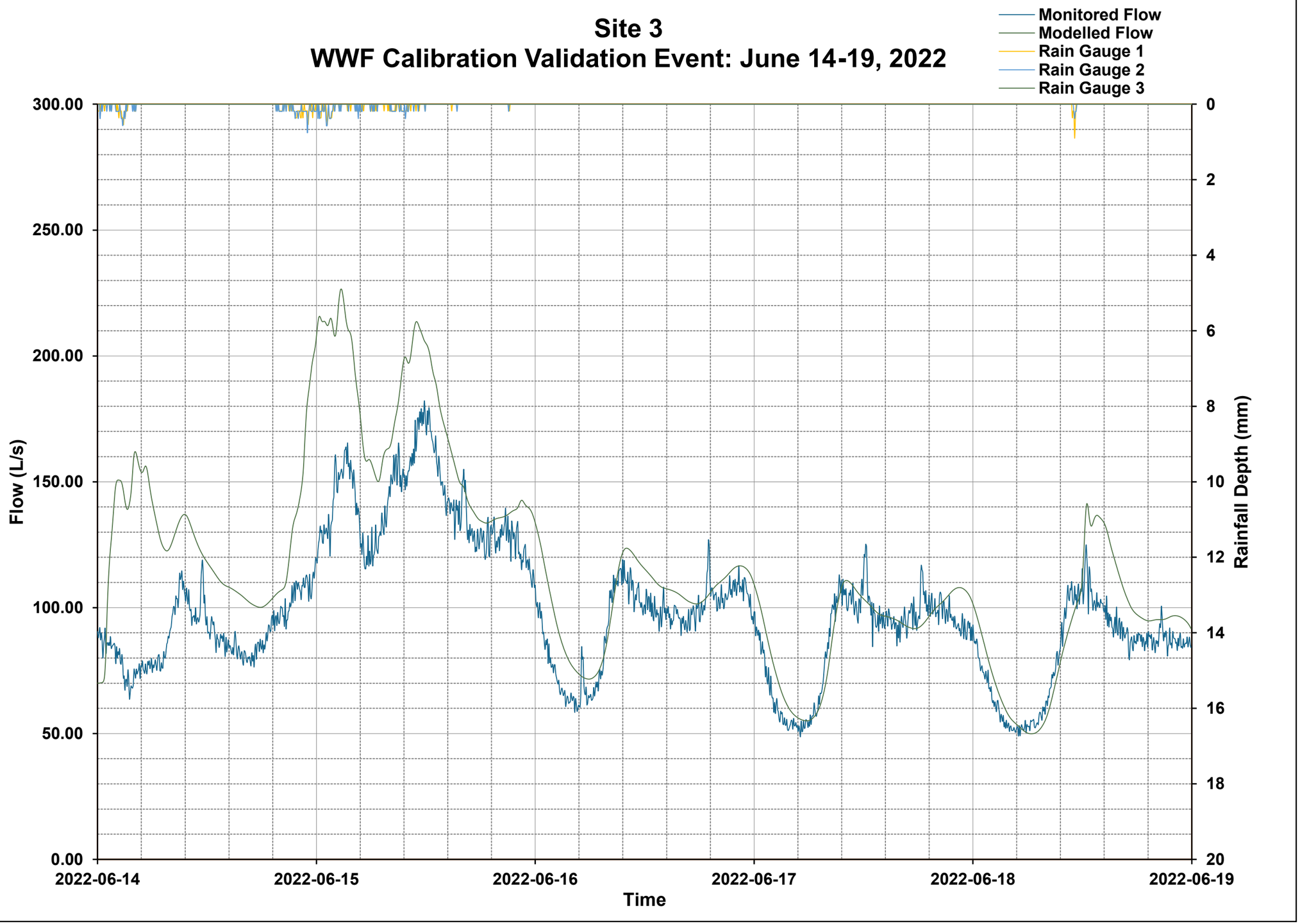

FIGURE C.18
WWF CALIBRATION - VALIDATION EVENT
SITE 3
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.18_WWF Calibration_Site 3_Validation.mxd

Site 4
WWF Calibration Validation Event: June 14-19, 2022

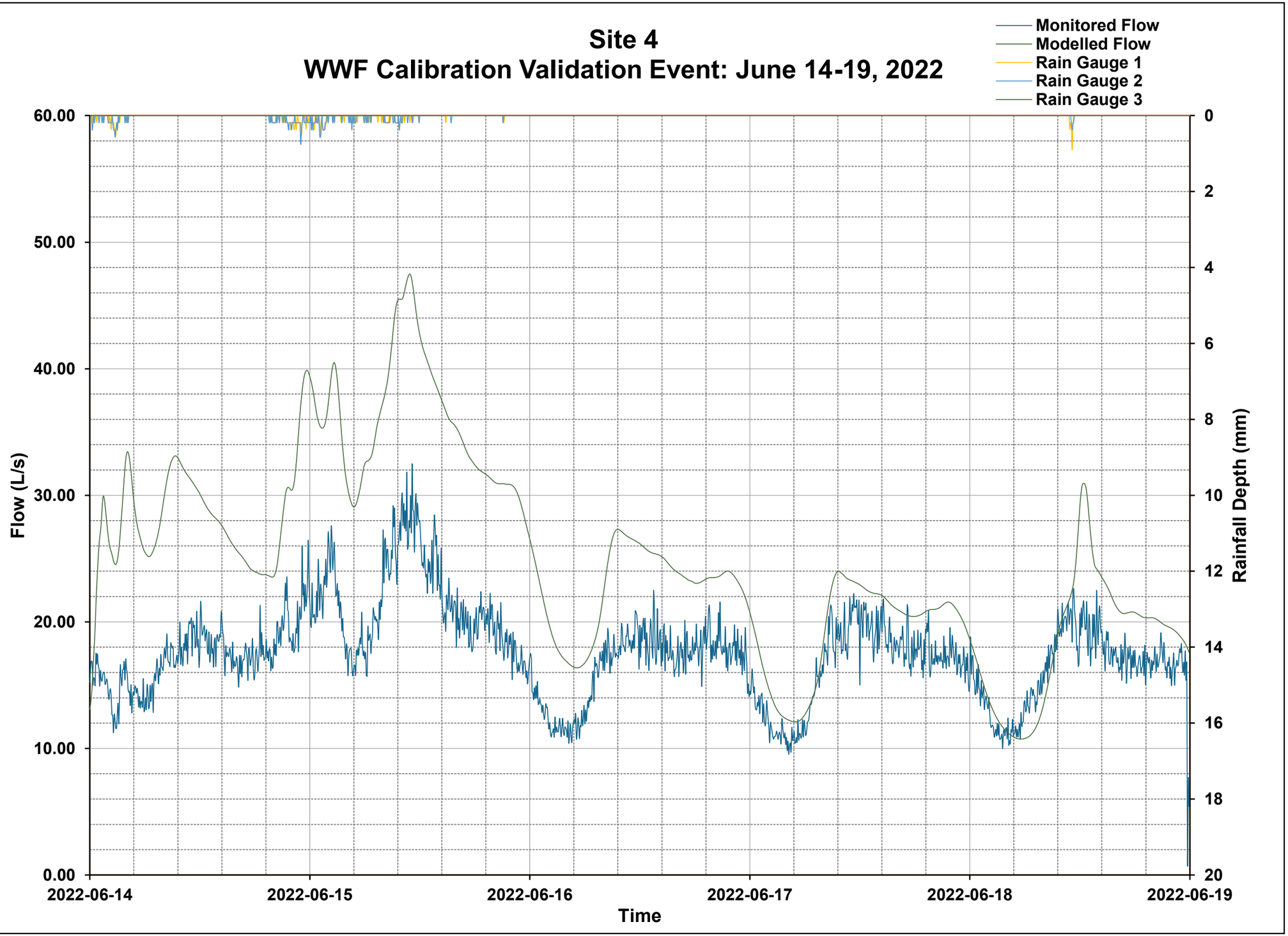

FIGURE C.19
WWF CALIBRATION - VALIDATION EVENT
SITE 4
SANITARY SEWER MASTER PLAN

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Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.19_WWF Calibration_Site 4_Validation.mxd

Site 5
WWF Calibration Validation Event: June 14-19, 2022

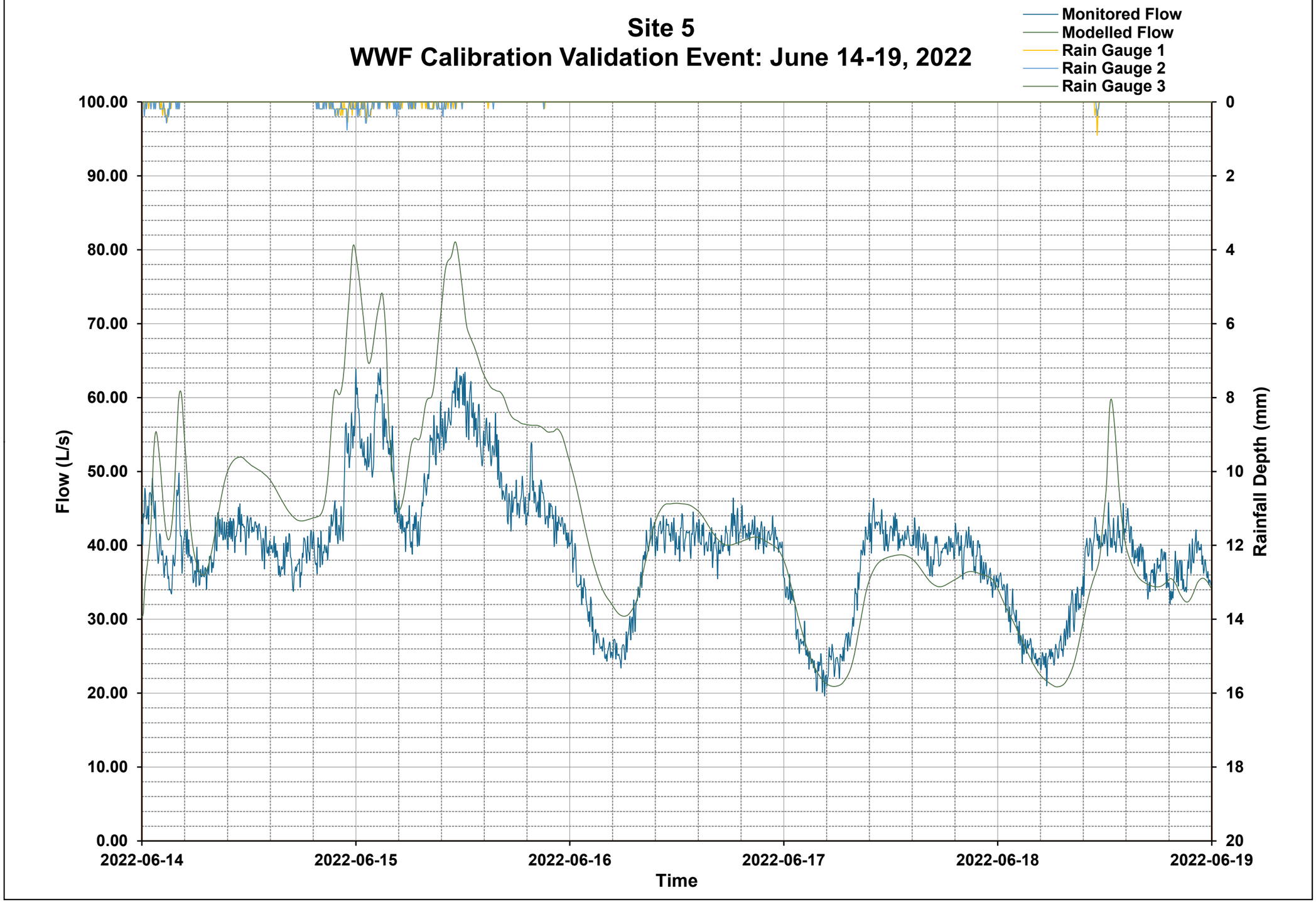

FIGURE C.20
WWF CALIBRATION - VALIDATION EVENT
SITE 5
SANITARY SEWER MASTER PLAN

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Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.20_WWF Calibration_Site 5_Validation.mxd

Site 6
WWF Calibration Validation Event: June 28 - July 3, 2022

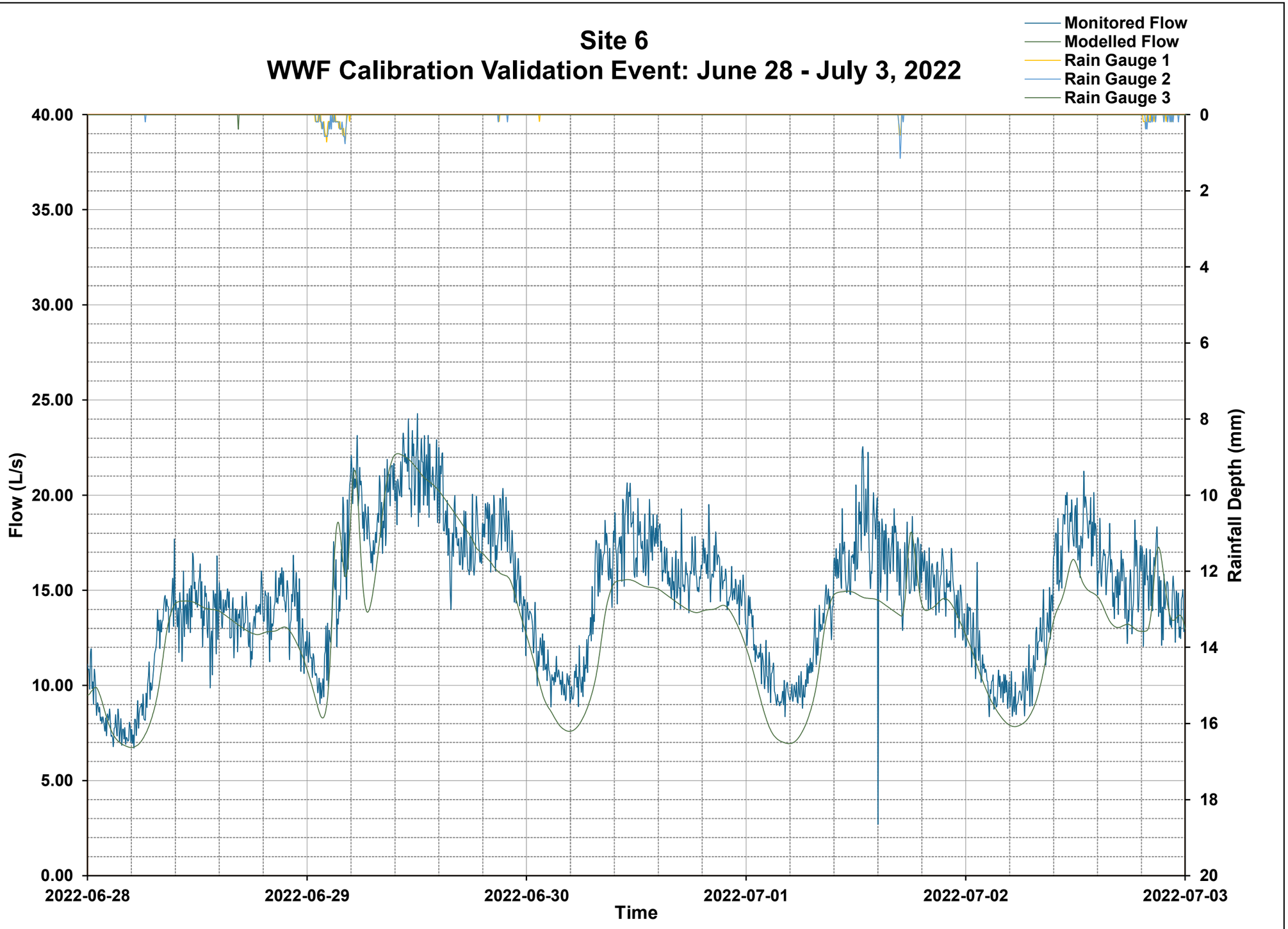

FIGURE C.21
WWF CALIBRATION - VALIDATION EVENT
SITE 6
SANITARY SEWER MASTER PLAN

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Date: 2024-01-30 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.21_WWF Calibration_Site 6_Validation.mxd

Site 7
WWF Calibration Validation Event: June 14-19, 2022

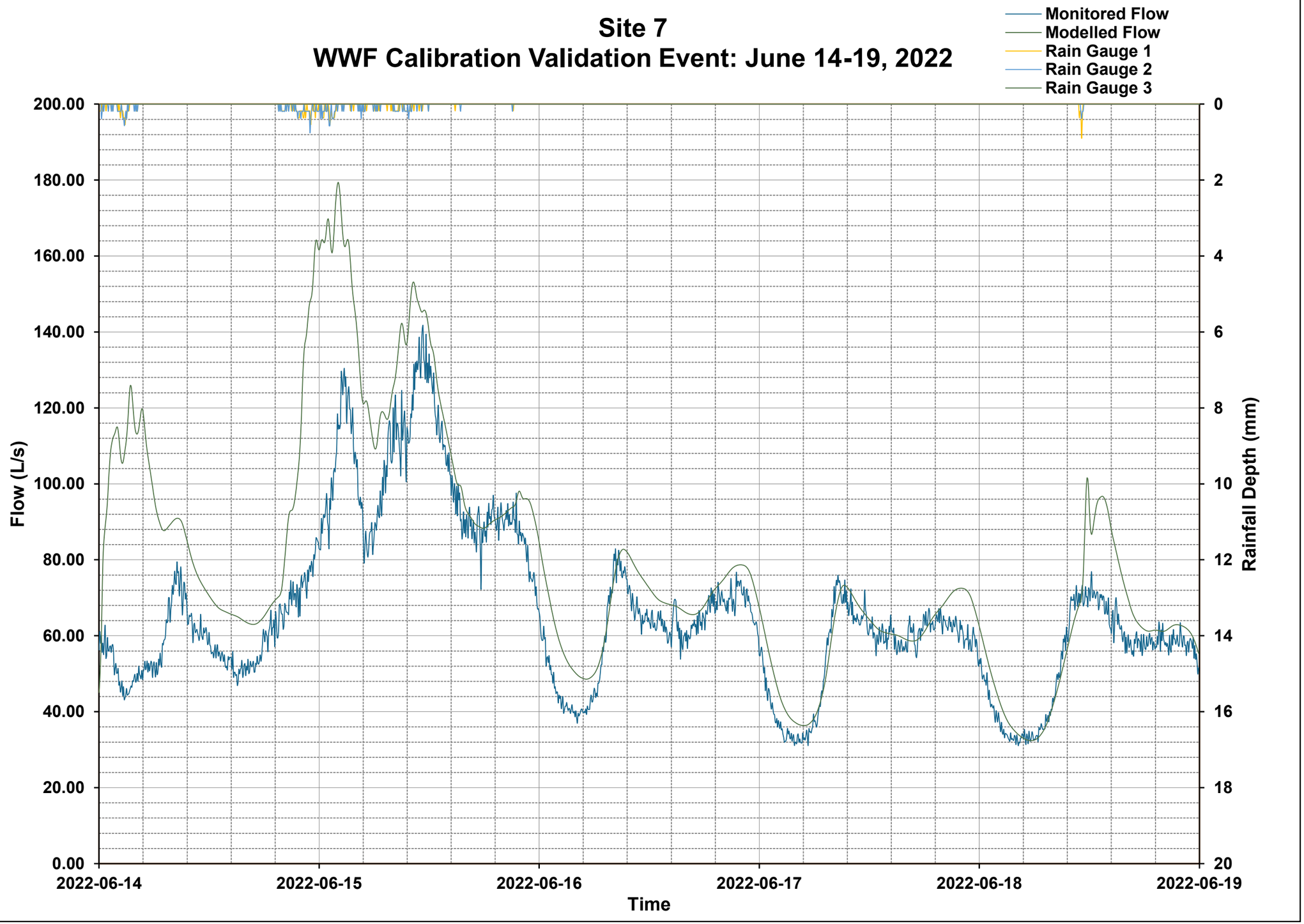

FIGURE C.22
WWF CALIBRATION - VALIDATION EVENT
SITE 7
SANITARY SEWER MASTER PLAN

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Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.22_WWF Calibration_Site 7_Validation.mxd

Site 8
WWF Calibration Validation Event: June 14-19, 2022

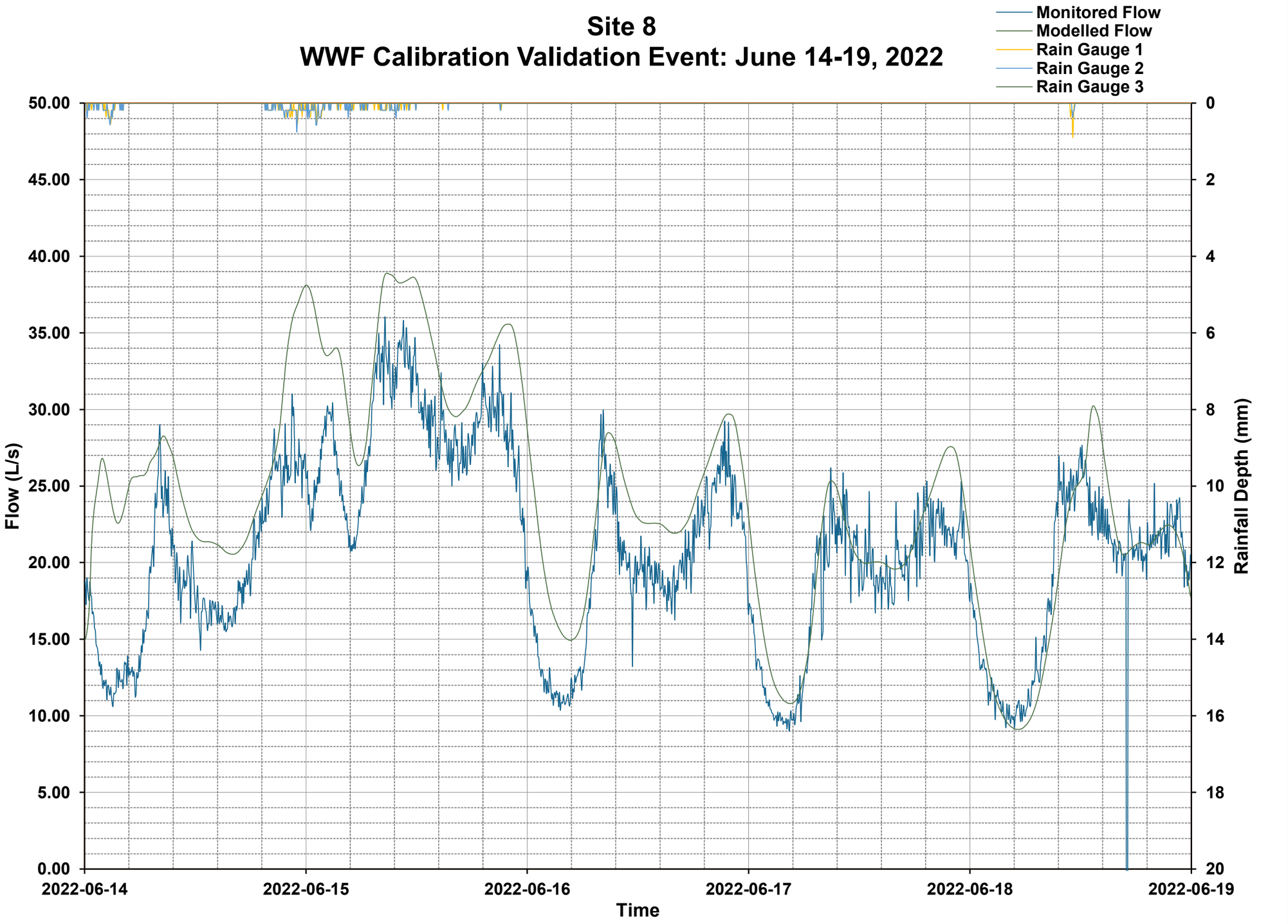

FIGURE C.23
WWF CALIBRATION - VALIDATION EVENT
SITE 8
SANITARY SEWER MASTER PLAN

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Date: 2024-01-30 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.23_WWF Calibration_Site 8_Validation.mxd

Site 9
WWF Calibration Validation Event: June 14-19, 2022

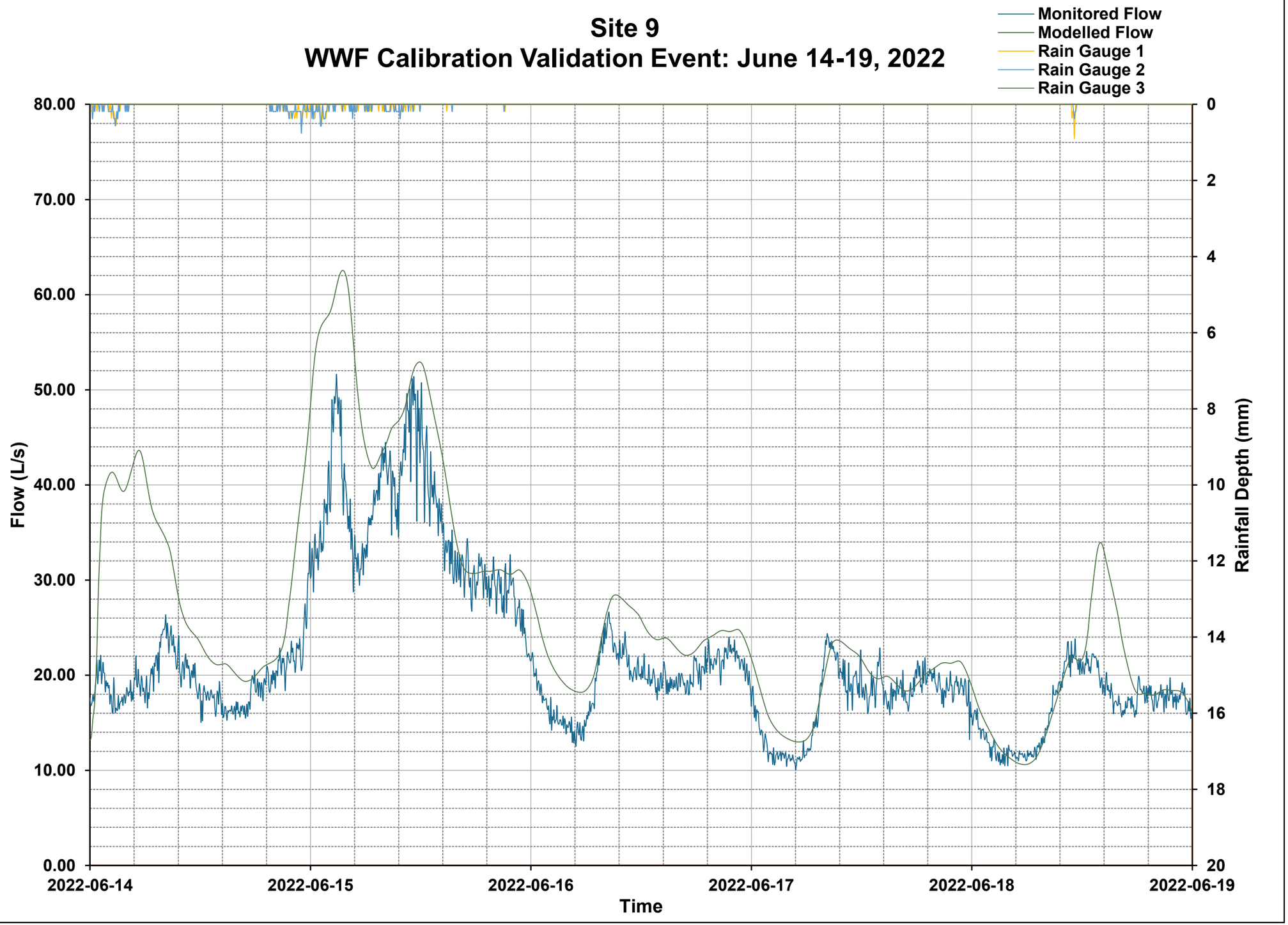

FIGURE C.24
WWF CALIBRATION - VALIDATION EVENT
SITE 9
SANITARY SEWER MASTER PLAN

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Site 10
WWF Calibration Validation Event: June 14-19, 2022

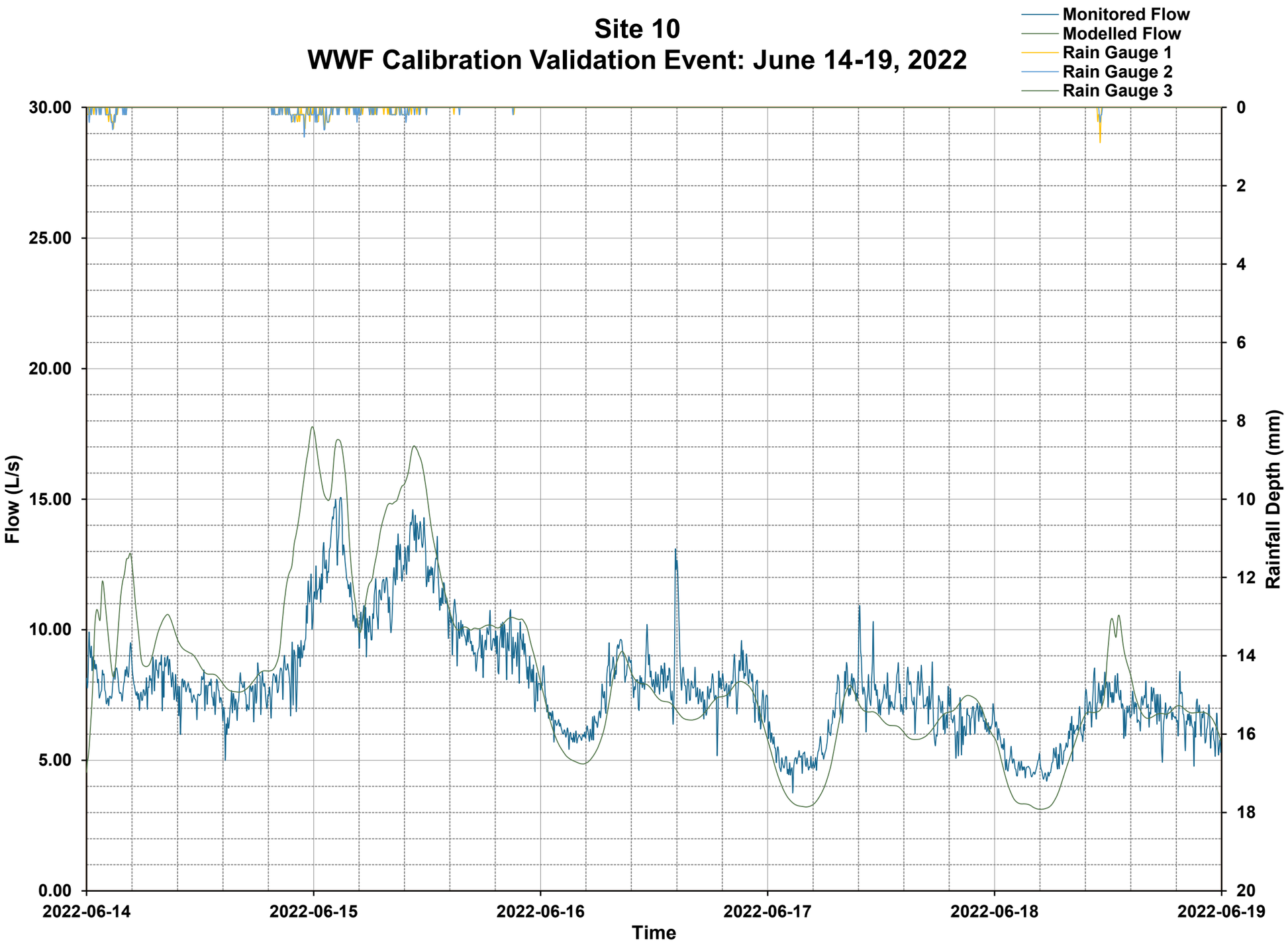

FIGURE C.25
WWF CALIBRATION - VALIDATION EVENT
SITE 10
SANITARY SEWER MASTER PLAN

Site 11
WWF Calibration Validation Event: June 23-28, 2022

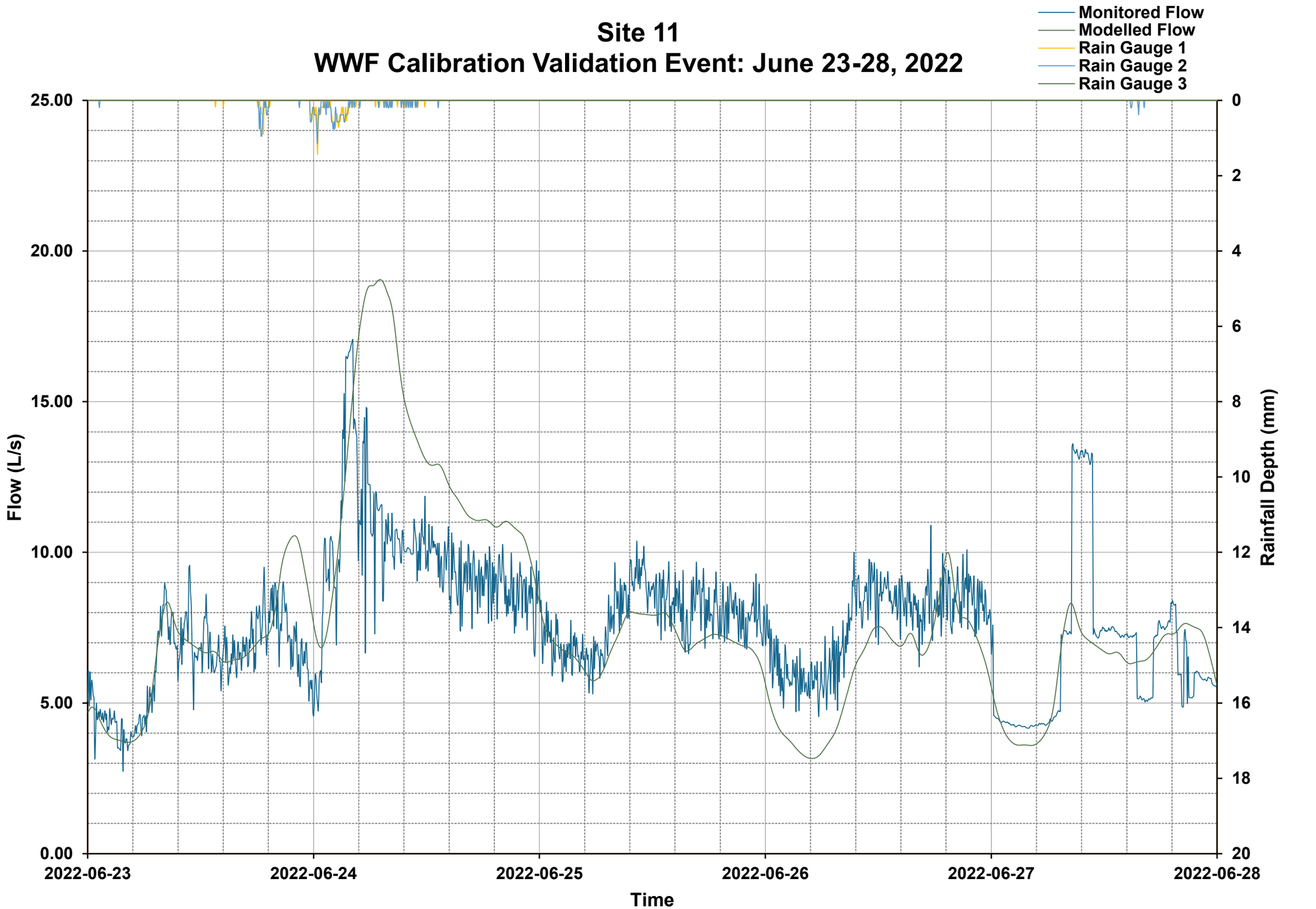

FIGURE C.26
WWF CALIBRATION - VALIDATION EVENT
SITE 11
SANITARY SEWER MASTER PLAN

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Site 12
WWF Calibration Validation Event: June 14-19, 2022

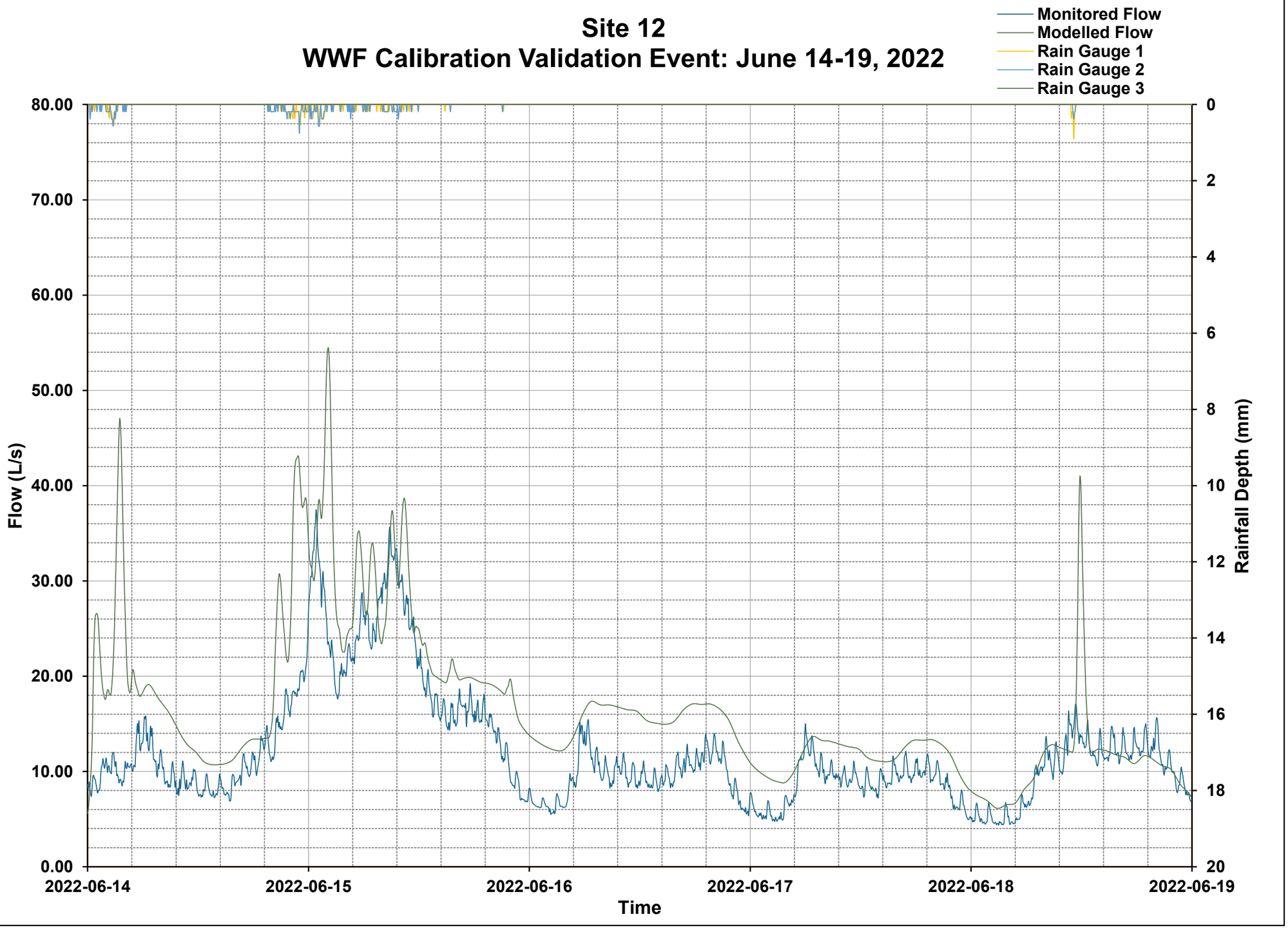

FIGURE C.27
WWF CALIBRATION - VALIDATION EVENT
SITE 12
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

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Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.27_WWF Calibration_Site 12_Validation.mxd

Site 13
WWF Calibration Validation Event: June 14-19, 2022

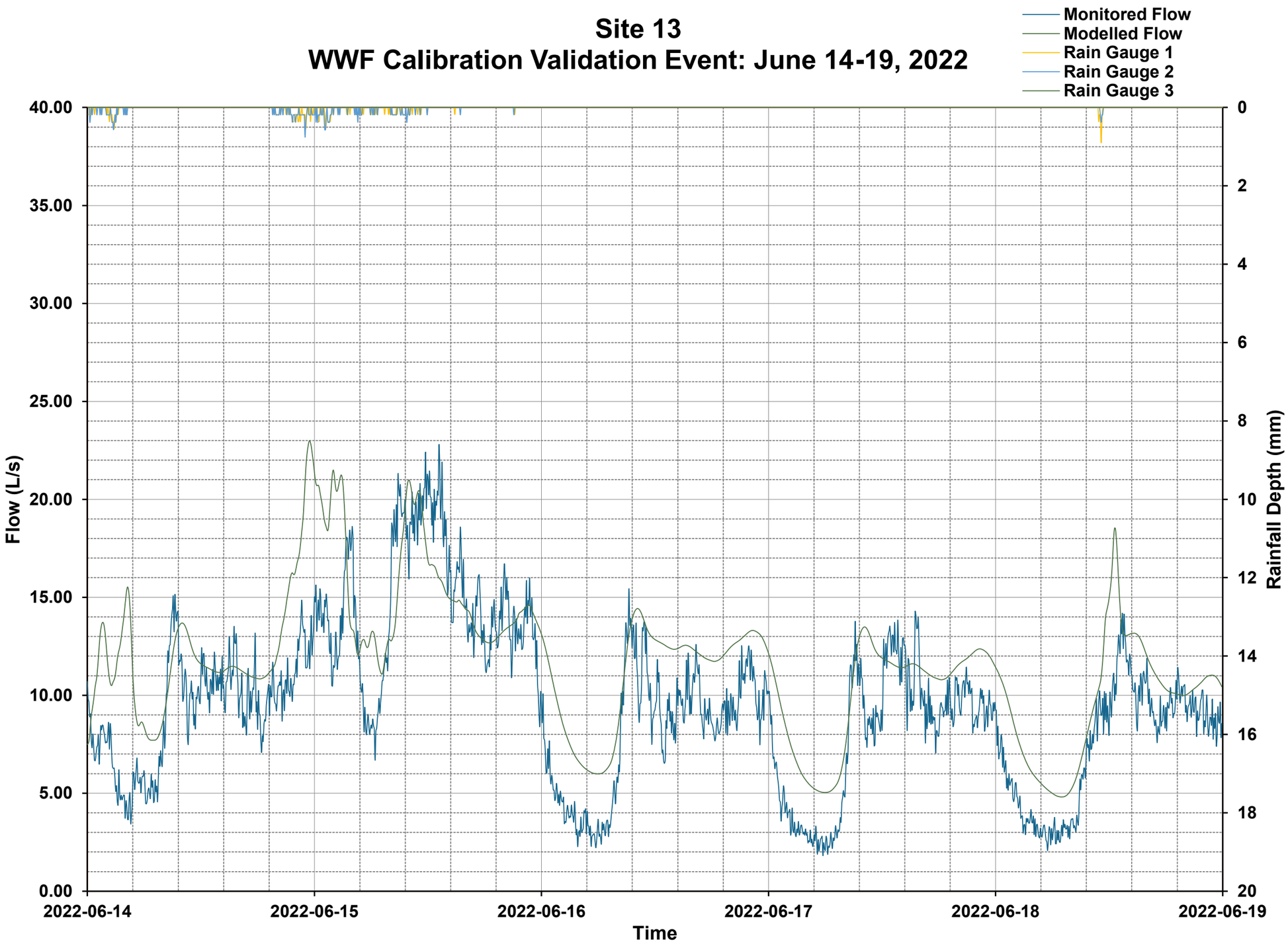

FIGURE C.28
WWF CALIBRATION - VALIDATION EVENT
SITE 13
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

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Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.28_WWF Calibration_Site 13_Validation.mxd

Site 14
WWF Calibration Validation Event: June 14-19, 2022

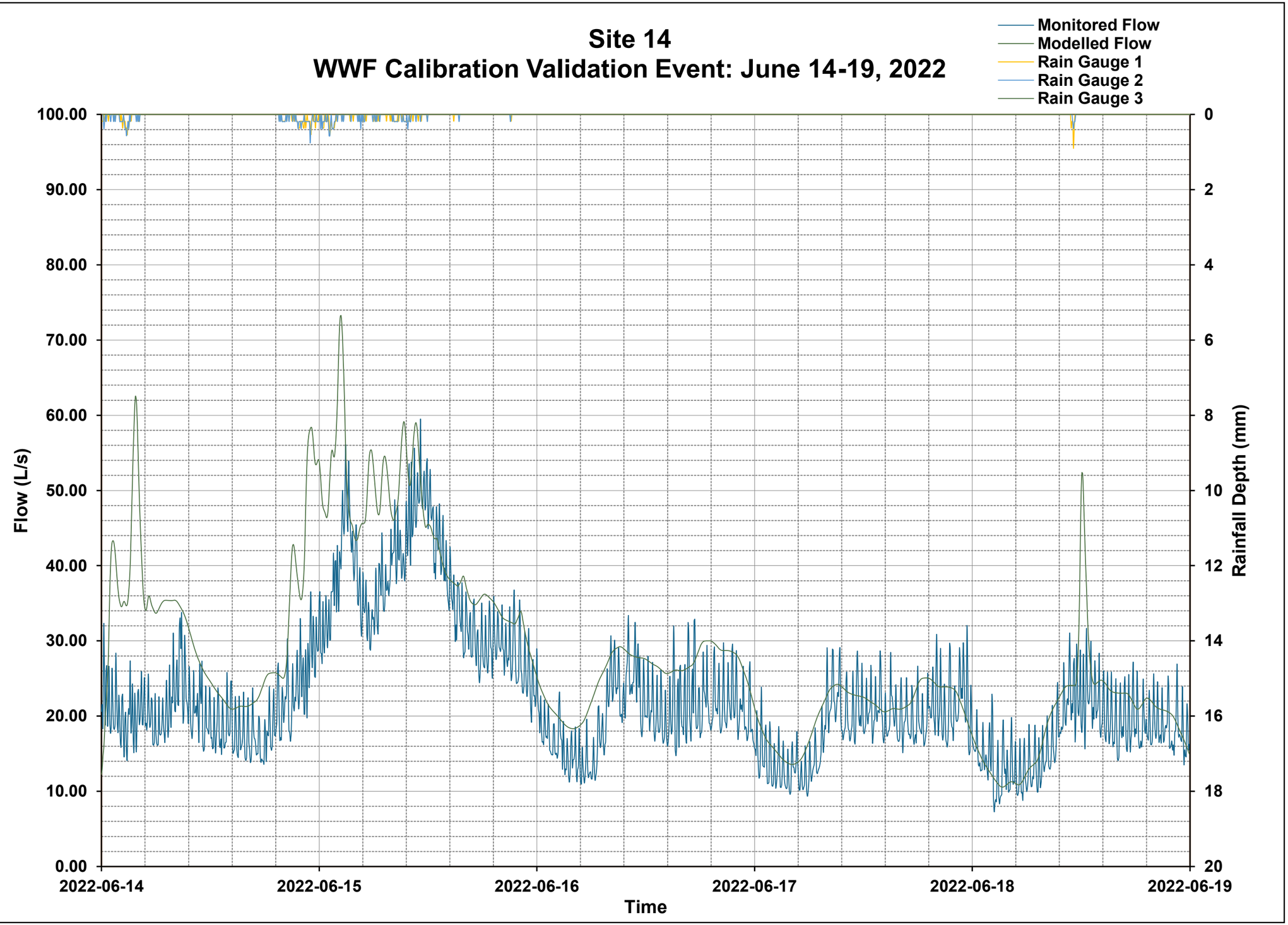

FIGURE C.29
WWF CALIBRATION - VALIDATION EVENT
SITE 14
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure C.29_WWF Calibration_Site 14_Validation.mxd

Site 15
WWF Calibration Validation Event: June 14-19, 2022

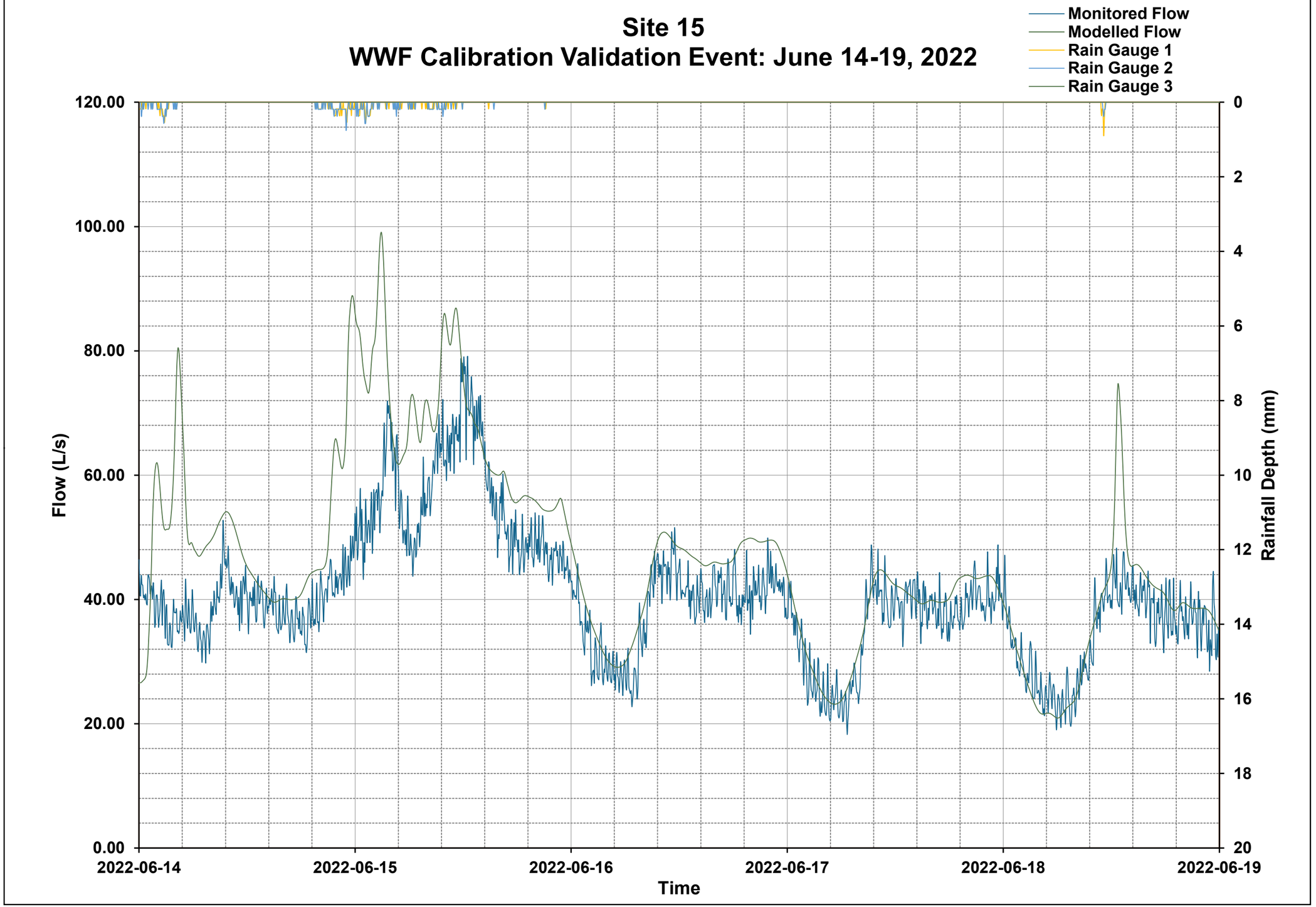

FIGURE C.30
WWF CALIBRATION - VALIDATION EVENT
SITE 15
SANITARY SEWER MASTER PLAN

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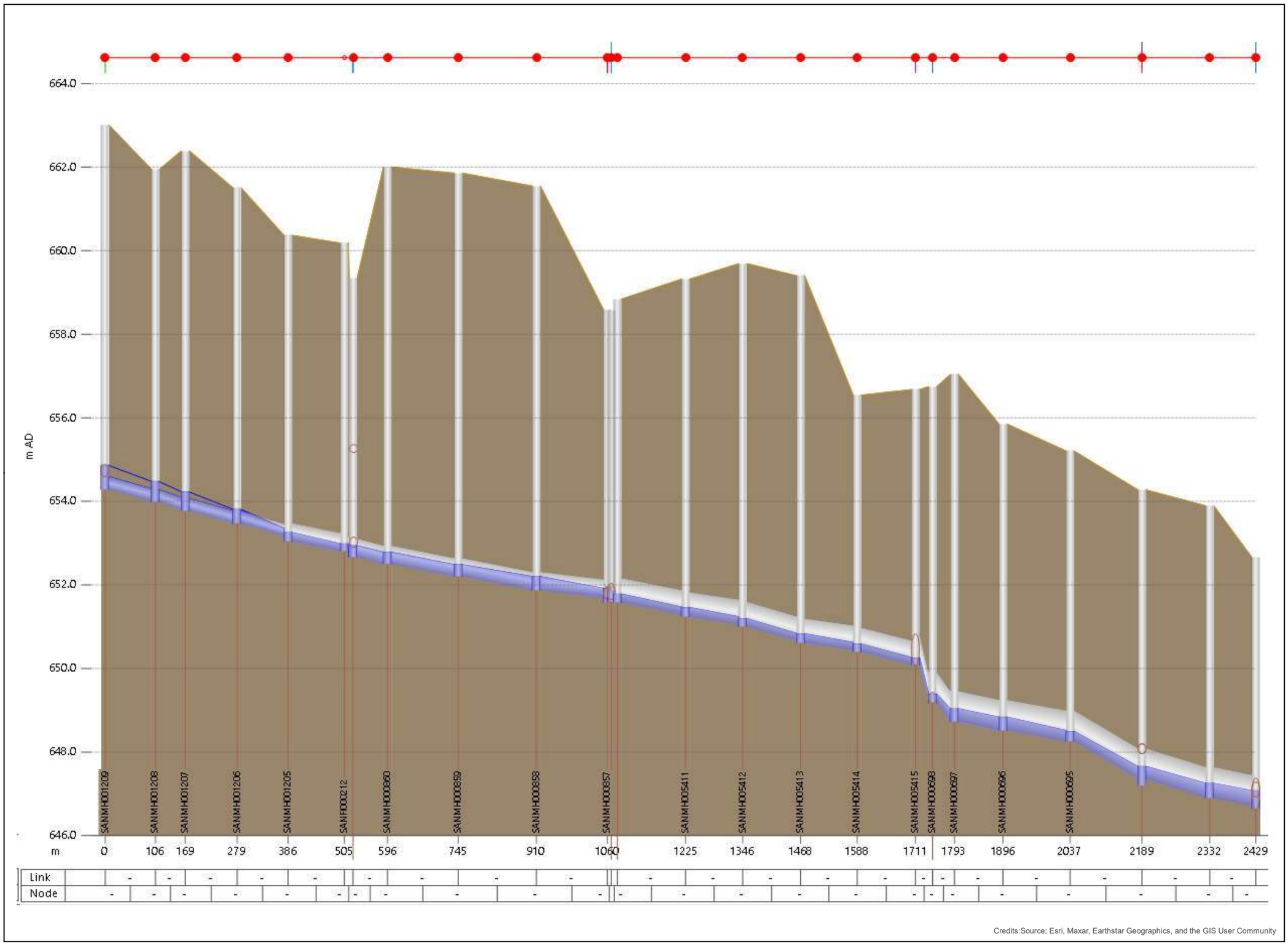
APPENDIX D
Longitudinal Profiles



Legend

- 25 Year Water Level
- Ground Elevation

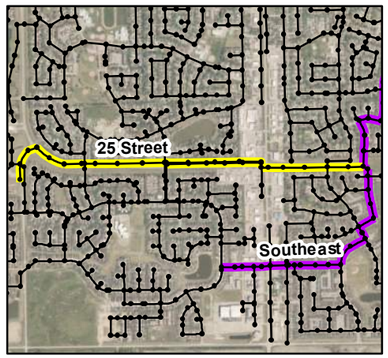


FIGURE D.1
EXISTING CONDITIONS
25 STREET TRUNK SEWER LP
SANITARY SEWER MASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure D.1_LP - 25St Trunk Sewer.mxd

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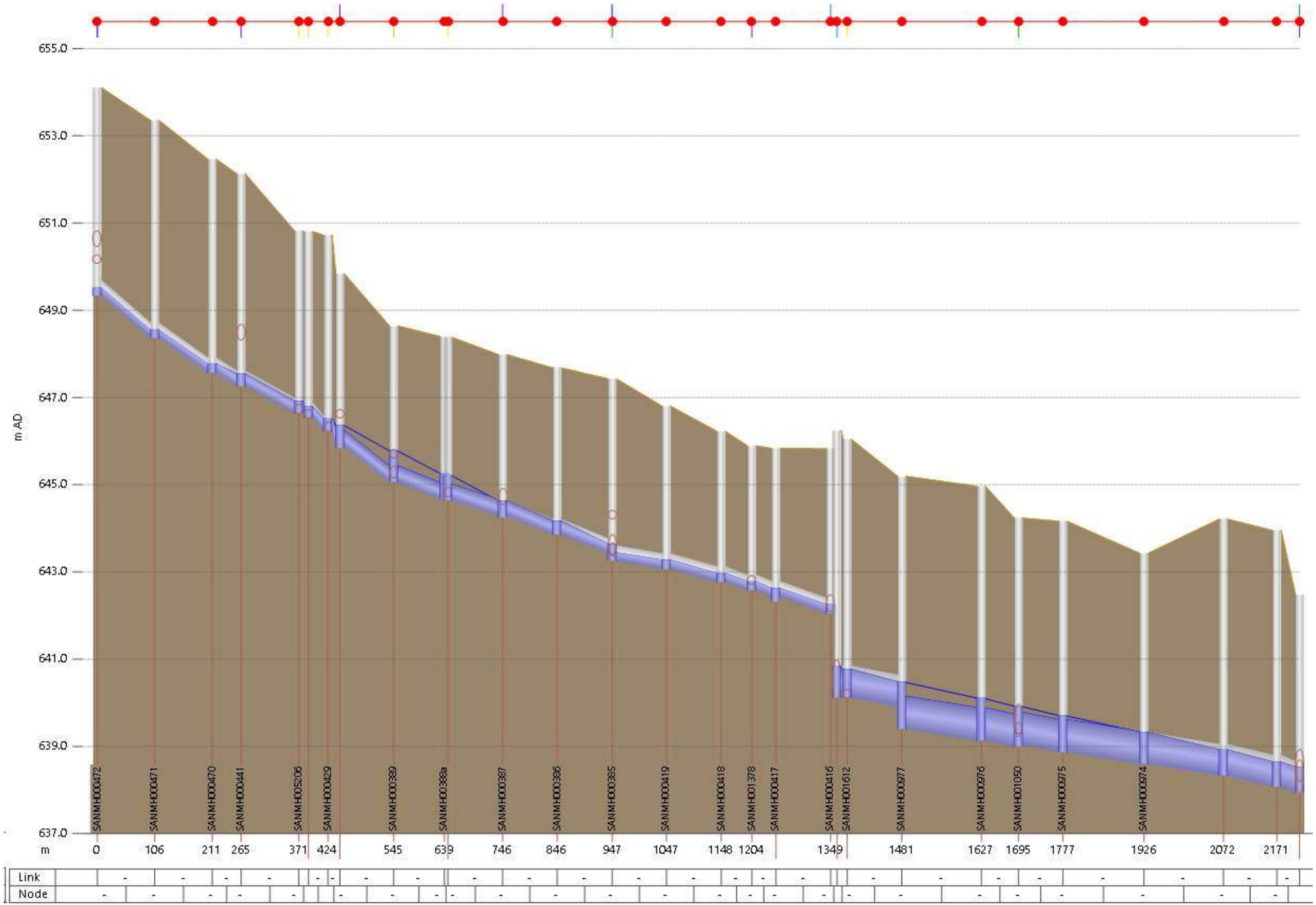
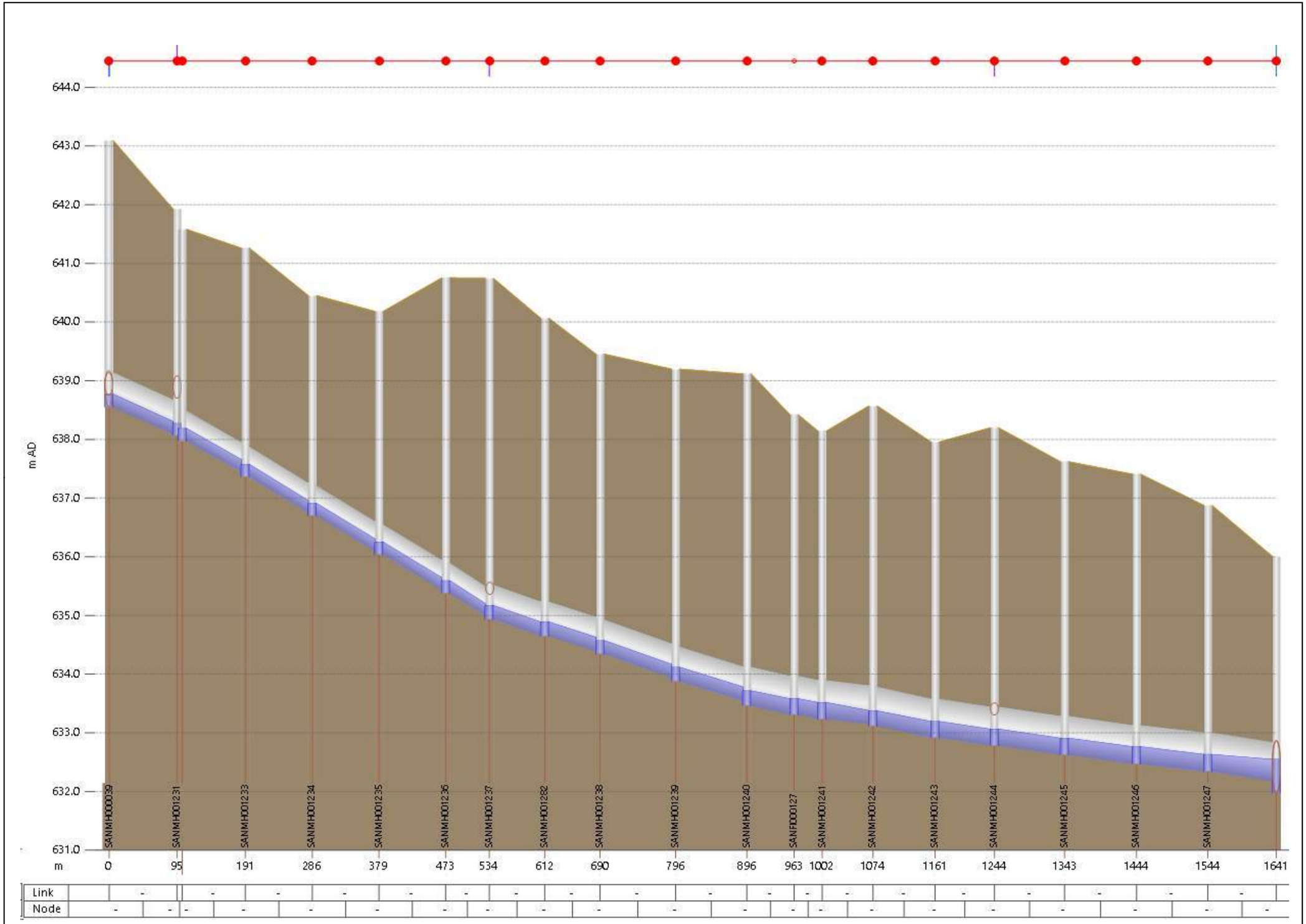


Legend

- 25 Year Water Level
- Ground Elevation

FIGURE D.2
EXISTING CONDITIONS
36 STREET TRUNK SEWER LP
SANITARY SEWER MASTER PLAN



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- 25 Year Water Level
- Ground Elevation

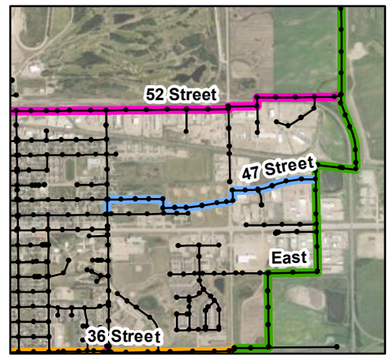


FIGURE D.3
EXISTING CONDITIONS
47 STREET TRUNK SEWER LP
SANITARY SEWER MASTER PLAN

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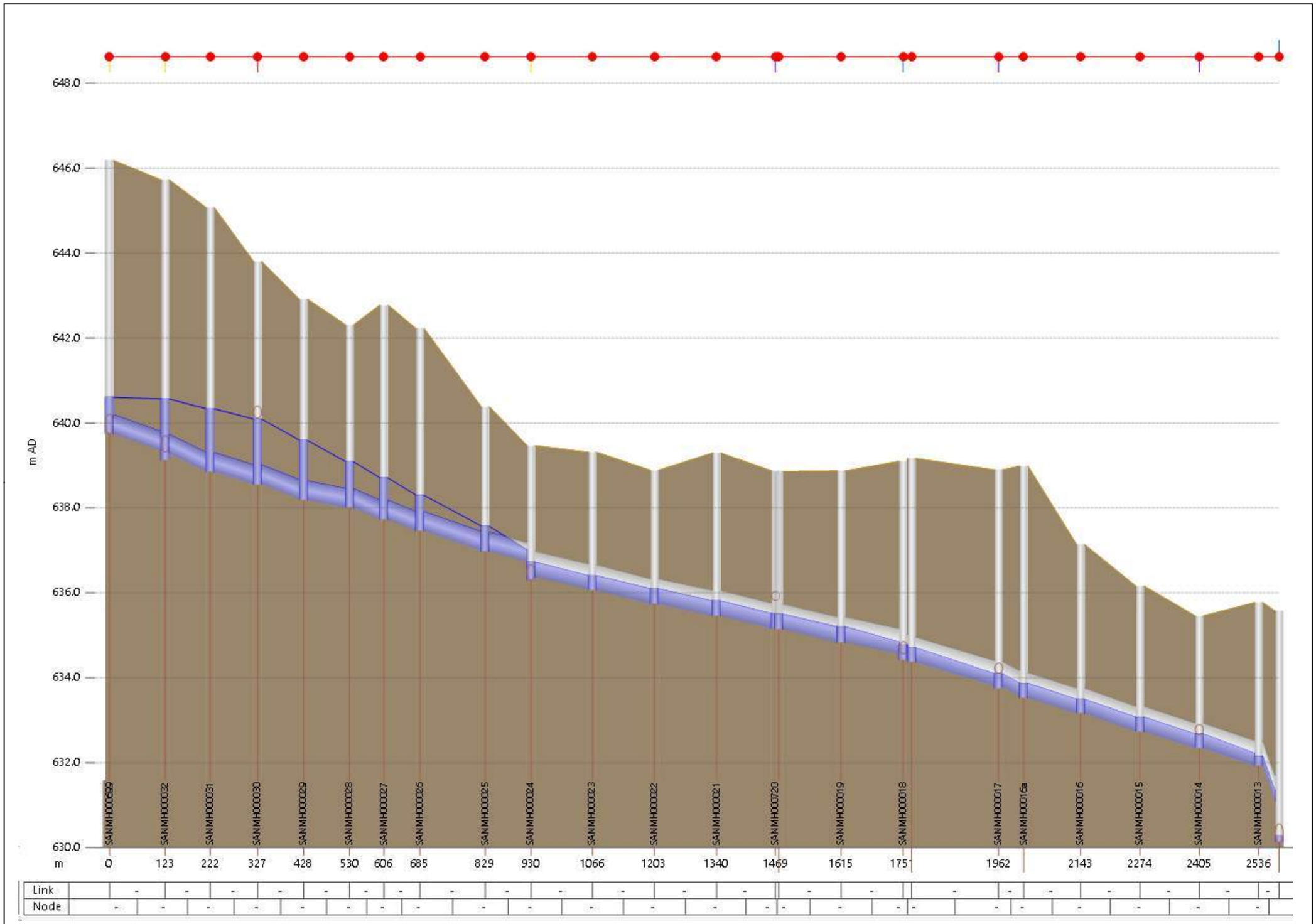

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE D.4
EXISTING CONDITIONS
52 STREET TRUNK SEWER LP
SANITARY SEWER MASTER PLAN

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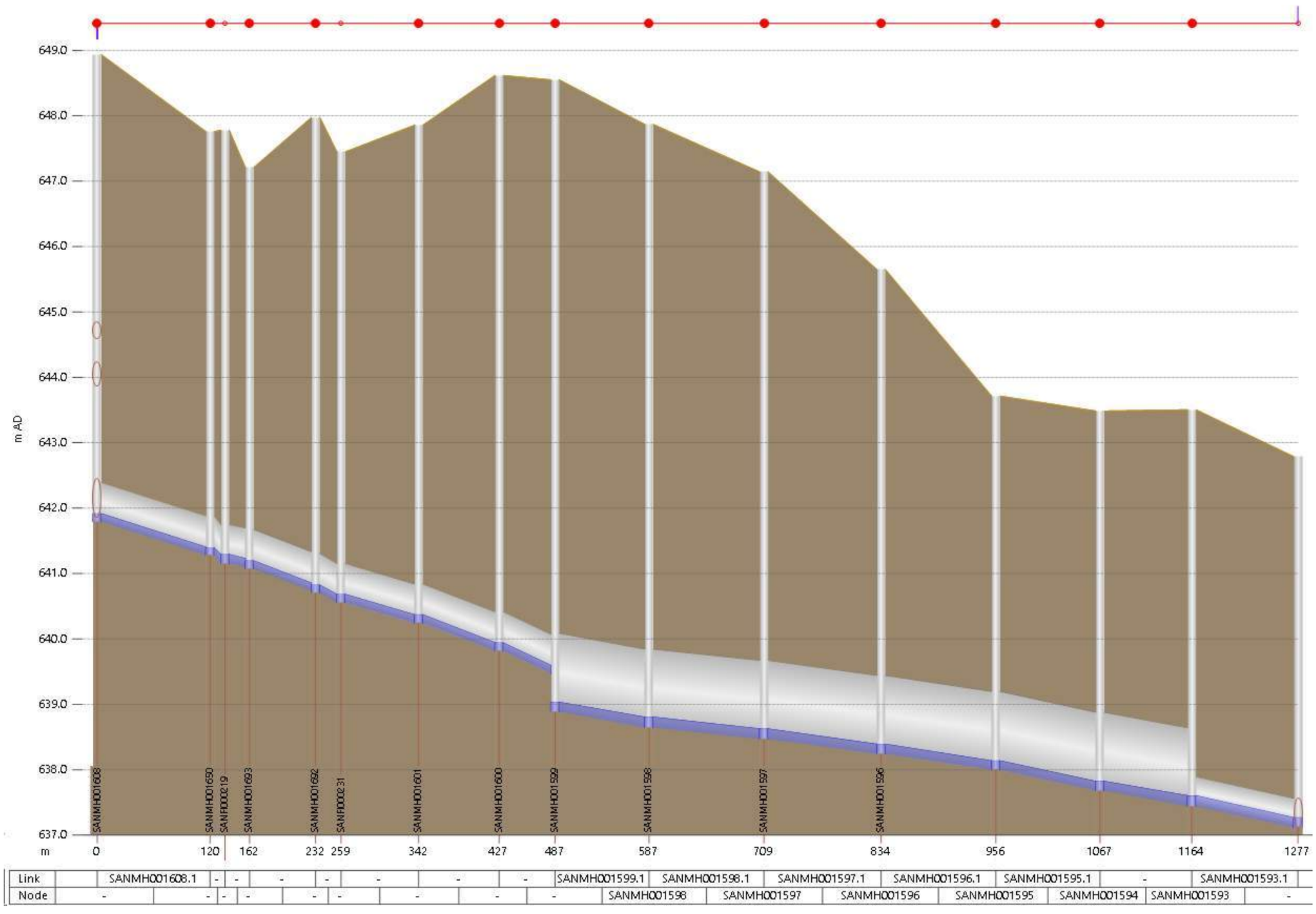


Legend

- 25 Year Water Level
- Ground Elevation

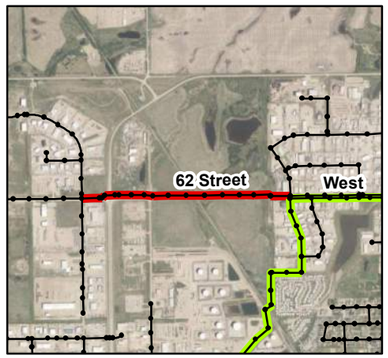
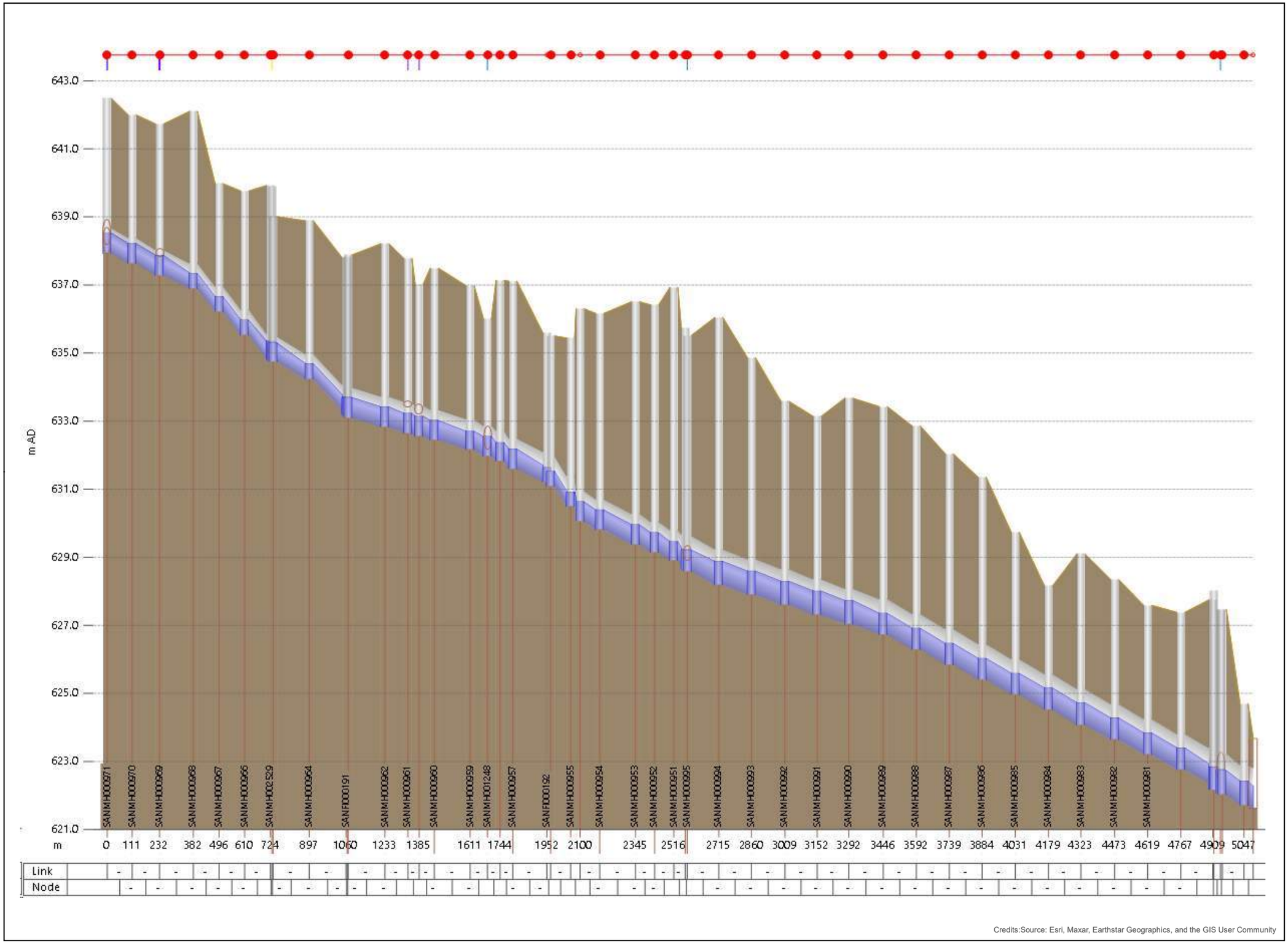


FIGURE D.5
EXISTING CONDITIONS
62 STREET TRUNK SEWER LP
SANITARY SEWER MASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

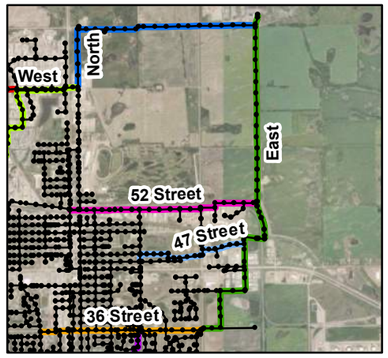
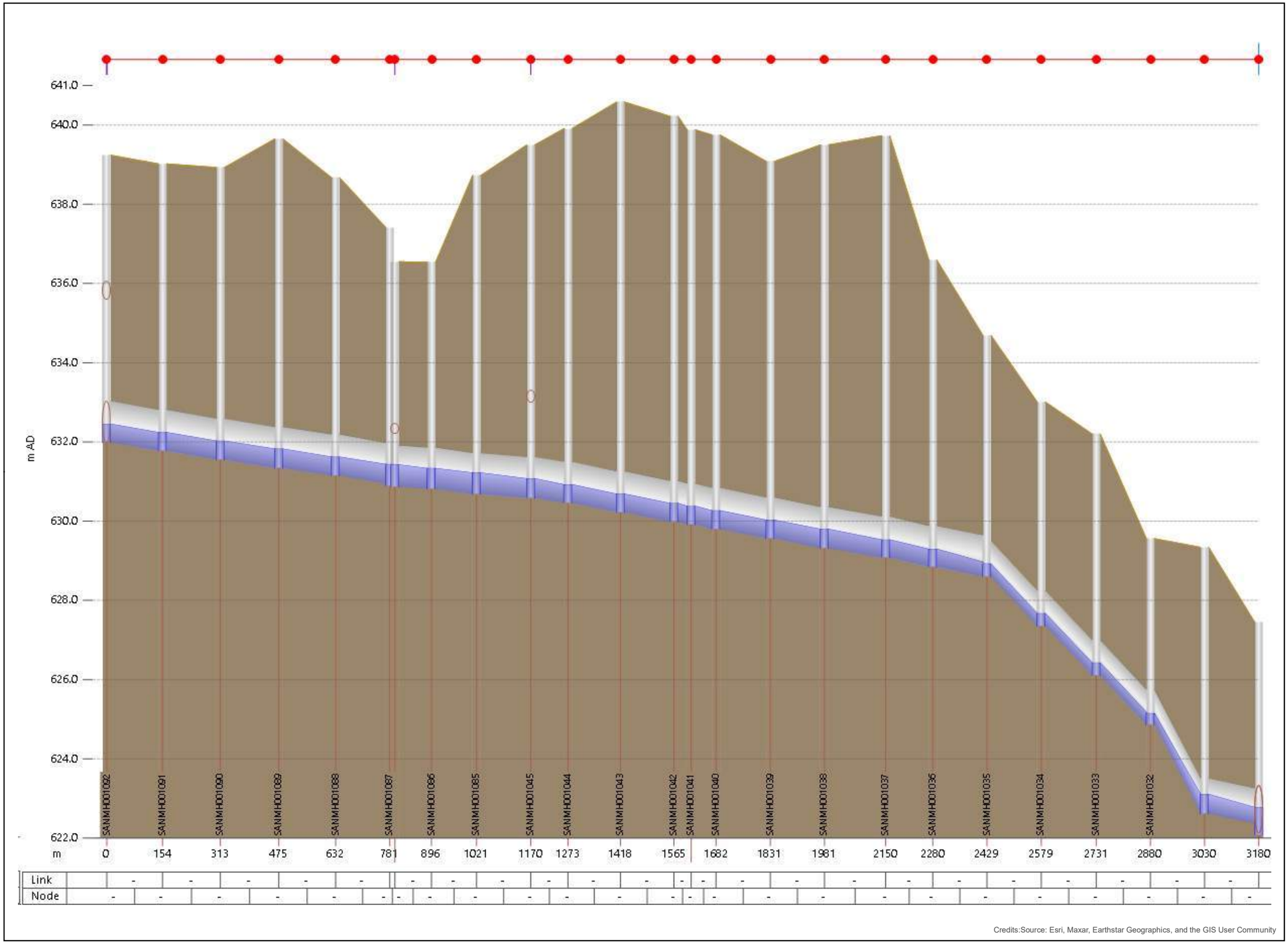


FIGURE D.6
EXISTING CONDITIONS
EAST TRUNK SEWER LP
SANITARY SEWER MASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

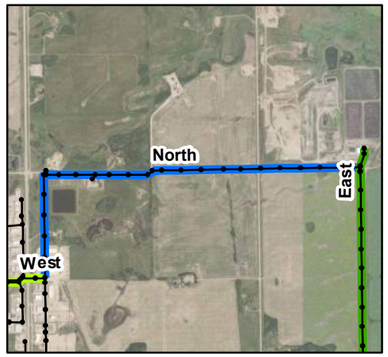
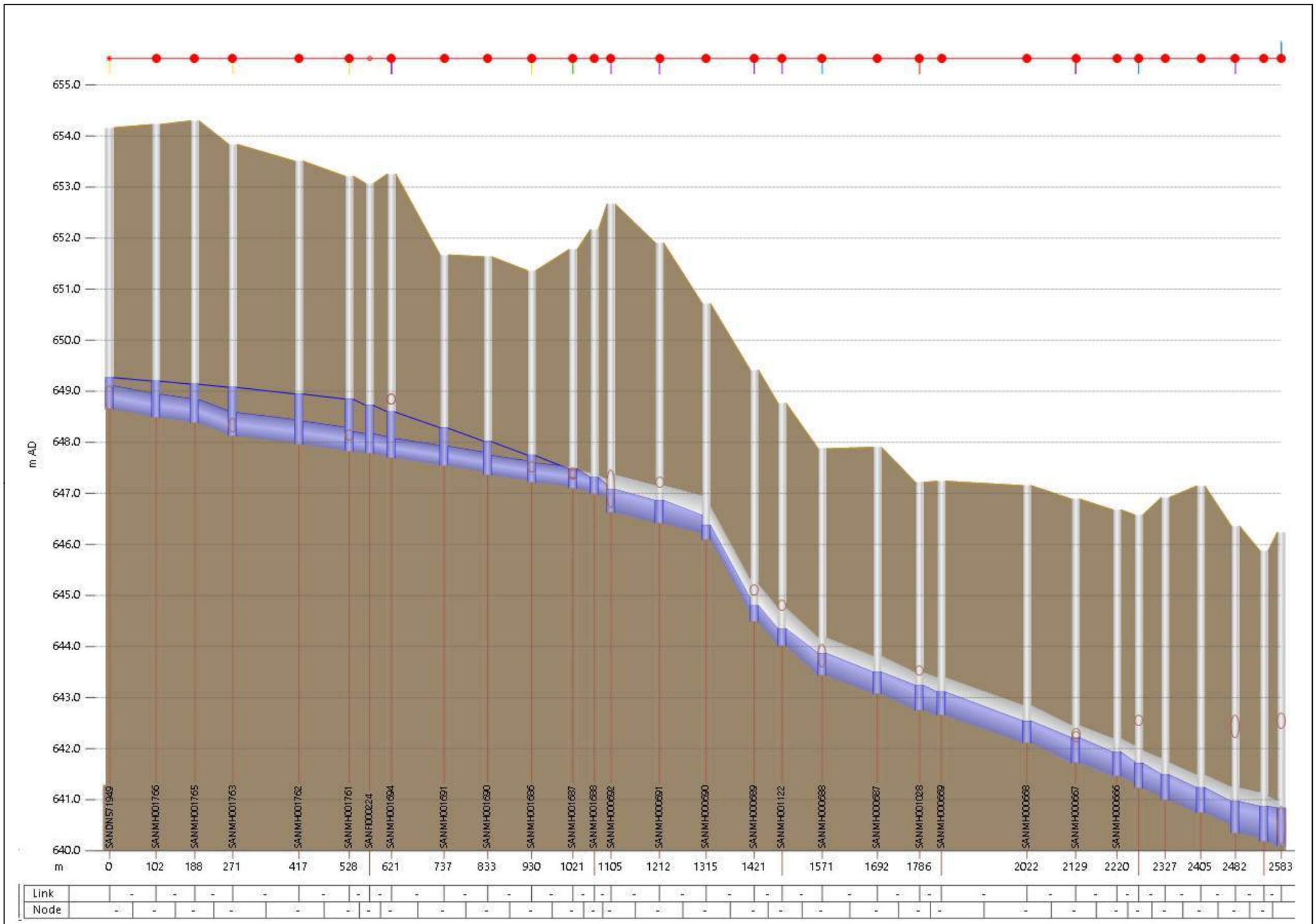


FIGURE D.7
EXISTING CONDITIONS
NORTH TRUNK SEWER LP
SANITARY SEWER MASTER PLAN



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- 25 Year Water Level
- Ground Elevation

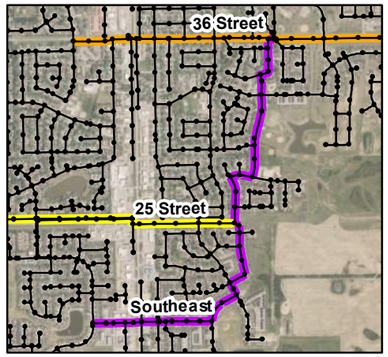


FIGURE D.8
EXISTING CONDITIONS
SOUTHEAST TRUNK SEWER LP
SANITARY SEWER MASTER PLAN

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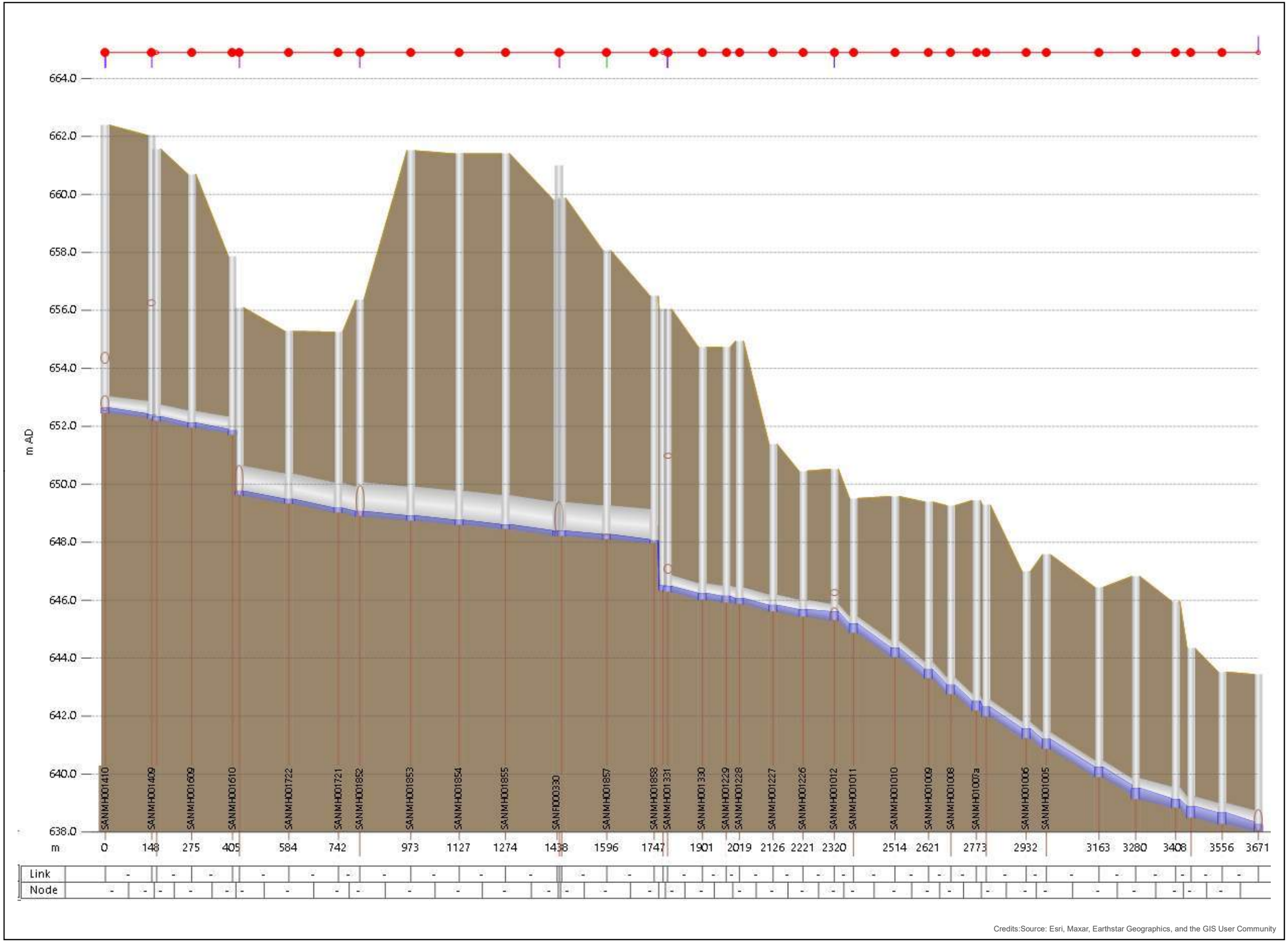

Legend

- 25 Year Water Level
- Ground Elevation

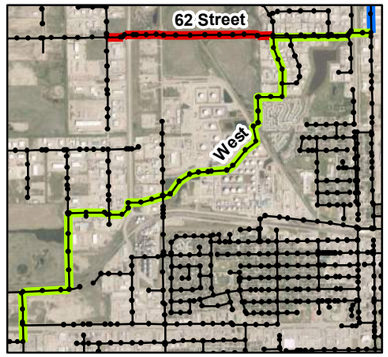

FIGURE D.9
EXISTING CONDITIONS
WEST TRUNK SEWER LP
SANITARY SEWER MASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Date: 2024-01-31 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure D.9_LP - West Trunk Sewer.mxd

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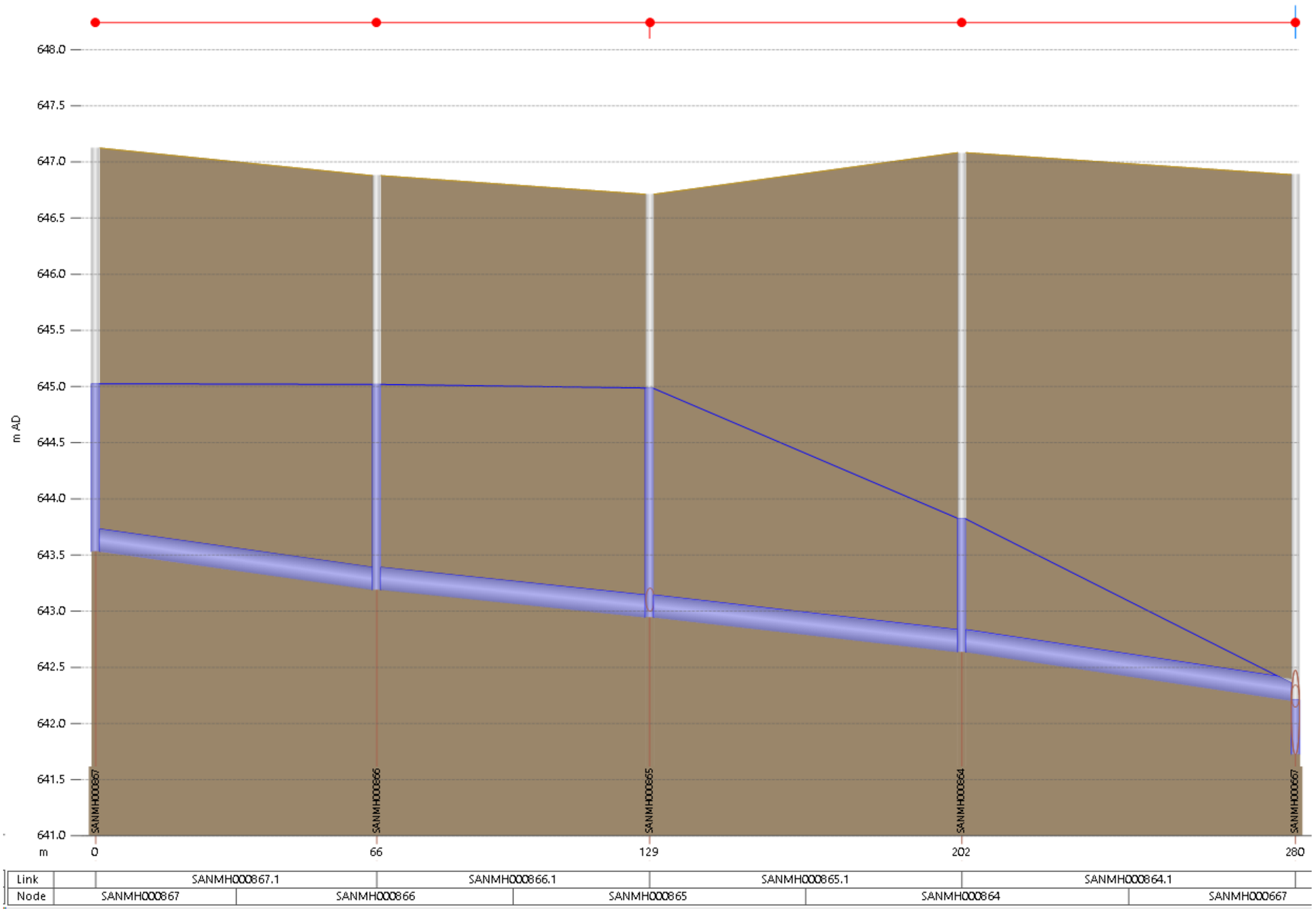


Legend

- 25 Year Water Level
- Ground Elevation

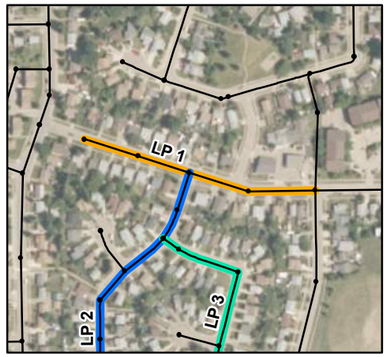
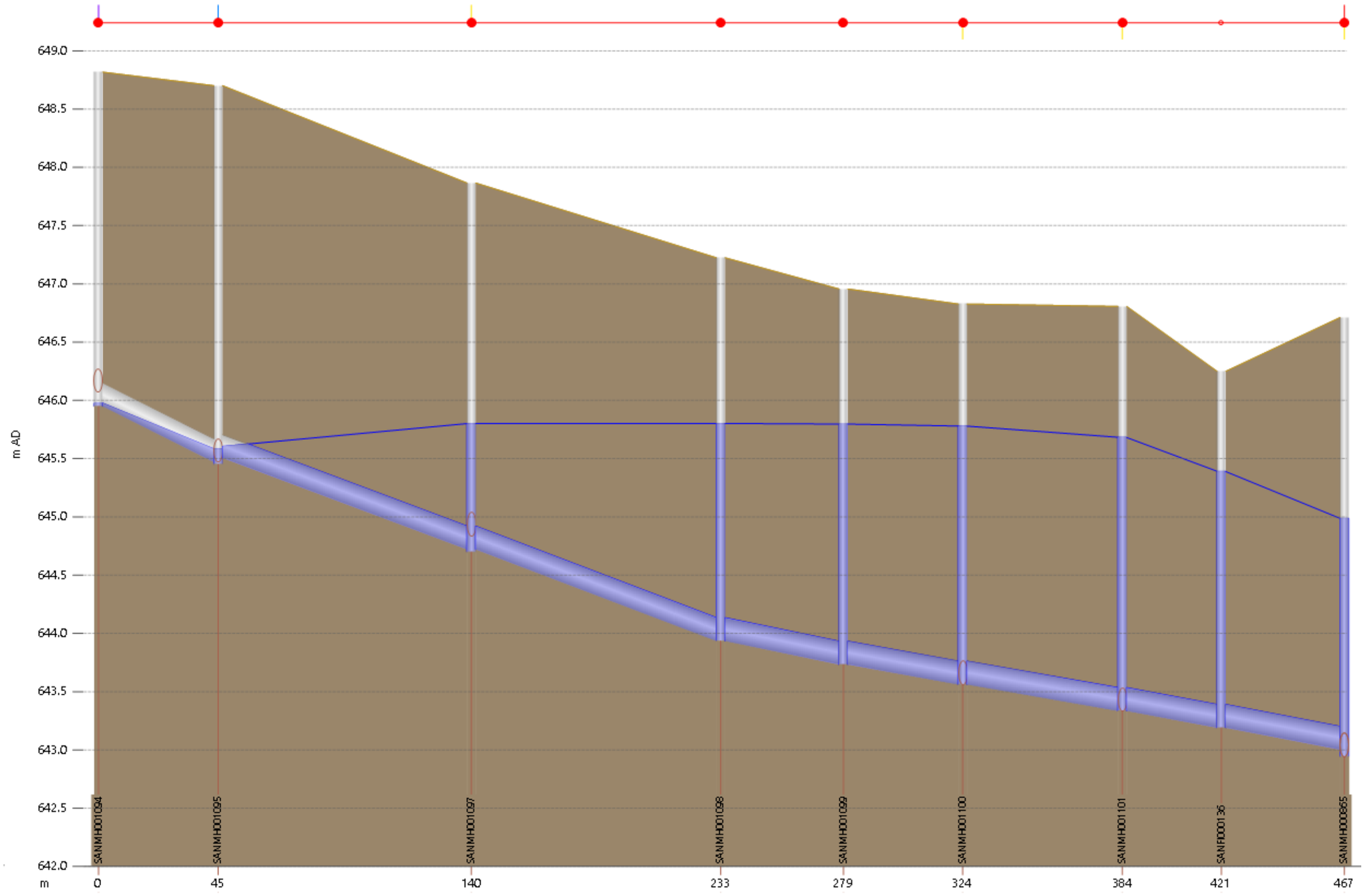


FIGURE D.10
EXISTING CONDITIONS - LP 1
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

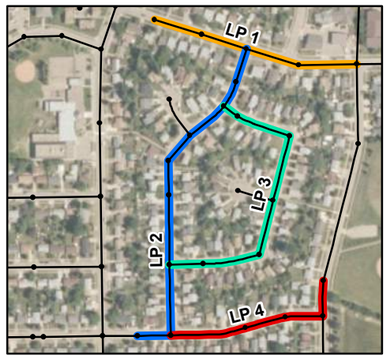
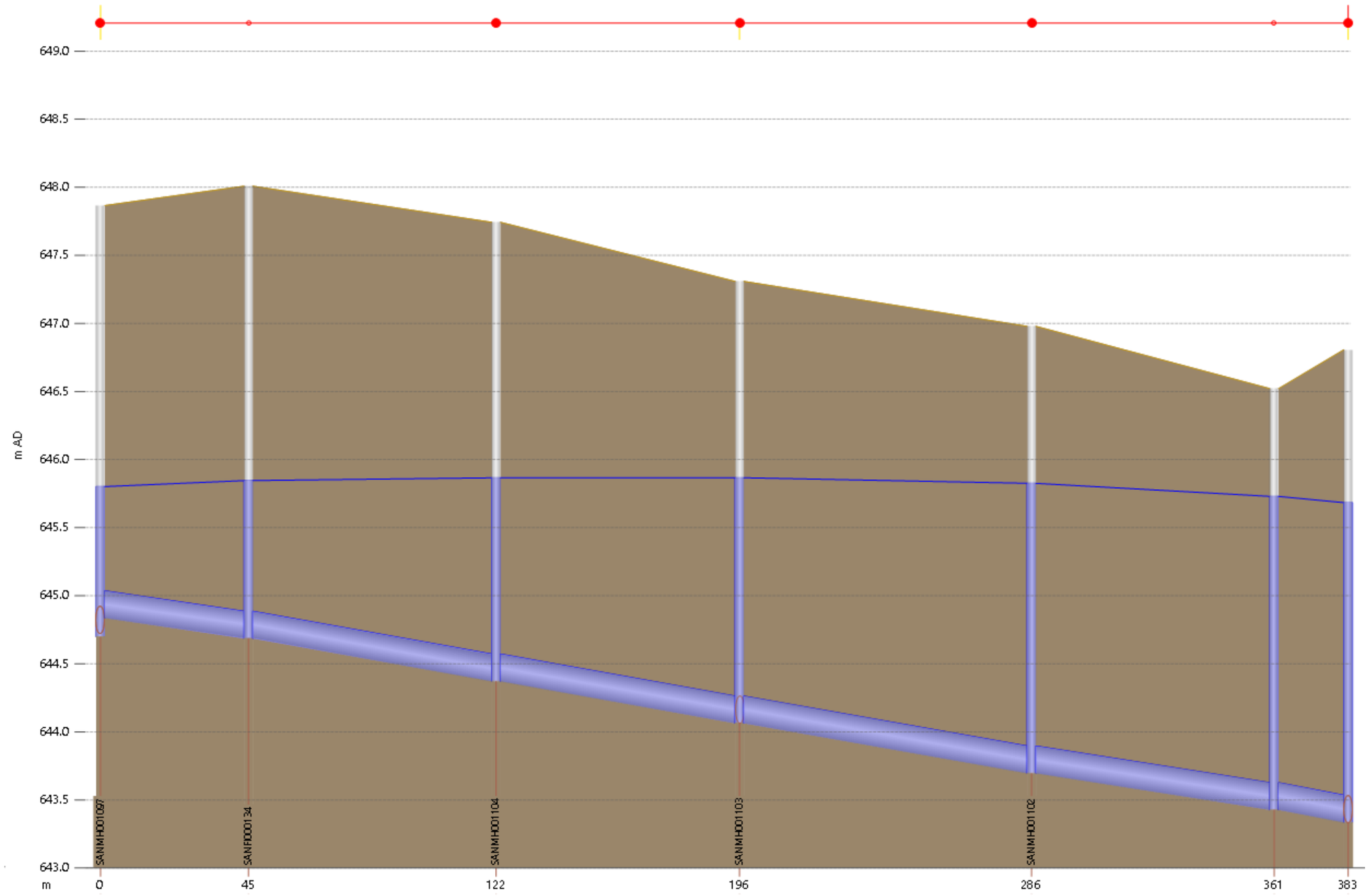


FIGURE D.11
EXISTING CONDITIONS - LP 2
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

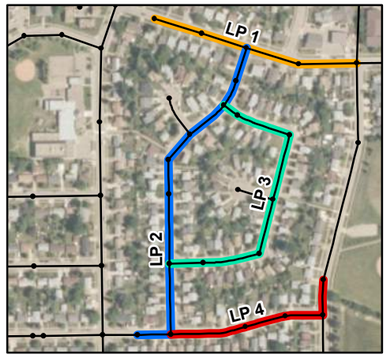
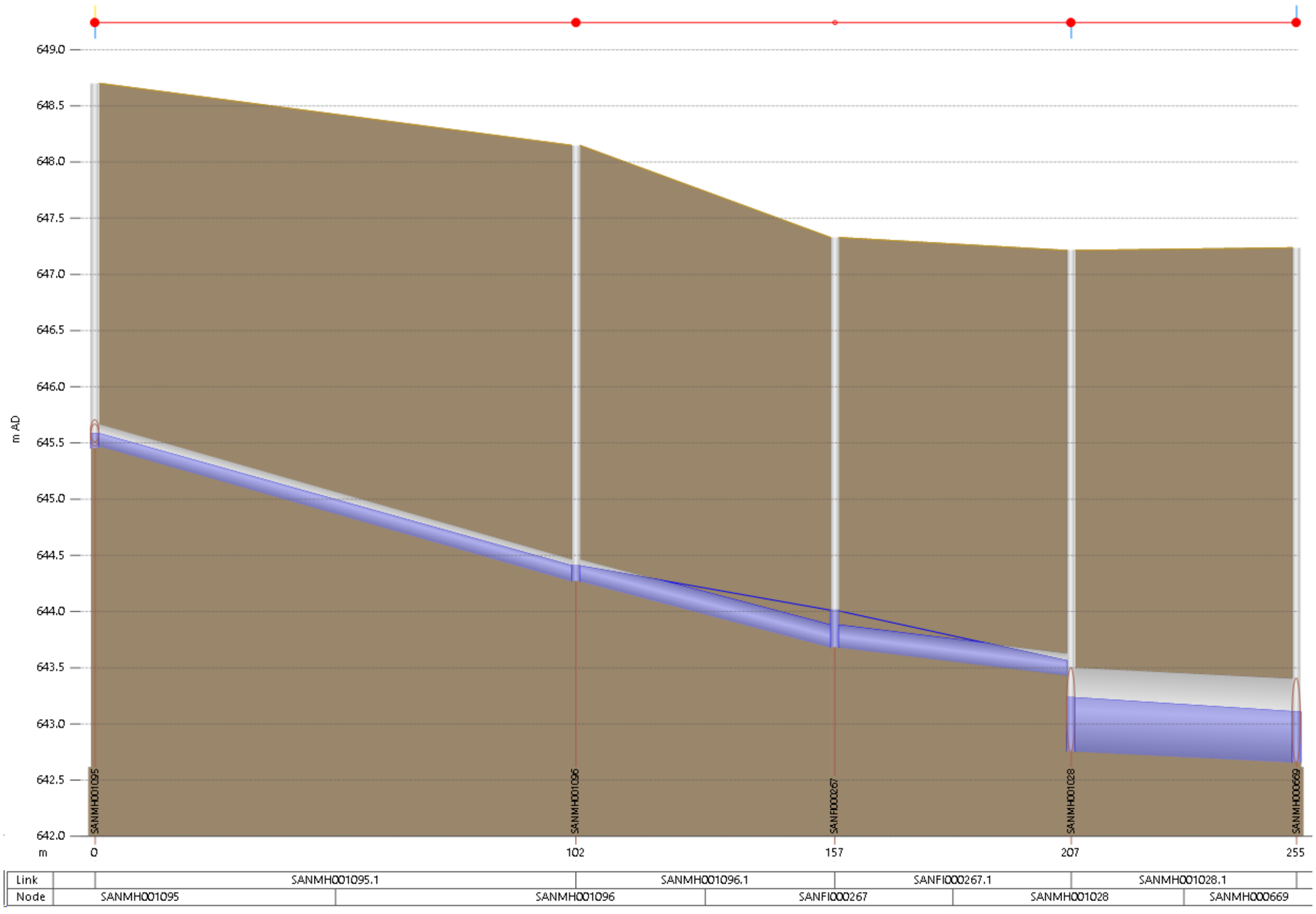


FIGURE D.12
EXISTING CONDITIONS - LP 3
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

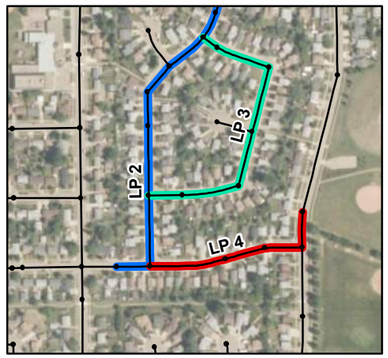
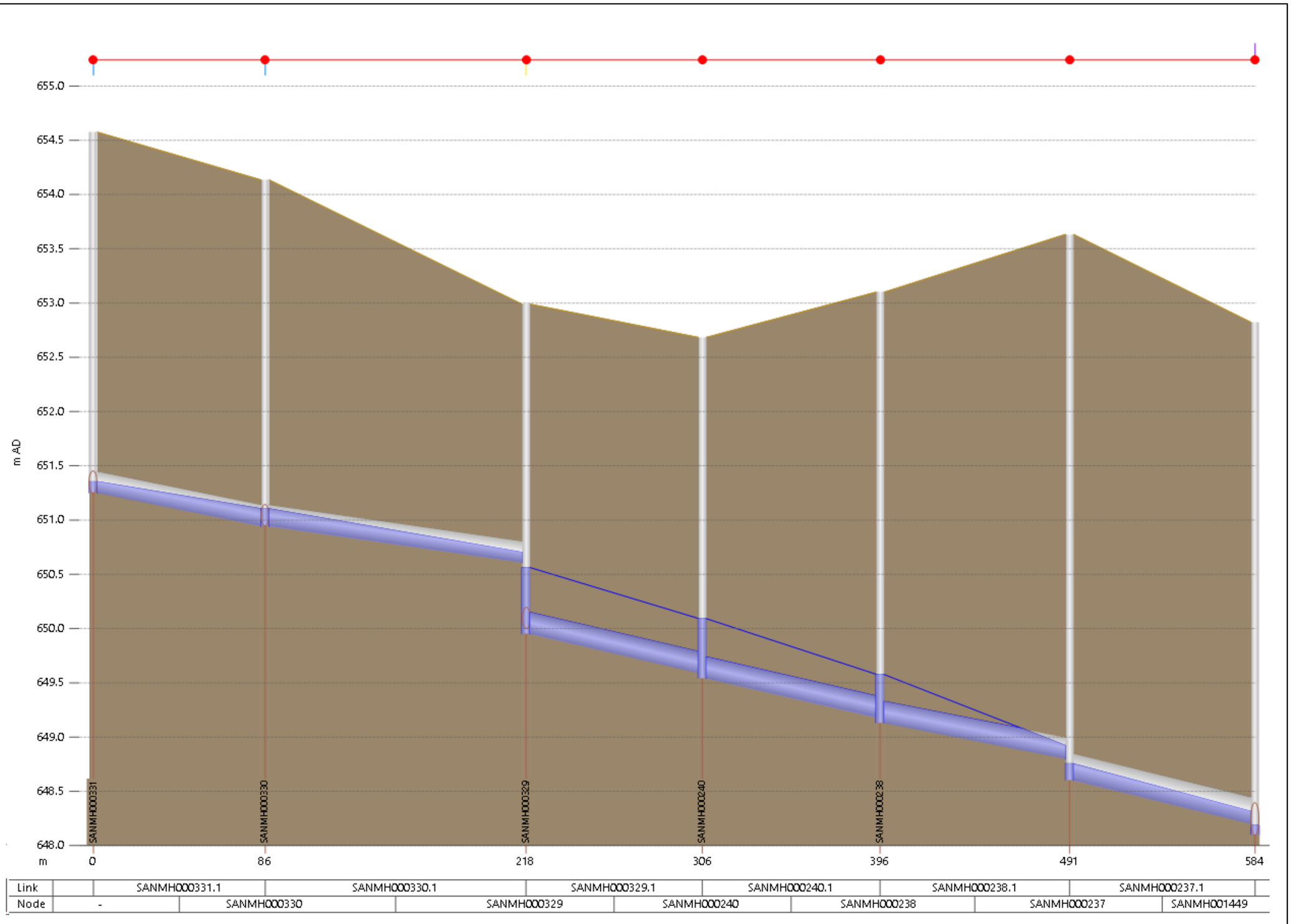


FIGURE D.13
EXISTING CONDITIONS - LP 4
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

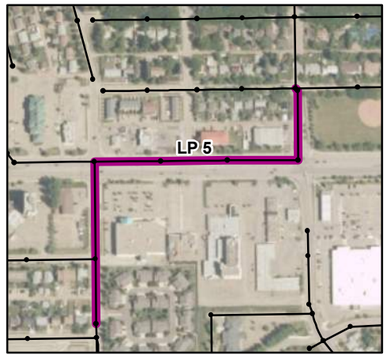
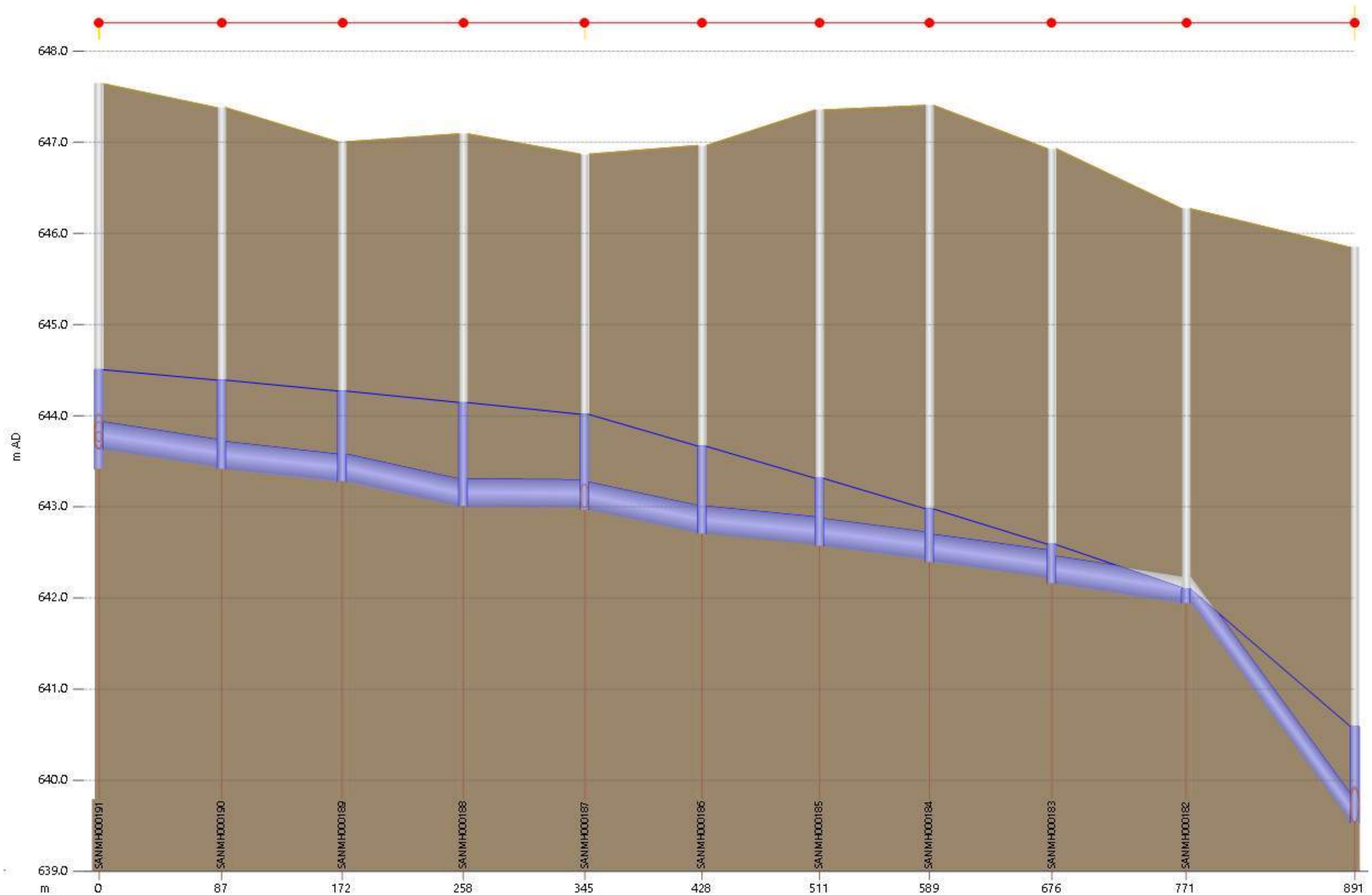


FIGURE D.14
EXISTING CONDITIONS - LP 5
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

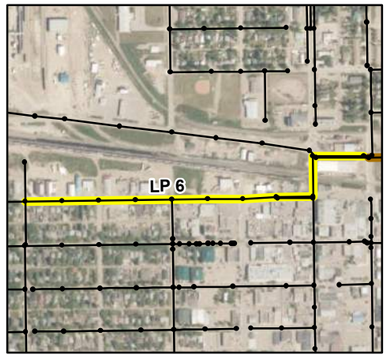


FIGURE D.15
EXISTING CONDITIONS - LP 6
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure D.15_LP 6.mxd

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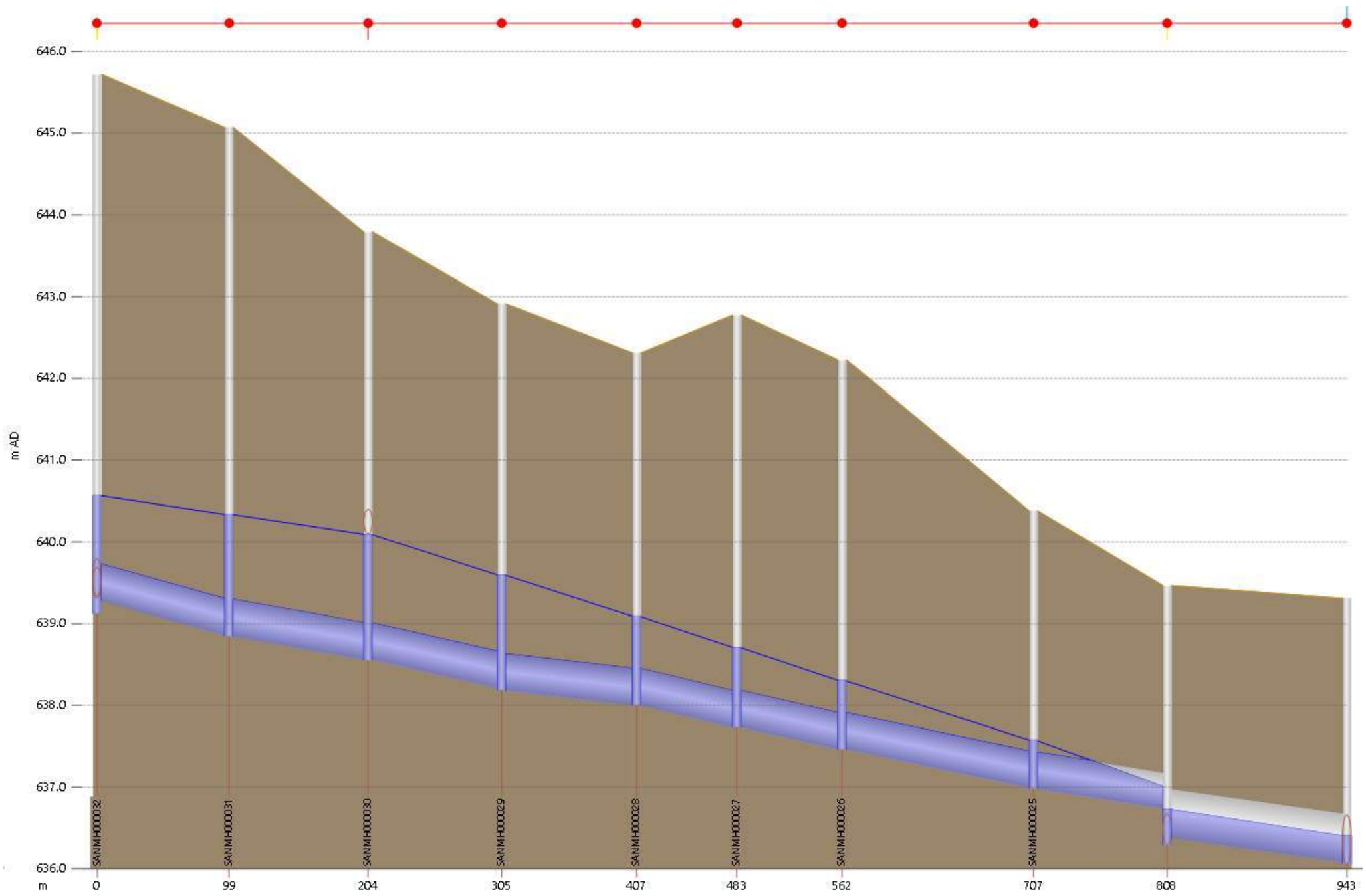


Legend

- 25 Year Water Level
- Ground Elevation

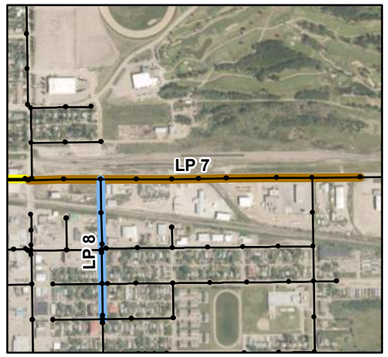
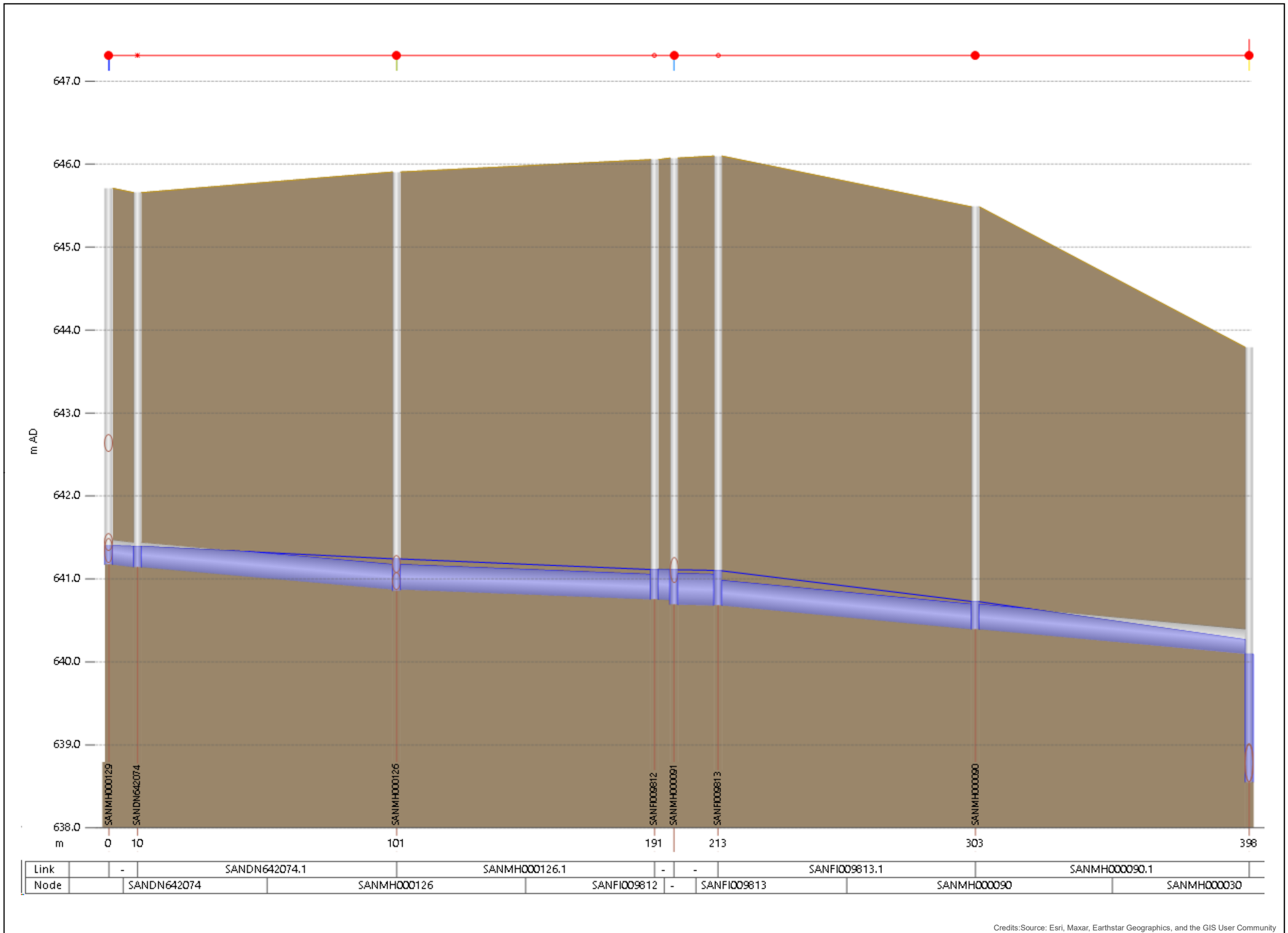


FIGURE D.16
EXISTING CONDITIONS - LP 7
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

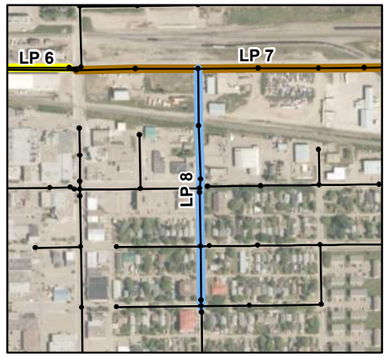


FIGURE D.17
EXISTING CONDITIONS - LP 8
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure D.17_LP 8.mxd

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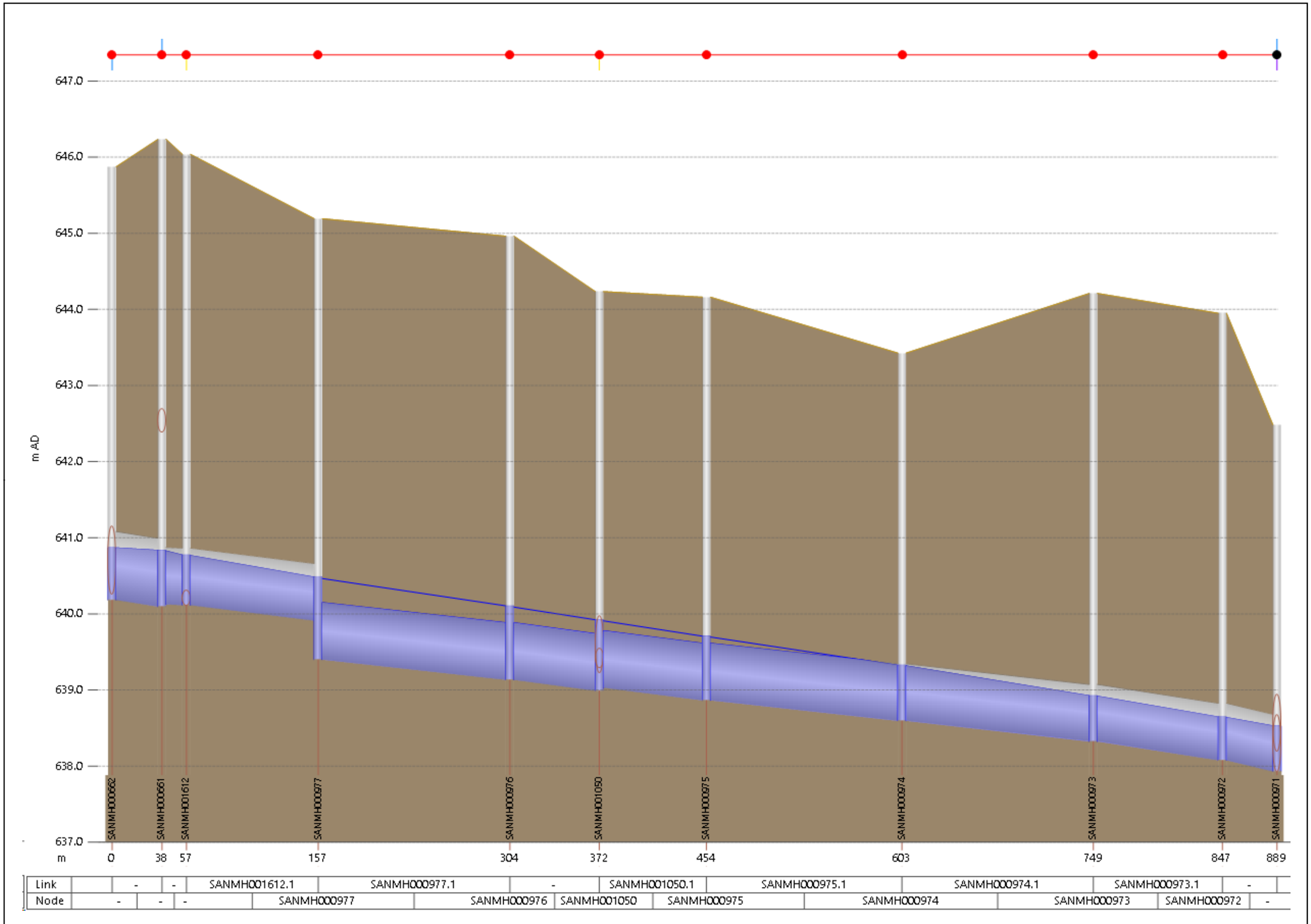


Legend

25 Year Water Level

Ground Elevation

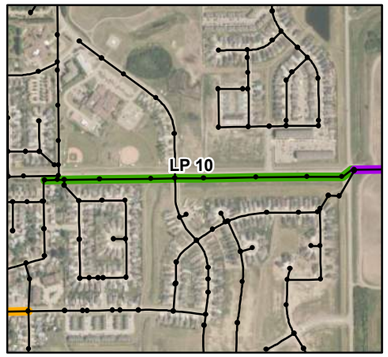
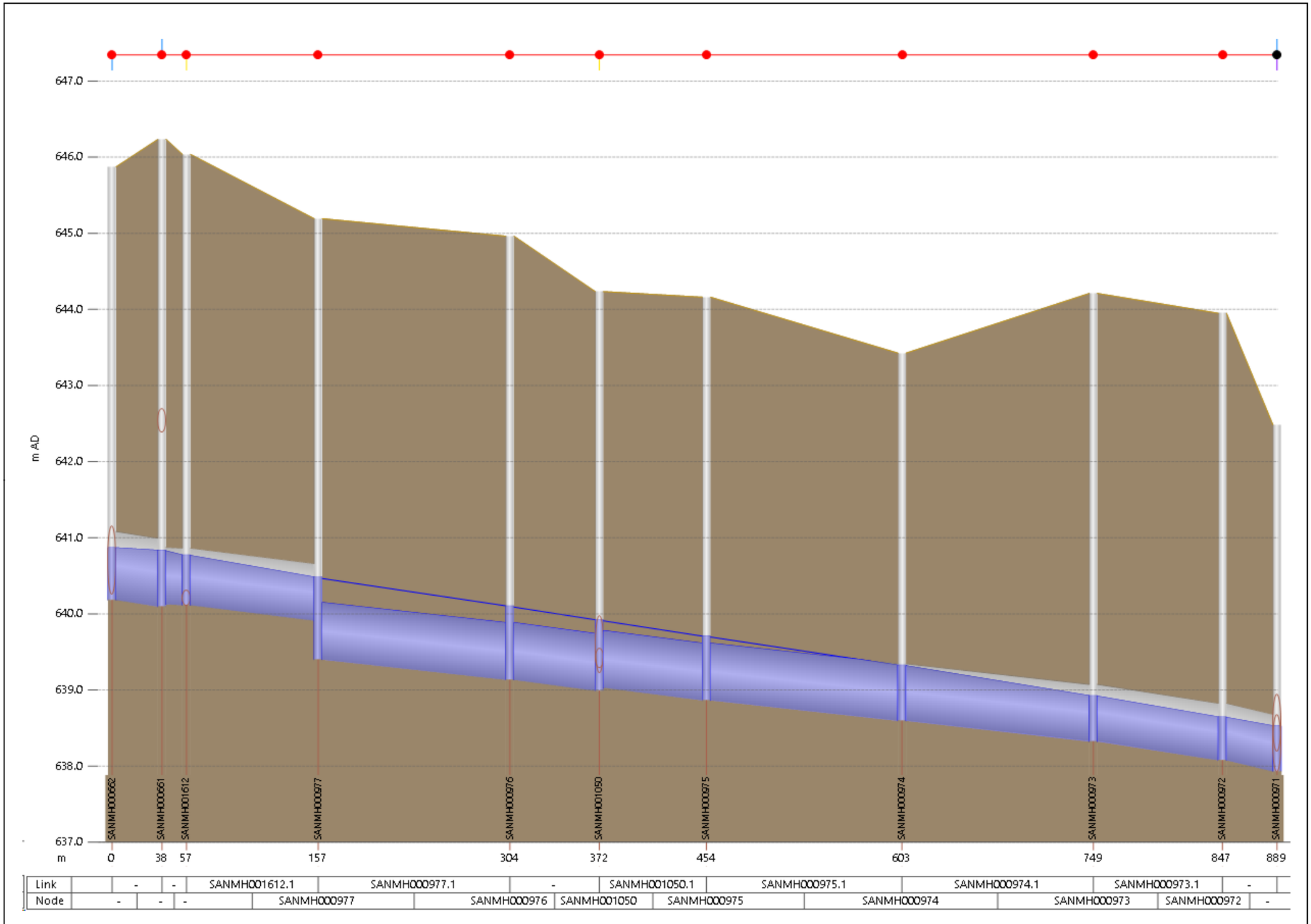


FIGURE D.19
EXISTING CONDITIONS - LP 10
SANITARY SEWERMASTER PLAN



Legend

25 Year Water Level

Ground Elevation

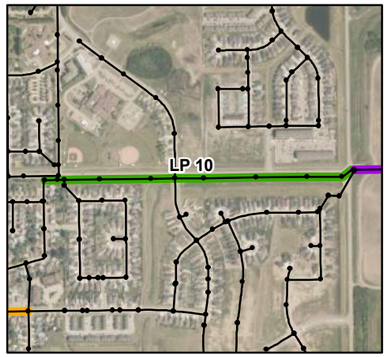
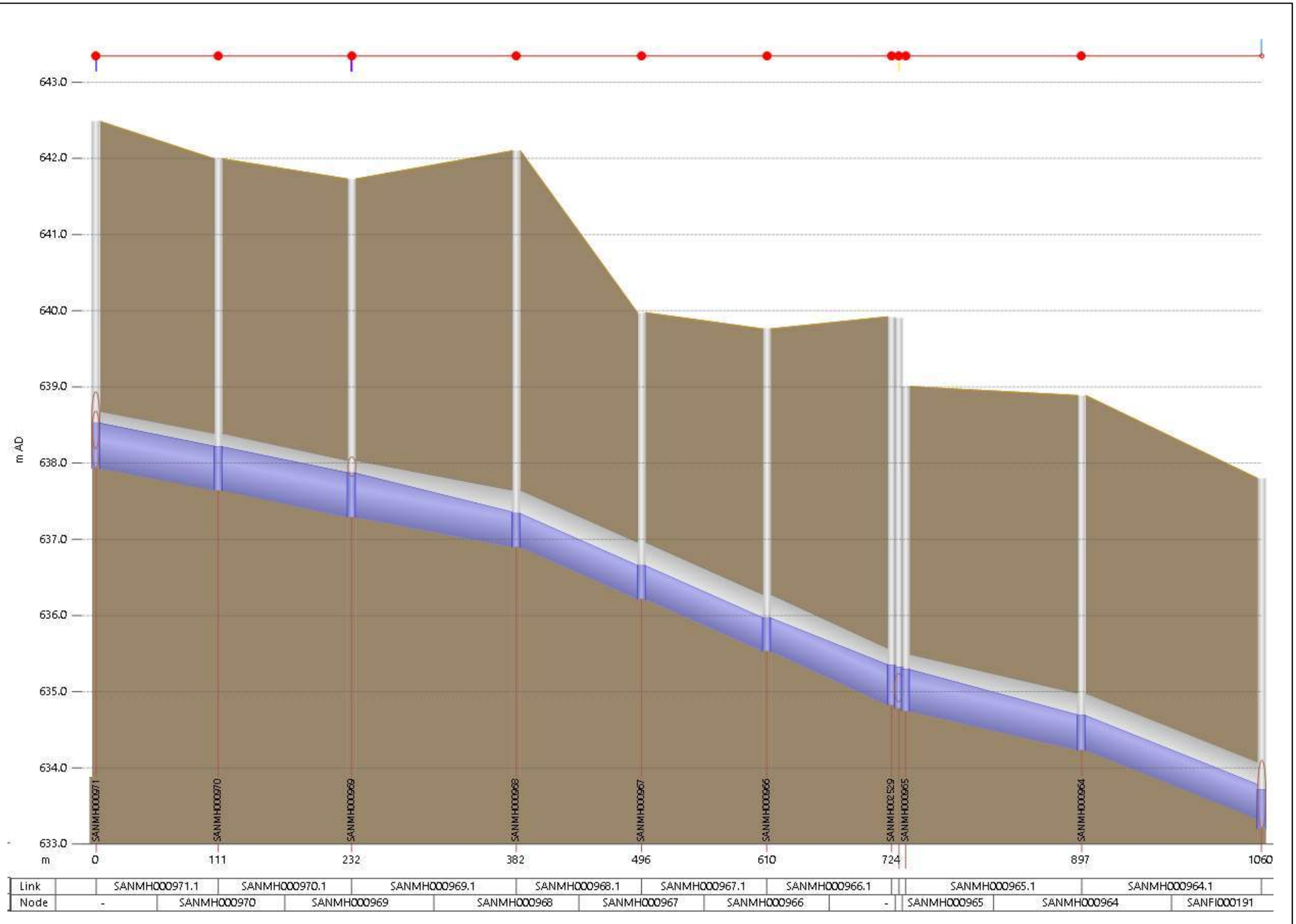


FIGURE D.19
EXISTING CONDITIONS - LP 10
SANITARY SEWERMASTER PLAN



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- 25 Year Water Level
- Ground Elevation

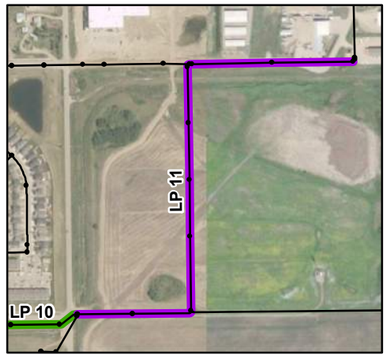
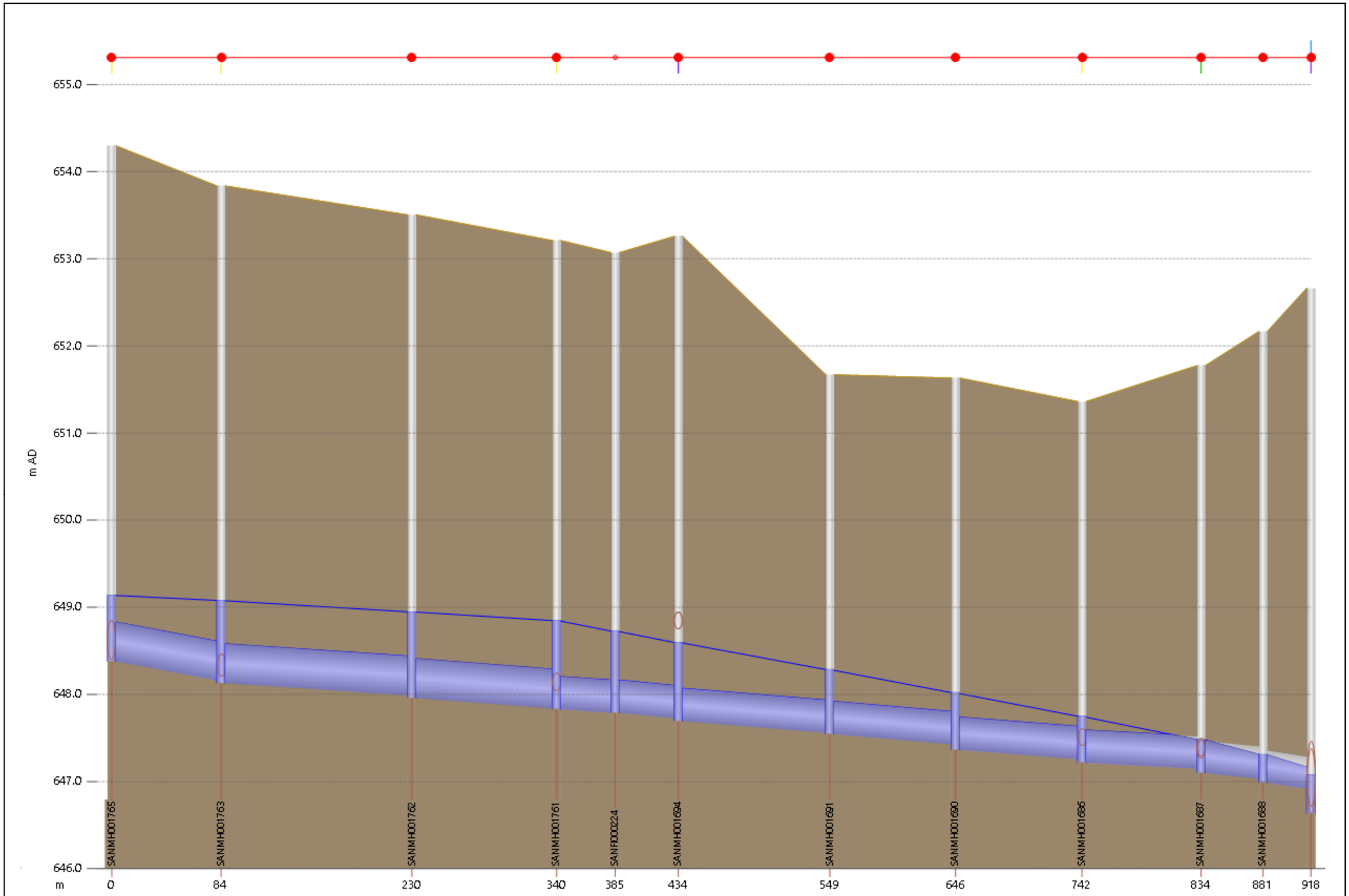


FIGURE D.20
EXISTING CONDITIONS - LP 11
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

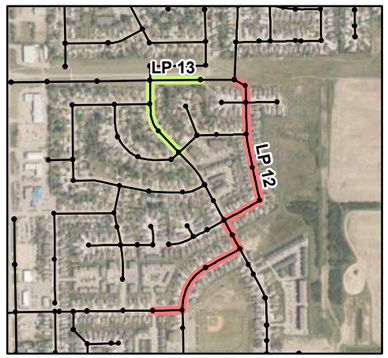
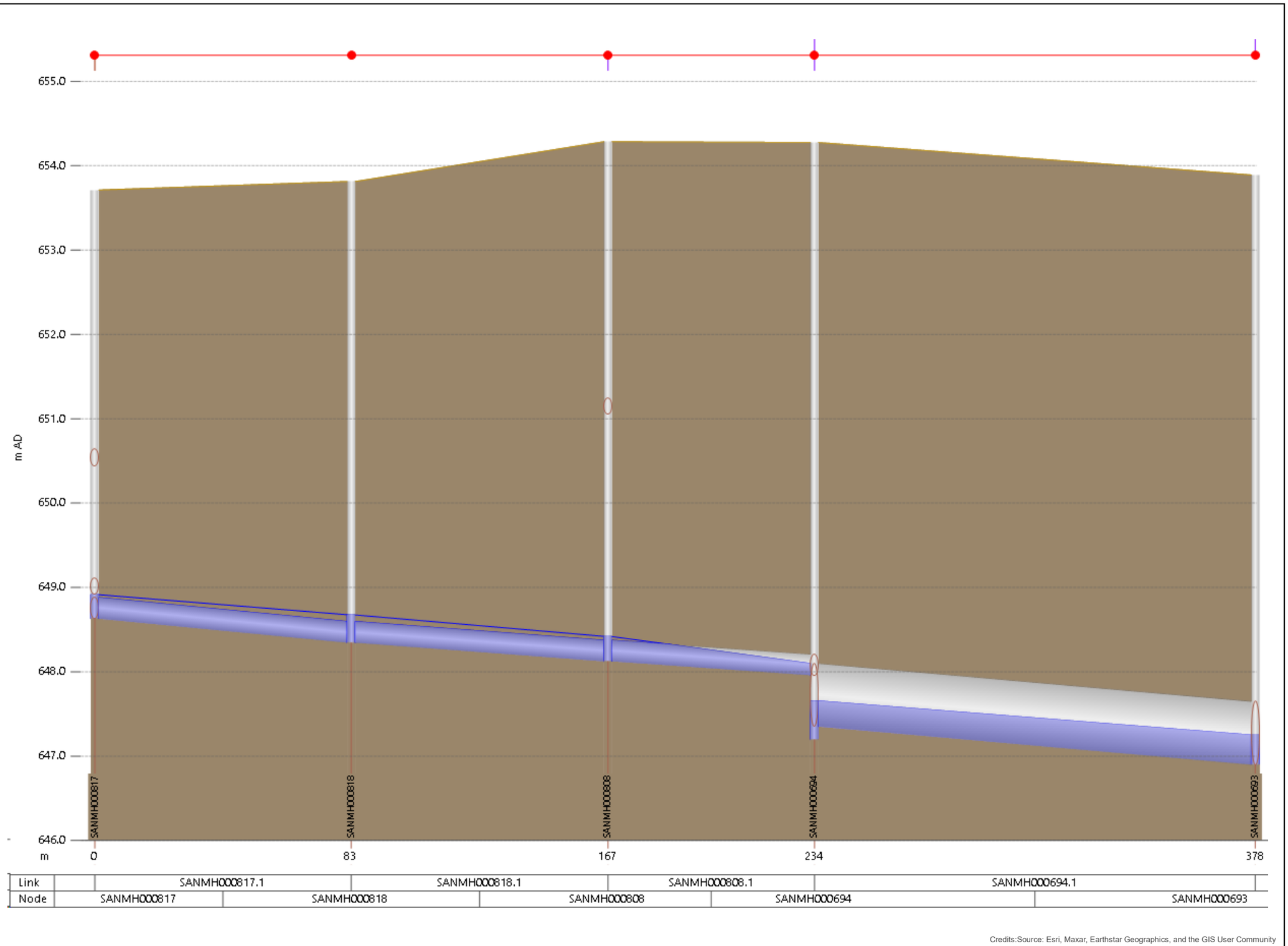


FIGURE D.21
EXISTING CONDITIONS - LP 12
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

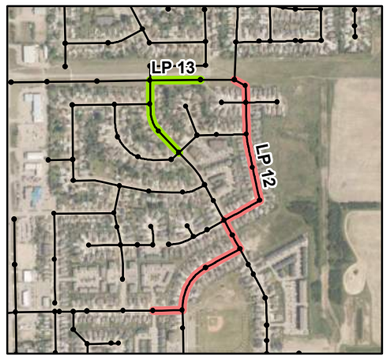
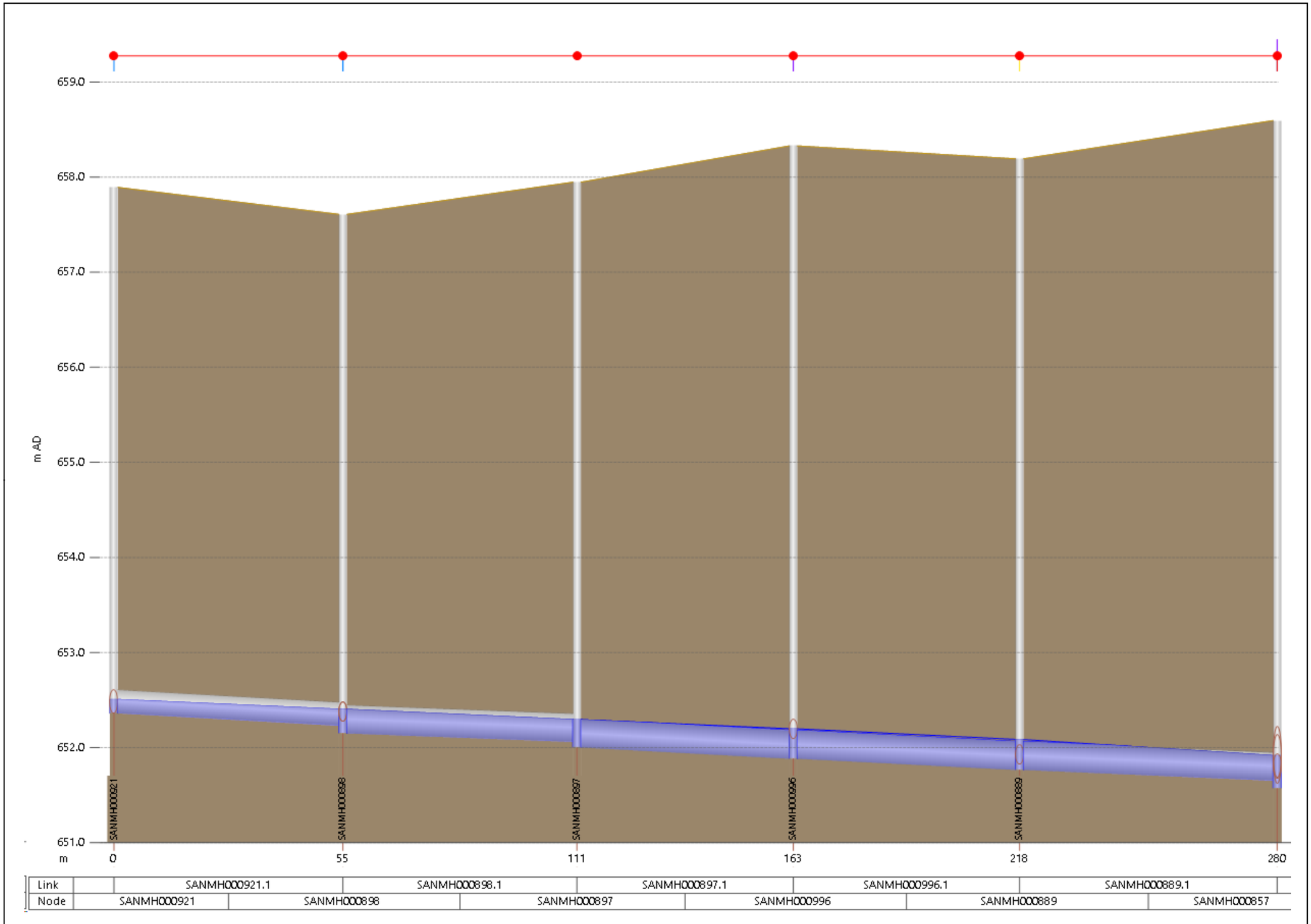


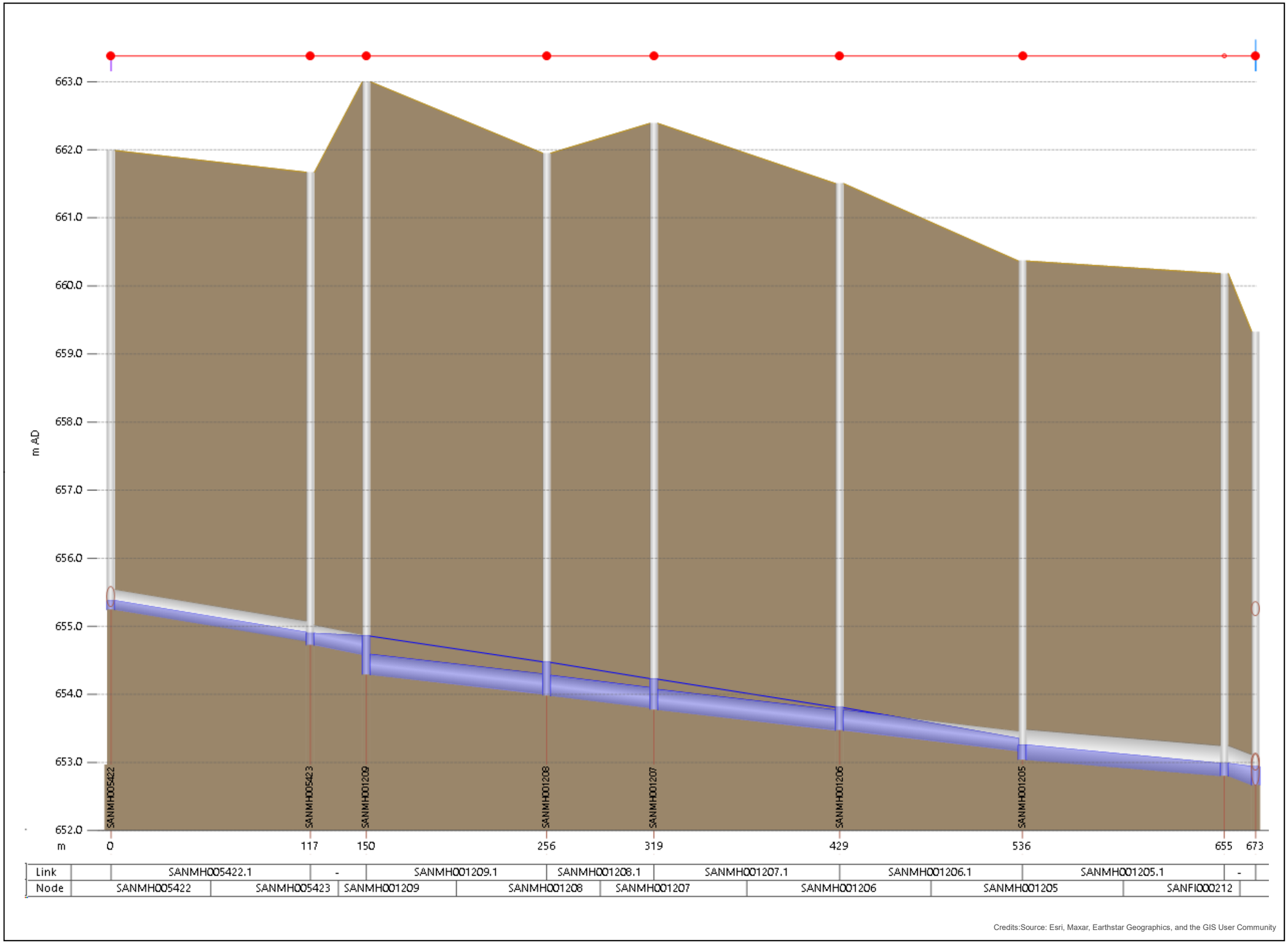
FIGURE D.22
EXISTING CONDITIONS - LP 13
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

FIGURE D.23
EXISTING CONDITIONS - LP 14
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

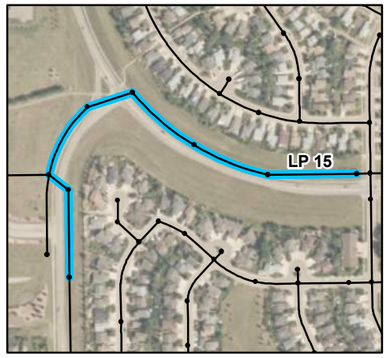
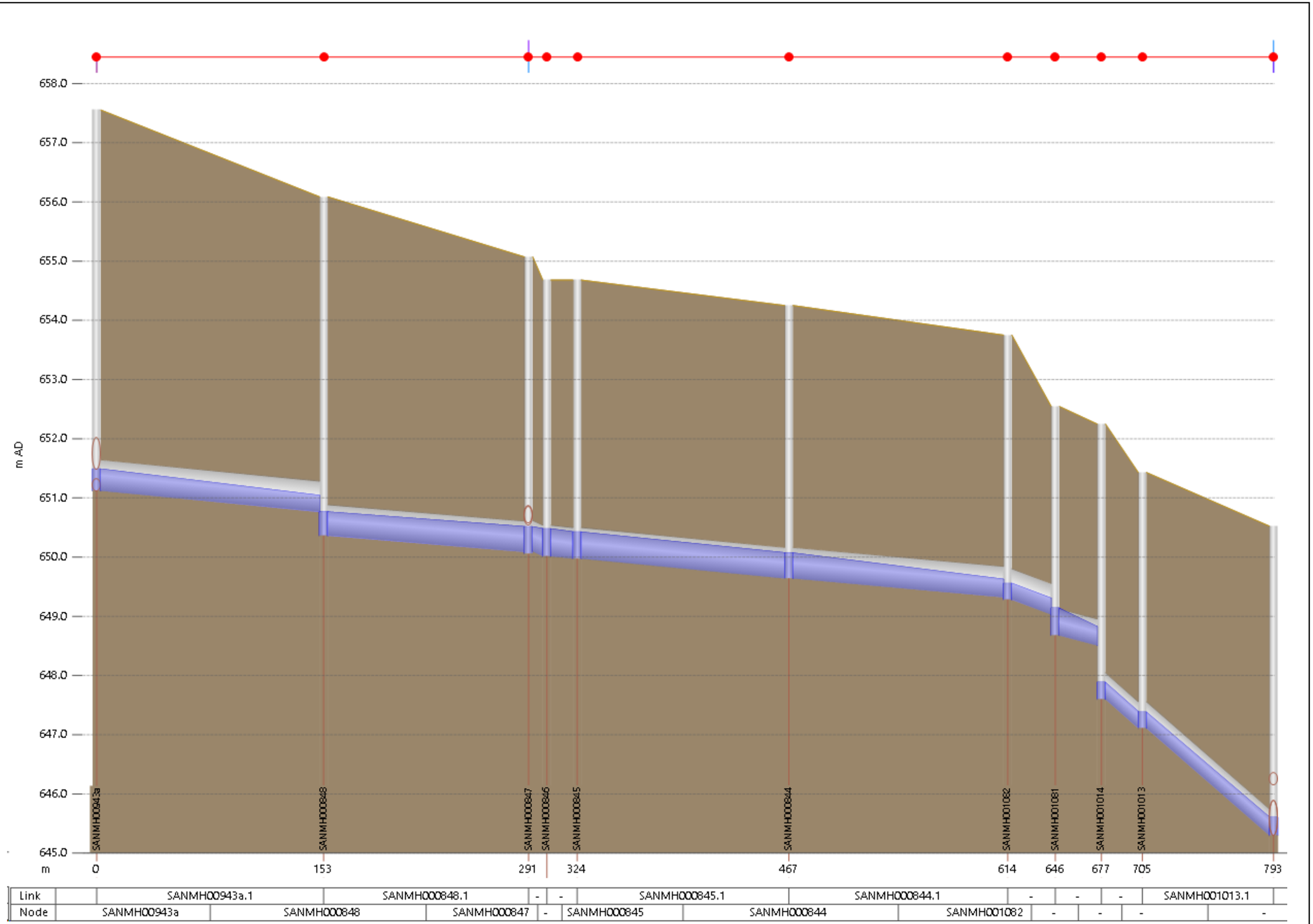


FIGURE D.24
EXISTING CONDITIONS - LP 15
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

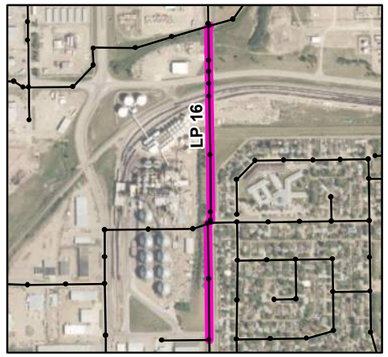
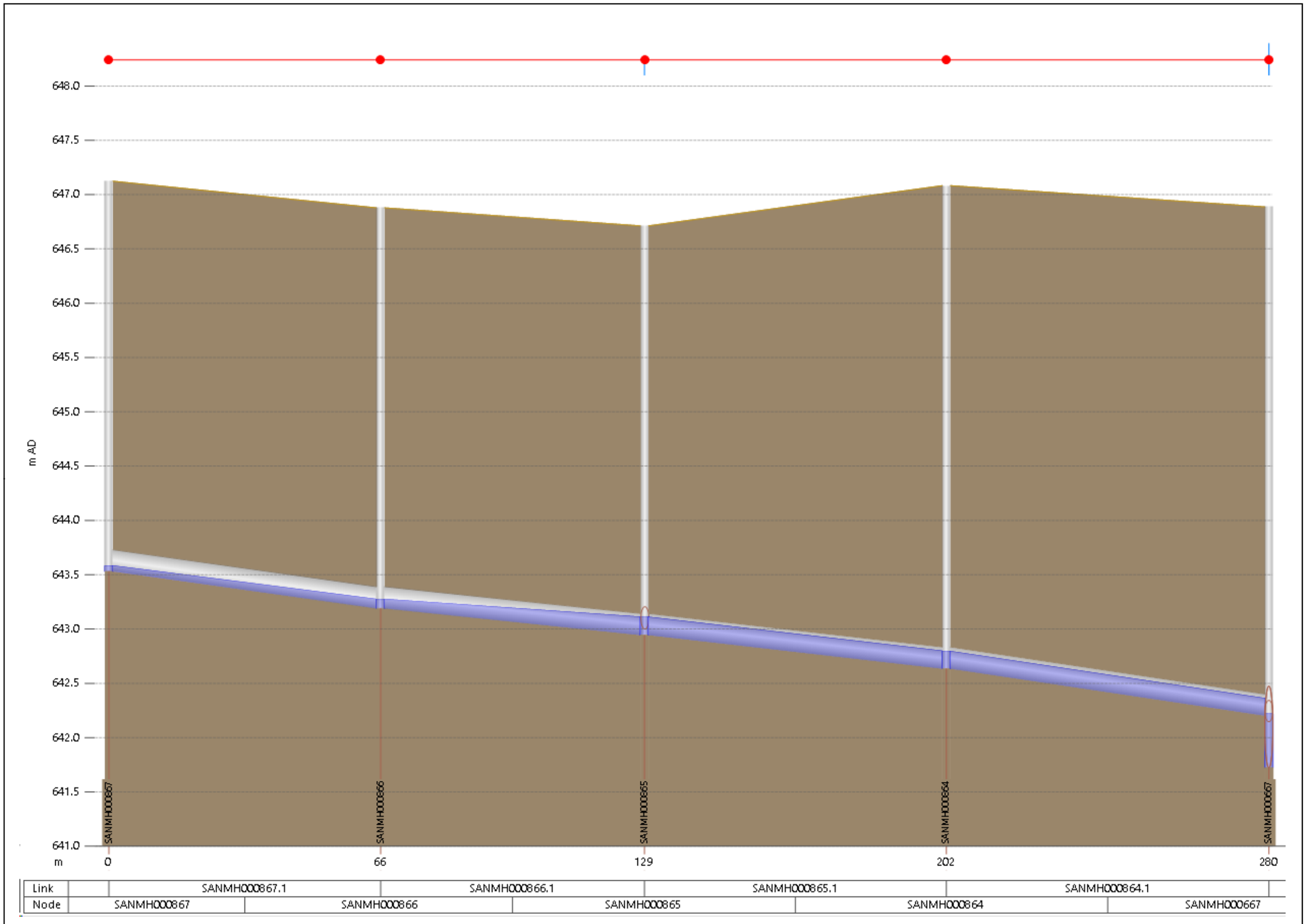


FIGURE D.25
EXISTING CONDITIONS - LP 16
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

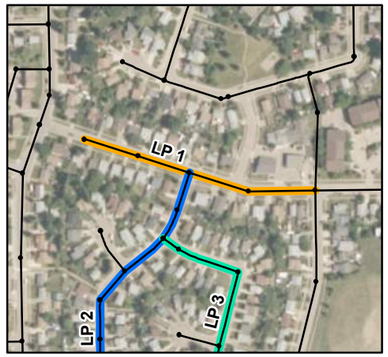
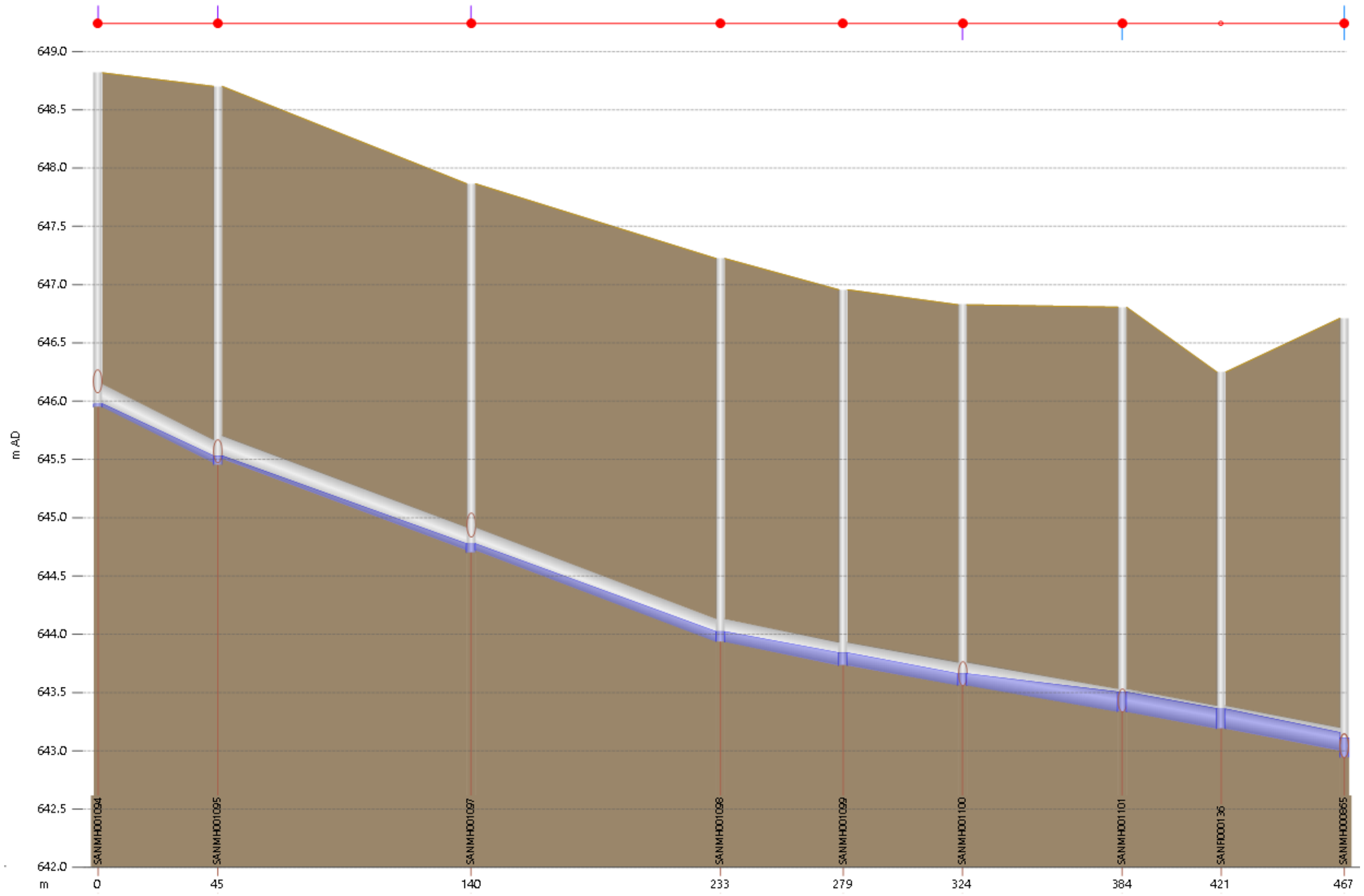


FIGURE D.26
EXISTING UPGRADES - LP 1
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

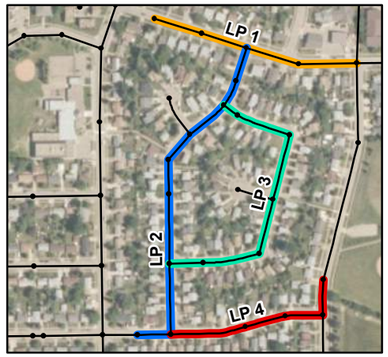
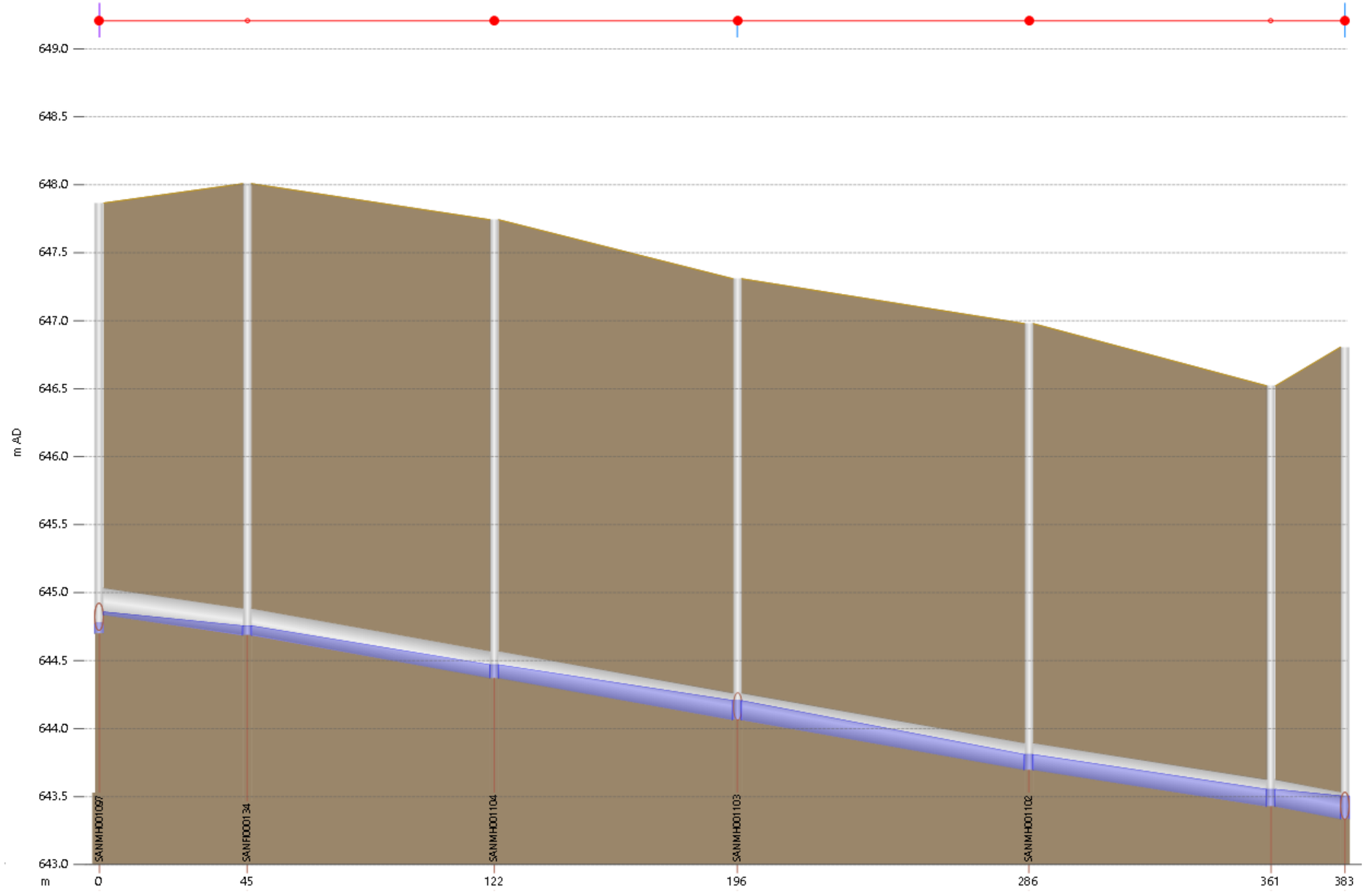


FIGURE D.27
EXISTING UPGRADES - LP 2
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



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Legend

- 25 Year Water Level
- Ground Elevation

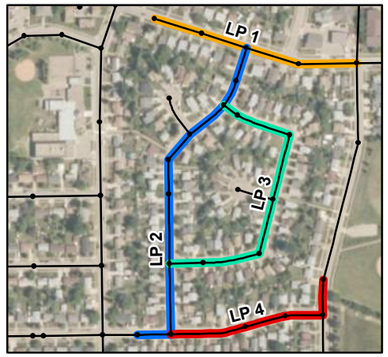
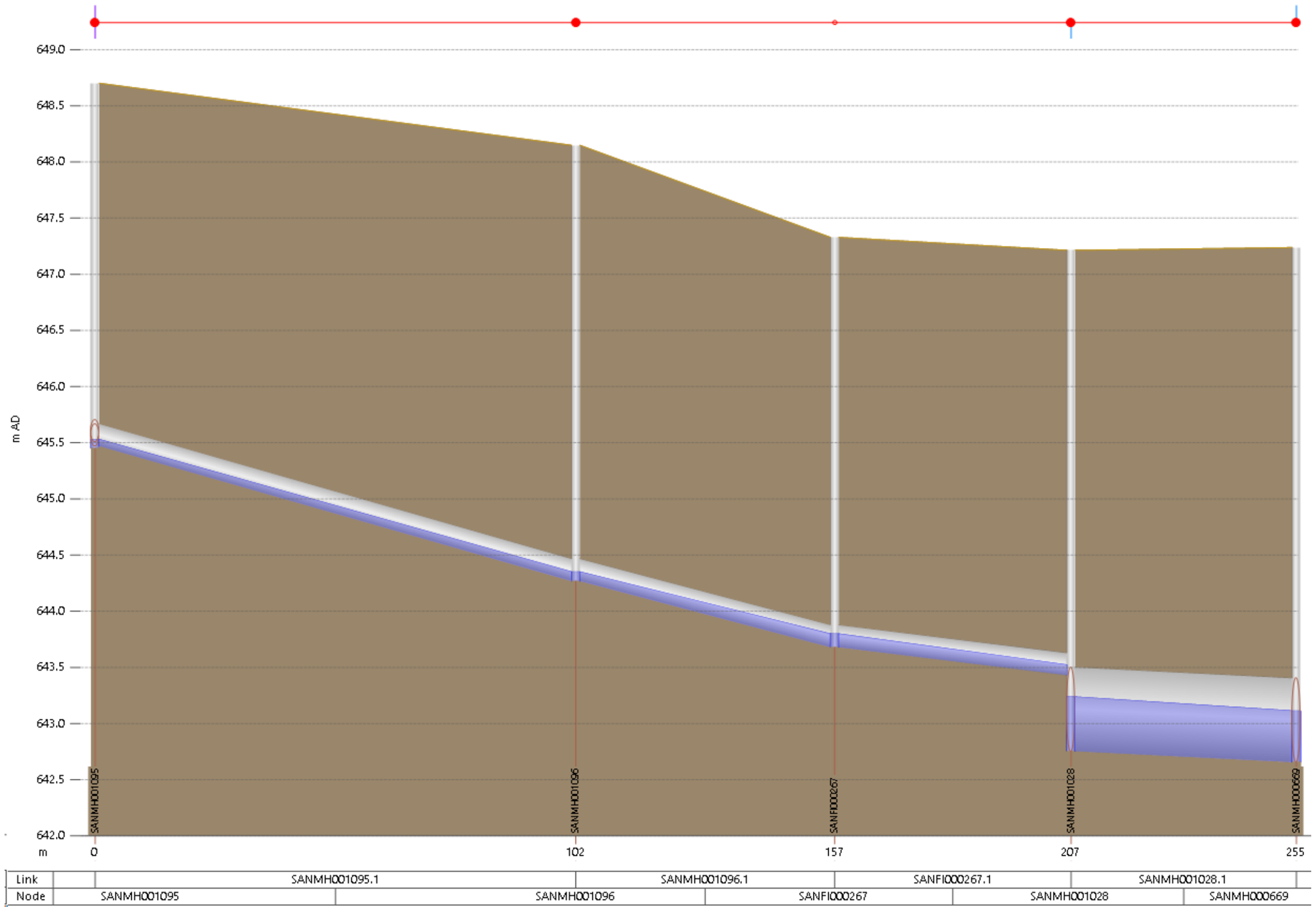


FIGURE D.28
EXISTING UPGRADES - LP 3
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

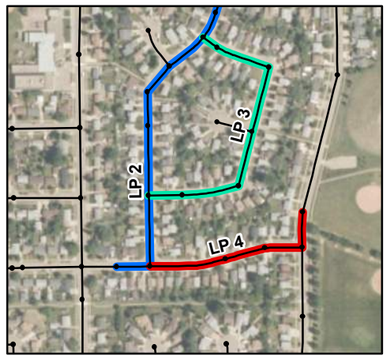
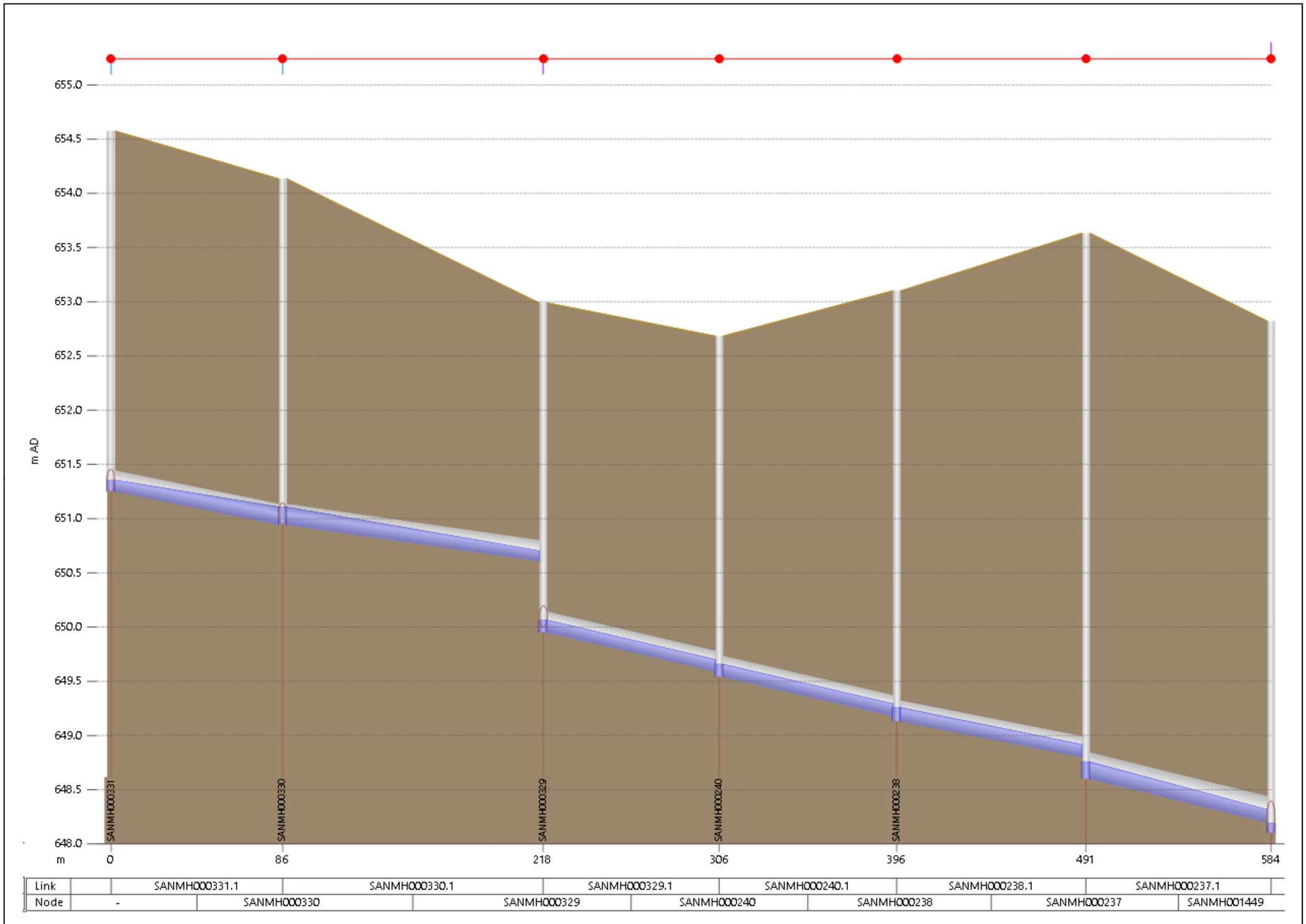


FIGURE D.29
EXISTING UPGRADES - LP 4
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

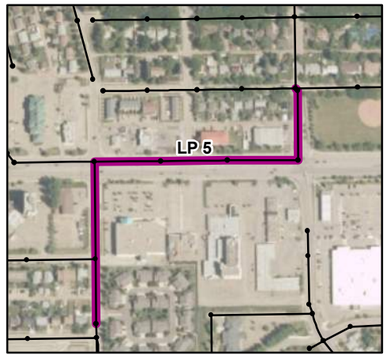
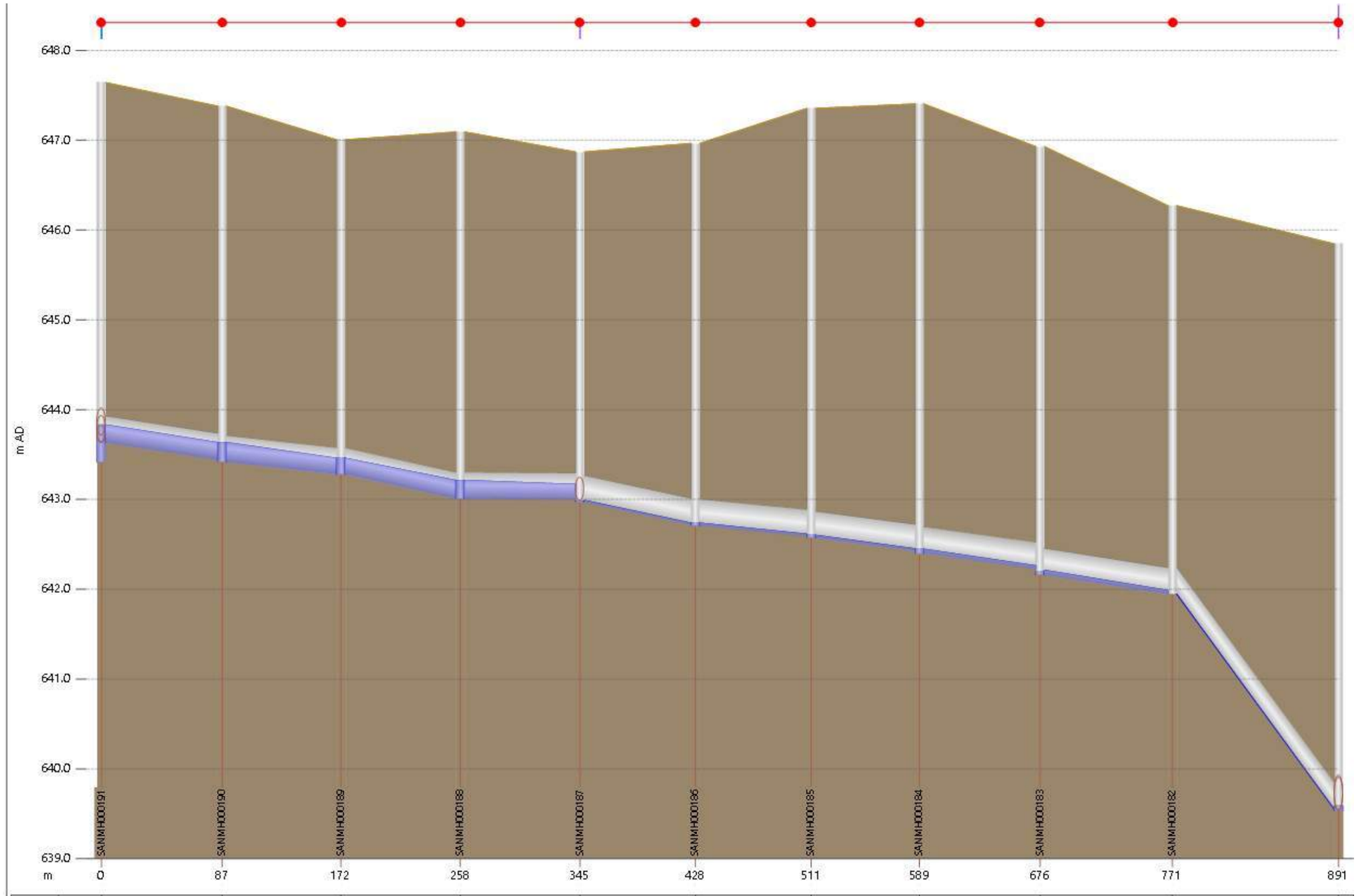


FIGURE D.30
EXISTING UPGRADES - LP 5
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

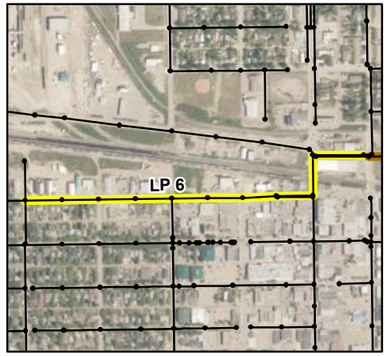
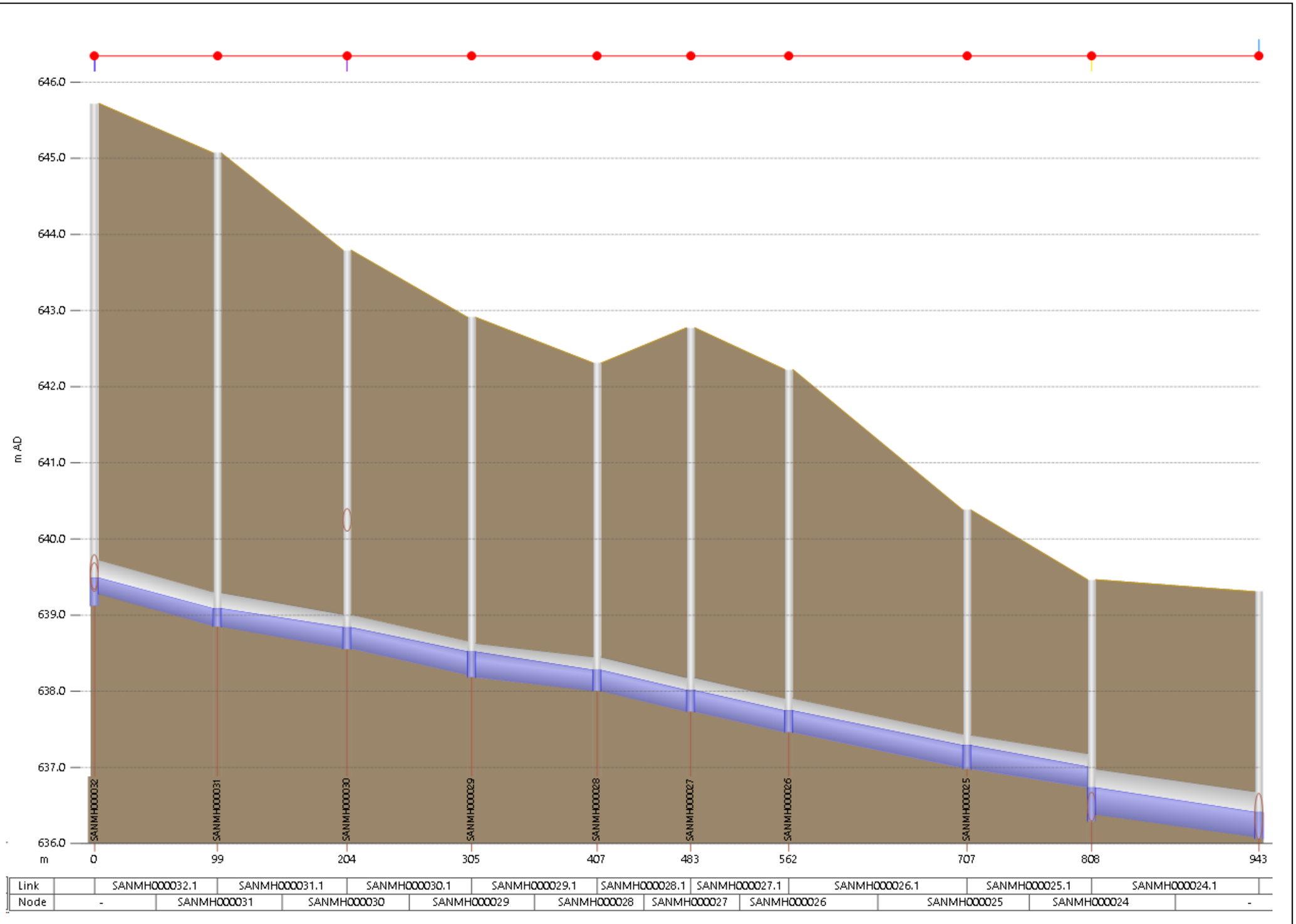


FIGURE D.31
EXISTING UPGRADES - LP 6
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

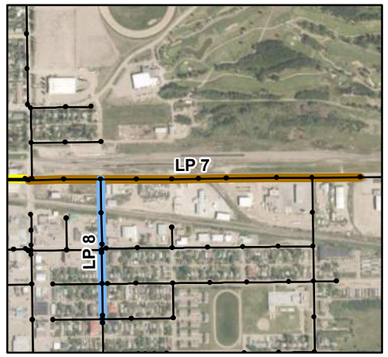
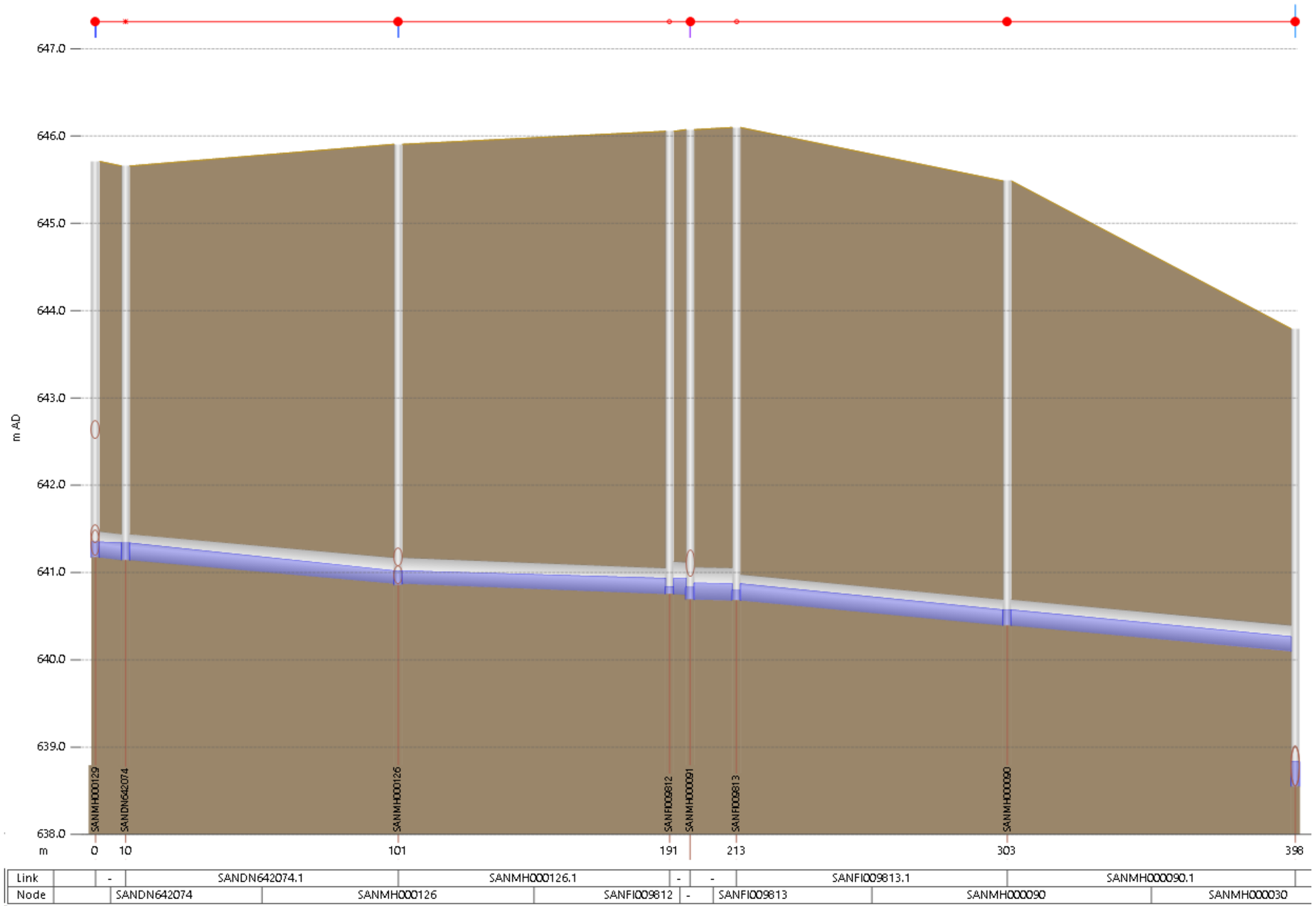


FIGURE D.32
EXISTING UPGRADES - LP 7
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

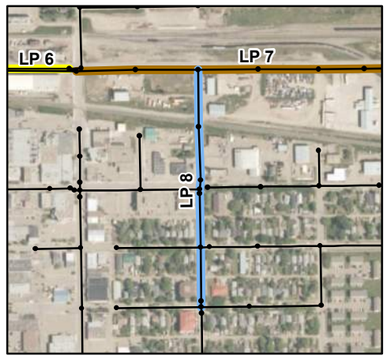
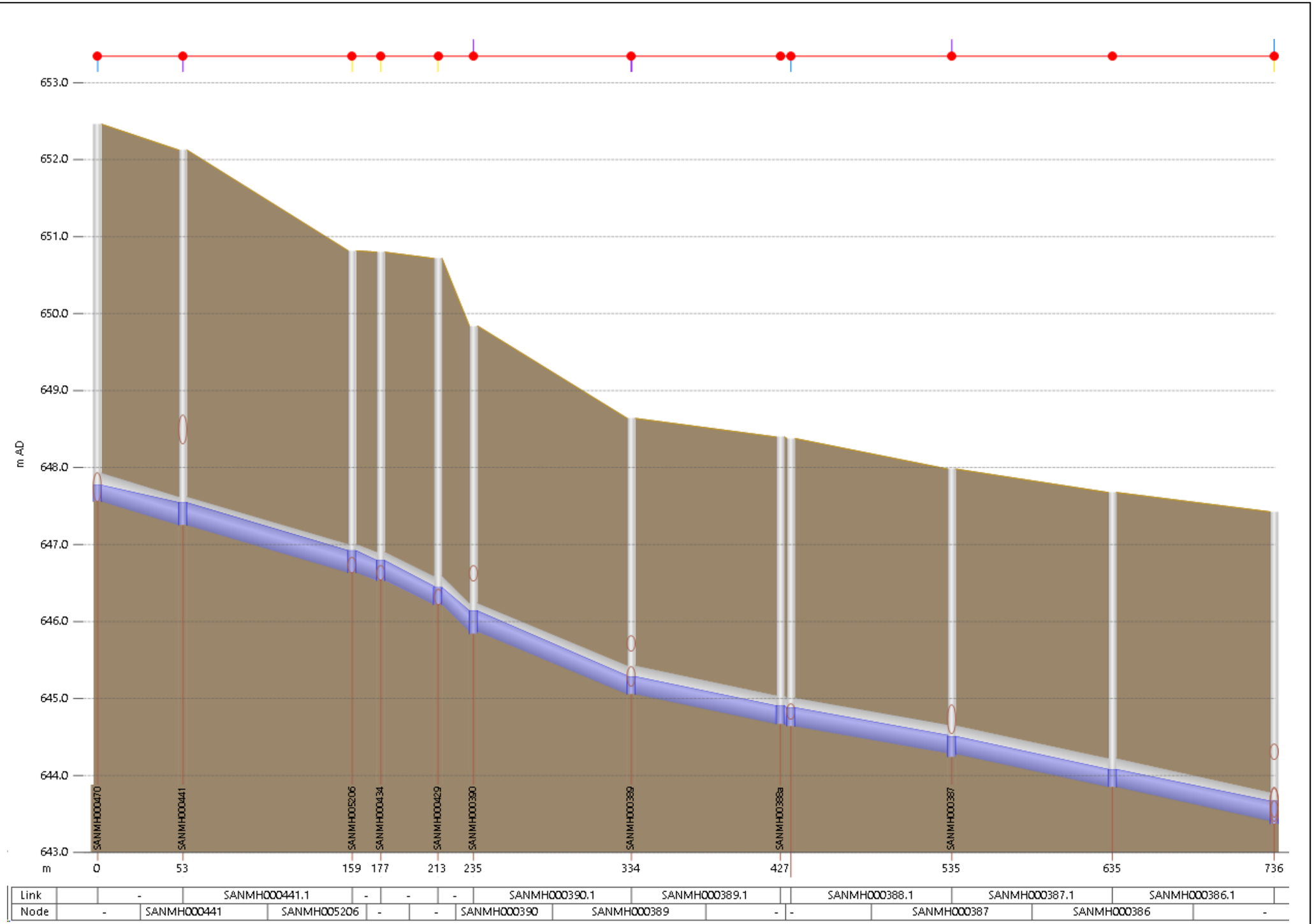


FIGURE D.33
EXISTING UPGRADES - LP 8
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

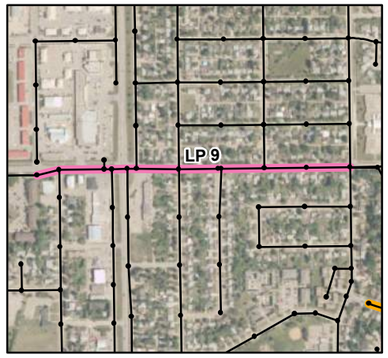
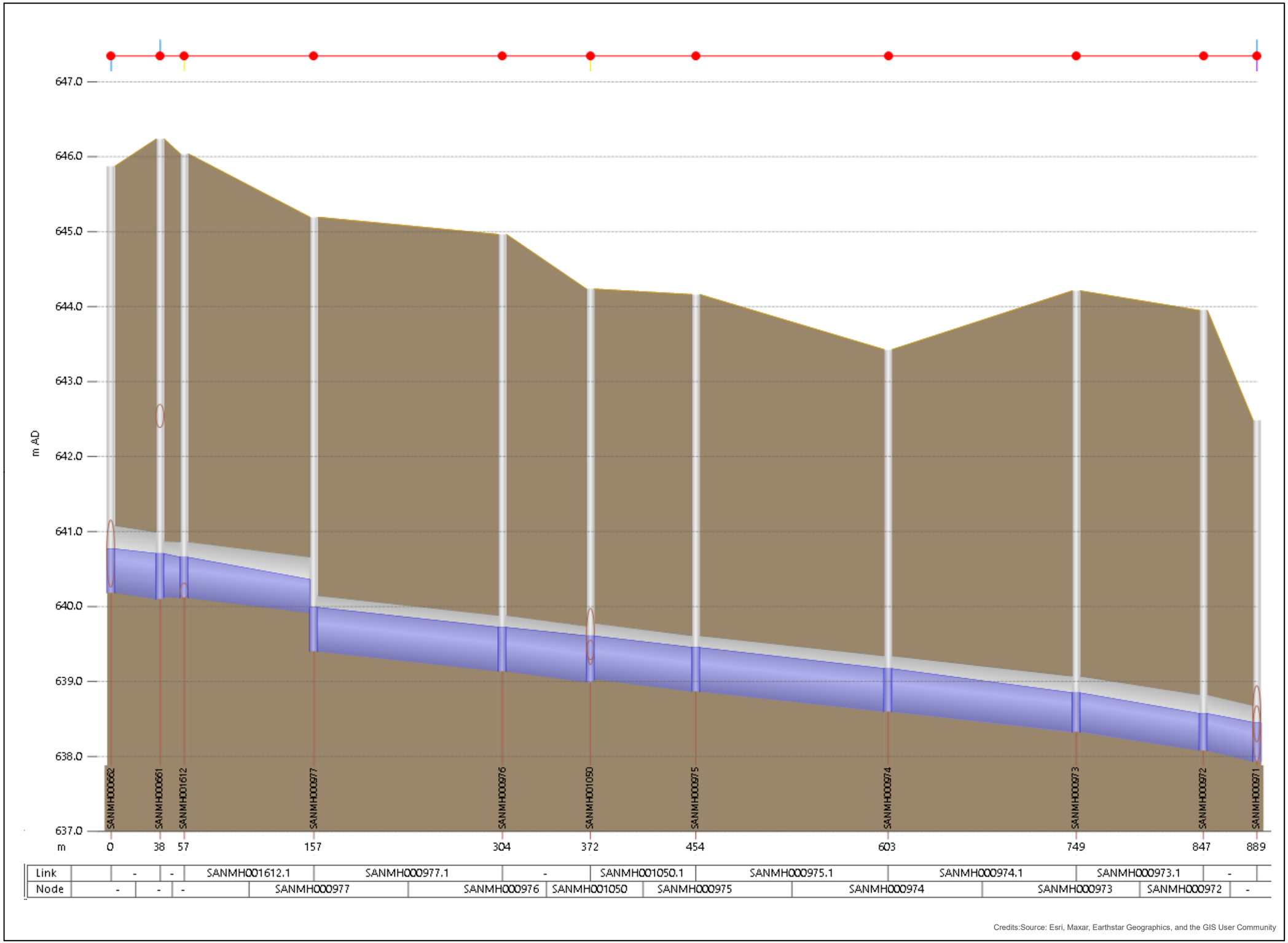


FIGURE D.34
EXISTING UPGRADES - LP 9
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- 25 Year Water Level
- Ground Elevation

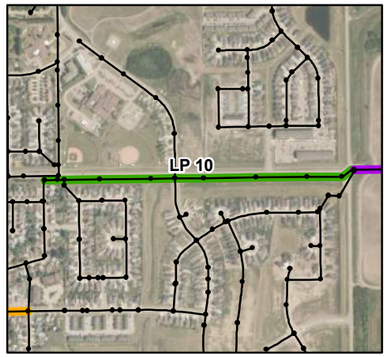


FIGURE D.35
EXISTING UPGRADES - LP 10
SANITARY SEWERMASTER PLAN

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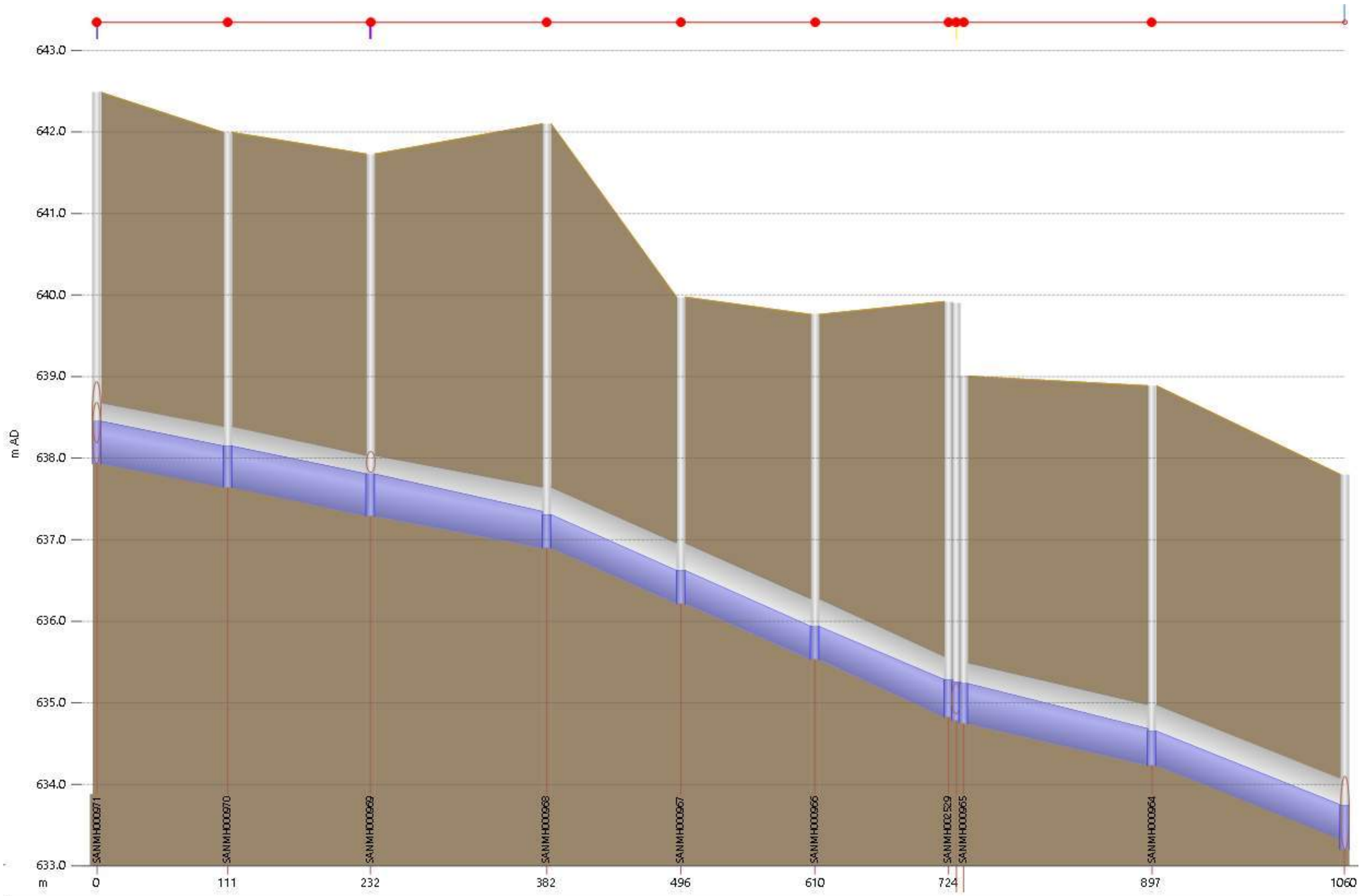

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- 25 Year Water Level
- Ground Elevation

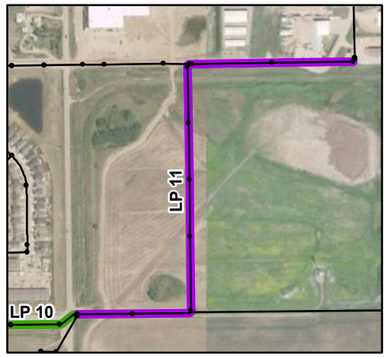

FIGURE D.36
EXISTING UPGRADES - LP 11
SANITARY SEWERMASTER PLAN

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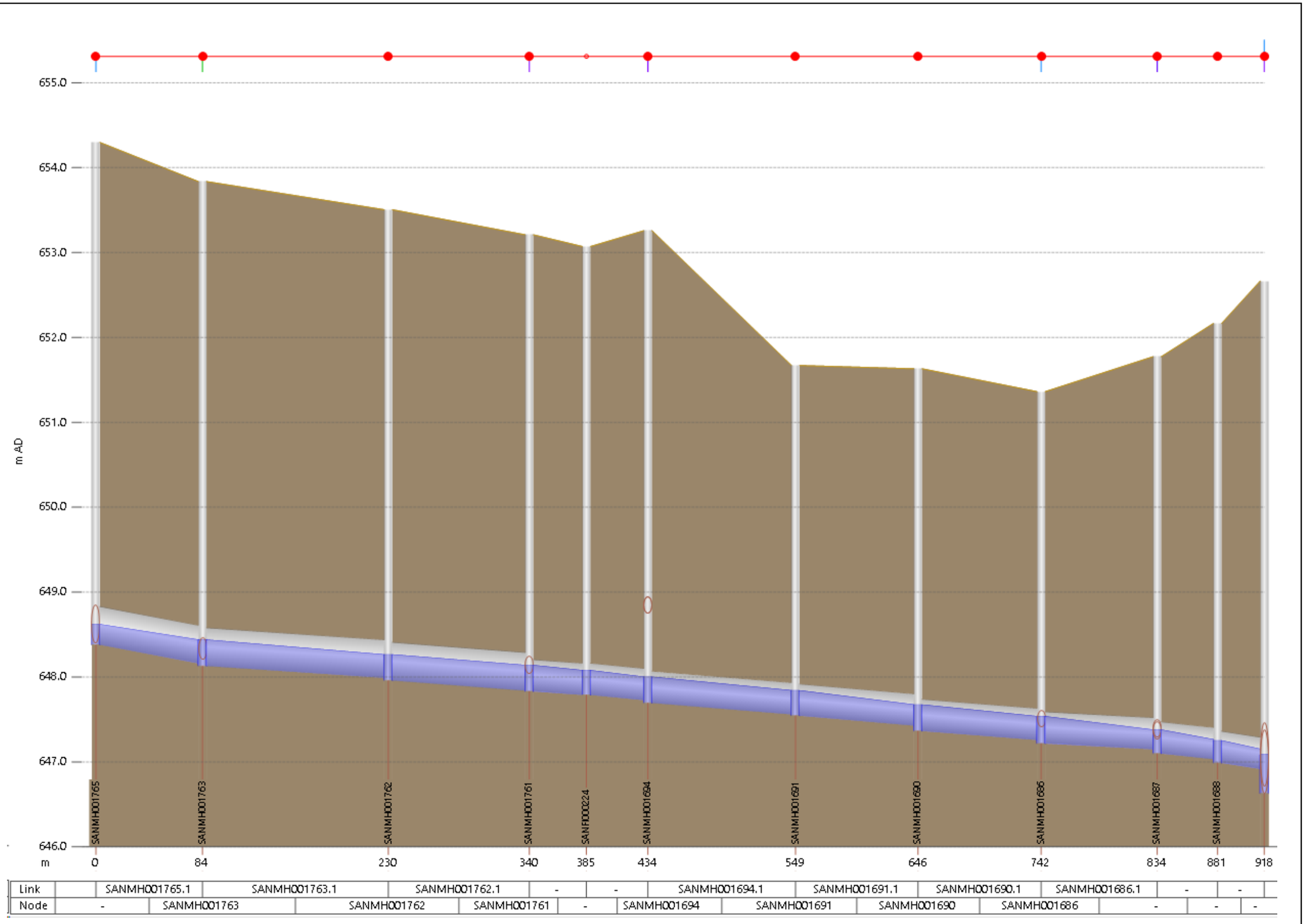

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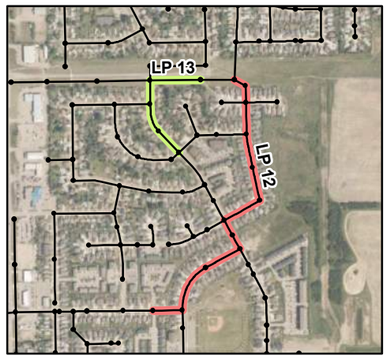
Legend

- 25 Year Water Level
- Ground Elevation



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE D.37
EXISTING UPGRADES - LP 12
SANITARY SEWERMASTER PLAN

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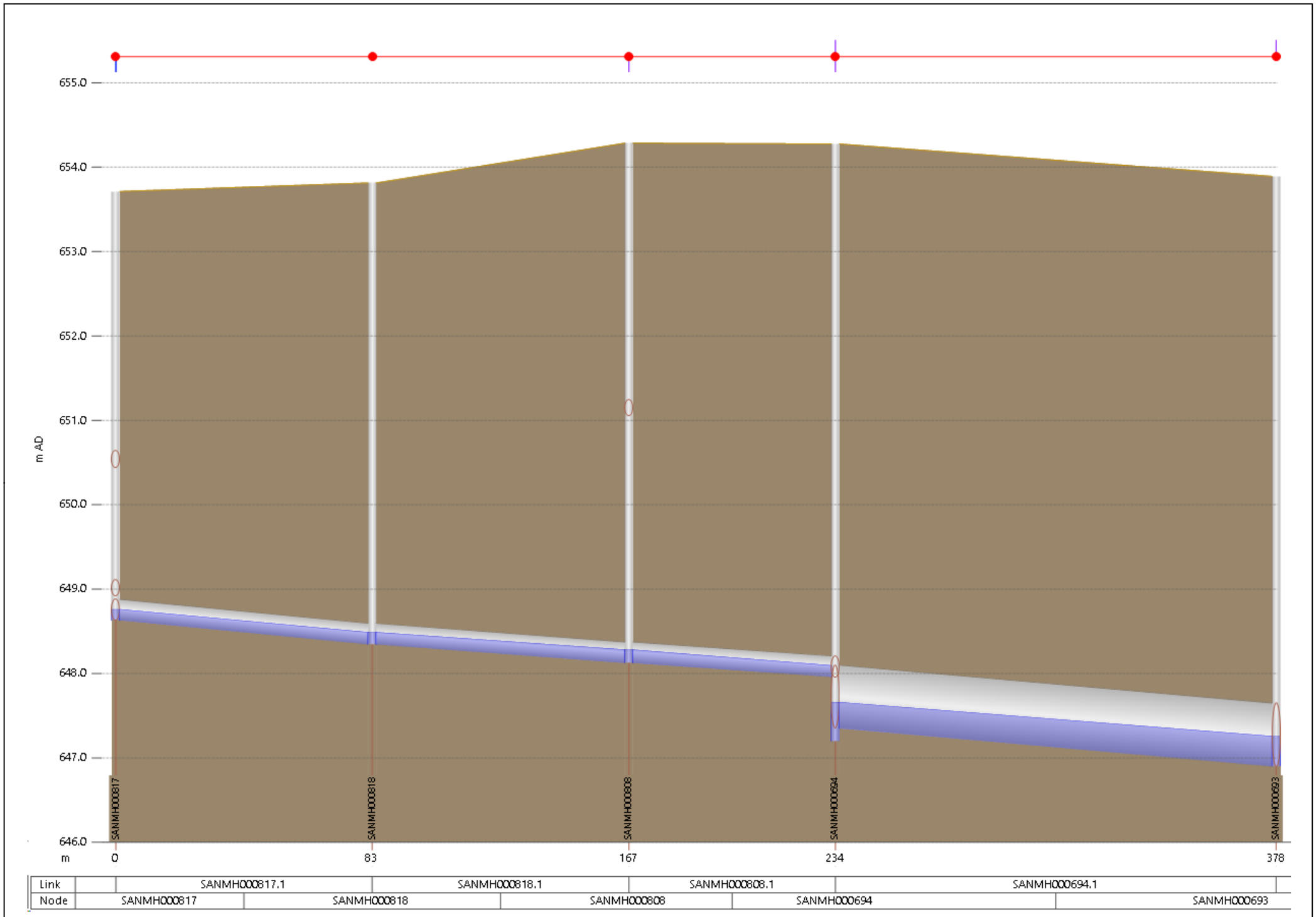

Legend

- 25 Year Water Level
- Ground Elevation

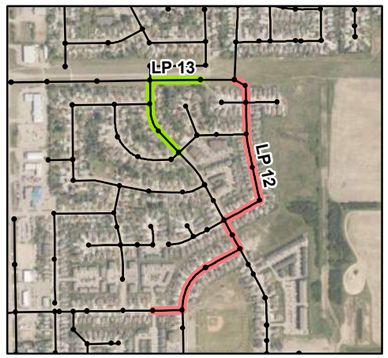

FIGURE D.38
EXISTING UPGRADES - LP 13
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Date: 2024-01-26 Document: Q:\Projects\28114_Lloyd_Sanitary_Master_Plan\251_Figures\3_Reporting\Figure D.38_LP 13 Existing Upgrades.mxd

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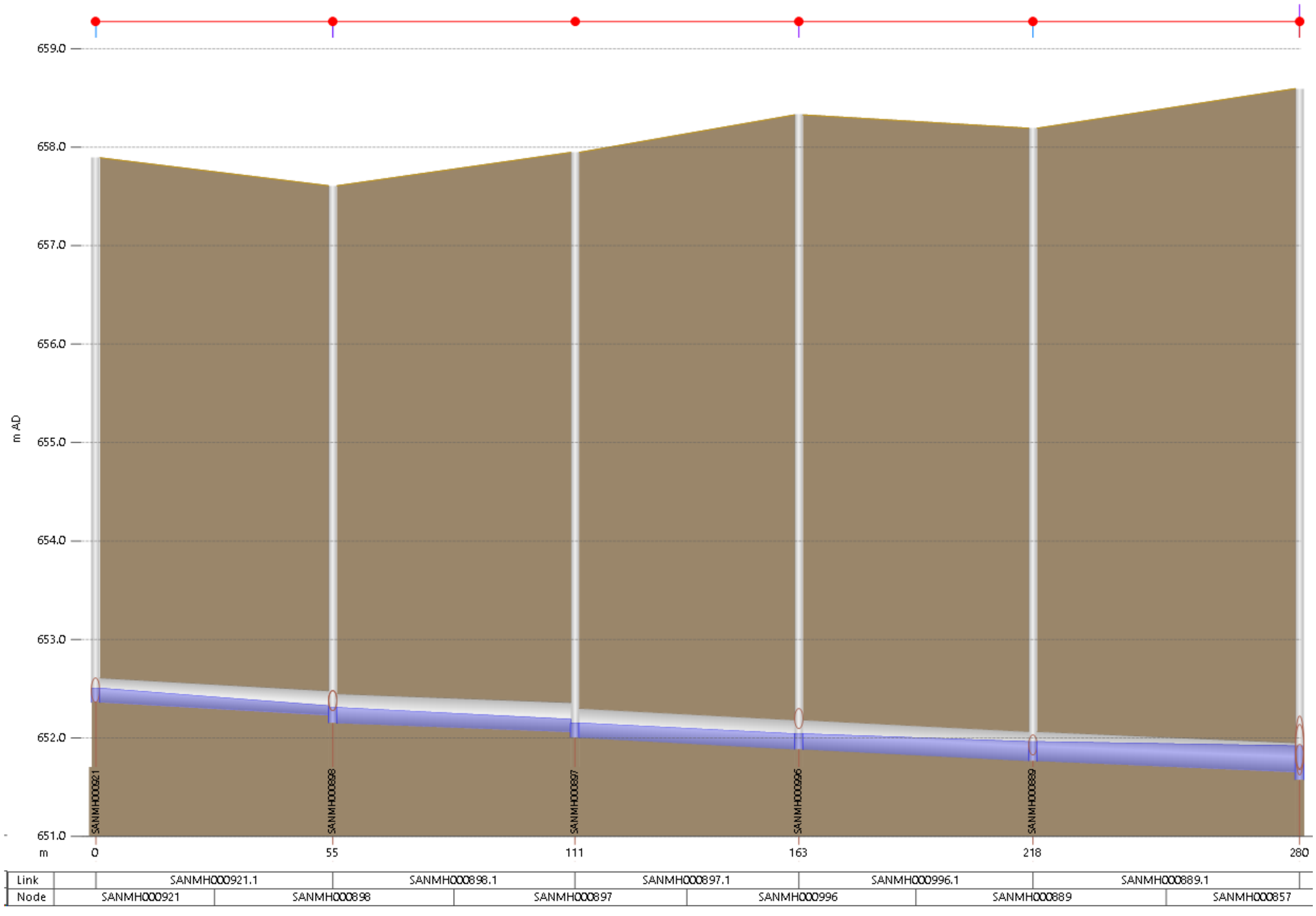
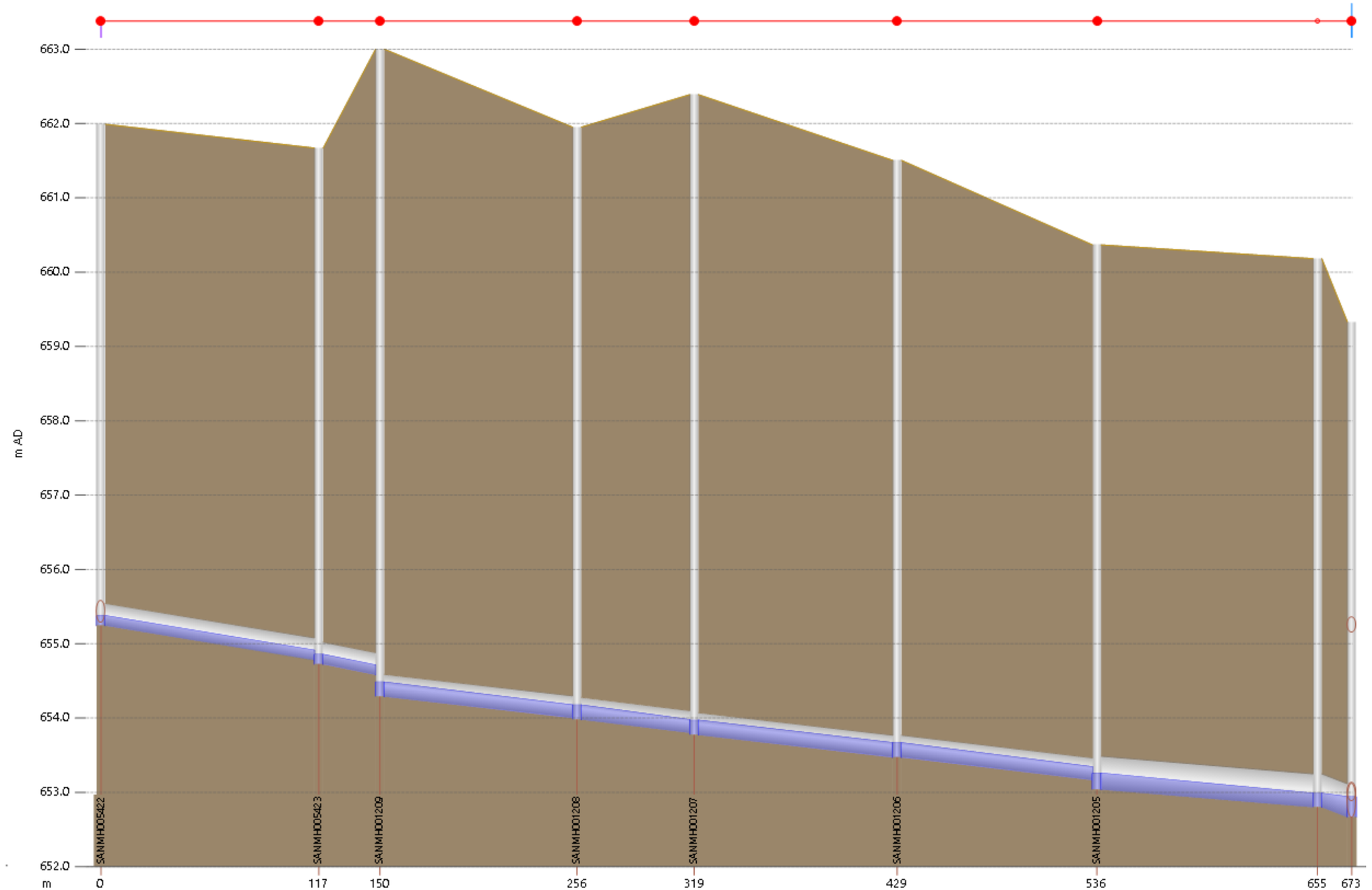


Legend

- 25 Year Water Level
- Ground Elevation

FIGURE D.39
EXISTING UPGRADES - LP 14
SANITARY SEWERMASTER PLAN



Legend

- 25 Year Water Level
- Ground Elevation

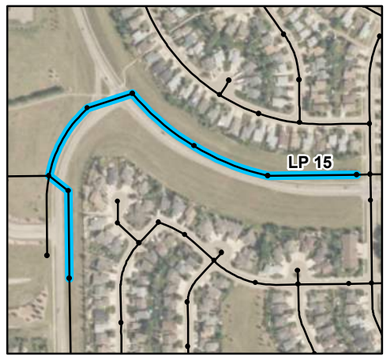
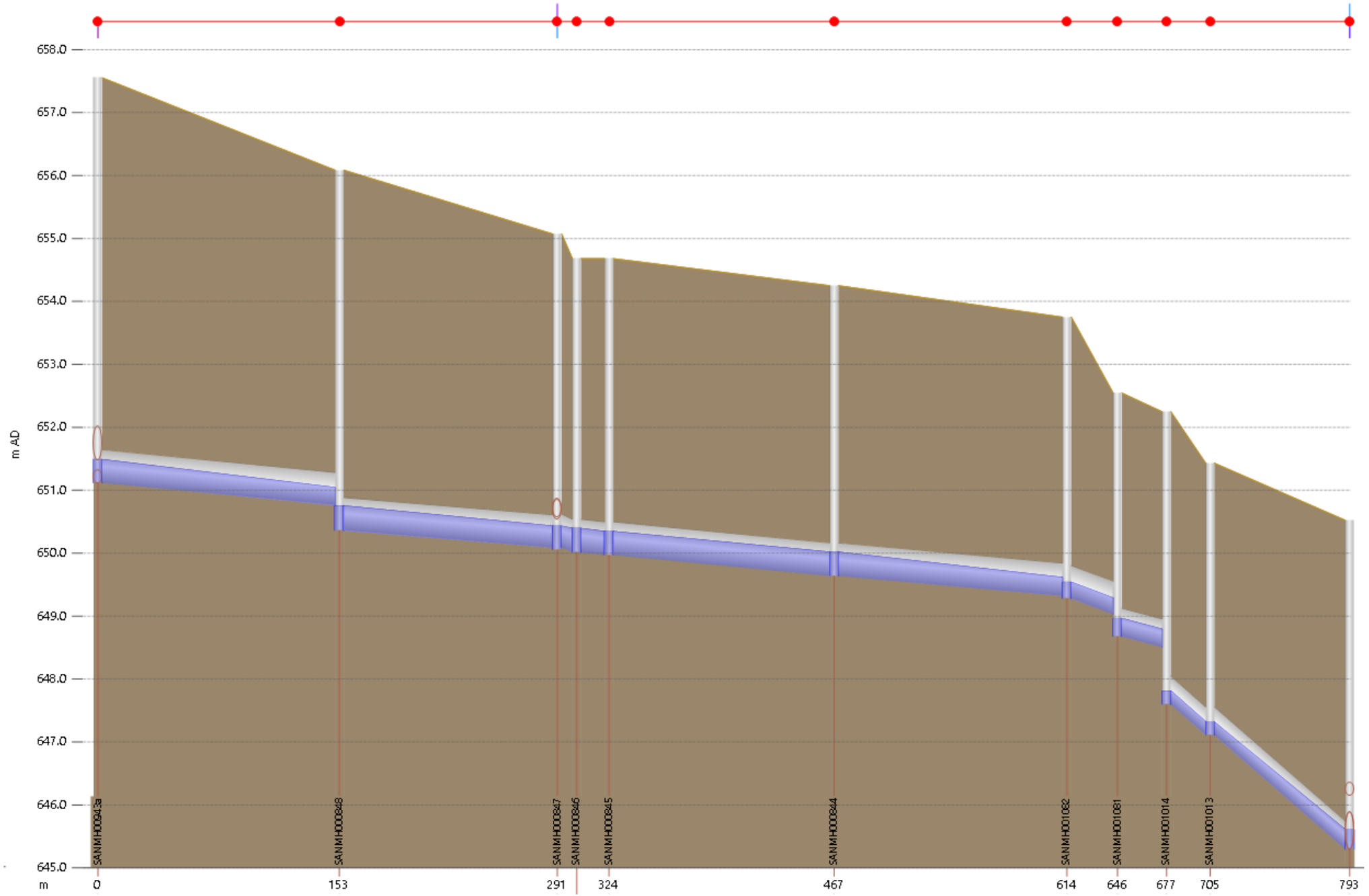


FIGURE D.40
EXISTING UPGRADES - LP 15
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Legend

- 25 Year Water Level
- Ground Elevation

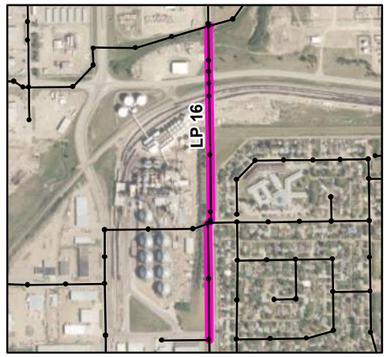
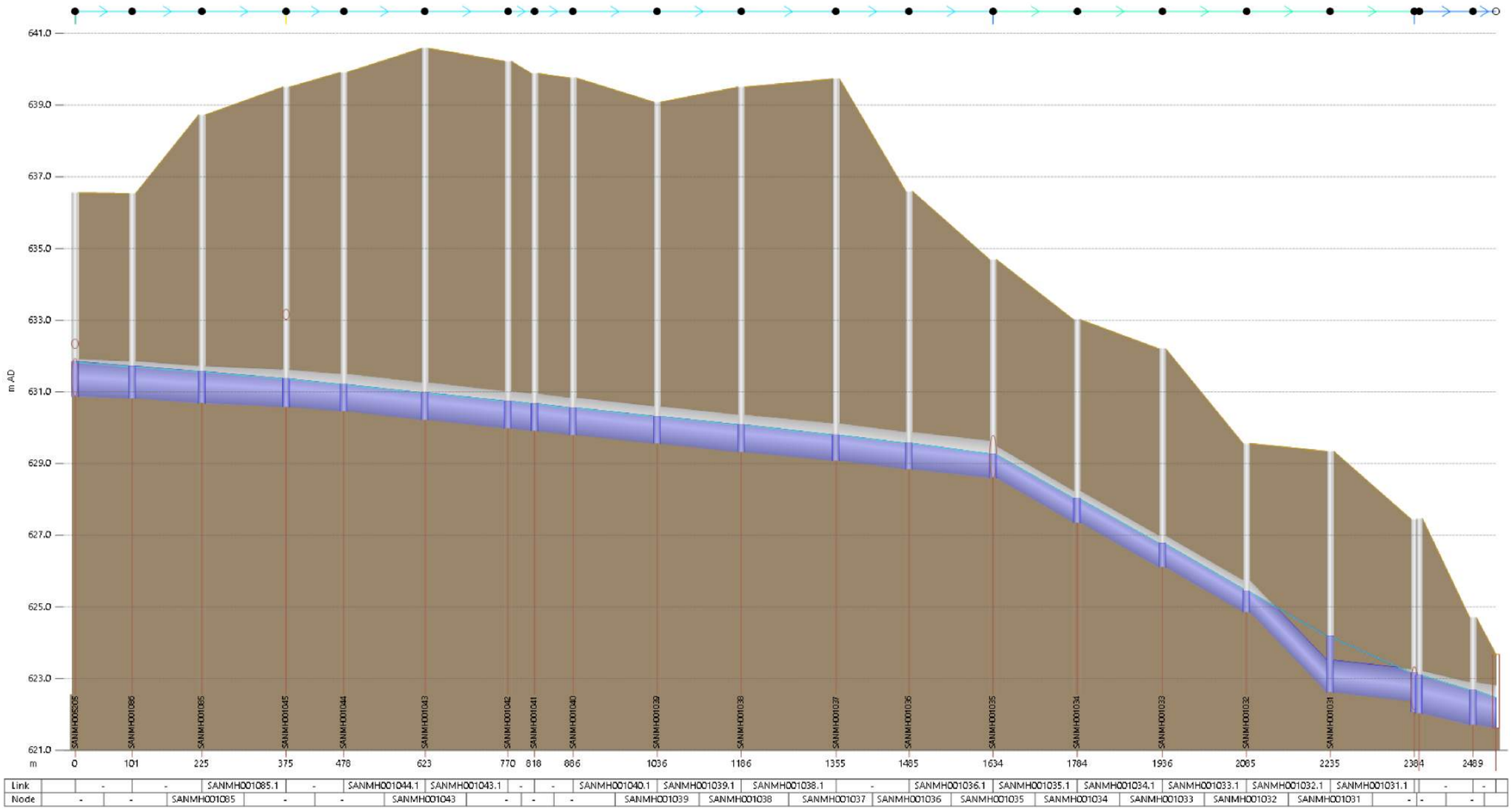


FIGURE D.41
EXISTING UPGRADES - LP 16
SANITARY SEWERMASTER PLAN

Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

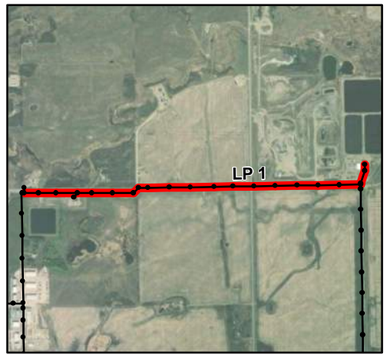
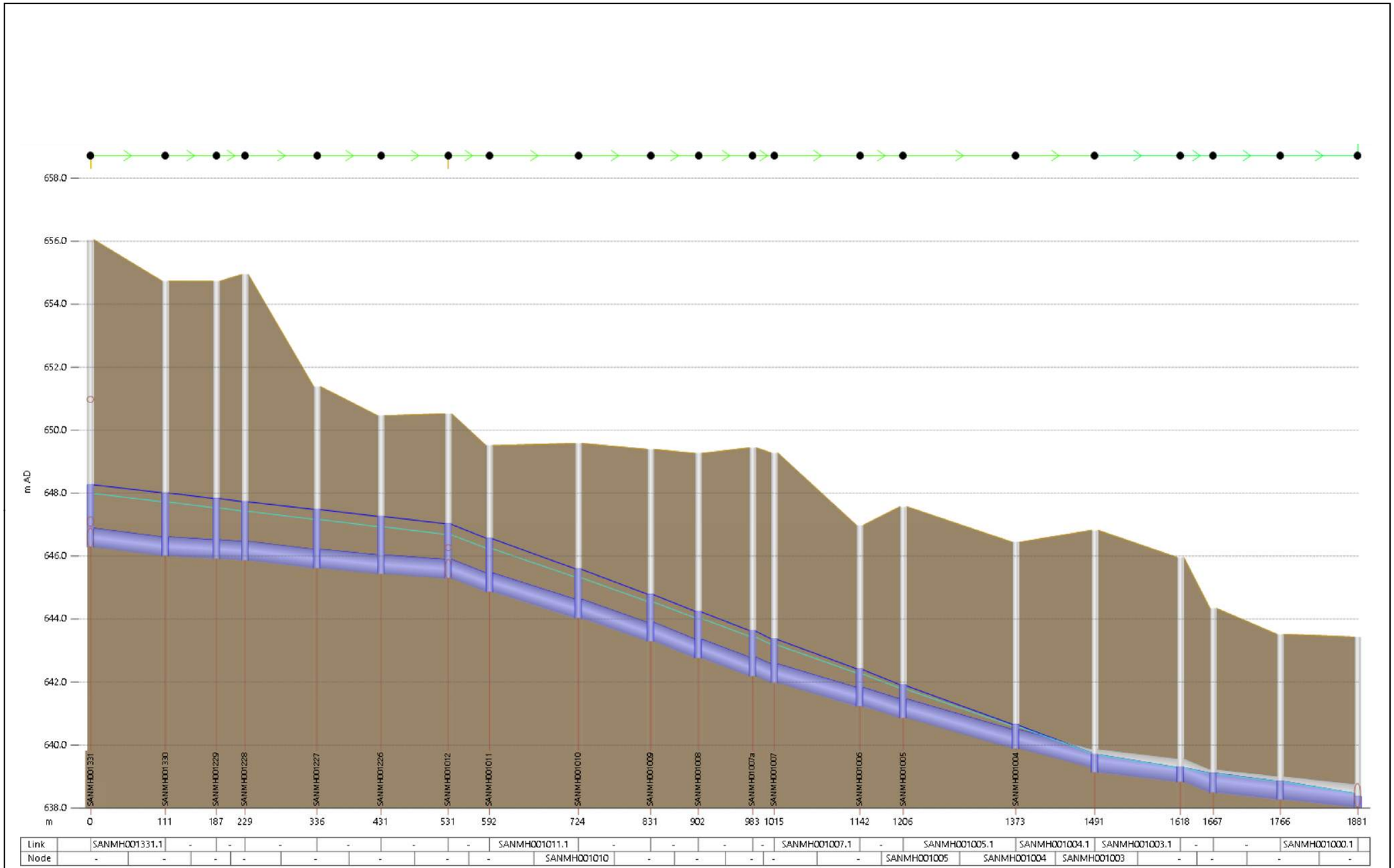


FIGURE D.42
FUTURE CONCEPTS - LP 1
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

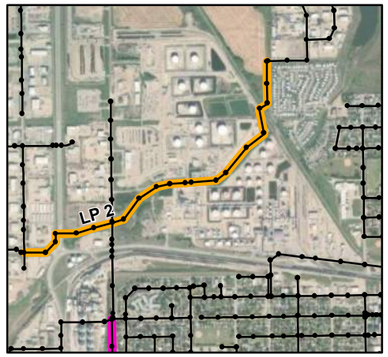
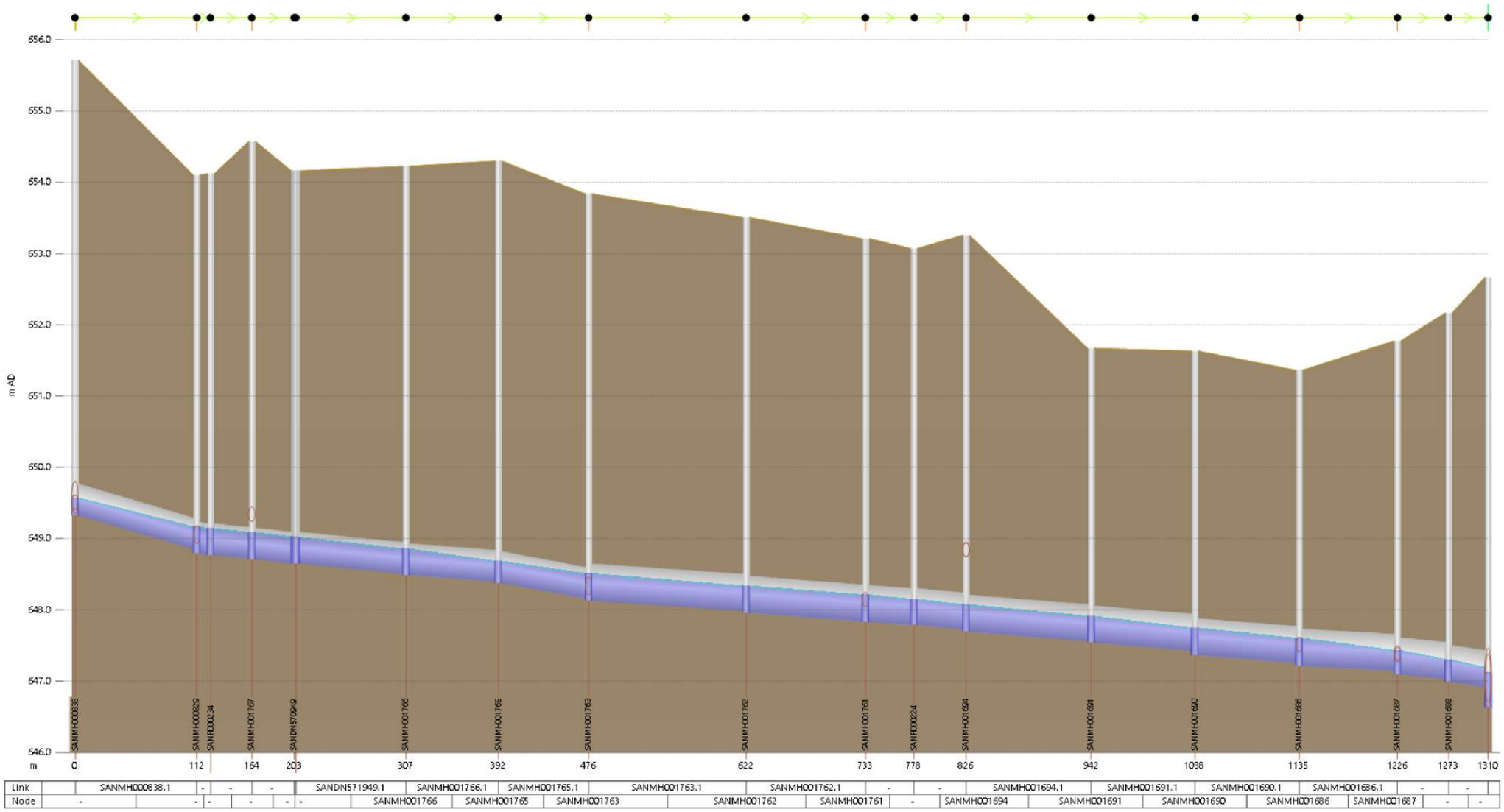


FIGURE D.43
FUTURE CONCEPTS - LP 2
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.



Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

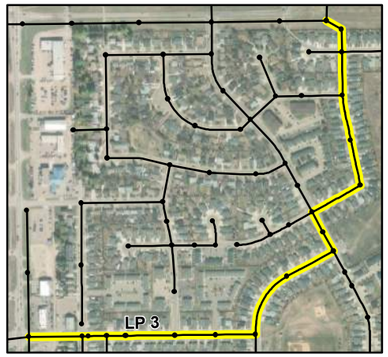
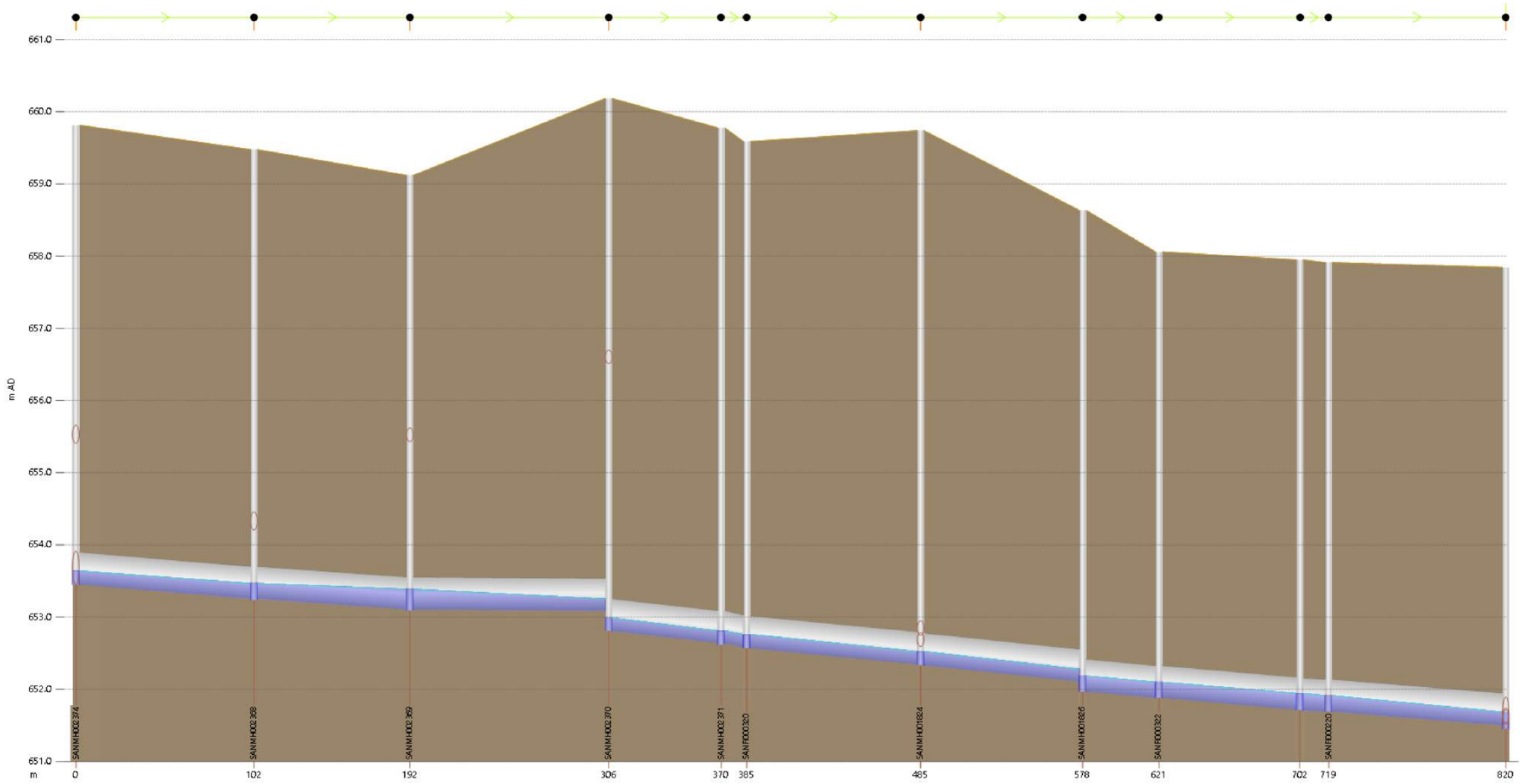


FIGURE D.44
FUTURE CONCEPTS - LP 3
SANITARY SEWER MASTER PLAN



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

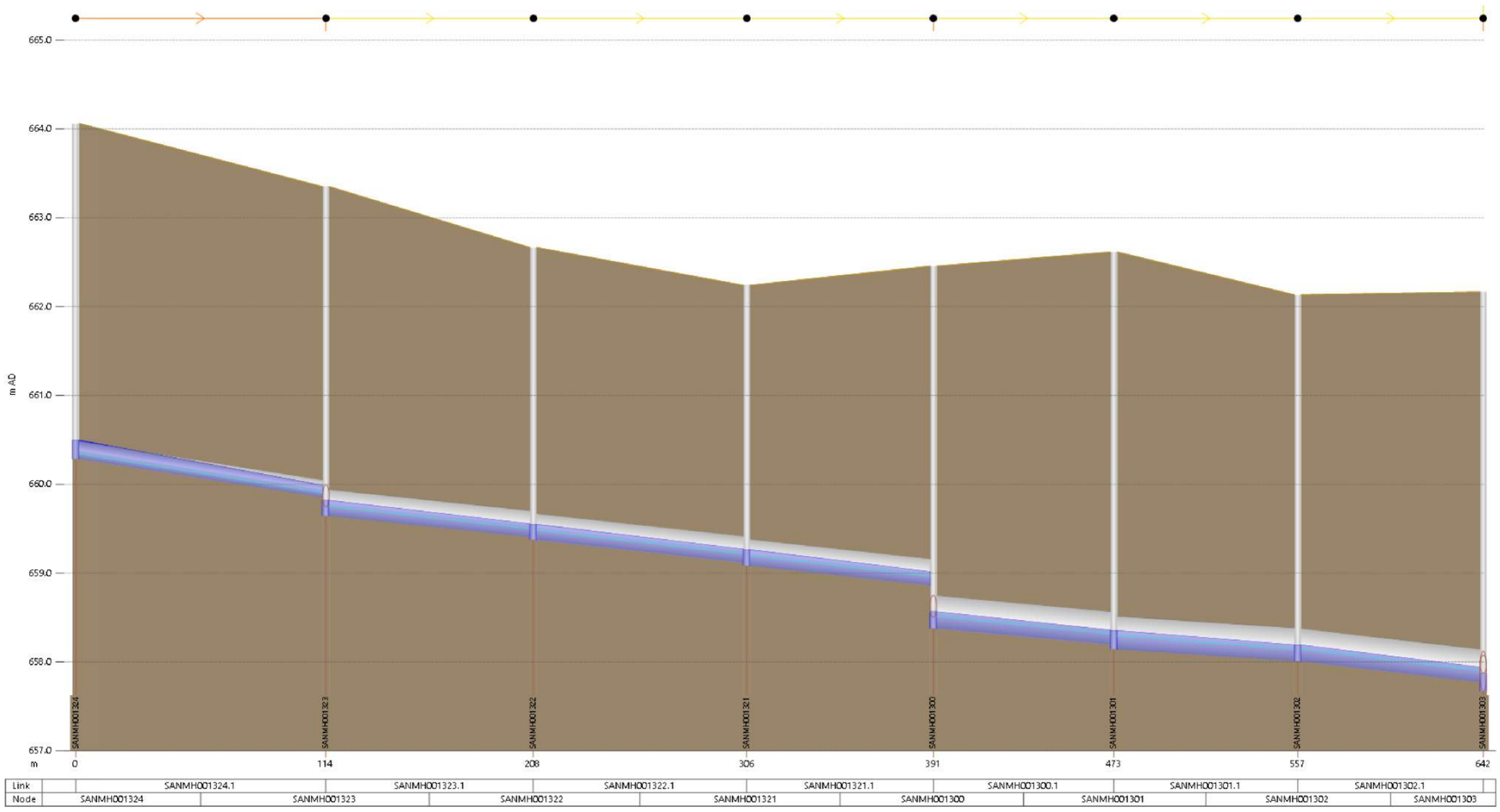
- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

FIGURE D.45
FUTURE CONCEPTS - LP 4
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

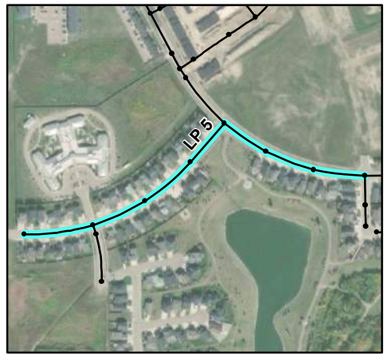
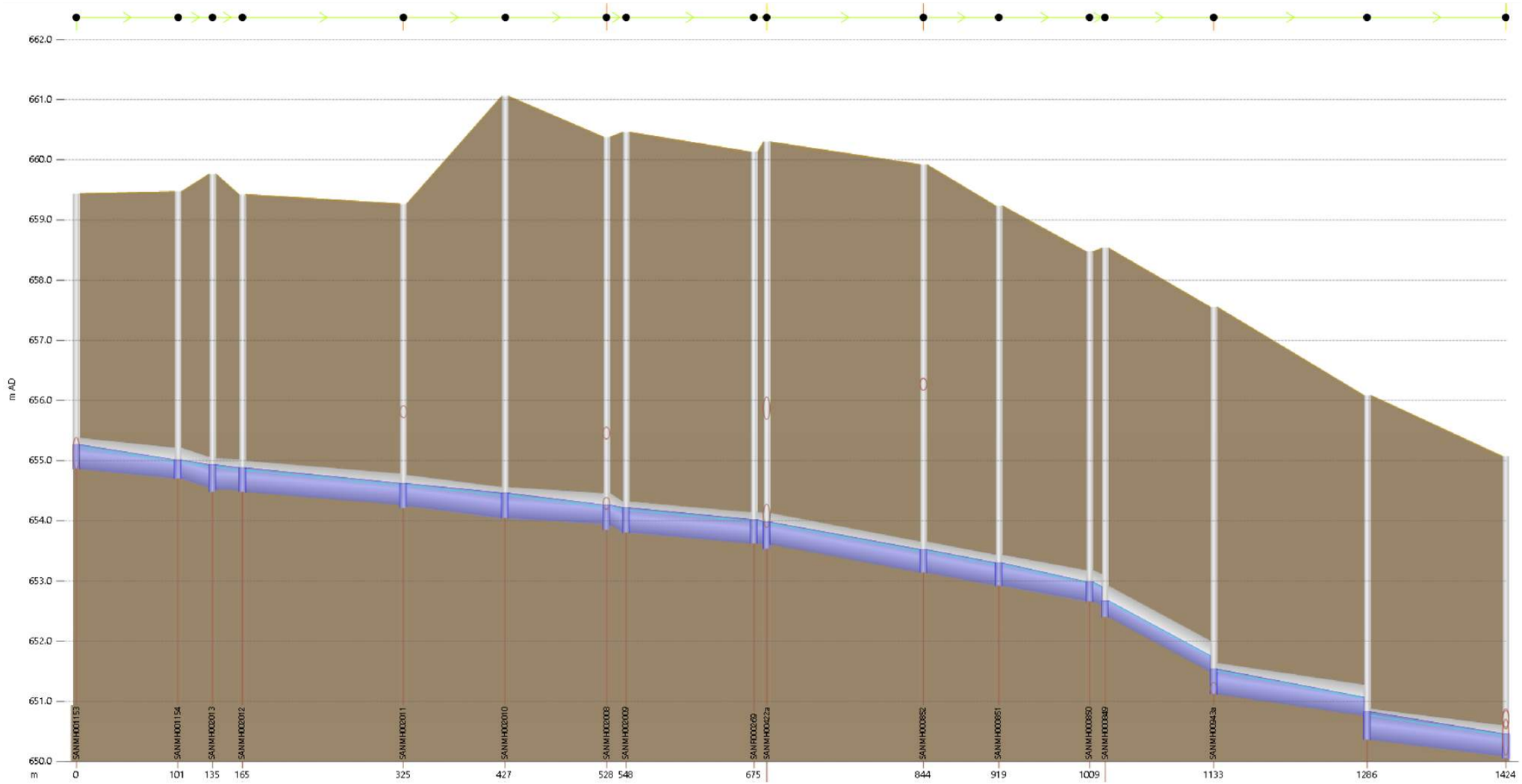


FIGURE D.46
FUTURE CONCEPTS - LP 5
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

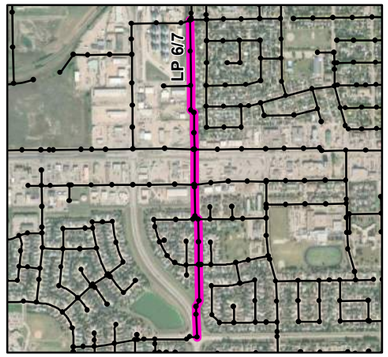
Integrated Expertise. Locally Delivered.



Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

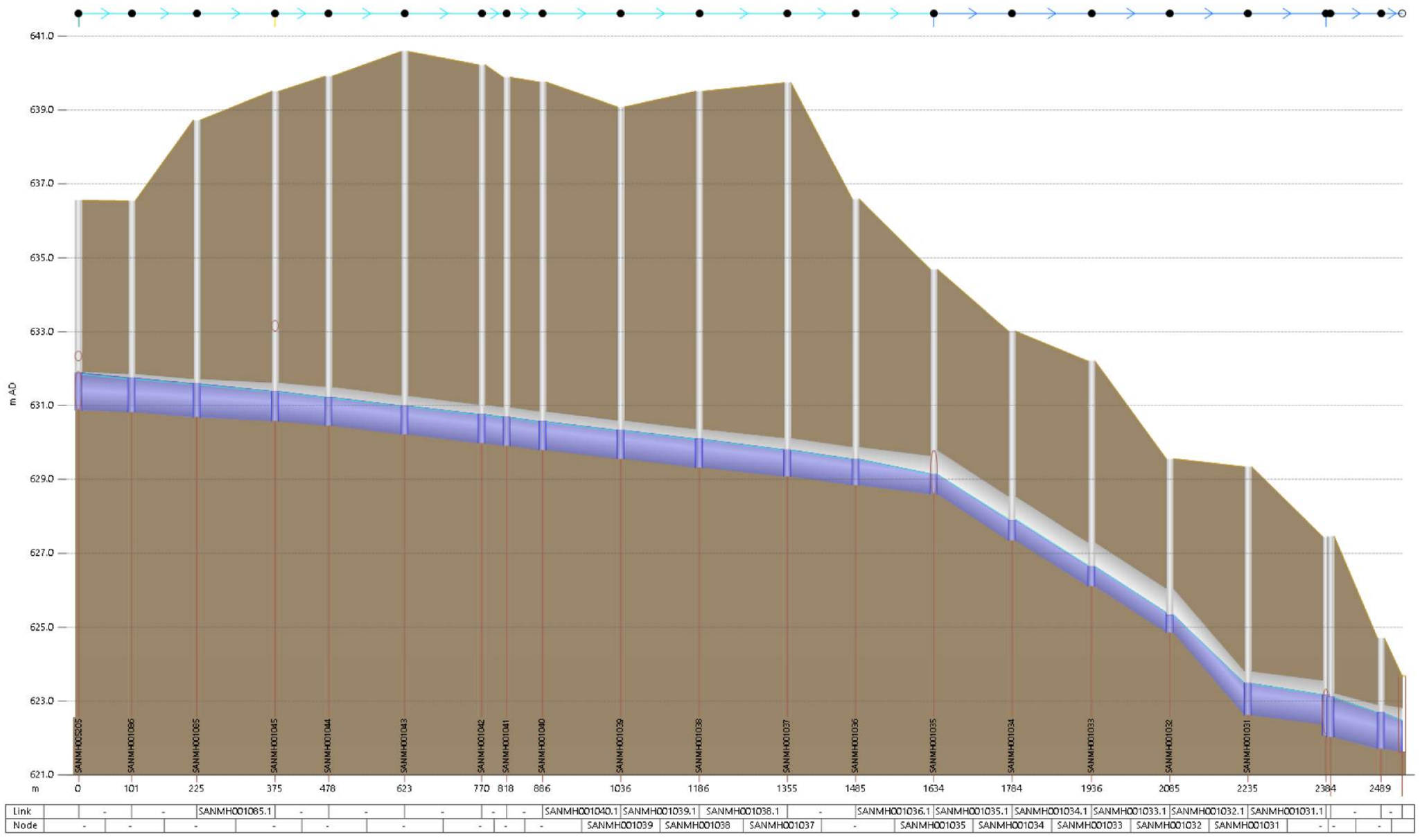


Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

FIGURE D.47
FUTURE CONCEPTS - LP 6/7
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

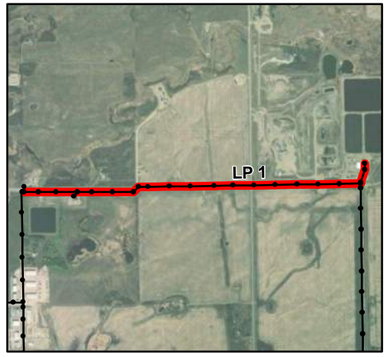
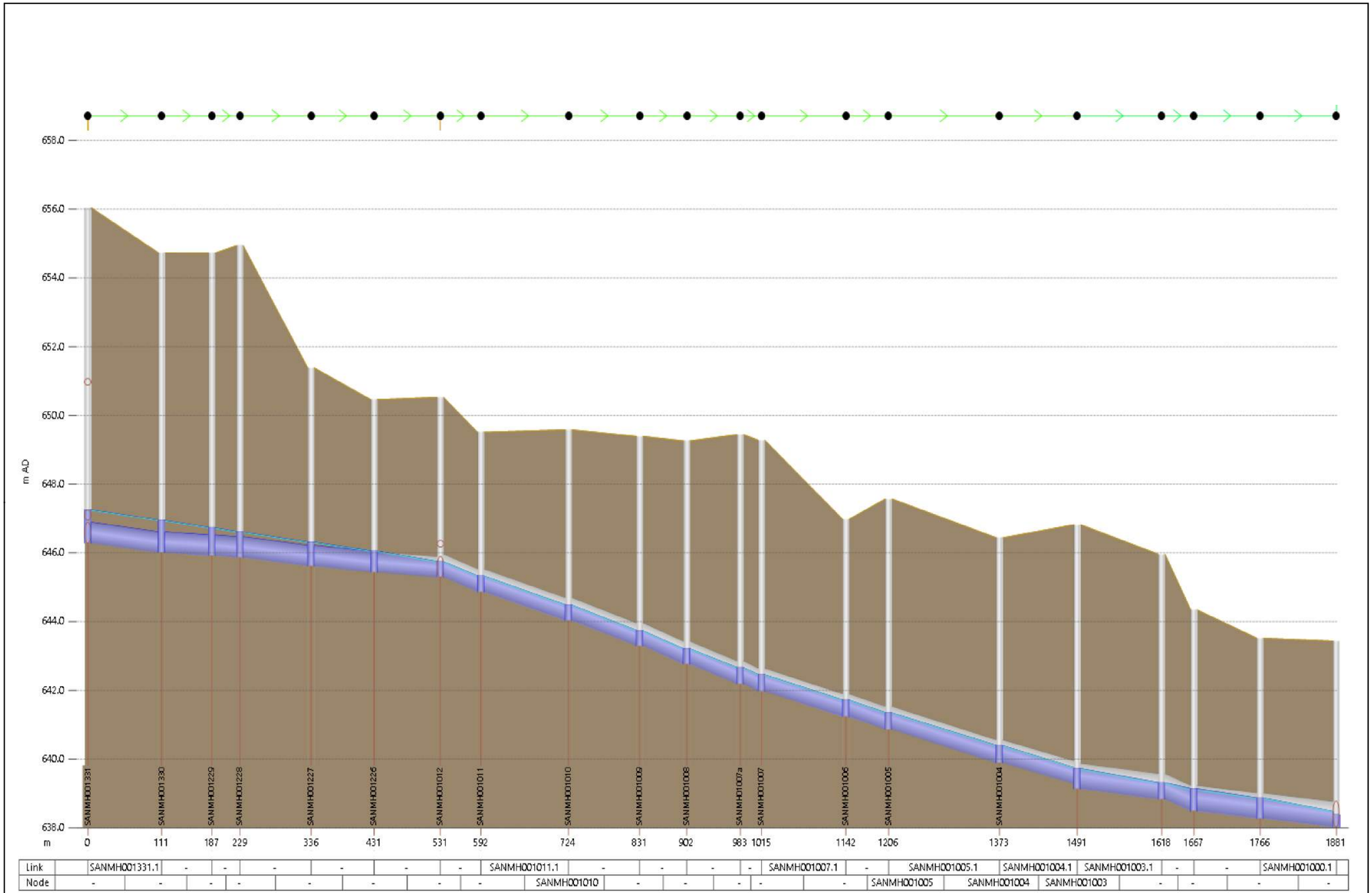


FIGURE D.48
FUTURE UPGRADES - LP 1
SANITARY SEWER MASTER PLAN



Credits:Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

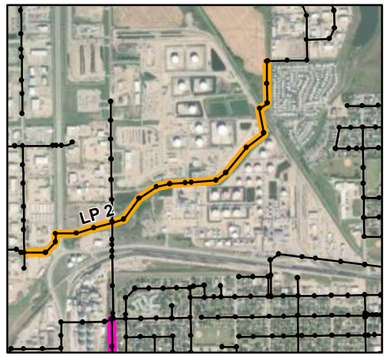
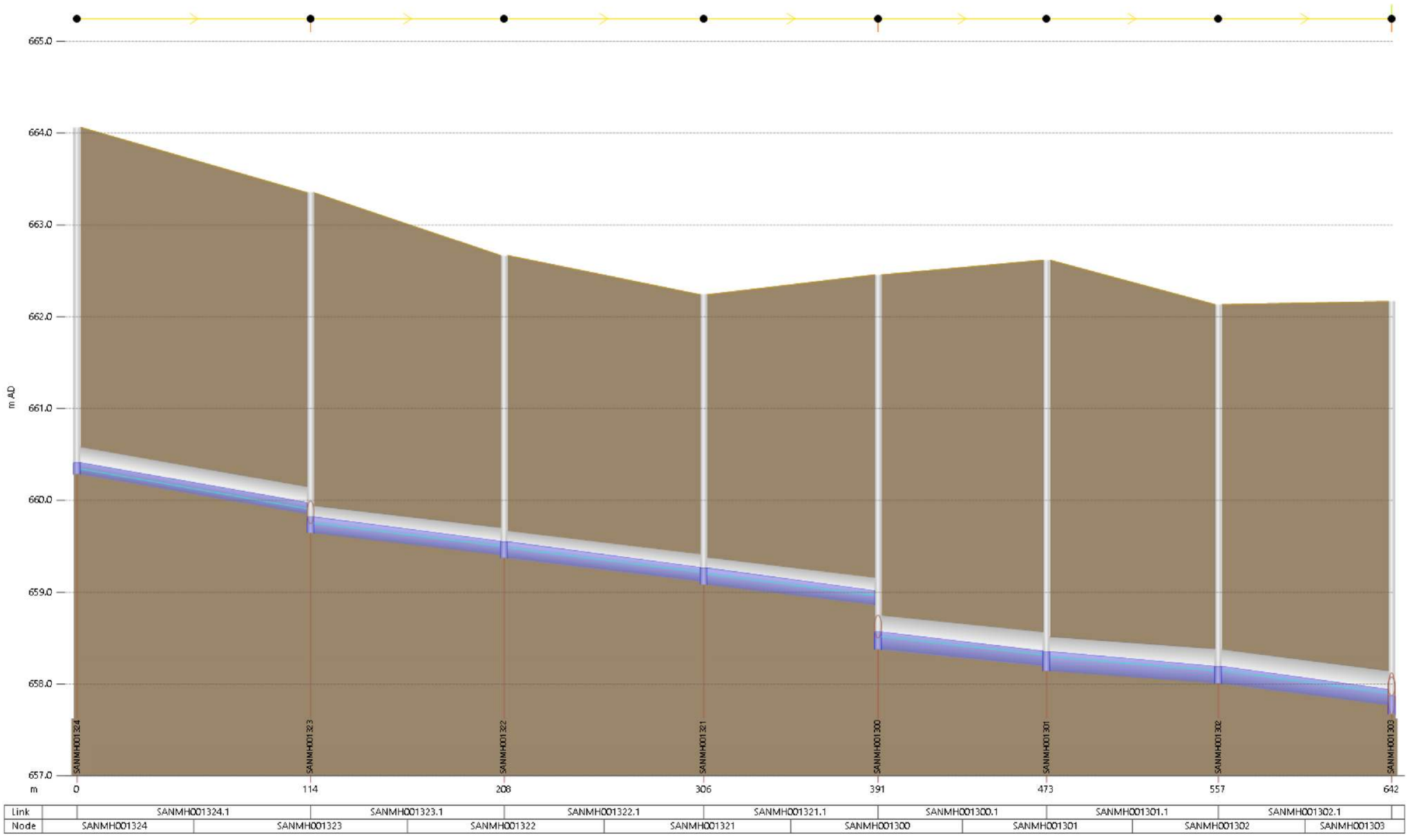


FIGURE D.49
FUTURE UPGRADES - LP 2
SANITARY SEWER MASTER PLAN

ISL LLOYDMINSTER

Integrated Expertise. Locally Delivered.



Legend

- Concept 1 HGL
- Concept 2 HGL

Both Concept 1 and 2 HGL are for the 1:25 Year 24-Hour Huff storm.

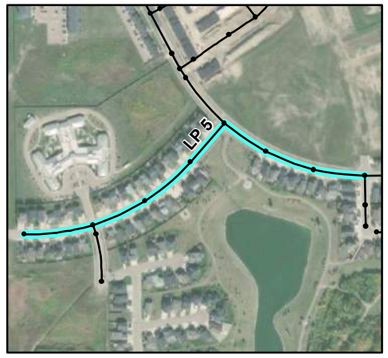


FIGURE D.50
FUTURE UPGRADES - LP 5
SANITARY SEWER MASTER PLAN

APPENDIX E
CCTV Inspection Reports

Tabular Report of PSR 2882-2881 for ISL

Setup	1	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	11:14	**Street**	49th Ave
City	Lloydminster	**Further location details**					

Up	2882	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Down	2881	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**		
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	99.6 **M**	**Length Surveyed**	99.6	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry	
Purpose		**Cat**				**Pressure**		

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing		**Easting**						**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								2882
0.0			MWL	Water Level			10					
99.6			AMH	Manhole								2881
99.6			FH	End of Survey								

99.6 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0

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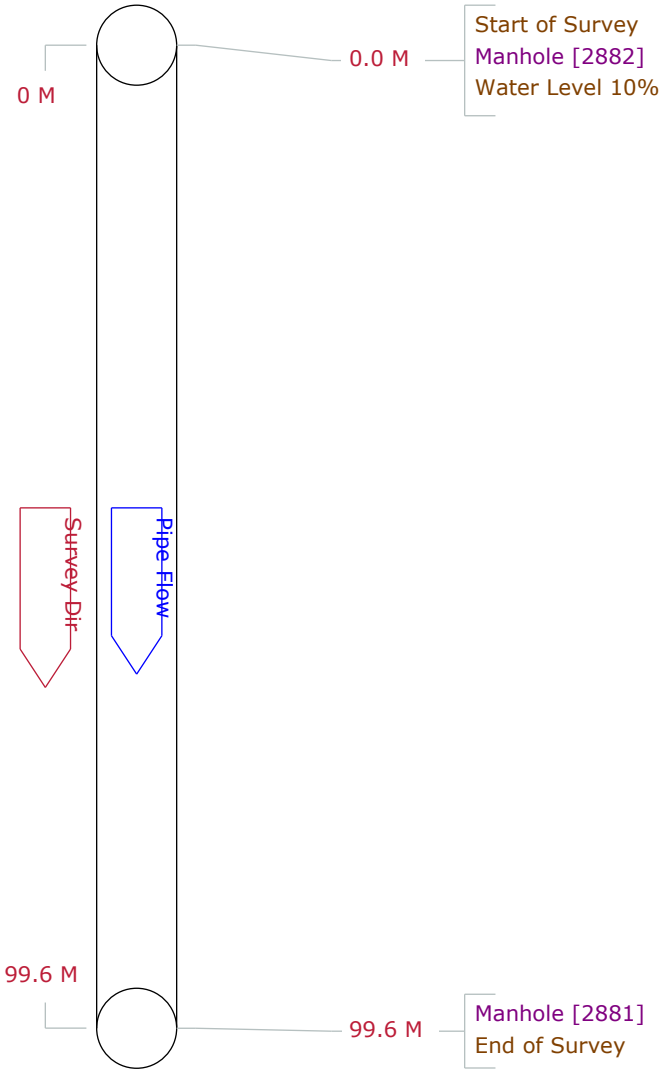
McGills Industrial Services Inc.
Phone:306-664-2220

Pipe Graphic Report of PSR 2882-2881 **for** ISL

Setup	1	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	11:14	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	2882	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	2881	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean** J	**Date Cleaned**
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	99.6 **M**	**Length Surveyed**	99.60 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 85-84 for ISL

Setup	2	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	12:47	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	85	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	84	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	200 **Width**	mm	**Preclean** J	**Date Cleaned**	2023-02-27
Material	Vitrified Clay Pipe	**Joint length**	M	**Total length**	100.2 M	**Length Surveyed**	100.2 M
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional Miscellaneous

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								85
0.0			MWL	Water Level			0					
1.8			FC	Fracture Circumferential					09	02		
3.1			FM	Fracture Multiple					03	06		
17.9			CL	Crack Longitudinal					09			
22.8			FC	Fracture Circumferential				J	12	04		
24.0			B	Broken					06			
35.1			FL	Fracture Longitudinal					06			
54.8			FL	Fracture Longitudinal					07			
79.6			FC	Fracture Circumferential				J	08	10		
82.1			B	Broken				J	05			
82.2			HVV	Hole Void Visible					04			
89.0			RFL	Roots Fine Lateral					11			
89.6			B	Broken					06			
98.0			MWLS	Water Level Sag			20					
100.2			AMH	Manhole								84
100.2			FH	End of Survey								

100.2 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	34	**Pipe Ratings Index**	2.8	**Peak** 5	**Mean Pipe**	0.3
O&M:	**Pipe Rating**	1	**Pipe Ratings Index**	1	**Peak** 1	**Mean Pipe**	0

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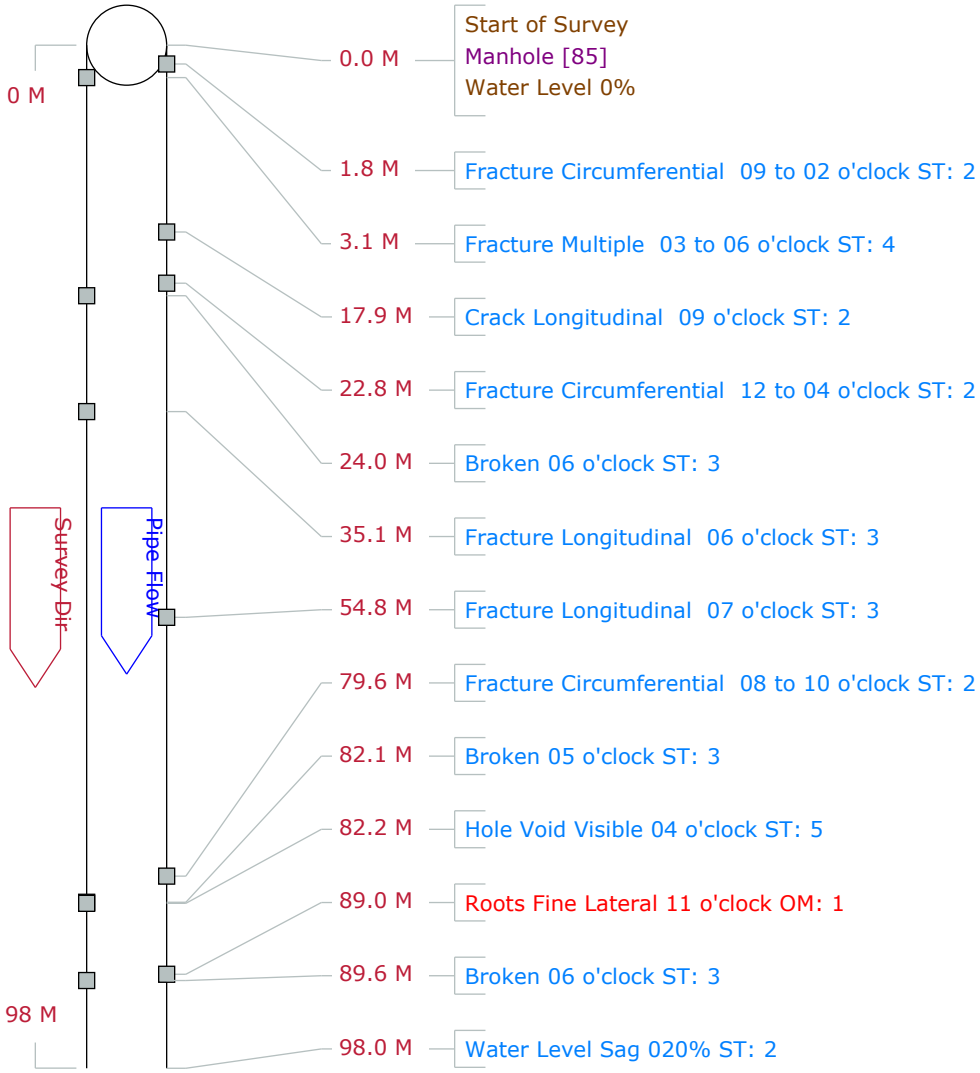
Pipe Graphic Report of PSR 85-84 **for** ISL

Setup	2	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	12:47	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	85	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	84	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	100.2 **M**	**Length Surveyed**	100.20 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1						
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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McGills Industrial Services Inc.
Phone:306-664-2220

Pipe Graphic Report of PSR 85-84 **for** ISL

Setup	2	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	12:47	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	85	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	84	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-27
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	100.2 **M**	**Length Surveyed**	100.20 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					

Additional info

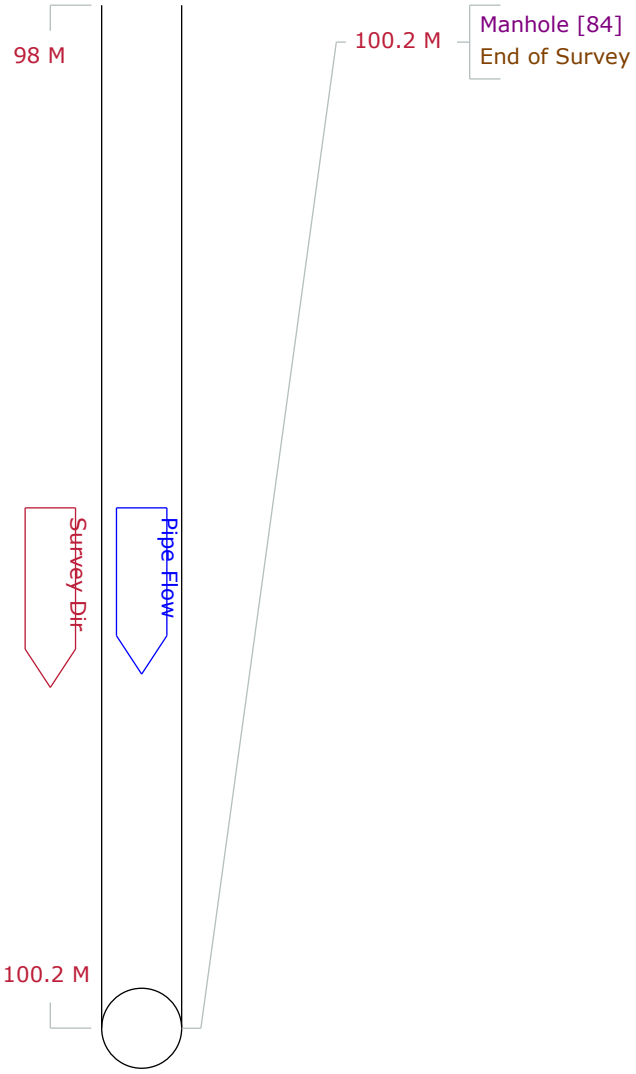
Structural O & M Constructional
Miscellaneous Hydraulic

Location

Project Lloydminster Phase 1 **Work Order**

Northing **Easting** **Elevation**

Coordinate System **GPS Accuracy**



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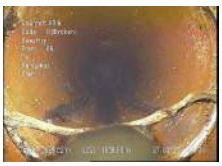
CCTV Picture List of 85-84 **for** ISL

Work Order			**Setup** 2
Video	**Survey Date**	2023-02-27	
Path to picture files	C:\FLEX6\Snaps\ISL\		
Path to video files	C:\FLEX6\Movies\ISL\		
Path to media files	C:\FLEX6\Media\ISL\		

Video Index **Count** 82.2 M
Code Hole Void Visible
Remarks
File Name 17.jpg



Video Index **Count** 89.6 M
Code Broken
Remarks
File Name 18.jpg

Tabular Report of PSR 357-356 for ISL

Setup	12	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	15:03	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	357	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	356	**Rim to invert**		**Grade to invert**		**Rim to grade**	M

Use	Sanitary	**Direction**	Up	**Flow control**				**Media No**	
Shape	Circular	**Height**	375	**Width**	mm	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Concrete Pipe (non-reinforced)	**Joint length**	M	**Total length**	68.5 M			**Length Surveyed**	68.5 M
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info						Structural	O & M	Constructional
Location						Miscellaneous		
Project	Lloydminster Phase 1					**Work Order**		
Northing		**Easting**				**Elevation**		
Coordinate System						**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								356
0.0			MWL	Water Level			45					
52.1			SRI	Surface Roughness Increased					12	12		
57.9			MWL	Water Level			25					25
68.5			AMH	Manhole								357
68.5			FH	End of Survey								

68.5 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	1	**Pipe Ratings Index**	1	**Peak**	1	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

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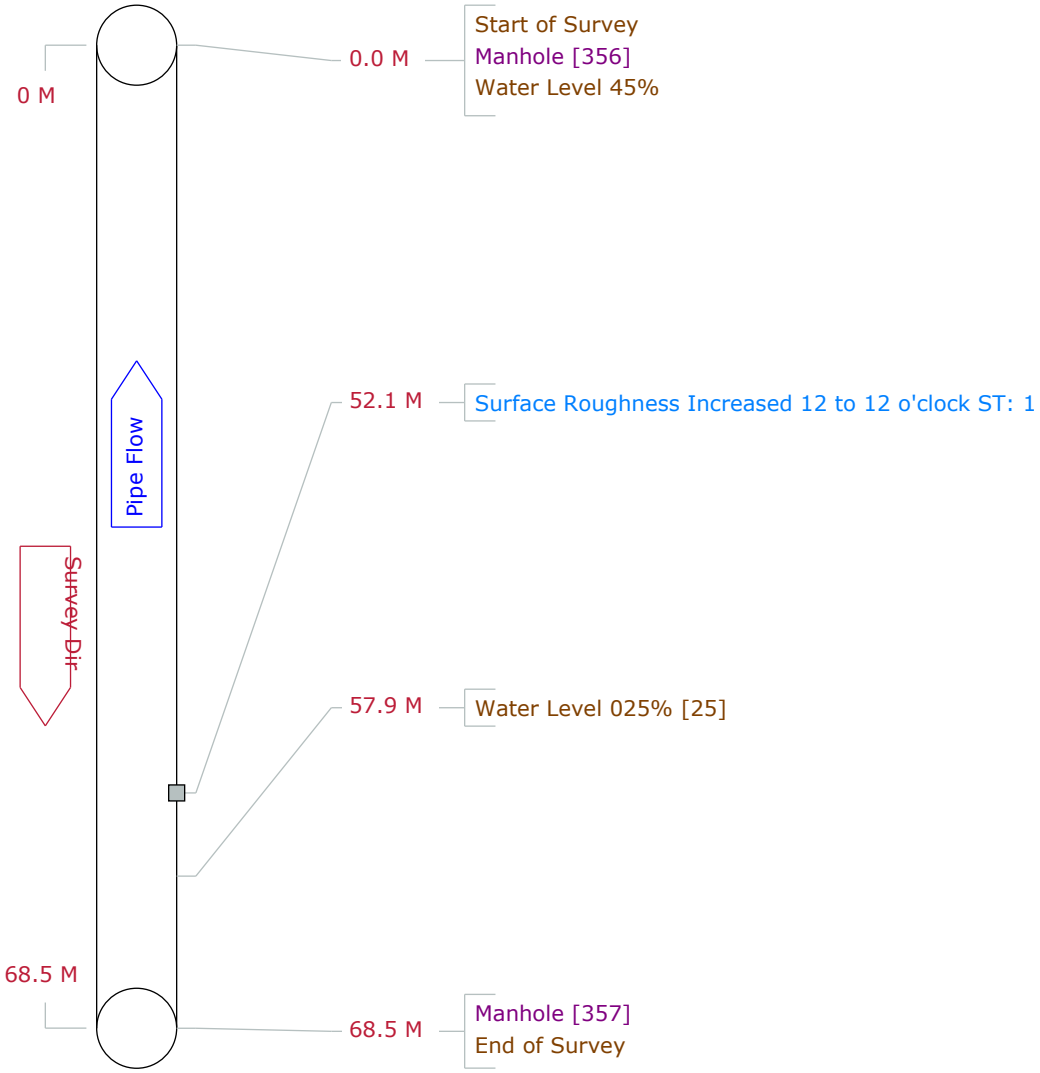
Pipe Graphic Report of PSR 357-356 **for** ISL

Setup	12	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	15:03	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	357	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	356	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	mm	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Concrete Pipe (non-reinforced)	**Joint length**	M	**Total length**	68.5 M	**Length Surveyed**	68.50 M
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



McGills Industrial Services Inc.
Phone:306-664-2220

Tabular Report of PSR 356-2882 for ISL

Setup	13	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	15:37	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	356	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	2882	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	70.4 **M**	**Length Surveyed**	70.4 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								356
0.0			MWL	Water Level			0					
70.4			AMH	Manhole								2882
70.4			FH	End of Survey								

70.4 **M** **Total Length Surveyed**

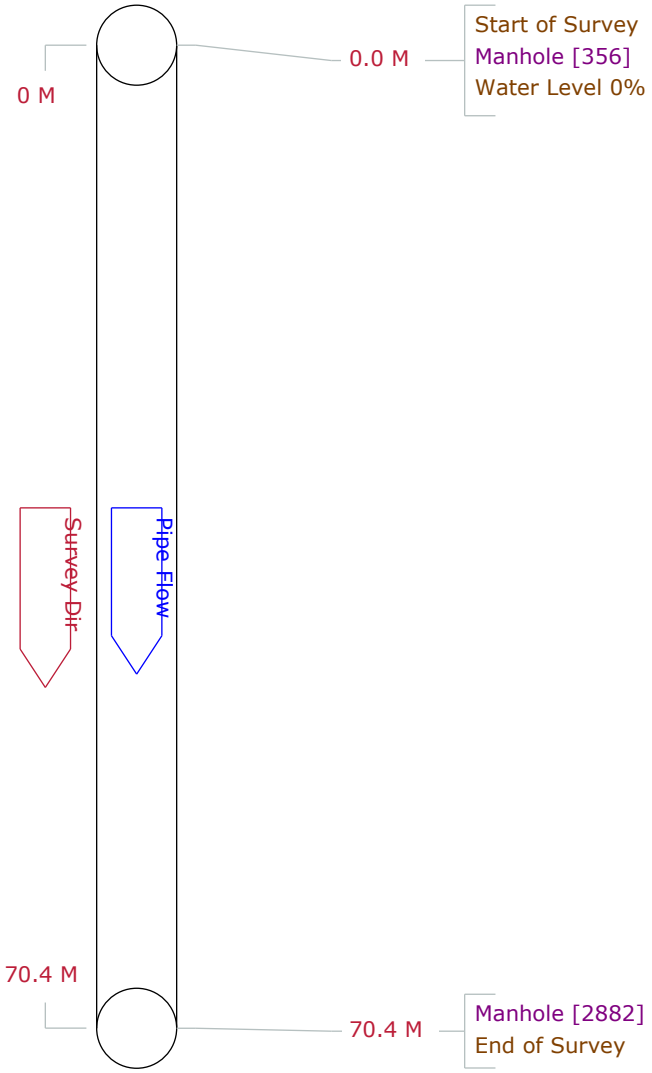
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 356-2882 **for** ISL

Setup	13	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	15:37	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	356	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	2882	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	70.4 **M**	**Length Surveyed**	70.40 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 561-544 for ISL

Setup	34	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	8:04	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	561	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	544	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Up	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	58.1 **M**	**Length Surveyed**	58.1 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								544
0.0			MWL	Water Level			30					
46.6			B	Broken					04			
58.1			AMH	Manhole								561
58.1			FH	End of Survey								

58.1 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	3	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0.1
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0

Pipe Graphic Report of PSR 561-544 **for** ISL

Setup	34	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	8:04	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	561	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	544	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length** 58.1 **M**		**Length Surveyed** 58.10	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					

Additional info

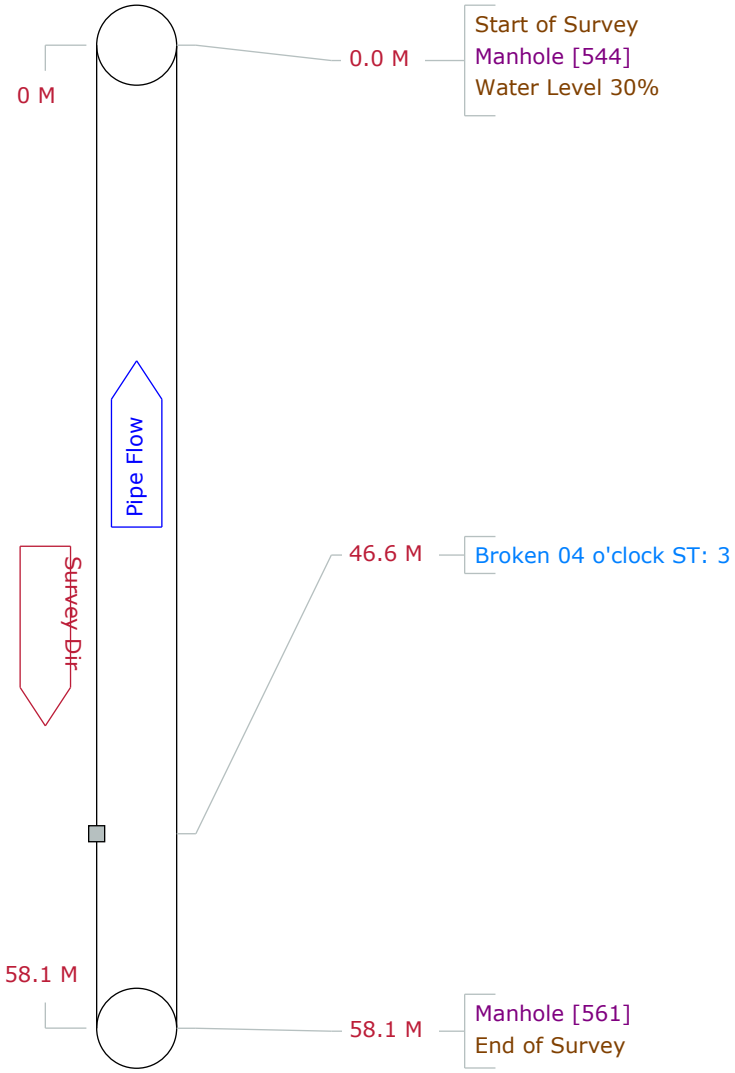
Structural O & M Constructional
Miscellaneous Hydraulic

Location

Project Lloydminster Phase 1 **Work Order**

Northing **Easting** **Elevation**

Coordinate System **GPS Accuracy**



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Tabular Report of PSR 544-655 for ISL

Setup	35	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	8:43	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	544	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	655	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	72.7 **M**	**Length Surveyed**	72.7 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								544
0.0			MWL	Water Level			20					
25.5			JOM	Joint Offset Medium								
34.6			CM	Crack Multiple					10	02		
63.4			CL	Crack Longitudinal				J	04			
72.7			AMH	Manhole								655
72.7			FH	End of Survey								

72.7 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	6	**Pipe Ratings Index**	2	**Peak**	3	**Mean Pipe** 0.1
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0

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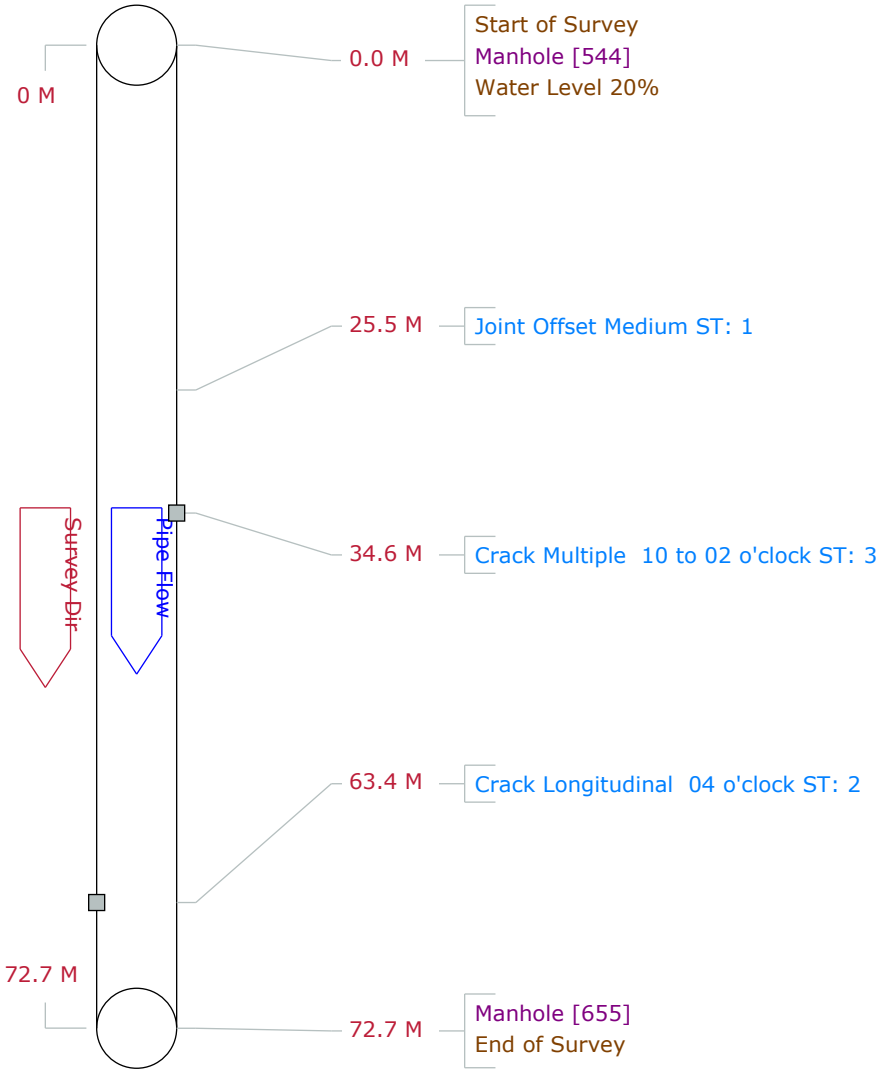
Pipe Graphic Report of PSR 544-655 **for** ISL

Setup	35	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	8:43	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	544	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	655	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length** 72.7 **M**		**Length Surveyed**	72.70 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 655-543 for ISL

Setup	36	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	9:02	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	655	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	543	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	26.8 **M**			**Length Surveyed**	26.8 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing		**Easting**						**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								655
0.0			MWL	Water Level			20					
1.7			B	Broken					02			
15.8			FM	Fracture Multiple					07	03		
21.9			MWL	Water Level			50					50
26.8			AMH	Manhole								543
26.8			FH	End of Survey								

26.8 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	7	**Pipe Ratings Index**	3.5	**Peak**	4	**Mean Pipe** 0.3
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0

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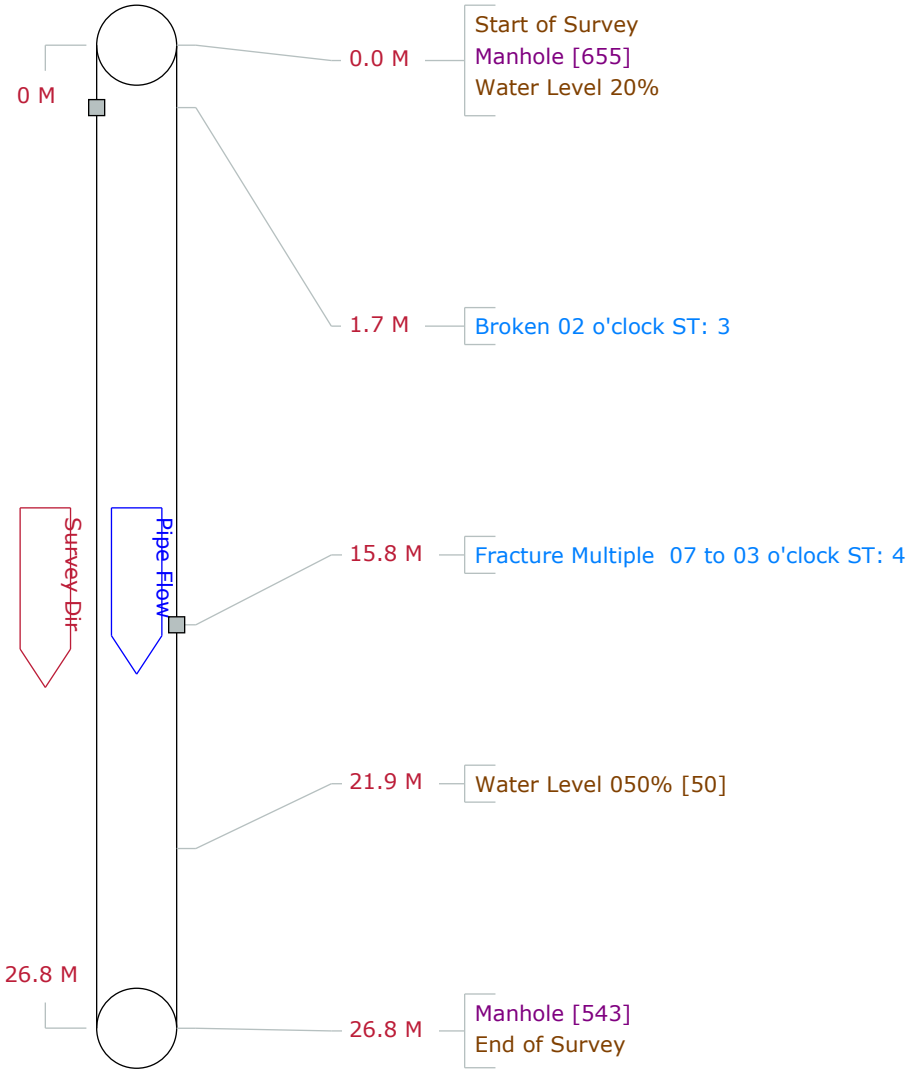
Pipe Graphic Report of PSR 655-543 **for** ISL

Setup	36	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	9:02	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	655	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	543	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**			
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	26.8 **M**	**Length Surveyed**	26.80 **M**		
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry		
Purpose		**Cat**							

Additional info		Structural	O & M	Constructional
Location		Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1		**Work Order**	
Northing	**Easting**		**Elevation**	
Coordinate System			**GPS Accuracy**	



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Tabular Report of PSR 543-656 for ISL

Setup	37	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	9:50	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	543	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	656	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	41.4 **M**	**Length Surveyed**	41.4 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								543
0.0			MWL	Water Level			0					
18.5			MWL	Water Level			25					25
24.9			MWL	Water Level			35					35
41.4			AMH	Manhole								656
41.4			FH	End of Survey								

41.4 **M** **Total Length Surveyed**

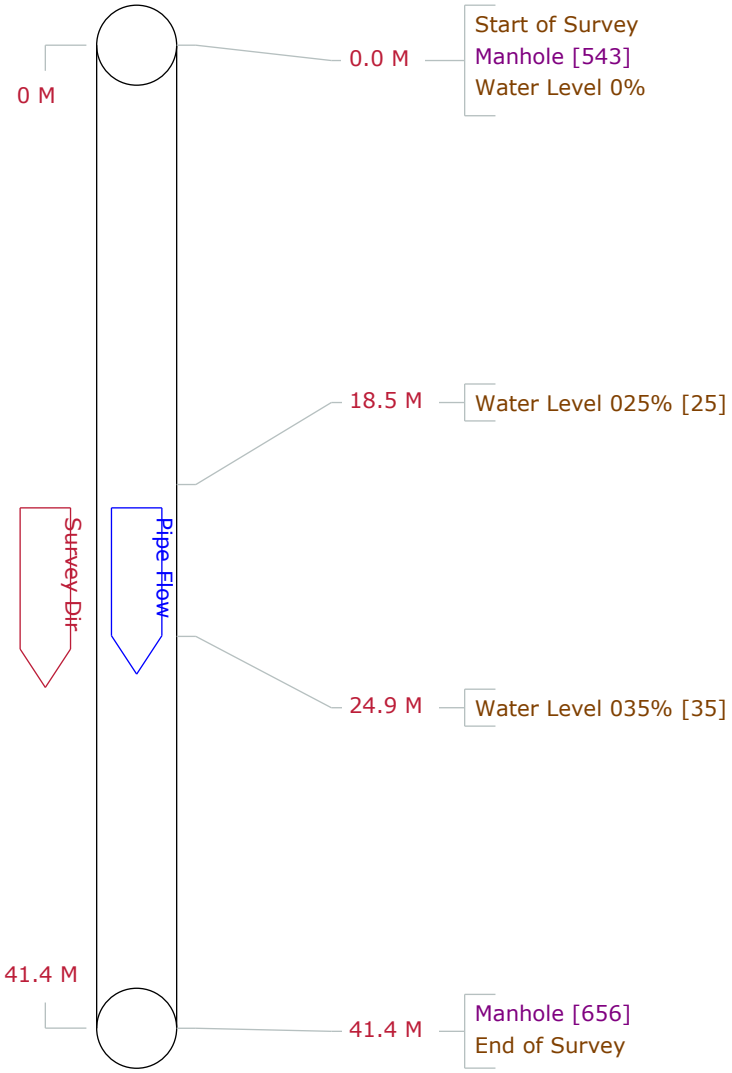
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 543-656 **for** ISL

Setup	37	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	9:50	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	543	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	656	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length** 41.4 **M**		**Length Surveyed** 41.40	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 656-542 for ISL

Setup	38	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	10:02	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	656	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	542	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	58.8 **M**	**Length Surveyed**	58.8 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								656
0.0			MWL	Water Level			20					
12.0			JSM	Joint Separated Medium								
16.5			JOM	Joint Offset Medium								
58.8			AMH	Manhole								542
58.8			FH	End of Survey								

58.8 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	2	**Pipe Ratings Index**	1	**Peak**	1	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

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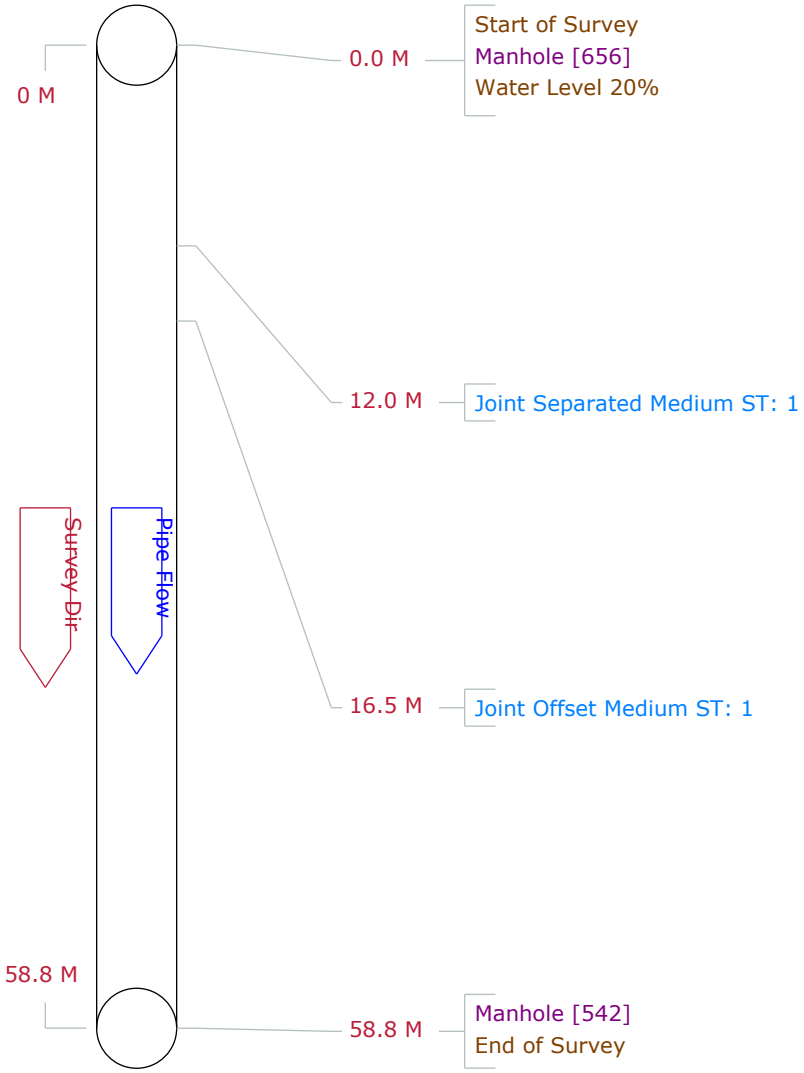
Pipe Graphic Report of PSR 656-542 **for** ISL

Setup	38	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	10:02	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	656	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	542	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length** 58.8 **M**		**Length Surveyed**	58.80 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project Lloydminster Phase 1		**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 542-461 for ISL

Setup	39	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	10:44	**Street**	42nd Street
City	Lloydminster	**Further location details**					

Up	542	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	461	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	47.5 **M**	**Length Surveyed**	47.5 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								542
0.0			MWL	Water Level			40					
21.4			B	Broken					10			
47.5			AMH	Manhole								461
47.5			FH	End of Survey								

47.5 **M** **Total Length Surveyed**

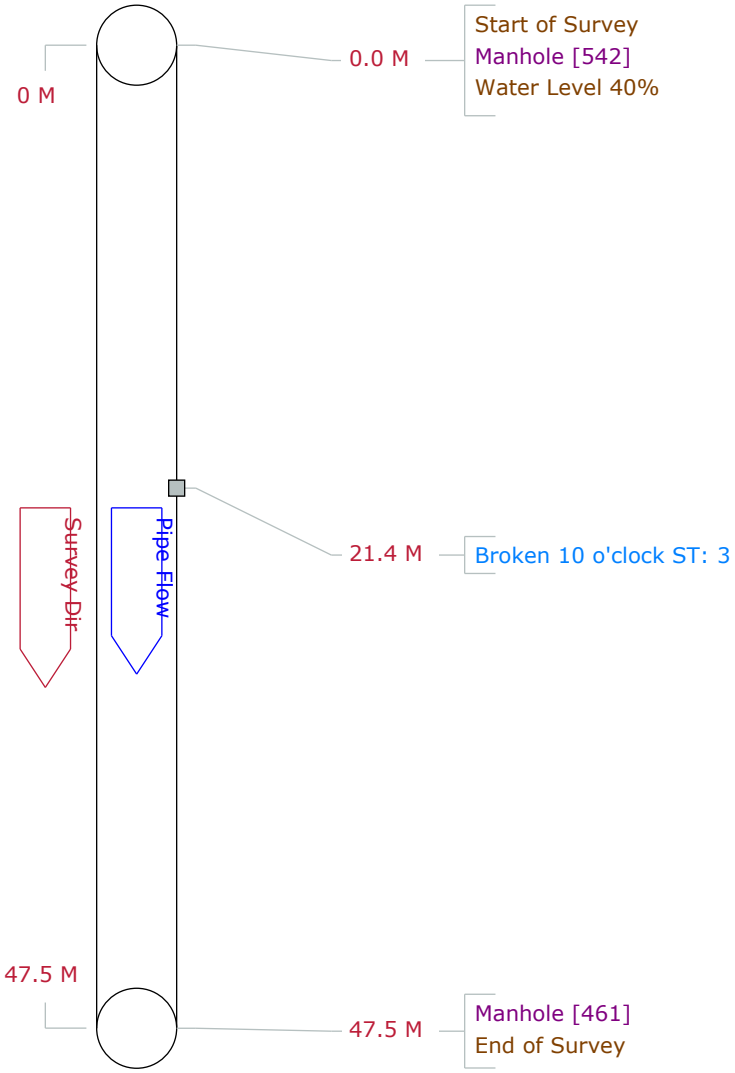
Scores

Structural:	**Pipe Rating**	3	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0.1
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0

Pipe Graphic Report of PSR 542-461 **for** ISL

Setup	39	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	10:44	**Street**	42nd Street
City	Lloydminster	**Further location details**					
Up	542	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	461	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length** 47.5 **M**		**Length Surveyed**	47.50 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project Lloydminster Phase 1		**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Phone:306-664-2220

Tabular Report of PSR 389-388 for ISL

Setup	30	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	16:33	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	389	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Down	388	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Use	Sanitary	**Direction**	Up	**Flow control**		**Media No**		
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	99.3 **M**	**Length Surveyed**	99.3	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp	
Purpose		**Cat**				**Pressure**		

Additional info			Structural	O & M	Constructional
Location			Miscellaneous		
Project	Lloydminster Phase 1		**Work Order**	
Northing		**Easting**	**Elevation**	
Coordinate System			**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								388
0.0			MWL	Water Level			45					
5.6			MGO	General Observation								388a
14.8			SRI	Surface Roughness Increased					12			
94.8			FL	Fracture Longitudinal					02			
99.3			AMH	Manhole								389
99.3			FH	End of Survey								

99.3 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	4	**Pipe Ratings Index**	2	**Peak**	3	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

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Pipe Graphic Report of PSR 389-388 for ISL

Setup	30	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	16:33	**Street**	36th Street
City	Lloydminster	**Further location details**					
Up	389	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	388	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length** 99.3 **M**		**Length Surveyed**	99.30 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp
Purpose		**Cat**					

Additional info

Location

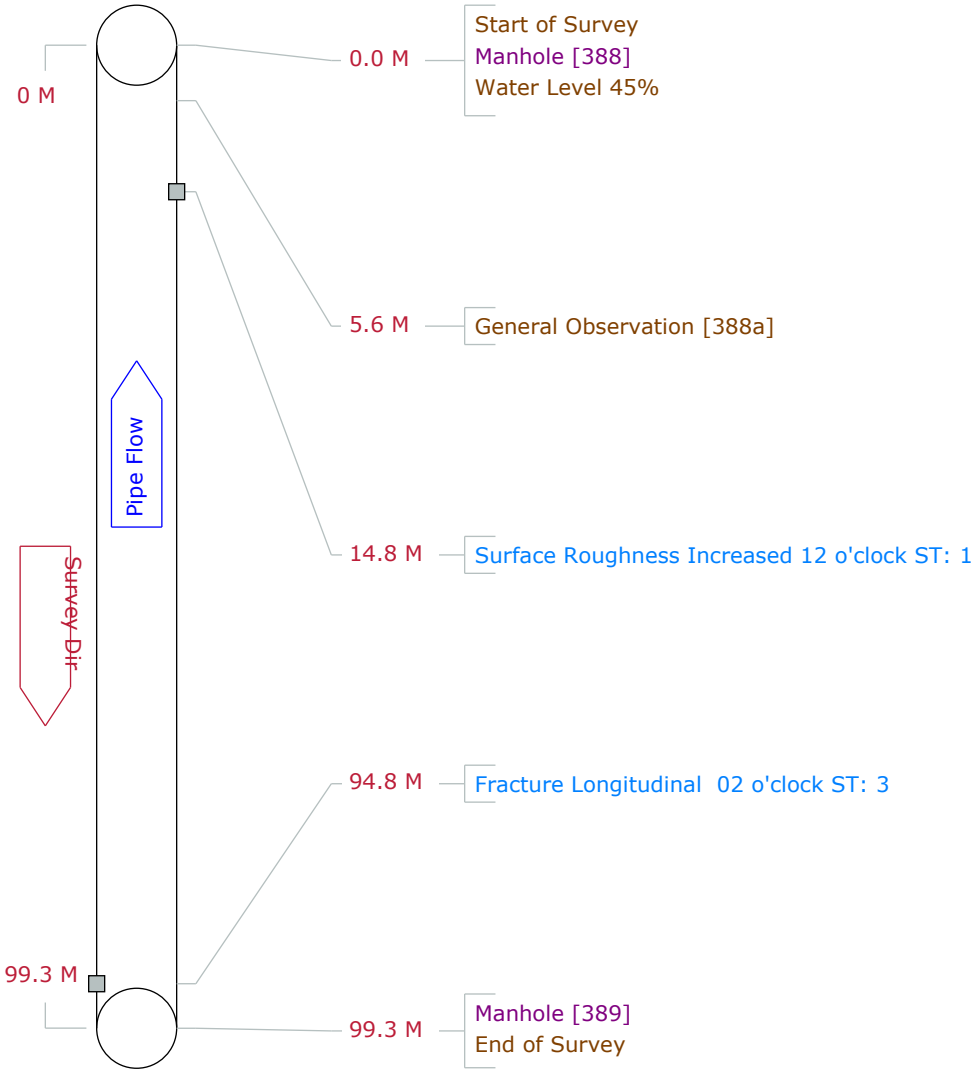
Project Lloydminster Phase 1

Northing **Easting** **Elevation**

Coordinate System **GPS Accuracy**

Structural O & M Constructional
Miscellaneous Hydraulic

Work Order



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Tabular Report of PSR 390-389 for ISL

Setup	31	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	16:59	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	390	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	389	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	**M**			**Length Surveyed**	94.9 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Damp
Purpose		**Cat**						**Pressure**	

Additional info						Structural	O & M	Constructional
Location						Miscellaneous		
Project	Lloydminster Phase 1					**Work Order**		
Northing		**Easting**				**Elevation**		
Coordinate System						**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								390
1.0			MWL	Water Level			25					
4.9			SAP	Surface Aggregate Projecting					12			
94.9			MSA	Abandoned Survey								Manhole insight

94.9 **M** **Total Length Surveyed**

Scores								
	Structural:	**Pipe Rating** 3	**Pipe Ratings Index** 3	**Peak** 3	**Mean Pipe** 0
	O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

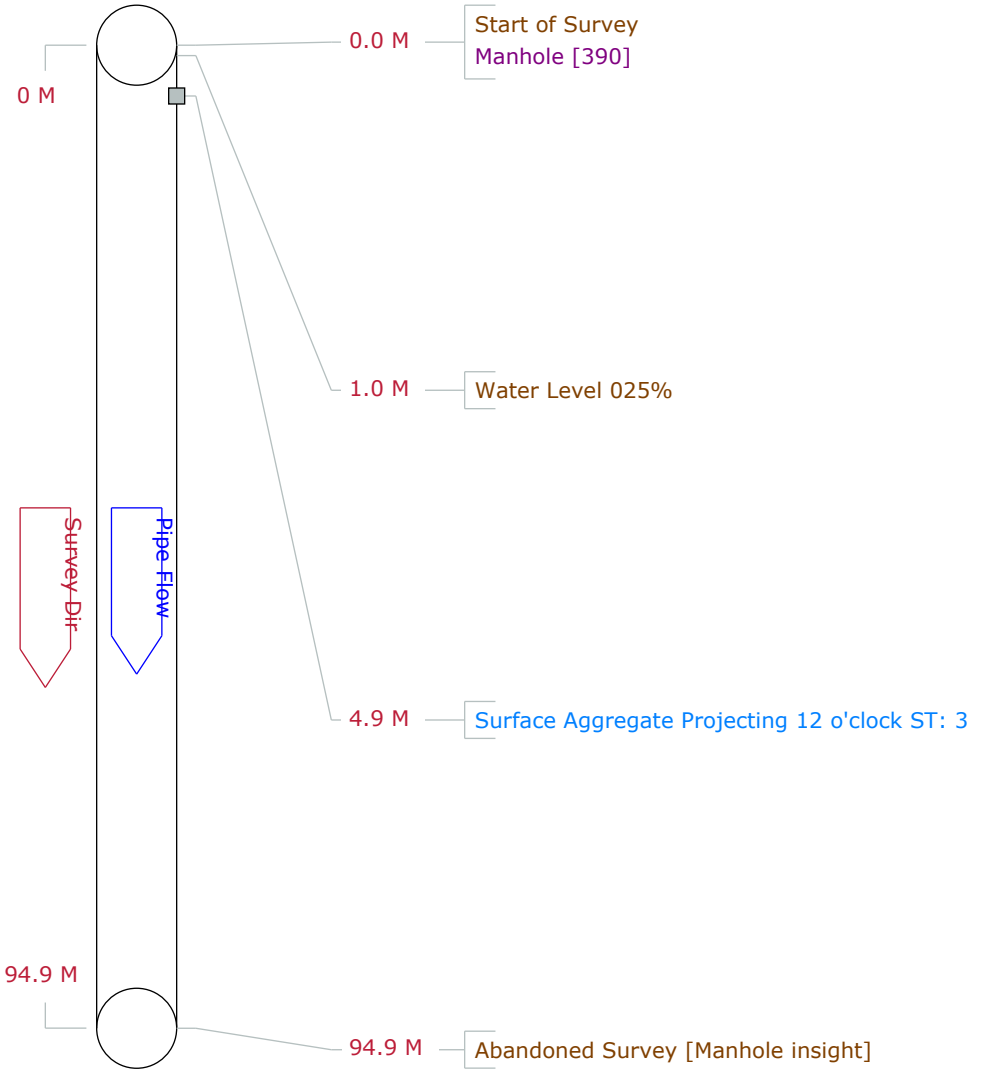
Pipe Graphic Report of PSR 390-389 **for** ISL

Setup	31	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	16:59	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	390	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	389	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**			
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	**M**	**Length Surveyed**	94.90	**M**	
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp		
Purpose		**Cat**							

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1	**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 429-390 for ISL

Setup	32	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	19:10	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	429	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Down	390	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Use	Sanitary	**Direction**	Up	**Flow control**		**Media No**		
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	21.2 **M**	**Length Surveyed**	21.2	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp	
Purpose		**Cat**				**Pressure**		

Additional info			Structural	O & M	Constructional
Location			Miscellaneous		
Project	Lloydminster Phase 1		**Work Order**	
Northing		**Easting**	**Elevation**	
Coordinate System			**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								390
0.0			MWL	Water Level			30					
11.0			MGO	General Observation								Rapid grade change
14.6			MWL	Water Level			15					15
21.2			AMH	Manhole								429
21.2			FH	End of Survey								

21.2 **M** **Total Length Surveyed**

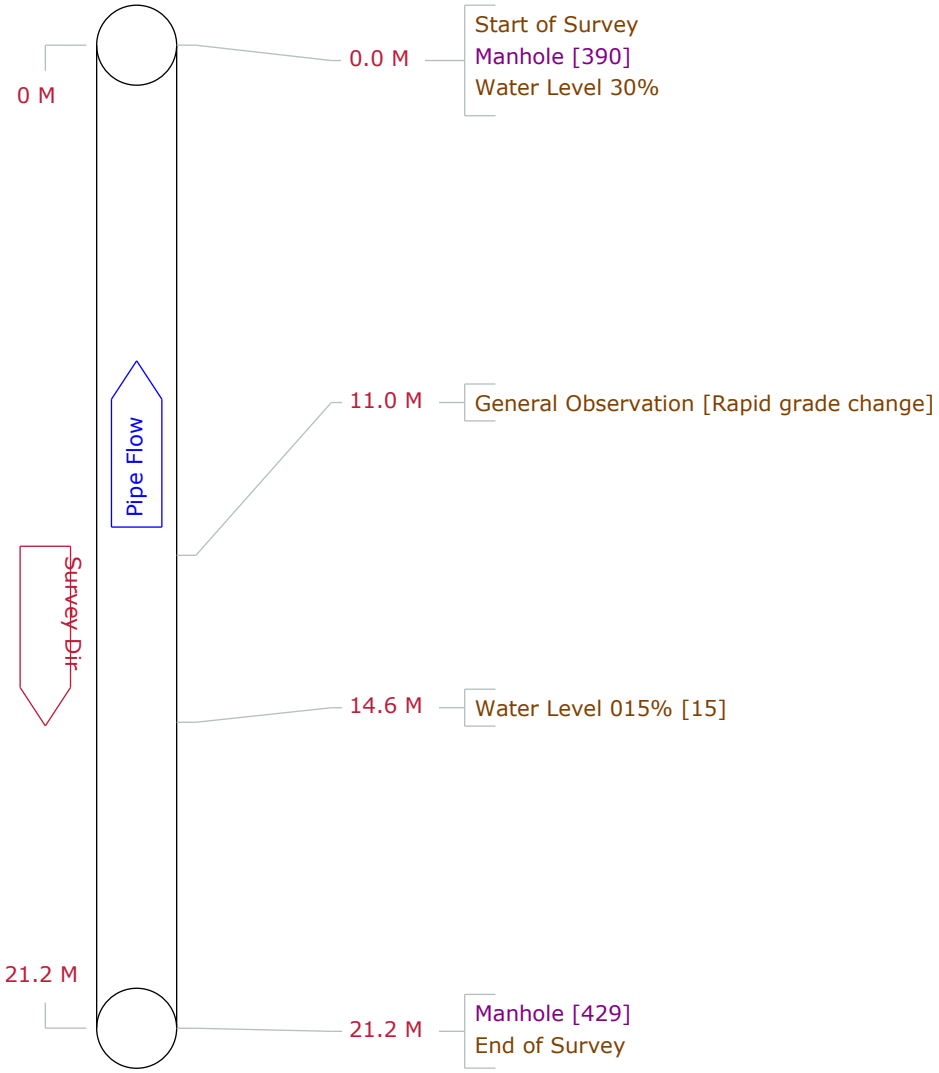
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 429-390 **for** ISL

Setup	32	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	19:10	**Street**	36th Street
City	Lloydminster	**Further location details**					
Up	429	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	390	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length** 21.2 **M**		**Length Surveyed**	21.20 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp
Purpose		**Cat**					

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project Lloydminster Phase 1		**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 434-429 for ISL

Setup	33	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	19:15	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	434	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**	
Down	429	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**	
Use	Sanitary	**Direction**	Up	**Flow control**		**Media No**			
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	**M**	**Length Surveyed**	8.0	**M**	
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp		
Purpose		**Cat**				**Pressure**			

Additional info				Structural	O & M
Location				Constructional	Miscellaneous
Project	Lloydminster Phase 1			**Work Order**	
Northing		**Easting**		**Elevation**	
Coordinate System				**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								429
0.0			MWL	Water Level			20					
0.8			MMC	Material change								CMP
6.8			MGO	General Observation								Pipe invert suspected broken
8.0			MSA	Abandoned Survey								Pipe rough, risky to proceed

8.0 **M** **Total Length Surveyed**

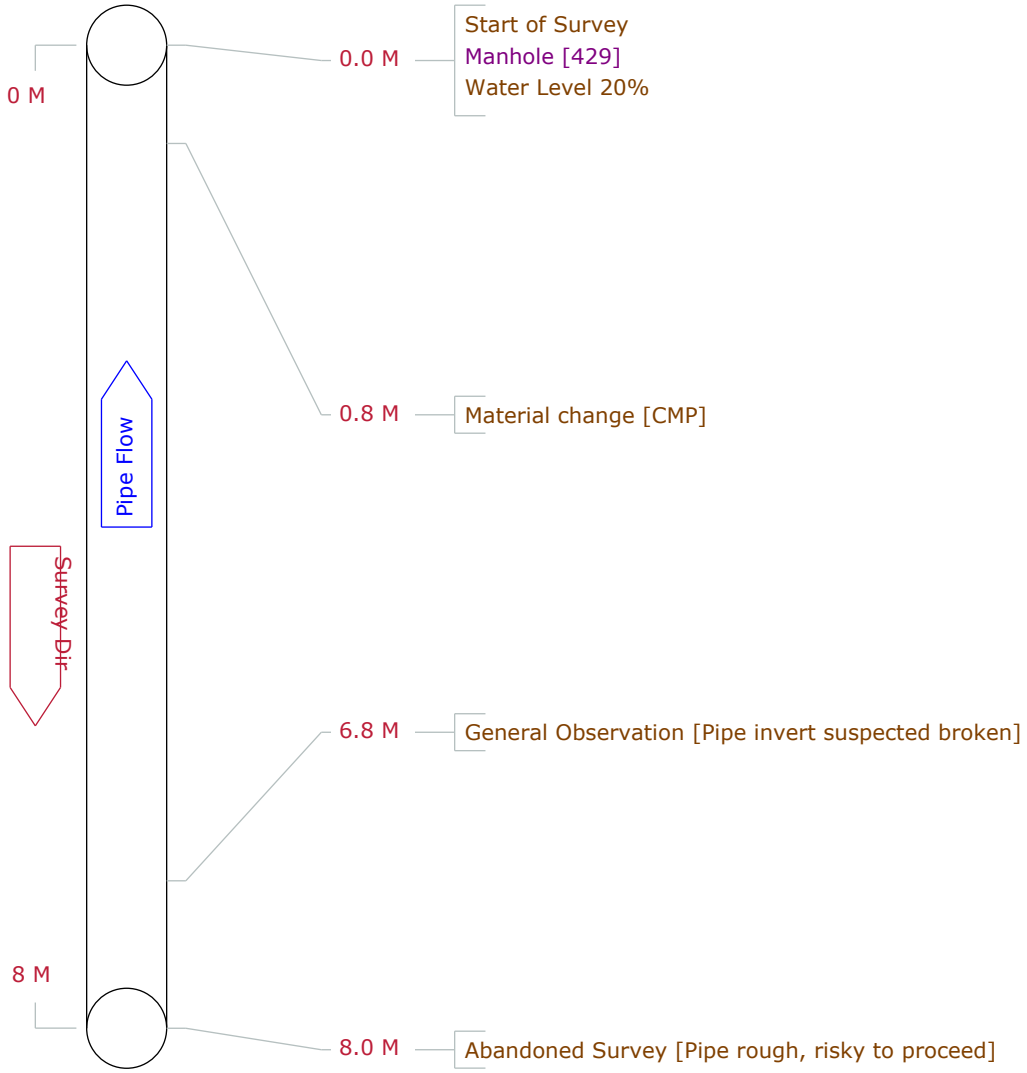
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0

Pipe Graphic Report of PSR 434-429 **for** ISL

Setup	33	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	19:15	**Street**	36th Street
City	Lloydminster	**Further location details**					
Up	434	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	429	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	mm	**Preclean** J	**Date Cleaned** 2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	M	**Total length**	M	**Length Surveyed**	08.00 M
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Damp
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 528-527 for ISL

Setup	3	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	13:39	**Street**	49th Ave
City	Lloydminster	**Further location details**					

Up	528	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	UNK	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-02-27
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	41.3 **M**			**Length Surveyed**	41.3 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing		**Easting**						**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								528
0.0			MWL	Water Level			50					
2.3			MWL	Water Level			20					20
7.0			DAE	Deposits Attached Encrustation			15		04			
19.8			DAE	Deposits Attached Encrustation			15		04			
27.5			DAE	Deposits Attached Encrustation			20		04	08		
32.1			DAE	Deposits Attached Encrustation			20		04	08		
36.8			DAE	Deposits Attached Encrustation			15		02			
41.3			AMH	Manhole								?
41.3			FH	End of Survey								

41.3 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	15	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe**	0.4

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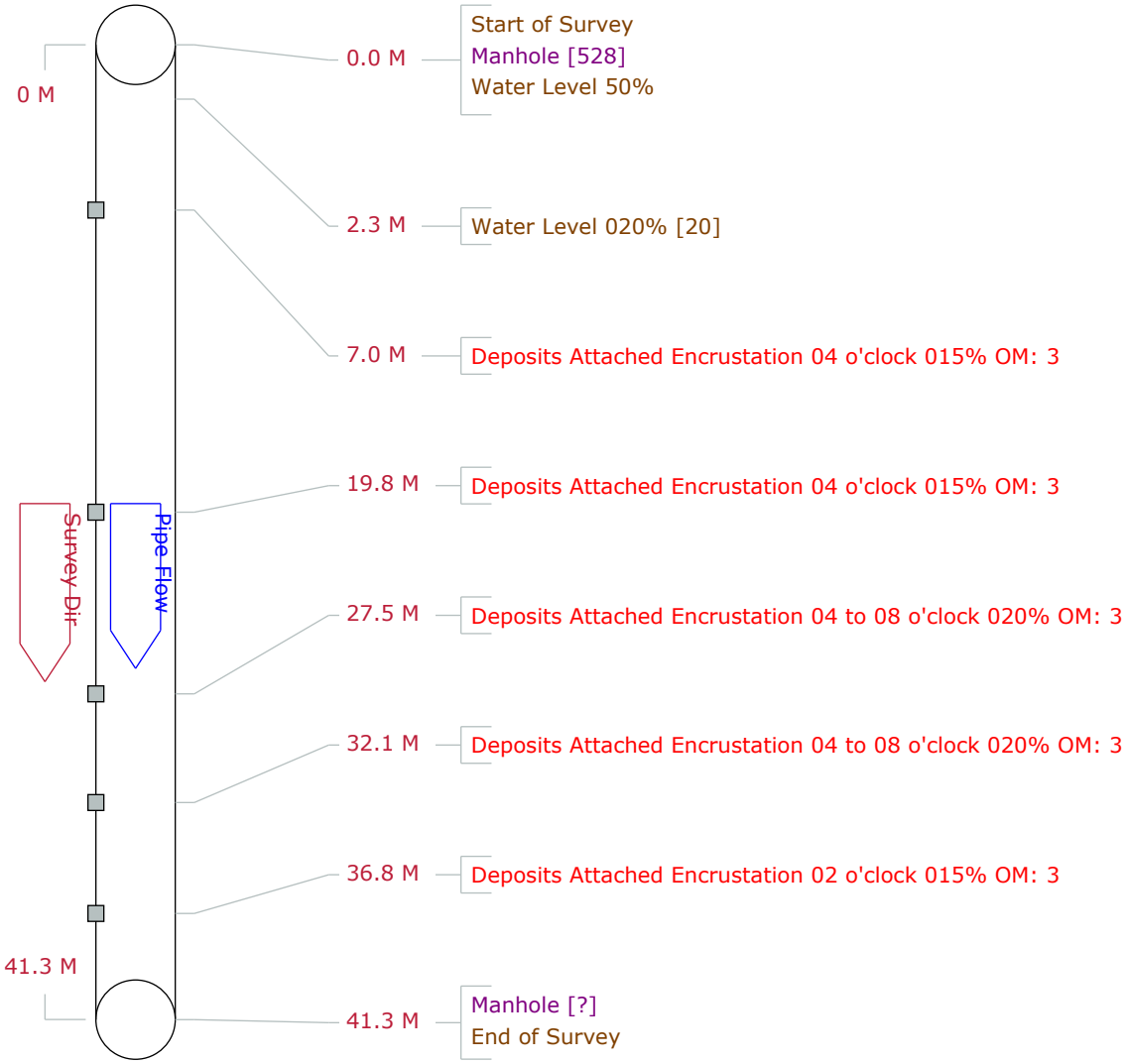
Pipe Graphic Report of PSR 528-527 **for** ISL

Setup	3	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	13:39	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	528	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	UNK	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	41.3 **M**	**Length Surveyed**	41.30 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1						
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR UNK-527 for ISL

Setup	4	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	16:00	**Street**	49th Ave
City	Lloydminster	**Further location details**					

Up	UNK	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	527	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	55.6 **M**	**Length Surveyed**	55.6 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video		CD	Code		In1	In2	%		Jnt	Fr	To		ImRef	Remarks
0.0				ST	Start of Survey										
0.0				AMH	Manhole										UNK
0.0				MWL	Water Level			10							
0.3				CM	Crack Multiple						12	12			
3.2				MWL	Water Level			25							25
9.3				MWL	Water Level			10							10
28.0				DAE	Deposits Attached Encrustation			15			03				
31.4				MWL	Water Level			25							25
35.7				MWL	Water Level			15							15
43.5				DAE	Deposits Attached Encrustation			15			03				
52.1				MWL	Water Level			40							40
55.6				AMH	Manhole										527
55.6				FH	End of Survey										

55.6 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	3	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0.1
O&M:	**Pipe Rating**	6	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0.1

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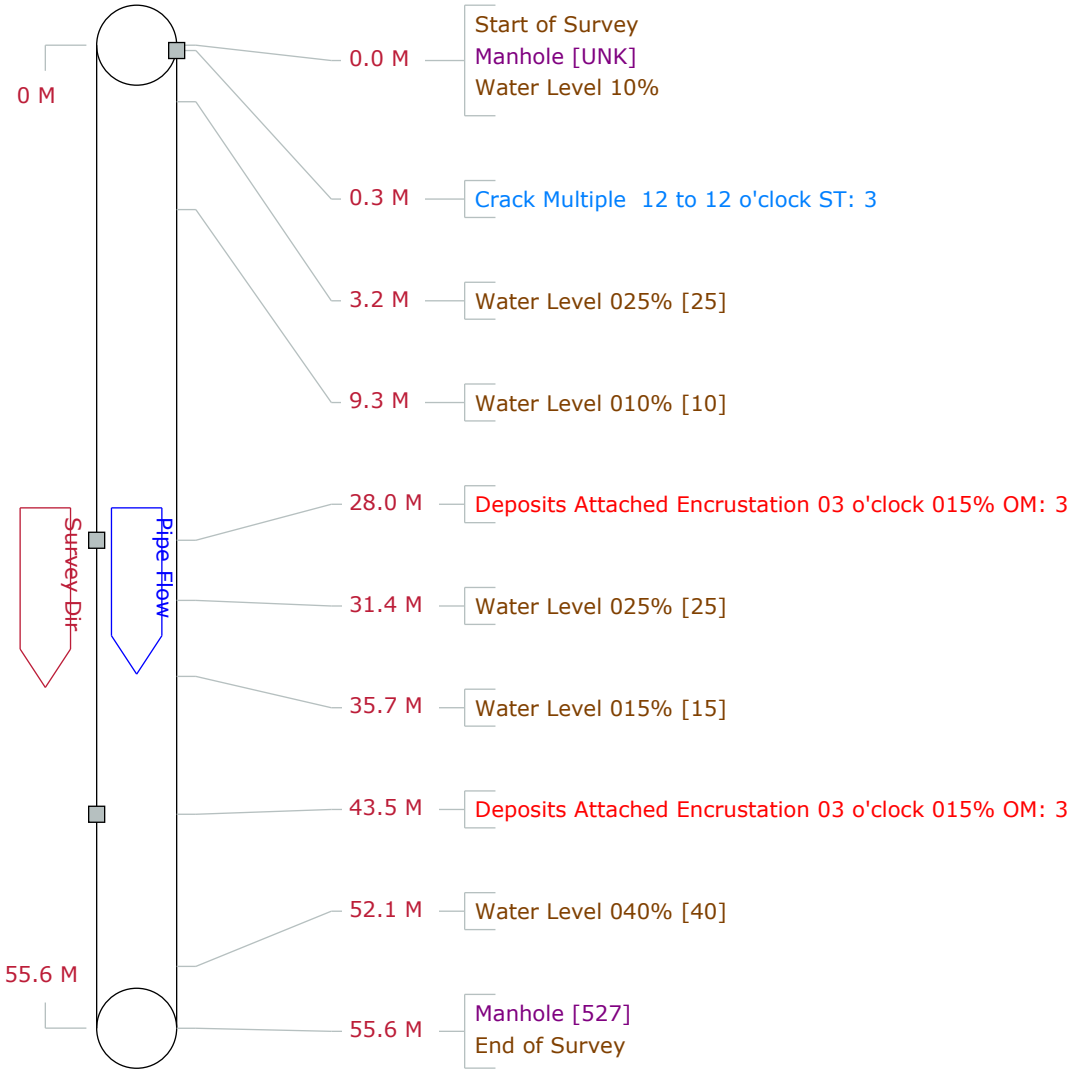
Pipe Graphic Report of PSR UNK-527 **for** ISL

Setup	4	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	16:00	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	UNK	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	527	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	55.6 **M**	**Length Surveyed**	55.60 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1	**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 527-512 for ISL

Setup	5	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	16:14	**Street**	49th Ave
City	Lloydminster	**Further location details**					

Up	527	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	512	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	**M**	**Length Surveyed**	101.7 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								527
0.0			MWL	Water Level			25					
8.0			DAGS	Deposits Attached Grease			10		10			
9.7			MWL	Water Level			25					25
29.6			JOM	Joint Offset Medium								
43.7			DAE	Deposits Attached Encrustation			15		03	09		
63.3			MWL	Water Level			10					10
74.5			DAE	Deposits Attached Encrustation			15		03	09		
80.7			CC	Crack Circumferential				J	09	05		
100.8			B	Broken					11			
101.7			MSA	Abandoned Survey								Drop insight, pipe damaged

101.7 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	5	**Pipe Ratings Index**	1.7	**Peak**	3	**Mean Pipe** 0
O&M:	**Pipe Rating**	8	**Pipe Ratings Index**	2.7	**Peak**	3	**Mean Pipe** 0.1

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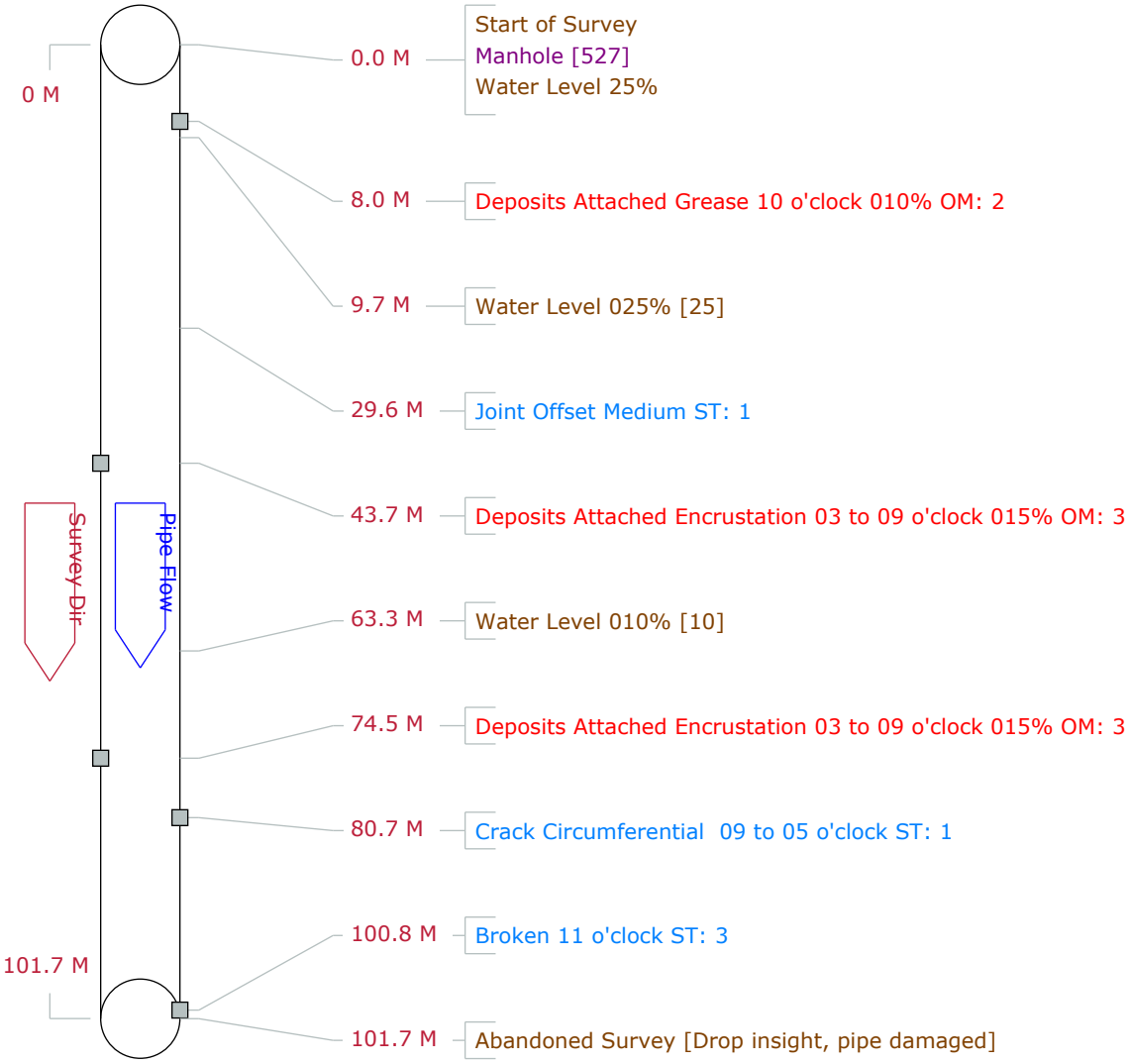
Pipe Graphic Report of PSR 527-512 **for** ISL

Setup	5	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-27	**Time**	16:14	**Street**	49th Ave
City	Lloydminster	**Further location details**					
Up	527	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	512	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	**M**	**Length Surveyed**	101.70 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1						
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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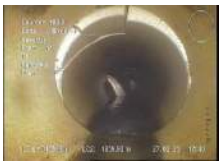
CCTV Picture List of 527-512 **for** ISL

Work Order		**Setup** 5
Video	**Survey Date** 2023-02-27	
Path to picture files	C:\FLEX6\Snaps\ISL\	
Path to video files	C:\FLEX6\Movies\ISL\	
Path to media files	C:\FLEX6\Media\ISL\	



Video Index **Count** 100.8 M
Code Broken
Remarks
File Name 22.jpg

Tabular Report of PSR 896-897 for ISL

Setup	8	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	11:33	**Street**	53rd Ave
City	Lloydminster	**Further location details**					

Up	896	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	897	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	300	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	56.6 **M**			**Length Surveyed**	56.6 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								896
0.0			MWL	Water Level			10					
15.0			MWL	Water Level			20					20
25.6			TBI	Tap Break-in Intruding	1	4			10			
56.6			AMH	Manhole								897
56.6			FH	End of Survey								

56.6 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	2	**Pipe Ratings Index**	2	**Peak**	2	**Mean Pipe**	0

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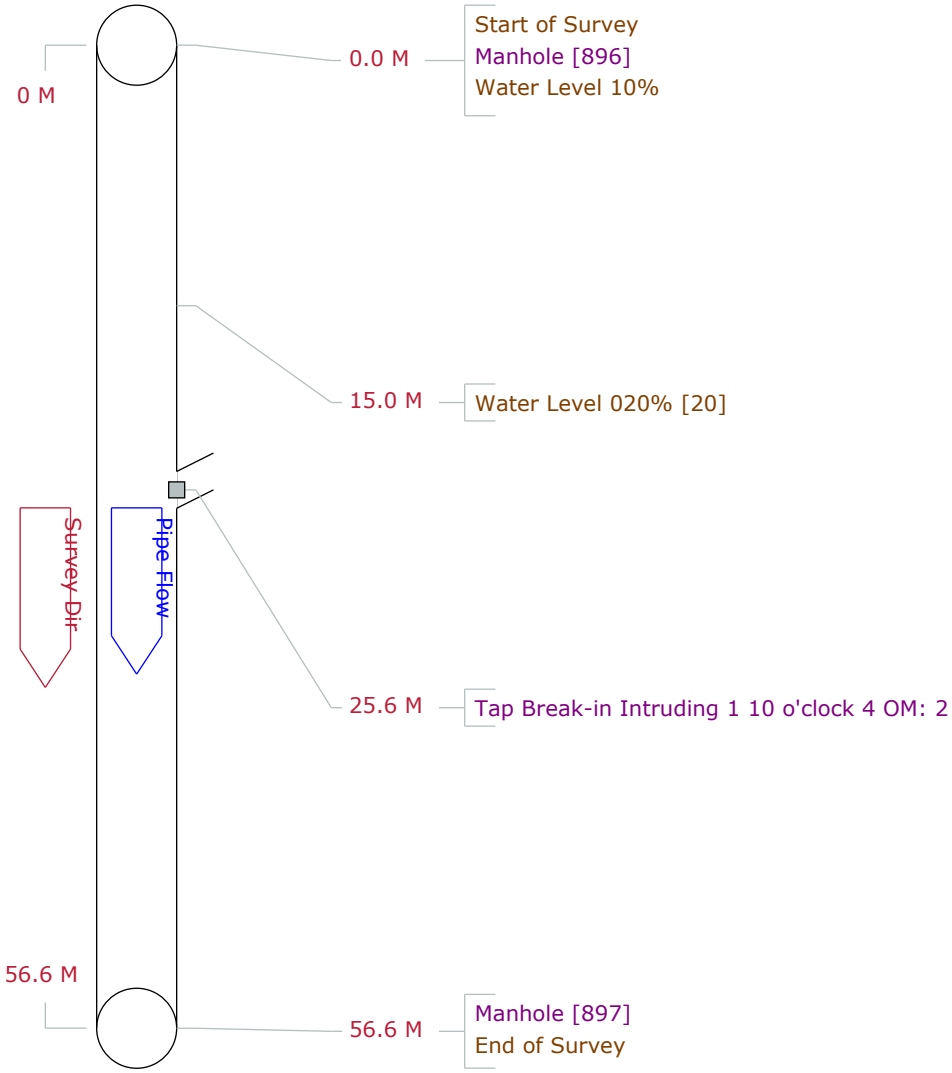
Pipe Graphic Report of PSR 896-897 **for** ISL

Setup	8	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	11:33	**Street**	53rd Ave
City	Lloydminster	**Further location details**					
Up	896	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	897	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	300	**Width**	mm	**Preclean** J	**Date Cleaned** 2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	56.6 **M**	**Length Surveyed**	56.60 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 897-886 for ISL

Setup	9	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	11:49	**Street**	53rd Ave
City	Lloydminster	**Further location details**					

Up	897	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	996	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	300	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	52.5 **M**			**Length Surveyed**	52.5 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing		**Easting**						**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								897
0.0			MWL	Water Level			10					
14.1			MWL	Water Level			15					15
49.2			MWL	Water Level			25					25
52.5			AMH	Manhole								996
52.5			FH	End of Survey								

52.5 **M** **Total Length Surveyed**

Scores							
	Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0
	O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

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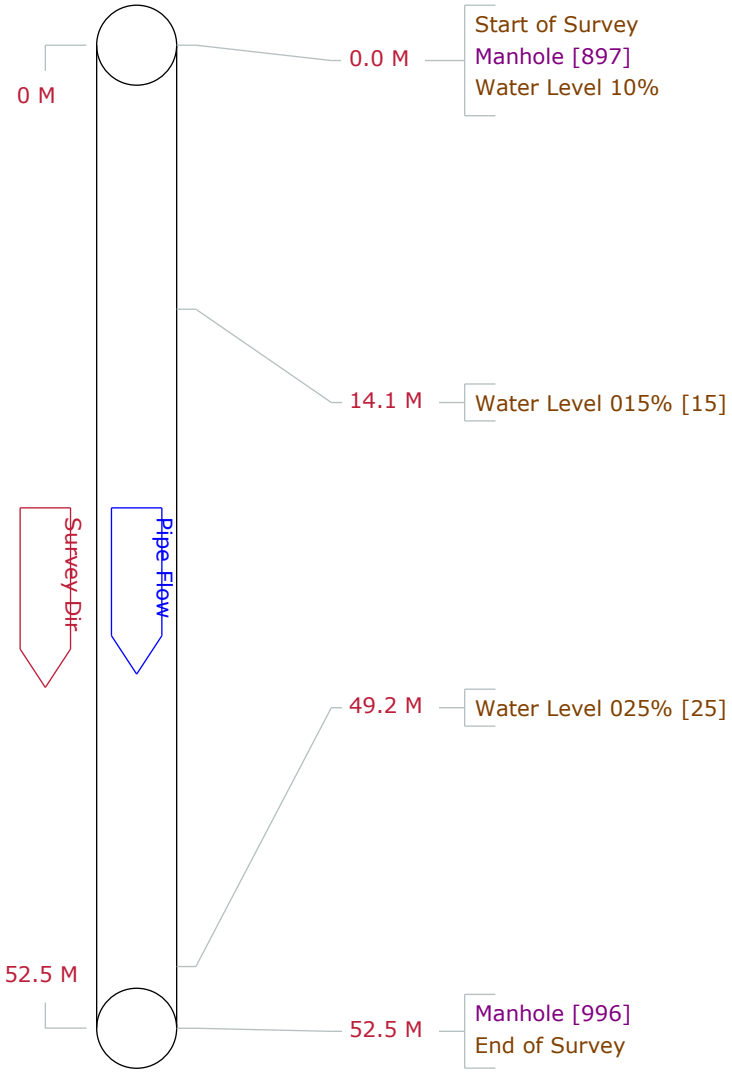
Pipe Graphic Report of PSR 897-886 **for** ISL

Setup	9	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	11:49	**Street**	53rd Ave
City	Lloydminster	**Further location details**					
Up	897	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	996	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	300 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	52.5 **M**	**Length Surveyed**	52.50 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1	**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 996-889 for ISL

Setup	10	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	12:57	**Street**	53rd Ave
City	Lloydminster	**Further location details**					

Up	996	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	889	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	300	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	53.4 **M**	**Length Surveyed**	53.4 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								996
0.0			MWL	Water Level			0					
46.3			MWL	Water Level			30					30
53.4			AMH	Manhole								889
53.4			FH	End of Survey								

53.4 **M** **Total Length Surveyed**

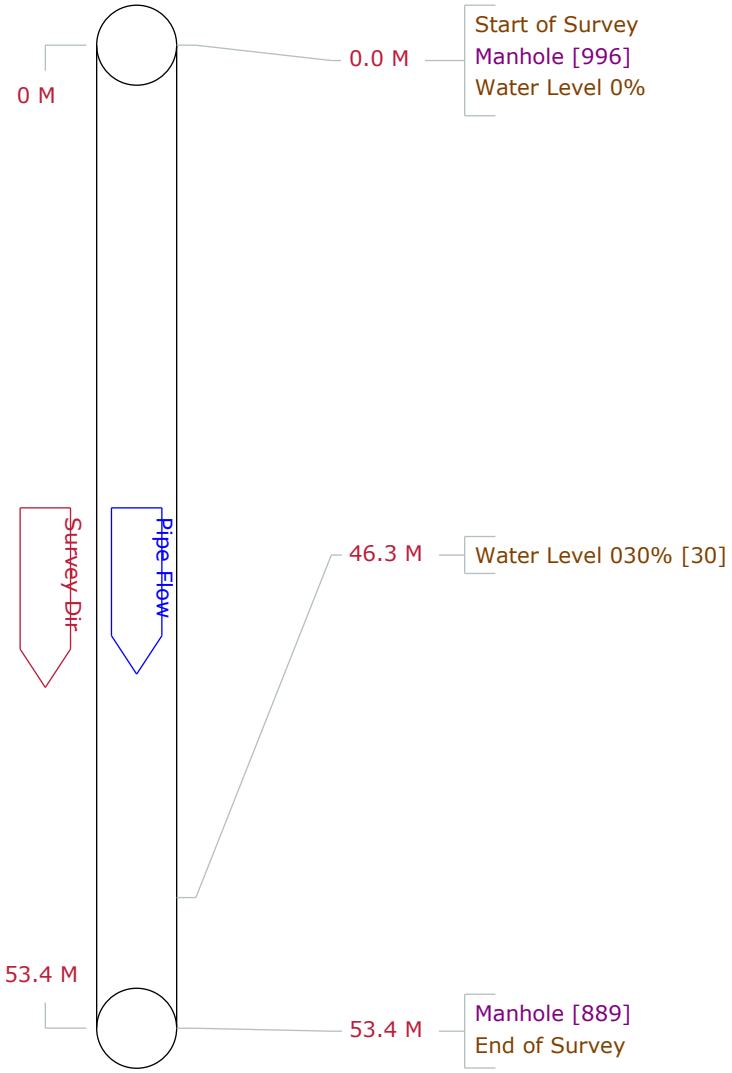
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 996-889 **for** ISL

Setup	10	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	12:57	**Street**	53rd Ave
City	Lloydminster	**Further location details**					
Up	996	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	889	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	300 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	53.4 **M**	**Length Surveyed**	53.40 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 889-857 for ISL

Setup	11	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	13:07	**Street**	53rd Ave
City	Lloydminster	**Further location details**					

Up	889	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Down	857	**Rim to invert**		**Grade to invert**		**Rim to grade**		**M**
Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**		
Shape	Circular	**Height**	300	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	61.0 **M**	**Length Surveyed**	61.0	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry	
Purpose		**Cat**				**Pressure**		

Additional info									
Location									
Project	Lloydminster Phase 1								
Northing		**Easting**				**Elevation**			
Coordinate System						**GPS Accuracy**			

Structural O & M Constructional Miscellaneous

Count	Video		CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								889
0.0				MWL	Water Level			20					
23.3				DAE	Deposits Attached Encrustation			20		03			
61.0				AMH	Manhole								857
61.0				FH	End of Survey								

61.0 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0
O&M:	**Pipe Rating**	3	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0

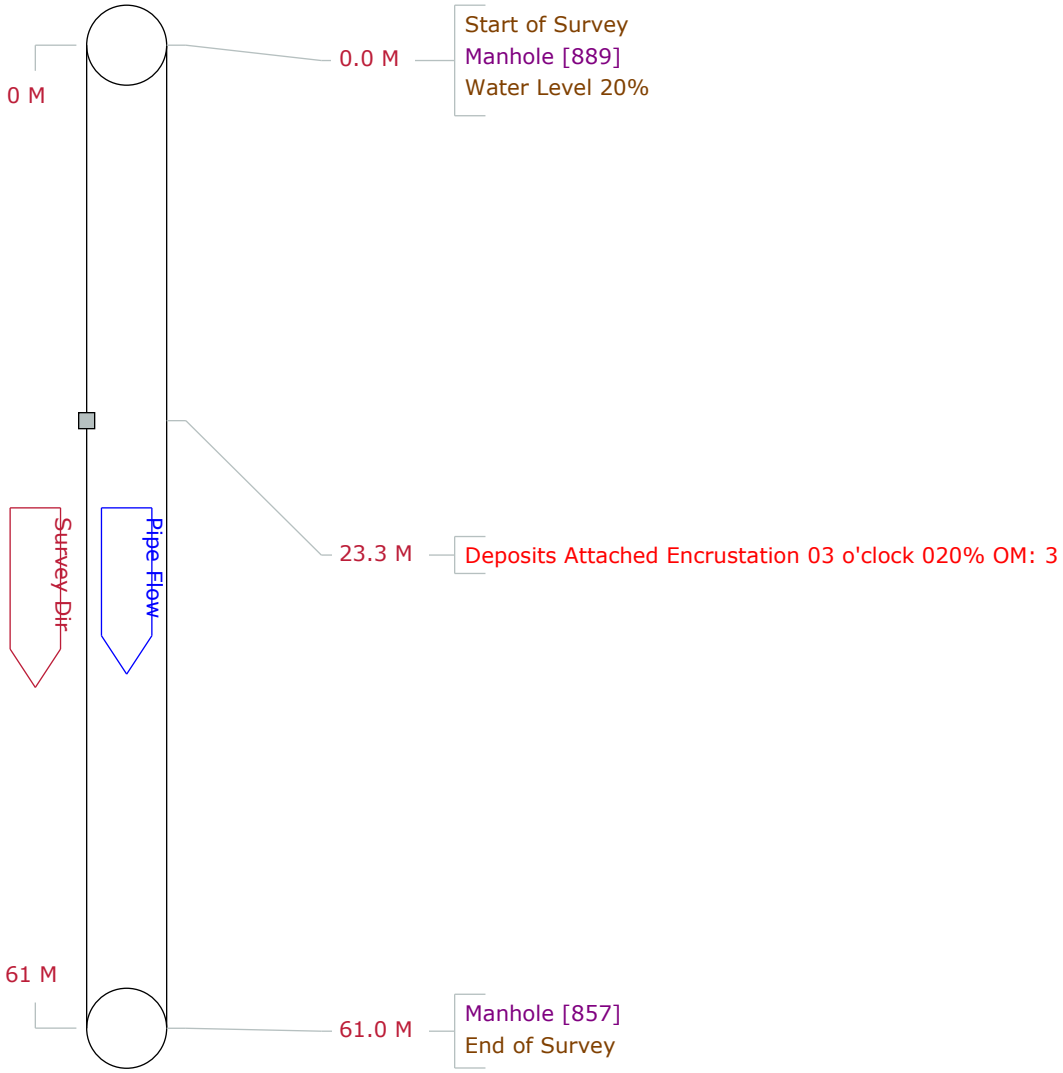
Pipe Graphic Report of PSR 889-857 **for** ISL

Setup	11	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	13:07	**Street**	53rd Ave
City	Lloydminster	**Further location details**					

Up	889	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	857	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**			
Shape	Circular	**Height**	300	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	61.0 **M**	**Length Surveyed**	61.00 **M**		
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry		
Purpose		**Cat**							

Additional info		Structural	O & M	Constructional
Location		Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1		**Work Order**	
Northing	**Easting**		**Elevation**	
Coordinate System			**GPS Accuracy**	



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Tabular Report of PSR 691-690 for ISL

Setup	27	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	13:08	**Street**	46th Ave
City	Lloydminster	**Further location details**					

Up	691	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	690	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**			**Media No**		
Shape	Circular	**Height**	750	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	103.1 **M**			**Length Surveyed**	103.1 **M**
Lining		**Year laid**		**Year rehabilitated**			**Weather**	Dry	
Purpose		**Cat**					**Pressure**		

Additional info				Structural	O & M	Constructional
Location				Miscellaneous		
Project	Lloydminster Phase 1			**Work Order**		
Northing		**Easting**		**Elevation**		
Coordinate System				**GPS Accuracy**		

Count	Video		CD	Code		In1	In2	%		Jnt	Fr	To		ImRef	Remarks
0.0				ST	Start of Survey										
0.0				AMH	Manhole										691
0.0				MWL	Water Level			30							
15.1				SRI	Surface Roughness Increased						12				
23.7				MWL	Water Level			20							20
84.8				DAE	Deposits Attached Encrustation			5			02				
103.1				AMH	Manhole										690
103.1				FH	End of Survey										

103.1 **M** **Total Length Surveyed**

Scores								
	Structural:	**Pipe Rating**	1	**Pipe Ratings Index**	1	**Peak**	1	**Mean Pipe** 0
	O&M:	**Pipe Rating**	2	**Pipe Ratings Index**	2	**Peak**	2	**Mean Pipe** 0

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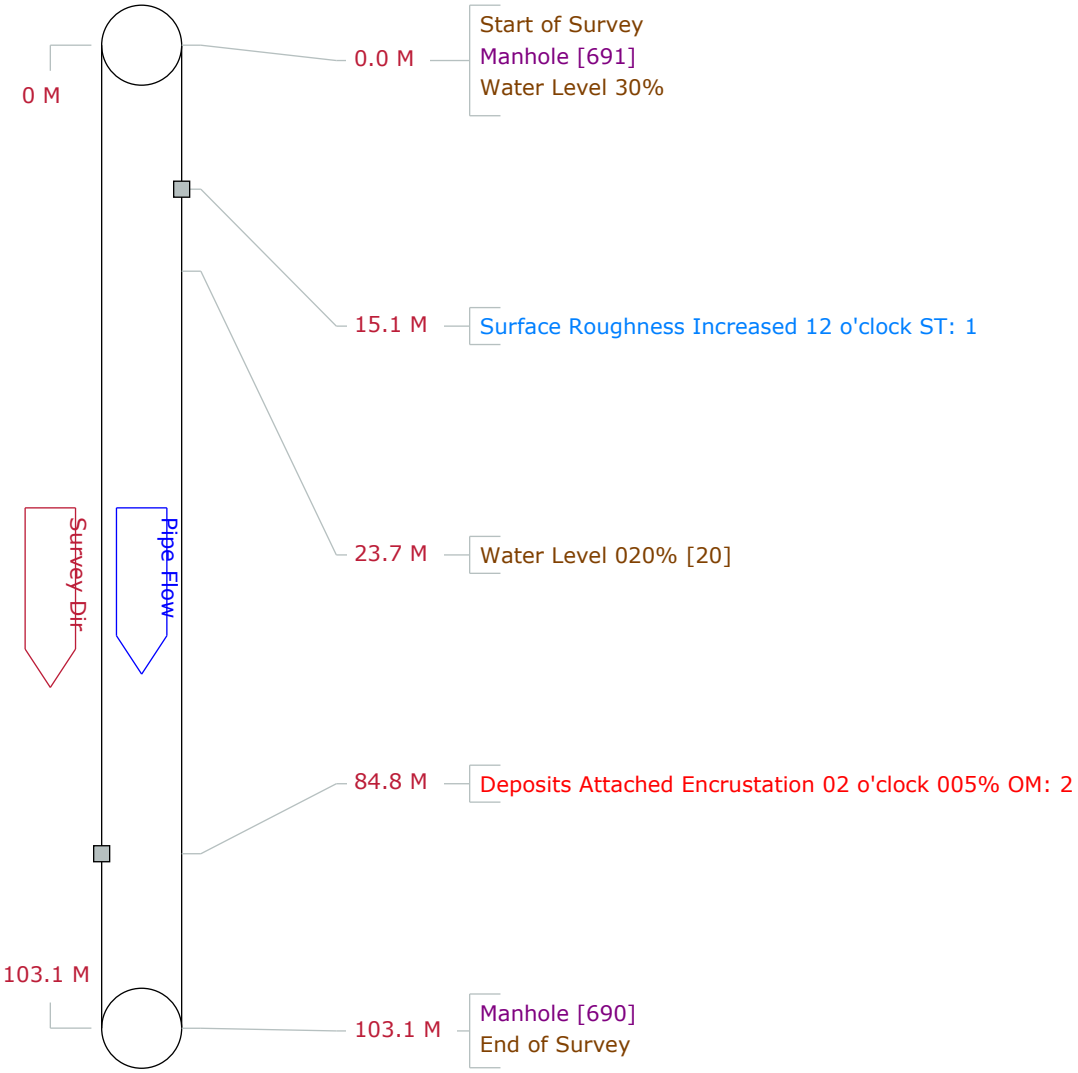
Pipe Graphic Report of PSR 691-690 **for** ISL

Setup	27	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	13:08	**Street**	46th Ave
City	Lloydminster	**Further location details**					
Up	691	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	690	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	750 **Width**	**mm**	**Preclean** J	**Date Cleaned**	
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	103.1 **M**	**Length Surveyed**	103.10 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 690-689 for ISL

Setup	28	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	13:29	**Street**	46th Ave
City	Lloydminster	**Further location details**					

Up	690	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	689	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**			**Media No**		
Shape	Circular	**Height**	750	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	105.6 **M**			**Length Surveyed**	105.6 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose				**Cat**				**Pressure**	

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing				**Easting**				**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video		CD	Code		In1	In2	%		Jnt	Fr	To		ImRef	Remarks
0.0				ST	Start of Survey										
0.0				AMH	Manhole										690
0.0				MWL	Water Level			20							
4.1				SRI	Surface Roughness Increased						12				
9.2				DAE	Deposits Attached Encrustation			5			02				
53.0				DAE	Deposits Attached Encrustation			5			08				
105.6				AMH	Manhole										689
105.6				FH	End of Survey										

105.6 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	1	**Pipe Ratings Index**	1	**Peak**	1	**Mean Pipe** 0
O&M:	**Pipe Rating**	4	**Pipe Ratings Index**	2	**Peak**	2	**Mean Pipe** 0

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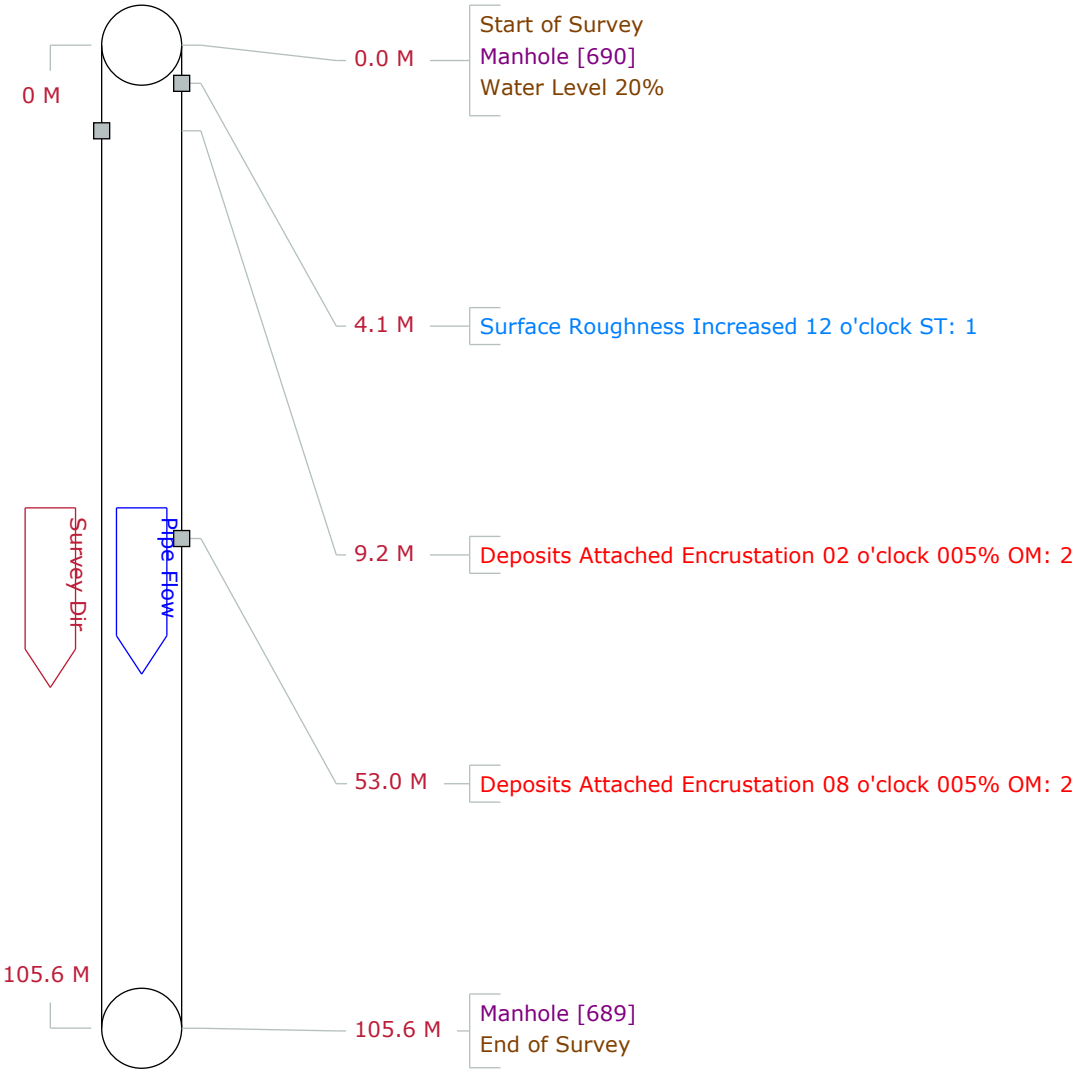
Pipe Graphic Report of PSR 690-689 **for** ISL

Setup	28	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	13:29	**Street**	46th Ave
City	Lloydminster	**Further location details**					
Up	690	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	689	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	750 **Width**	**mm**	**Preclean** J	**Date Cleaned**	
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	105.6 **M**	**Length Surveyed**	105.60 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1						
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



McGills Industrial Services Inc.
Phone:306-664-2220

Tabular Report of PSR 692-691 for ISL

Setup	29	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	14:25	**Street**	46th Ave
City	Lloydminster	**Further location details**					

Up	692	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	691	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Up	**Flow control**		**Media No**	
Shape	Circular	**Height**	750	**Width**	**mm**	**Preclean**	J
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	105.0 **M**	**Length Surveyed**	105.0 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video		CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								691
0.0				MWL	Water Level			25					
84.8				SRI	Surface Roughness Increased					12			
105.0				AMH	Manhole								692
105.0				FH	End of Survey								

105.0 **M** **Total Length Surveyed**

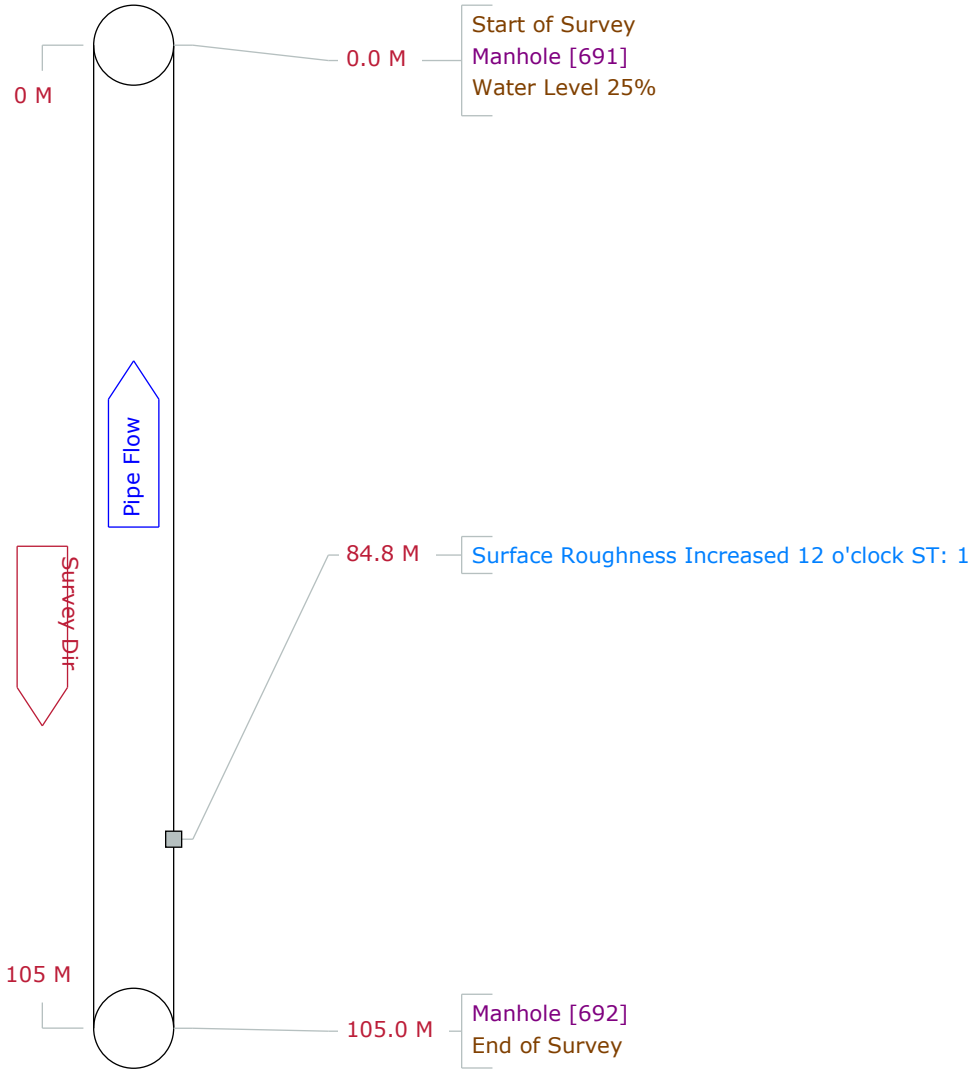
Scores

Structural:	**Pipe Rating**	1	**Pipe Ratings Index**	1	**Peak**	1	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 692-691 **for** ISL

Setup	29	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	14:25	**Street**	46th Ave
City	Lloydminster	**Further location details**					
Up	692	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	691	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	750 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-02
Material	Concrete Pipe (non-reinforced)	**Joint length**	**M**	**Total length**	105.0 **M**	**Length Surveyed**	105.00 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1641-1273 for ISL

Setup	22	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:18	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1641	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1273	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	88.1 **M**	**Length Surveyed**	88.1 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1641
0.0			MWL	Water Level			10					
88.1			AMH	Manhole								1273
88.1			FH	End of Survey								

88.1 **M** **Total Length Surveyed**

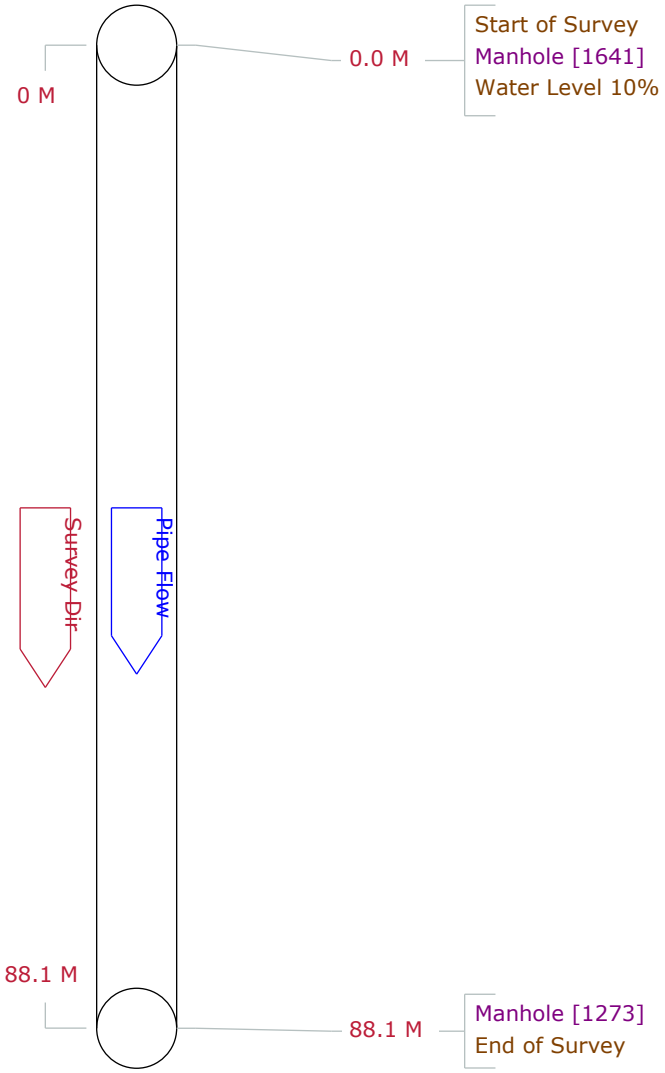
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 1641-1273 **for** ISL

Setup	22	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:18	**Street**	18th Street
City	Lloydminster	**Further location details**					
Up	1641	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1273	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	450 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length** 88.1 **M**		**Length Surveyed**	88.10 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1273-1642 for ISL

Setup	23	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:34	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1273	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1642	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	51.9 **M**			**Length Surveyed**	51.9 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info						Structural	O & M	Constructional
Location						Miscellaneous		
Project	Lloydminster Phase 1					**Work Order**		
Northing		**Easting**				**Elevation**		
Coordinate System						**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1273
0.0			MWL	Water Level			10					
51.9			AMH	Manhole								1642
51.9			FH	End of Survey								

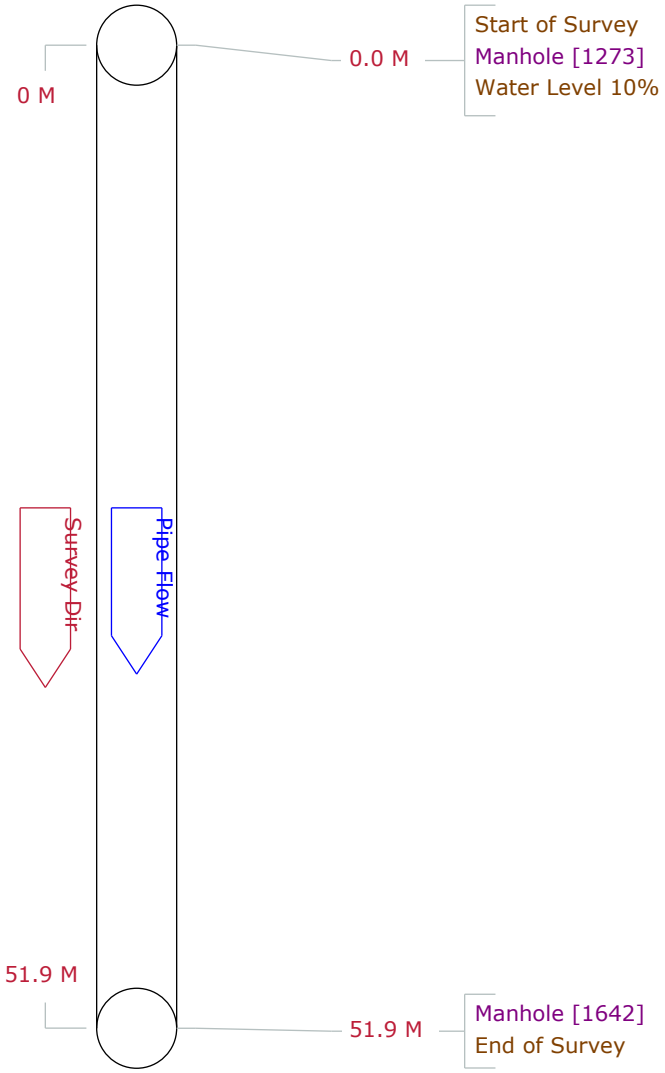
51.9 **M** **Total Length Surveyed**

Scores							
Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0
O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

Pipe Graphic Report of PSR 1273-1642 **for** ISL

Setup	23	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:34	**Street**	18th Street
City	Lloydminster	**Further location details**					
Up	1273	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1642	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	450 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	51.9 **M**	**Length Surveyed**	51.90 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1642-1644 for ISL

Setup	24	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:44	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1642	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1644	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	77.2 **M**	**Length Surveyed**	77.2 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video		CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								1642
0.0				MWL	Water Level			15					
77.2				AMH	Manhole								1644
77.2				FH	End of Survey								

77.2 **M** **Total Length Surveyed**

Scores								
	Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
	O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

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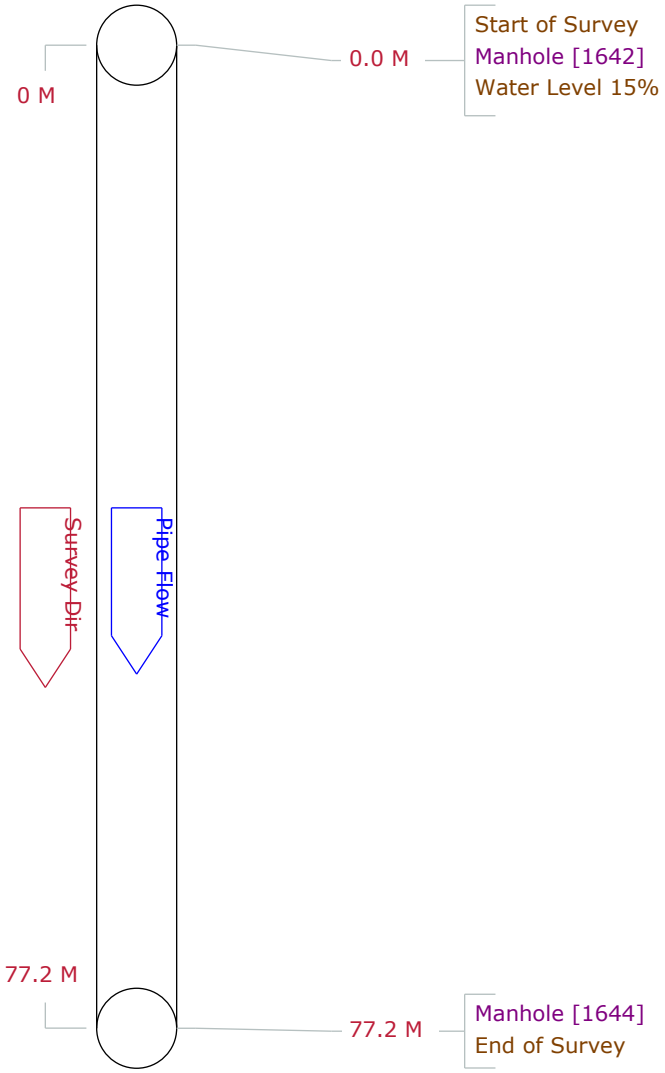
Pipe Graphic Report of PSR 1642-1644 **for** ISL

Setup	24	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:44	**Street**	18th Street
City	Lloydminster	**Further location details**					
Up	1642	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1644	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	450 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length** 77.2 **M**		**Length Surveyed**	77.20 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1644-1643 for ISL

Setup	25	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:56	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1644	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1643	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	53.3 **M**			**Length Surveyed**	53.3 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info				Structural	O & M	Constructional
Location				Miscellaneous		
Project	Lloydminster Phase 1			**Work Order**		
Northing		**Easting**		**Elevation**		
Coordinate System				**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1644
0.0			MWL	Water Level			15					
53.3			AMH	Manhole								1643
53.3			FH	End of Survey								

53.3 **M** **Total Length Surveyed**

Scores							
	Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0
	O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

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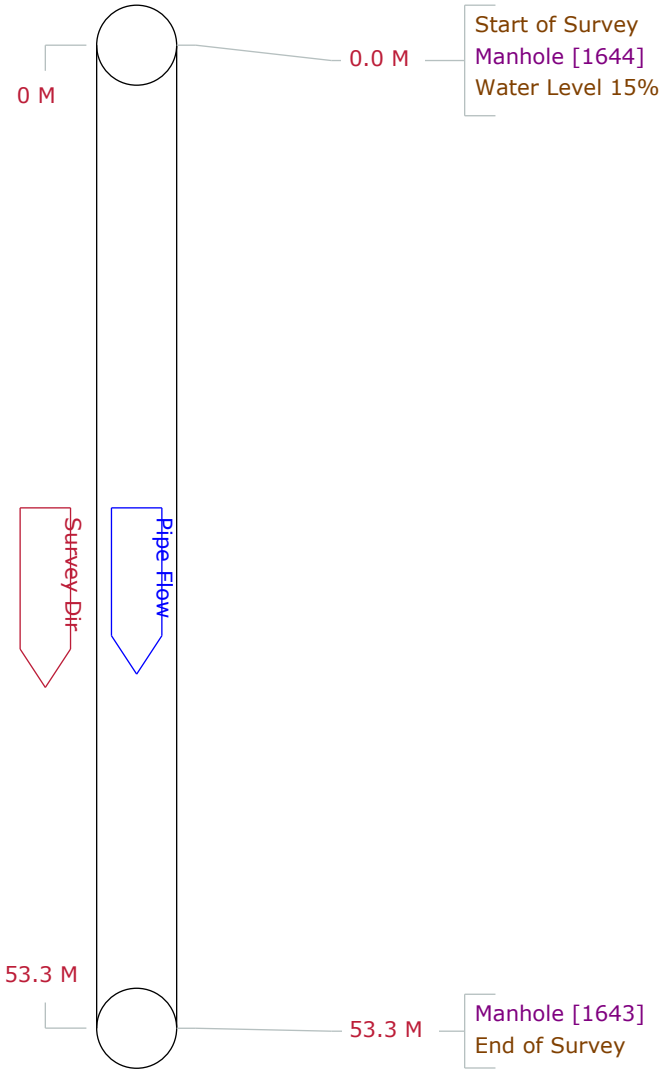
Pipe Graphic Report of PSR 1644-1643 **for** ISL

Setup	25	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	9:56	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1644	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1643	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**			
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	53.3 **M**	**Length Surveyed**	53.30 **M**		
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry		
Purpose		**Cat**							

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1	**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 1643-838 for ISL

Setup	26	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	10:18	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1643	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	838	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	54.6 **M**	**Length Surveyed**	54.6 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video		CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								1643
0.0				MWL	Water Level			15					
54.6				AMH	Manhole								838
54.6				FH	End of Survey								

54.6 **M** **Total Length Surveyed**

Scores								
	Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
	O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

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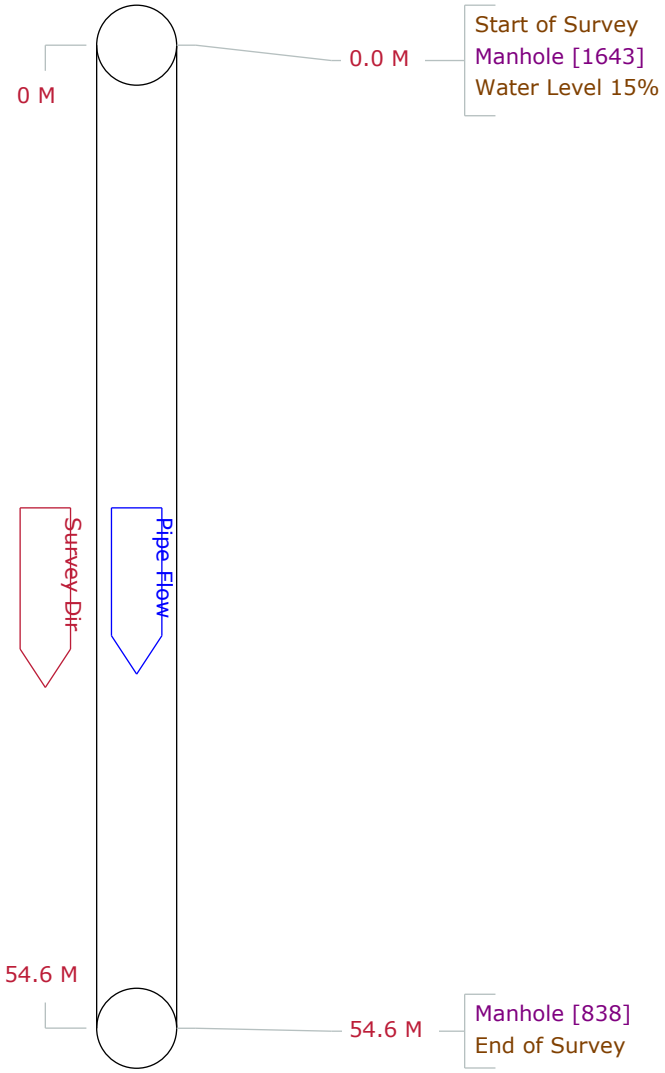
Pipe Graphic Report of PSR 1643-838 **for** ISL

Setup	26	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-02	**Time**	10:18	**Street**	18th Street
City	Lloydminster	**Further location details**					

Up	1643	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	838	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**			
Shape	Circular	**Height**	450	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-02
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	54.6 **M**	**Length Surveyed**	54.60	**M**	
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry		
Purpose		**Cat**							

Additional info	Structural	O & M	Constructional
Location	Miscellaneous	Hydraulic	
Project	Lloydminster Phase 1	**Work Order**	
Northing	**Easting**	**Elevation**	
Coordinate System		**GPS Accuracy**	



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Tabular Report of PSR 1492-842 for ISL

Setup	6	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	9:50	**Street**	23rd Street
City	Lloydminster	**Further location details**					

Up	1492	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	842	**Rim to invert**		**Grade to invert**		**Rim to grade**	M

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	300	**Width**	mm	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Polyvinyl Chloride	**Joint length**	M	**Total length**	98.4 M			**Length Surveyed**	98.4 M
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info						Structural	O & M	Constructional
Location						Miscellaneous		
Project	Lloydminster Phase 1					**Work Order**		
Northing		**Easting**				**Elevation**		
Coordinate System						**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1492
0.0			MWL	Water Level			10					
10.2			MWL	Water Level			15					15
22.9			MWL	Water Level			10					10
61.2			MWL	Water Level			15					15
72.3			MWL	Water Level			10					10
82.6			MWL	Water Level			20					20
89.4			MWL	Water Level			15					15
98.4			AMH	Manhole								842
98.4			FH	End of Survey								

98.4 **M** **Total Length Surveyed**

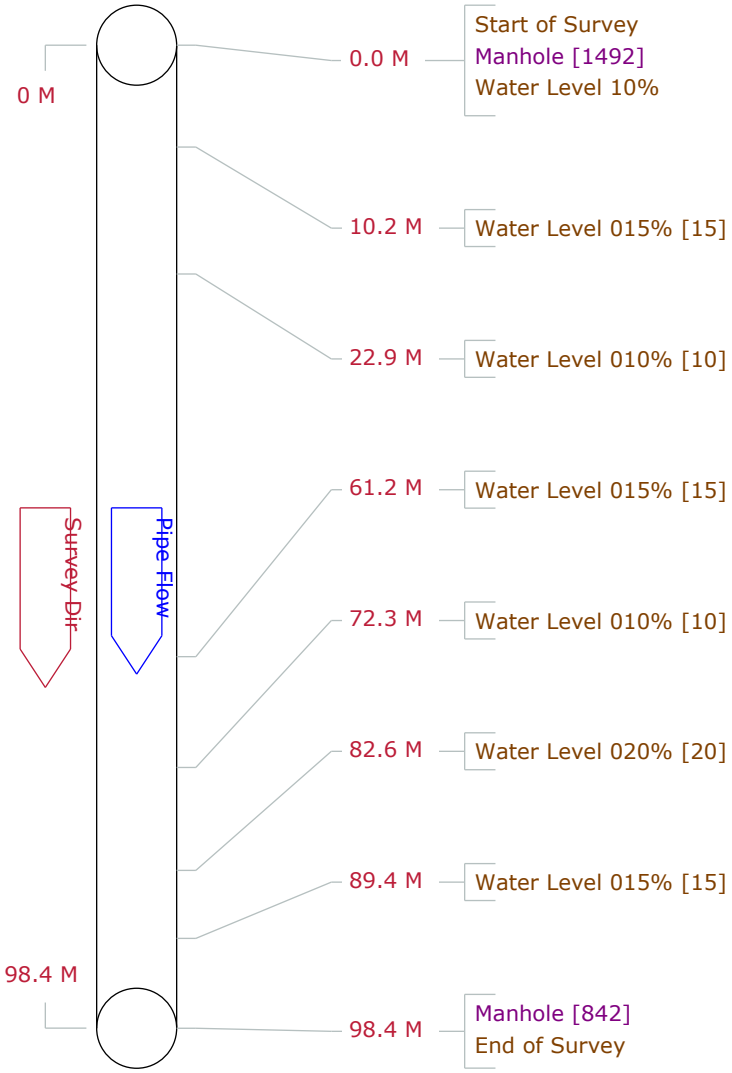
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 1492-842 **for** ISL

Setup	6	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	9:50	**Street**	23rd Street
City	Lloydminster	**Further location details**					
Up	1492	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	842	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	300 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length** 98.4 **M**		**Length Surveyed**	98.40 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Phone:306-664-2220

Tabular Report of PSR 842-5420 for ISL

Setup	7	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	10:07	**Street**	23rd Street
City	Lloydminster	**Further location details**					

Up	842	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	5420	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	300	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-02-28
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	91.0 **M**			**Length Surveyed**	91.0 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing		**Easting**						**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								842
0.0			MWL	Water Level			20					
13.6			MWL	Water Level			10					10
26.7			MWLS	Water Level Sag			20					20
91.0			AMH	Manhole								5420
91.0			FH	End of Survey								

91.0 **M** **Total Length Surveyed**

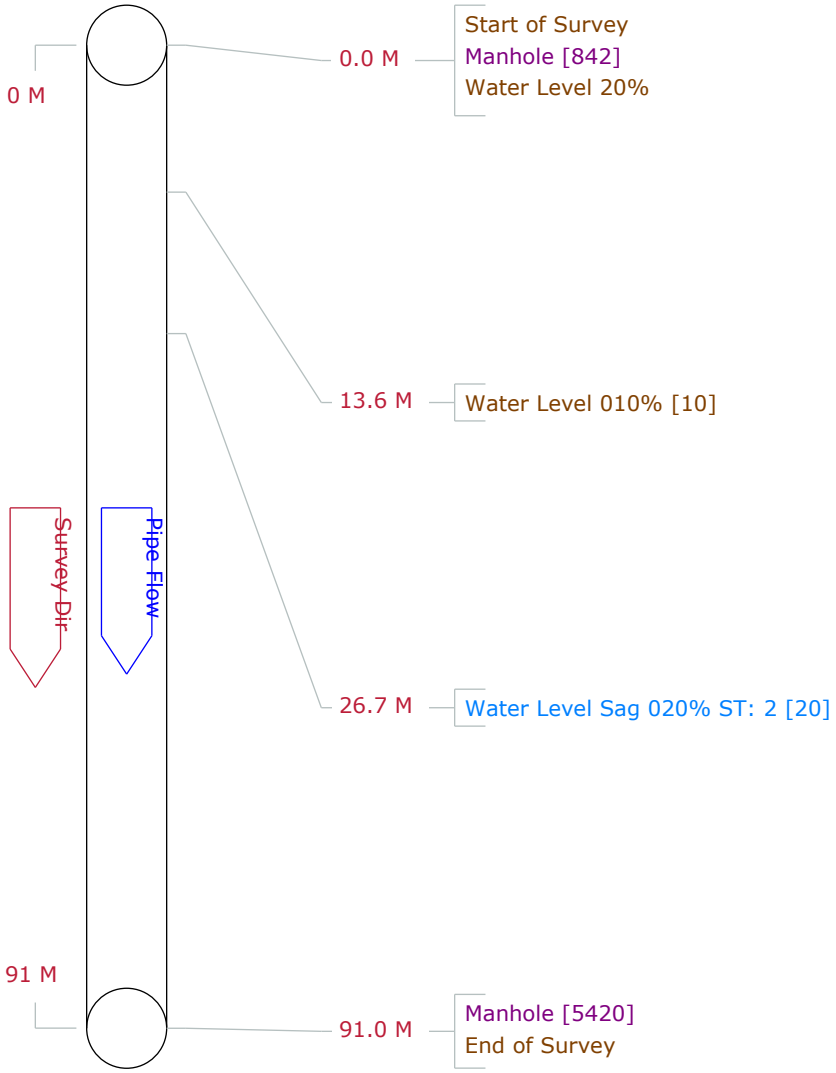
Scores

Structural:	**Pipe Rating**	2	**Pipe Ratings Index**	2	**Peak**	2	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 842-5420 **for** ISL

Setup	7	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	10:07	**Street**	23rd Street
City	Lloydminster	**Further location details**					
Up	842	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	5420	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	300 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length** 91.0 **M**		**Length Surveyed** 91.00	**M**
Lining		**Year laid**		**Year rehabilitated**		**Weather** Dry	
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1351-1352 for ISL

Setup	20	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	17:34	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	1351	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1352	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	525	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	89.7 **M**			**Length Surveyed**	89.7 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info								Structural	O & M	Constructional
Location								Miscellaneous		
Project	Lloydminster Phase 1							**Work Order**		
Northing		**Easting**						**Elevation**		
Coordinate System								**GPS Accuracy**		

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1351
0.0			MWL	Water Level			10					
89.7			AMH	Manhole								1352
89.7			FH	End of Survey								

89.7 **M** **Total Length Surveyed**

Scores							
	Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0
	O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

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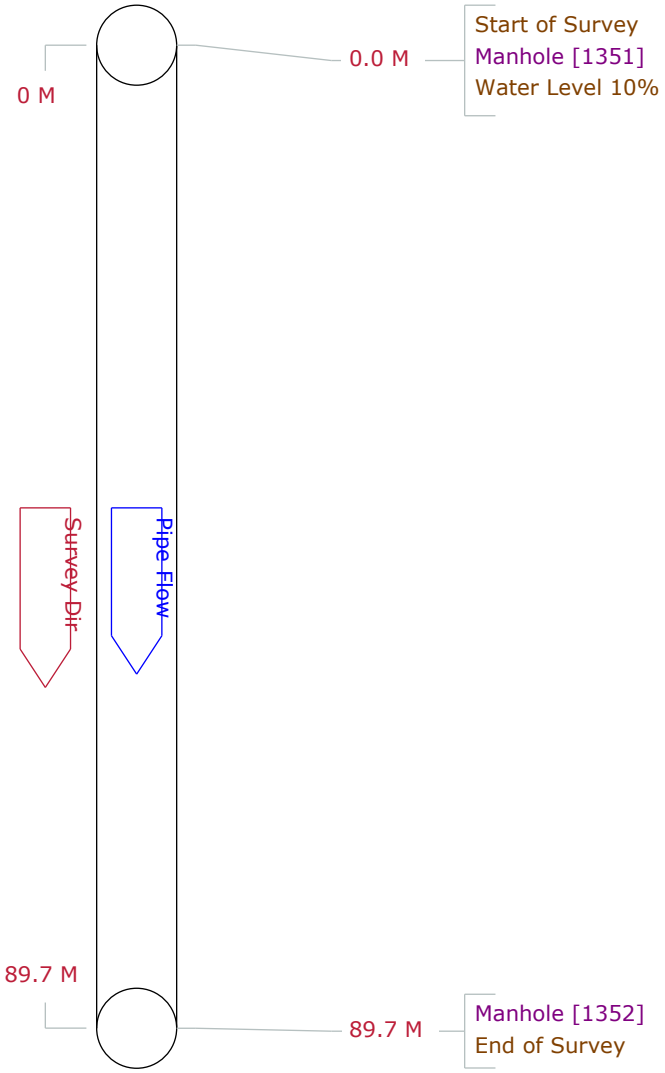
Phone:306-664-2220

Pipe Graphic Report of PSR 1351-1352 **for** ISL

Setup	20	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	17:34	**Street**	36th Street
City	Lloydminster	**Further location details**					
Up	1351	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1352	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	525	**Width**	**mm**	**Preclean** J	**Date Cleaned**
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	89.7 **M**	**Length Surveyed**	89.70 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1352-1344 for ISL

Setup	21	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	17:59	**Street**	36th Street
City	Lloydminster	**Further location details**					

Up	1352	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1344	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**				**Media No**	
Shape	Circular	**Height**	525	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	91.5 **M**			**Length Surveyed**	91.5 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info				Structural	O & M	Constructional
Location				Miscellaneous		
Project	Lloydminster Phase 1			**Work Order**		
Northing		**Easting**		**Elevation**		
Coordinate System				**GPS Accuracy**		

Count	Video		CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								1352
0.0				MWL	Water Level			10					
91.5				AMH	Manhole								1344
91.5				FH	End of Survey								

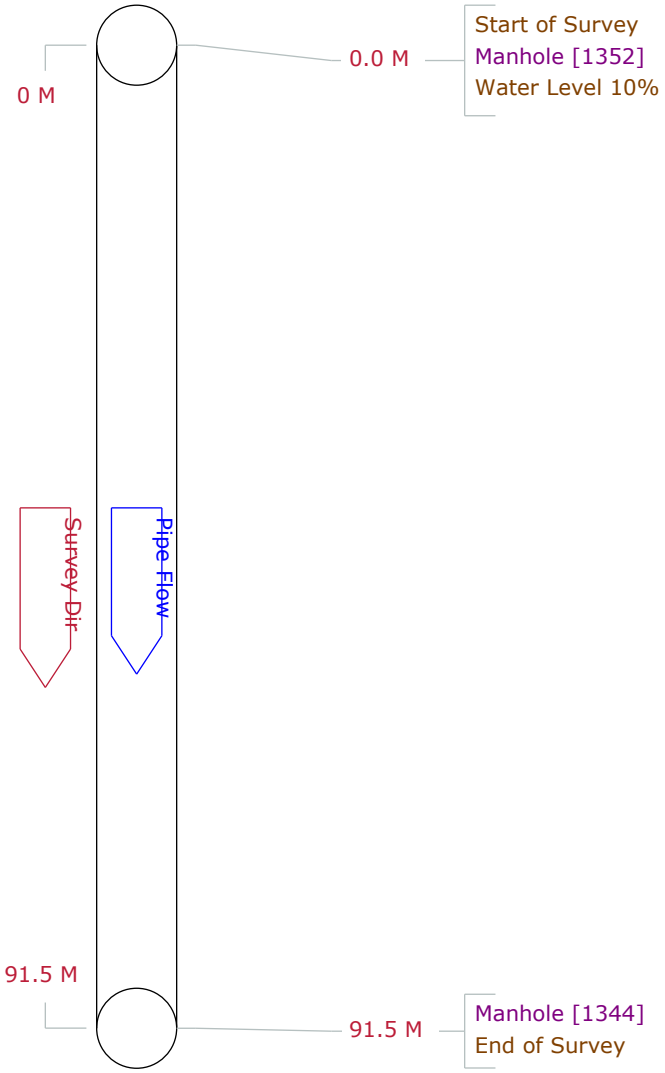
91.5 **M** **Total Length Surveyed**

Scores							
	Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0
	O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

Pipe Graphic Report of PSR 1352-1344 **for** ISL

Setup	21	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	17:59	**Street**	36th Street
City	Lloydminster	**Further location details**					
Up	1352	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1344	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	525	**Width**	**mm**	**Preclean** J	**Date Cleaned**
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	91.5 **M**	**Length Surveyed**	91.50 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1663-1662 for ISL

Setup	14	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	19:05	**Street**	70th Ave
City	Lloydminster	**Further location details**					

Up	1662	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1663	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	110.6 **M**	**Length Surveyed**	110.6 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1662
0.0			MWL	Water Level			15					
110.6			AMH	Manhole								1663
110.6			FH	End of Survey								

110.6 **M** **Total Length Surveyed**

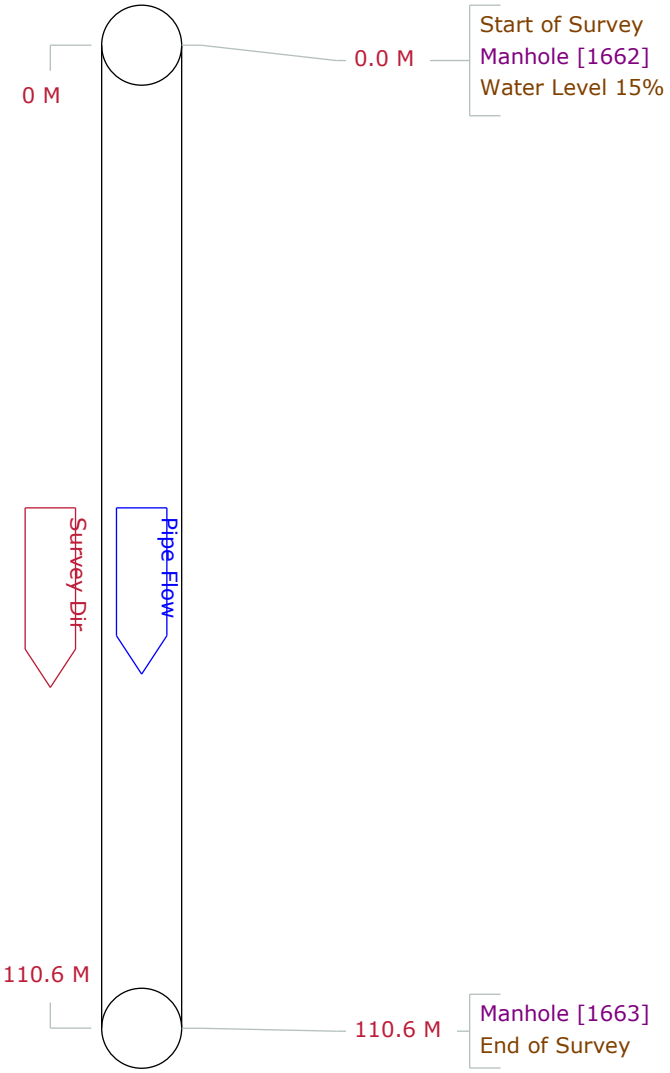
Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
O&M:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0

Pipe Graphic Report of PSR 1663-1662 **for** ISL

Setup	14	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-02-28	**Time**	19:05	**Street**	70th Ave
City	Lloydminster	**Further location details**					
Up	1662	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1663	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	110.6 **M**	**Length Surveyed**	110.60 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 1662-1661 for ISL

Setup	15	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	8:57	**Street**	70th Ave
City	Lloydminster	**Further location details**					

Up	1662	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1661	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	89.5 **M**	**Length Surveyed**	89.5 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								1662
0.0			MWL	Water Level			10					
89.5			AMH	Manhole								1661
89.5			FH	End of Survey								

89.5 **M** **Total Length Surveyed**

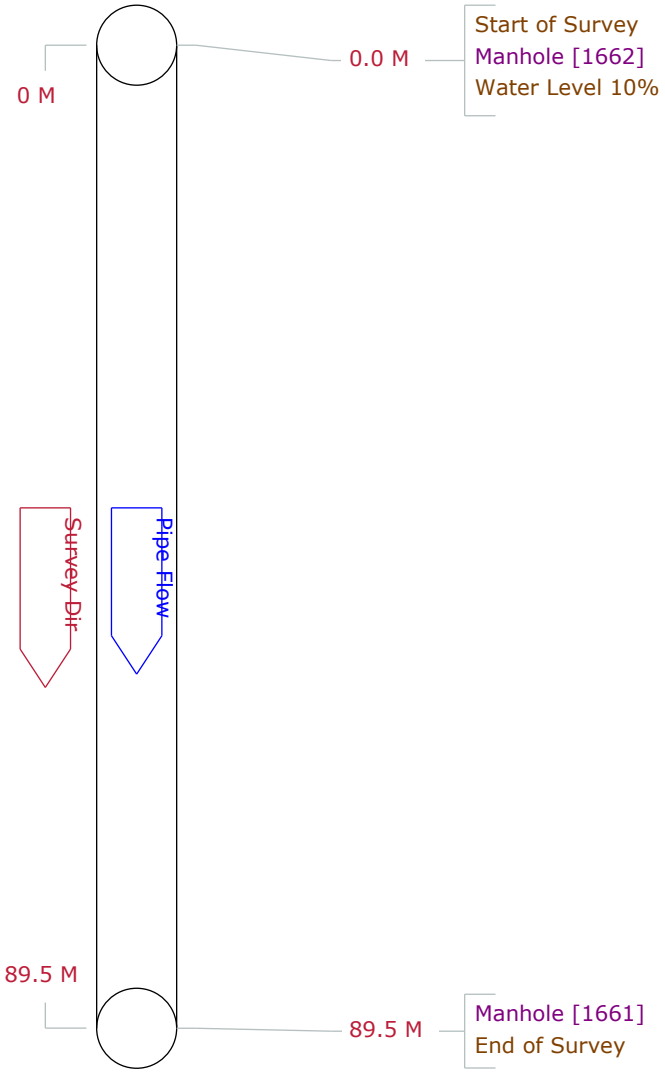
Scores							
	Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0
	O&M:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Peak** 0	**Mean Pipe** 0

McGills Industrial Services Inc.
Phone:306-664-2220

Pipe Graphic Report of PSR 1662-1661 **for** ISL

Setup	15	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	8:57	**Street**	70th Ave
City	Lloydminster	**Further location details**					
Up	1662	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	1661	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-02-28
Material	Polyvinyl Chloride	**Joint length**	**M**	**Total length**	89.5 **M**	**Length Surveyed**	89.50 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 515-514 for ISL

Setup	16	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	11:47	**Street**	35th Street
City	Lloydminster	**Further location details**					

Up	515	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	514	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**			**Media No**		
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J	**Date Cleaned**	2023-03-01
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	**M**			**Length Surveyed**	66.0 **M**
Lining		**Year laid**		**Year rehabilitated**				**Weather**	Dry
Purpose		**Cat**						**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								515
0.0			MWL	Water Level			10					
17.4			MWL	Water Level			20					20
18.8			DAE	Deposits Attached Encrustation			10		04			
20.3			DAE	Deposits Attached Encrustation			20		03			
35.8			DAE	Deposits Attached Encrustation			25		08			
44.8			DAGS	Deposits Attached Grease			5		02			
59.8			DAE	Deposits Attached Encrustation			20		10			
65.2			DAE	Deposits Attached Encrustation			35		03			
66.0			FC	Fracture Circumferential					12	04		
66.0			MSA	Abandoned Survey								DAE

66.0 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	2	**Pipe Ratings Index**	2	**Peak**	2	**Mean Pipe** 0
O&M:	**Pipe Rating**	19	**Pipe Ratings Index**	3.2	**Peak**	5	**Mean Pipe** 0.3

McGills Industrial Services Inc.
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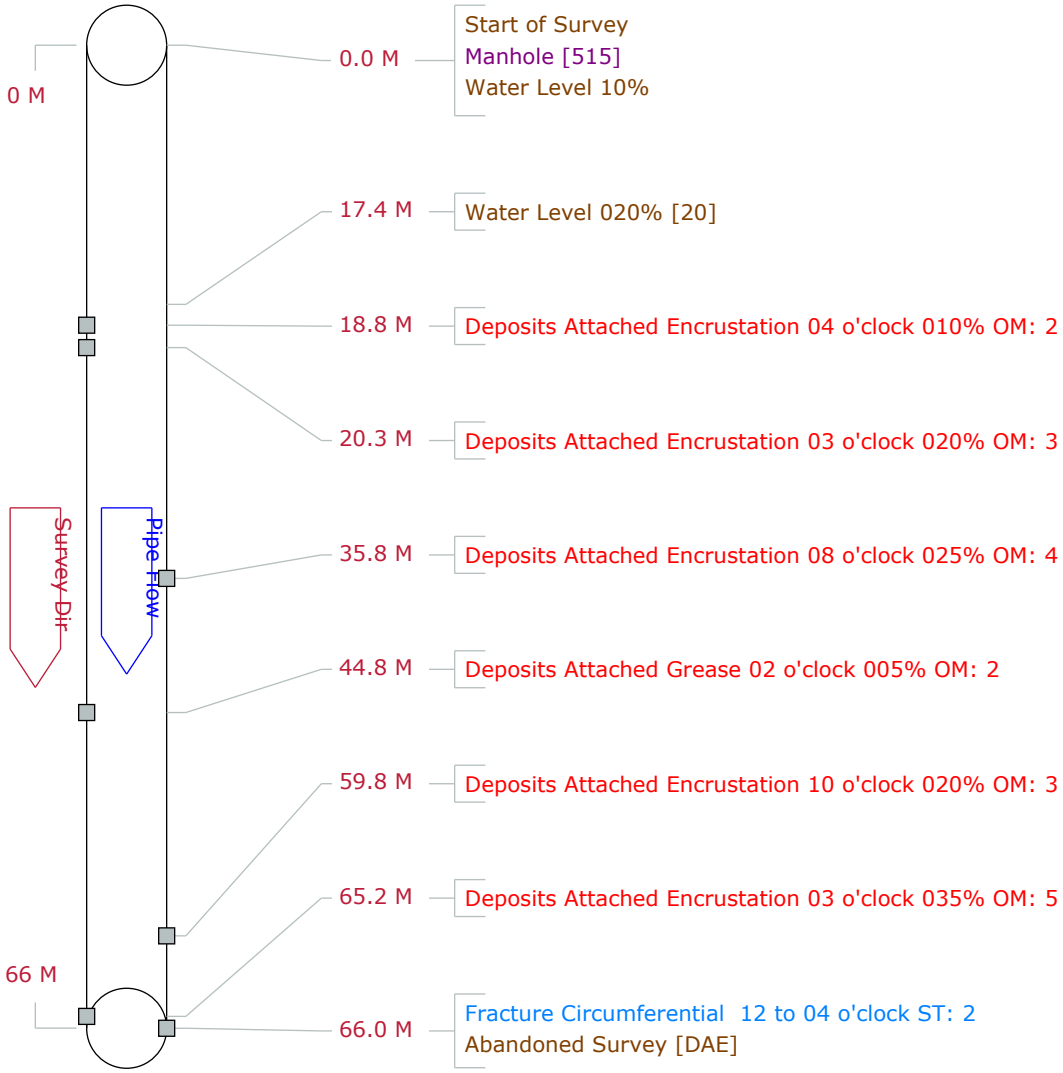
Pipe Graphic Report of PSR 515-514 **for** ISL

Setup	16/17 **Surveyor** Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL		
P/O #		**Date**	2023-03-01	**Time**	11:47
Street	35th Street				
City	Lloydminster	**Further location details**			
Up	515	**Rim to invert**		**Grade to invert**	**Rim to grade** M
Down	514	**Rim to invert**		**Grade to invert**	**Rim to grade** M
Use	Sanitary	**Direction**	Downstream	**Flow control**	**Media No**
Shape	Circular	**Height**	375 **Width**	mm **Preclean** J	**Date Cleaned** 2023-03-01
Material	Vitrified Clay Pipe	**Joint length**	M **Total length** M		**Length Surveyed** 66.00 M
Lining		**Year laid**	**Year rehabilitated**		**Weather** Dry
Purpose		**Cat**			
Additional info				Structural O & M Constructional Miscellaneous Hydraulic	
Location					
Project	Lloydminster Phase 1			**Work Order**	
Northing		**Easting**		**Elevation**	
Coordinate System				**GPS Accuracy**	



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Phone:306-664-2220

CCTV Picture List of 515-514 **for** ISL

Work Order			**Setup** 16/17
Video	**Survey Date**	2023-03-01	
Path to picture files	C:\FLEX6\Snaps\ISL\		
Path to video files	C:\FLEX6\Movies\ISL\		
Path to media files	C:\FLEX6\Media\ISL\		

Video Index **Count** 65.2 M
Code Deposits Attached Encrustation
Remarks
File Name 34.jpg

Tabular Report of PSR 515-514 for ISL

Setup	17	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	12:07	**Street**	35th Street
City	Lloydminster	**Further location details**					

Up	515	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	514	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Up	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	**M**	**Length Surveyed**	18.4 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info	Reverse set up on sheet:16	Structural	O & M	Constructional
Location		Miscellaneous		
Project	Lloydminster Phase 1	**Work Order**		
Northing	**Easting**	**Elevation**		
Coordinate System		**GPS Accuracy**		

Count	Video		CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								514
1.0				MWL	Water Level			35					
18.4				DAE	Deposits Attached Encrustation			35		09			
18.4				MSA	Abandoned Survey								DAE

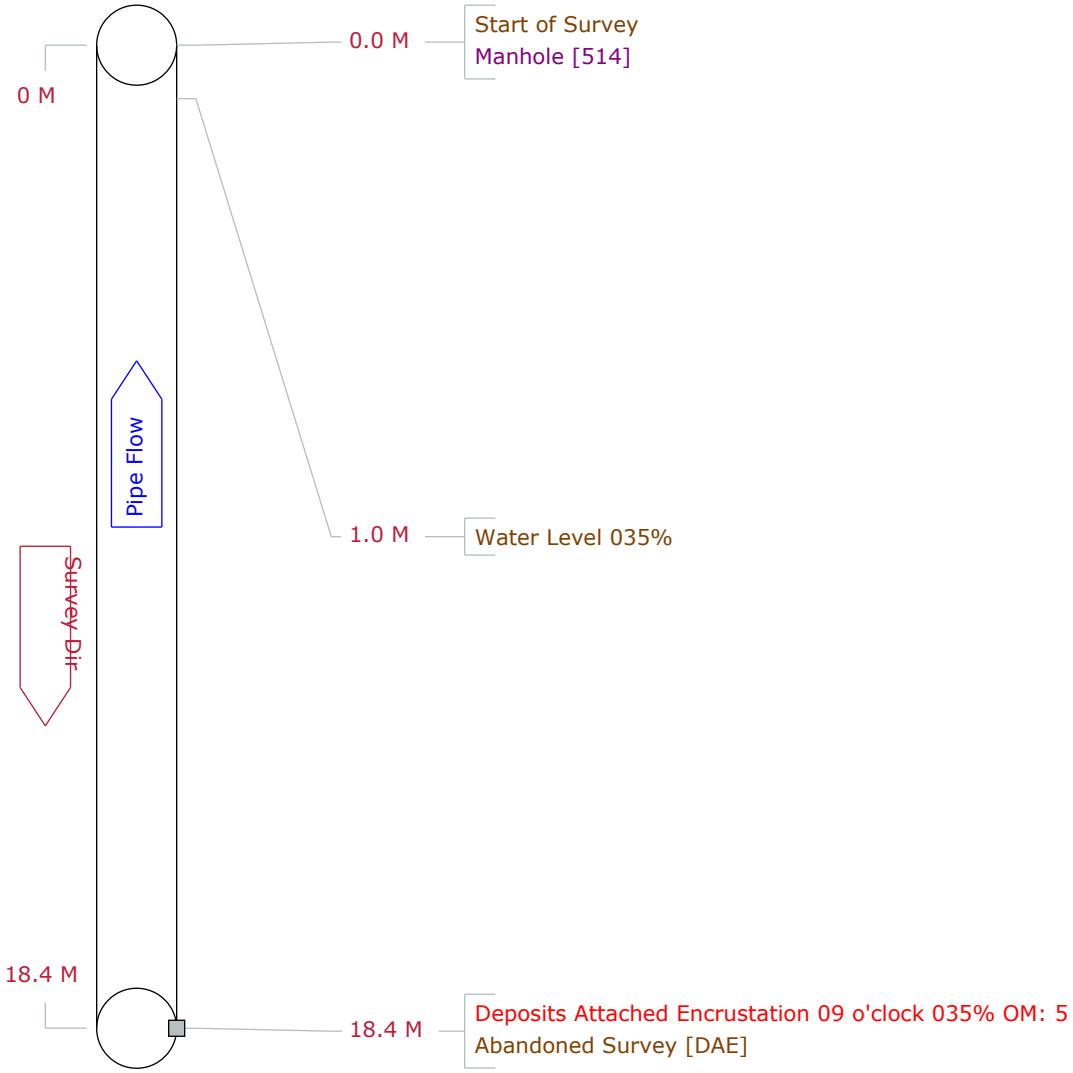
18.4 **M** **Total Length Surveyed**

Scores								
	Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe**	0
	O&M:	**Pipe Rating**	5	**Pipe Ratings Index**	5	**Peak**	5	**Mean Pipe**	0.3

Pipe Graphic Report of PSR 515-514 **for** ISL

Setup	17/16	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	12:07	**Street**	35th Street
City	Lloydminster	**Further location details**					
Up	515	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	514	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Use	Sanitary	**Direction**	Upstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	mm	**Preclean** J	**Date Cleaned** 2023-03-01
Material	Vitrified Clay Pipe	**Joint length**	M	**Total length**	M	**Length Surveyed**	18.40 M
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info	Reverse set up on sheet:16						
Location							
Project	Lloydminster Phase 1						
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 514-513 for ISL

Setup	18	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	13:05	**Street**	35th Street
City	Lloydminster	**Further location details**					

Up	514	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	513	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	**M**	**Length Surveyed**	82.6 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								514
0.0			MWL	Water Level			25					
5.8			DAE	Deposits Attached Encrustation			20		04	08		
7.5			DAGS	Deposits Attached Grease			10		02	11		
33.6			OBZ	Obstacle Other			10		04	09		Rod
36.8			DAE	Deposits Attached Encrustation			15		03			
43.1			DAGS	Deposits Attached Grease			10		11			
56.1			DAGS	Deposits Attached Grease			10		01	11		
82.6			MSA	Abandoned Survey								manhole ahead

82.6 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	0	**Pipe Ratings Index**	0	**Peak**	0	**Mean Pipe** 0
O&M:	**Pipe Rating**	14	**Pipe Ratings Index**	2.3	**Peak**	3	**Mean Pipe** 0.2

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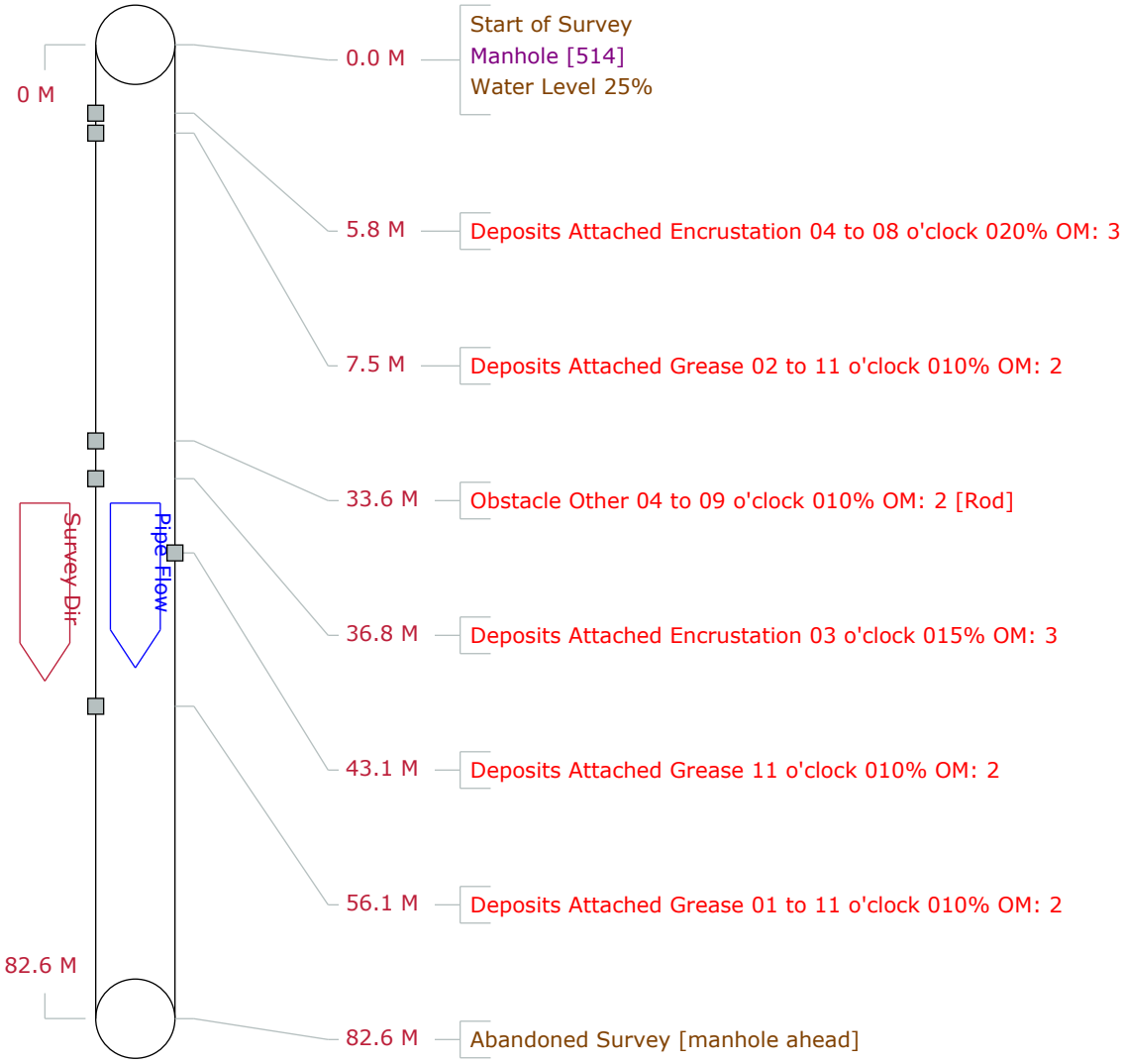
Pipe Graphic Report of PSR 514-513 **for** ISL

Setup	18	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	13:05	**Street**	35th Street
City	Lloydminster	**Further location details**					
Up	514	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Down	513	**Rim to invert**		**Grade to invert**		**Rim to grade**	M
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	mm	**Preclean** J	**Date Cleaned** 2023-03-01
Material	Vitrified Clay Pipe	**Joint length**	M	**Total length**	M	**Length Surveyed**	82.60 M
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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Tabular Report of PSR 513-512 for ISL

Setup	19	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	14:58	**Street**	35th Street
City	Lloydminster	**Further location details**					

Up	513	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	512	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	375	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	77.9 **M**	**Length Surveyed**	77.9 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								513
0.0			MWL	Water Level			25					
3.4			B	Broken					12			
26.0			TBD	Tap Break-in Defective	4				02			
49.1			B	Broken					08	12		
77.9			AMH	Manhole								512
77.9			FH	End of Survey								

77.9 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	8	**Pipe Ratings Index**	4	**Peak**	5	**Mean Pipe** 0.1
O&M:	**Pipe Rating**	3	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0

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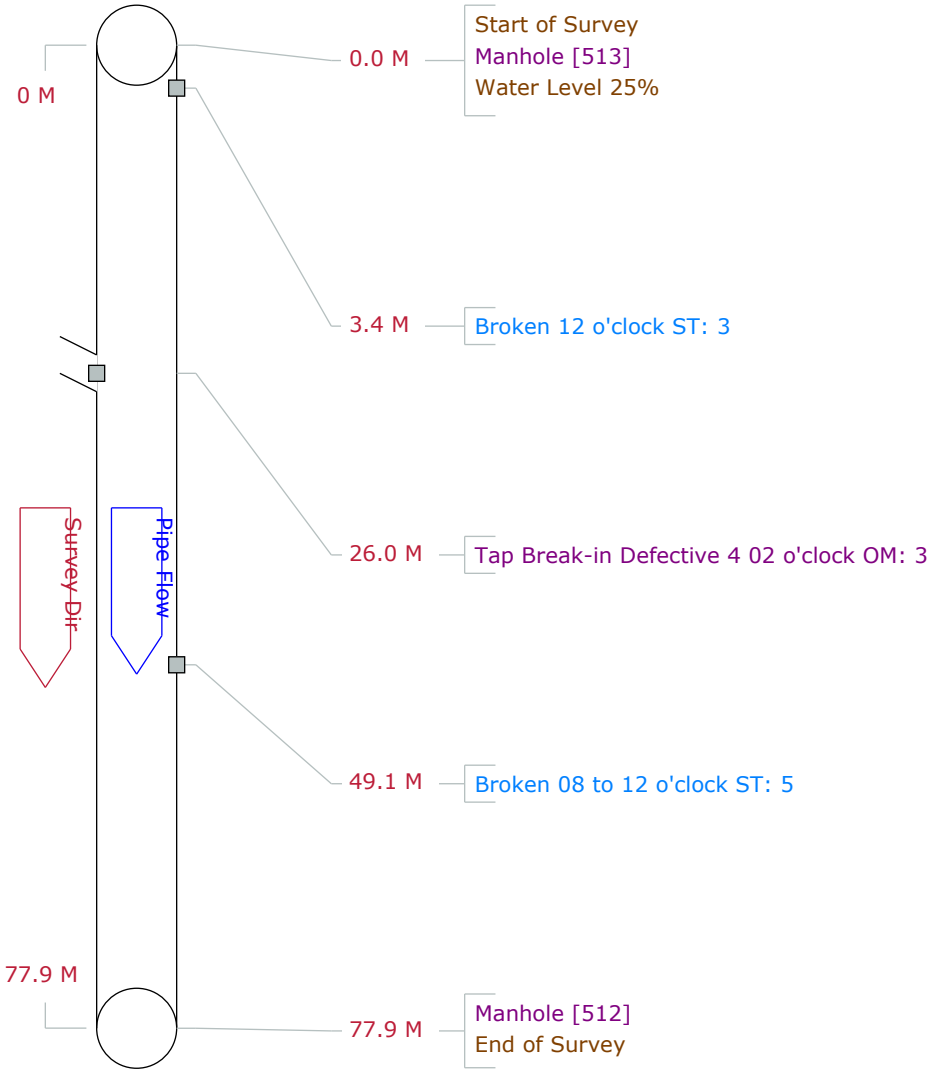
Pipe Graphic Report of PSR 513-512 **for** ISL

Setup	19	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-01	**Time**	14:58	**Street**	35th Street
City	Lloydminster	**Further location details**					
Up	513	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	512	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	375 **Width**	**mm**	**Preclean** J	**Date Cleaned**	2023-03-01
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length** 77.9 **M**		**Length Surveyed**	77.90 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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CCTV Picture List of 513-512 **for** ISL

Work Order			**Setup** 19
Video	**Survey Date**	2023-03-01	
Path to picture files	C:\FLEX6\Snaps\ISL\		
Path to video files	C:\FLEX6\Movies\ISL\		
Path to media files	C:\FLEX6\Media\ISL\		

Video Index **Count** 26.0 M
Code Tap Break-in Defective
Remarks
File Name 39.jpg

Tabular Report of PSR 613-624 for ISL

Setup	40	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	14:01	**Street**	52nd Ave
City	Lloydminster	**Further location details**					

Up	613	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	614	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**

Use	Sanitary	**Direction**	Down	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	**mm**	**Preclean**	J
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	75.8 **M**	**Length Surveyed**	75.8 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**				**Pressure**	

Additional info						Structural	O & M
Location						Constructional	Miscellaneous
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Count	Video	CD	Code		In1	In2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								613
0.0			MWL	Water Level			10					
12.8			MWL	Water Level			20					20
13.5			OBM	Obstacle Pipe Material			20		05			
46.4			H	Hole					08			
60.1			DAE	Deposits Attached Encrustation			15		02			
62.9			DAE	Deposits Attached Encrustation			20		03			
75.8			AMH	Manhole								614
75.8			FH	End of Survey								

75.8 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating**	3	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0
O&M:	**Pipe Rating**	9	**Pipe Ratings Index**	3	**Peak**	3	**Mean Pipe** 0.1

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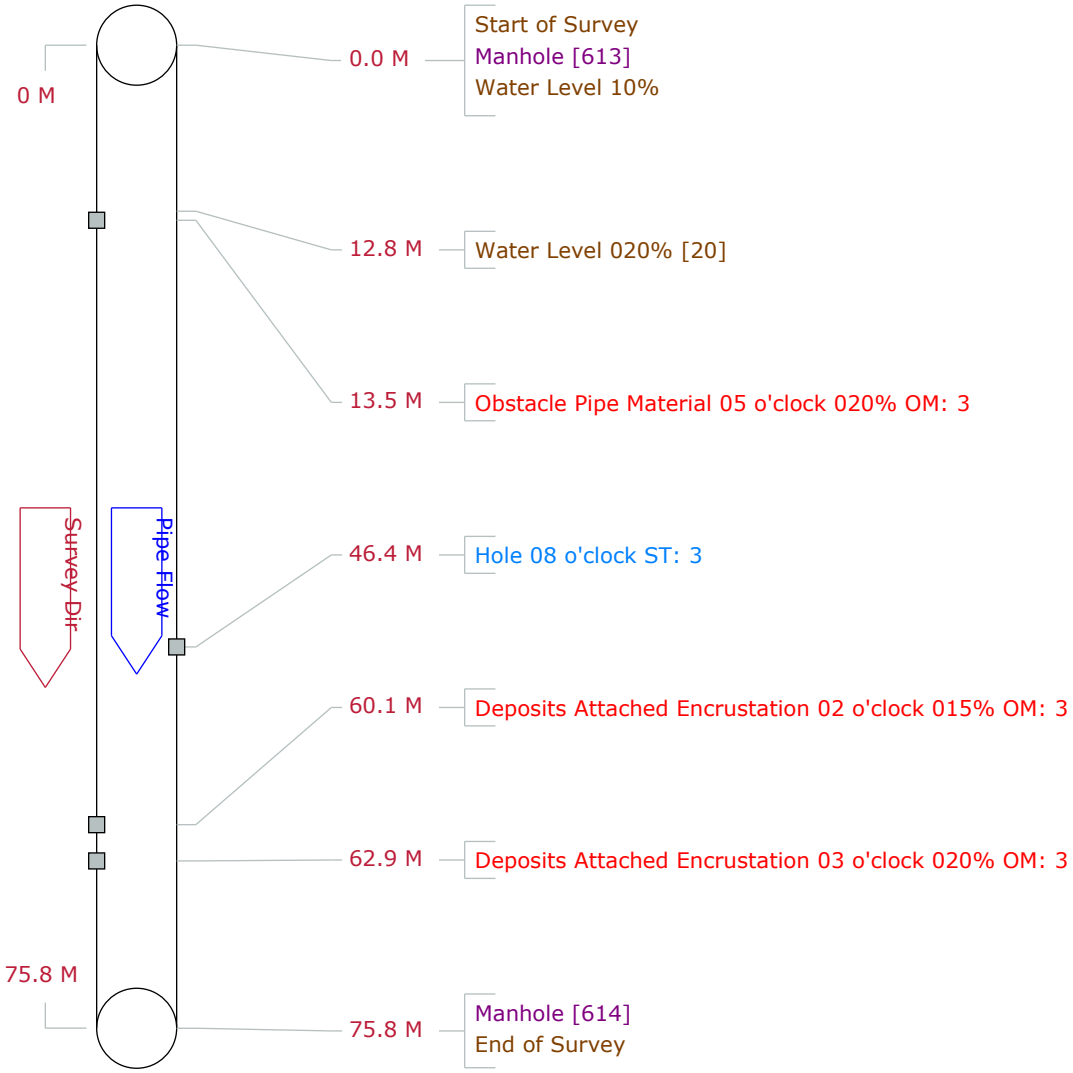
Pipe Graphic Report of PSR 613-624 **for** ISL

Setup	40	**Surveyor**	Ben Cooper	**Certificate #**	U-315-06023838	**System Owner**	
Drainage		**Survey Customer**	ISL				
P/O #		**Date**	2023-03-03	**Time**	14:01	**Street**	52nd Ave
City	Lloydminster	**Further location details**					
Up	613	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Down	614	**Rim to invert**		**Grade to invert**		**Rim to grade**	**M**
Use	Sanitary	**Direction**	Downstream	**Flow control**		**Media No**	
Shape	Circular	**Height**	200	**Width**	mm	**Preclean** J	**Date Cleaned** 2023-03-03
Material	Vitrified Clay Pipe	**Joint length**	**M**	**Total length**	75.8 **M**	**Length Surveyed**	75.80 **M**
Lining		**Year laid**		**Year rehabilitated**		**Weather**	Dry
Purpose		**Cat**					
Additional info							
Location							
Project	Lloydminster Phase 1					**Work Order**	
Northing		**Easting**				**Elevation**	
Coordinate System						**GPS Accuracy**	

Structural O & M Constructional
Miscellaneous Hydraulic



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APPENDIX F

CCTV Inspection Videos
(SharePoint Link)

APPENDIX G
Risk Assessment

Table G.1: Existing System Upgrades Risk Assessment Parameter Summary

Upgrade No.	Name	Category	Length	Category Weighted Score									Combined Weighted Score
				Average Change in HGL	HGL Impact (2.4m)	HGL Impact (3.0m)	HGL Impact (3.5m)	HGL Impact (4.0m)	Existing Upstream Impact	Future Upstream Impact	Generalized Pipe Condition	Road Condition Upgrade Potential	
1	Aurora Sewer Upgrades	Capacity	391.17	0.40	0.89	0.78	0.67	0.67	0.09	0.00	0.13	0.07	3.69
2	44 Street Sewer Upgrade	Capacity	273.47	0.40	0.00	0.16	0.27	0.27	0.27	0.20	0.13	0.02	1.71
3	51 Street Sewer Upgrade	Capacity	916.34	0.40	0.00	0.47	0.27	0.27	0.36	0.27	0.22	0.07	2.31
4	52 Street Trunk Upgrade	Capacity	807.62	0.60	0.00	0.00	0.13	0.13	0.36	0.27	0.22	0.04	1.76
5	48 Avenue Sewer Upgrade	Capacity	297.77	0.40	0.00	0.31	0.27	0.27	0.09	0.07	0.22	0.07	1.69
6	36 Street Trunk Upgrade West	Capacity	402.17	0.20	0.00	0.62	0.67	0.67	0.18	0.07	0.18	0.07	2.64
7	36 Street Trunk Upgrade East	Capacity	851.11	0.60	0.00	0.00	0.00	0.00	0.44	0.27	0.13	0.02	1.47
8	East Trunk Upgrade	Capacity	1060.35	0.40	0.00	0.00	0.00	0.00	0.44	0.33	0.13	0.11	1.42
9	Southeast Trunk Upgrade	Capacity	833.93	0.60	0.00	0.00	0.53	0.53	0.36	0.27	0.04	0.04	2.38
10	47 Avenue Sewer Upgrade	Capacity	234.14	0.80	0.00	0.31	0.40	0.40	0.09	0.00	0.18	0.07	2.24
11	53 Avenue Sewer Upgrade	Capacity	487.69	0.80	0.00	0.00	0.00	0.00	0.18	0.13	0.18	0.07	1.36
12	25 Street Trunk Upgrade	Capacity	386.00	1.00	0.00	0.00	0.00	0.00	0.09	0.13	0.13	0.02	1.38
13	59 Avenue Sewer Upgrade	Capacity	502.16	0.40	0.00	0.00	0.00	0.00	0.27	0.27	0.09	0.11	1.13
14	49 Avenue Sewer Replacement	Condition	100.93	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.22	0.04	0.36
15	42 Street East Sewer Replacement	Condition	71.02	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.18	0.04	0.31
16	42 Street West Sewer Replacement	Condition	358.06	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.18	0.07	0.33
17	36 Street Sewer Replacement	Condition	156.80	0.00	0.00	0.00	0.00	0.00	0.18	0.07	0.16	0.07	0.47
18	52 Avenue Sewer Replacement	Condition	148.15	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.18	0.09	0.36
19	46 Avenue Sewer Replacement	Condition	315.60	0.00	0.00	0.00	0.00	0.00	0.44	0.27	0.13	0.04	0.89
20	35 Street Sewer Replacement	Condition	164.92	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.20	0.07	0.36

Table G.2: Existing System Upgrades Risk Assessment Parameter Summary

Upgrade No.	Name	Category	Average Change in HGL	HGL Impact (2.4m)		HGL Impact (3.0m)		HGL Impact (3.5m)		HGL Impact (4.0m)		Existing Upstream Impact		Future Upstream Impact		Generalized Pipe Condition	Road Condition Upgrade Potential
				Basements	Population	Basements	Population	Basements	Population	Basements	Population	Catchment Area	Population	Catchment Area	Population		
			m									ha		ha			
1	Aurora Sewer Upgrades	Capacity	-3.66	63.00	262.40	63.00	262.40	63.00	262.40	71.00	295.72	7.03	562	0.00	0	Fair	Fair
2	44 Street Sewer Upgrade	Capacity	-3.76	0.00	0.00	2.00	0.00	6.00	22.28	10.00	25.07	295.35	5796	125.82	2125	Fair	Negligible
3	51 Street Sewer Upgrade	Capacity	-4.27	0.00	0.00	22.00	21.66	33.00	39.66	49.00	75.16	494.79	7846	373.79	3170	Failing	Fair
4	52 Street Trunk Upgrade	Capacity	-4.72	0.00	0.00	0.00	0.00	3.00	0.00	3.00	0.00	572.39	9840	373.79	3170	Failing	Poor
5	48 Avenue Sewer Upgrade	Capacity	-5.22	0.00	0.00	11.00	0.00	11.00	0.00	11.00	0.00	99.78	1833	0.19	0	Failing	Fair
6	36 Street Trunk Upgrade West	Capacity	-3.71	0.00	0.00	32.00	129.12	71.00	287.39	84.00	341.53	150.82	4435	0.34	0	Poor	Fair
7	36 Street Trunk Upgrade East	Capacity	-5.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	220.85	11121	187.14	3733	Fair	Negligible
8	East Trunk Upgrade	Capacity	-4.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	259.71	13023	1018.35	23883	Fair	Excellent
9	Southeast Trunk Upgrade	Capacity	-5.02	0.00	0.00	0.00	0.00	21.00	87.47	55.00	229.08	135.43	6628	186.15	3646	Excellent	Poor
10	47 Avenue Sewer Upgrade	Capacity	-5.87	0.00	0.00	6.00	24.99	19.00	79.14	19.00	79.14	18.97	1471	0.00	0	Poor	Fair
11	53 Avenue Sewer Upgrade	Capacity	-6.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	124.01	3518	168.63	481	Poor	Fair
12	25 Street Trunk Upgrade	Capacity	-8.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.46	696	7.00	318	Fair	Negligible
13	59 Avenue Sewer Upgrade	Capacity	-4.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	261.94	4885	337.79	3170	Good	Excellent
14	49 Avenue Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.76	162	0.00	0	Failing	Poor
15	42 Street East Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.11	739	0.00	0	Poor	Poor
16	42 Street West Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.68	739	0.00	0	Poor	Fair
17	36 Street Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.88	3562	0.34	0	Poor/Fair	Fair
18	52 Avenue Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	157	0.00	0	Poor	Good
19	46 Avenue Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	288.56	12441	239.81	4739	Fair	Poor
20	35 Street Sewer Replacement	Condition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	83.29	1958	0.00	0	Poor/Failing	Fair

Table G.3: Existing System Upgrades Risk Assessment - Net HGL Impact

Upgrade No.	Category	Maximum Change in HGL	Average Change in HGL	Raw Score	Weighted Score
		m	m		
1	Capacity	-5.09	-3.66	2	0.40
2	Capacity	-4.99	-3.76	2	0.40
3	Capacity	-5.03	-4.27	2	0.40
4	Capacity	-6.38	-4.72	3	0.60
5	Capacity	-5.34	-5.22	2	0.40
6	Capacity	-3.95	-3.71	1	0.20
7	Capacity	-6.00	-5.43	3	0.60
8	Capacity	-5.12	-4.48	2	0.40
9	Capacity	-5.96	-5.02	3	0.60
10	Capacity	-6.87	-5.87	4	0.80
11	Capacity	-6.91	-6.38	4	0.80
12	Capacity	-8.68	-8.10	5	1.00
13	Capacity	-5.15	-4.54	2	0.40
14	Condition	0.00	0.00	0	0.00
15	Condition	0.00	0.00	0	0.00
16	Condition	0.00	0.00	0	0.00
17	Condition	0.00	0.00	0	0.00
18	Condition	0.00	0.00	0	0.00
19	Condition	0.00	0.00	0	0.00
20	Condition	0.00	0.00	0	0.00

Table G.4: Existing System Upgrades Risk Assessment - HGL Impact (2.4m)

Upgrade No.	Category	HGL Impacted		Raw Score	Weighted Score
		Basement Count	Population		
1	Capacity	63	262.40	5	0.89
2	Capacity	0	0.00	0	0.00
3	Capacity	0	0.00	0	0.00
4	Capacity	0	0.00	0	0.00
5	Capacity	0	0.00	0	0.00
6	Capacity	0	0.00	0	0.00
7	Capacity	0	0.00	0	0.00
8	Capacity	0	0.00	0	0.00
9	Capacity	0	0.00	0	0.00
10	Capacity	0	0.00	0	0.00
11	Capacity	0	0.00	0	0.00
12	Capacity	0	0.00	0	0.00
13	Capacity	0	0.00	0	0.00
14	Condition	0	0.00	0	0.00
15	Condition	0	0.00	0	0.00
16	Condition	0	0.00	0	0.00
17	Condition	0	0.00	0	0.00
18	Condition	0	0.00	0	0.00
19	Condition	0	0.00	0	0.00
20	Condition	0	0.00	0	0.00

Table G.5: Existing System Upgrades Risk Assessment - HGL Impact (3.0m)

Upgrade No.	Category	HGL Impact		Raw Score	Weighted Score
		Basement Count	Population		
1	Capacity	63	262.40	5	0.78
2	Capacity	2	0.00	1	0.16
3	Capacity	22	21.66	3	0.47
4	Capacity	0	0.00	0	0.00
5	Capacity	11	0.00	2	0.31
6	Capacity	32	129.12	4	0.62
7	Capacity	0	0.00	0	0.00
8	Capacity	0	0.00	0	0.00
9	Capacity	0	0.00	0	0.00
10	Capacity	6	24.99	2	0.31
11	Capacity	0	0.00	0	0.00
12	Capacity	0	0.00	0	0.00
13	Capacity	0	0.00	0	0.00
14	Condition	0	0.00	0	0.00
15	Condition	0	0.00	0	0.00
16	Condition	0	0.00	0	0.00
17	Condition	0	0.00	0	0.00
18	Condition	0	0.00	0	0.00
19	Condition	0	0.00	0	0.00
20	Condition	0	0.00	0	0.00

Table G.6: Existing System Upgrades Risk Assessment - HGL Impact (3.5m)

Upgrade No.	Category	Potentially HGL Impact		Raw Score	Weighted Score
		Basement Count	Population		
1	Capacity	63	262.40	5	0.67
2	Capacity	6	22.28	2	0.27
3	Capacity	33	39.66	2	0.27
4	Capacity	3	0.00	1	0.13
5	Capacity	11	0.00	2	0.27
6	Capacity	71	287.39	5	0.67
7	Capacity	0	0.00	0	0.00
8	Capacity	0	0.00	0	0.00
9	Capacity	21	87.47	4	0.53
10	Capacity	19	79.14	3	0.40
11	Capacity	0	0.00	0	0.00
12	Capacity	0	0.00	0	0.00
13	Capacity	0	0.00	0	0.00
14	Condition	0	0.00	0	0.00
15	Condition	0	0.00	0	0.00
16	Condition	0	0.00	0	0.00
17	Condition	0	0.00	0	0.00
18	Condition	0	0.00	0	0.00
19	Condition	0	0.00	0	0.00
20	Condition	0	0.00	0	0.00

Table G.7: Existing System Upgrades Risk Assessment - HGL Impact (4.0m)

Upgrade No.	Category	Potentially HGL Impact		Raw Score	Weighted Score
		Basement Count	Population		
1	Capacity	71	295.72	4	0.44
2	Capacity	10	25.07	22.27968	2.48
3	Capacity	49	75.16	3	0.33
4	Capacity	3	0.00	1	0.11
5	Capacity	11	0.00	2	0.22
6	Capacity	84	341.53	5	0.56
7	Capacity	0	0.00	0	0.00
8	Capacity	0	0.00	0	0.00
9	Capacity	55	229.08	4	0.44
10	Capacity	19	79.14	4	0.44
11	Capacity	0	0.00	0	0.00
12	Capacity	0	0.00	0	0.00
13	Capacity	0	0.00	0	0.00
14	Condition	0	0.00	0	0.00
15	Condition	0	0.00	0	0.00
16	Condition	0	0.00	0	0.00
17	Condition	0	0.00	0	0.00
18	Condition	0	0.00	0	0.00
19	Condition	0	0.00	0	0.00
20	Condition	0	0.00	0	0.00

Table G.8: Existing System Upgrades Risk Assessment - Existing Upstream Impact

Upgrade No.	Category	Existing Upstream Impact			Raw Score	Weighted Score
		Catchment Area ha	Parcels	Population		
1	Capacity	7.03	135	562	1	0.09
2	Capacity	295.35	1,888	5,796	3	0.27
3	Capacity	494.79	2,720	7,846	4	0.36
4	Capacity	572.39	3,524	9,840	4	0.36
5	Capacity	99.78	694	1,833	1	0.09
6	Capacity	150.82	1,145	4,435	2	0.18
7	Capacity	220.85	2,556	11,121	5	0.44
8	Capacity	259.71	2,813	13,023	5	0.44
9	Capacity	135.43	1,590	6,628	4	0.36
10	Capacity	18.97	228	1,471	1	0.09
11	Capacity	124.01	1,287	3,518	2	0.18
12	Capacity	46.46	258	696	1	0.09
13	Capacity	261.94	1,619	4,885	3	0.27
14	Condition	2.76	41	162	1	0.09
15	Condition	36.11	178	739	1	0.09
16	Condition	26.68	145	739	1	0.09
17	Condition	95.88	918	3562	2	0.18
18	Condition	2.94	37	157	1	0.09
19	Condition	288.56	3105	12441	5	0.44
20	Condition	83.29	532	1958	1	0.09

Table G.9: Existing System Upgrades Risk Assessment - Future Upstream Impact

Upgrade No.	Category	Future Upstream Impact		Raw Score	Weighted Score
		Catchment Area ha	Population		
1	Capacity	0.00	0	0	0.00
2	Capacity	125.82	2,125	3	0.20
3	Capacity	373.79	3,170	4	0.27
4	Capacity	373.79	3,170	4	0.27
5	Capacity	0.19	0	1	0.07
6	Capacity	0.34	0	1	0.07
7	Capacity	187.14	3,733	4	0.27
8	Capacity	1,018.35	23,883	5	0.33
9	Capacity	186.15	3,646	4	0.27
10	Capacity	0.00	0	0	0.00
11	Capacity	168.63	481	2	0.13
12	Capacity	7.00	318	2	0.13
13	Capacity	337.79	3,170	4	0.27
14	Condition	0.00	0	0	0.00
15	Condition	0.00	0	0	0.00
16	Condition	0.00	0	0	0.00
17	Condition	0.34	0	1	0.07
18	Condition	0.00	0	0	0.00
19	Condition	239.81	4,739	4	0.27
20	Condition	0.00	0	0	0.00

Table G.10: Existing System Upgrades Risk Assessment - Generalized Pipe Condition

Upgrade No.	Category	Length	Year Installed	Material	Raw Score	Generalized Pipe Condition	Weighted Score
1	Capacity	391.17	1980-1986	VCT	3	Fair	0.13
2	Capacity	273.47	1987	VCT	3	Fair	0.13
3	Capacity	916.34	1948	VCT	5	Failing	0.22
4	Capacity	807.62	1948	VCT	5	Failing	0.22
5	Capacity	297.77	1940-1947	VCT	5	Failing	0.22
6	Capacity	402.17	1966	VCT	4	Poor	0.18
7	Capacity	851.11	1981	CONC	3	Fair	0.13
8	Capacity	1060.35	1981	CONC	3	Fair	0.13
9	Capacity	833.93	2006	PVC	1	Excellent	0.04
10	Capacity	234.14	1978	VCT	4	Poor	0.18
11	Capacity	487.69	1980-1986	VCT	4	Poor	0.18
12	Capacity	386.00	1988	CONC	3	Fair	0.13
13	Capacity	502.16	1982-1984	VCT/CONC	2	Good	0.09
14	Condition	100.93	1965	VCT	5	Failing	0.22
15	Condition	71.02	1990	CONC	4	Poor	0.18
16	Condition	358.06	1974	VCT	4	Poor	0.18
17	Condition	156.80	1966-1968	CONC/CMP	3.5	Poor/Fair	0.16
18	Condition	148.15	1973	VCT	4	Poor	0.18
19	Condition	315.60	1980	CONC	3	Fair	0.13
20	Condition	164.92	1973	VCT	4.5	Poor/Failing	0.20

Table G.11: Existing System Upgrades Risk Assessment - Road Condition Upgrade Potential

Upgrade No.	Category	Length	Imagery Year	Road Condition	Upgrade Coupling Potential	Road Condition Upgrade Potential	Raw Score	Weighted Score
1	Capacity	391.17	2009	Fair	Moderate	Fair	3	0.07
2	Capacity	273.47	2022	Good	Negligible	Negligible	1	0.02
3	Capacity	916.34	2012	Good/Fair	Moderate	Fair	3	0.07
4	Capacity	807.62	2012-2016	Fair	Low	Poor	2	0.04
5	Capacity	297.77	2012	Poor	Moderate	Fair	3	0.07
6	Capacity	402.17	2018	Fair/Poor	Moderate	Fair	3	0.07
7	Capacity	851.11	2018	Good/ Excellent	Negligible	Negligible	1	0.02
8	Capacity	1060.35	2022	Good/ Excellent	Very High	Excellent	5	0.11
9	Capacity	833.93	2009-2019	Good	Low	Poor	2	0.04
10	Capacity	234.14	2019	Fair	Moderate	Fair	3	0.07
11	Capacity	487.69	2012	Fair	Moderate	Fair	3	0.07
12	Capacity	386.00	2019	Good/ Excellent	Negligible	Negligible	1	0.02
13	Capacity	502.16	2019	Poor	Very High	Excellent	5	0.11
14	Condition	100.93	2009	Fair	Low	Poor	2	0.04
15	Condition	71.02	2019	Fair	Low	Poor	2	0.04
16	Condition	358.06	2012	Good/Fair	Moderate	Fair	3	0.07
17	Condition	156.80	2018	Fair	Moderate	Fair	3	0.07
18	Condition	148.15	2019	Poor	High	Good	4	0.09
19	Condition	315.60	2009	Good	Low	Poor	2	0.04
20	Condition	164.92	2012 and 2019	Fair	Some	Fair	3	0.07

APPENDIX H
Cost Estimates

Table H.1: Existing System Capacity Upgrades Cost Estimates

Upgrade No.	Item	Material	Quantity	Unit	Unit Cost[1]	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost[2]
1	250mm Gravity Sewer	PVC	240	Metres	$560	$134,571	$40,371	$26,241	$210,000
	300mm Gravity Sewer	PVC	151	Metres	$620	$93,538	$28,062	$18,240	$140,000
	200mm Gravity Sewer Removal	VCT	391	Metres	$90	$35,206	$10,562	$6,865	$60,000
	Pavement Rehabilitation	N/A	391	Metres	$1,030	$402,909	$120,873	$78,567	$610,000
					Existing Upgrade 1 Sub-Total:	**$666,223**	**$199,867**	**$129,914**	**$1,020,000**
2	250mm Gravity Sewer	PVC	273	Metres	$560	$153,146	$45,944	$29,863	$230,000
	200mm Gravity Sewer Removal	VCT	273	Metres	$90	$24,613	$7,384	$4,799	$40,000
	Pavement Rehabilitation	N/A	273	Metres	$1,030	$281,679	$84,504	$54,927	$430,000
					Existing Upgrade 2 Sub-Total:	**$459,437**	**$137,831**	**$89,590**	**$700,000**
3	375mm Gravity Sewer	PVC	502	Metres	$770	$386,791	$116,037	$75,424	$580,000
	300mm Gravity Sewer Removal	VCT	345	Metres	$100	$34,459	$10,338	$6,720	$60,000
	Rail Crossing (Directional Drilling)	N/A	80	Metres	$1,850	$148,000	$44,400	$28,860	$230,000
	Pavement Rehabilitation	N/A	345	Metres	$1,030	$354,927	$106,478	$69,211	$540,000
					Existing Upgrade 3 Sub-Total:	**$924,177**	**$277,253**	**$180,215**	**$1,410,000**
4	300mm Gravity Sewer	PVC	15	Metres	$620	$9,338	$2,801	$1,821	$20,000
	525mm Gravity Sewer	CONC	808	Metres	$910	$734,932	$220,480	$143,312	$1,100,000
	450mm Gravity Sewer Removal	VCT	808	Metres	$110	$88,838	$26,651	$17,323	$140,000
	Pavement Rehabilitation	N/A	823	Metres	$1,030	$847,359	$254,208	$165,235	$1,270,000
					Existing Upgrade 4 Sub-Total:	**$1,680,467**	**$504,140**	**$327,691**	**$2,530,000**
5	375mm Gravity Sewer	PVC	298	Metres	$770	$229,286	$68,786	$44,711	$350,000
	300mm Gravity Sewer Removal	VCT	276	Metres	$100	$27,566	$8,270	$5,375	$50,000
	375mm Gravity Sewer Removal	PVC	22	Metres	$100	$2,211	$663	$431	$10,000
	Rail Crossing	N/A	298	Metres	$10,270	$3,058,145	$917,444	$596,338	$4,580,000
					Existing Upgrade 5 Sub-Total:	**$3,317,209**	**$995,163**	**$646,856**	**$4,990,000**
6	450mm Gravity Sewer	PVC	402	Metres	$870	$349,889	$104,967	$68,228	$530,000
	375mm Gravity Sewer Removal	VCT	402	Metres	$100	$40,217	$12,065	$7,842	$70,000
	Pavement Rehabilitation	N/A	402	Metres	$1,030	$414,236	$124,271	$80,776	$620,000
					Existing Upgrade 6 Sub-Total:	**$804,342**	**$241,303**	**$156,847**	**$1,220,000**
7	900mm Gravity Sewer	CONC	851	Metres	$2,090	$1,778,818	$533,645	$346,870	$2,660,000
	750mm Gravity Sewer Removal	CONC	851	Metres	$170	$144,689	$43,407	$28,214	$220,000
	Pavement Rehabilitation	N/A	42	Metres	$1,030	$42,954	$12,886	$8,376	$70,000
					Existing Upgrade 7 Sub-Total:	**$1,966,461**	**$589,938**	**$383,460**	**$2,950,000**
8	900mm Gravity Sewer	CONC	1,060	Metres	$2,090	$2,216,136	$664,841	$432,147	$3,320,000
	750mm Gravity Sewer Removal	CONC	1,060	Metres	$170	$180,260	$54,078	$35,151	$270,000
	Pavement Rehabilitation	N/A	336	Metres	$1,030	$346,563	$103,969	$67,580	$520,000
					Existing Upgrade 8 Sub-Total:	**$2,742,959**	**$822,888**	**$534,877**	**$4,110,000**
9	525mm Gravity Sewer	PVC	834	Metres	$910	$758,875	$227,663	$147,981	$1,140,000
	375mm Gravity Sewer Removal	PVC	577	Metres	$100	$57,723	$17,317	$11,256	$90,000
	450mm Gravity Sewer Removal	PVC	257	Metres	$110	$28,237	$8,471	$5,506	$50,000
	Pavement Rehabilitation	N/A	834	Metres	$1,030	$858,947	$257,684	$167,495	$1,290,000
					Existing Upgrade 9 Sub-Total:	**$1,703,782**	**$511,135**	**$332,237**	**$2,570,000**
10	300mm Gravity Sewer	PVC	234	Metres	$620	$145,169	$43,551	$28,308	$220,000
	250mm Gravity Sewer Removal	VCT	234	Metres	$90	$21,073	$6,322	$4,109	$40,000
	Pavement Rehabilitation	N/A	234	Metres	$1,030	$241,168	$72,350	$47,028	$370,000
					Existing Upgrade 10 Sub-Total:	**$407,409**	**$122,223**	**$79,445**	**$630,000**
11	300mm Gravity Sewer	PVC	263	Metres	$620	$163,104	$48,931	$31,805	$250,000
	375mm Gravity Sewer	PVC	225	Metres	$770	$172,954	$51,886	$33,726	$260,000
	250mm Gravity Sewer Removal	VCT	263	Metres	$90	$23,676	$7,103	$4,617	$40,000
	300mm Gravity Sewer Removal	VCT	225	Metres	$100	$22,462	$6,738	$4,380	$40,000
	Pavement Rehabilitation	N/A	488	Metres	$1,030	$502,317	$150,695	$97,952	$760,000
					Existing Upgrade 11 Sub-Total:	**$884,512**	**$265,354**	**$172,480**	**$1,350,000**
12	375mm Gravity Sewer	PVC	386	Metres	$770	$297,221	$89,166	$57,958	$450,000
	300mm Gravity Sewer Removal	CONC	386	Metres	$100	$38,600	$11,580	$7,527	$60,000
	Pavement Rehabilitation	N/A	386	Metres	$1,030	$397,582	$119,275	$77,528	$600,000
					Existing Upgrade 12 Sub-Total:	**$733,403**	**$220,021**	**$143,014**	**$1,110,000**
13	600mm Gravity Sewer	CONC	502	Metres	$960	$482,071	$144,621	$94,004	$730,000
	450mm Gravity Sewer Removal	CONC	147	Metres	$110	$16,185	$4,855	$3,156	$30,000
	525mm Gravity Sewer Removal	CONC	355	Metres	$120	$42,603	$12,781	$8,308	$70,000
	Pavement Rehabilitation	N/A	502	Metres	$1,030	$517,222	$155,166	$100,858	$780,000
	Rail Crossing (Directional Drilling)	N/A	110	Metres	$1,850	$203,500	$61,050	$39,683	$310,000
					Existing Upgrade 13 Sub-Total:	**$1,261,580**	**$378,474**	**$246,008**	**$1,920,000**
					Total:	**$17,560,000**	**$5,270,000**	**$3,430,000**	**$26,510,000**

[1] Costs herein are comparable to other municipalities. Costs are representative of 2024 dollars. Unit costs have been rounded to the nearest $10.

[2] The total cost has been rounded up to the nearest $10,000.

Table H.2: Existing System Condition Upgrades Cost Estimates

Upgrade No.	Item	Material	Quantity	Unit	Unit Cost[1]	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost[2]
14	200mm Gravity Sewer	PVC	101	Metres	$540	$54,505	$16,351	$10,628	$90,000
	200mm Gravity Sewer Removal	VCT	101	Metres	$90	$9,084	$2,725	$1,771	$20,000
	Pavement Rehabilitation	N/A	101	Metres	$1,030	$103,962	$31,189	$20,273	$160,000
					Existing Upgrade 14 Sub-Total:	**$167,551**	**$50,265**	**$32,672**	**$270,000**
15	375mm Gravity Sewer	PVC	71	Metres	$770	$54,682	$16,404	$10,663	$90,000
	375mm Gravity Sewer Removal	CONC	71	Metres	$100	$7,102	$2,130	$1,385	$20,000
	Pavement Rehabilitation	N/A	71	Metres	$1,030	$73,146	$21,944	$14,263	$110,000
					Existing Upgrade 15 Sub-Total:	**$134,929**	**$40,479**	**$26,311**	**$220,000**
16	375mm Gravity Sewer	PVC	358	Metres	$770	$275,704	$82,711	$53,762	$420,000
	375mm Gravity Sewer Removal	VCT	358	Metres	$100	$35,806	$10,742	$6,982	$60,000
	Pavement Rehabilitation	N/A	358	Metres	$1,030	$368,799	$110,640	$71,916	$560,000
					Existing Upgrade 16 Sub-Total:	**$680,309**	**$204,093**	**$132,660**	**$1,040,000**
17	375mm Gravity Sewer	PVC	157	Metres	$770	$120,734	$36,220	$23,543	$190,000
	375mm Gravity Sewer Removal	VCT	157	Metres	$100	$15,680	$4,704	$3,058	$30,000
	Pavement Rehabilitation	N/A	157	Metres	$1,030	$161,501	$48,450	$31,493	$250,000
					Existing Upgrade 17 Sub-Total:	**$297,914**	**$89,374**	**$58,093**	**$470,000**
18	200mm Gravity Sewer	PVC	148	Metres	$540	$80,001	$24,000	$15,600	$120,000
	200mm Gravity Sewer Removal	CONC/CMP	148	Metres	$90	$13,333	$4,000	$2,600	$20,000
	Pavement Rehabilitation	N/A	148	Metres	$1,030	$152,594	$45,778	$29,756	$230,000
					Existing Upgrade 18 Sub-Total:	**$245,929**	**$73,779**	**$47,956**	**$370,000**
19	750mm Gravity Sewer	CONC	316	Metres	$1,350	$426,064	$127,819	$83,082	$640,000
	750mm Gravity Sewer Removal	CONC	316	Metres	$170	$53,652	$16,096	$10,462	$90,000
	Pavement Rehabilitation	N/A	316	Metres	$1,030	$325,071	$97,521	$63,389	$490,000
					Existing Upgrade 19 Sub-Total:	**$804,787**	**$241,436**	**$156,933**	**$1,220,000**
20	375mm Gravity Sewer	PVC	165	Metres	$770	$126,988	$38,097	$24,763	$190,000
	375mm Gravity Sewer Removal	VCT	165	Metres	$100	$16,492	$4,948	$3,216	$30,000
	Pavement Rehabilitation	N/A	165	Metres	$1,030	$169,868	$50,960	$33,124	$260,000
					Existing Upgrade 20 Sub-Total:	**$313,348**	**$94,004**	**$61,103**	**$480,000**
					Total:	**$2,650,000**	**$800,000**	**$520,000**	**$4,070,000**

[1] Costs herein are comparable to other municipalities. Costs are representative of 2024 dollars. Unit costs have been rounded to the nearest $10.

[2] The total cost has been rounded up to the nearest $10,000.

Table H.3: Future System Concept Cost Estimates

Upgrade No.	Item	Material	Quantity	Unit	Unit Cost[1]	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost[2]
Concept 1	200mm Forcemain	PVC	916	Metres	$540	$494,424	$148,327	$96,413	$740,000
	300mm Gravity Sewer	PVC	929	Metres	$620	$575,794	$172,738	$112,280	$870,000
	375mm Gravity Sewer	PVC	1,347	Metres	$770	$1,037,421	$311,226	$202,297	$1,560,000
	450mm Gravity Sewer	PVC	4,006	Metres	$870	$3,485,394	$1,045,618	$679,652	$5,220,000
	525mm Gravity Sewer	PVC	848	Metres	$910	$771,771	$231,531	$150,495	$1,160,000
	600mm Gravity Sewer	PVC	3,097	Metres	$960	$2,973,504	$892,051	$579,833	$4,450,000
	675mm Gravity Sewer	PVC	1,888	Metres	$1,160	$2,189,964	$656,989	$427,043	$3,280,000
	750mm Gravity Sewer	PVC	1,722	Metres	$1,350	$2,324,700	$697,410	$453,317	$3,480,000
	900mm Gravity Sewer	PVC	993	Metres	$2,090	$2,074,534	$622,360	$404,534	$3,110,000
	1050mm Gravity Sewer	PVC	1,292	Metres	$2,250	$2,906,325	$871,898	$566,733	$4,350,000
	1200mm Gravity Sewer	CONC	7,445	Metres	$2,400	$17,868,000	$5,360,400	$3,484,260	$26,720,000
	Lift Station 1 (31 L/s)	N/A	1	Item	$700,000	$700,000	$210,000	$136,500	$1,050,000
					Future Concept 1 Total:	**$37,401,831**	**$11,220,549**	**$7,293,357**	**$55,990,000**
Concept 2	200mm Forcemain	PVC	916	Metres	$540	$494,424	$148,327	$96,413	$740,000
	300mm Gravity Sewer	PVC	929	Metres	$620	$575,794	$172,738	$112,280	$870,000
	375mm Gravity Sewer	PVC	1,347	Metres	$770	$1,037,421	$311,226	$202,297	$1,560,000
	450mm Gravity Sewer	PVC	4,278	Metres	$870	$3,721,773	$1,116,532	$725,746	$5,570,000
	525mm Gravity Sewer	PVC	848	Metres	$910	$771,771	$231,531	$150,495	$1,160,000
	600mm Gravity Sewer	PVC	3,653	Metres	$960	$3,506,784	$1,052,035	$683,823	$5,250,000
	675mm Gravity Sewer	PVC	792	Metres	$1,160	$918,720	$275,616	$179,150	$1,380,000
	750mm Gravity Sewer	PVC	2,021	Metres	$1,350	$2,728,350	$818,505	$532,028	$4,080,000
	900mm Gravity Sewer	PVC	961	Metres	$2,090	$2,008,490	$602,547	$391,656	$3,010,000
	1050mm Gravity Sewer	PVC	829	Metres	$2,250	$1,865,250	$559,575	$363,724	$2,790,000
	1200mm Gravity Sewer	CONC	7,128	Metres	$2,400	$17,107,200	$5,132,160	$3,335,904	$25,580,000
	1350mm Gravity Sewer	PVC	1,639	Metres	$2,560	$4,195,840	$1,258,752	$818,189	$6,280,000
	Lift Station 1 (31 L/s)	N/A	1	Item	$700,000	$700,000	$210,000	$136,500	$1,050,000
					Future Concept 2 Total:	**$39,631,817**	**$11,889,545**	**$7,728,204**	**$59,320,000**

[1] Costs herein are comparable to other municipalities. Costs are representative of 2024 dollars. Unit costs have been rounded to the nearest $10.
[2] The total cost has been rounded up to the nearest $10,000.

Table H.4: Cost Estimates for Recommended Upgrades under Growth Conditions

Concept No.	Upgrade No.	Item	Material	Quantity	Unit	Unit Cost[1]	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost[2]
Concept 1	1	900mm Gravity Sewer Removal	CONC	750	Metres	$220	$165,000	$49,500	$32,175	$250,000
		1200mm Gravity Sewer	CONC	750	Metres	$2,400	$1,800,000	$540,000	$351,000	$2,700,000
		Pavement Rehabilitation	PVC	750	Metres	$1,030	$772,500	$231,750	$150,638	$1,160,000
						Upgrade 1 Sub-Total:	**$2,737,500**	**$821,250**	**$533,813**	**$4,110,000**
	2	600mm Gravity Sewer Removal	CONC	958	Metres	$130	$124,540	$37,362	$24,285	$190,000
		675mm Gravity Sewer	PVC	958	Metres	$1,160	$1,111,280	$333,384	$216,700	$1,670,000
						Upgrade 2 Sub-Total:	**$1,235,820**	**$370,746**	**$240,985**	**$1,860,000**
	6	200mm Gravity Sewer Removal	PVC	114	Metres	$90	$10,260	$3,078	$2,001	$20,000
		300mm Gravity Sewer	PVC	114	Metres	$620	$70,680	$21,204	$13,783	$110,000
		Pavement Rehabilitation	PVC	114	Metres	$1,030	$117,420	$35,226	$22,897	$180,000
						Upgrade 3 Sub-Total:	**$198,360**	**$59,508**	**$38,680**	**$310,000**
						Future Upgrades Concept 1 Total:	**$4,171,680**	**$1,251,504**	**$813,478**	**$6,280,000**
Concept 2	1	900mm Gravity Sewer Removal	CONC	750	Metres	$220	$165,000	$49,500	$32,175	$250,000
		1200mm Gravity Sewer	CONC	750	Metres	$2,400	$1,800,000	$540,000	$351,000	$2,700,000
		Pavement Rehabilitation	PVC	750	Metres	$1,030	$772,500	$231,750	$150,638	$1,160,000
						Upgrade 1 Sub-Total:	**$2,737,500**	**$821,250**	**$533,813**	**$4,110,000**
	2	600mm Gravity Sewer Removal	CONC	958	Metres	$130	$124,540	$37,362	$24,285	$190,000
		675mm Gravity Sewer	PVC	958	Metres	$1,160	$1,111,280	$333,384	$216,700	$1,670,000
						Upgrade 2 Sub-Total:	**$1,235,820**	**$370,746**	**$240,985**	**$1,860,000**
						Future Upgrades Concept 2 Total:	**$3,973,320**	**$1,191,996**	**$774,797**	**$5,970,000**

[1] Costs herein are comparable to other municipalities. Costs are representative of 2024 dollars. Unit costs have been rounded to the nearest $10.
[2] The total cost has been rounded up to the nearest $10,000.

Table H.5: Cost Estimates for Future Servicing

Horizon	ID	Item	Material	Quantity	Unit	Unit Cost[1]	Sub-Total	Contingency (30%)	Engineering (15%)	Total Cost[2]
5-Year	7,24,25	450mm Gravity Sewer	PVC	449	Metres	$870	$390,630	$117,189	$76,173	$590,000
		600mm Gravity Sewer	PVC	350	Metres	$960	$336,000	$100,800	$65,520	$510,000
		675mm Gravity Sewer	PVC	617	Metres	$1,160	$715,720	$214,716	$139,565	$1,080,000
						Total Cost:	**$1,442,350**	**$432,705**	**$281,258**	**$2,180,000**
	18,23,28,34,41	300mm Gravity Sewer	PVC	928	Metres	$620	$575,360	$172,608	$112,195	$870,000
		1200mm Gravity Sewer	CONC	1,621	Metres	$2,400	$3,890,400	$1,167,120	$758,628	$5,820,000
						Total Cost:	**$4,465,760**	**$1,339,728**	**$870,823**	**$6,690,000**
	30	450mm Gravity Sewer	PVC	452	Metres	$870	$393,240	$117,972	$76,682	$590,000
						Total Cost:	**$393,240**	**$117,972**	**$76,682**	**$590,000**
	31	1200mm Gravity Sewer	CONC	912	Metres	$2,400	$2,188,800	$656,640	$426,816	$3,280,000
						Total Cost:	**$2,188,800**	**$656,640**	**$426,816**	**$3,280,000**
10-Year	13	375mm Gravity Sewer	PVC	602	Metres	$770	$463,540	$139,062	$90,390	$700,000
						Total Cost:	**$463,540**	**$139,062**	**$90,390**	**$700,000**
	27	1200mm Gravity Sewer	CONC	904	Metres	$2,400	$2,169,600	$650,880	$423,072	$3,250,000
						Total Cost:	**$2,169,600**	**$650,880**	**$423,072**	**$3,250,000**
	29	600mm Gravity Sewer	PVC	559	Metres	$960	$536,640	$160,992	$104,645	$810,000
						Total Cost:	**$536,640**	**$160,992**	**$104,645**	**$810,000**
	20,26,East Trunk 1	1200mm Gravity Sewer	PVC	4,009	Metres	$2,400	$9,621,600	$2,886,480	$1,876,212	$14,390,000
						Total Cost:	**$9,621,600**	**$2,886,480**	**$1,876,212**	**$14,390,000**
20-Year	4,19,21	375mm Gravity Sewer	PVC	324	Metres	$770	$249,480	$74,844	$48,649	$380,000
		750mm Gravity Sewer	PVC	844	Metres	$1,350	$1,139,400	$341,820	$222,183	$1,710,000
		900mm Gravity Sewer	PVC	164	Metres	$2,090	$342,760	$102,828	$66,838	$520,000
						Total Cost:	**$1,731,640**	**$519,492**	**$337,670**	**$2,610,000**
	17	450mm Gravity Sewer	PVC	358	Metres	$870	$311,460	$93,438	$60,735	$470,000
						Total Cost:	**$311,460**	**$93,438**	**$60,735**	**$470,000**
	3	450mm Gravity Sewer	PVC	442	Metres	$870	$384,540	$115,362	$74,985	$580,000
						Total Cost:	**$384,540**	**$115,362**	**$74,985**	**$580,000**
	35,36	525mm Gravity Sewer	PVC	550	Metres	$910	$500,500	$150,150	$97,598	$750,000
		675mm Gravity Sewer	PVC	175	Metres	$1,160	$203,000	$60,900	$39,585	$310,000
						Total Cost:	**$703,500**	**$211,050**	**$137,183**	**$1,060,000**
	32	450mm Gravity Sewer	PVC	439	Metres	$870	$381,930	$114,579	$74,476	$580,000
						Total Cost:	**$381,930**	**$114,579**	**$74,476**	**$580,000**
	2,33	375mm Gravity Sewer	PVC	421	Metres	$770	$324,170	$97,251	$63,213	$490,000
						Total Cost:	**$324,170**	**$97,251**	**$63,213**	**$490,000**
	0,1,11,14,15,22	450mm Gravity Sewer	PVC	575	Metres	$870	$500,250	$150,075	$97,549	$750,000
		675mm Gravity Sewer	PVC	1,096	Metres	$1,160	$1,271,360	$381,408	$247,915	$1,910,000
		750mm Gravity Sewer	PVC	797	Metres	$1,350	$1,075,950	$322,785	$209,810	$1,610,000
		900mm Gravity Sewer	PVC	829	Metres	$2,090	$1,732,610	$519,783	$337,859	$2,600,000
		1050mm Gravity Sewer	PVC	1,292	Metres	$2,250	$2,907,000	$872,100	$566,865	$4,350,000
						Total Cost:	**$7,487,170**	**$2,246,151**	**$1,459,998**	**$11,220,000**
Ultimate	6	200mm Forcemain	PVC	902	Metres	$540	$487,080	$146,124	$94,981	$730,000
						Total Cost:	**$487,080**	**$146,124**	**$94,981**	**$730,000**
	8	450mm Gravity Sewer	PVC	296	Metres	$870	$257,520	$77,256	$50,216	$390,000
						Total Cost:	**$257,520**	**$77,256**	**$50,216**	**$390,000**
	5	525mm Gravity Sewer	PVC	298	Metres	$910	$271,180	$81,354	$52,880	$410,000
						Total Cost:	**$271,180**	**$81,354**	**$52,880**	**$410,000**
	9,38,39,40,42	450mm Gravity Sewer	PVC	812	Metres	$870	$706,440	$211,932	$137,756	$1,060,000
		600mm Gravity Sewer	PVC	1,562	Metres	$960	$1,499,520	$449,856	$292,406	$2,250,000
		750mm Gravity Sewer	PVC	81	Metres	$1,350	$109,350	$32,805	$21,323	$170,000
						Total Cost:	**$2,315,310**	**$694,593**	**$451,485**	**$3,480,000**
	12	600mm Gravity Sewer	PVC	253	Metres	$960	$242,880	$72,864	$47,362	$370,000
						Total Cost:	**$242,880**	**$72,864**	**$47,362**	**$370,000**
	10,16	450mm Gravity Sewer	PVC	184	Metres	$870	$160,080	$48,024	$31,216	$240,000
		600mm Gravity Sewer	PVC	372	Metres	$960	$357,120	$107,136	$69,638	$540,000
						Total Cost:	**$517,200**	**$155,160**	**$100,854**	**$780,000**
	N/A	Lift Station 1 (31 L/s)	N/A	1	Item	$700,000	$700,000	$210,000	$136,500	$1,050,000
						Total Cost:	**$700,000**	**$210,000**	**$136,500**	**$1,050,000**

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2 The total cost has been rounded up to the nearest $10,000.