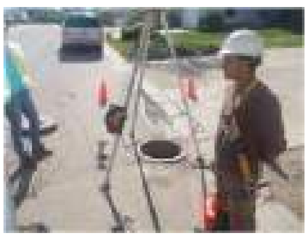
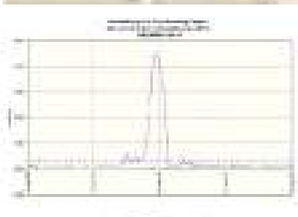
TECHNICAL MEMORANDUM B.1.5

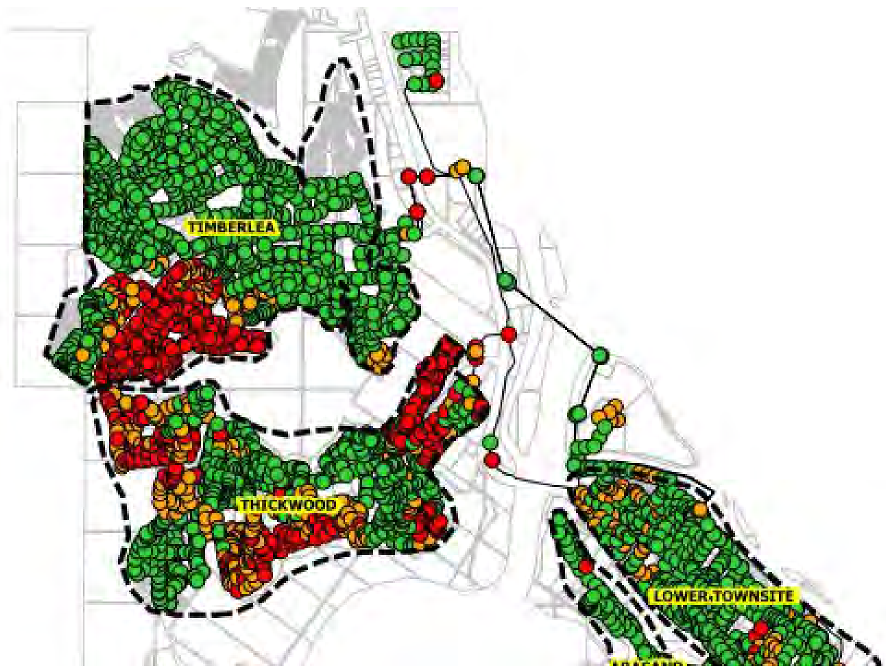
Regional Municipality of Wood Buffalo

Wastewater Collection System Master Plan

Hydraulic Model and Design Criteria Update







September 2014

Executive Summary

The Regional Municipality of Wood Buffalo (Municipality) has retained Associated Engineering (AE) to develop a Waste Water Master Plan to allow for the strategic planning and operation of the wastewater treatment, wastewater collection, and stormwater management systems. The project has included sanitary sewer flow monitoring in 2011, 2012, and 2013 to provide the data required to review, analyse, and update the results of the 2009 Sanitary Master Plan model.

This report summarizes the results of the three years of the flow monitoring program and applies the knowledge gained to update and calibrate the model to current conditions and to develop design criteria to be used in the sanitary collection system analysis.

The Municipality has extensively upgraded its sanitary sewer system since 2009 to implement many of the recommendations of the 2009 Master Plan. Updating the model involved the following:

- Adding the new sewer lines constructed since 2009 to the model and the supporting GIS data base.
- Replacing pump curves for each pump station based on field measurements of their capacity, and updating Lift Stations 1A and 1B and the Cornwall Lift Station, which have recently been upgraded.
- Adding new development areas developed since 2009 (primarily in Timberlea).
- Updating the sewershed data in the GIS data base and the model using a consistent methodology to document the model parameters and provide a reliable data base to support future model activities.

Model parameters were reviewed and refined using the latest 2013 flow and rainfall monitor data. Inflow/Infiltration rates were increased in Timberlea and Thickwood to better represent the recorded flows. Model validation testing confirmed that the re-calibrated model represents the dry-weather and wet-weather flows reasonably well and that it is a reliable tool for assessing the system capacity and design criteria.

Comparison of the observed and simulated flows with the Municipality's design criteria indicates that the design criteria underestimate the wet-weather flows in older neighbourhoods that have weeping tiles connected to the sanitary sewer system, and slightly over-estimate the dry-weather flows. Inflow/Infiltration rates are unusually high in Timberlea, suggesting that there may be an extraneous source of stormwater inflow such as connected roof drains in this neighbourhood.

In newer areas and future development areas, the current design standards for Inflow/Infiltration provide approximately a 1:25 year service level. Considering rising property values and impacts of climate change, a higher service level might be appropriate. However, the current design criteria for dry-weather flow are conservative (high). Taken together, these factors tend to offset each other such that the Municipality's design criteria provide a reasonable estimate of design flow for the planning and design of future sanitary sewer drainage systems, and no change in the design criteria is proposed at this time.

AE proposes to complete the system assessment using the calibrated model parameters and the 1:25 year return period, 4-hour duration, design storm. Model parameters for existing development areas are documented in Tables 4-2 to 4-4. Proposed model parameters for new development areas are as follows:

- Average Dry-weather flow — 300 L/capita/day – Residential; 0.20 L/s/ha – Industrial and Commercial (single storey)
- Peaking Factor — Modified Harmon's Equation Peaking Factor $= 1 + 8/(4+P^{1/2})$
- Inflow/Infiltration — 0.38 L/s/ha gross (water-tight sag manholes)
- Pipe Capacity — Minimum 1.2 x design flow

AE recommends that the Municipality:

- Implement an Inflow/Infiltration reduction program in existing neighbourhoods to increase the service level to a 1:100 year storm.
- Search for and eliminate any extraneous sources of Inflow/Infiltration in the Timberlea neighbourhood.
- Conduct additional flow monitoring to confirm the design flows in Timberlea and Dickensfield and to confirm the design flow parameters in new development areas over time.
- Incorporate the future development areas and populations summarized in the "Urban Development Sub-Region Population Projections" (Associated Engineering, December 2013), to maintain a consistent approach to planning.

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1 Introduction

Associated Engineering (AE) has been involved in a number of long term planning projects with the Regional Municipality of Wood Buffalo (the Municipality). These include a Waste Water Master Plan to allow for the strategic planning and operation of the wastewater treatment, wastewater collection, and stormwater management system.

The current Wastewater Master Plan project includes the following tasks:

- Task A Wastewater Treatment Master Plan
- Task B Wastewater Collection System Master Plan
- Task C Stormwater Management Master Plan
- Task D Asset Management Capital Plan
- Task E Wastewater Green Initiatives Framework

This Technical Memorandum is part of Task B.1.5, the sanitary sewer hydraulic model and design criteria update.

The objective of this Technical Memorandum is to:

- Establish an updated, calibrated hydraulic model of the existing sanitary sewer collection system for the Urban Service Area.
- Review current municipal design criteria regarding dry weather and wet weather flow conditions for modelling of existing and new development areas.

All of the information presented in this Technical Memorandum will be applied in the final modeling and preparation of upgrade plans and future system expansion plans for the Municipality, under Task B.2.5 of the overall Waste Water Master Plan project.

2 Background

A wastewater collection system master plan was completed in 2009 for the Municipality titled "Urban Service Area Wastewater Master Plan" (Master Plan) (Stantec, 2009). Since that report, there have been several complaints related to sanitary sewer backup and basement flooding from residents, especially in the Timberlea neighbourhood, which led to a number of studies and assessments throughout the Municipality to identify solutions to deficiencies in the system. These were not previously identified in the 2009 Master Plan.

In 2011, the Municipality initiated a three-year flow monitoring program to collect data required to review, analyse, and update the results of the 2009 Master Plan model. The first year of the flow monitoring program ran from May 2011 to October 2011 and collected data at 12 flow meters and 4 rain gauges shown in Figure 2-1. Initial calibration of the model was conducted based on the first year's flow and rainfall monitoring data and identified significant variations in inflow and infiltration (I/I) from the 2009 Master Plan, especially in the Timberlea area, that had not previously been recognized.

The second year of the flow monitoring program was refined and ran from May 2012 to October 2012, collecting data at 13 flow meters and 4 rain gauges. Locations are shown in Figure 2.2. Eight flow meters and four rain gauges were located at the same sites as in 2011. Three new flow meters were added in Timberlea to help quantify the I/I rates in this neighbourhood, and one flow meter was added in Dickensfield. Gauge 9, in Thickwood, was relocated to a better site upstream of a major flow split. In addition, 7 sump pump meters were installed to measure flows generated by house weeping tiles.

The additional data allowed for further refinement of the calibration and the wet weather flow parameters in the hydraulic model. The flow meter data confirmed the high I/I rates in Timberlea, and the sump pump meter data confirmed that most of the I/I is contributed by house weeping tiles. The three new flow meters confirmed that peak groundwater flow rates were relatively low and not a major contributor to peak flows, although the total volume of groundwater flow could be significant.

Based on the calibrated version of the 2009 Master Plan model, AE was able to provide significant input to major infrastructure projects including:

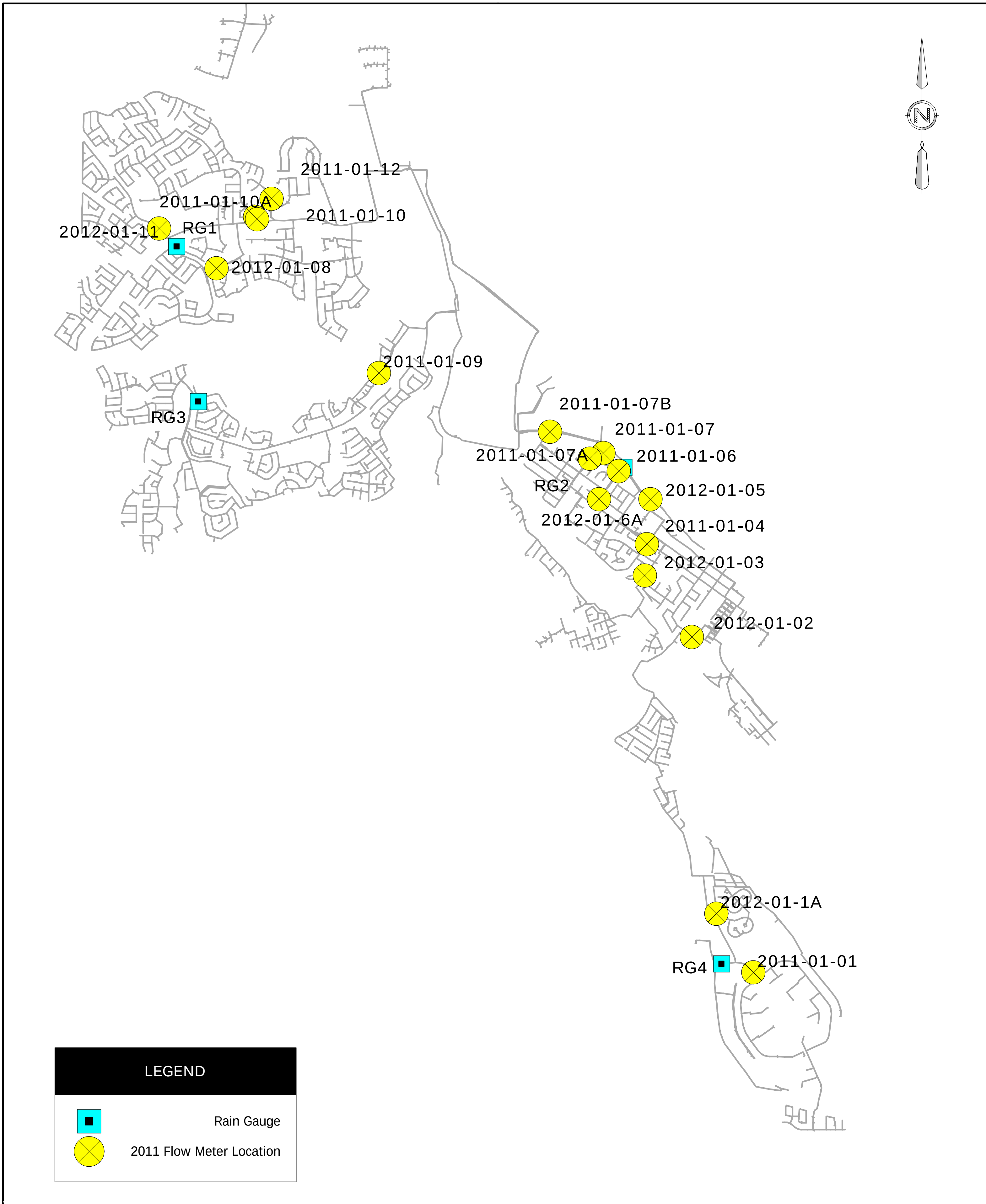
- Timberlea Sanitary Sewer Hydraulic Assessment.
- Confederation Way Interceptor.
- MacKenzie Lift Station (LS) Upgrade and Diversion Assessment.
- MacKenzie Boulevard Assessment.
- MacKenzie/Gregoire Inflow and Infiltration Study.

Year 3 of the flow monitoring program continued in 2013 with the installation and operation of eleven (11) flow meters and four (4) recording rain gauges, as shown in Figure 2.3. Six (6) of the flow meters were located at the same locations as in the previous years, and four (4) were installed on branch lines in the Timberlea and Thickwood neighbourhoods to measure flows in the branch lines and help quantify the I/I in these neighbourhoods. One (1) meter (MacKenzie) was re-located a short distance downstream to a manhole with better hydraulic conditions to improve the flow measurements.

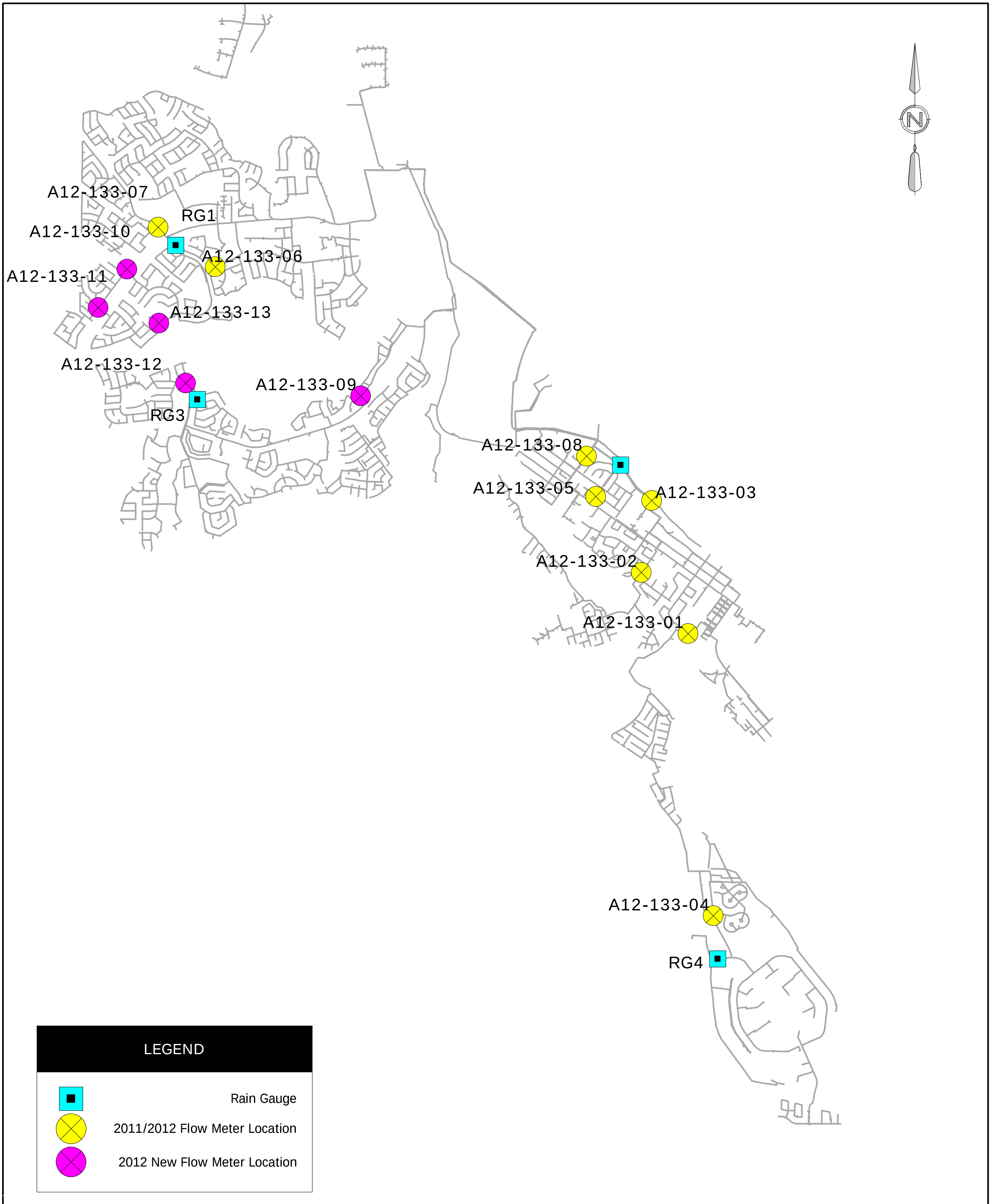
Results of the flow monitoring programs are provided in the following reports:

- 2011 Sanitary Sewer Flow Monitoring and Assessment Program, Associated Engineering, October 2012.
- 2012 Flow Monitoring Program, Associated Engineering, August 2013.
- 2013 Flow Monitoring Program, Associated Engineering, January 2013 (in preparation).

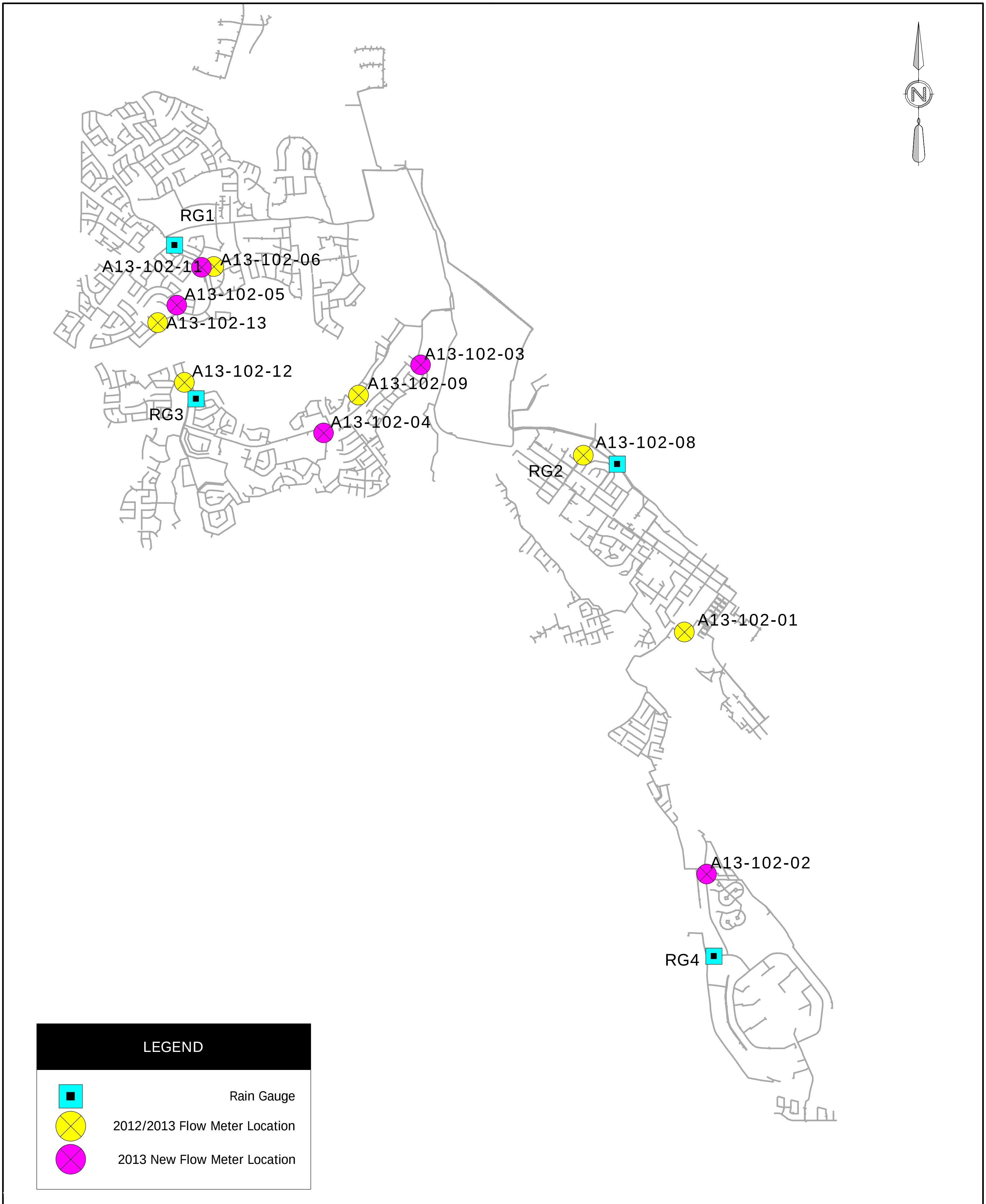
This Technical Memorandum summarizes the information learned in the previous studies and provides an updated hydraulic model for the Urban Service Area. It includes a summary of the model updates, calibration/validation in 2013, and application of this knowledge to a review of the design standards used for the existing and future sanitary sewer systems.



PREPARED BY:	PREPARED FOR:	Figure 2-1 2011 Monitor Location Plan TM B.1.5 Hydraulic Model and Design Criteria Update	PROJECT No: 201236 DATE: January 2014 SCALE:1:60,000



PREPARED BY:	PREPARED FOR:	Figure 2-2 2012 Monitor Location Plan TM B.1.5 Hydraulic Model and Design Criteria Update	PROJECT No: 201236 DATE: January 2014 SCALE:1:60,000



PREPARED BY:	PREPARED FOR:	Figure 2-3 2013 Monitor Location Plan TM B.1.5 Hydraulic Model and Design Criteria Update	PROJECT No: 201236 DATE: January 2014 SCALE:1:60,000

3 Hydraulic Model Network Update

3.1 NETWORK

The hydraulic model of the sanitary sewer system was originally developed for the 2009 Master Plan. The hydraulic model was developed using the GIS database provided by the Municipality at the time, and using as-built record plans. Where the GIS and record plans did not provide sufficient information regarding invert elevations and/or pipe diameters, assumptions had been made to complete the network set-up.

As part of the Timberlea Sanitary Sewer Assessment (Associated Engineering, 2011), a complete review of record plan and GIS information for the Timberlea neighbourhood was conducted and the model was updated to reflect the most accurate information available. A field survey of select locations was conducted to provide confirmation of sewer inverts where they could not be confirmed with record plan information.

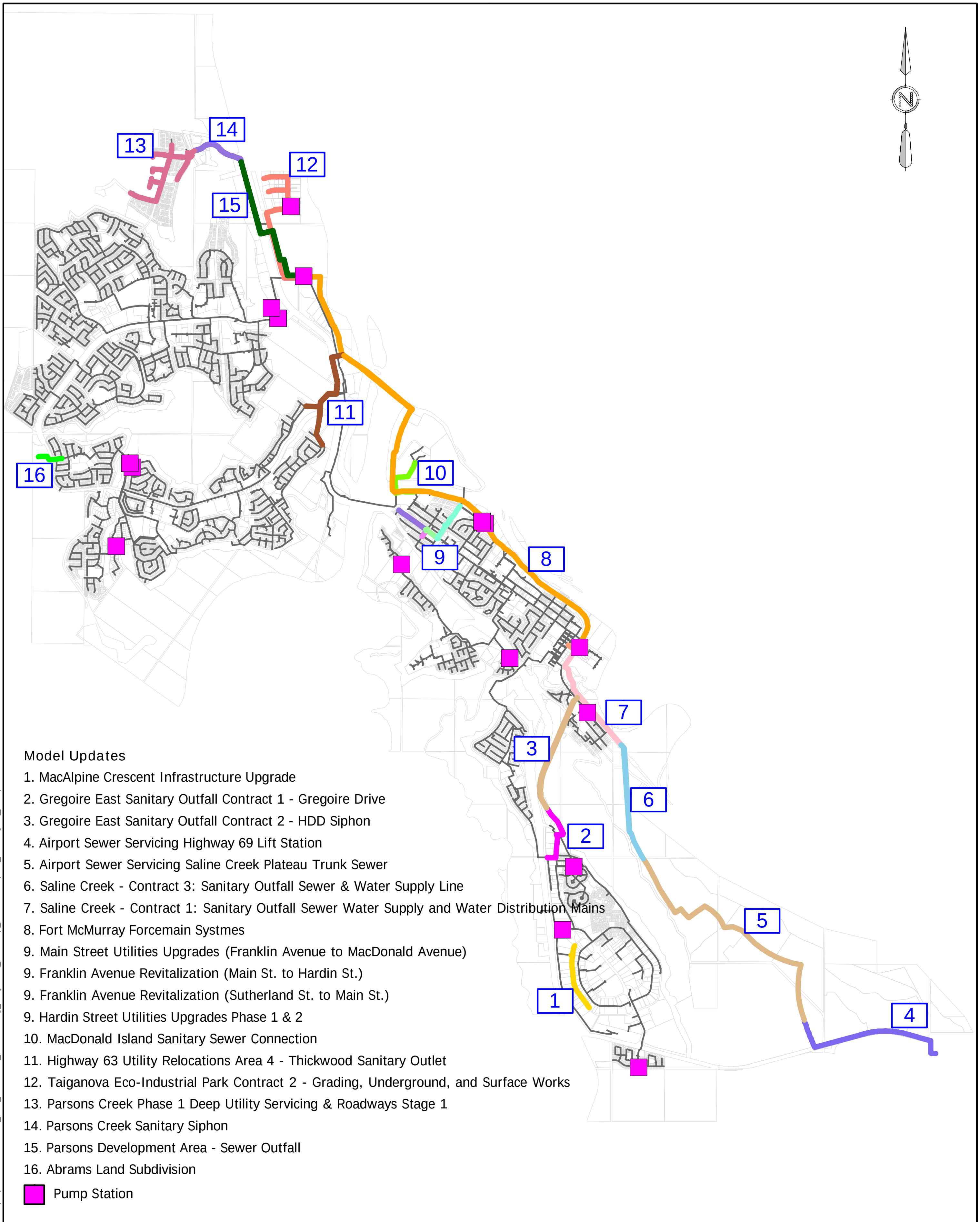
For this study, a number of recent upgrades were added to the model to reflect existing development conditions (up to year 2012). Figure 3-1 shows the upgrades that have been completed and incorporated into the model since the 2009 Master Plan study. AE used as-built record plans as the source of information to update the model.

Note that the Gregoire East Outfall has been constructed but is not in service (as of October, 2013). It was added to the model but was not connected for the calibration of existing conditions. It will be connected for all upgraded and future scenarios. Also note that the model is only as accurate as the data from which it is built and AE was not able to check or confirm every pipe. Therefore the model or GIS should not be used for design/construction purposes.

3.2 SEWERSHEDS

AE has reviewed and updated the sewershed information in the model to ensure it reflects the current land use and development conditions that are relevant to dry-weather and wet-weather flows in the sanitary sewer system. The data is recorded in GIS format to ensure that it is accessible and easily updated and that all assumptions are traceable. Final GIS files containing the catchment data will be provided to the Municipality for future use and reference.

The sewersheds were delineated using AE's in-house GIS procedures, developed specifically for stormwater and wastewater model development. The preparation of this database ensures consistent methodology for any changes that may be required in the model for future scenarios, and provides a reliable database to support the existing system model.



PREPARED BY:	PREPARED FOR:	FIGURE 3-1	PROJECT No.: 20123694
Associated Engineering	Regional Municipality of Wood Buffalo	Wastewater Master Plan Existing System Model Updates 2013 TM B.1.5 Hydraulic Model and Design Criteria Update	DATE: January 2014 SCALE: 1:75,000

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Map File: \\S-edm-fs-01\projects\20123694\02_WW_Collection_MP\Working_Dwgs\010_GIS\map_2013masterplan_workingfile_jl.map

3.3 MODEL VALIDATION

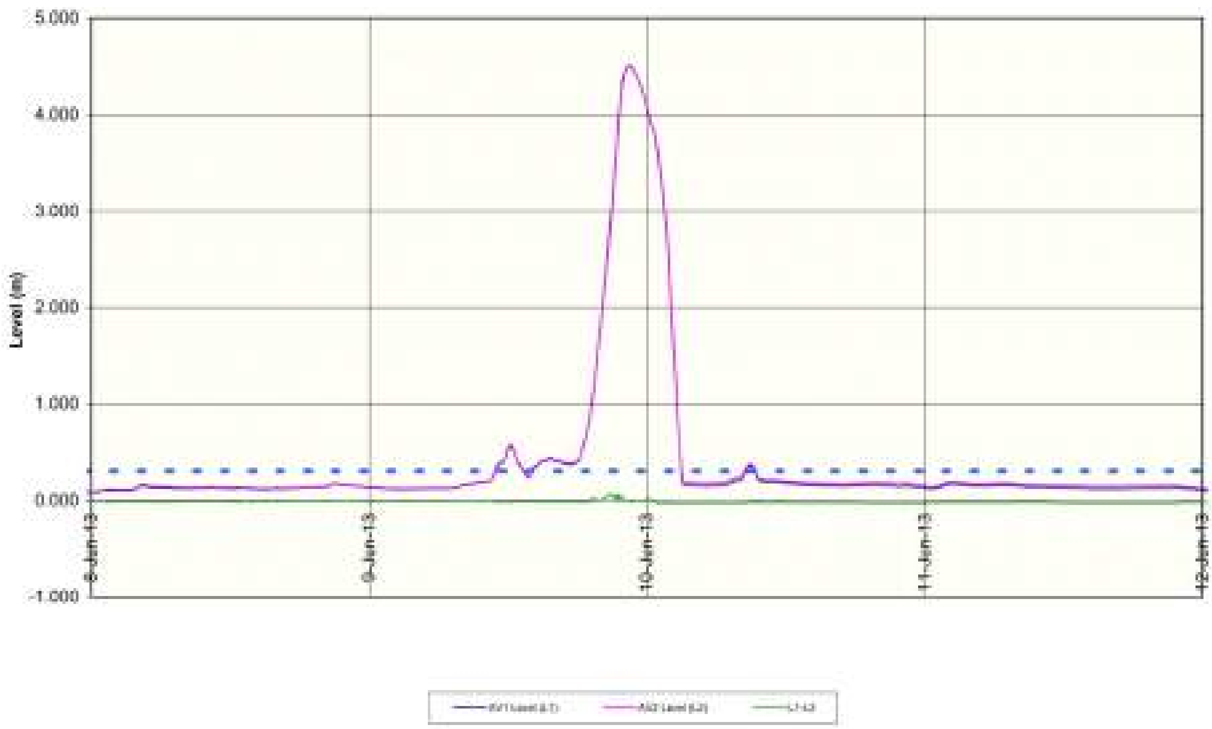
As noted above, the 2009 sanitary sewer model was calibrated using flow and rainfall data collected in 2011 and 2012. The flow monitoring program in 2013 provided additional data to confirm and refine the model parameters.

Details of the 2013 flow monitoring program are being reported separately, and key findings are summarized below.

The 2013 flow monitoring program extended from June 1 to September 30, 2013 and involved 11 flow meters and 4 rain gauges. Seven (7) significant storm events, with rainfall amounts exceeding 10 mm, occurred during the 2013 monitoring season.

The largest storm occurred on June 7-9 and had a return period of approximately 1:2 years (that is to say, it was a relatively minor event). It surcharged the sanitary trunk in Timberlea as shown in Figure 3-2. Figure 3.2 shows the monitored water levels at Gauge 13, near the St Anne School on Brett Drive downstream of Eglert Drive, and indicates surcharge to a maximum depth of at least 4.5 m. At least one basement was reported to have flooded in that event.

Figure 3-2
Monitored Water Levels in June 2013 at Timberlea Gauge 13
Brett Drive Downstream of Eglert Drive



In general, the 2013 flow monitoring program showed similar results as in the previous years (2011 and 2012) and confirmed that significant I/I rates are occurring in Timberlea and Thickwood which were developed with weeping tiles connected to the sanitary sewers. High I/I rates were also observed in the Mackenzie Industrial area in 2013 as were observed previously in 2011 and 2012. The Mackenzie I/I assessment in 2011 indicated that high I/I rates in that neighbourhood are due to sanitary manholes located in poorly graded utility lots.

The 2013 flow data were used to confirm the model calibration. Slight changes in model parameters were required except in the Thickwood area. I/I parameters were increased significantly in Thickwood to better represent peak flows based on data for four flow meters in the neighbourhood. Higher flows occur in this neighbourhood are due to weeping tiles that are connected to the sanitary sewer system.

Inconsistent results occurred in the Dickensfield area on west end of Thickwood, compared with the 2012 model calibration. This discrepancy is believed to be due to difficult site conditions that affected the accuracy of the flow data and to issues with the rain gauge at this site. The model calibration is questionable at this site, and additional flow monitoring is recommended to confirm the model calibration in this basin.

Figure 3.3 provides a comparison of simulated and observed flows at Gauge 13, located in the Timberlea neighbourhood, for the June 2013 storm event and confirms the model accuracy at this location. Figure 3.4 shows the simulated and observed flows on Timberline Drive, in the downstream end of Thickwood, using the original and re-calibrated model. It indicates a good comparison of simulated and observed flow.

Appendix A provides these and other validation plots comparing the simulated and measured flows at all gauge sites for the three storm events. These plots show that the model represents dry-weather and peak wet-weather flows reasonably well and confirm that it is a reliable tool for assessing the system capacity and design criteria.

Figure 3-3
Model Validation Timberlea Gauge 13 – Brett Drive Downstream of Eglert Drive

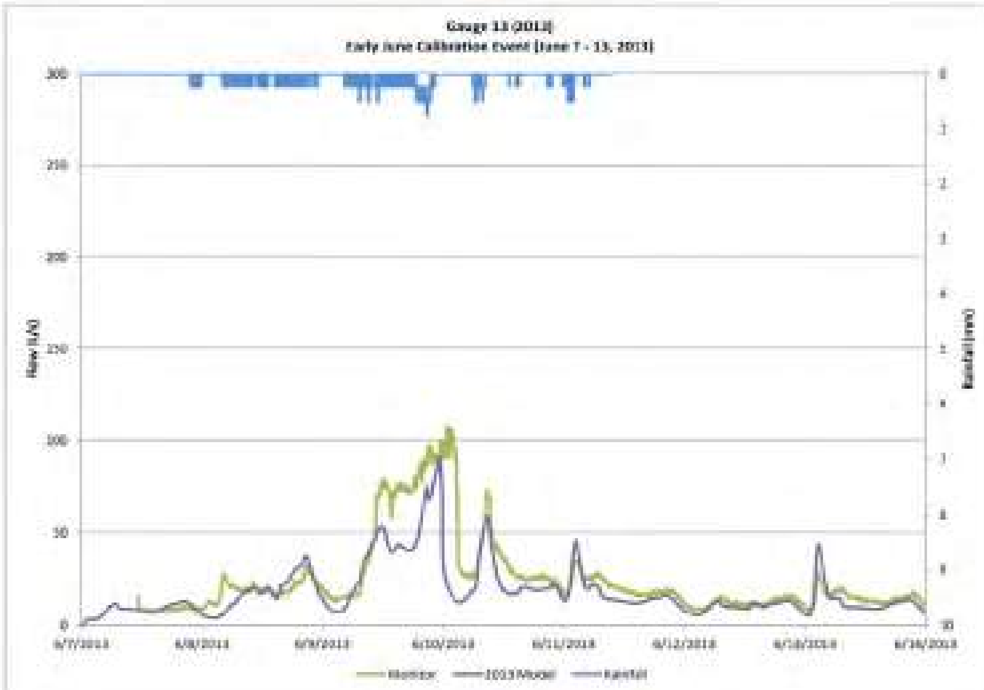
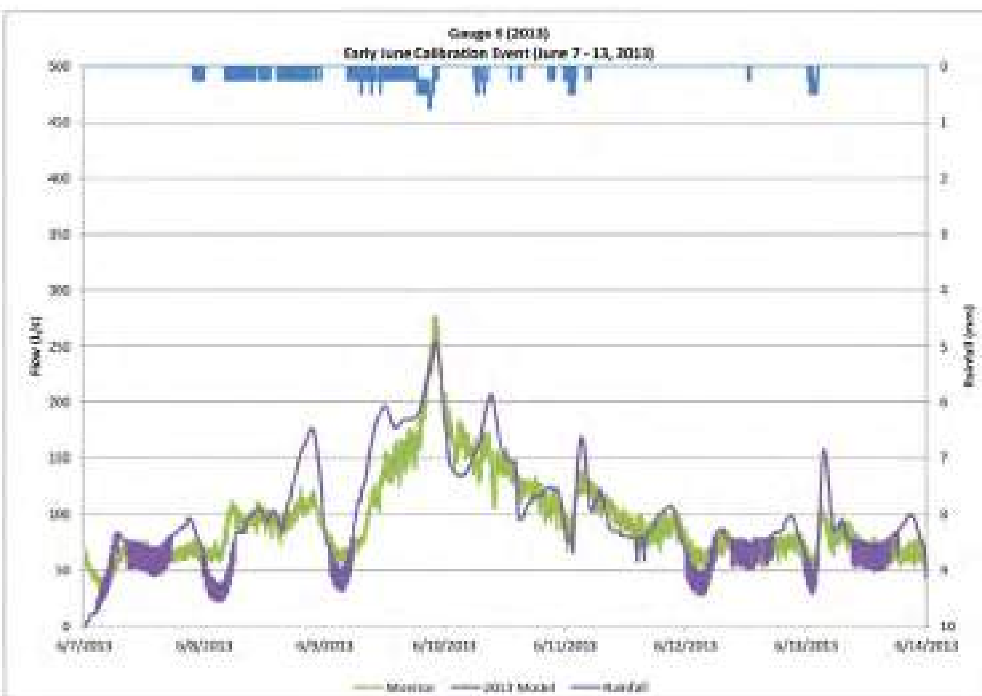


Figure 3.4
Model Validation Thickwood Gauge 9 – Timberline Drive at Rookery Bay



4 Design Criteria Review

The Regional Municipality of Wood Buffalo Engineering Servicing Standards and Development Procedures (ESS) were recently updated to provide information and to define the minimum acceptable standards for new developments to developers and other interested parties requiring knowledge of the principles governing the development of land in the Municipality.

Section 5 of that document outlines the standards pertaining to the sanitary sewer system and covers such items as design flow and pipe flow formulas, acceptable velocity, minimum pipe diameters, grades and depth of cover, manhole spacing, hydraulic losses, service conditions, and pipe materials. While a number of these parameters remain applicable over time, the flow monitoring and modelling programs identified a need to review the way design flows are being calculated. In particular, the wet-weather (I/I) flows are significantly higher in older residential areas that have weeping tiles connected to the sanitary sewer system, than the current design standards would suggest.

Assessment of existing systems is based on actual flow and involves the use of hydraulic modeling to simulate the flow within the system. The hydraulic model has been calibrated to actual rainfall events to refine the parameters associated with inflow and infiltration. Model results can be compared with the design criteria to identify areas where flows in the system are different from design assumptions, as is the case in the Municipality.

However, the parameters applicable to the existing system are based on development and construction practices that were quite different than are used today (e.g. weeping tiles were once allowed to be connected to the sanitary sewer system). These differences will need to be considered in assigning design criteria for future development areas.

AE has conducted a review of the current criteria pertaining to dry-weather and wet-weather flows and identified updates that should be implemented for assessment of existing systems and design of future systems. These design criteria will be used with future population estimates to develop design flows for the system capacity analysis.

4.1 CURRENT CRITERIA

The current design criteria pertaining to design flow calculations are summarized below. In these standards, the following definitions are used:

- The gross development area is the total area within the development boundary.
- The net development area is the gross development area minus street right-of-ways, parks, and school sites, and thus represents the total lot area within a designated land use. It is typically about 70% of the gross development area.

Population Density

Sanitary sewage systems shall be designed on the population density basis of either the ultimate subdivision design population in the Area Structure Plan or the Land Use Bylaw as follows:

- Single Family — 18 units/net ha @ 3.5 people/unit — 63 ppha (net)
- Low Density — 44 units/net ha @ 3.5 people/unit — 154 ppha (net)
- Medium Density — 148 units/net ha @ 2.5 people/unit — 370 ppha (net)
- High Density — 296 units/net ha @ 2.5 people/unit — 740 ppha (net)

If the design populations are unknown and are outside the current Area Structure Plan, then 50 persons per **gross** developable hectare for conceptual design should be used.

Commercial and Industrial design flows will be based on an equivalent population of 37 persons/**gross** ha or from specific development application details, whichever is greater.

The sewer main capacity shall be designed to convey the peak hourly sewage contribution and infiltration, without the use of holding tanks, and based on the following:

Domestic Contribution (Residential

1. Minimum average contribution of 360 litres per capita per day.
2. Peak hourly flow for each contributing area calculated at an average flow multiplied by a peaking factor:

   $$\text{Peaking Factor} = 1 + \frac{14}{(4+P^{1/2})} \quad \text{(Harmon Formula)}$$

3. Add Inflow/Infiltration

Where P = the population in thousands.
The maximum peaking factor shall be 3.5, corresponding to a serviced population of 2,650 people.

Commercial/Industrial Contributions

.1 Industrial flows – minimum average contribution of 0.20 litres per second per gross hectare or as supported by design brief.

.2 Commercial and Institutional (churches, schools, etc.) flows – minimum average contribution of 0.20 litres per second per gross hectare.

.3 For more specific Industrial, Commercial and Institutional applications Table 4-1 may be utilized unless the development has higher or specialized flow generation.

4. Peak hourly flow for each contributing area calculated at average flow multiplied by a minimum peaking factor of 3.0 to 3.5 as calculated using the Harmon Formula based on equivalent population.
5. Add Inflow/Infiltration.

Table 4-1
Commercial/Institutional and Industrial Sanitary Flow Generation Factors on the Basis of Land Use From ESS

Type of Establishment	Future Average Flow Generation L/day/m^2 of Floor Area
Office Buildings	8
Restaurants	20
Bars and Lounges	12
Hotels and Motels	14
Neighbourhood Stores	8
Department Stores	8
Shopping Centres	4
Laundries and Dry Cleaning	41
Banks and Financial Buildings	12
Medical Buildings and Clinics	12
Warehouses	4
Meat and Food Processing Plants	115
Car Washes	77
Service Stations	8
Auto Dealers, Repair and Service	6
Super Market	8
Trade Businesses-Plumbers, Exterminators, etc.	8
Mobile Home Dealer, Lumber Co., Drive-In Movies, Flea Market	7
Places of Assembly – Churches, Schools, Libraries, Theatres	24
Factories – Manufacturing raw products into finished products	33
Hospitals	1700 L/bed/day

Note that the flow generation rates in Table 4-1 range from 4.0 L/d/m^2 of flow area (shopping centres and warehouses) to a high of 115 L/d/m^2 of floor area for meat and food processing plants. The high value corresponds to approximately 575 m^3 per hectare, assuming a single-storey plant and 50% site coverage, which is 25 times the design flow rate for a typical single family residential neighbourhood. Industrial area flow rates are highly variable and depend on the specific type of industrial activity which is often unknown at the planning stage; therefore a conservative value is required.

Infiltration

.1 Roof leaders and weeping tiles shall not be connected to the sanitary sewer system. In existing areas where weeping tiles are connected to the sanitary system, a minimum allowance for weeping tile contribution of 0.6 litres per second per **gross** hectare shall be provided, subject to site-specific flow monitoring.

.2 The sanitary sewer and manhole system shall be water-tight. However, an infiltration allowance of 0.28 litres per second per **gross** hectare shall be expected.

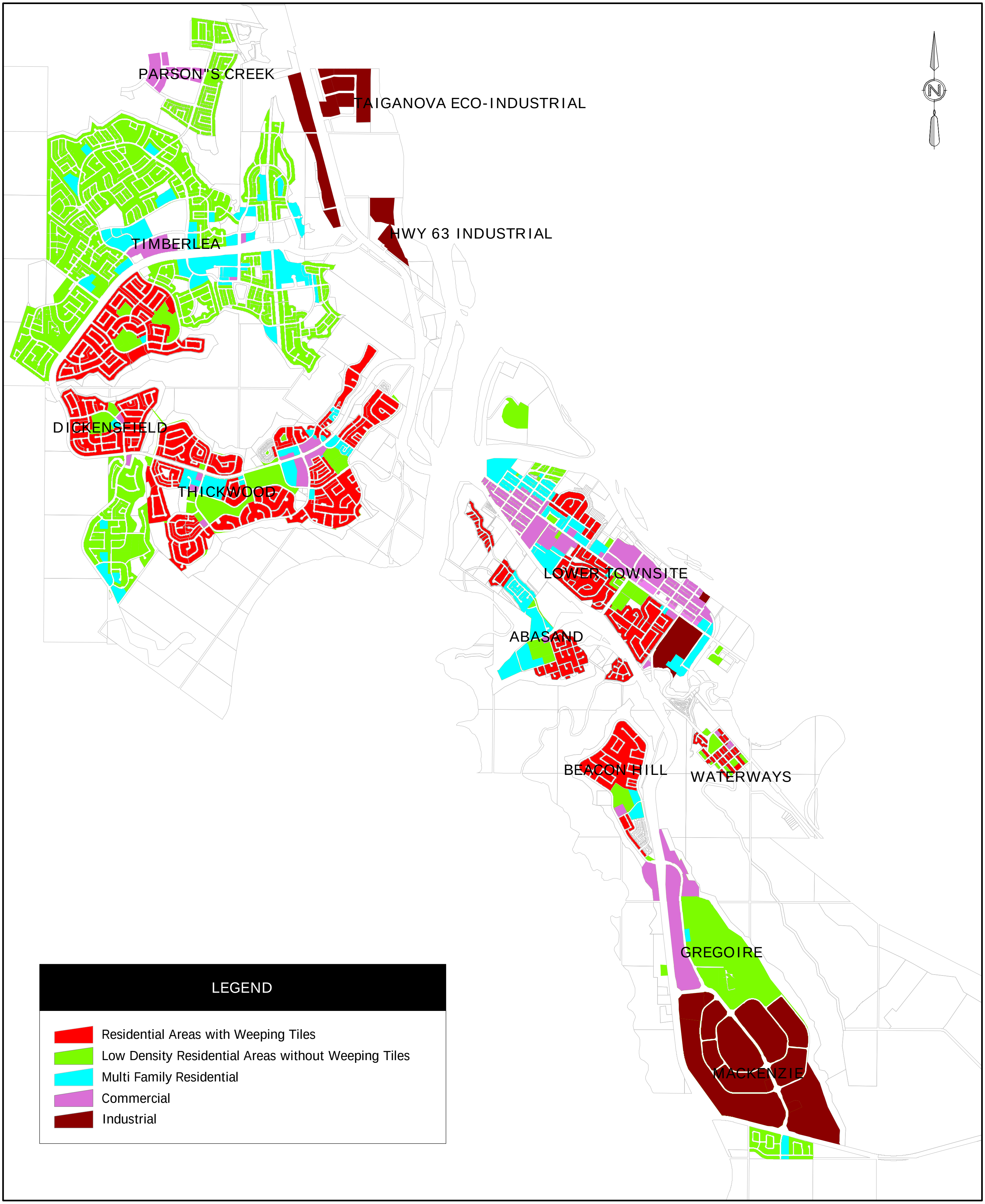
.3 Any manholes located in “sags” (low areas subject to inundation during major rainfall events) are subject to an additional allowance of 0.4 litres per second per manhole.

In general, Items 1 and 2 above indicate that for I/I contributions:

- Newer areas without weeping tile connected to the sanitary sewer system should be designed for a minimum of 0.28 L/s/ha, assuming no sanitary manholes are located in street sags.
- Older areas with weeping tiles connected to the sanitary sewer system should be designed for a base I/I rate of 0.28 L/s/ha plus weeping tile flow of 0.6 L/s/ha plus sag manhole inflow of 0.04 L/s/ha, assuming 1 sag manhole per hectare of gross development area, for a total I/I flow of 0.92 L/s/ha.

For reference, Figure 4-1 illustrates the areas that have weeping tiles connected to the sanitary sewer system in the Municipality. The areas were identified based on the following assumptions:

- Residential Development constructed prior to the year 2000 have weeping tiles connected to the sanitary sewer system. After 2000, the Municipality implemented a bylaw that made connecting weeping tiles to the sanitary sewer system illegal.
- Residential Development that is considered to have weeping tiles includes the following zoning descriptions:
  - Low Density Residential.
  - Mixed Form Single Detached Residential.
  - Single Detached Residential.
  - Single Family Small Lot Residential.
- Medium Density, High Density, and Manufactured Home developments are considered to not have weeping tiles.
- Commercial, Institutional and Industrial developments are considered to not have weeping tiles.



Project Number: 20123694
Universal Transverse Mercator - Zone 12
Date: 1/10/2014
Scale: 1:60,000

Associated Engineering

Regional Municipality of Wood Buffalo

FIGURE 4-1
Wastewater Master Plan
Areas With Weeping Tiles Connected to Sanitary Sewer System

4.2 CALIBRATED MODEL FLOWS

The sanitary sewer model was calibrated using three (3) years of flow monitoring data, collected between May, 2011 and October, 2013. Nine rainfall events between 2011 and 2013 were simulated using the hydraulic model and the results were compared to the flow monitor data collected during those rainfall events. The model parameters were adjusted as required to match the monitor data.

4.2.1 Dry-Weather Flow (DWF)

Table 4-2 provides the total simulated DWF generated for each residential neighbourhood. Based on the available population data, Table 4-2 also gives the calculated average per capita DWF generation rate per neighbourhood. Note that the average per-capita flow generation rate is 300 L/c/d which is approximately 83% of the current design standard. This suggests that the current design standard for average dry-weather flow may be slightly conservative.

Table 4-3 provides the total generated DWF for the Mackenzie neighbourhood and the portion of the LTS that is non-residential. The generation rate for these areas is based on contributing area instead of population. Note that these data indicates the design flow of 0.20 L/s/ha (gross) for industrial areas may be conservative; however, the industrial area flows can vary widely and therefore a conservative value is appropriate, and no change is proposed.

For business/commercial areas, the calibrated model data indicates the current standard of 0.20 L/s/ha may be too low for the Lower Townsite which contains a number of multi-storey buildings. High groundwater tables could also be a factor. The minimum design flow of 0.20 L/s/ha is meant for single storey development and should be increased for multi-storey development using the floor area factors in Table 4-1.

Table 4-2
Residential Dry-Weather Flow

Neighbourhood	Population 2012 Census	Calibrated Average DWF Generation Rate (L/cap/day)
Timberlea	33,500	300
Thickwood Heights	17,500	300
Lower Townsite (Residential)	10,800	300
Abasand Heights	5,239	300
Beacon Hill	2,193	300
Waterways	726	300
Gregoire/Prairie Creek (Excluding MacKenzie Industrial)	4,053+	300
Average Generation Rate	74,709	300

Table 4-3
Non-Residential Dry-Weather Flow

Neighbourhood	Calibrated DWF (L/s)	Net Contributing Area (ha)	Average DWF Generation Rate (L/s/ha)
Lower Townsite (Non-Residential)	73	169	0.6
MacKenzie	14	266	0.10

4.2.2 Peaking Factor

In the current standard, dry-weather flow peaking factors are calculated using Harmon's Equation, which has often been found in various studies to be conservative.

Figure 4.2 shows the diurnal curves used in the calibrated model of the existing system, based on flow monitor data. The data indicate a peak flow of approximately 1.6 for residential areas, and 1.3 for commercial/industrial areas. More conservative values should be considered to allow for the possibility of higher flows than occurred during the monitoring program.

Figure 4-2
Diurnal Curves Used in the Calibrated Model of the Existing System

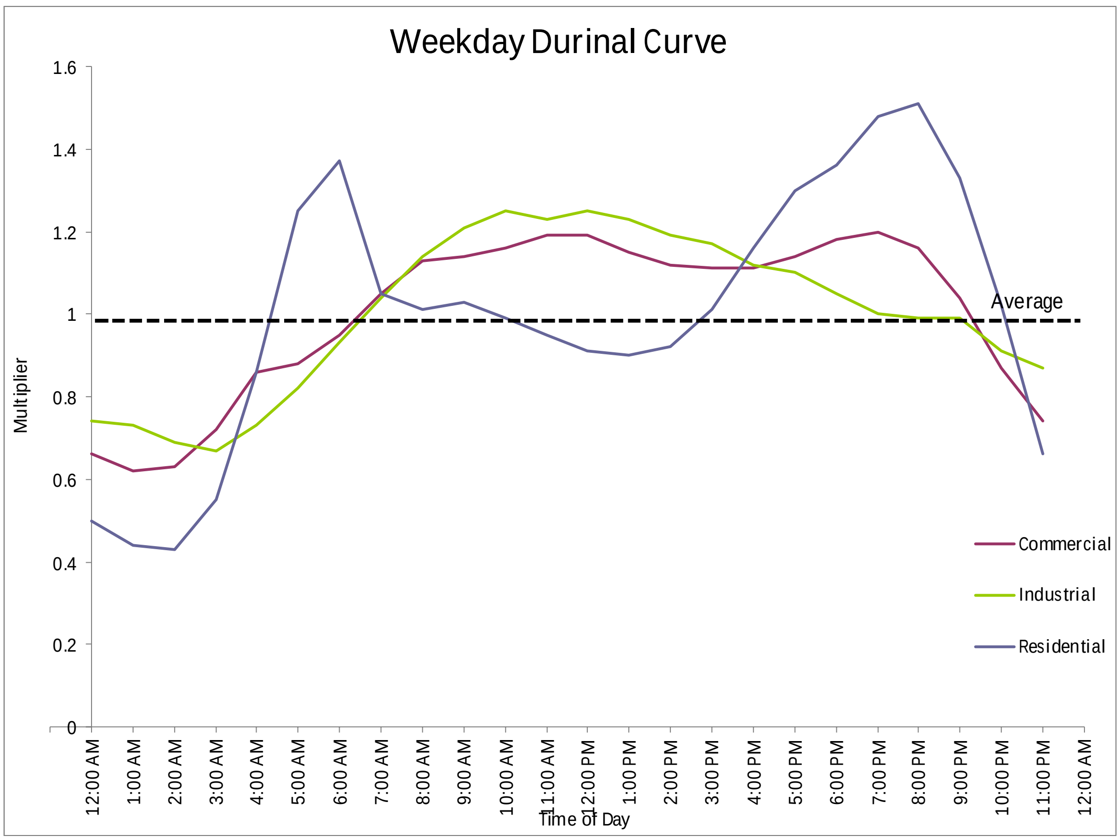
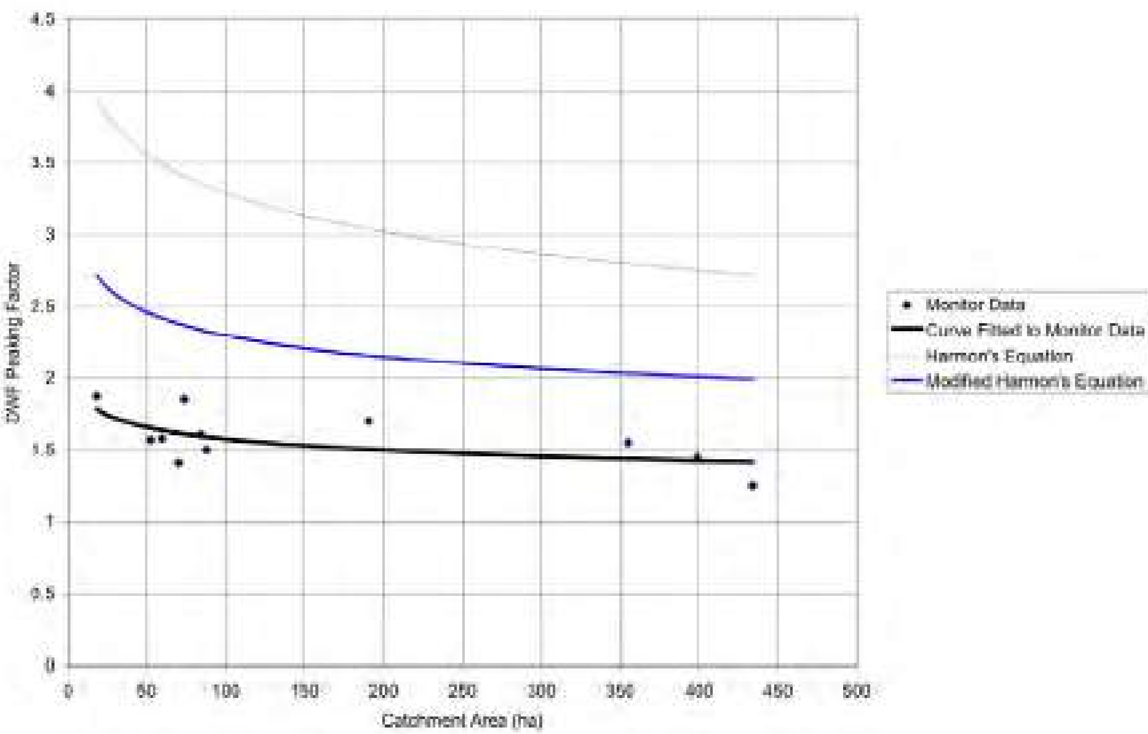


Figure 4.3 shows the relationship between peaking factor and catchment area derived from the flow monitor data compared with the design values calculated using Harmon's Equation. As shown in this graph, Harmon's values are considerably higher than were actually monitored. Therefore, a revised form of Harmon's Equation is proposed as follows, with the coefficient of 14 replaced with a value of 8:

Peaking Factor = $1 + 8/(4+P^{1/2})$ (Modified Harmon Formula)

Figure 4-3
Relationship Between Peaking Factor and Catchment Area



4.2.3 Inflow/Infiltration (I/I)

Table 4-4 provides a summary of the calibrated model parameters for wet-weather flow, the percent I/I based on land use and the predicted I/I rates for a 1:25-year design storm and 1:100 year event for various areas within the Municipality. The I/I model uses three parameters to describe the inflow/infiltration process:

- R is a runoff coefficient that represents the proportion of rainfall that is expressed as runoff; values of 0.01 to 0.1, representing 1% to 10% runoff, are typical depending on local conditions, but higher values occur in Timberlea.
- T is the time delay between the start of the storm and the peak flow and represents the response time of the watershed; values of 0.5 to 2 hours are typical.
- K is the ratio of the recession time of the runoff hydrograph to the rise time and is a measure of the "peakiness" of the runoff response to rainfall.

The I/I model simulates slow, medium and fast-acting components of the runoff hydrograph and combines these into the total I/I inflow. The total percentage of rainfall volume in Table 4-4 represents this total flow volume.

Note that the I/I volume ranges from 1% of rainfall in newer areas to a value of 4 to 18% in older areas that have weeping tiles connected to the sanitary sewers. The value of 18% in Timberlea is unusually high and suggests that there may be sources of extraneous stormwater inflow in this neighbourhood, potentially connected roof drains or cross-connections to the storm sewer system. In other municipalities that AE has monitored, older residential areas typically generate about 10% runoff and peak flows of about 2.5-3 L/s/ha of I/I in a 1:25 year storm.

The current design standards specify a design wet-weather flow rate of 0.88 L/s/ha plus sag inflow for older areas having street sags and weeping tiles connected to the sanitary sewers, and 0.28 L/s/ha for newer areas without weeping tile connections or street sags. Note that the design value of 0.28 L/s/ha for areas without weeping tiles closely matches the value of 0.27 L/s/ha simulated with the model in the 1:25 year storm. However, the I/I rates are substantially higher in older residential areas (Timberlea and Thickwood) than the ESS would indicate. Therefore, the system assessment should be based on the calibrated model flows.

Current standards are somewhat ambiguous on the issue of roof leader connections and seem to imply that these would be allowed. The ESS states "Roof leaders and building foundation drains shall not be connected to the sanitary sewer system. In existing areas where roof leaders and weeping tile are connected to the sanitary system, a minimum allowance for weeping tile contribution of 0.6 L/s per gross hectare shall be provided, subject to site-specific flow monitoring".

Under no circumstances should roof leaders be connected to the sanitary sewer, either in existing or new development areas as they can generate significant flows in even a minor storm event. It is possible that some roof leaders are currently connected, and these could account for the higher flows experienced in Timberlea. If these connections exist they should be eliminated.

Table 4-4
Calibrated Wet-Weather Flow Parameters Based on Land Use

Land Use Description	Term	R	T (hours)	K (hours)	Total Percentage of Rainfall Volume (%)	4 Hour Storm	
						1:25 Year Storm I/I Rate (L/s/ha)	1:100 Year Storm I/I Rate (L/s/ha)
Timberlea - Residential with Weeping Tiles	Short Term	0.03	1	5	18	4.7	6.0
	Medium Term	0.10	0.5	5			
	Long Term	0.05	10	5			
Thickwood - Residential with Weeping Tiles	Short Term	0.01	1	5	10	2.7	3.3
	Medium Term	0.06	0.5	5			
	Long Term	0.03	10	5			
LTS/Abasand - Residential with Weeping Tiles	Short Term	0.01	1	5	4	1.0	1.3
	Medium Term	0.02	0.5	5			
	Long Term	0.01	10	5			
Newer areas of Timberlea - Residential without Weeping Tiles	Short Term	0.01	1	5	1	0.27	0.32
	Medium Term	0	0	0			
	Long Term	0	0	0			
MacKenzie - Commercial/ Industrial	Short Term	0.03	1	5	3	0.73	0.93
	Medium Term	0	0	0			
	Long Term	0	0	0			
Downtown - Business/ Commercial	Short Term	0.01	1	5	1	0.27	0.31
	Medium Term	0	0	0			
	Long Term	0	0	0			

4.2.4 Level of Service

It is important to understand the level of service provided by the existing infrastructure as well as the intended level of service to be provided by future design. In sanitary sewer systems, the amount of I/I in the system is related to rainfall. Currently, the ESS Procedures specify a design flow but do not consider the level of service actually provided or correlate the design parameters to a specific design storm event.

Current design standards for new areas without weeping tile connections, specify a design flow of 0.28 L/s/ha plus an additional allowance for manholes located in street sags.

The monitor and model data summarized in Table 4.4 indicate that areas without weeping tile connections can generate approximately 0.28 L/s/ha in a 1:25 year storm and 0.32 L/s/ha in a 1:100 year storm. This implies that the current standard provides approximately a 1:25 year level of service.

The Inflow/Infiltration allowance should be increased to 0.32 L/s/ha and manholes within sag areas be prohibited or sealed to provide a 1:100 year level of service.

For existing areas, AE recommends that the system be upgraded to provide capacity for the 1:25 year storm and that an I/I reduction program be undertaken to provide an increased level of service to 1:100 years. This would require a 25% reduction in I/I which could be achieved through sealing manholes, extending roof downspouts, and eliminating any extraneous connections such as roof leaders and connected catch basins.

4.2.5 Climate Change

With climate change affecting the patterns of rainfall across the globe, heavy rainfall events may become more frequent. The current opinion of the scientific community is that the magnitude of extreme rainfalls will increase by about 10 to 20%. On this basis, it would be prudent to include an additional safety factor of 20% in the design storm rainfall and I/I to account for the potential effects of climate change, which would increase the peak Inflow/Infiltration allowance to 0.38 L/s/ha.

4.2.6 Pipe Capacity

The Municipality’s current design standards specify the pipe capacity be based on the pipe flowing full. Some municipalities such as Edmonton specify that the design flow be achieved with the pipe flowing part-full, which has the effect of adding a small factor of safety to the pipe design. Alberta Environment’s Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, March 2013, specify that the pipe capacity be based on 80% of depth, corresponding to a flow capacity equal to 86% of the theoretical pipefull capacity. AE proposes a safety factor (ratio of pipefull capacity to design peak design flow) equal to 1.2, which yields total design capacities that are comparable with existing standards (see below) and slightly more conservative than Alberta Environment’s design criteria (proposed capacity is 1.2 times peak flow vs 1.16 with Environment’s criteria and is essentially the same).

4.2.7 Recommended Design Criteria

The following is a summary of the revised design criteria for calculating peak flows in a sanitary sewer system for modelling of new development areas:

- Average Dry-weather flow — 300 L/capita/day – Residential
  0.20 L/s/ha – Industrial and Commercial (single storey)

- Peaking Factor — Modified Harmon's Equation Peaking Factor = 1 + 8/(4+P1/2)
- Inflow/Infiltration — 0.38 L/s/ha gross (water-tight sag manholes)
- Pipe Capacity — Minimum 1.2 x design flow

Table 4.5 compares the current estimate of design flows for a typical residential subdivision of 100 hectares compared with the Municipality's current Servicing Standards.

Table 4-5
Comparison of Design Criteria

Item	Measurement	Servicing Standard	Current Estimate
Gross Area	ha	100	100
Net Area	ha	70	70
Population Density	per net hectare	63	63
Population	people	4410	4410
Average DWF	L/c/day	360	300
	L/s	18.38	15.31
Peak Factor		3.30	2.31
Peak DWF	L/s	60.55	35.39
Inflow/Infiltration	L/s/ha	0.28	0.38
	L/s	28.0	38.0
Total Flow	L/s	88.55	73.39
Pipe Capacity Factor		1	1.20
Pipe Design Flow	L/s	88.5	88.0
	L/s/ha	0.89	0.88

This analysis demonstrates that the pipe design flow for new development areas, calculated with the current model parameters, will be comparable to those computed with the Municipality's Servicing Standards. The decrease in dry-weather flow is offset by higher inflow/infiltration rates; therefore, no change to the Servicing Standards is required.

For calculating design flows in existing development, the calibrated flow values flows summarized in Tables 4.2, 4.3, and 4.4 and peaking factors summarized in Figure 4.1 should be used.

5 Conclusions

- The hydraulic model of the Fort McMurray sanitary sewer collection system has been calibrated based on three year of flow data and currently reflects the development conditions as of early 2013.
- Inflow/Infiltration rates are somewhat higher in Timberlea and Thickwood than were previously thought, and required an increase in I/I parameters in these two areas based on 2013 flow data.
- Inflow/Infiltration rates are unusually high in the Timberlea neighbourhood and suggest that extraneous source of stormwater runoff such as connected roof drains may exist in this neighbourhood.
- Peak flows in existing development areas, where weeping tiles are connected to the sanitary sewer system, are considerably higher than the Municipality's design standards would indicate (in the absence of flow monitor data such as has been compiled in the flow monitoring program).
- In new development areas, where weeping tiles are not connected to the sanitary sewer system, the Municipality's current I/I design standard provides a service level of approximately 1:25 years. The design values for dry-weather flow are somewhat conservative and design values for Inflow/Infiltration are too low. Taken together, these factors are offsetting such that the Municipality's Servicing Standards provide a reasonable estimate of the total flow to be used in design of new sanitary sewer systems. Therefore, no change in the Servicing Standards is required.

6 Recommendations

- Use the updated, calibrated model developed in this project for assessment of the existing sanitary sewer collection system and evaluation of upgrade requirements.
- Design upgrades in existing neighbourhoods to provide a 1:25 year service level and implement an Inflow/Infiltration reduction program to increase the service level to a 1:100 year storm.
- Search for and eliminate any extraneous sources of Inflow/Infiltration in the Timberlea neighbourhood.
- For assessment of existing development areas, use the actual flow values based on monitoring and model calibration as summarized in Tables 4-2 to 4-4. Generally, these values result in larger flows than the design criteria would indicate.
- For modelling of future development areas, use the model parameters based on actual flows as summarized below. Generally, these parameters will produce similar end results (pipe sizes and design flows) as the standard values provided in the Municipality's Servicing Standards.
  - Average Dry-weather flow: 300 L/capita/day – Residential
0.20 L/s/ha – Industrial and Commercial (single storey)
  - Peaking Factor: Modified Harmon's Equation Peaking Factor
= 1 + 8/(4+P1/2)
  - Inflow/Infiltration: 0.38 L/s/ha gross (water-tight sag manholes)
  - Pipe Capacity: Minimum 1.2 x design flow

- Incorporate the future development areas and populations summarized in the "Urban Development Sub-Region Population Projections" (Associated Engineering, December 2013), to maintain a consistent approach to planning.
- Conduct additional flow monitoring to verify flow rates in the Dickensfield neighbourhood and to verify the Inflow/Infiltration reduction proposed for the Timberlea and Mackenzie neighbourhoods.
- Continue flow monitoring in a baseline program to confirm design standards over a longer term.

Closure

This report was prepared for the Regional Municipality of Wood Buffalo to summarize the results of the three years of the flow monitoring program, to update and calibrate the model to current conditions, and to develop design criteria to be used in the sanitary collection system analysis.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.

PROFESSIONAL ENGINEER
LARRY E. BODNARUK
ALBERTA

Sept. 25, 2014

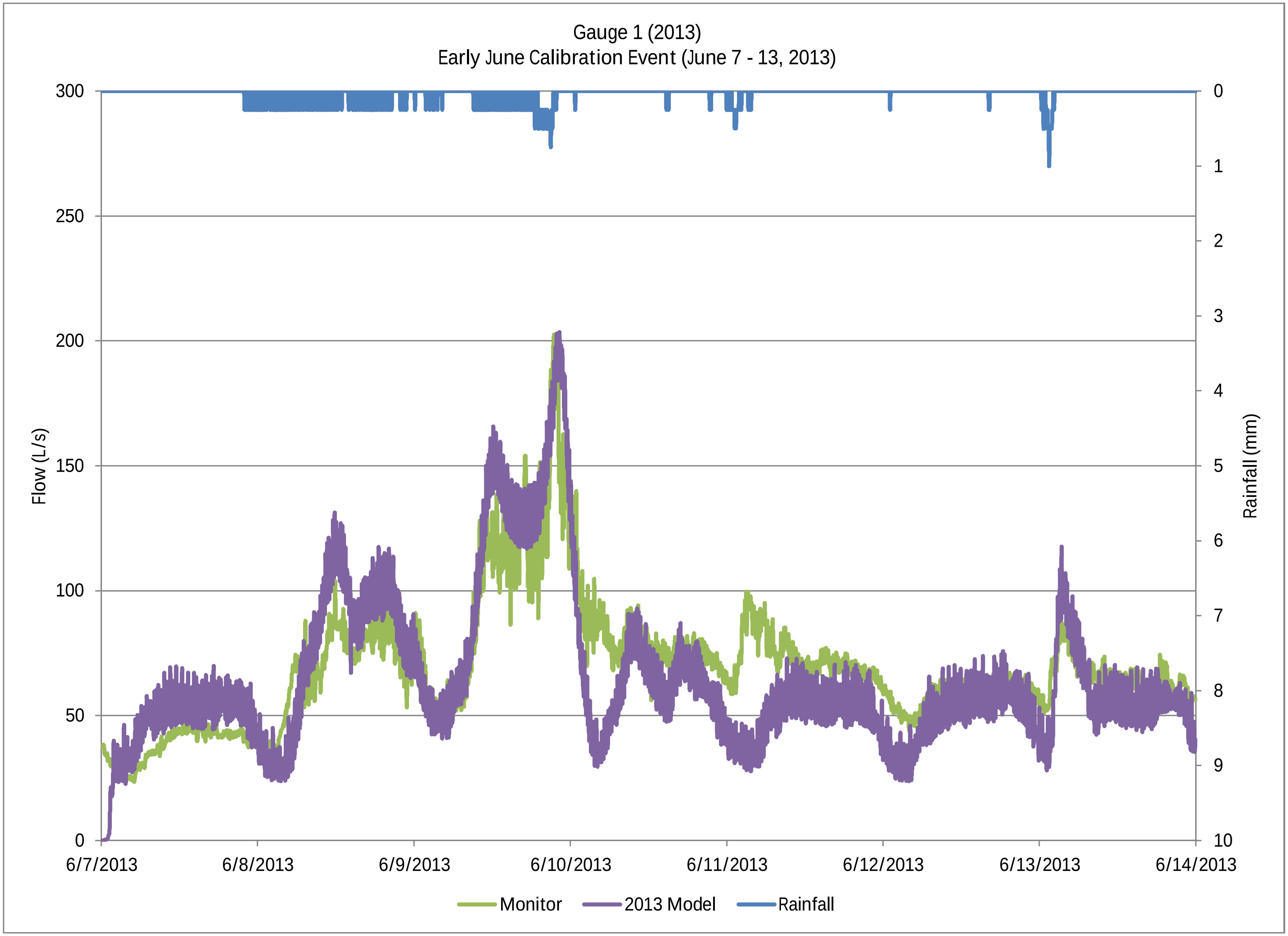
Larry Bodnaruk, P. Eng.
Project Manager

For Tara Sherman, P.Eng.
Water Resources Engineer

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: Sept. 26, 2014

APEGA Permit to Practice P 3979

Appendix A – 2013 Model Validation Plots



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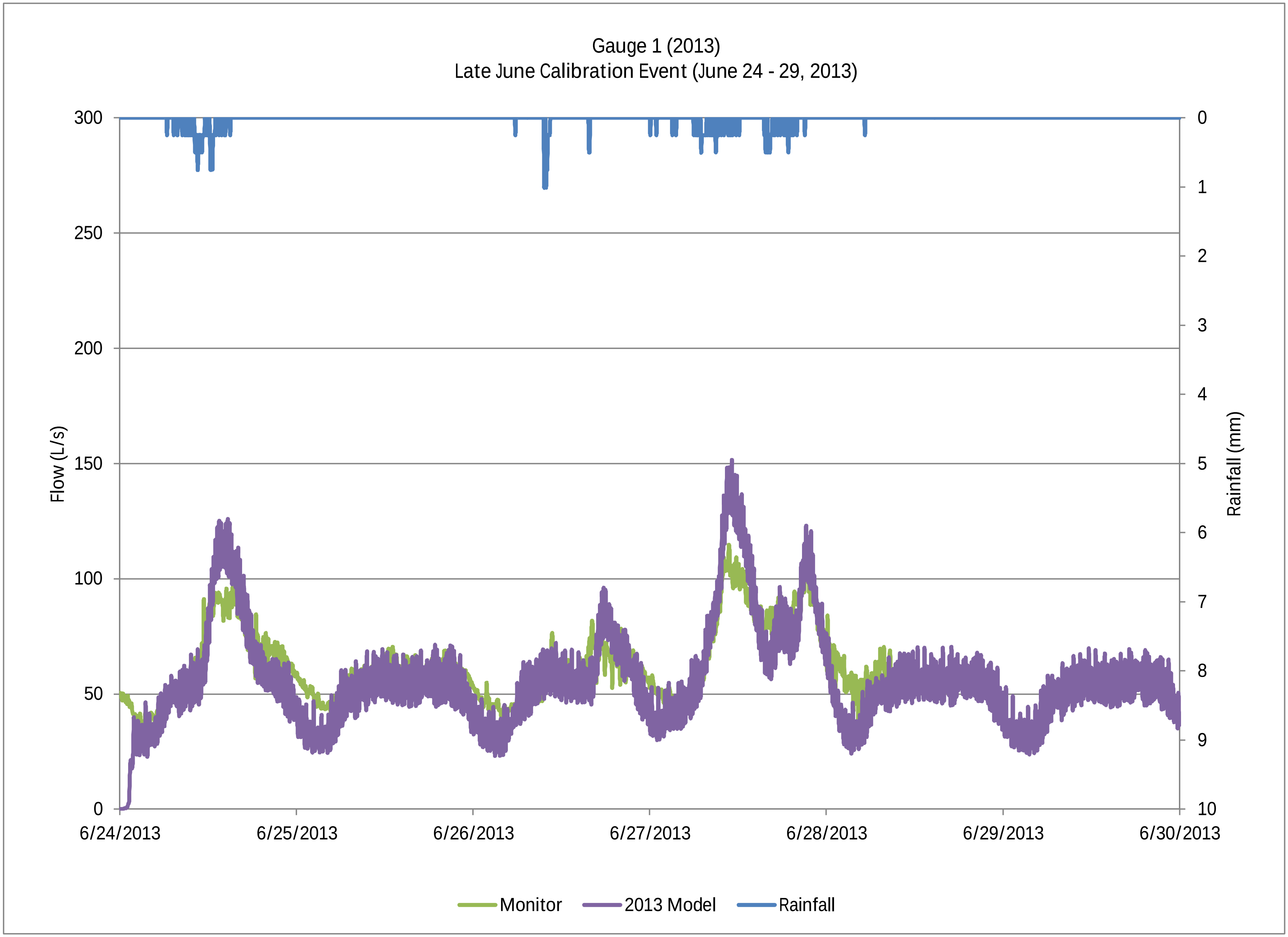
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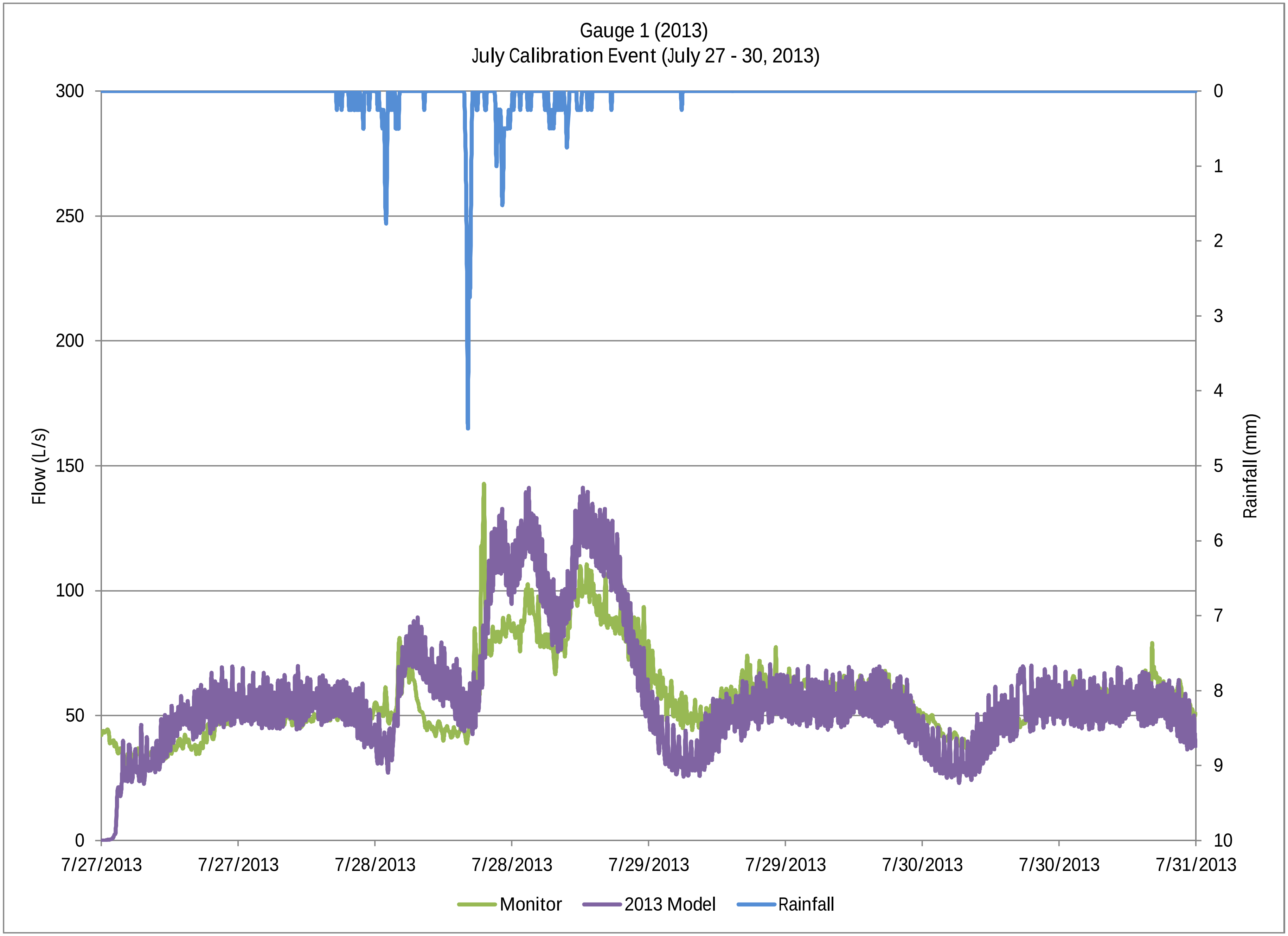
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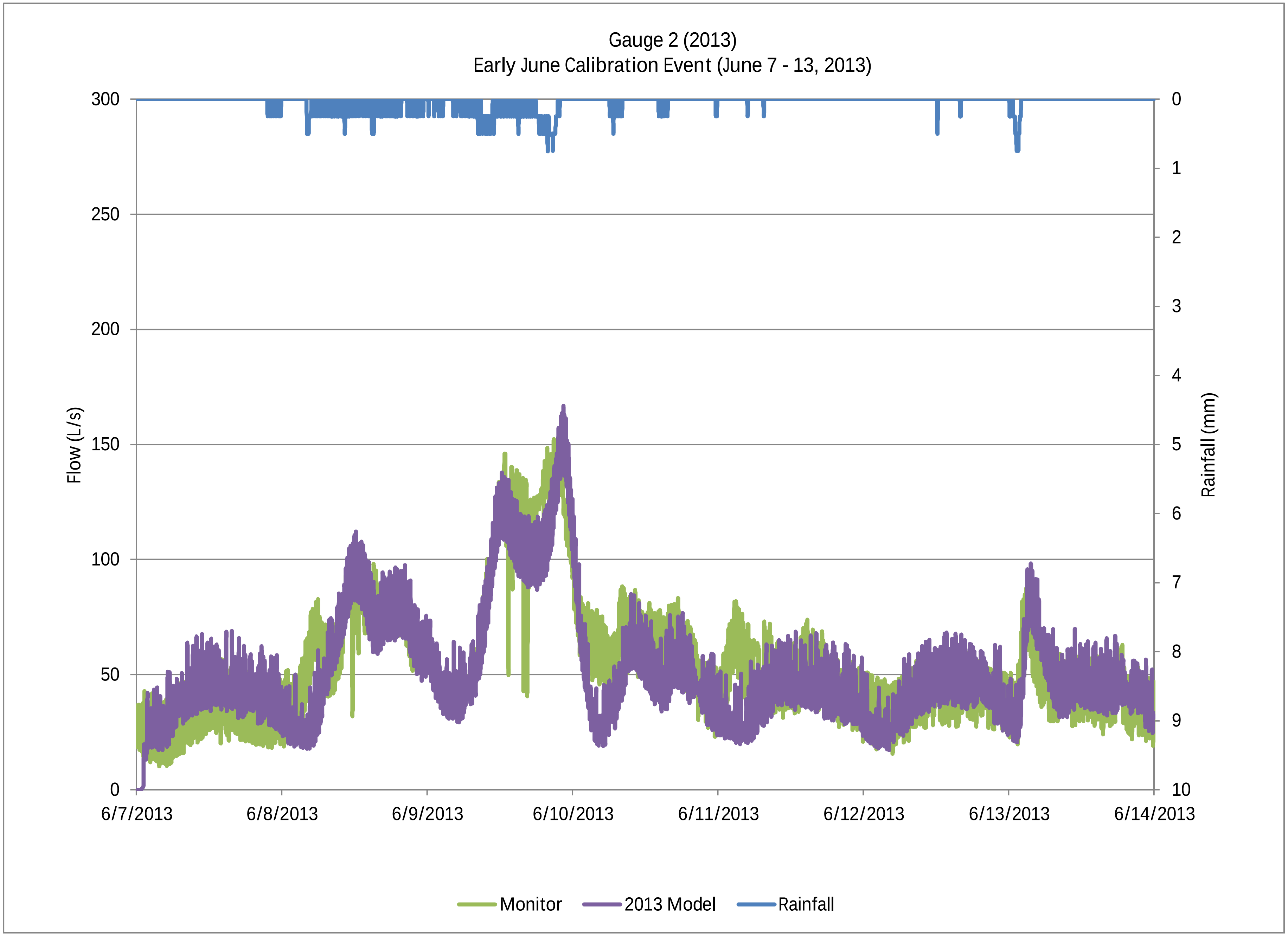
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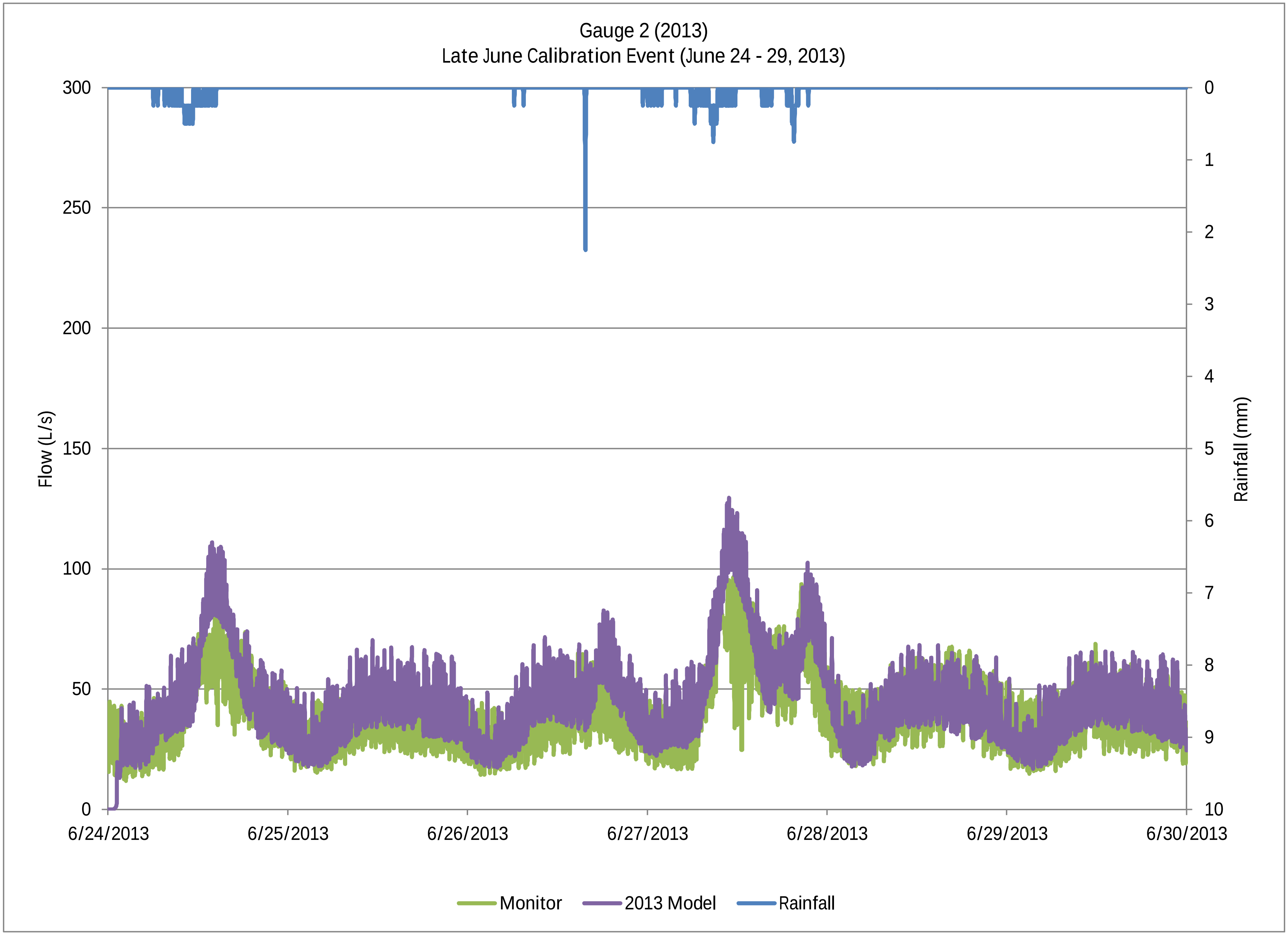

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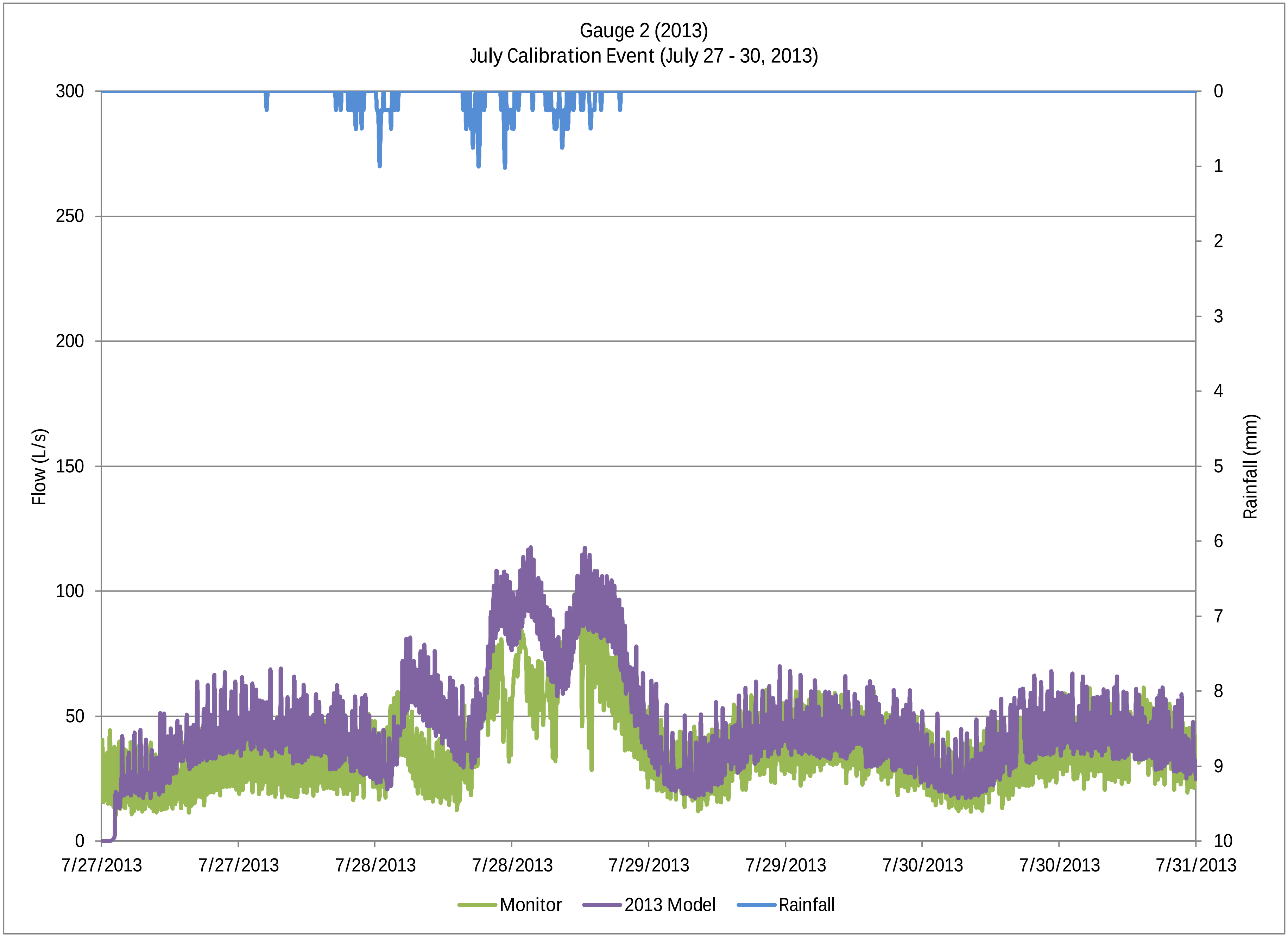

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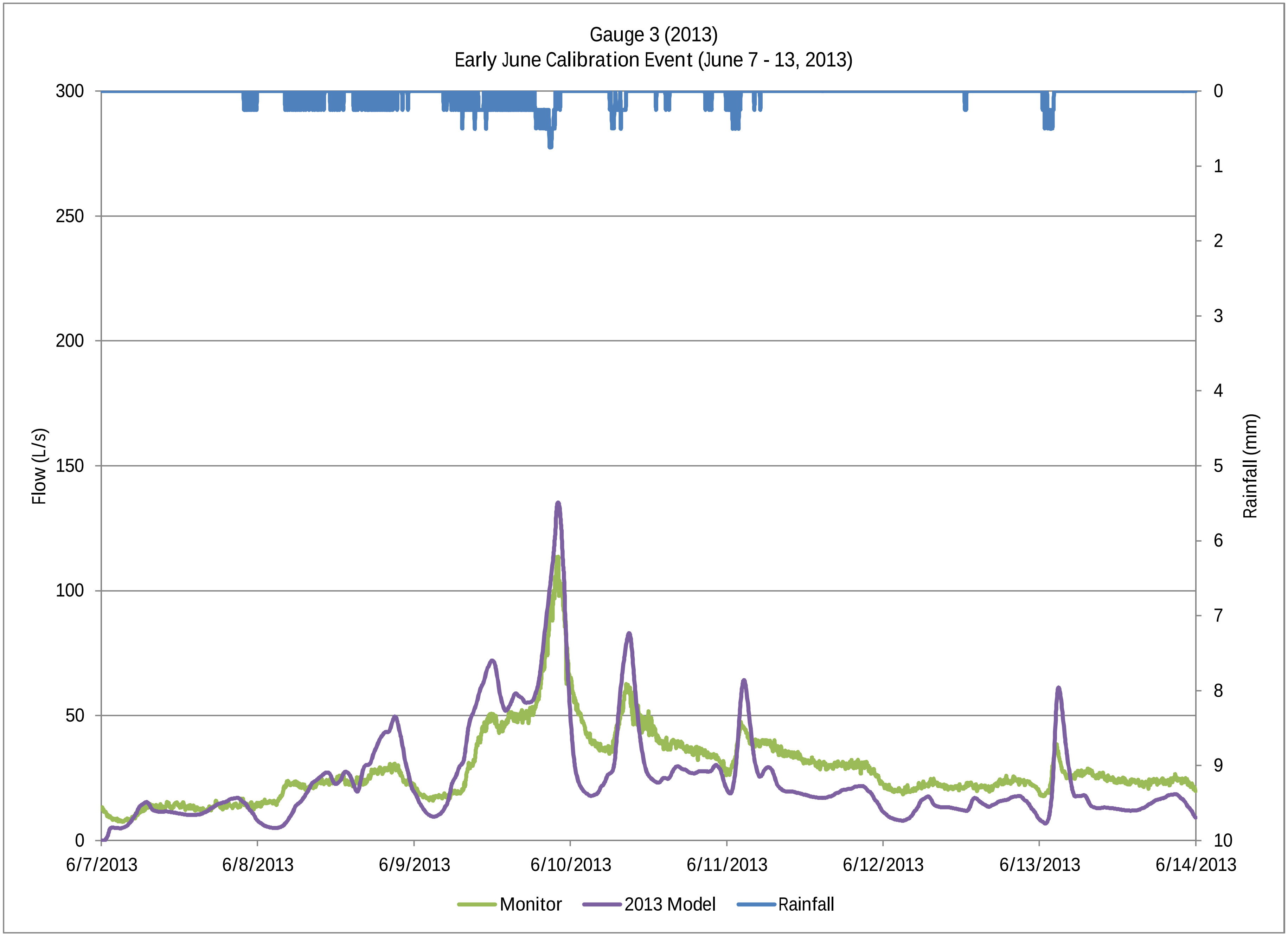
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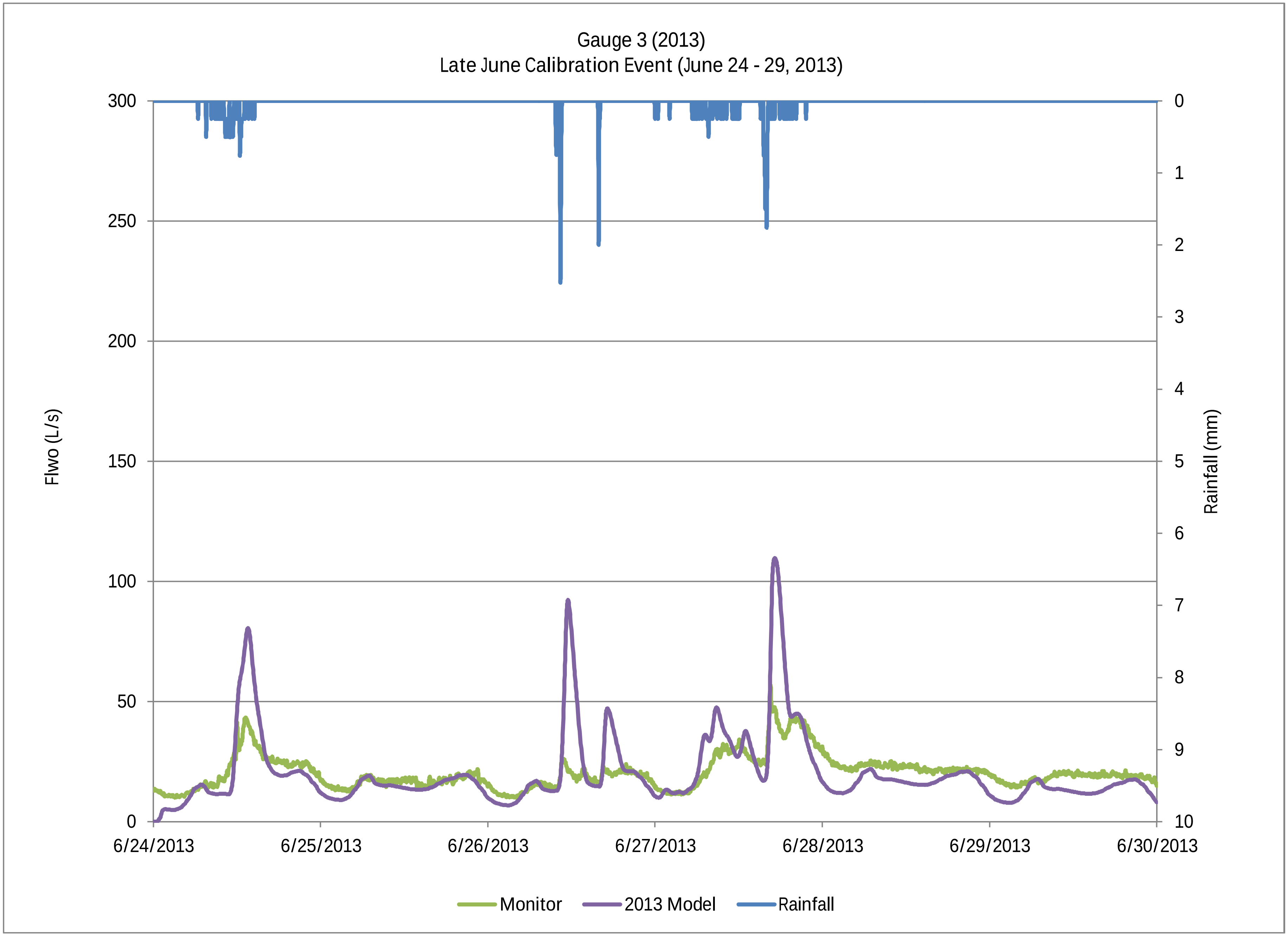
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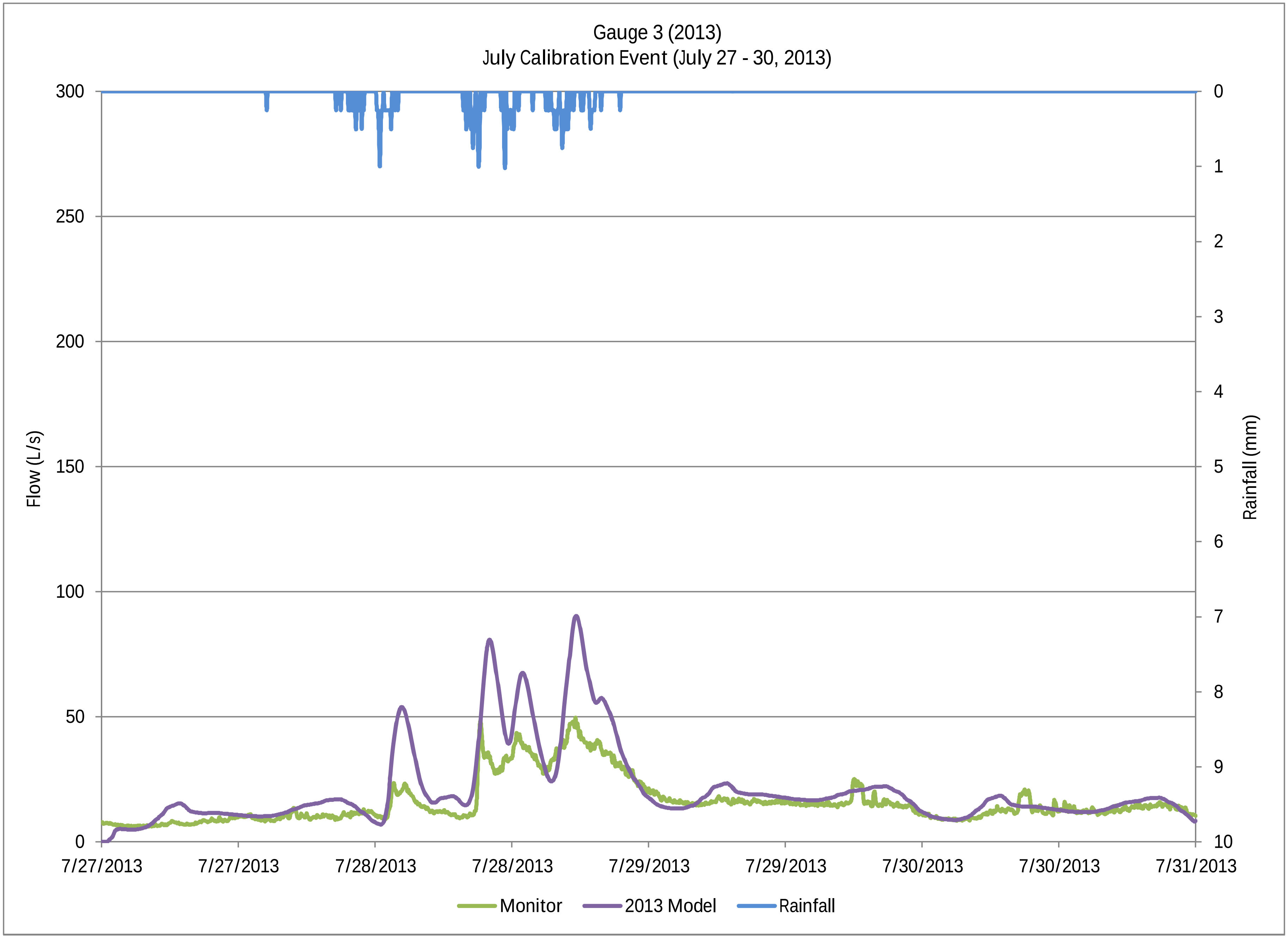

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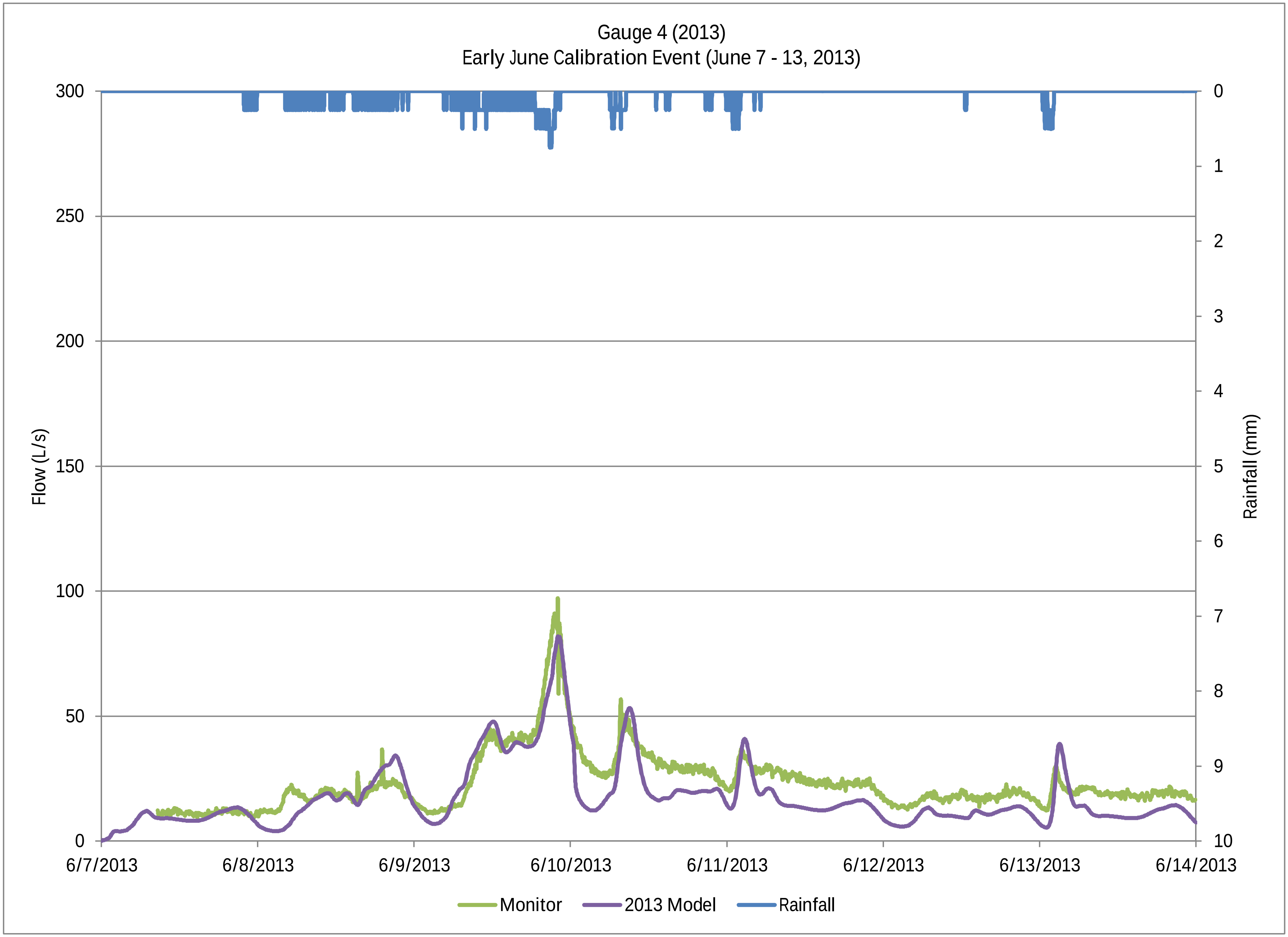
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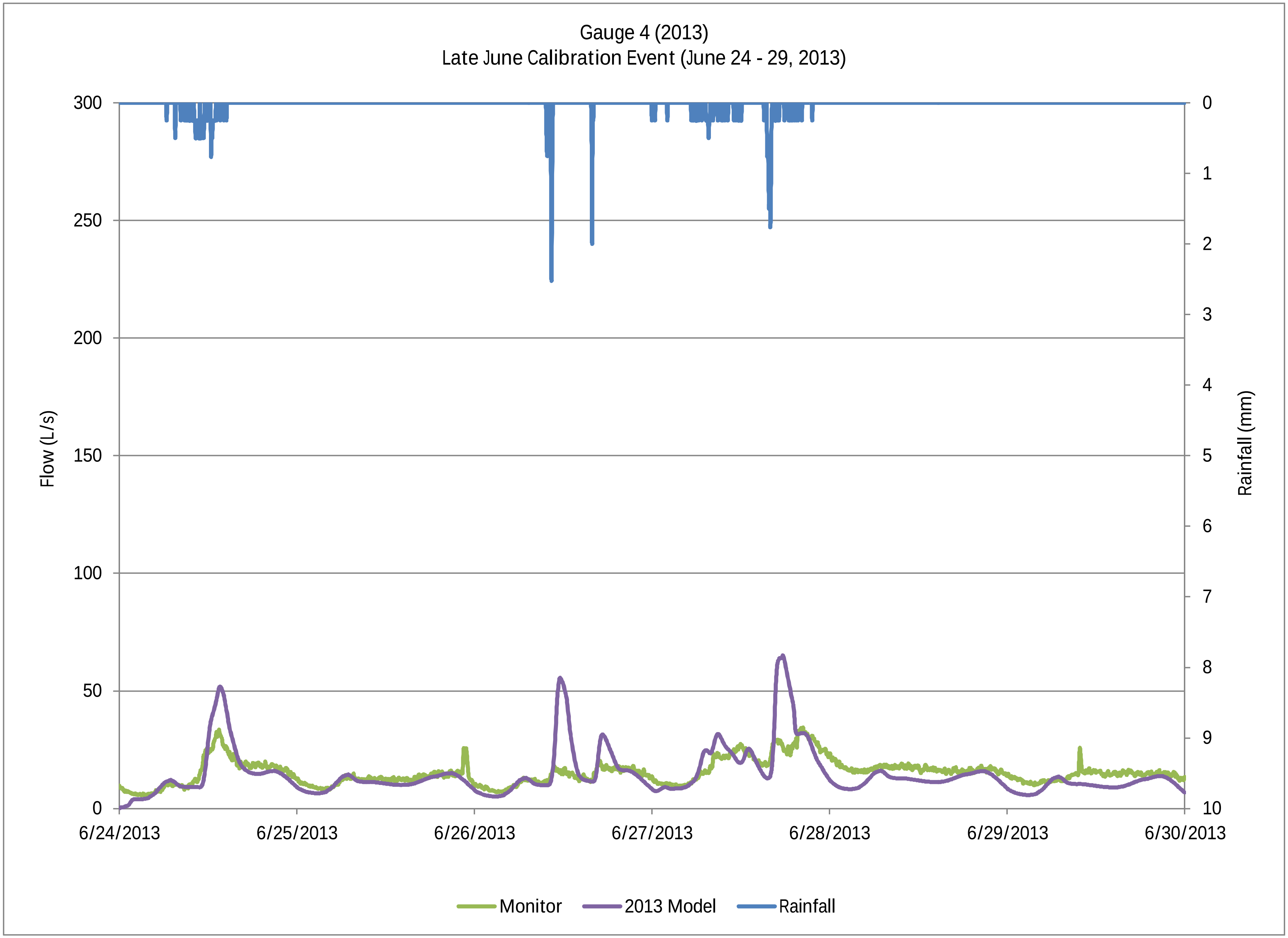
6/14/2013
Monitor
2013 Model
Rainfall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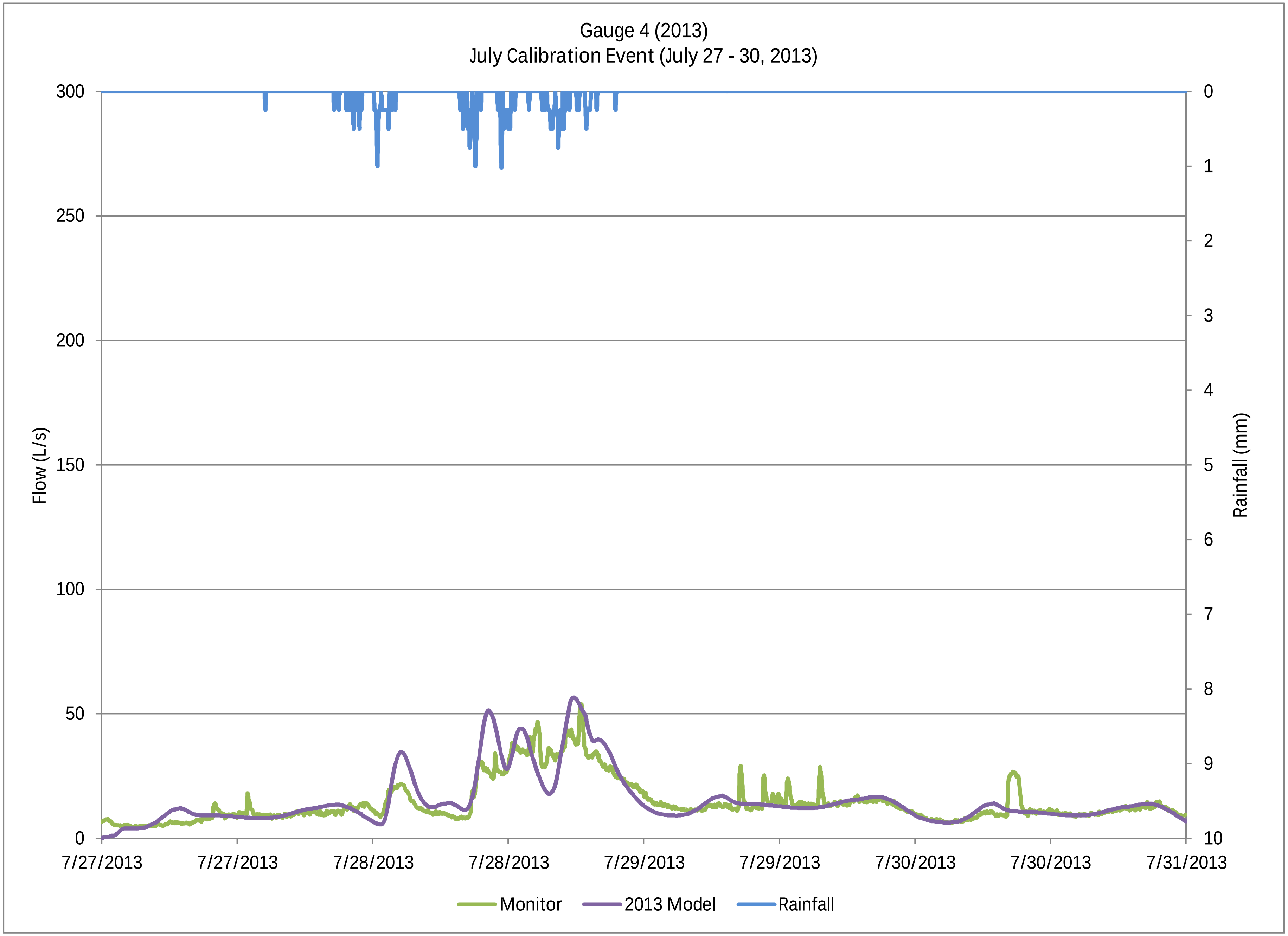

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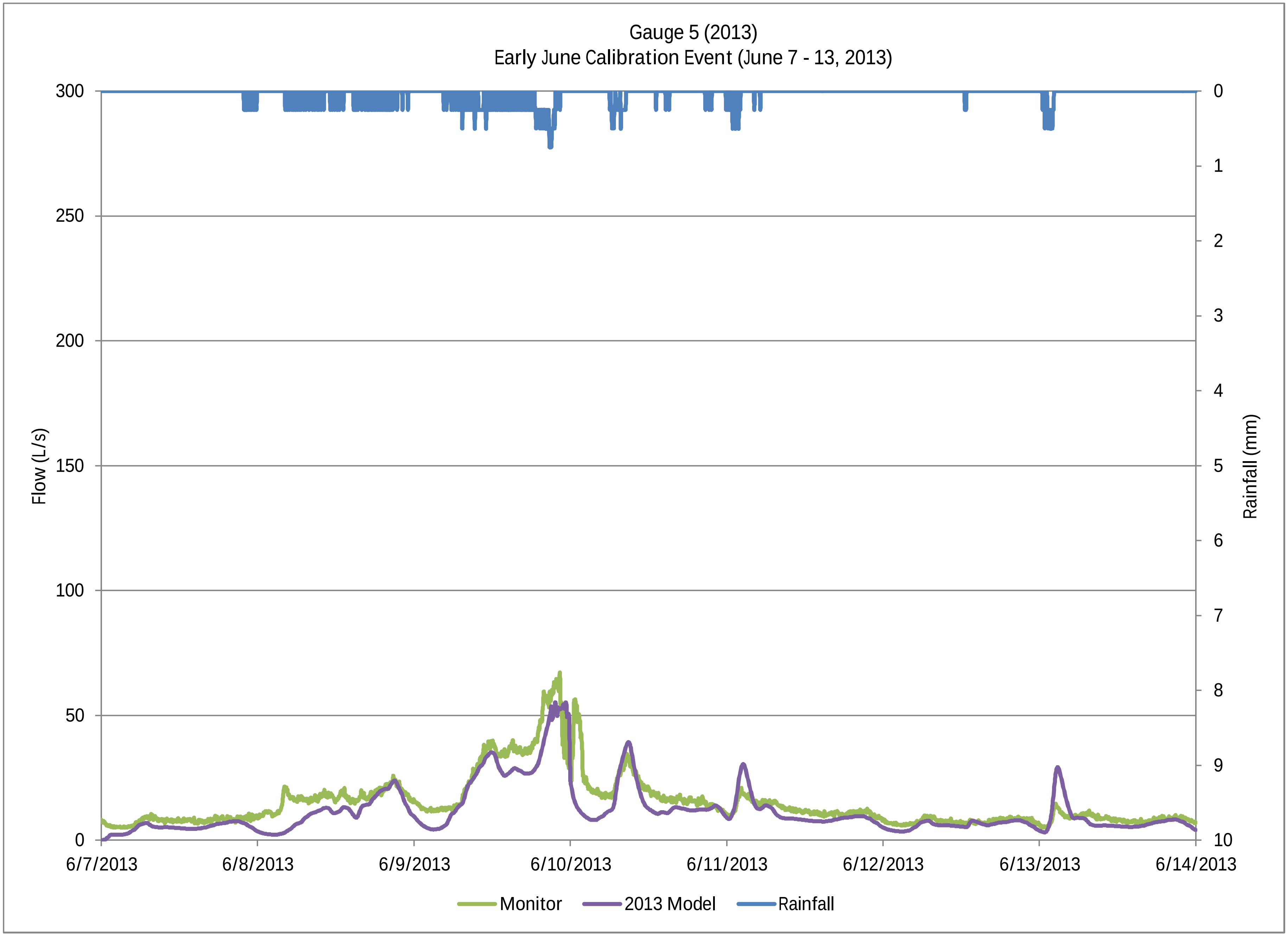

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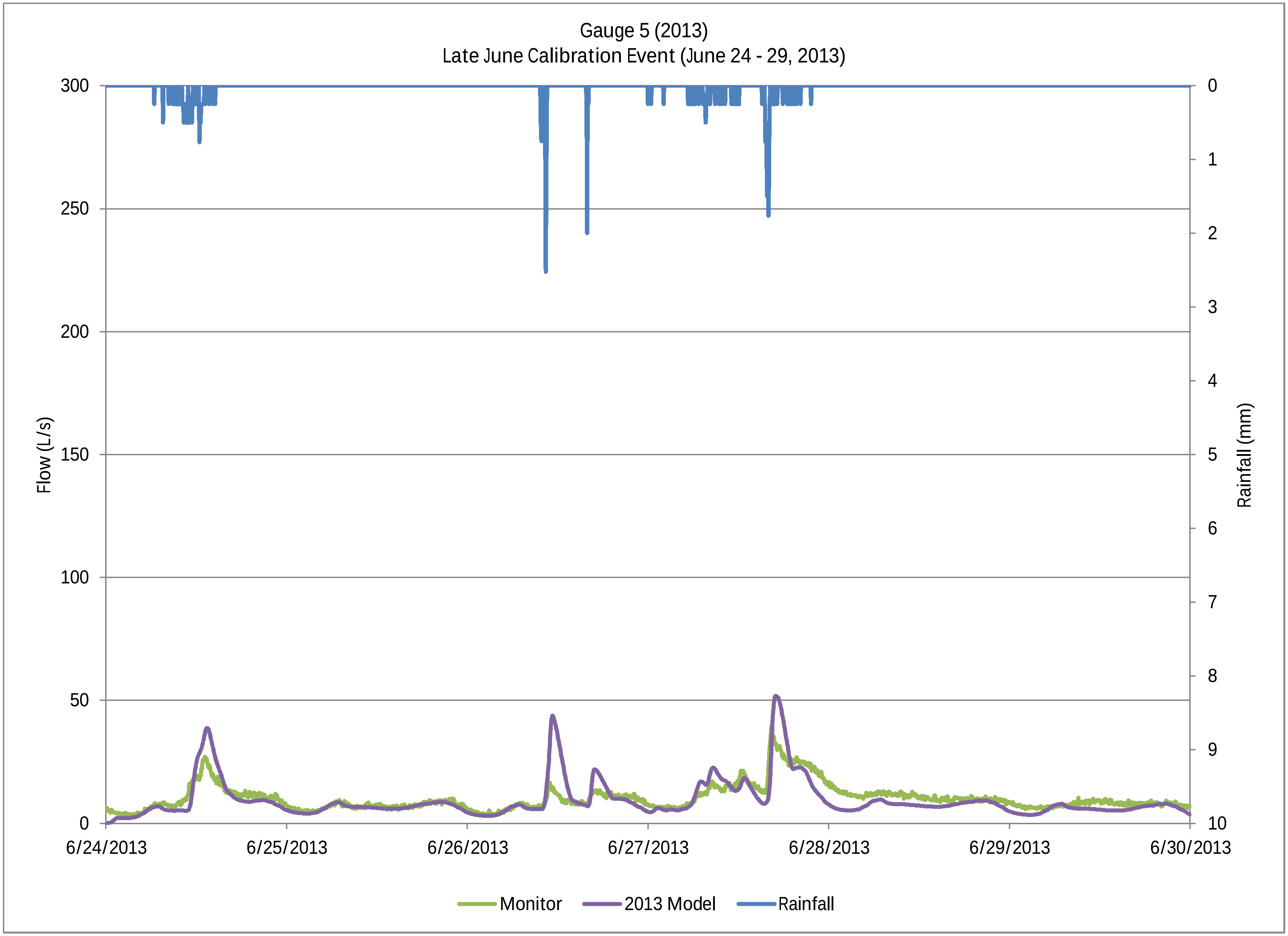
Monitor
2013 Model
Rainfall



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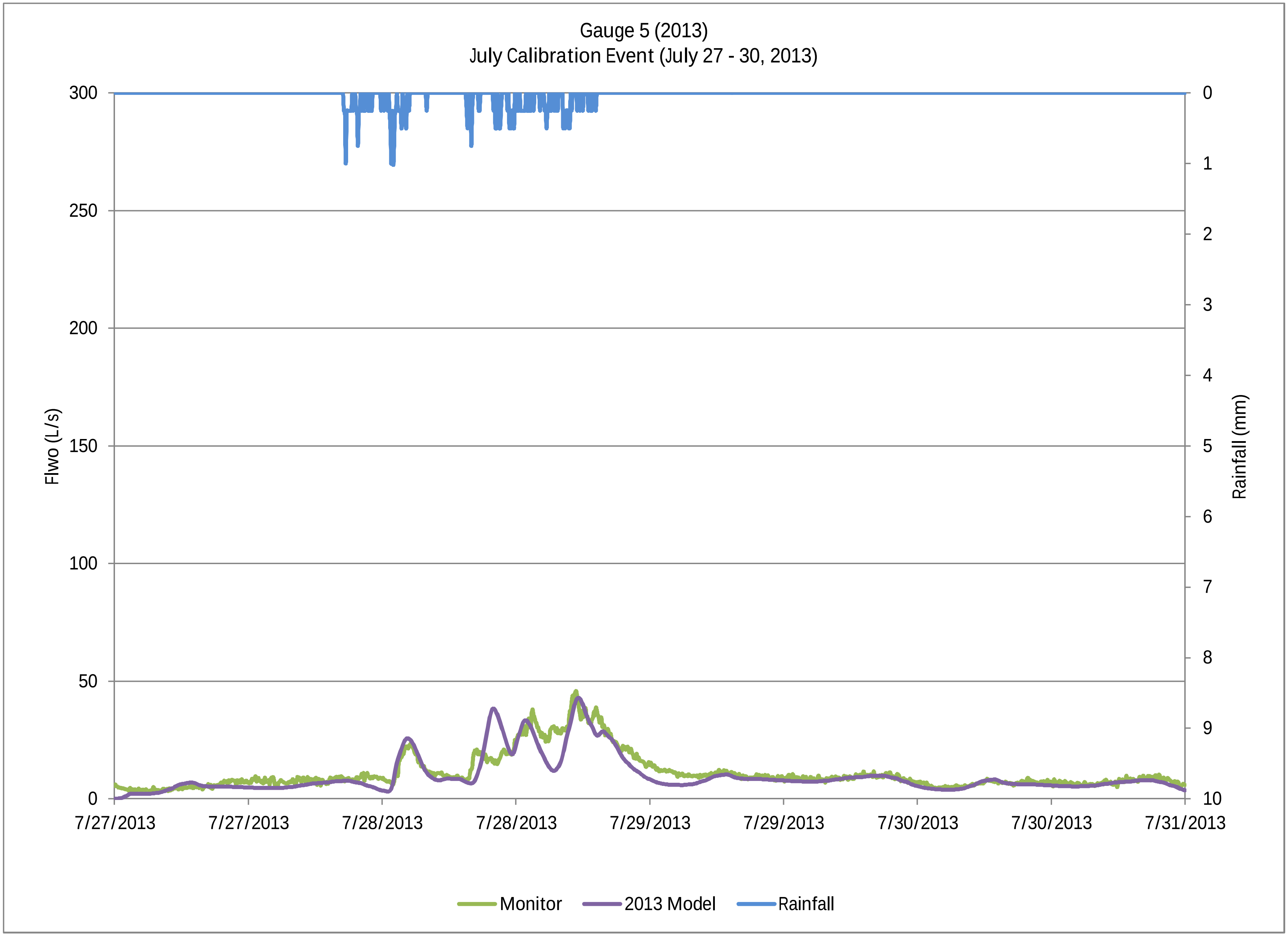

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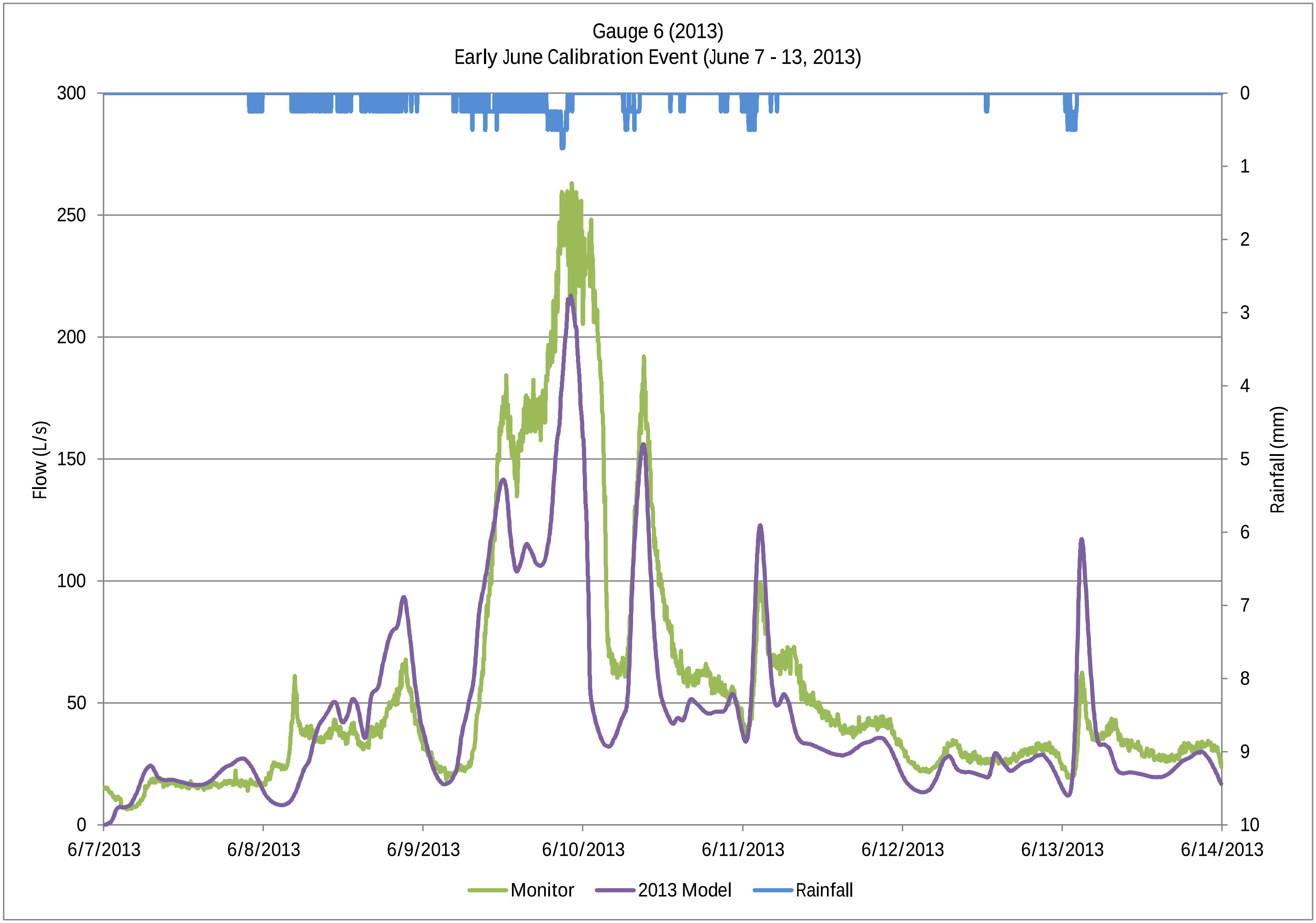

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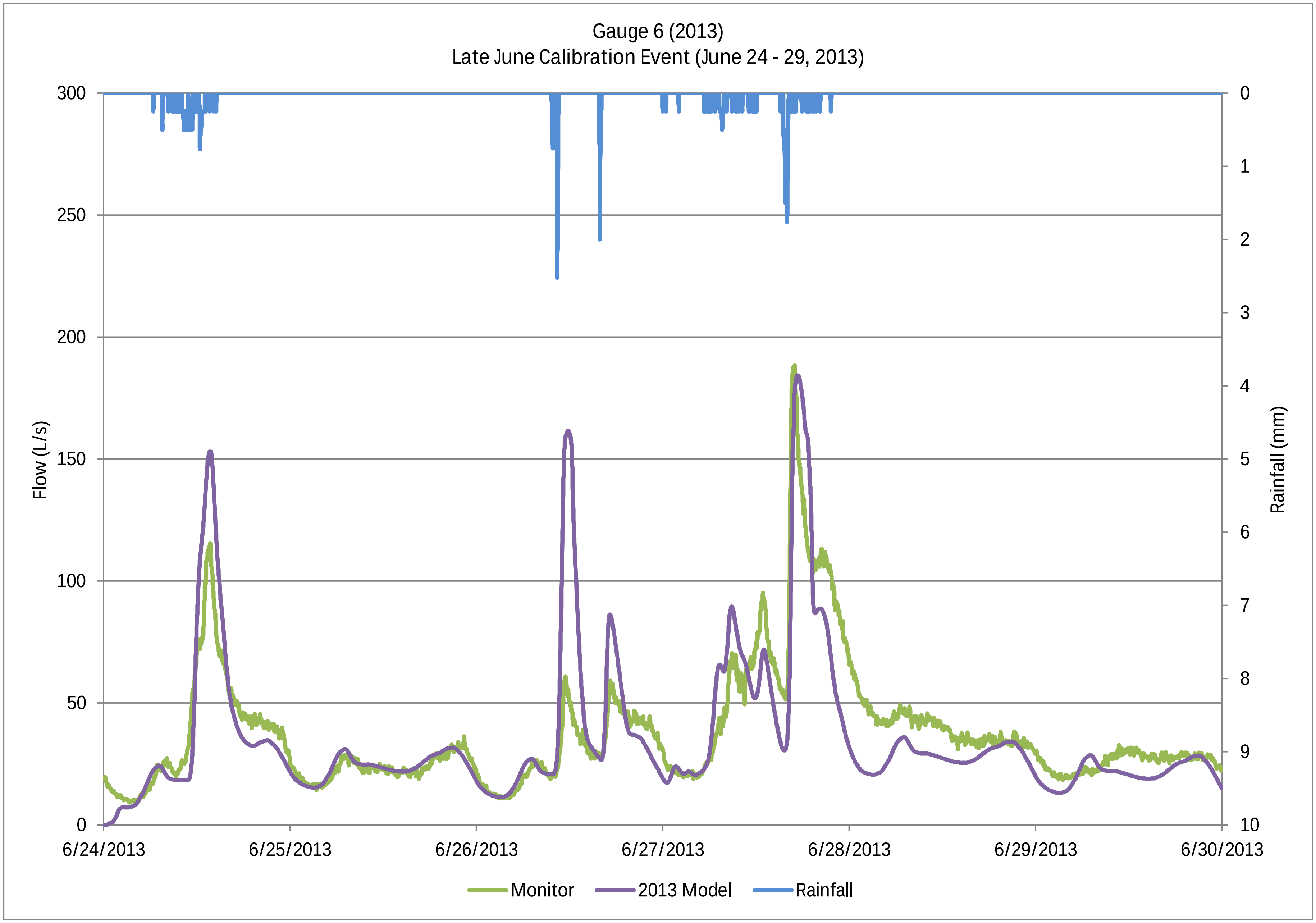
Monitor
2013 Model
Rainfall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Monitor
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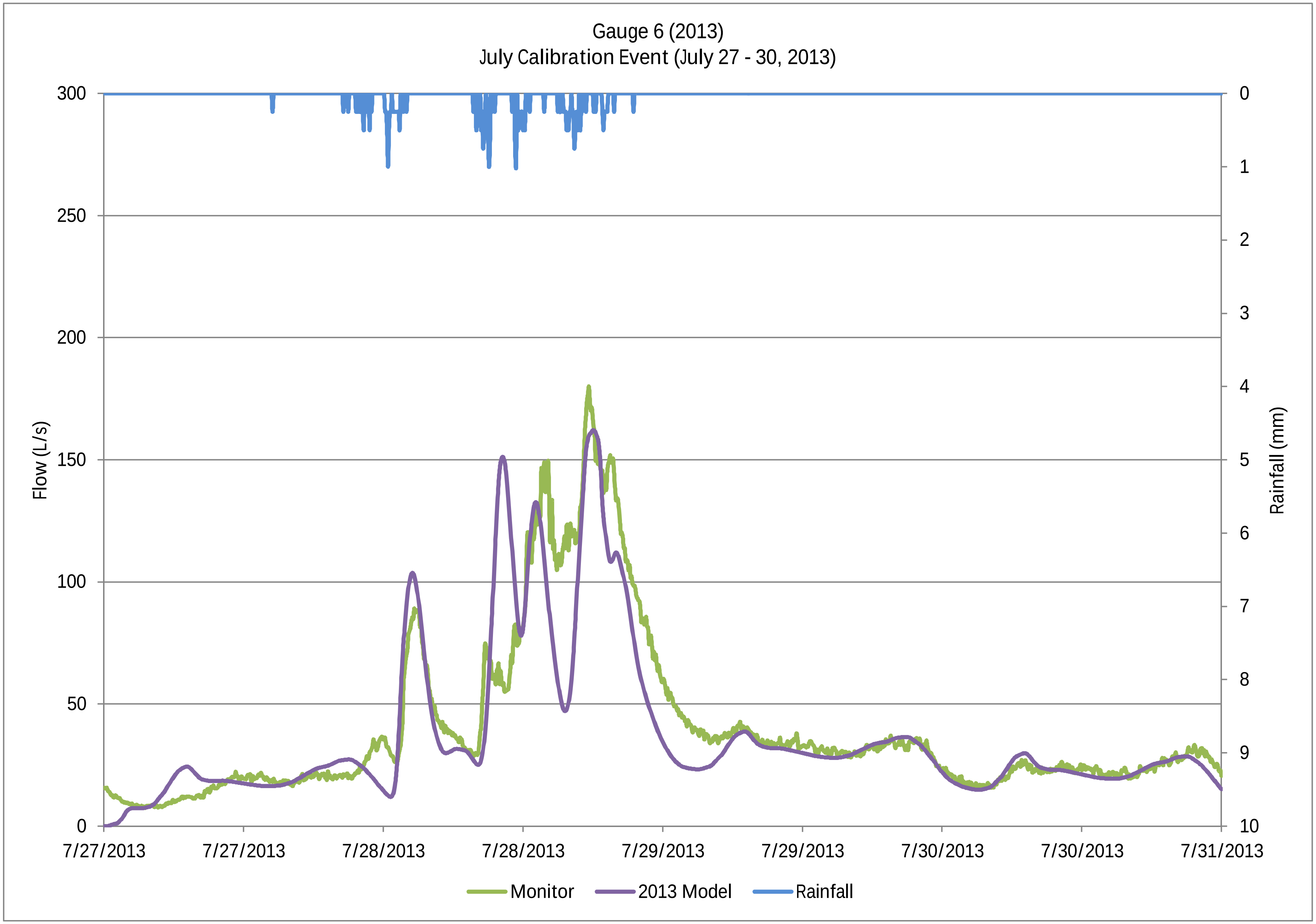
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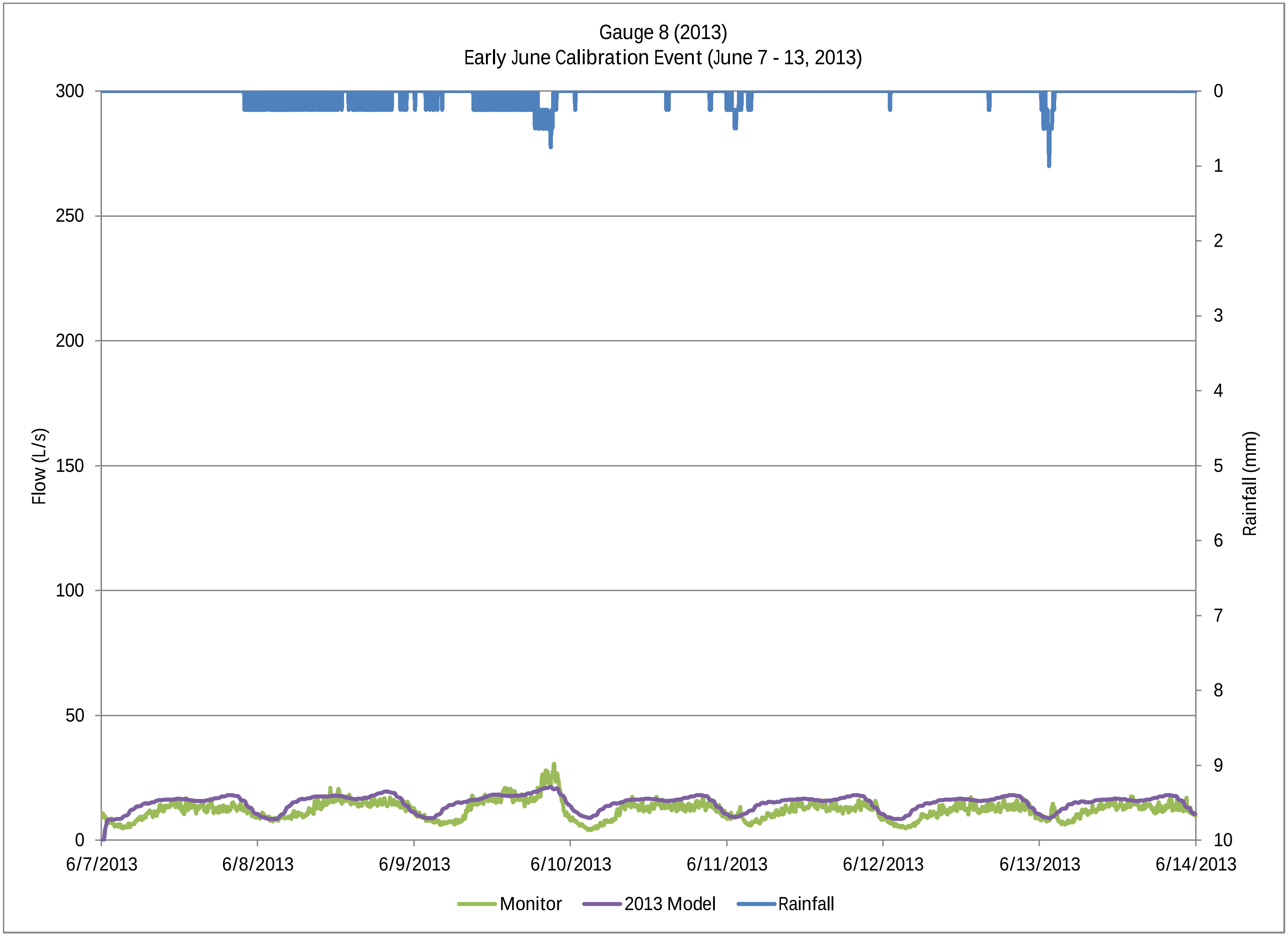
Monitor
2013 Model
Rainfall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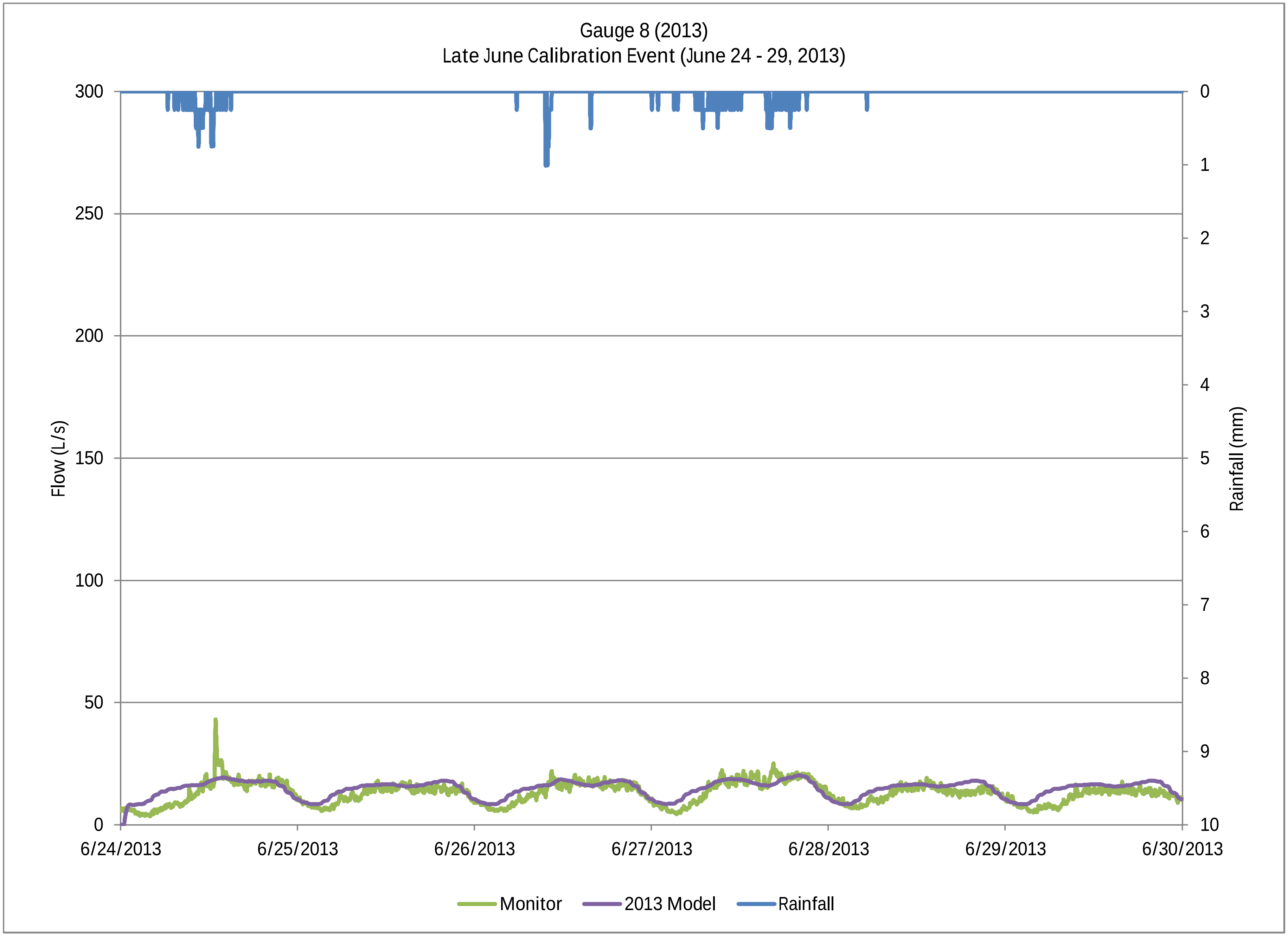
6/14/2013
Monitor
2013 Model
Rainfall



Gauge 8 (2013)
Late June Calibration Event (June 24 - 29, 2013)
Flow (L/s)
Rainfall (mm)
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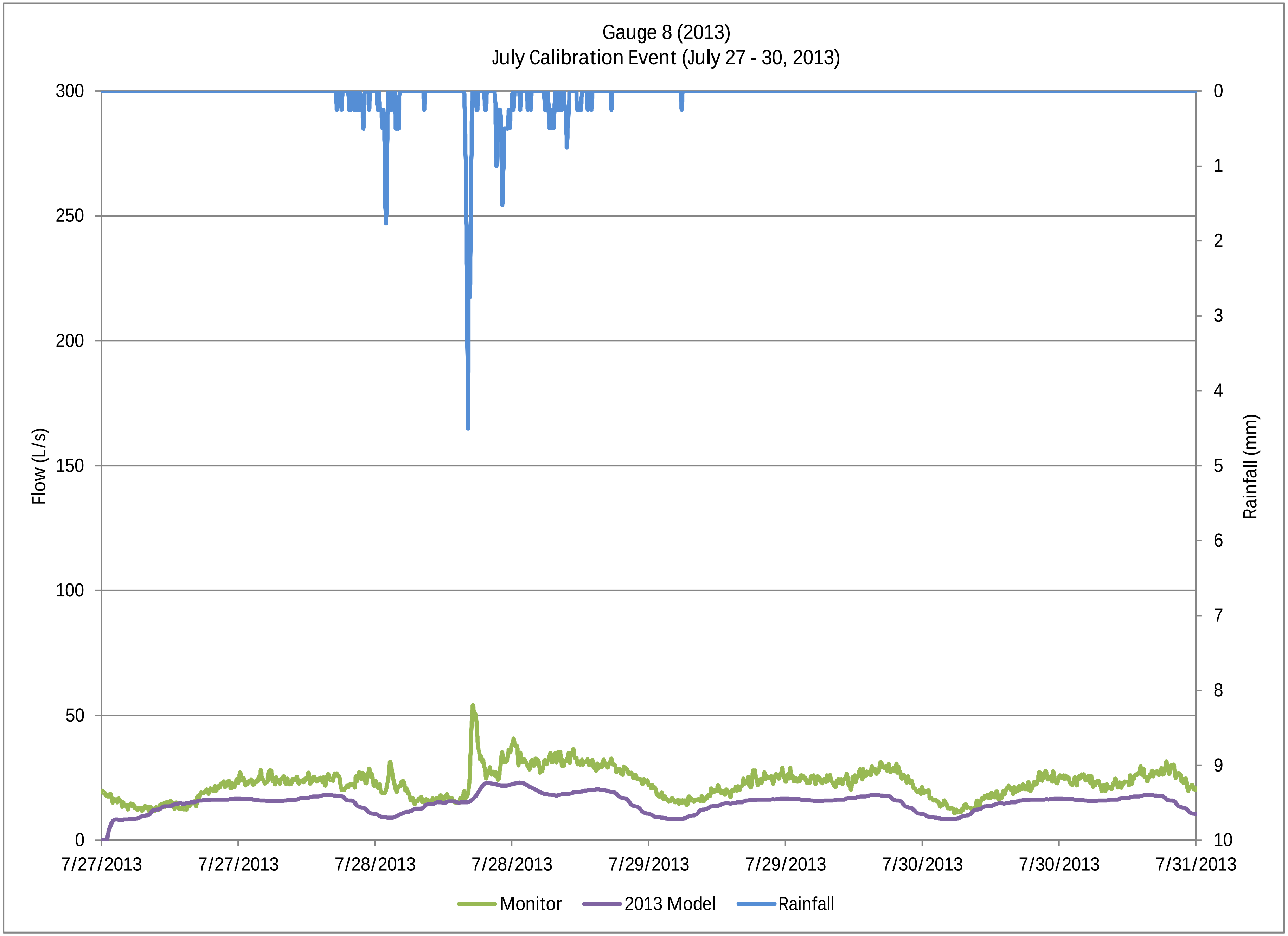
Monitor
2013 Model
Rainfall



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July Calibration Event (July 27 - 30, 2013)
Flow (L/s)
Rainfall (mm)
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Monitor
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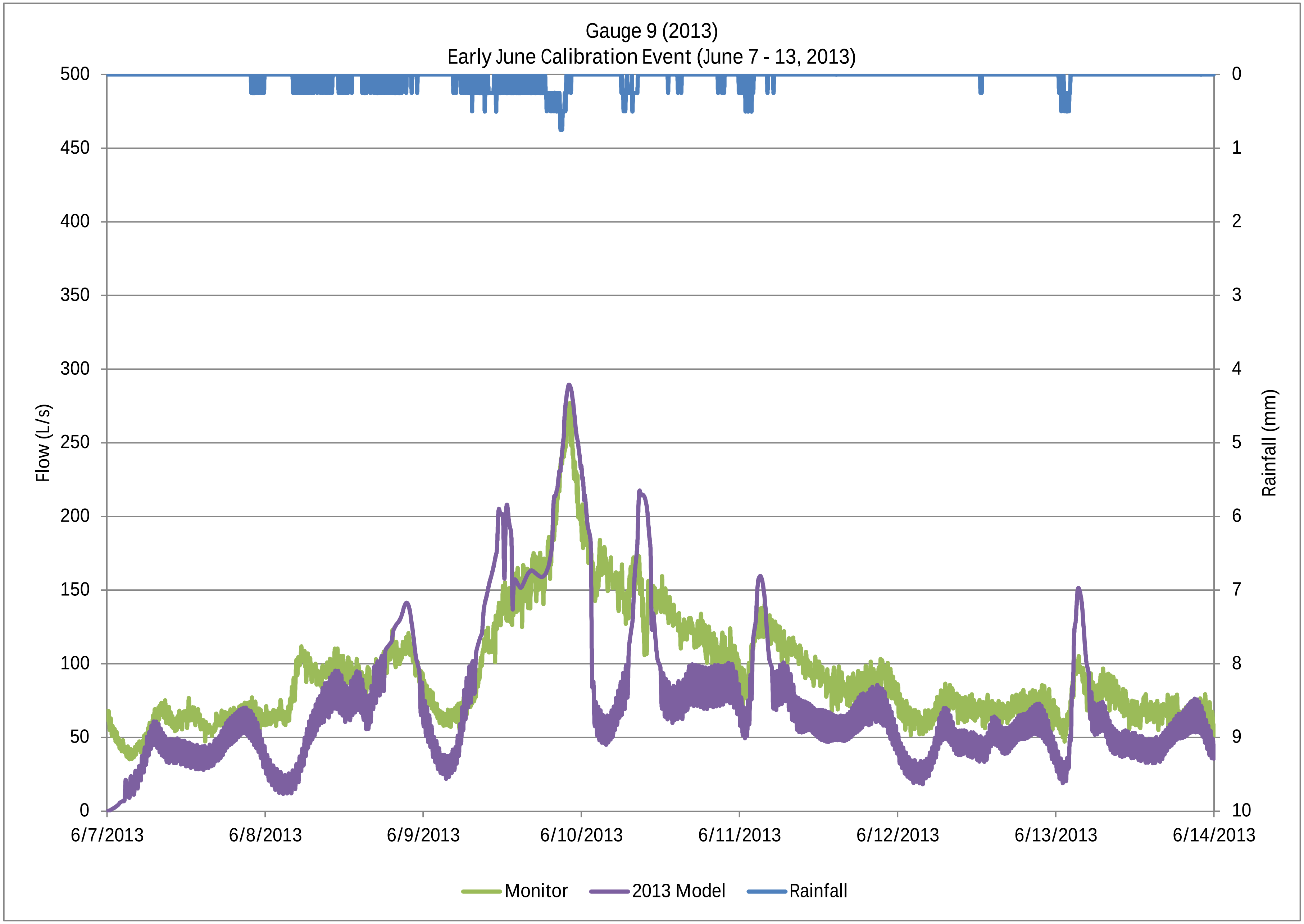

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Rainfall (mm)
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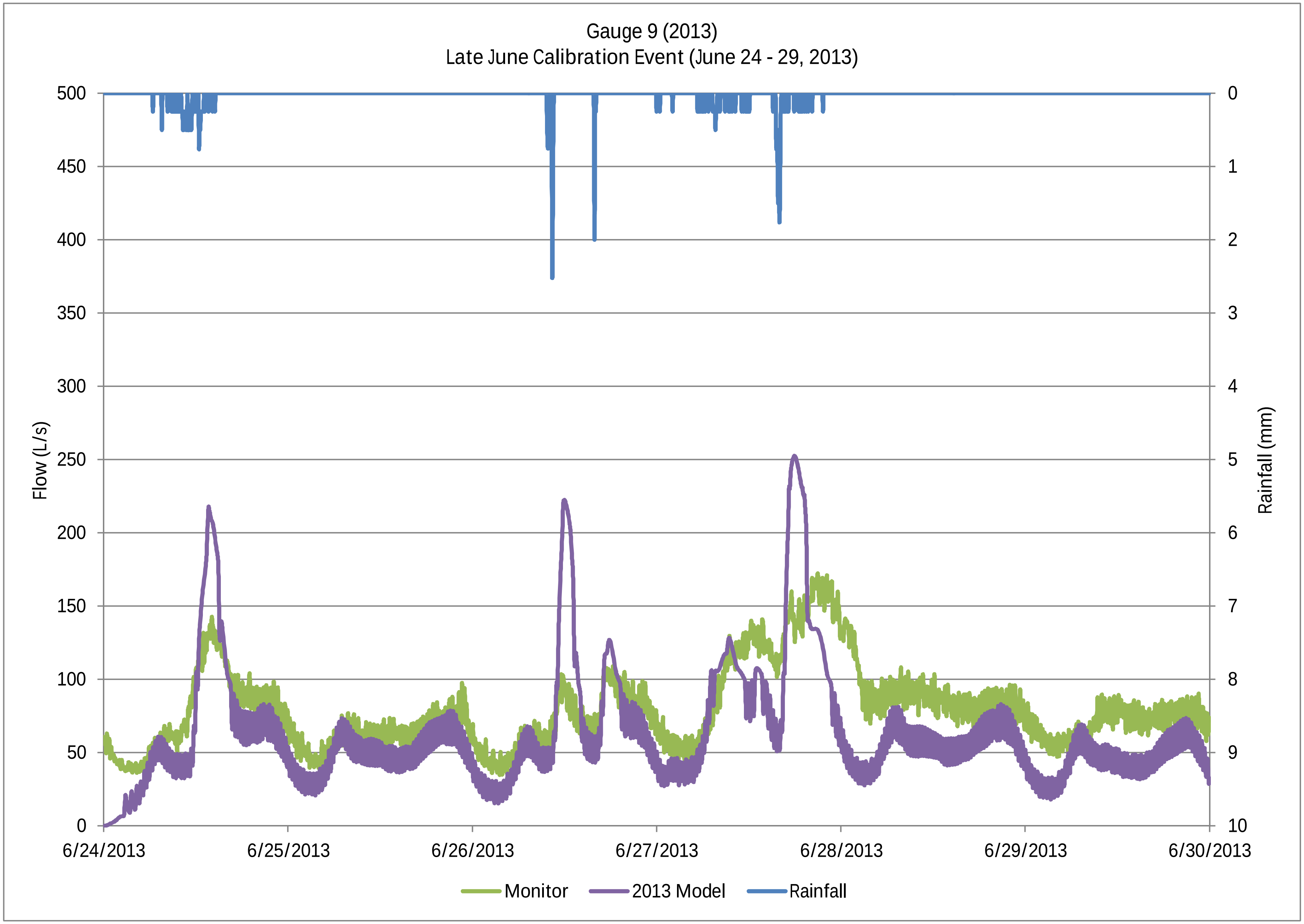
6/12/2013
6/13/2013
6/14/2013
Monitor
2013 Model
Rainfall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Flow (L/s)
Rainfall (mm)
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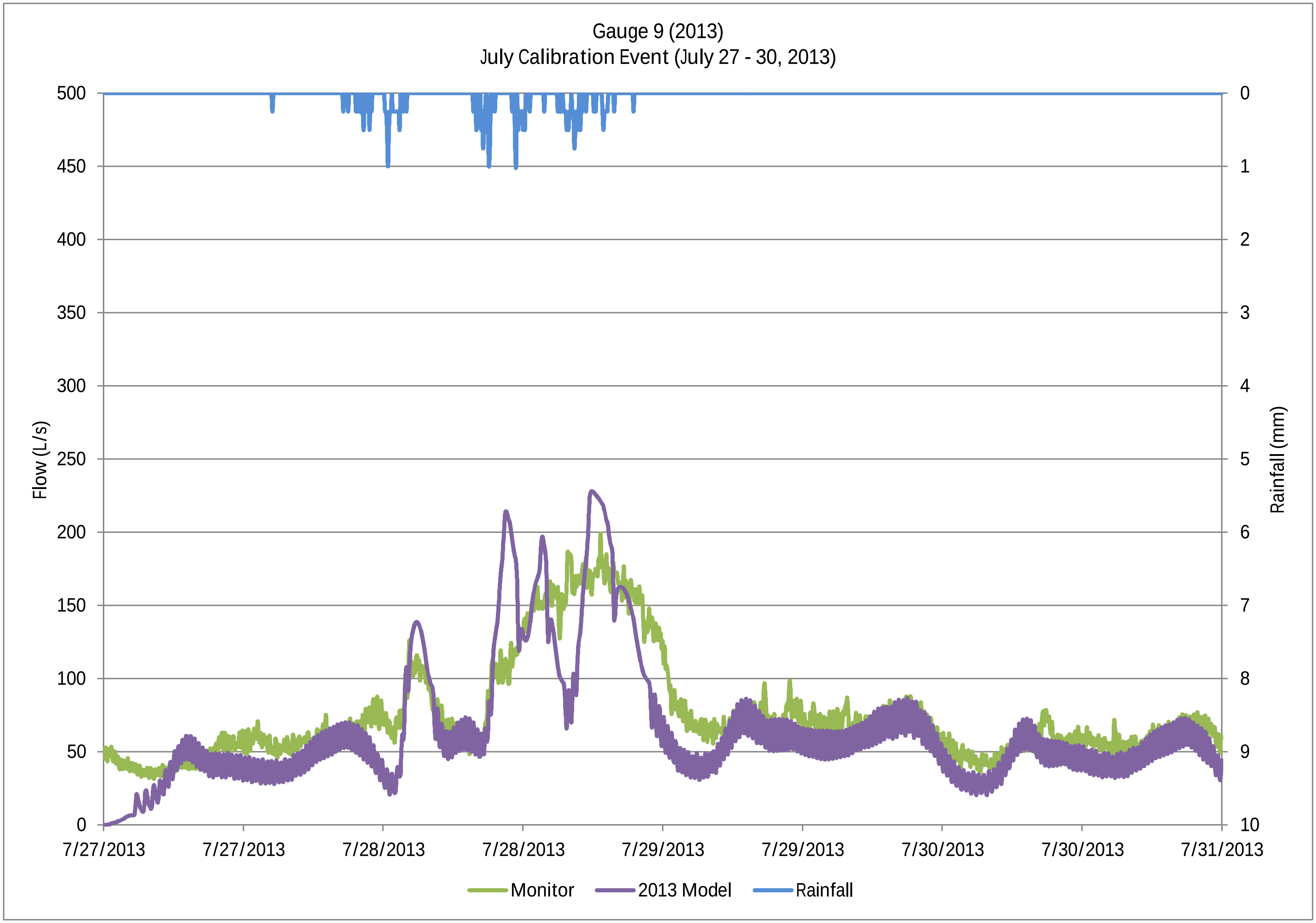
6/30/2013
Monitor
2013 Model
Rainfall



Gauge 9 (2013)
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Flow (L/s)
Rainfall (mm)
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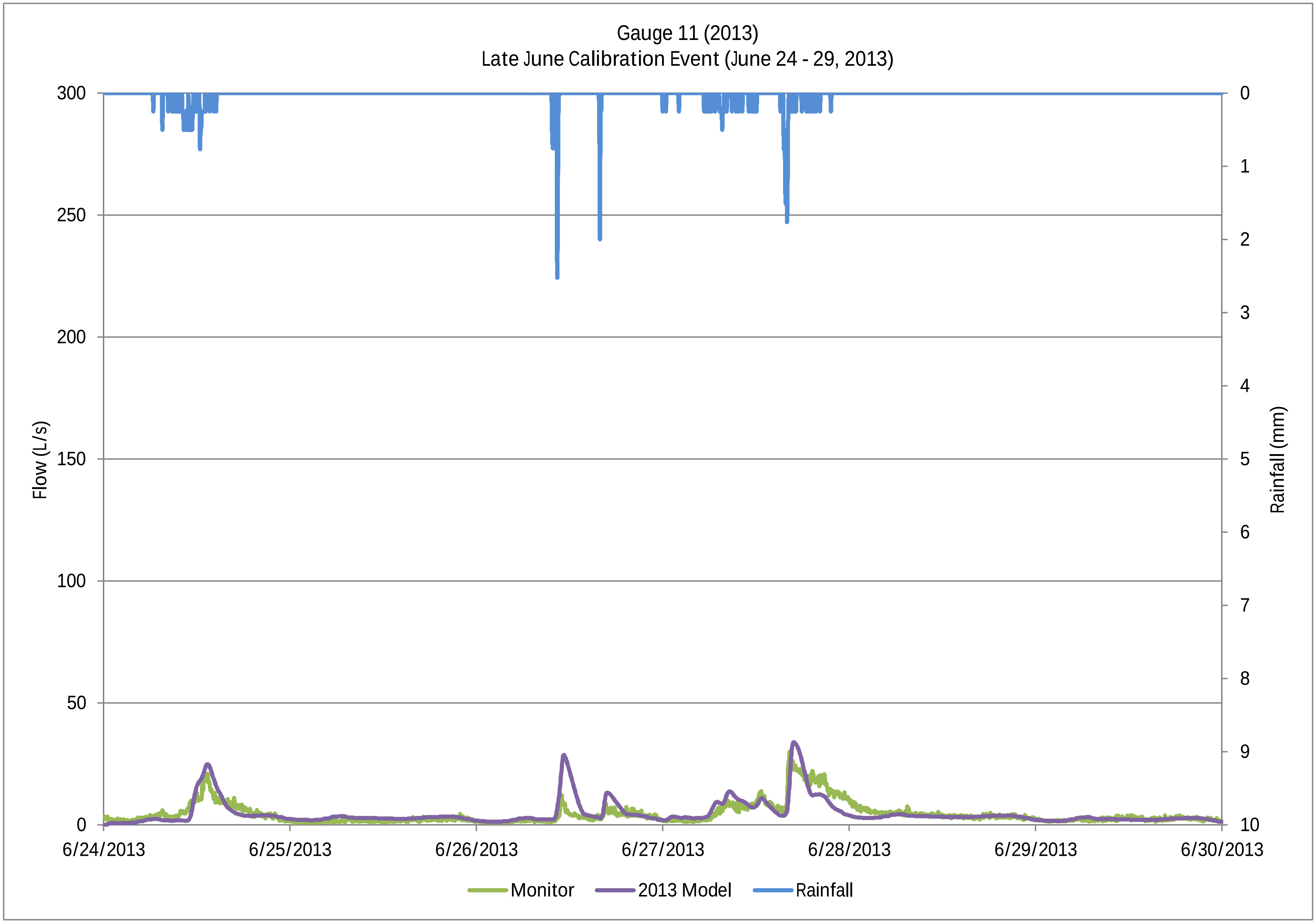
7/30/2013
7/30/2013
7/31/2013
Monitor
2013 Model
Rainfall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Rainfall (mm)
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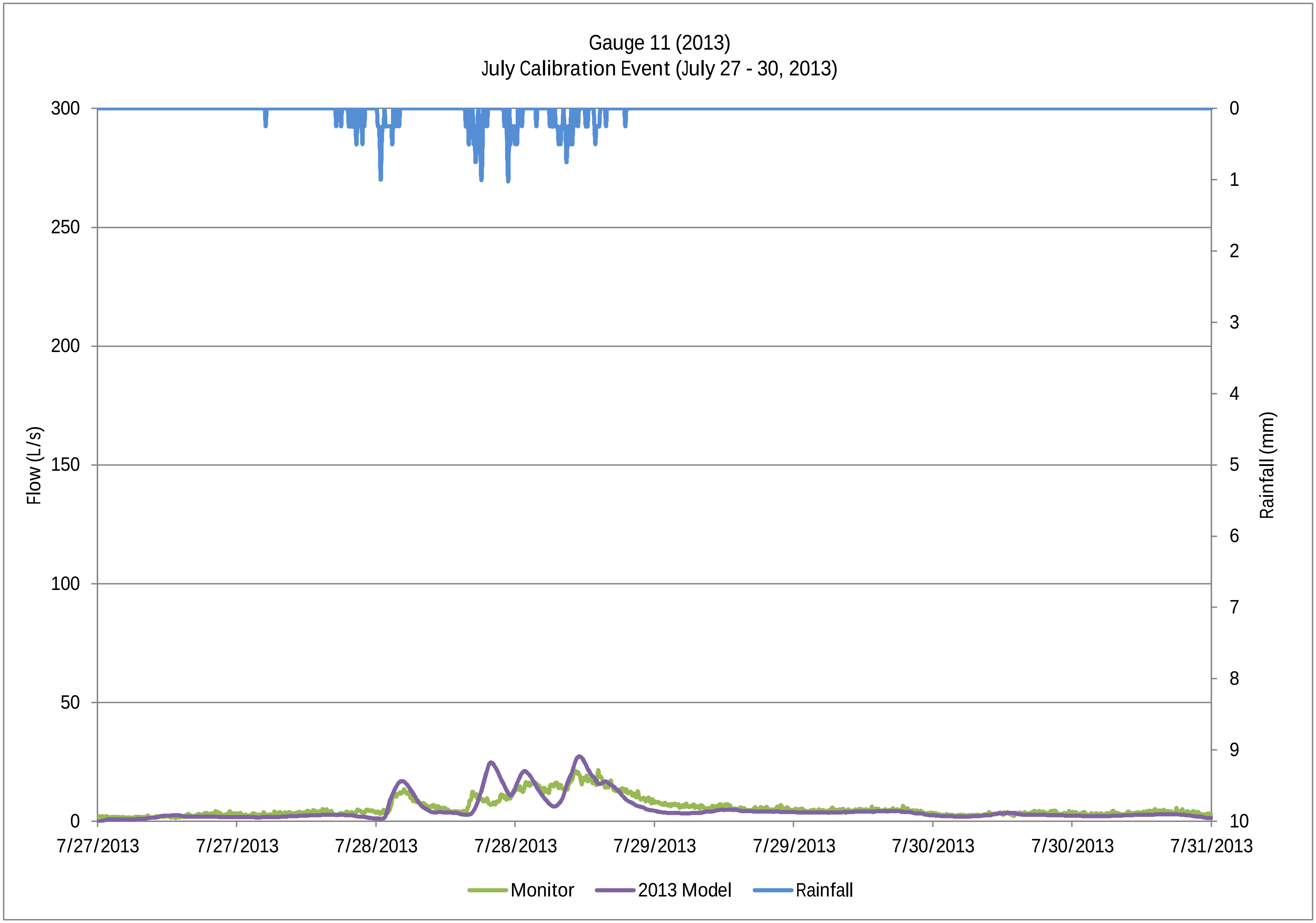
Monitor
2013 Model
Rainfall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Rainfall (mm)
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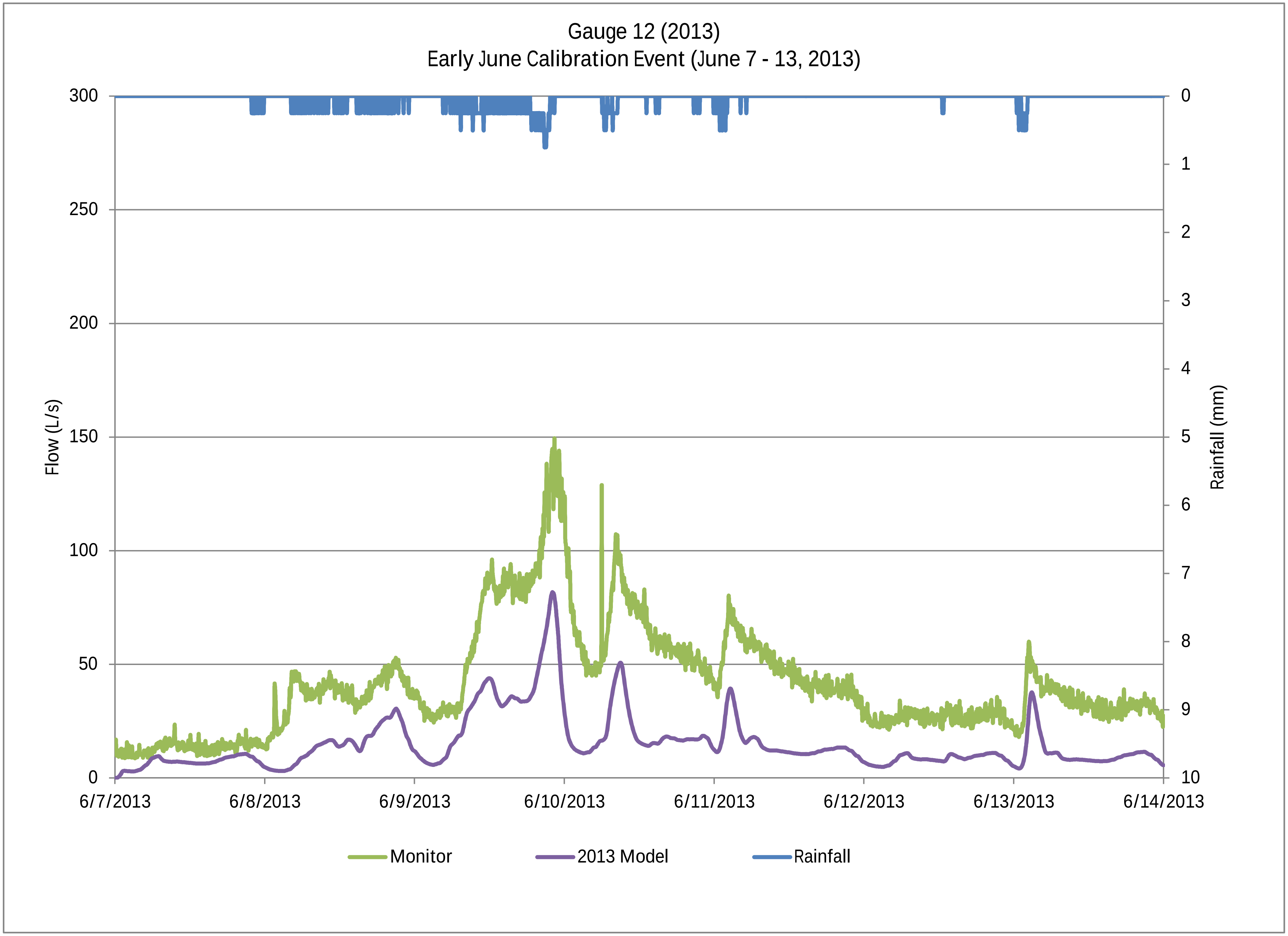
Monitor
2013 Model
Rainfall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Flow (L/s)
Rainfall (mm)
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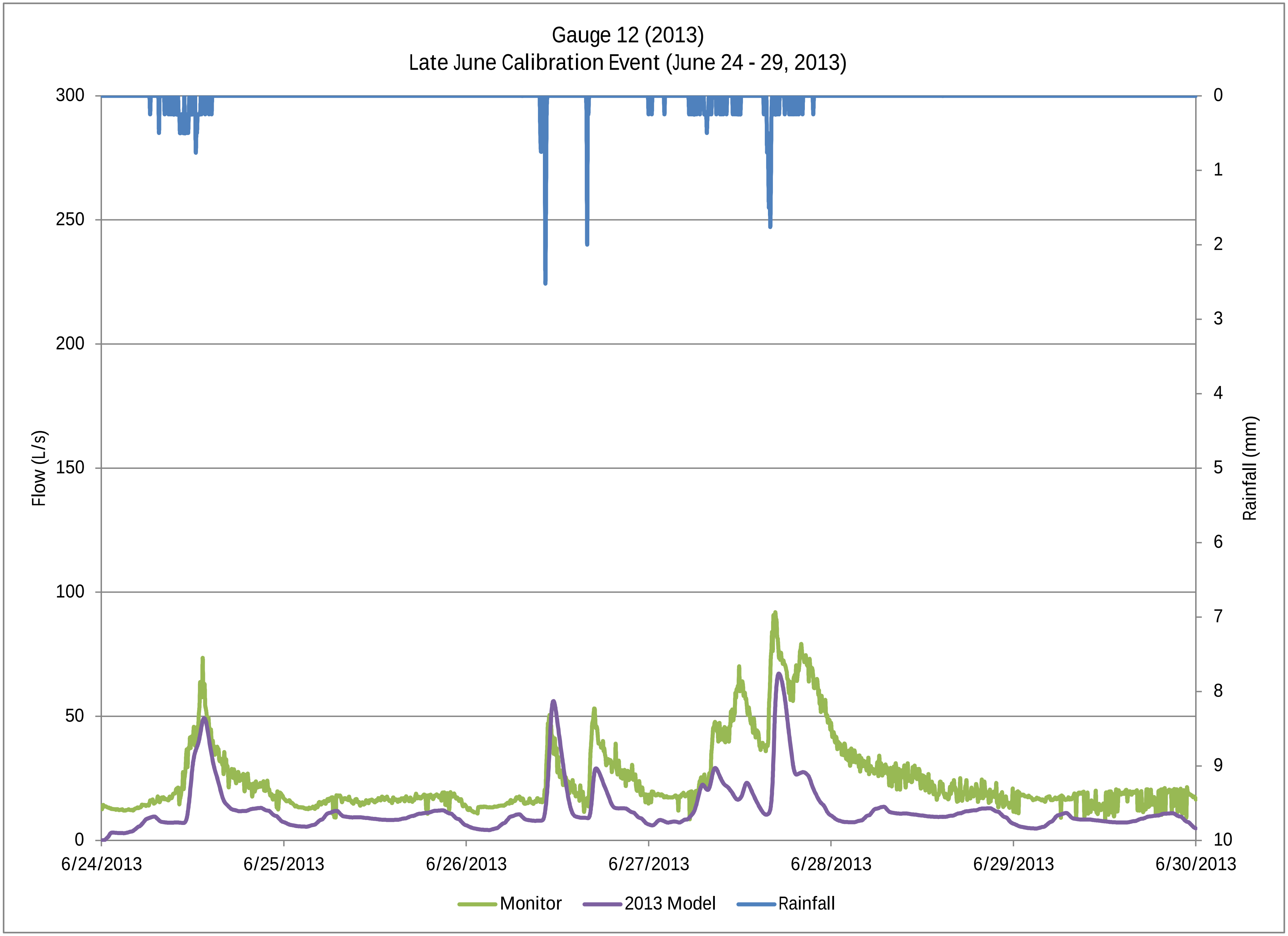
Monitor
2013 Model
Rainfall



Gauge 12 (2013)
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Flow (L/s)
Rainfall (mm)
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Monitor
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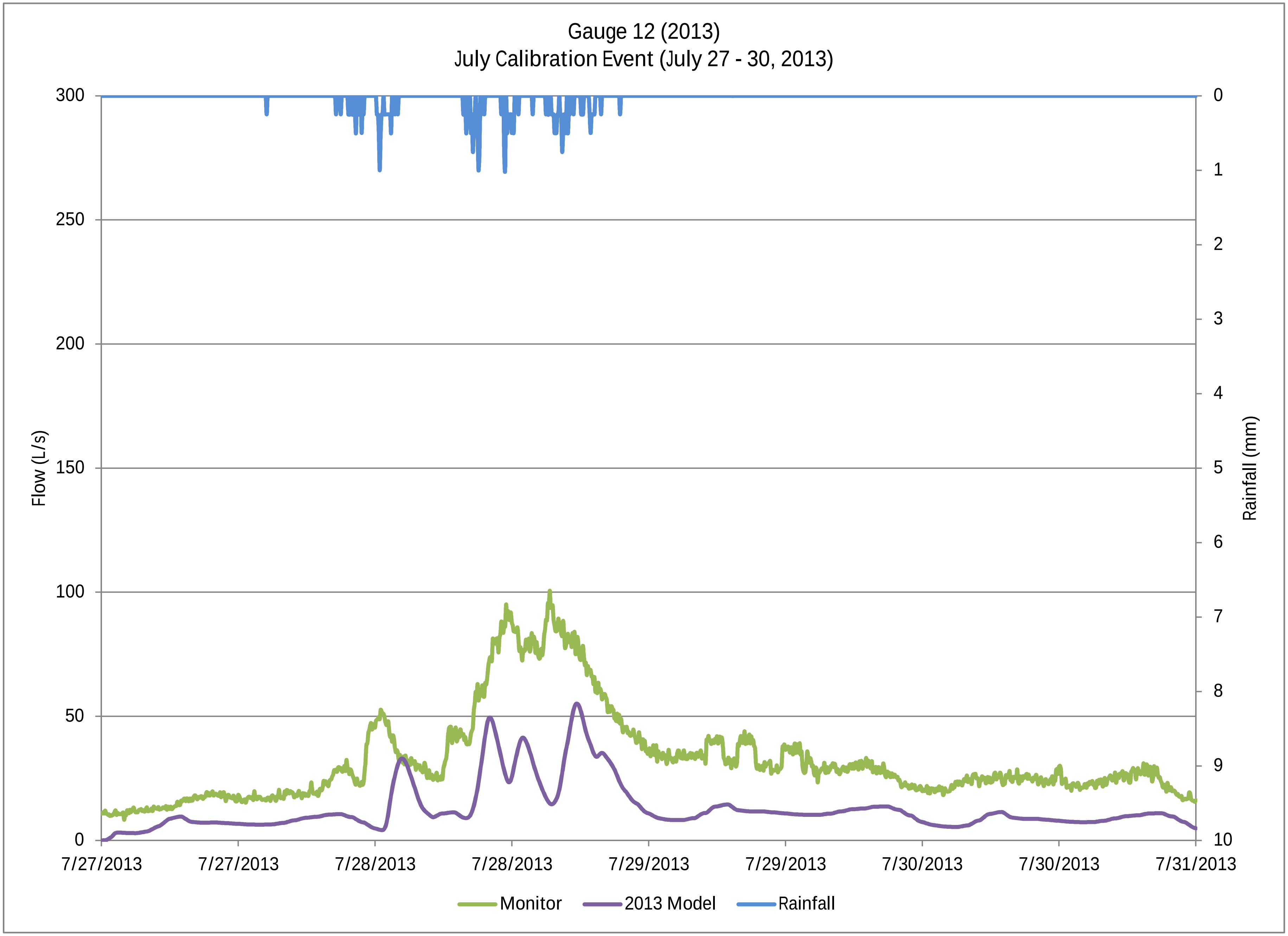
Rainfall



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Rainfall (mm)
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Monitor
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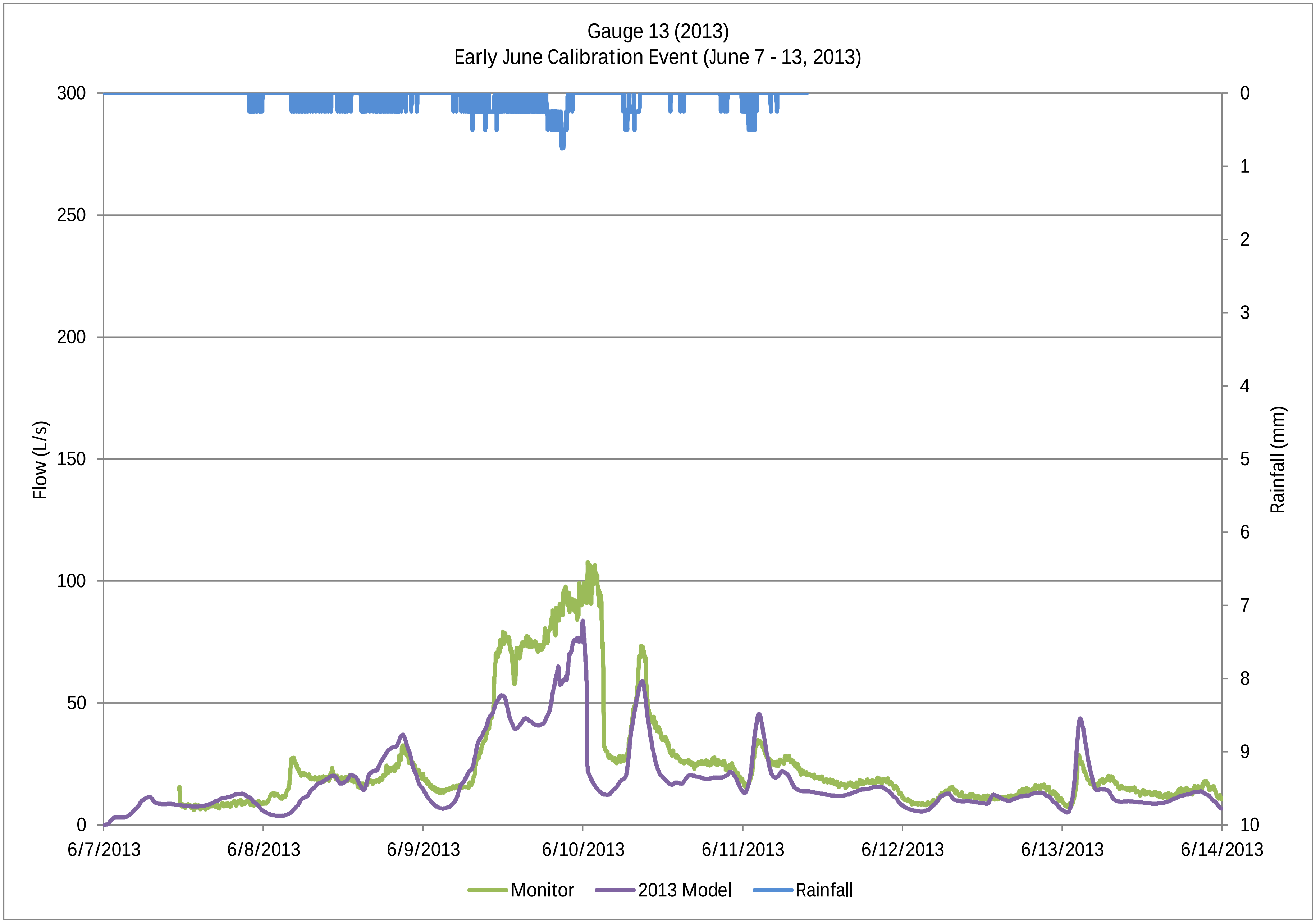
Rainfall



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Flow (L/s)
Rainfall (mm)
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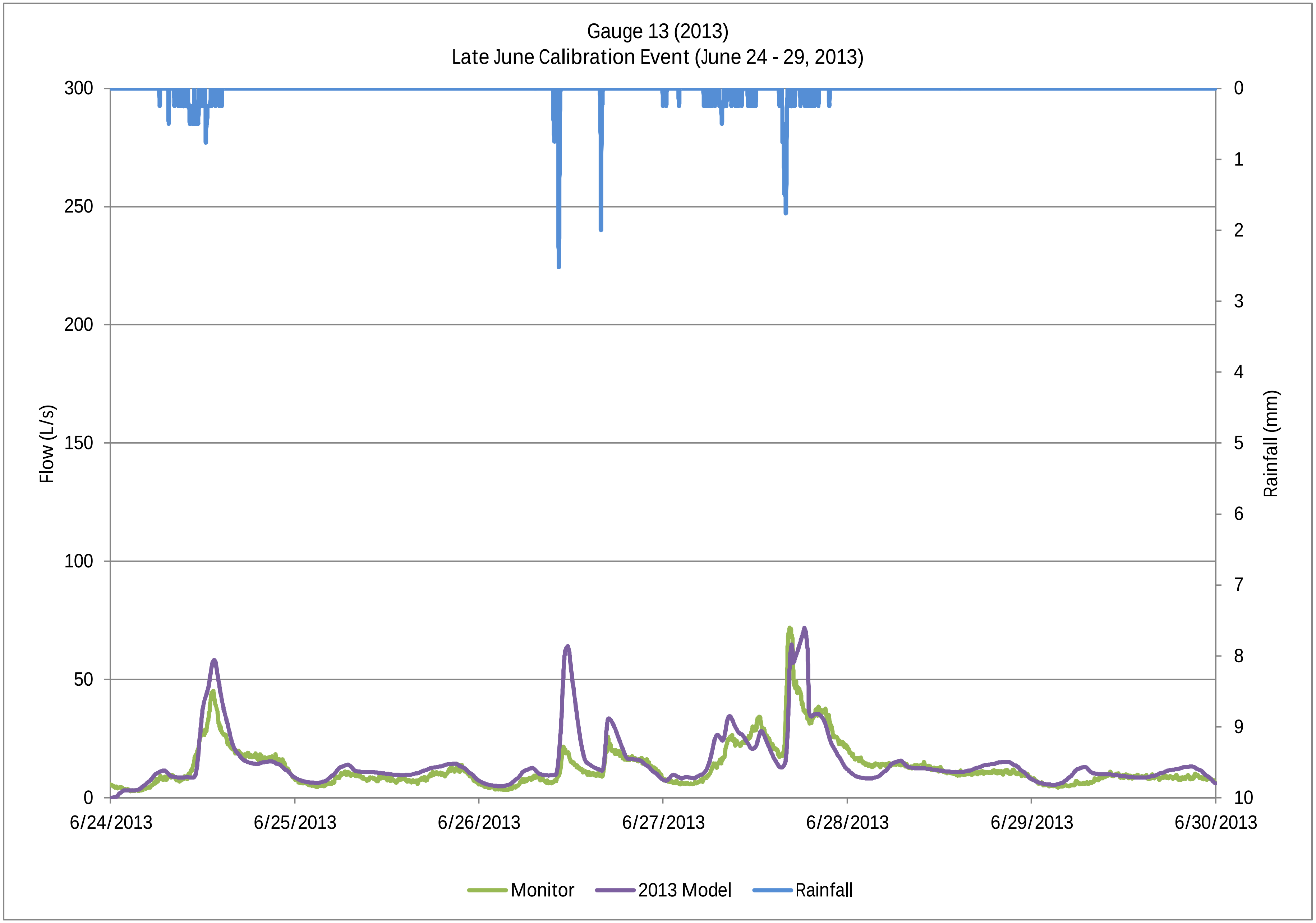
Monitor
2013 Model
Rainfall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Flow (L/s)
Rainfall (mm)
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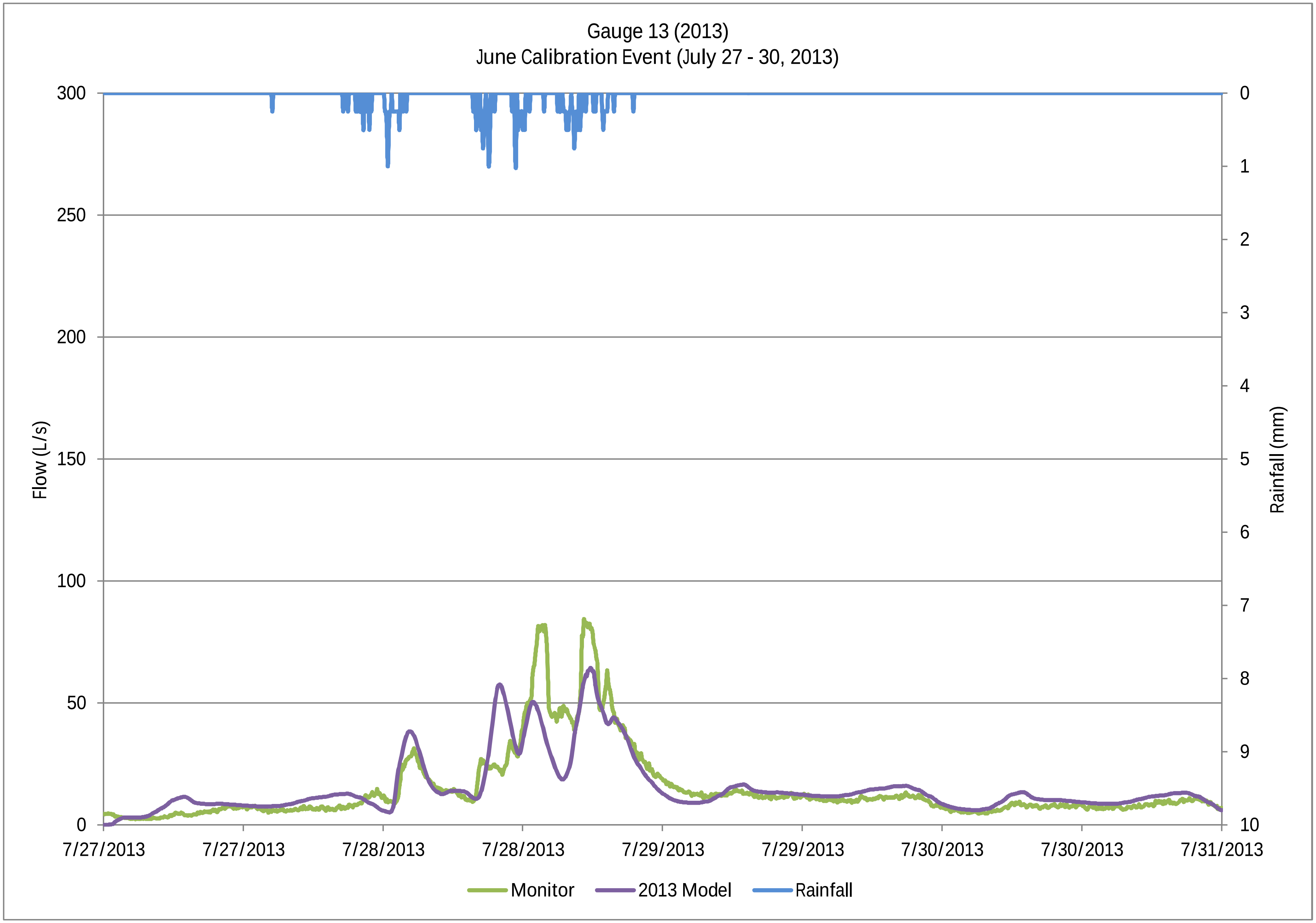
6/30/2013
Monitor
2013 Model
Rainfall


Gauge 13 (2013)
June Calibration Event (July 27 - 30, 2013)
Flow (L/s)
Rainfall (mm)
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7/31/2013
Monitor
2013 Model
Rainfall

TECHNICAL MEMORANDUM B.2.4

Regional Municipality of Wood Buffalo

Wastewater Master Plan

Lift Stations Evaluations

March 2014

Executive Summary

1 OBJECTIVE/PURPOSE

The objective of this task is to complete an evaluation of all of the lift stations within the urban jurisdiction of the Regional Municipality of Wood Buffalo (the “Municipality”). These lift stations are the connecting link between the collection system and the wastewater treatment facility (WWTF). Both of these are being evaluated under separate technical memos as part of the overall Wastewater Master Plan.

Twelve lift stations are currently being operated and maintained by the Municipality. The Airport lift station is due to be abandoned in the near future and was not evaluated. Three others, Gregoire Park, Mackenzie Industrial Park, and Waterways, are scheduled for upgrades, so these were only evaluated for flow capacities. The remaining eight have had complete investigations, including flows, mechanical, electrical/instrumentation, structural, and potential flooding concerns.

These evaluations will provide maximum flow capabilities, as tested, from each facility. In addition any concerns or recommended upgrades will be presented for further evaluation.

2 MAIN FINDINGS

- Of the eight facilities inspected, three (3) have potential flooding concerns, based on their location and elevations. They include Grayling Terrace, 1A (Father Mercredi), and Waterways.
- Structurally, most lift stations are in satisfactory condition. Some cracking is evident at Grayling Terrace, and 1A. There is some surface rust or corrosion evident at four of the facilities (Eco-Park, Prairie Creek, Grayling Terrace, and Wood Buffalo).
- There is a major electrical concern at the Abasand lift station. The wet well access is inside the building housing all the electrical/instrumentation equipment and wiring. If the gases from the wet well escape into the building, an electrical spark could ignite the gases and cause a fire or explosion. Many (5) of the other lift stations do not have intrinsically safe barriers for the level (Flygt) bulbs in the wet wells. These could also cause an explosion if gases built up in the wet well, and the level indicator cabling was damaged. There are also minor upgrades at some of the stations that should be implemented, including grounding concerns and non-functional instruments.
- From a flow/capacity perspective, only three of the stations have flow and pressure monitoring allowing proper testing of the pumps. The Eco-Park and Prairie Creek pumps are operating below their curves; Cornwall’s pumps are performing satisfactorily. Flow and pressure monitoring not only permits the capability to monitor pump performance, it also provides recording of flow volumes from each facility, which cumulatively provides loading on the wastewater treatment facilities. Maximum flows were obtained for each station; however, some of the facilities with variable speed pumps had the flow locked to a pre-set, reduced level. Increased flow is likely available if/when the pump controls are “unlocked”.

- Monorail beams and hoists inspection certifications have expired at several stations.

3 RECOMMENDATIONS

- Isolate the wet well access from the electrical equipment room at the Abasand lift station. The current installation is a potential explosion hazard, and violates the Canadian Electrical Code.
- Minor rust/corrosion repairs should be completed where obvious on both the concrete and exposed steel in the facilities to prevent further deterioration.
- Supply and install intrinsically safe barriers on the level switches to minimize the possibility of fire/explosion. This is an Electrical Code violation.
- Install flow meters and pressure gauges (or ideally, pressure transmitters) where feasible, and then re-test the pumps to provide a more accurate assessment of their performance vs. the design conditions. In addition, where pumps have been locked to a reduced speed, full speed testing should be completed to determine maximum available flow at those facilities. This work should be included in the upgrades of the Gregoire, Mackenzie Park, and Waterways lift stations.
- Supply and install fall protection (as per OH & S requirements) at those lift stations that have only open ladders in their wet wells.
- Inspect and certify monorail beams and hoists where certification has expired.

4 NEXT STEPS

Prioritization of Recommendations:

- Correct all of the Code violations.
- Lift stations #1B, #1A, and Cornwall have variable frequency drives on the pump motors. As part of the facility control programming, these have been locked at a speed lower than 100%. To accurately test these pumps, the programming should be unlocked to allow for full speed operation for verification of the pump operations, and determination of maximum output available at each station. As mentioned above, flow and pressure monitoring would be required to complete this testing.
- Complete corrosion repairs to concrete and exposed steel.

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List of Figures

1 Background

The Wastewater Collection Master Plan, originally completed in 2006, is an integral part of the updated Wastewater Master Plan (WWMP), currently being undertaken for the Regional Municipality of Wood Buffalo (Municipality). At the time of this assessment, the wastewater collection system plan is being updated. Part of the scope for the update is an evaluation of the lift stations. These facilities are the link between the collection system and the wastewater treatment facility (WWTF).

The resulting evaluation will help to determine the maximum existing pump capacity, and identify possible replacement or refurbishment requirements for the lift stations' equipment, specifically the pumps.

1.1 PURPOSE/METHODOLOGY

Site inspections were undertaken in early 2013 to evaluate the conditions of the lift stations. In addition to evaluation of the pumps and process mechanical equipment, the structural and electrical/instrumentation aspects were also examined.

A total of twelve lift stations are currently being operated and maintained by the Municipality:

1. Eco-Park – Tiaganova Lift Station
2. Prairie Creek Lift Station
3. Airport Lift Station
4. Lift Station #1B
5. Grayling Terrace Lift Station
6. Abasand – Riverview Heights Lift Station
7. Lift Station #1A – Father Mercredi
8. Cornwall – Thickwood Heights Lift Station
9. Wood Buffalo Lift Station
10. Gregoire Park Lift Station
11. Mackenzie Industrial Park Lift Station
12. Waterways Lift Station

The Airport lift station was not evaluated, as it is due to be abandoned in the near future. The last three stations, Gregoire Park, Mackenzie Industrial Park, and Waterways, were evaluated only for flow capacities. All three of these facilities are already scheduled to be upgraded. The flows were required to accurately calibrate the wastewater collection model.

Process mechanical, electrical/instrumentation and structural inspection reports are located in the Appendices of this technical memorandum. They examine the specific aspects of each discipline, and make recommendations for improvements or upgrades. The mechanical reports also include the testing of each pump, both individually and combined, to obtain the maximum output capability of each station.

To test each pump against its design point and overall pump curve, both flow and pressure readings are required. Only three of the lift stations (Eco-Park, Prairie Creek, and Cornwall) have both of these parameters measured. The remaining stations were tested for flow output, but it was not possible to determine if the pumps were operating as designed.

Some of the stations do not have flow meters. To test the pumps' output, the volume of the wetwell was calculated and a timed drawdown was performed. Since it was not possible to isolate the influent flow, the refill flow rate was also calculated and added to the pumping drawdown rate to determine the actual flow of each pump.

If the Municipality is able to make the modifications recommended above, it will be possible to re-test the facilities against their original design parameters. These recommendations include installation of pressure monitoring (discharge pressure as a minimum, preferably both suction and discharge), and flow measurement.

2 Eco-Park - Tiaganova Lift Station

The Eco-Park – Tiaganova Lift Station is located in a light industrial area, just north of the WWTF. The facility was constructed in 2010 and is in very good working condition. Process mechanical, structural, and electrical/ instrumentation inspections were completed on August 21, 2013. Detailed inspection reports can be found in Appendix A.

Figure 2-1
ECO-Park (Tiaganova) Lift Station

2.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed; both with constant speed motors.
- Operation is duty/standby.
- The maximum output capacity of the lift station is 48 L/sec.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of 57 L/sec. from the lift station.

Pump Number	Maximum Flow L/sec.	Pump Discharge Pressure, kPa
SWP-401	48	260
SWP-402	48	260

2.2 ELEVATION

- Top of floor: 247.5 m.
- Access platform: 249.1 m.
- Flood level: 250.0 m.
- Flood concern: Minimal (refer to note below).

The generator and (bottom of) the electrical panels are elevated approximately 3 m above the existing ground level to minimize the effects if flooding should occur. The area surrounding the lift station is asphalt and is sloped away from the facility to maximize drainage.

2.3 CONDITION

2.3.1 Mechanical

- Station is new – all equipment is in good working condition.
- HVAC functions as designed.
- Pumps are slightly below the design point of their curves. Pump SWP-402 produces approximately 10% less than SWP-401.
- The pressure gauge on P-401 reads approximately 45 kPa higher than the pressure transmitter.

2.3.2 Electrical/Instrumentation

- The wet well level transmitter is not installed permanently. The bolts to fasten it down are sitting in the adjacent cable tray.
- Level indicator (Flygt) bulbs do not have intrinsically safe barriers. If there is a build-up of gases in the wet well and a level indicator cable is damaged, a spark could cause an explosion.
- The power meter is not functioning properly. Voltage is shown, but current and power readings are not indicated.
- MAU-501 (the main supplier of heating and ventilation for the dry well) did not turn on when the thermostat was adjusted.

2.3.3 Structural

- Concrete is in good condition; minimal cracking, spalling or rebar corrosion.
- Structural steel supports are in good condition, with corrosion.
- Concrete walls in the dry well have minor cracking in patch repairs and water staining at form tie patches and in the south wall.

- Minor cracks in concrete root slab of wet well.
- Rust staining in antennae foundation.
- Section of metal siding missing on south exterior wall.

2.4 CONCERNS

- Minor items as listed in Section 2.5 Recommendations.

2.5 RECOMMENDATIONS

- Evaluate differential in pressure readings between gauge and transmitter when pump SWP-401 is operating.
- Remove/repair surface corrosion on dry well steel platform beams and bolts.
- Monitor concrete cracks in dry well walls for any (further) deterioration.
- Chip out and re-patch form-tie holds in the dry well walls at the water stains.
- Seal cracks in the wet well concrete roof slab.
- Replace section of exterior cladding on south wall at bottom where it has come off.
- Install intrinsically safe barriers for the Flygt bulbs.
- Repair controls for MAU-501.
- Repair power meter.
- Bolt down wet well level transmitter.

3 Prairie Creek Lift Station

The Prairie Creek lift station is located in a residential area, south of Highway 69 (enroute to the airport). The facility was constructed in 2000 and is in good working condition. Process mechanical, structural, and electrical/instrumentation inspections were completed on August 21, 2013. Detailed inspection reports can be found in Appendix B.

Figure 3-1
Prairie Creek Lift Station

3.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed, both with constant speed motors.
- The operation is duty/standby.
- The maximum output capacity of the lift station is 32 L/sec.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of 37 L/sec. from the lift station.

Pump Number	Maximum Flow L/sec.	Pump Discharge pressure, kPa
P-1	32	300
P-2	32	30

3.2 ELEVATION

- Record drawing: Floor is 375.25 m.
- Flood concern: Minimal.

The area is approximately 125 m above the flood plain. The finished floor of the pumphouse is approximately 300 mm above the surrounding ground. The area is landscaped to drain away from the lift station.

3.3 CONDITION

3.3.1 Mechanical

- Pumps are operating below their curves.
- Pressure gauge on the main floor is not functional; used gauge in lower, restricted access area of discharge piping for the pumps' testing.
- Pressure gauge reading fluctuates rapidly between 20-40 psi, when P-2 operates.
- Fittings, valves, etc. in the drywell are beginning to show rust.
- Maximum flow with 2 pumps running is not much higher than one pump operating.

3.3.2 Electrical/Instrumentation

- Power meter is not fully functional. The current reading was not indicated.
- Flygt bulbs do not have intrinsically safe barriers. If there is a build-up of gases in the wet well and a level indicator cable is damaged, a spark could cause an explosion.
- The PLC controller (Magelis) is obsolete and has broken control buttons.

3.3.3 Structural

- Concrete is in overall good condition with the exception of shrinkage cracks in the main floor of the drywell.

- Monorail beam has some surface rust on the exterior portion.
- Building is in good condition.
- Ladder access to dry well valve pit is difficult with the existing ladder and handrail.

3.4 CONCERNS

- Determine why the pressure reading fluctuates significantly for only one pump.

3.5 RECOMMENDATIONS

- Investigate why the pressure gauge fluctuates for only one pump.
- Install a pressure transmitter on the discharge line.
- Replace the PLC controller.
- Install intrinsically safe barriers for the Flygt bulbs.
- Seal the cracks in the main floor slab in the drywell.
- Clean up all surface corrosion on the monorail, valves, fittings, etc.
- Improve hand holds to access dry well valve pit.

4 Airport Lift Station

The Airport lift station is located in the parking lot at the municipal airport. Evaluation of this facility was not undertaken, as the station is scheduled to be abandoned in the near future (2014).

5 Lift Station #1B

The #1B lift station is located south of Prairie Loop Boulevard and west of Franklin Avenue. The facility was constructed in 2007 and is in very good condition. A process mechanical inspection was done on September 18, 2013. The structural and electrical inspections were completed October 4, 2013. Detailed inspection reports can be found in Appendix C.

Figure 5-1
1B Lift Station

5.1 CAPACITY/FLOWS/EFFICIENCY

- The station has four pumps installed; all of them have variable frequency drives. All of the pumps are locked to run at 45 Hz. (full speed is 60 Hz.). This corresponds to 75% of the design flow for each pump.
- Operation of the pumps is lead/lag/2nd lag. The 4th pump is a standby pump. The lead pump designation shifts each time the station cycles.
- The maximum output capacity of the lift station, with three pumps running, is 402 L/sec. However, not all the pumps were operating at full speed.

Pump Number	Maximum Flow, L/sec.
P-101	183
P-102	171
P-103	184
P-104	188
P-103 + P-104	342
P-104 + P-101	275
P-101 + P-102	288
P-102 + P-103	297
P-101 + P-103	307
P-104, 101, 102	326
P-101, 102, 103	390
P-102, 103, 104	402
P-103, 104, 101	401

5.2 ELEVATION

- Floor: 252 m.
- Flood concern: Minimal.

The lift station is located higher than the surrounding ground and is graded to slope away from the facility.

5.3 CONDITION

5.3.1 Mechanical

- Piping, valves, etc. are in good condition and there is minimal rusting.
- Unable to get a pressure reading to compare operating conditions to curves, but the individual flow readings taken correspond well to the design flow.

5.3.2 Electrical/Instrumentation

- Transfer switch interlinking cables are not adequately supported.
- The Panduit covers are missing from the VFD cubicles.
- Isolator handles on the VFDs for P-103 and P-104, do not engage.
- Two exterior electrical outlet boxes are unfinished and exposed.

5.3.3 Structural

- Gas and electrical lines penetrating walls need to be sealed.
- The certification period for both cranes has expired.
- Generator slab concrete is spalling.
- Wet well ladder does not have a cage or any fall protection.
- Exterior repairs to siding, stone façade, and eavestrough's downspout are required.
- Exterior fibreboard around foundation is deteriorating.
- Exterior wood siding is damaged and deteriorating.
- Cracks in vertical trim and stone and mortar.
- A section of the guardrail is missing at the south floor hatch.
- Wet well door stop steel angle is corroded.

5.4 CONCERNS

- Operating 3 pumps simultaneously only provides a marginal flow increase over 2-pump operation.
- There is an inconsistency in the lag pumps' responses. Sometimes, the lag pump operates at 45 Hz and other times, it operates at 60 Hz. This same anomaly also occurs when three pumps are run concurrently.

5.5 RECOMMENDATIONS

- Install a pressure transmitter or gauge to monitor the pumps' performance.
- Investigate inconsistency in lag pumps' response, i.e., full speed vs. reduced speed.
- Obtain pump design conditions from the Municipality to confirm design vs. actual operation of pumps.
- Finish electrical work on exterior outlet boxes.
- Caulk gas and electrical lines at wall penetrations.
- Re-certify the monorail cranes.
- Repair concrete as required.
- Tidy up the wiring in the transfer switch panel.
- Repair side, insulation, stone façade, and eavestrough's downspout as required.

6 Grayling Terrace Lift Station

The Grayling Terrace lift station is located on the south side of the City, on Grayling Crescent, west of Highway 63. The facility was constructed in 1982.

A process mechanical inspection was done on September 18, 2013, and the structural and electrical inspections were completed on October 4, 2013. Detailed inspection reports can be found in Appendix D.

Figure 6-1
Grayling Terrace Lift Station

6.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed, both with constant speed motors.
- The operation is duty/standby.
- Since there is no flow, pressure, or level monitoring, the pump flows were calculated by timing a laser distance measured drawdown of the wet well, along with a timed, measured re-fill.
- The output capacity of the lift station is 16 L/sec.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of 29.5 L/sec. from the lift station.

Pump Number	Average Flow, L/sec.
1	16
2	15

6.2 ELEVATION

- The 1982 record drawings indicate the top of step elevation is 254.4 m. A portable GPS reading indicated that same elevation to be 241 m. With a flood plain elevation of 250 m, the record drawing elevation should be checked. The lift station is situated in a low area, at the bottom (south) end of

Abasand Drive. Preventative measures were required when the City experienced the severe flooding conditions earlier in 2013.

- Flood concern: Severe.

6.3 CONDITION

6.3.1 Mechanical

- There is no flow meter, pressure indication, or level transmitter. Flow was calculated using a timed laser level measurements, in the wet well during drawdown.
- Flows are mid-curve, but cannot confirm if pumps are operating as designed.
- Some rusting evident in wet well.

6.3.2 Electrical/Instrumentation

- Electrical penetrations in wet well wall are not sealed.
- Cables in the PLC panel and HVAC system are not mechanically protected.
- Grounding was done through conduits.
- The PLC processor power supply was operating at 50^{o}C, which is very high for electronics.
- Flygt bulbs do not have intrinsically safe barriers. If there is a build-up of gases in the wet well and a level indicator cable is damaged, a spark could cause an explosion.

6.3.3 Structural

- Cracks are evident in masonry block wall that go through entire wall.
- There is no safety cage/fall protection for wet well ladder.
- There is no safe work load or inspection sticker for the monorail hoist in the wet well.
- There is peeling paint and graffiti that requires a clean-up.
- Letters are missing from the station's identification sign.
- There is a large space in the dry well entrance apron slab.

6.4 CONCERNS

- No flow, pressure, or level recording.
- Elevations on record drawings do not reflect the actual conditions. According to the record drawings, there should not be any flooding concerns; however, actual events in early 2013 have indicated otherwise.
- The station is over 30 years old. Consideration should be given to upgrading or replacing the old equipment, as it is unlikely that spare parts are available.

6.5 RECOMMENDATIONS

- Add flow, pressure, and level recording to monitor operation and efficiency of pumps.
- Install intrinsically safe barriers for the Flygt bulbs.

- Replace the PLC power supply if operating temperatures indicate overloading.
- Confirm the adequacy of the grounding.
- Repair cracks in the exterior walls.
- Inspect/certify the monorail crane.
- Provide fall protection for wet well entry.
- Replace letters on the exterior sign.
- Pat space in apron slab.

7 Abasand - Riverview Heights Lift Station

The Abasand lift station is located in the southwest end of the City, on Athabasca Avenue. The facility was constructed in 2005 and is generally in good operating condition.

A process mechanical inspection was done on September 18, 2013. The structural and electrical inspections were completed on October 4, 2013. Detailed inspection reports can be found in Appendix E.

Figure 7-1
Abasand (Riverview Heights) Lift Station

7.1 CAPACITY/FLOWS/EFFICIENCY

- The lift station has two pumps installed, both with constant speed motors.
- The operation is duty/standby.
- Pressure indication does not exist at this facility; could not confirm pumps' design operation.
- The output capacity of the lift station is 37 L/sec.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of 47 L/sec. from the lift station.

Pump Number	Maximum Flow, L/sec.
1	29.9
2	37.8

7.2 ELEVATION

- Floor elevation, from a portable GPS unit, is 321 m. The record drawings show the floor elevation to be 16.7 m, which does not correspond to any geodetic values. This facility is located on a hill in the southwest section of the City, approximately 70 m above the flood plain. It is elevated with respect to its surroundings, providing good drainage.
- Flood concern is minimal.

7.3 CONDITION

7.3.1 Mechanical

- Piping, valves, etc. are in good condition; there is minimal rusting at flanges and bolts.
- HVAC functioning satisfactorily. Furnace was operating with front cover removed.
- Obtained flow and level readings, but not pressure readings.

7.3.2 Electrical/Instrumentation

- There is evidence of a previous capacitor failure (burnt cable and debris).
- The conduits are used for grounding.
- The power supply to the PLC panel runs through the pump starter panel.
- Unprotected cables were run in the roof area.

7.3.3 Structural

- Large shrinkage cracks in the main floor slab.
- No safety cage/fall protection to enter wet well.
- Monorail crane past its inspection due date.
- Voids and segregation in exterior concrete foundation.
- Corrosion on the generator exhaust pipe.
- Bent metal molding on the door.

7.4 CONCERNS

- Wet well access inside the electrical room is potentially explosive. If gases escape through the access hatches, a spark could ignited the gases causing a fire.
- Having a pressure reading would provide a method to compare the pumps' operation to its original design parameters. The original design conditions would also be required.
- The output of pump #2 is approximately 25% higher that the output of Pump #1.

7.5 RECOMMENDATIONS

- Utilize fall protection system to access wet well.
- Isolate the wet well access from the electrical/equipment room; currently a code violation.

- Install a pressure transmitter or gauge.
- Upgrade the wiring.
- Complete further testing of both pumps to determine why there is a 25% difference in performance. (Check current draw, check if impellers are fouled, etc.)
- Inspect/recertify monorail crane.
- Seal cracks in main floor slab and repair spalled concrete and voids in concrete foundation.
- Remove rust from generator exhaust pipe and repaint with heat resistant paint.
- Seal shrinkage cracks in floor slab.
- Repair bent molding on door.

8 Lift Station #1A – Father Mercredi

The 1A (Father Mercredi) lift station is located at the end of Father Mercredi Street on the east side of the City, adjacent to the Athabasca River. The facility was constructed in 1977, and is in generally good working condition. Upgrades (the addition of two larger pumps) were recently completed in 2012.

A process mechanical inspection was done September 19, 2013, and the structural and electrical inspections were completed on October 4, 2013. Detailed inspection reports can be found in Appendix F.

Figure 8-1
#1A (Father Mercredi) Lift Station

8.1 CAPACITY/FLOWS/EFFICIENCY

- The station has four pumps installed. The two original pumps, RSP-001 and 002, have constant speed 480 V motors. The two new pumps, RSP-003 and 004, have variable frequency drives with 600 V motors. The new pumps are locked to run at 42.6 Hz (71.5% of design flow).
- Operation is lead/lag with the two new pumps only. Old pumps are in AUTO for standby service.
- RSP-001 and 002 are operating above their design point. RSP-003 and 004 flows, when converted to full speed (60 Hz) equivalents, are slightly below their design point. Addition of a third pump, operating concurrently, provided only a minimal increase (6%) in flow and was not tested further.

- The maximum output capacity of the lift station is approximately 530 L/sec. However, not all the pumps were running at 100% speed.
- Testing was performed by the RMWB in April, 2013 with three pumps, which resulted in a net increase in flow of only 6%. Because of this negligible increase, testing was not done with 3 pumps.

Pump Number	Maximum Flow, L/sec.
RSP-001	459
RSP-002	413
RSP-003	370
RSP-004	357
RSP-003 + 002	516
RSP-004 + 002	520
RSP-003 + 001	505
RSP-004 + 001	530
RSP-003 + 004	515

8.2 ELEVATION

- Floor elevation, recorded with a portable GPS unit, is 247 m.
- Floor elevation, from 2012 record drawings, is 249.02 m.
- Flood concern: Significant, but a berm (approximately 2-3 m high) has been constructed around the facility to reduce the risk.

8.3 CONDITION

8.3.1 Mechanical

- Piping, valves, etc. are in good condition.
- Two new, larger pumps were recently added.
- Flow and level readings were available, but pressure monitoring was not.

8.3.2 Electrical/Instrumentation

- Poor identification/labelling between the 600 V. and 480 V. equipment.
- No site ground was found.
- Level switches (Flygt bulbs) do not have intrinsically safe barriers. If there is a build-up of gases in the wet well, and a level indicator cable is damaged, a spark could cause an explosion.
- Filters on VFD cabinet doors are dirty.

8.3.3 Structural

- Minor concrete spalling of foundation around the double doors.
- There are shrinkage cracks in main slab and wet well wall.

- No ratings or inspection stickers for the monorails.
- Uncovered openings (pipe in wetwell and hole in dry well) in the floor, which could allow things to fall through.
- Graffiti is evident on all the exterior walls.

8.4 CONCERNS

- To confirm pump operation, the discharge pressure indication is required.
- Electrical labelling is unclear.
- The 480 V. equipment is nearing the end of its useful life.
- As per RMWB testing, there is no significant increase in flow with three pumps over two pumps.

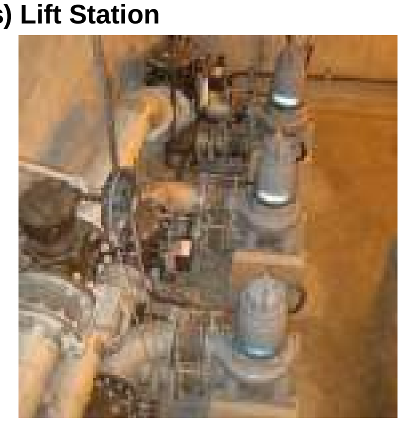
8.5 RECOMMENDATIONS

- Conduct additional testing to confirm maximum flow with 3-pump operation.
- Provide proper grounding.
- Clean/replace the VFD cabinet filters.
- Install intrinsically safe barriers on the level switches to reduce explosion hazard.
- Provide pressure monitoring.
- Have monorails inspected/re-certified.
- Repair spalled concrete in foundation. Monitor other cracks.
- Clean-up or remove the graffiti.
- Cover opening in main floor slabs to prevent things falling into the wet well.

9 Cornwall - Thickwood Heights Lift Station

The Cornwall (Thickwood Heights) lift station is located on Cornwall Drive in the Thickwood area. The facility was constructed in 1976, and generally, is in good working condition. Mechanical upgrades (replacement of the pumps and interior piping) were completed in 2012. The process mechanical, structural, and electrical inspections were completed on August 21, 2013. Detailed inspection reports can be found in Appendix G.

Figure 9-1
Cornwall (Thickwood Heights) Lift Station



9.1 CAPACITY/FLOWS/EFFICIENCY

- The station has three pumps installed; each has a variable speed drive.
- Operation is lead/lag, with a standby pump. The lead pump rotates through all three pumps, changing with each pump cycle.
- The first two trials with two pumps running had one pump running at 43 Hz and the second pump running at 48 Hz. The third trial (002 + 003) had one pump running at 43 Hz and the second at 60 Hz. This accounts for the increase in flow and pressure for that trial.
- The first trial with three pumps running had the lead operating at 43 Hz and the other two at 60 Hz. The other two trials had the lead pump running at 43 Hz, second pump running at 48 Hz, and the third pump running at 60 Hz. This may be a programming discrepancy.
- The maximum output capacity of the lift station in its current configuration is approximately 97.9 L/sec., with pumps RSP-002 & 003 in operation. However, to obtain maximum installed flow, all pumps should be operating at 100% speed.
- In an emergency situation, the standby pump can be operated simultaneously with the lead and lag pumps to provide a maximum flow of 107 L/sec. from the lift station.

Pump Number	Maximum Flow L/sec.	Pump Discharge pressure, kPa
RSP-001* (155)	51.9	69 - 67
RSP-002* (153)	52.0	69 - 67
RSP-003* (154)	49.9	67 - 66
RSP-002* + 001	80.0	94 - 89
RSP-003* + 001	78.6	94 - 90
RSP-002* + 003	97.9	118 – 115

* Denotes lead pump, always operating at 43 Hz.
(Bracketed) number denotes the manufacturer's pump/curve tagging.

9.2 ELEVATION

- Floor elevation, recorded with a portable GPS unit, is 360 m.
- The station is located on the hill in Thickwood, approximately 110 m above the flood plain. The area is relatively level, but flooding should not be an issue.
- Flood concern: Minimal.

9.3 CONDITION

9.3.1 Mechanical

- Mechanical equipment has recently been refurbished. All equipment is in good condition and operating as designed.

- Pump speeds are inconsistent when operating in tandem. One set of trials had one pump operating at full speed; a second trial had two pumps operating but both at reduced speeds. This may be due to a programming discrepancy.
- Pumps individually are running close to the best efficiency points on their curves.
- Check air balance. There is a dust build-up in the ceiling vent in the wet well entrance.

9.3.2 Electrical/Instrumentation

- Flygt bulbs do not have intrinsically safe barriers. If there is a build-up of gases in the wet well, and a level indicator cable is damaged, a spark could cause an explosion.
- The power meter was not fully functional. There were no current readings displayed.
- Generator test button was not functional.

9.3.3 Structural

- Concrete walls and floors are overall in good condition.
- Apron slab is in poor condition, with a major crack and large spall.
- Paint is peeling at louvre wood slats.
- Bolts in dry well walls are cut-off and exposed.

9.4 CONCERNS

- The control philosophy for the pumps' speeds is inconsistent when operating multiple pumps.

9.5 RECOMMENDATIONS

- Fix the programming issue that is causing inconsistent pump speeds.
- Test pumps all running at full speed to obtain maximum flow available from station.
- Provide intrinsically safe barriers for Flygt bulbs.
- Check air balance between wet well and dry well.
- Repair the apron slab at the entrances.
- Complete general repair/touch-up for louvres, panels, and bolts.
- Paint ends of cut-off bolts in dry well walls.

10 Wood Buffalo Lift Station

The Wood Buffalo lift station is located on Woodward Lane in the Thickwood area. The facility was constructed in 2001, and is in good working condition.

Process mechanical inspection was done on September 19, 2013. The structural and electrical inspections were completed on October 4, 2013. Detailed inspection reports can be found in Appendix H.

Figure 10-1
Wood Buffalo Lift Station

10.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed; each has a variable speed drive.
- Operation is duty/standby.
- Both submersible pumps are driven with variable speed drives for the motors. All pump cycles tested were operating at 100% speed.
- Since there is no flow or pressure monitoring, pump flows were calculated by timing a measured drawdown of the wet well, along with a timed re-fill.
- The maximum output capacity of the lift station is approximately 52 L/sec.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of approximately 114 L/sec. from the lift station.

Pump Number	Maximum Flow, L/sec.
Pump #1	52.1
Pump #2	52.3

10.2 ELEVATION

- Grade elevation, recorded with a portable GPS unit, is 363 m.
- Grade elevation, from 1999 record drawings, is 358.6 m.
- The lift station is located on the hill in Thickwood, approximately 113 m above the flood plain. All critical equipment is elevated an additional 0.89 m above the surrounding ground level.
- Flood concern: Minimal.

10.3 CONDITION

10.3.1 Mechanical

- Facility is in good operating condition.
- Only level readings are available; there is no flow or pressure indication. Flow rates were calculated with timed drawdowns and timed refills.

10.3.2 Electrical/Instrumentation

- Wet well equipment (heaters, switches and receptacles) do not meet the Canadian Electrical Code Part I, Section 18, in accordance with Class I, Zone 2.
- Blackening noted on VFD and output filter cables, indicating hydrogen sulfide exposure.
- Grounds for motors not terminated on their respective VFDs.

10.3.3 Structural

- Generally good; some minor repairs necessary to cuts and perforations in exterior cladding.
- Monorails certification has expired.
- No fall protection (ladder cage) for wet well entry.
- Minor corrosion on exterior handrails.
- Minor graffiti on back wall.
- Paint peeling on dry well door.

10.4 CONCERNS

- Wet well wiring does not meet code.
- Pump design points are required to confirm if the pumps are operating as originally designed.
- Flow and pressure monitoring is also required to test pump design vs. actual operation.

10.5 RECOMMENDATIONS

- Rewire wet well and replace equipment.
- Terminate motor grounds to their respective VFDs.
- Install flow and pressure monitoring.
- Repair cuts and perforations in exterior cladding.
- Clean-up and repaint handrails and wet well ladder.
- Re-certify the monorail crane.

11 Gregoire Park Lift Station

The Gregoire Park lift station is located behind the residences on the north loop of Gregoire Crescent. The facility, constructed in 1976, is in poor working condition.

Process mechanical inspection was done October 9, 2013; no structural or electrical inspections were completed, since the station is scheduled to be upgraded. An inspection report can be found in Appendix I.

Figure 11-1
Gregoire Park Lift Station

11.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed; both with constant speed motors. Pump #2 also has a natural gas engine drive as a back-up to the motor.
- Operation is duty/standby.
- Since there is no flow, pressure or level monitoring, pump flows were calculated by timing a laser distance measured drawdown of the wet well, along with a timed, measured re-fill.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of approximately 40 L/sec. from the lift station.

Pump Number	Maximum Flow, L/sec.
Pump #1	34
Pump #2	33

11.2 ELEVATION

- Floor elevation, recorded with a portable GPS unit, is 364 m.
- Flood concern: Minimal.

11.3 CONDITION

11.3.1 Mechanical

- Two pumps, one motor driven; the other has both a motor and a natural gas engine drive.
- Pump #1 is leaking severely at its seals.
- During initial testing, pumps were cycling every minute.
- Substantial rusting on all equipment, fittings, valves, and piping.

11.4 CONCERNS

- Laser measurement, combined with varying influent rates, provides limited accuracy for flow measurements.

12 Mackenzie Industrial Park Lift Station

The Mackenzie Industrial Park lift station is located on MacKenzie Boulevard, just east of Highway 63. The facility was constructed in 1976 and is in fair working condition.

Process mechanical inspection was done on October 9, 2013; structural or electrical inspections were not completed, since the station is scheduled to be upgraded. An inspection report can be found in Appendix J.

Figure 12-1
Mackenzie Industrial Park Lift Station

12.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed; both with constant speed motors. Pump #2 also has a natural gas engine drive as a back-up to the motor.
- Since there is no flow, pressure or level monitoring, pump flows were calculated by timing a laser distance measured drawdown of the wet well, along with a timed, measured re-fill.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of 52 L/sec. from the lift station.

- Operation is duty/standby.

Pump Number	Maximum Flow, L/sec.
Pump #1	52
Pump #2	46

12.2 ELEVATION

- Floor elevation, recorded with a portable GPS unit, is 376 m.
- Flood concern: Minimal.

12.3 CONDITION

12.3.1 Mechanical

- Two pumps, one motor driven; the other pump has both a motor and a natural gas engine drive.
- Pressure gauges on the pump discharges are not functioning.
- Substantial rusting on all equipment, fittings, valves, and piping.

12.4 CONCERNS

- Laser measurement, combined with varying influent rates, provides limited accuracy for flow measurements.

13 Waterways Lift Station

The Waterways lift station is located on the corner of McCormick Drive and Railway Avenue. The facility was constructed in 1976 and is in poor working condition.

A process mechanical inspection was done on October 9, 2013. Structural or electrical inspections were not completed, since the station is scheduled to be upgraded. An inspection report can be found in Appendix K.

Figure 13-1
Waterways Lift Station

13.1 CAPACITY/FLOWS/EFFICIENCY

- The station has two pumps installed; both with constant speed motors. Pump #2 also has a natural gas engine drive as a back-up to the motor.
- Operation is duty/standby.
- Since there is no flow, pressure or level monitoring, pump flows were calculated by timing a laser distance measured drawdown of the wet well, along with a timed, measured re-fill.
- In an emergency situation, the standby pump can be operated simultaneously with the duty pump to provide a maximum flow of 41 L/sec. from the lift station.

Pump Number	Maximum Flow, L/sec.
Pump #1	32.5
Pump #2	37.3

13.2 ELEVATION

- Floor elevation, recorded with a portable GPS unit, is 252 m.
- Flood concern: Probable. It is located near the Athabasca River (west).

13.3 CONDITION

13.3.1 Mechanical

- Two pumps, one motor driven; the other has both a motor and a natural gas engine drive.
- Pressure gauges on pump discharges are not functional.
- Substantial rusting on all equipment, fittings, valves and piping.

13.4 CONCERNS

- Laser measurement, combined with varying influent rates, provides limited accuracy for flow measurements.

Closure

This report was prepared for the Regional Municipality of Wood Buffalo Wastewater Master Plan to present the evaluations of all of the lift stations within the urban jurisdiction of the Regional Municipality of Wood Buffalo.

The services provided by Associated Engineering Alberta Ltd. Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd. Ltd.

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ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature: Erin Asselin
Date: March 12, 2014.

APEGA Permit to Practice P 3979

Appendix A – Eco-Park - Tiaganova Lift Station

Appendix A contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 5
COMPONENT:	Infrastructure Assessment	DATE:	August 21, 2013		
LOCATION:	Eco Park Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Structural Comments, and Recommendations

I was on site at Eco Park Sewage Lift Station (Taiganova) on Wednesday August 21, 2013 to conduct a structural assessment of the station. The Wet Well and Dry Well below grade have a reinforced concrete slab foundation and reinforced concrete walls. The main floor slab/roof slab is a reinforced concrete structural slab. Access to the Dry Well is provided by a structural steel spiral staircase and intermediate access platforms supported from the walls and HSS columns. Access to the Wet Well is by steel ladder with safety cage. Walls for the Lift Station above grade are reinforced concrete with exterior metal siding. The EL 249.1 platform above the main floor slab is a structural slab supported on reinforced concrete columns with access provided by structural steel stairs. The single gabled roof is constructed of Pre-Engineered wood trusses, exterior metal deck and plywood ceiling. The main floor is equipped with a one tonne capacity monorail. Access to the building is through a steel double door on the north side of the building.

The reinforced concrete foundation slab at the bottom of the Dry Well is in good condition with no signs of cracking, spalling or rebar corrosion. The sump pit is in good condition. The reinforced concrete pump foundations and thrust blocks are in good condition. The reinforced concrete walls in the Dry Well are in fair condition but have repair patches in several locations. One patch at the foundation level in the northwest corner has minor shrinkage cracks that should be monitored to see if they get worse. There is evidence of water seepage and staining on the south wall at platform EL. 239.94 but no cracks were observed. There were a few form tie patch locations that showed evidence of water seepage that could cause the patches to deteriorate and need replacement. These areas should be monitored for progressive deterioration.
The reinforced concrete interior main floor slab, EL 249.1 platform slab and support columns are all in good condition. The structural steel stairs, platforms and handrails are generally in good condition. There is some corrosion on some of the EL 239.94 platform channels and structural bolts that should be cleaned up and painted. The plywood ceiling is in good condition. The roof trusses were not accessible for inspection.
The monorail is in good condition.

The reinforced concrete apron slab at the north entrance doors is in good condition. There are some minor hairline cracks in the main floor slab at the door threshold. The steel double doors are in good condition.
The metal wall siding is in good condition with some minor areas on the louvers where paint is peeling and should be touched up. A section of siding is missing at the bottom of the wall on the south side and should be replaced. The steel double doors are in good condition. There is some minor corrosion on the siding bottom flashing at the door entrance that should be removed and touched up. The building envelope, including metal siding and roof deck, is generally in good condition. Eavestrough and downspouts are in good condition.

The inside of the Wet Well was visually inspected from the top access hatch only, because it was designated as confined space access only. The access hatch and access ladder and safety cage appear to be in good condition. The concrete roof slab near the access hatch has several shrinkage cracks greater than 0.3 mm wide. These cracks should be sealed as they have external exposure and in time could become wider and spall the concrete exposing the rebar.

The antennae concrete foundation has rust staining from some of the form tie hole patches. This should be cleaned up and tie hole chipped out and re-patched to seal it off from moisture ingress.

The general condition of the station structure is good except for the minor issues mentioned previously that require maintenance.

Recommendations

1. Monitor the condition of cracks in the Dry Well concrete wall patches. If they become worse, grind or chip out the patches and replace with an approved cementaceous grout patch. Monitor the location of water stains on the walls for cracks and spalling. If cracks are detected they may require repair.

2. Chip out form tie patches in Dry Well walls and re-patch with approved cementaceous grout.

3. Remove surface corrosion on the Dry Well steel platform channel and bolts and re-paint to prevent future corrosion.

4. Monitor cracks in the main floor slab at the double doors. Seal them if they become worse.

5. Remove loose chipped paint on the exterior wall louvers and re-paint to prevent corrosion. Replace the missing section of metal siding on the bottom of the wall on the south side. Sand off minor corrosion and re-paint the bottom flashing on the siding at the door.

6. Seal cracks in the roof slab over the Wet Well to prevent further cracking and spalling.

7. Chip out the tie hole patch in the antennae foundation to find the source of the rust staining. Clean up and epoxy paint the rusting steel and re-patch the concrete with an approved grout.

Photo 1: Dry Well concrete wall patch has minor cracking.

Photo 2: Water staining on Dry Well south wall.

Photo 3: Signs of water leaking at Dry Well wall form tie patch.

Photo 4: Minor corrosion on platform channel and bolts.

Photo 5: Missing section of metal siding on the bottom of the wall on the south side.	Photo 6: Loose chipped paint on the exterior wall louvers

Photo 7: Minor corrosion on the bottom siding flashing at the door.	Photo 8: Cracks in the roof slab over the Wet Well.

	
Photo 9: Cracks in the roof slab over the Wet Well greater than 0.3 mm.	Photo 10: Rust staining on the antennae foundation.
	
Photo 11: Cracks in the main floor slab at the double doors.	Photo 12: Access hatch in roof slab over Wet Well.

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process Mechanical	DATE:	August 21, 2013		
LOCATION:	TaigaNova Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process mechanical comments and recommendations

We were on site at Eco Park (TaigaNova) Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – drawings - floor = 247.5 m. Flood level = 250 m.
- Facility was constructed in 2010. Process mechanical equipment in good condition.
- Pumps operate smoothly, with minimal vibration.
- Pumps are each designed to produce 60 L/sec @ 28 m TDH. Actual flows are approx. 48 L/sec @ 27 m TDH.
- Combined pumping – approx. 57 L/sec @ 31 m TDH. Low differential with 2 pumps may be due to possible plugging of discharge of SWP-402.
- This is one of three RMWB lift stations that has electronic flow, pressure, and level monitoring.
- Some rusting evident at unpainted equipment flanges.
- Pressure reading at gauge for SWP-401 does not correspond with pressure transmitter. Gauge = 280 kPa; Transmitter = 236 kPa. Difference of 44 kPa = 4.5 meters. Elevation difference = 240.3 – 237.7 = 2.6 m. 2.6 m would be the correct difference due to elevation.
- Gauge for SWP-402 matches transmitter, which is also incorrect – should differ by 2.6 m (25.5 kPa).
-

<u>Recommendations</u>

- Confirm pressure reading differentials when SWP-401 is operating.
- Check actual vs. design flows.

		
Photo 1: SWP – 401 & discharge valves, piping		Photo 2: Pumps and discharge piping
		
Make-up Air Unit (MAU-501)		

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Infrastructure Assessment	DATE:	August 21, 2013		
LOCATION:	Eco Park Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

We were on site at Eco Park Sewage Lift Station (Taiganova) on Wednesday August 21, 2013 to conduct a condition assessment of the station. The purpose is to establish the maintenance required for the site and any optional improvements.

Analysis:
The site has a single service with a backup generator. The electrical equipment were installed to be above the flood level. There is a Schneider Magelis touchscreen and a Modicon Quantum for PLC local monitoring and control.

There is a MDS4710 Radio (Glentel) for SCADA communications.

Investigation:
The wet well level transmitter has been removed and not reinstalled permanently; the enclosure is sitting freely on top of the penetration. The level transmitter appeared to be functioning adequately.

The flygt bulbs are not equipped with intrinsically safe barriers. Should the wet well have suitable concentrations of explosive gases and the cable to the Flygt bulbs are damage a spark would cause an explosion.

The HVAC MUA-501 unit did not turn on with adjustments to the thermostat.

There was no visible H2S corrosion.

The power meter was not indicating current as expected, the voltage between Phase A and C was 6% high. This is considered nominal. The ATCO meter was X10 rated and indicated that the consumption was around 12.9 kVA.

Several duty-standby cycles were observed and created and the system transferred pumps and maintained level as expected.

Recommendations
1. The Flygt bulbs could have an intrinsically save relay installed, Flygt makes one with a built in relay.
2. The power meter was not displaying current, maybe there were no current transformers, or it could have failed..
3. The HVAC unit should be investigated before winter. The ventilation did not turn on as intended.
4. Bolt down the LIT (complete the installation).

Photo 1: Bolts for the LIT are in the cable tray

Photo 2: Current and power not indicating

NP 3171 HT 3~ 453

Performance curve

Pump

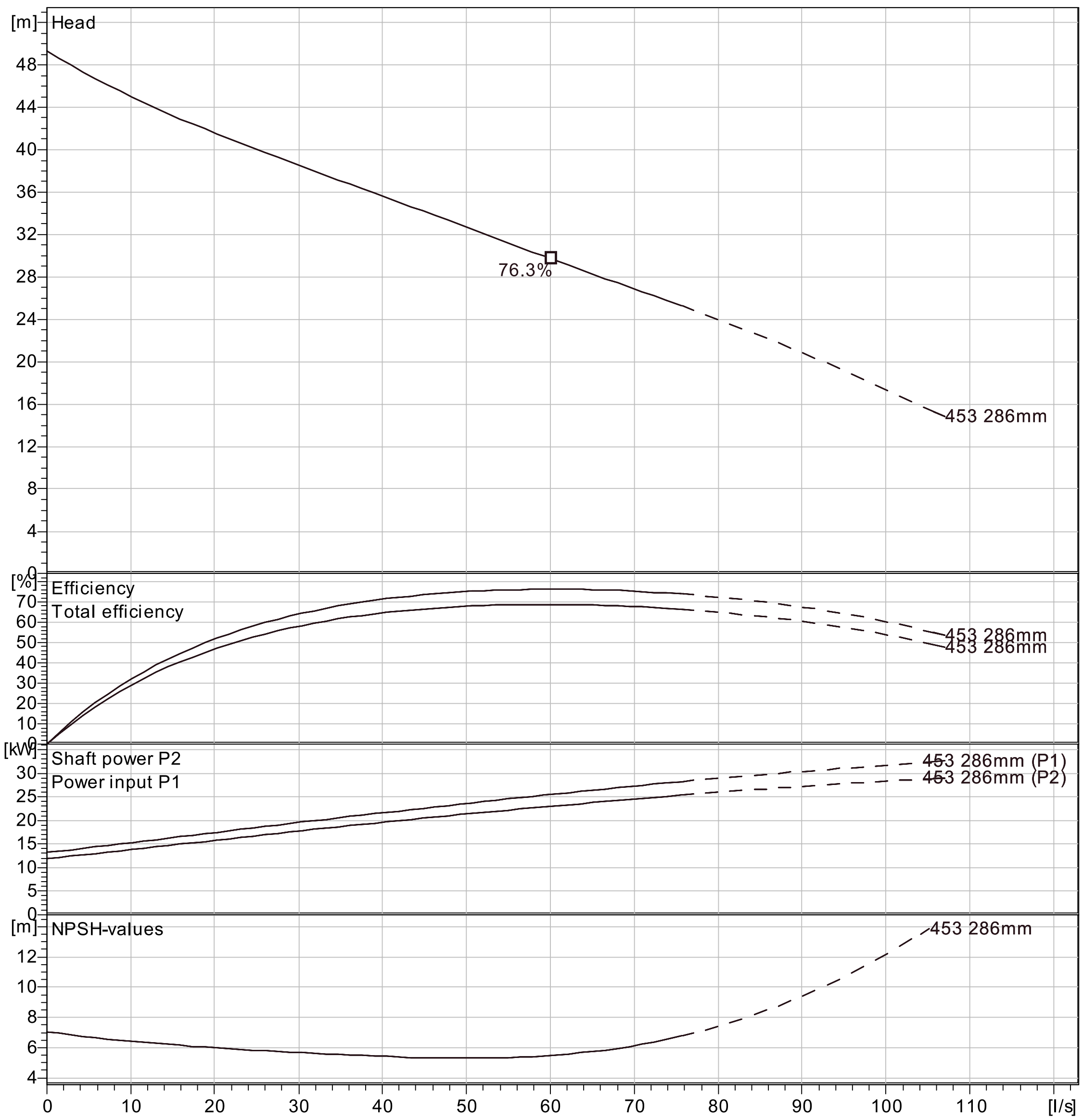
Outlet width	100 mm
Inlet diameter	150 mm
Impeller diameter	286 mm
Number of blades	2
	0 mm

Motor

Motor #	N3171.181 25-19-4AA-W 34hp
Stator variant	6
Frequency	60 Hz
Rated voltage	600 V
Number of poles	4
Phases	3~
Rated power	25.4 kW
Rated current	32 A
Starting current	228 A
Rated speed	1765 1/min

Power factor	
1/1 Load	0.86
3/4 Load	0.81
1/2 Load	0.70

Efficiency	
1/1 Load	89.5 %
3/4 Load	90.5 %
1/2 Load	90.0 %



Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-11-28	

Eco-Park Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.	
	(L/sec)	(kPa)	(m.)	(m.)	P-1	P-2
1	43.8	280	28.6	1.70	60	
	43.7	280	28.6	1.65	60	
2	48.6	270	27.6	2.00		60
	48.3	260.0	26.6	1.85		60
	48.2	260	26.6	1.80		60
1	48.5	262	26.8	1.99	60	
	48.6	262	26.8	1.95	60	
	48.5	260	26.6	1.90	60	
	48.5	260	26.6	1.80	60	
2	44.3	280	28.6	1.71		60
	43.7	280	28.6	1.60		60

Eco-Park Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.	
	(L/sec)	(kPa)	(m.)	(m.)	P-1	P-2
1 + 2	56.00	312.00	31.9	2.00	60	60
	57.70	307.00	31.4	1.90	60	60
	57.40	306.00	31.3	1.80	60	60
	57.30	305.00	31.1	1.70	60	60

Appendix B – Prairie Creek Lift Station

Appendix B contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 4
COMPONENT:	Infrastructure Assessment	DATE:	August 21, 2013		
LOCATION:	Prairie Creek Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Progress/Status/Conformance To Design/Workmanship/Comments/Recommendations

I was on site at the Prairie Creek Sewage Lift Station on Wednesday August 21, 2013 to conduct a structural assessment of the station. The Wet Well and Dry Well below grade have a reinforced concrete slab foundation and precast concrete box section walls. The ground level floor slab is a reinforced concrete structural slab. Access to the Dry Well is provided by a ladder that is very awkward to get on to. Access to the Wet Well is provided by ladder with safety cage. I was not able to access the Wet Well because it is confined space. The building is a Brytex Pre-Engineered Self-Framing with a single gabled standing seam roof. The Wet Well side of the building is equipped with a ½ ton capacity monorail and crane. The monorail extends through an opening in the entrance door and outside the building.

The reinforced concrete foundation slab at the bottom of the Dry Well is in good condition with no signs of cracking, spalling or rebar corrosion. The precast concrete walls in the Dry Well are in good condition. The main floor structural slab on the Dry Well side has shrinkage cracks in it that should be monitored to see if they migrate or get wider. In that case they will need to be sealed. The Diesel generator base is in good condition.
The structural steel ladders and handrails are in good condition but because of the orientation of the hand rails, accessing the dry well is very awkward. The steel entrance door is in good condition.

The reinforced concrete foundation slab at the bottom of the Wet Well was not accessible. The precast concrete walls in the Wet Well were not accessible but were in good condition on the Dry Well side. The reinforced concrete main floor slab is in good condition on the Wet Well side with no cracks observed. The structural steel ladder and safety cage are in good condition as viewed from the top of the access hatch. The ½ ton capacity monorail is in good condition but it has surface corrosion on the monorail section that extends outside the building and on the base plates. The corrosion should be removed with a wire wheel and re-painted. The steel entrance door is in good condition.

The Brytex Pre-Engineered building is in good condition. The walls and standing seam roof are in good condition.

The general condition of the station structure is good except for the minor issues mentioned previously that require maintenance.

Recommendations

1. Seal the crack in the main floor slab on the Dry Well side.
2. Remove corrosion on the monorail beam and base plates and re-paint.
3. Ladder to Dry Well Valve Pit is awkward to access. Add hand holds to provide safe access.

	
Photo 1: Front entrance to Dry Well and Wet Well.	Photo 2: Standing seam roof in good condition.
	
Photo 3: Interior wall and ceiling panels in good condition.	Photo 4: Interior of building on Dry Well side in good condition.

Photo 5: Crack in main floor concrete floor slab on Dry Well side to be sealed.

Photo 6: Accessing Dry Well Valve Pit is awkward with existing ladder and hand holds.

Photo 7: Monorail beam is corroded where it extends outside through door. Clean with wire brush and re-paint.

Photo 8: Monorail base plates are corroded. Clean with wire brush and re-paint.

Photo 9: Wet Well access hatch, ladder, and safety cage.

Photo 10: Monorail and crane on the Wet Well side of the Station.

Photo 11: Exterior wall panels in good condition.

Photo 12:

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	August 21, 2013		
LOCATION:	Prairie Creek Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process Mechanical comments and recommendations

We were on site at Prairie Creek Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – drawings – floor = 375.25 m. Not a flood concern.
- Facility was constructed in 2001.
- Facility has flow, level and pressure monitoring. (Pressure is via gauge only.)
- Facility is a wet well/dry well configuration, but the pumps are submersible.
- Access to the dry well – valves & piping is very restricted.
- Design flow (Drwg. 20004 PS-01) is 19.3 L/sec @ 33 m. TDH. – not a good pump selection – see curve.
- Pumps produce approx. 32 L/sec @ 29 psi (76 ft.). Both are well below the actual pump curve.
- The pressure gauge on the main floor is not functional.
- The pressure gauge in the dry pit fluctuates substantially when pump P-2 is operational.
- Combined flow (both pumps running) = approx. 36 L/sec @ 30 psi (69.3 ft.). Very little gain in flow by operating two pumps simultaneously.
- Rusting evident on various flanges, fittings, bolts, etc.

<u>Recommendations</u>

- Investigate pump operation. Pumps are both below their curve, but above the design flow.
- Repair/replace main floor pressure gauge, or install a pressure transmitter.

		
Photo 1: Restricted access into dry pit.		Photo 2: Wet well.
		
Photo 3: Rusting of fittings, valves, bolts, etc.		Photo 4:

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 4
COMPONENT:	Infrastructure Assessment	DATE:	August 21, 2013		
LOCATION:	Prairie Creek Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

We were on site at Prairie Creek Sewage Lift Station on Wednesday August 21, 2013 to conduct a condition assessment of the station. The purpose is to establish the maintenance required for the site and any optional improvements.

Analysis:

The site has a single service with a backup generator. The electrical equipment were installed to be above the flood level. There is a Schneider Magelis XBT-D021D10 and a 140CPU11302 for PLC local monitoring and control.

There is a MDS4710 Radio (Glentel) for SCADA communications.

Investigation:

The SCADA wiring prevents the door from closing on the communications panel. The door was missing to the communications panel.

There site does not have a pressure transmitter.

The Flygt bulbs are not equipped with intrinsically safe barriers. Should the wet well have suitable concentrations of explosive gases and the cable to the Flygt bulbs are damage a spark would cause an explosion.

There was no visible H2S corrosion.

The power meter was not indicating current as expected, the voltage between Phase A and C was 6% high. This is considered nominal. The ATCO meter was X10 rated and indicated that the consumption was around 12.9 kVA.

Several duty-standby cycles were observed and created and the system transferred pumps and maintained level as expected.

The MCC is only 13 years old, it easily have another 12-25 years of life if well maintained.

Recommendations

1. The DC power supply appears to be older and could be easily replaced. This would improve the availability of the PLC.
2. The PLC and HMI are at the end of life and should be replaced to The Municipality standard Modicon Quantum.
3. The Flygt bulbs could have an intrinsically save relay installed, Flygt makes one with a built in relay.
4. The leased line can be removed if the radio tower has proven reliable.
5. Clean out and maintain transformer and MCC.

Photo 1:

Photo 2: XBT Magelis controller (obsolete and broken buttons) and communication panel without door.

Photo 3: Transfer switch and MCC in good condition.

Photo 4: Control panel (buttons are damaged) Multi-ranger is in good working order.

		
Photo 5: Control Points		Photo 6:

CP 3170 HT 3~ 464

Performance curve

Pump

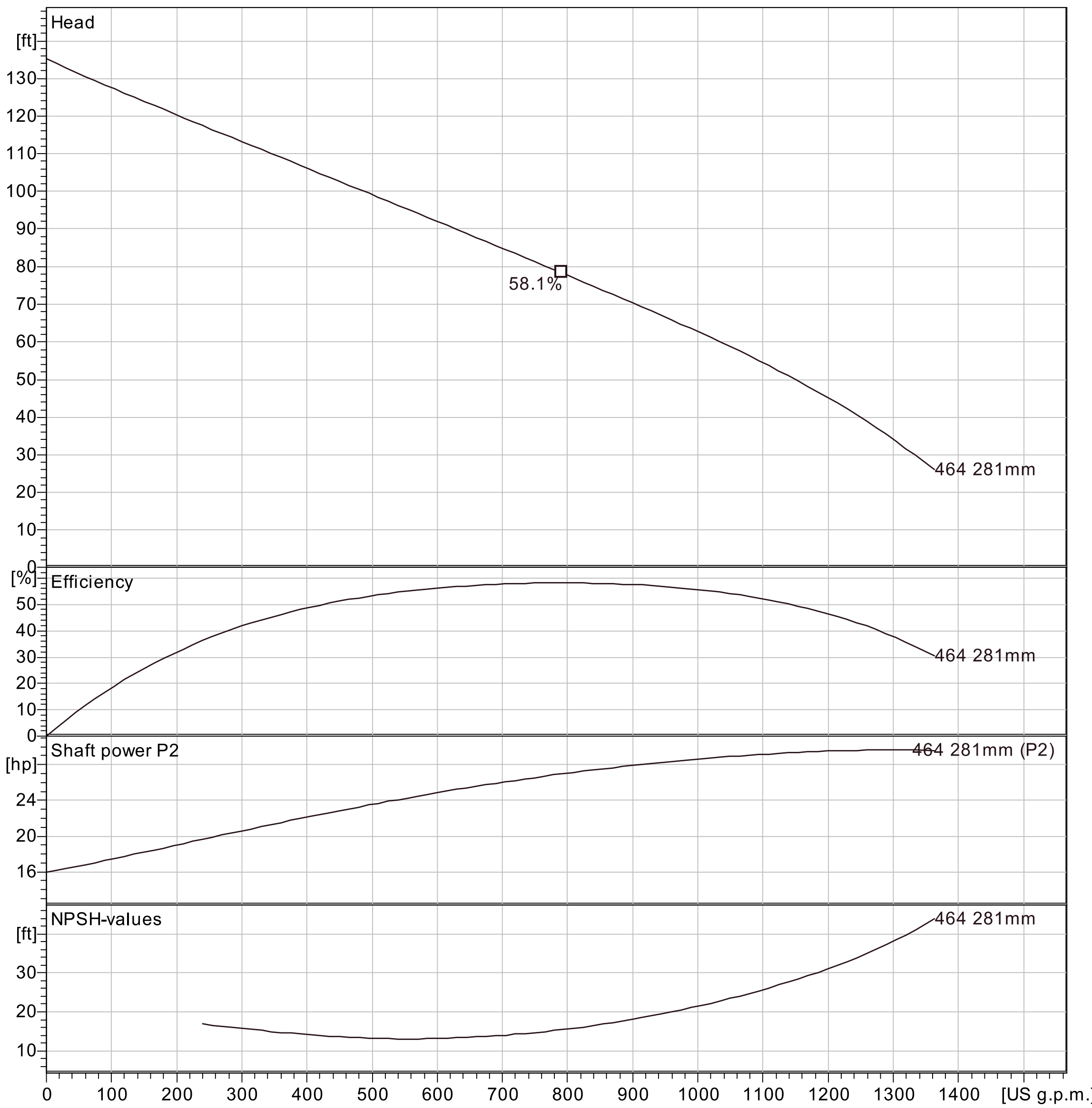
Inlet diameter	150 mm
Impeller diameter	281 mm
Number of blades	1
	76 mm

Motor

Motor #	C3170.180 27-20-4AA-W 30hp
Stator variant	
Frequency	60 Hz
Rated voltage	600 V
Number of poles	4
Phases	3~
Rated power	30 hp
Rated current	28 A
Starting current	174 A
Rated speed	1750 1/min

Power factor	
1/1 Load	0.90
3/4 Load	0.89
1/2 Load	0.84

Efficiency	
1/1 Load	85.5 %
3/4 Load	86.5 %
1/2 Load	86.0 %



Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-08-15	

Prairie Creek Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.	
	(L/sec)	(psi)	(m.)	(m.)	P-1	P-2
1	31.8	30	21.1	1.70	60	
	31.8	31	21.8	1.60	60	
2	32.4	28	19.7	1.50		60
	32.3	28	19.7	1.30		60

Note: When P-2 is running, there is severe fluctuation in the pressure gauge.

Prairie Creek Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.	
	(L/sec)	(psi)	(m.)	(m.)	P-1	P-2
1 + 2	36.24	30.00	21.1	1.75	60	60
	37.21	30.00	21.1	1.65	60	60
	35.88	30.00	21.1	1.55	60	60
	36.28	30.00	21.1	1.45	60	60
	36.41	30.00	21.1	1.35	60	60
	33.08	30.00	21.1	1.25	60	60

Appendix C – Lift Station #1B

Appendix C contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 7
COMPONENT:	Infrastructure Assessment	DATE:	October 04, 2013		
LOCATION:	1B Sewage Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk, Richard Coldbeck	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Structural Comments, and Recommendations

We were on site at 1B Sewage Lift Station on Friday October 04, 2013 to conduct a condition assessment of the station. The general condition of the station structure is fair with repair and maintenance required.

The Lift Station building has standard masonry block walls with exterior wood siding. There is architectural stone at each of the four exterior corners. The roof is sloped and metal clad, with eaves trough and downspout. The building structure is supported on a concrete foundation. The building has separate Wet and Dry Wells with a standard masonry block wall separating the two. The Wet and Dry Wells each have a steel double door and apron slab providing access. The main floor is reinforced concrete. Aluminum hatches in the floor provide access into the Wet Well. Access down into the Wet Well is by a ladder to an intermediate platform. The walls of the Wet Well are reinforced concrete. A 2 tonne monorail and hoist is located inside the building over the Wet Well hatches. A 1 tonne monorail and hoist is located over the access hatches on the Dry Well side. The monorail beams are supported by the masonry block walls.

There are two electrical outlet boxes in the front exterior wall that are unfinished and exposed to the elements. There is exposed fiber board and insulation at the foundation level around the perimeter of the building that is deteriorating. The stone and mortar are cracking at the northwest corner of the outside wall. The exterior wood siding is damaged and deteriorating in several locations. The vertical section of siding trim has cracked at the northwest corner adjacent to the stone. The gas line that projects through the siding on the back wall is not caulked on the outside. The electrical cables that project through the block wall and siding on the southeast side is not sealed on the outside. There is a roughly cut opening on the outside wall that is caulked around the cables inside the building but the outside looks unfinished. The ceiling has been roughly cut and caulked where electrical cables pass through on the Dry Well side. The eaves trough downspout on the southeast corner is damaged and ends beside the foundation instead of directing water away from the building. A section of guardrail is missing at the south floor hatch on the Dry Well side. The Dry Well main floor concrete slab has been roughly patched in several locations and bolts have been cut off and left exposed in the slab. The 2 tonne monorail hoist in the Wet Well is tagged as last inspected on 01/09/2010 and is overdue for inspection. The 1 tonne monorail hoist on the Dry Well side is also due for inspection. There is no safety cage around the ladder down into the Wet Well, so a fall protection system is required for personnel to access the Wet Well using the ladder.
The door stop on the Wet Well concrete apron slab is a steel angle that is corroded and is fastened to the slab with nails that project above the angle. The molding at the inside bottom of the Dry Well entrance door is bent. There is concrete and steel debris on the ground at the southeast corner of the building that is a trip hazard. The plastic form tie pocket formers in the antennae concrete foundation have not been stripped out and patched. The generator concrete slab is spalling on the west side of the slab.

Recommendations

1. Finish the electrical work as required on the exterior outlet boxes and install covers.
2. Install flashing or siding to protect the fiber board and insulation at the foundation along the perimeter of the building. Replace damaged fiber board and insulation as required.
3. Seal cracks in stone and mortar and replace or caulk cracked siding trim at the northwest corner.
4. Caulk around the gas line where it projects through the outside wall.
5. Seal off the siding on the southeast side where electrical cables enter the building.
6. Repair the ceiling and re-caulk where electrical cables pass through the ceiling on the Dry Well side.
7. Repair the damaged eaves trough downspout and add extension to drain away from the building.
8. Replace the section of missing guardrail at the south floor hatch on the Dry Well side.
9. Apply an approved concrete sealer to the patches in the Dry Well main floor concrete slab.
10. Patch over bolts that were cut off and left exposed in the Dry Well main floor concrete slab.
11. Have the 2 tonne monorail crane in the Wet Well and the 1 tonne monorail crane in the Dry Well inspected by a certified crane inspector as their certification has expired.
12. Ensure a fall protection system is in place when personnel are using the ladder to access the Wet Well.
13. Replace the door stop angle on the Wet Well apron slab with a painted or galvanized angle and bolt it to the slab with galvanized Kwik bolts.
14. Fasten the door molding at the inside bottom of the Dry Well entrance door.
15. Clean up concrete and steel debris at the southeast corner of the building where it is a trip hazard.
16. Remove plastic form tie formers in the antennae concrete foundation and patch voids with an appoved cementaceous repair grout.
17. Chip out unsound concrete that has spalled on the generator foundation slab and patch with an appoved cementaceous repair grout.

	
Photo 1: Exposed electrical outlet box on outside wall.	Photo 2: Exposed fiber board and insulation at building foundation.
	
Photo 3: Crack in siding trim on northeast corner.	Photo 4: Crack in stone and mortar on northeast corner.

	
Photo 5: Caulk siding around gas line.	Photo 6: Repair damaged siding.
	
Photo 7: Remove form tie former and patch at antennae foundation.	Photo 8: Repair and extend downspout at southeast corner.

	
Photo 9: Install cover or seal siding where electrical cables enter at southeast corner.	Photo 10: Replace section of missing guardrail on Dry Well side.
	
Photo 11: Repair ceiling and re-caulk where electrical cables enter ceiling.	Photo 12: Fix bent door molding on Dry Well door.

Photo 13: Patches in the Dry Well main floor concrete slab.

Photo 14: Bolt cut off and exposed in the Dry Well main floor concrete slab.

Photo 15: Access ladder down into the Wet Well with no safety cage. Fall protection is needed to enter on the ladder.

Photo 16: 2 tonne monorail on Wet Well side.

	
Photo 17: 2 tonne monorail hoist certification has expired according to inspection sticker.	Photo 18: Door stop angle has corroded and is fastened to the apron slab with nails at Dry Well.
	
Photo 19: Concrete and steel debris is trip hazard at southeast corner.	Photo 20: Generator concrete slab is spalling and needs repair.

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	September 18, 2013		
LOCATION:	1B Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Bryan & Brandy - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process Mechanical comments and recommendations

We were on site at 1B Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – Step slab = 252 m. Potential flood concern.
- Facility was constructed in ??.
- Facility is in good condition – minimal rusting evident.
- Facility has flow, and level monitoring, but no pressure indication.
- Facility is a wet well/dry well configuration, but the pumps are submersible.
- There are 4 pumps installed, each with a variable frequency drive.
- Design flow not available, but the individual pumps are operating to the right of the maximum efficiency point on the pump curve. On average, each pump produces 175 L/sec. This is operating at 74.6% speed (44.76 Hz.). If converted to full speed (60 Hz.), equivalent flow would be 233 L/sec.
- Combined flows (@ 45 Hz.) with 2 pumps running = approx. 292 L/sec; with 3 pumps running = approx. 381 L/sec.
- Check voltage and current readings during operation to determine if pump is operating past its power limit.

<u>Recommendations</u>

- Install pressure indication (either gauge or transmitter)
- Check pumps' operation at full speed operation.

		
Photo 1: Wet well/pumps.		Photo 2: Dry well – discharge piping.
		
Photo 3: Upper and lower discharge piping.		Photo 4:

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	4LTLS3
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:		DATE:			
LOCATION:	1B Pump Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Richard Coldbeck, Mike Yourechuk	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

1B Pumping Station

General
There are separate entrance doors to the wet and dry wells and a wall between the areas so that segregation is achieved.
A visual and an inspection using a thermal camera were undertaken.
Electrical connections were visually checked for indication of overheating or hydrogen sulphide presence, which is indicated by blackening of the copper cables.
Visual check of grounding was undertaken.

Electrical room visual inspection
Some equipment, including Panelboard B was not labelled.
Variable frequency drives checked and no loose connections and burning was seen.
Isolators on VFD 103, 104 do not engage properly.
Panduit missing from VFD cubicles
Transfer switch interlinking cables have not been installed properly.

Electrical room thermal camera survey
No hot components were found with the thermal camera, although the intermittent duty of the pumps means that the camera would not indicate all faults.

Wet Well Area
All electrical apparatus, including receptacles, lights and heaters seem to be suitable and be wired in accordance with Class I, Zone 2 operation as Canadian Electrical Code Part 1 section 18 and section 22-700.
Pump cables should be wired to code and have correct glands installed.
Hoist should be suitable for the Class 1 Zone 2 area.

Recommendations

- Tidy up wiring in transfer switch panel
- Replace missing Panduit in VFD starters as necessary.
- Provide supports on VFD enclosure isolator handles.
- Ensure Code Compliance with Canadian Electrical Code Part 1 section 18 and section 22-700
- Confirm hoist is suitable for Class 1, Zone 2 area.

Some equipment, including Panelboard B was not labelled.

Panduit missing from VFD cubicles

Transfer switch interlinking cables have not been installed properly.

R. Coldbeck

Nov 4, 2013

#1B

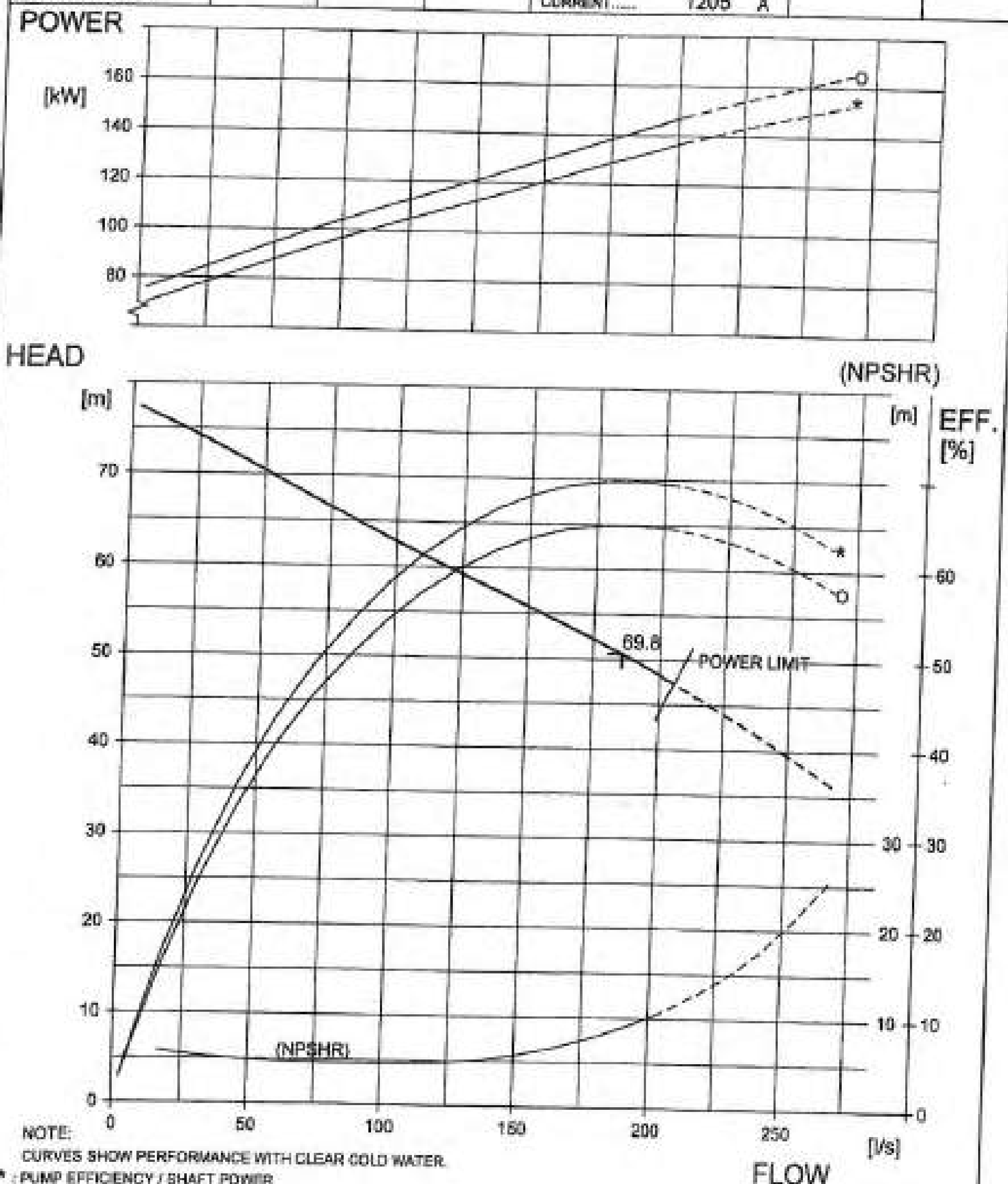
FLYGT

PERFORMANCE CURVE

DATE	PROJECT:	ISSUE	PROD
2010-06-16		4	N3231/715 FM

NO. OF BLADES...... 3	TOT.MOM.OF INERTIA..... 1.93 KGM²	POLES 4 FREQ 60 HZ	CURVE NO 63-470
	RATED SPEED....... 1780 RPM	VOLTAGE..... 600 V	IMPELLER DIAMETER 375 MM
		MOTOR SHAFT POWER...... 138 kW 185 hp	MOTOR TYPE 43-30-4AA /06 (12)
		STARTING TORQUE...... 870 NM	GEAR TYPE RATIO
		MAX TORQUE...... 2350 NM	
		RATED CURRENT..... 170 A	
		STARTING CURRENT..... 1205 A	

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.84	0.79	0.69
MOTOR EFFICIENCY	92.5%	93.0%	92.0%
GEAR EFFICIENCY			



NOTE:
CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER.
* : PUMP EFFICIENCY / SHAFT POWER
O : OVERALL EFFICIENCY / INPUT POWER
(NPSHR) = (NPSH3) + margins

unix AUTHOR: GPWEB1 CUPF (rev.7.43)

1B Lift Station Pumps

Pump(s)	Flow	Level	Frequency, Hz.			
	(L/sec)	(m.)	P-101	P-102	P-103	P-104
101	176	1.29	45			
	172	1.15	45			
	183	1.07	45			
102	166	1.20		45		
	165	1.15		45		
	171	1.10		45		
103	177	1.27			45	
	177	1.20			45	
	172	1.15			45	
	184	1.10			45	
104	171	1.27				45
	175	1.20				45
	176	1.15				45
	188	1.10				45

1B Lift Station Pumps

Pump(s)	Flow	Level	Frequency, Hz.			
	(L/sec)	(m.)	P-101	P-102	P-103	P-104
103 & 104	332	1.15			56.8	59.4
	342	1.1			56.8	59.4
104 & 101	275	1.2	45			45
	247	1.15	45			45
	237	1.1	45			45
101 & 102	287	1.29	45	45		
	273	1.2	45	45		
	288	1.15	45	45		
	282	1.1	45	45		
102 & 103	297	1.27		45	59.4	
	287	1.2		45	59.4	
	292	1.15		45	59.4	
	286	1.1		45	59.4	
101 & 103	304	1.29	45		45	
	299	1.2	45		45	
	300	1.15	45		45	
	307	1.1	45		45	

1B Lift Station Pumps

Pump(s)	Flow	Level	Frequency, Hz.			
	(L/sec)	(m.)	P-101	P-102	P-103	P-104
104, 101, 102	326	1.27	45	45		45
	284	1.2	45	45		45
	292	1.15	45	45		45
	262	1.1	45	45		45
101, 102, 103	390	1.27	45	45	59.4	
	353	1.2	45	45	59.4	
	333	1.15	45	45	59.4	
	367	1.1	45	45	59.4	
102, 103, 104	402	1.27		45	59.4	59.4
	388	1.2		45	59.4	59.4
	402	1.15		45	59.4	59.4
	390	1.1		45	59.4	59.4
103, 104, 101	362	1.2	59.4		45	45
	401	1.15	59.4		45	45
	383	1.1	59.4		45	45

Appendix D – Grayling Terrace Lift Station

Appendix D contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 4
COMPONENT:	Infrastructure Assessment	DATE:	October 04, 2013		
LOCATION:	Grayling Terrace Sewage Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Richard Coldbeck	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Structural Comments, and Recommendations

We were on site at Grayling Terrace Sewage Lift Station on Friday October 04, 2013 to conduct a condition assessment of the station.
The general condition of the station structure is fair with some repair and maintenance required.

The Lift Station building has standard masonry block walls with metal cladding at the top near the roof and metal and wood flashing at the bottom. The roof is flat and is supported by structural steel beams and steel deck. The building structure is supported on a concrete foundation. The building has separate Wet and Dry Wells with a standard masonry block wall separating the two. The Wet and Dry Wells each have a steel door and apron slab providing access. The main floor is reinforced concrete. Two aluminum hatches in the floor provide access into the Wet Well. Access down into the Wet Well is by a ladder to an intermediate platform. The walls of the Wet Well are reinforced concrete. A monorail and hoist is located inside the building over the Wet Well hatches. The Lodestar hoist is a ½ ton capacity and is supported from the trolley by two wire rope slings. The monorail is supported by a framework of structural steel beams that are supported by the masonry block walls.

Letters are missing from the station sign at the front of the building. The concrete apron slab to the Dry well is spalled. Paint is peeling on the exterior wall metal flashing and Dry Well steel door. There are cracks along the joints of the masonry block wall in the Dry Well that go through the entire wall. There are also cracks in the masonry block wall in the Wet Well that are less severe. There is some graffiti on the steel door of the Wet Well. There is no Safe Work Load marked on the monorail beam and the manufacturers tag is missing from the hoist. There is also no inspection sticker on the hoist. There is no safety cage around the ladder down into the Wet Well so a fall protection system is required for personnel to access the Wet Well.

Recommendations

1. Replace the missing letters from the station identification sign.
2. Patch the spall in the Dry Well apron slab to eliminate trip hazard and stop further spalling.
3. Remove peeling paint and re-paint flashing, Dry Well steel door, and graffiti on Wet Well steel door.
4. Re-seal the cracks in the joint of the masonry block wall in the Dry Well.
5. Have the monorail crane inspected by a certified crane inspector and mark the Safe Working Load on the monorail beam.
6. Ensure a fall protection system is in place when personnel are using the ladder to access the Wet Well.

Photo 1: Grayling Terrace entrance to Dry Well.

Photo 2: Letters missing on Station Identification Sign.

Photo 3: Dry Well apron slab.

Photo 4: Spall in Dry well apron slab.

	
Photo 5: Paint peeling off metal wall flashing.	Photo 6: Paint peeling off Dry Well steel door.
	
Photo 7: Graffiti on Wet Well steel door.	Photo 8: Cracks in joints of masonry block wall in Dry Well.

Photo 9: Cracks in joints of masonry block wall in Wet Well.

Photo 10: ½ ton monorail hoist in Wet Well. Monorail beam not labeled with safe working load.

Photo 11: ½ ton monorail hoist missing manufacturers label.

Photo 12: Access ladder to Wet Well. Use fall protection system when using ladder.

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	September 19, 2013		
LOCATION:	Grayling Terrace Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Bryan ??, Brandy ?? - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process Mechanical comments and recommendations

We were on site at Grayling Terrace Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – Step slab = 257 m.; drawing = 254.44 m. Definite flood concern.
- Facility was constructed in 1982.
- Facility is in fair condition – rusting evident.
- Facility has no flow, pressure, or level monitoring.
- Flow calculation was performed by timing drawdowns, and re-filling. Level was measured using a laser distance finder.
- Facility is a wet well configuration; all pumps, valves, and piping are in the wet well.
- There are 2 constant speed pumps installed.
- Station does not operate frequently. According to operators, average refill time is 45 minutes.
- Design flow not available, but the individual pumps are operating left side of the pump curve. On average, each pump produces 13 L/sec.
- Combined flows with 2 pumps running = approx. 26 L/sec.
- Facility is in need of a wholesale mechanical upgrade.

Recommendations

- Install flow, pressure, and level monitoring to confirm pumps' operation.
- Clean/repair rusted surfaces.

		
Photo 1: Wet well access.		Photo 2: Wet well – intermediate landing.

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	5GTLS
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 3
COMPONENT:		DATE:			
LOCATION:	Grayling Terrace	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Richard Coldbeck	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

Grayling Terrace Lift Station

General

There are separate entrance doors to the wet and dry wells and a wall between the areas so that segregation is achieved.
A visual and an inspection using a thermal camera was undertaken.
Electrical connections were visually checked for indication of overheating or hydrogen sulphide presence, which is indicated by blackening of the copper cables.
Visual check of grounding was undertaken.

Electrical room visual inspection

Grounding is through conduits.
Transfer switch panel is old and is most probably unreliable and difficult to maintain.
Pump control panel and starters look in good condition.
No signs of burning cables generally, but some residue was seen on some cables.
Some cables into the PLC panel and to the H&V system are not mechanically protected.
Space is at a premium and the UPS is on top of the PLC panel.

Electrical room thermal camera survey

The Symax 300 PLC processor power supply temperature was detected at 50 degC. This is high for an electronic component but no burning was seen on the exterior.
No other hot components were found with the thermal camera, although the intermittent duty of the pumps means that the camera would not indicate all faults.

Wet Well Area

Cabling to hoist and connection to pumps to be suitable and be wired in accordance with Class I, Zone 2 operation as Canadian Electrical Code Part 1 section 18 and section 22-700.
Hole through wall not sealed.

Recommendations

- Ensure code compliance to Canadian Electrical Code Part 1 section 18 and section 22-700
- Replace transfer switch panel
- Confirm adequacy of grounding preferably using a ground fault loop detector.
- Clean power connections where residue is present.
- Mechanically protect cables.
- Check PLC power supply for overloading and change to avoid premature failure.
- Mount UPS in an enclosure (if possible).

- Install intrinsically safe barriers on level switches.
- Seal penetration between wet and dry wells.

Transfer panel is old and is most probably unreliable and difficult to maintain.

No signs of burning cables generally, but some residue was seen on some cables.

Some cables to the H&V system are not mechanically protected.

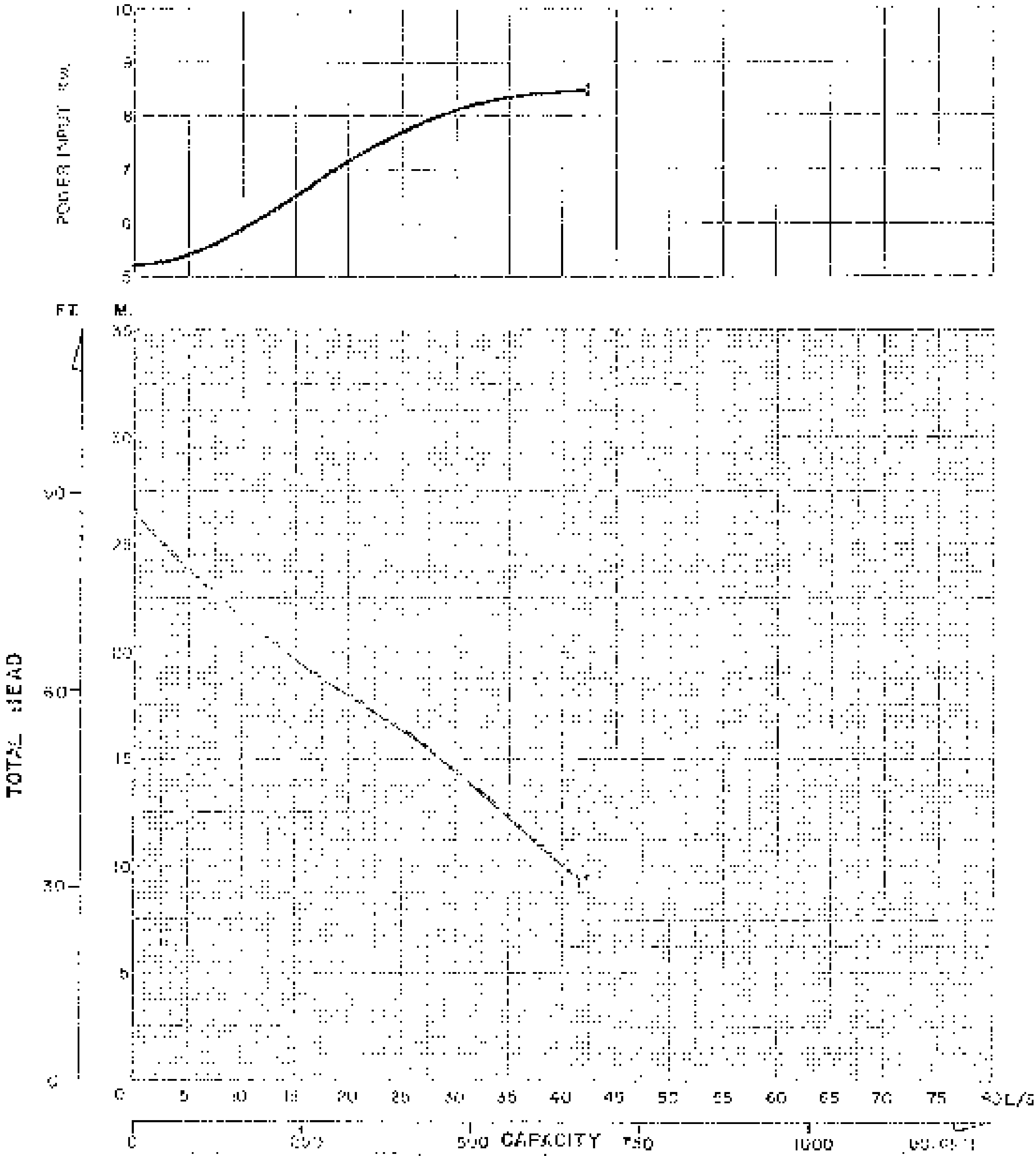
Some cables into the PLC panel are not mechanically protected.

	
Space is at a premium and the UPS is on top of the PLC panel	The Symax 300 PLC power supply temperature was detected at 50 degC

R.Coldbeck

Nov 4, 2013

Grayling Terrace



FLYGT CANADA

C 3126 HT

PERFORMANCE CURVE

C 3126

Grayling Terrace Pumps' Drawdowns

Pump(s)	WW area	Pumping					Filling					Pump rate
	m^2	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L/sec
1	6.25	10.43	10.54	0.74	120	6.19	10.51	10.41	0.63	120	5.26	11.45
2	6.25	10.40	10.56	1.01	120	8.38	10.59	10.49	0.61	120	5.10	13.48
1	6.25	10.65	10.80	0.92	100	9.18	10.70	10.42	1.72	240	7.18	16.36
1 + 2	6.25	10.40	10.64	1.51	60	25.19	10.67	10.54	0.77	180	4.30	29.50
1 + 2	6.25	10.43	10.61	1.14	60	18.95	10.77	10.42	2.23	600	3.72	22.66
1	6.25	10.74	10.79	0.33	30	11.03	10.80	10.71	0.59	240	2.45	13.48
2	6.25	10.78	10.84	0.38	30	12.71	10.77	10.70	0.41	180	2.26	14.97
1 + 2	6.25	10.70	10.80	0.57	60	9.48	10.77	10.73	0.21	180	1.18	10.66

Appendix E – Abasand - Riverview Heights Lift Station

Appendix E contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 5
COMPONENT:	Infrastructure Assessment	DATE:	October 04, 2013		
LOCATION:	Riverview Heights Sewage Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Richard Coldbeck	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Structural Comments, and Recommendations

We were on site at Riverview Heights Sewage Lift Station on Friday October 04, 2013 to conduct a condition assessment of the station.
The general condition of the station structure is good with some repair and maintenance required.

The Lift Station building has metal clad walls and a single gable shingled roof with eaves trough and down spouts. The station building is supported on a concrete foundation. The building has one room that houses the Dry Well and provides access hatches in the floor to the Wet Well. Access into the building is through a steel double door with a small structural steel landing on the outside providing a step up into the building. The main floor is reinforced concrete. Aluminum hatches in the floor provide access into the Wet Well. Access down into the Wet Well is by a ladder made of rungs cast into the Precast concrete boxes that form the walls of the Wet Well. A monorail and hoist is located inside the building over the Wet Well hatches and is labelled 500 LBS Capacity.

The concrete foundation has voids and segregation on the east and west sides at the ground level. There is corrosion on the generator exhaust pipe where it exits the building on the east wall. There are several large shrinkage cracks in the concrete in main floor slab and paint is peeling off of the slab. The metal molding on the inside of the door at the bottom is bent. The monorail is overdue for inspection with the next inspection date of 29/04/13 on the inspection sticker. There is no safety cage around the ladder down into the Wet Well so a fall protection system is required for personnel to access the Wet Well.

Recommendations

1. Patch the voids and segregation in the concrete foundations with an approved cementaceous repair grout to prevent further deterioration and keep small rodents out.
2. Remove corrosion from the generator exhaust pipe and protect the exposed metal with an approved material that can withstand the heat being generated.
3. Seal the shrinkage cracks in the concrete floor slab with an approved concrete floor sealer. Do paint touch-ups where paint is peeling off of the concrete floor slab.
4. Screw the bent metal molding back onto the door at the bottom on the inside or replace it completely.
5. Have the monorail crane inspected by a certified inspector as it is overdue for an inspection according to the inspection sticker.
6. Ensure a fall protection system is in place when personnel are using the ladder rungs to access the Wet Well.

Photo 1: East side of building with voids and segregation of concrete foundation.

Photo 2: Voids and segregation in concrete foundation.

Photo 3: Voids and segregation in concrete foundation.

Photo 4: Corrosion on generator exhaust pipe.

Photo 5: Paint is peeling off of main floor concrete slab.

Photo 6: Crack in main floor concrete floor slab.

Photo 7: Crack in main floor concrete floor slab.

Photo 8: 500 LB Capacity Monorail crane.

Photo 9: Monorail inspection sticker indicates inspection is overdue.

Photo 10: Bent molding on the inside of the door at the bottom.

Photo 11: Wet Well access hatch. Use Fall Protection System to access Wet Well using ladder rungs.

Photo 12:

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	September 18, 2013		
LOCATION:	Abasand Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Bryan ??, Brandy ?? - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process Mechanical comments and recommendations

We were on site at Abasand (Riverview Heights) Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – Threshold = 321 m. No flood concern.
- Facility was constructed in 2005.
- Facility is in fair condition – minimal rusting evident at flanges & bolts.
- Facility has flow and level monitoring, but no pressure indication.
- Facility is a wet well configuration. Valves and piping are in the building above the wet well hatches. This is a code violation, as the wet well access is inside the pump room. Leaking sewer gases could potentially ignite or explode.
- There are 2 constant speed pumps installed.
- Design flow not available, but the individual pumps are operating middle/right side of the pump curve. On average, P-1 produces 30 L/sec; P-2 produces 37 L/sec.
- Combined flows with 2 pumps running = approx. 46 L/sec.
- Facility should be upgraded to isolate the wet well access from the mechanical/electrical equipment.

Recommendations

- Isolate wet well access from the electrical equipment room.
- Install pressure monitoring (either gauge or transmitter).

		
Photo 1: Discharge valves piping, above wet well access.		Photo 2: Discharge piping, flow meter.
		
Photo 3: Wet well.		Photo 4:

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	6ABLS
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:		DATE:			
LOCATION:	Riverview Heights	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Richard Coldbeck, Mike Yourechuk	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

Abasand Lift Station

General

The electrical room is located over the wet well. Explosive gasses could be expelled from the wet well area and be ignited by sparks generated by electrical equipment.
All electrical apparatus is to be suitable and be wired in accordance with Class I, Zone 2 operation as Canadian Electrical Code Part 1 section 18 and section 22-700.
The existing receptacles, lights, disconnects and heaters do not have this rating and are not wired as required by code.
A visual and an inspection using a thermal camera was undertaken.
Electrical connections were visually checked for indication of overheating or hydrogen sulphide presence, which is indicated by blackening of the copper cables.
Visual check of grounding was undertaken.

Electrical Room Visual Inspection

The main station ground appears to be the incoming water line.
Pump starter panel is not fabricated well and supplies run through this cabinet to the PLC cabinet. There is evidence of previous capacitor failure with burnt cables and debris present.
The power supply to the PLC panel runs through the pump starter panel.
The conduits are used for grounding.
PLC some connectors are stripped back too far.
Unprotected rubber cables were run in the roof area.
Unused cables should be removed.

Electrical room thermal camera survey

No hot components were found with the thermal camera, although the intermittent duty of the pumps means that the camera would not indicate all faults.

Recommendations

- The pumping station well construction does not meet existing code and the placement of electrical equipment directly over the wet well could provide an ignition source for combustible gasses expelled. Ensure Code Compliance with Canadian Electrical Code Part 1 section 18 and section 22-700.
- The pump panel requires rebuilding and maintenance to ensure reliability. There are damaged cables in the panel.
- Power wiring to the PLC panel should not pass through the pump panel.
- Check connections to the PLC and re-terminate as necessary.
- Confirm adequacy of grounding preferably using a ground fault loop detector.

- Install intrinsically safe barriers on level switches.
- Cables should be run in conduit and protected from damage.
- Unused cables should be removed.

	
The pump panel requires rebuilding and maintenance to ensure reliability.	*The pump panel requires rebuilding and maintenance to ensure reliability. There are damaged cables in the panel.*

Confirm adequacy of grounding preferably using a ground fault loop detector.

Cables should be run in conduit and protected from damage.

Unused cables should be removed.

R. Coldbeck

Nov 4, 2013

NP 3102 MT 1~ 465

Performance curve

Pump

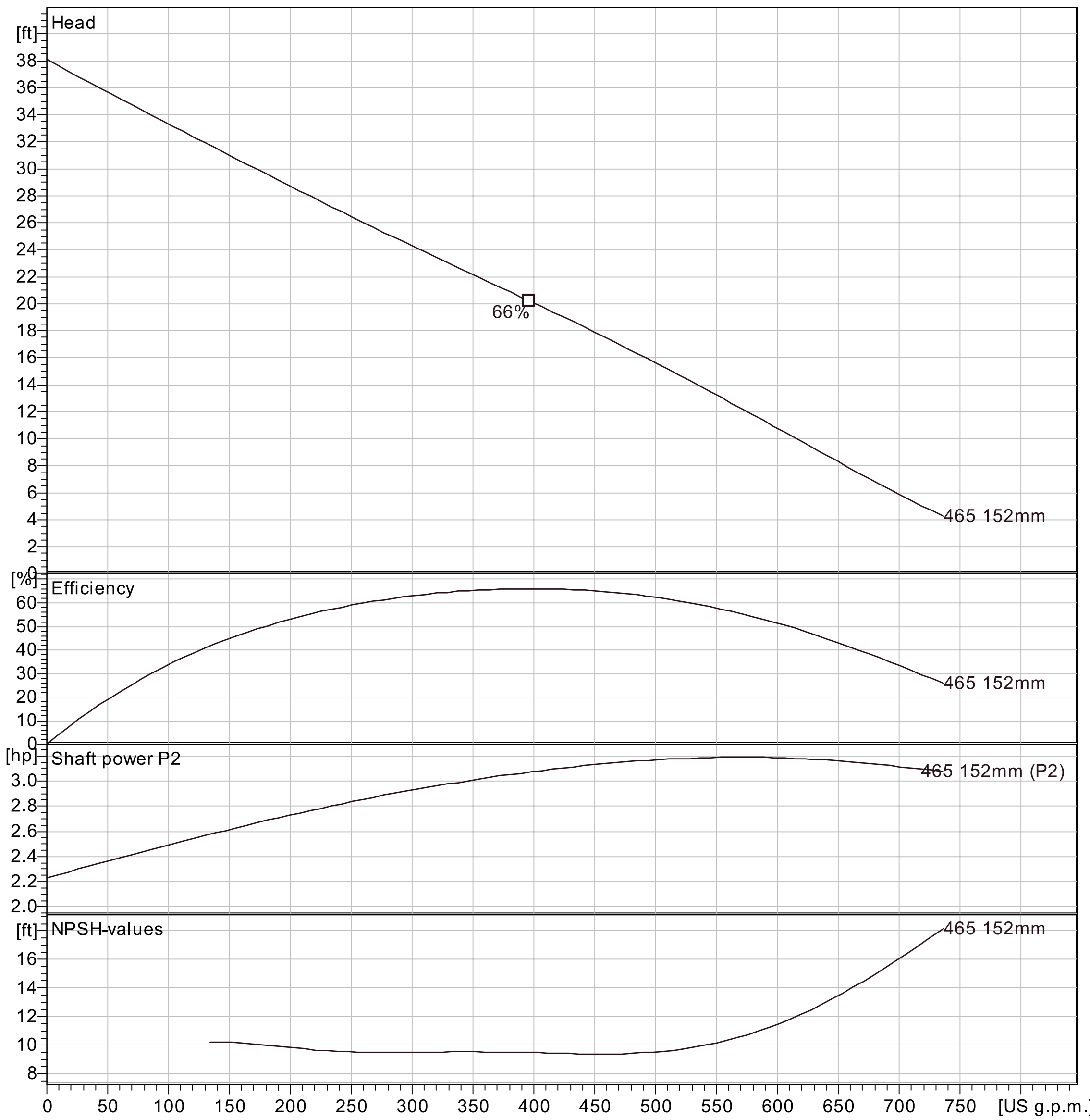
Inlet diameter	100 mm
Impeller diameter	152 mm
Number of blades	2

Motor

Motor #	N3102.181 18-11-4AL-W 3,9hp
Stator variant	
Frequency	60 Hz
Rated voltage	230 V
Number of poles	4
Phases	1~
Rated power	3.9 hp
Rated current	16 A
Starting current	45 A
Rated speed	1755 1/min

Power factor	
1/1 Load	0.94
3/4 Load	0.95
1/2 Load	0.95

Efficiency	
1/1 Load	82.0 %
3/4 Load	82.5 %
1/2 Load	79.5 %



Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-10-01	

Abasand Lift Station Pumps

Pump(s)	Flow	Head	Level	Frequency, Hz.	
	(L/sec)	(kPa.)	(m.)	P-1	P-2
1	12.7	N/A	2.09	60	
	25.3		2.00	60	
	27.6		1.95	60	
	29.9		1.90	60	
	27.8		1.85	60	
2	37.0		2.00		60
	37		1.95		60
	37.4		1.90		60
	37.8		1.85		60
1	14.3		2.05	60	
	27.7		2.00	60	
	29.4		1.95	60	
	31.4		1.90	60	
1	15.6		2.05	60	
	26.9		2.00	60	
	29.5		1.95	60	
	36.54		1.90	60	
	28.97		1.85	60	
2	24.75		2.05		60
	36.93		2.00		60
	36.87		1.95		60
	37.35		1.90		60
	36.6		1.85		60

Abasand Lift Station Pumps

Pump(s)	Flow	Head	Level	Frequency, Hz.	
	(L/sec)	(kPa.)	(m.)	P-1	P-2
1 + 2	26.0	N/A	2.05	60	60
	46.2		2.00	60	60
	47.0		1.95	60	60
	46.6		1.90	60	60
	47.1		1.85	60	60
1 + 2	30.69		2.05	60	60
	46.48		2.00	60	60
	46.87		1.95	60	60
	46.53		1.9	60	60
	47.8		1.85	60	60

Appendix F – Lift Station #1A - Father Mercredi

Appendix F contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 6
COMPONENT:	Infrastructure Assessment	DATE:	October 04, 2013		
LOCATION:	1A Father Mercredi Sewage Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Richard Coldbeck	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Structural Comments, and Recommendations

We were on site at 1A Father Mercredi Sewage Lift Station on Friday October 04, 2013 to conduct a condition assessment of the station.
The general condition of the station structure is fair with some repair and maintenance required.

The Lift Station building has standard masonry block walls with metal cladding at the top near the roof. The exterior side walls have a brick façade and the front and back walls have an exterior parging. The roof is flat and is supported by open web steel joists and a steel deck. The building structure is supported on a concrete foundation. The building has separate Wet and Dry Wells with a standard masonry block wall separating the two. The Wet Well has a steel double door and concrete apron slab providing access. The Dry Well has a single steel door providing access with no concrete apron slab. The main floor is reinforced concrete structural slab with beams. The walls of the Wet and Dry Wells are reinforced concrete. Access down into the Wet and Dry Wells is by structural steel stairs with concrete landings. There are floor hatches with overhead monorails and hoists for lifting equipment out of the Wet and Dry Wells. Monorail and hoist SN 1250-1 is located inside the building over the Wet Well hatch. It is supported by structural steel beams bolted to the concrete shaft walls. The rated capacity and inspection sticker was not visible from the main floor. A hoist was also mounted on the underside of the main floor slab and it was being used to service equipment in the Wet Well. Its rated capacity is not known. Monorail and hoist SN 1250-2, located on the main floor of the Dry Well, is supported by a structural steel frame on the main floor. It is labelled with a rated capacity of 5 tonnes but its inspection sticker was not visible. Monorails and hoists 1250-3 and 1250-4 are located at the bottom of the Dry Well and are supported off of the concrete walls. Each is labelled with a rated capacity of 5 tonnes. Their inspection stickers were also not visible.

The rated capacity for the monorail and hoists in the Wet Well is not clearly labelled. Their last inspection dates are not known. The last inspection date for the three monorails and hoists in the Dry Well is not known.
There is graffiti on the outside doors and walls of the station. There is a gap between the louver and the outside brick wall near the entrance to the Wet Well. There is some minor damage to the metal siding on the north outside wall of the building. There is also some spalling of the concrete foundation on the north side near the double doors. There are minor cracks in the main concrete floor slab near the entrance and stair opening in the Dry Well. There are cracks on the inside corner of the MCC housekeeping pad. There are minor shrinkage cracks in the concrete wall of the Wet Well where pipes pass through the wall. There is an oversized pipe opening through the main floor slab in the Wet Well that would allow things to fall down into the Wet Well. There is a rectangular opening in the main floor slab of the Dry Well, that would allow things to fall into the Dry Well.

Recommendations

1. Have the monorail cranes inspected by a certified crane inspector(if current inspection has expired) and mark the Safe Working Load on the monorail beam as required.
2. Paint over the graffiti on the exterior walls and doors if deemed necessary.
3. Caulk the gap between the brick and louver near the Wet Well entrance.
4. Repair damaged metal siding on the north side of the building.
5. Repair the spalled concrete foundation on the north side near the double doors.
6. Monitor and seal concrete shrinkage cracks in the Dry Well main floor slab, MCC housekeeping pad, and concrete walls of the Wet Well, if they become worse.
7. Install a shroud or cover plate over the oversized pipe opening in the main floor slab of the Wet Well to prevent things falling through.
8. Install a grill or cover plate over the opening in the main floor slab of the Dry Well to prevent things falling through.

Photo 1: Monorail crane SN 1250-1 over the Wet Well. The rated capacity and inspection sticker are not visible.

Photo 2: Hoist in Wet Well mounted to underside of main floor slab was being used to service equipment. The rated capacity and inspection sticker are not visible.

Photo 3: Cover the oversized pipe opening to prevent things falling into the Wet Well.

Photo 4: Caulk the gap between the louver and the brick near the entrance to the Wet Well.

	
Photo 5: Repair the damaged metal siding on the north side.	Photo 6: Monorail crane SN 1250-2 on the main floor of the Dry Well. The crane inspection certificate may have expired.
	
Photo 7: Shrinkage cracks in the Dry Well main floor slab near the stair opening.	Photo 8: Shrinkage cracks in the MCC housekeeping pad on the Dry Well side.

INSPECTION/SITE MEETING REPORT

Photo 9: Shrinkage cracks in the Wet Well wall where a pipe passes through the wall.

Photo 10: Monorail cranes SN 1250-3 and SN 1250-4 at the bottom of the Dry Well. The crane inspection certificates may have expired.

Photo 11: Opening in the main floor slab of the Dry Well where things can fall through into the Dry Well.

Photo 12: Graffiti on the Wet Well doors ad brick wall.

Photo 13: The concrete foundation is spalling on the north side near the double doors.

Photo 14: Parging has been removed on the oustside wall near the door to the Dry Well.

Photo 15: Concrete is spalling off a cabinet foundation on the north side of the building.

Photo 16:

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	September 19, 2013		
LOCATION:	1A Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Bryan ??, Brandy ?? - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process mechanical comments and recommendations

We were on site at 1A (Father Mercredi) Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – Threshold = 247 m. Definite flood concern, although a berm has been built around the facility.
- Facility was constructed in ????, and upgraded in 2011.
- Facility is in good condition – minimal rusting evident at flanges & bolts.
- Facility has flow and level monitoring, but no pressure indication.
- There are grinders installed to macerate the incoming sewage. Both are operating satisfactorily.
- Facility is a wet well/dry well configuration. Pumps, valves and piping are in the lower level adjacent to the wet well. (Considered a restricted access entry).
- There are 4 pumps installed. The two original constant speed pumps (P-001 & P-002, both 480 V.) are designed for 221 L/sec @ 43 m. TDH. The two new variable speed pumps (P-003 & P-004; both 600 V.) are designed for 518 L/sec @ 43 m. TDH.
- Pumps P-001 & P-002 are operating well above their design point. On average, each produces 400 L/sec. Pumps P-003 and P-004 are each pre-set to operate at 42.6 Hz. Each is producing approximately 360 L/sec. If converted to 60 Hz operation, corresponding flow should be approximately 507 L/sec, which is in line with the provided design flow.
- Combined flows with 2 pumps running = averages approx. 500 L/sec. This is independent of whether it is 2 large pumps or 1 large and 1 small pump. Large pumps still operate at 42.6 Hz., even when run manually.

<u>Recommendations</u>

- Install pressure indication (either gauge or transmitter).
- Test pumps at full speed operation.
-

Photo 1: Dry well - discharge valves and piping.

Photo 2: Two new pumps (P-003 & P-004) & piping.

Photo 3: Wet well access.

Photo 4:Pumphouse exterior, showing berm at left.

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	7LTLS2
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 3
COMPONENT:		DATE:			
LOCATION:	Lower Town Site 1A Father Mercredi	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Richard Coldbeck, Mike Yourechuk	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

Lower Town Site / 1A Father Mercredi Lift Station

General

There are separate entrance doors to the wet and dry wells and a wall between the areas so that segregation is achieved.
A visual and an inspection using a thermal camera was undertaken.
Electrical connections were visually checked for indication of overheating or hydrogen sulphide presence, which is indicated by blackening of the copper cables.
Visual check of grounding was undertaken.

Electrical room visual inspection

There is a mixture of 480VAC and 600VAC utility and generator supplies in this building. Equipment was not thoroughly identified such that it was clear where the point of supply came from.
All 480VAC equipment seems to be about 40 years old and approaching end of life.
480 and 600 VAC ground systems seem to be connected together. Under fault conditions the neutral leg of the un-failed system could experience a voltage rise equivalent to the failed circuit's line to ground voltage. Single phase loads could be subject to overvoltage under fault conditions. No site ground was found.
Electrical connections that were accessible were inspected and no hydrogen sulfide or cable heating issues were identified.
New 600VAC VFD filters seem dirty and the air cooling is therefore reduced which may lead to overheating and reduced life expectancy.
Wall penetrations in 600V AC room checked; all seemed to meet CEC Code 2-126
SOW rubber cables were only protected to 5' in the 600VAC electrical room.
Light fittings rusted. This may indicate that electrical equipment generally has been subject to humid conditions that would shorten the life expectancy.

Electrical room thermal camera survey

No hot components were found with the thermal camera, although the intermittent duty of the pumps means that the camera would not indicate all faults.

Recommendations

- All equipment including heaters, lights and other equipment to be labelled stating point of supply and voltage.
- All panelboards supplies to be identified.
- Confirm adequacy of grounding preferably using a ground fault loop detector. Identify if any single phase loads are present.
- VFD ventilation filters to be cleaned.

- Install intrinsically safe barriers on level switches.
- Consider replacement of 480VAC installation
- If SOW cables are can be subject to mechanical damage then provide mechanical protection higher than 5'
- Replace light fittings
- Undertake detailed inspection and preventative maintenance on all electrical equipment.

All 480VAC equipment seems to be approaching end of life.

480 and 600 VAC ground systems seem to be connected together. No site ground was found.

All equipment including heaters, lights and other equipment to be labelled stating point of supply and voltage.

All panelboards supplies to be identified.

VFD ventilation filters to be cleaned.

Consider protection of SOW cables in new MCC room

Light fittings rusted

R. Coldbeck

Nov 4, 2013

xylem
Let's Solve Water

NZ 3306/735 3~ 670

FLYGT

Performance curve

Pump

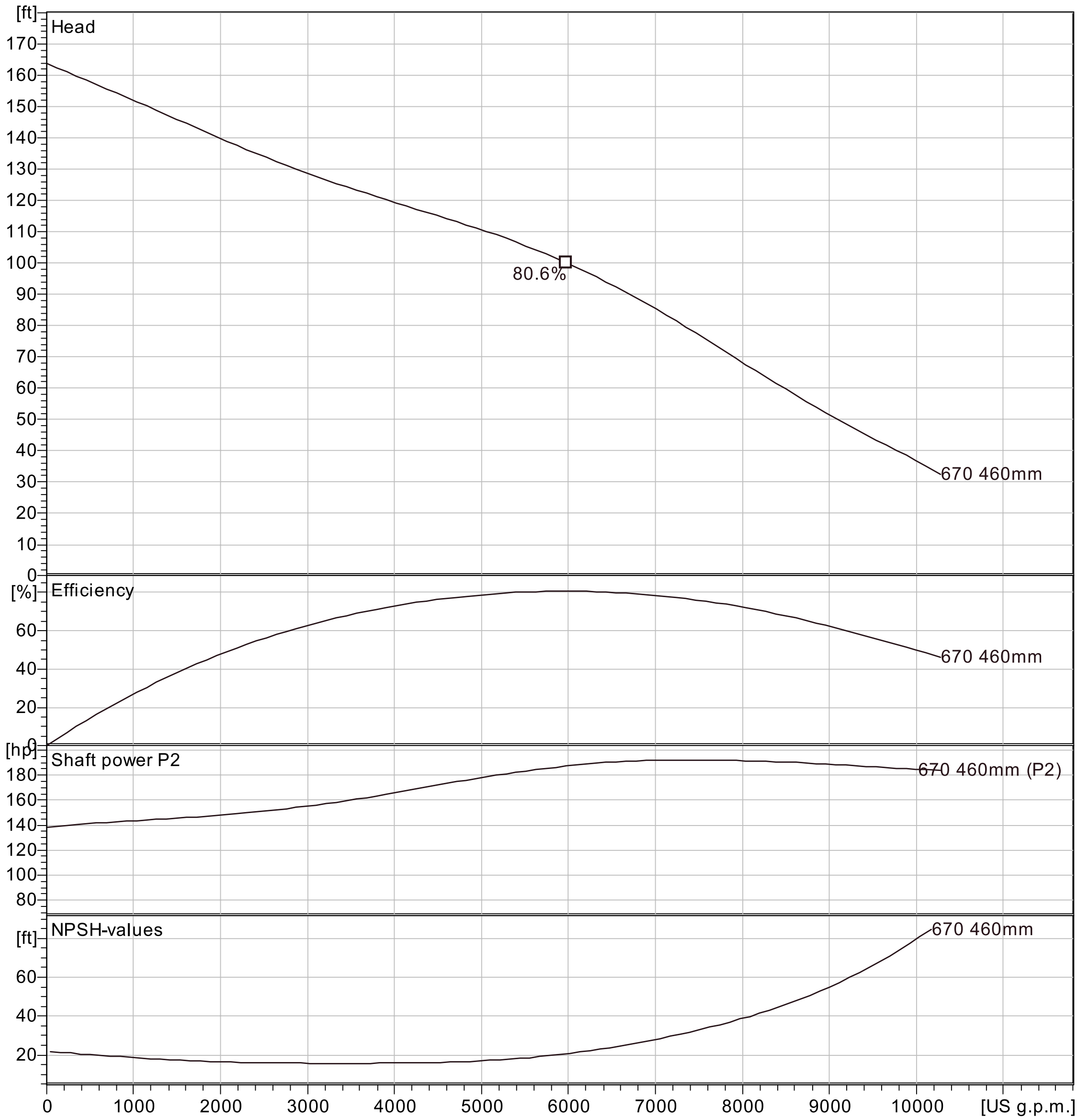
Inlet diameter	350 mm
Impeller diameter	460 mm
Number of blades	3

Motor

Motor #	N0735.000 43-44-6BC-D 215hp
Stator variant	
Frequency	60 Hz
Rated voltage	460 V
Number of poles	6
Phases	3~
Rated power	215 hp
Rated current	260 A
Starting current	1550 A
Rated speed	1185 1/min

Power factor	
1/1 Load	0.83
3/4 Load	0.79
1/2 Load	0.69

Efficiency	
1/1 Load	93.5 %
3/4 Load	93.5 %
1/2 Load	93.0 %



Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-10-03	

xylem
Let's Solve Water

NP 3400/865 3~ 670

Performance curve

FLYGT

Pump

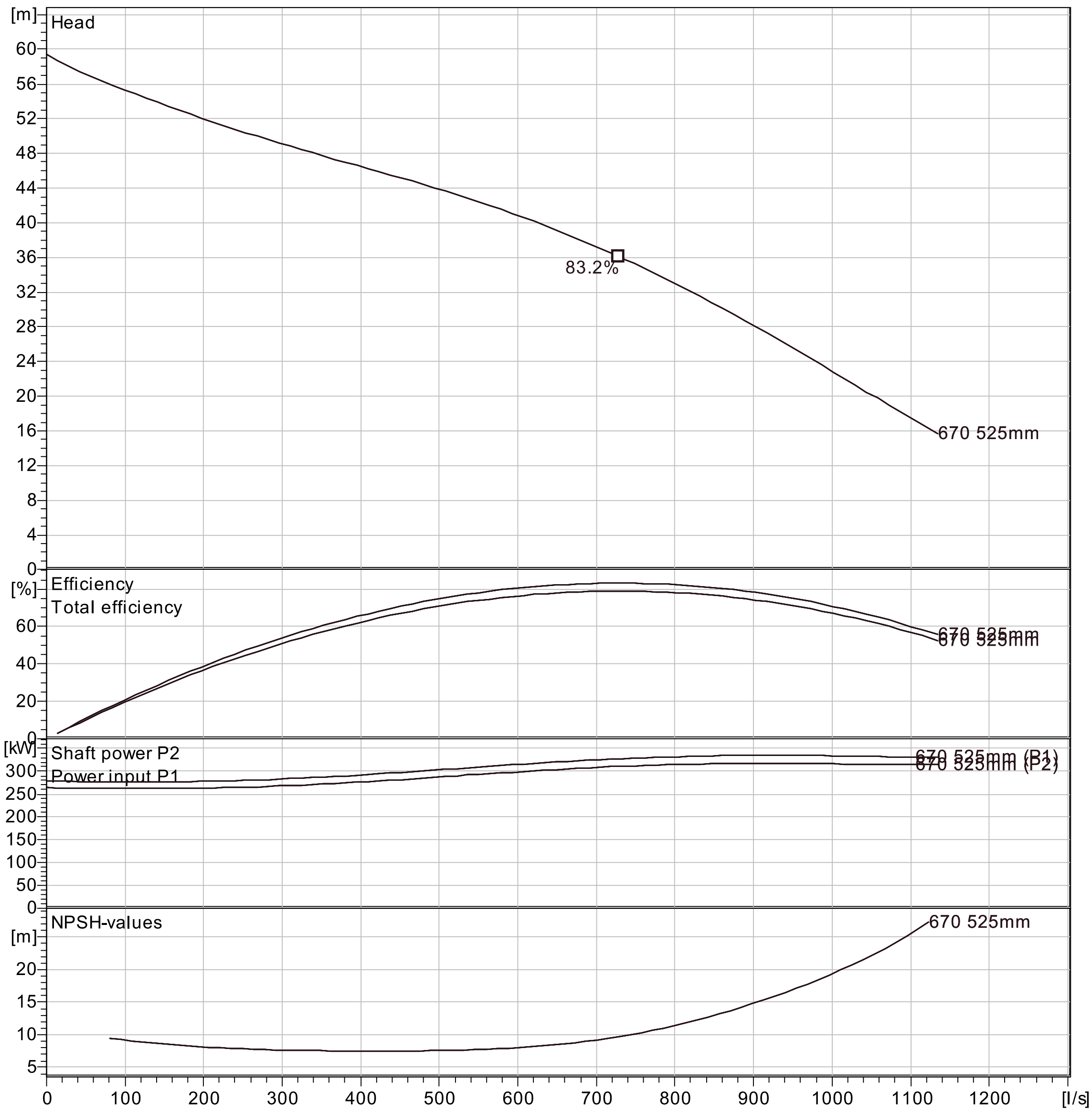
Outlet width	400 mm
Inlet diameter	500 mm
Impeller diameter	525 mm
Number of blades	3
	0 mm

Motor

Motor #	N0865.000 54-66-6AA-W 470hp
Stator variant	2
Frequency	60 Hz
Rated voltage	600 V
Number of poles	6
Phases	3~
Rated power	350 kW
Rated current	435 A
Starting current	2840 A
Rated speed	1190 1/min

Power factor	
1/1 Load	0.82
3/4 Load	0.77
1/2 Load	0.67

Efficiency	
1/1 Load	94.5 %
3/4 Load	94.5 %
1/2 Load	93.0 %



Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-11-28	

1A Lift Station Pumps

Pump(s)	Flow	Level	Frequency, Hz.			
	(L/sec)	(m.)	P-1	P-2	P-3	P-4
1	300	2.80	60			
	463	2.75	60			
	403	2.70	60			
	383	2.65	60			
	412	2.60	60			
	456	2.50	60			
	459	2.40	60			
	457	2.30	60			
	455	2.20	60			
2	282	2.80		60		
	361	2.70		60		
	393	2.60		60		
	412	2.50		60		
	413	2.40		60		
	407	2.30		60		
	401	2.20		60		
3	300	2.53			42.6	
	370	2.45			42.6	
	354	2.20			42.6	
4	323	2.72				42.6
	244	2.65				42.6
	357	2.45				42.6
	340	2.30				42.6
	335	2.20				42.6

1A Lift Station Pumps

Pump(s)	Flow	Level	Frequency, Hz.			
	(L/sec)	(m.)	P-1	P-2	P-3	P-4
3 + 2	360	2.6		60	42.6	
	510	2.4		60	42.6	
	516	2.3		60	42.6	
4 + 2	475	2.7		60		42.6
	480	2.6		60		42.6
	484	2.5		60		42.6
	520	2.4		60		42.6
	516	2.3		60		42.6
	505	2.2		60		42.6
3 + 1	438	2.7	60		42.6	
	403	2.6	60		42.6	
	475	2.5	60		42.6	
	505	2.4	60		42.6	
	503	2.3	60		42.6	
	490	2.2	60		42.6	
4 + 1	478	2.7	60			42.6
	378	2.6	60			42.6
	469	2.5	60			42.6
	525	2.4	60			42.6
	530	2.3	60			42.6
	516	2.2	60			42.6
3 + 4	422	2.7			42.6	50.4
	417	2.6			42.6	50.4
	414	2.5			42.6	50.4
	484	2.4			42.6	50.4
	515	2.3			42.6	50.4
	514	2.2			42.6	50.4

Appendix G – Cornwall - Thickwood Heights Lift Station

Appendix G contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 5
COMPONENT:	Infrastructure Assessment	DATE:	August 21, 2013		
LOCATION:	Cornwall Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Progress/Status/Conformance To Design/Workmanship/Comments/Recommendations

I was on site at the Cornwall Sewage Lift Station on Wednesday August 21, 2013 to conduct a structural assessment of the station. The Wet Well and Dry Well below grade have a reinforced concrete slab foundation and reinforced concrete walls. The ground level floor slab is a reinforced concrete structural slab. Access to the Dry Well is provided by a structural steel stairs and landings supported from the concrete walls. Access to the Wet Well is also by structural steel stairs with landings supported from the concrete walls. The main floor walls above grade are standard masonry block wall on the interior and metal cladding on the exterior. The roof is flat and is supported by metal decking on open web steel joists. I did not inspect the top exterior of the roof. There are separate steel doors on the south side of the building to access the Dry Well and Wet Well. The building is equipped with a 500 kg capacity monorail and crane in the Dry Well, a Davit crane on the main floor of the Dry Well, and a 750 kg capacity monorail and crane on the Main floor of the Wet Well.

The reinforced concrete foundation slab at the bottom of the Dry Well is in good condition with no signs of cracking, spalling or rebar corrosion. The sump pit is in good condition. The reinforced concrete pump foundations are in good condition. The reinforced concrete walls in the Dry Well are in good condition. There are several bolts in the wall that have been cut off but not painted. These should be painted like most of the others have, to prevent corrosion.
The 500 kg capacity monorail is in good condition. The structural steel stairs, platforms and handrails are in good condition. The Dry Well main floor slab is in good condition. The Davit crane is in good condition. The open web steel joists and metal decking are in good condition. The masonry block wall looks newly painted and is in good condition. The steel entrance door is in good condition.

The reinforced concrete foundation slab at the bottom of the Wet Well is in good condition with no signs of cracking, spalling or rebar corrosion. The reinforced concrete walls in the Wet Well are in good condition. They appear to have a textured surface parging or coating that is adhering to the concrete reasonably well although it was peeling off at one location. The reinforced concrete main floor slab is in good condition. The structural steel stairs, platforms and handrails are in good condition. The 750 kg capacity crane and monorail are in good condition. The steel entrance door is in good condition. There was a large accumulation of dust in the vent in the ceiling over the entrance.

The reinforced concrete apron slab at the front entrance doors is in poor condition. There is a major crack in the slab at the SW corner near the Wet Well entrance. There is a large spall in the apron slab in front of the Dry Well entrance. Both should be repaired.
The metal wall siding is in fair condition with some panels having large dents and discolouration. There are some minor gaps in the panel joints at a few locations. The underside of the louver slats are wood and the paint is peeling off. These should be sanded to remove peeling paint and re-painted. The building envelope, including metal siding and roof deck, is generally in fair condition. There are no eaves trough or downspouts.

The general condition of the station structure is good except for the minor issues mentioned previously that require maintenance.

Recommendations

1. Paint the ends of the bolts that were cut off in the Dry Well walls to prevent corrosion in the future.
2. Monitor wall parging in the Wet Well to see if it continues to fall off with time.
3. Repair the crack and spall in the apron slab at the door entrances.
4. Sand and re-paint the wood slats at the underside of the louvers.
5. Clean the dust and debris from the vent in the ceiling at the entrance to the Wet Well.

Photo 1: Front entrances of Cornwall Sewage Lift Station. The apron slab has spalls and cracks that need repair.

Photo 2: The wall of Dry Well has bolts that are cut off that need paint to prevent corrosion similar to these shown.

Photo 3: Parging on Wet Well concrete wall is peeling off.

Photo 4: Major crack in apron slab requires repair.

Photo 5: The Wet Well ceiling vent is clogging with dust and debris and requires cleaning.

Photo 6: Paint is peeling off the underside of louver slats and requires sanding and re-painting.

Photo 7: Discoloration of panels at the back of station is primarily an aesthetic issue.

Photo 8: Slight gaps in panel joints.

Photo 9: Dry Well stairs and handrail in good condition.

Photo 10: Masonry block wall in Wet Well stairway in good condition.

Photo 11: Wet Well grating in good condition.

Photo 12: Door to Wet Well in good condition.

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	August 21, 2013		
LOCATION:	Cornwall Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune Mike Yourechuk, Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave ?? - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process Mechanical comments and recommendations

We were on site at Cornwall (Thickwood Heights) Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – Threshold = 360 m. No flood concern.
- Facility was constructed in ????, and mechanically & electrically upgraded in 2012.
- Facility is in good condition – minimal rusting evident at flanges & bolts.
- Facility has flow, pressure, and level monitoring.
- There is a grinder installed to macerate the incoming sewage; operating satisfactorily.
- Facility is a wet well/dry well configuration. Pumps, valves & piping are in the lower level adjacent to the wet well.
- There are 3 variable speed pumps installed. Each is pre-set to run at 43 Hz. The design conditions are not available; each pump is running very close to the best efficiency point on the curves, producing approximately 50 L/sec @ 68 kPa. If converted to 60 Hz operation, corresponding flow should be approximately 70 L/sec, which is in line with the provided design flow.
- Combined flows with 2 pumps running = averages approx. 75-80 L/sec. for pumps 1 +2 and 1 + 3. However, pumps 2 + 3 produce approximately 97 L/sec.
- All 3 pumps operating together provide approx. 107 L/sec. This has one pump at 43 Hz, one at 48 Hz. and one at 60 Hz. With all three pumps running, one at 43 Hz. and the other two at 60 Hz., flow is approx. 127 L/sec.

<u>Recommendations</u>

- Test pumps individually at full speed operation.
- Check anomalies in pump combinations. Pumps 2 + 3 combined produce more than 1+2 or 1+3.

	
Photo 1: Dry well – Pumps, discharge valves and piping.	Photo 2: Grinder & bypass channel.
	
Photo 3: Discharge piping, including flow and pressure monitoring.	Photo 4:

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 5
COMPONENT:	Infrastructure Assessment	DATE:	August 21, 2013		
LOCATION:	Cornwall Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Mitch Lejeune Scott Friel	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave Bernard		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

We were on site at Cornwall Sewage Lift Station on Wednesday August 21, 2013 to conduct a condition assessment of the station. The purpose is to establish the maintenance required for the site and any optional improvements.

Analysis:
The site has a single service with a backup generator. The system was recently upgraded by NASON and much of the system has been replaced. The PLC was a Modicon 140CPS11420.

There is a MDS4710 Radio (Glentel) for SCADA communications.

There was a Convergint BAS system for the HVAC control.

Investigation:

The Flygt bulbs are not equipped with intrinsically safe barriers. Should the wet well have suitable concentrations of explosive gases and the cables to the Flygt bulbs are damaged, a spark would cause an explosion.

There was little visible H_2S corrosion.

The power meter was not working and was registering considerably lower than expected (5 kVA) with the pump running. The ATCO meter was X10 rated and indicated that the consumption was around 51.4 kVA.

Several duty-standby cycles were observed and created and the system transferred pumps and maintained level as expected.

The generator test button was not working.

Recommendations
1. The Flygt bulbs could have an intrinsically safe relay installed, Flygt makes one with a built in relay.
2. The power meter was not displaying current, maybe there were no current transformers, or it could have failed.
3. Obtain as-builts before the contractor is off site.
4. Recommend HVAC review for the wet well.

Photo 1: Front entrances of Cornwall Sewage Lift Station. The apron slab has spalls and cracks that need repair.

Photo 2: The pressure balancing is 'off' (notice dust trail along door and vent is fill with dust below).

Photo 3:.

Photo 4: Vent in wet well, top of stair.

PRODUCT

Serial No.		Performance curve No.		Motor module/type	Voltage (V)
3171.181	1240155	63- 435-00-3030		152	600
Base module 031	Impeller No. 696 52 58			Imp.diam/Blade angle 244	Water temp °C 23.1

TEST RESULTS

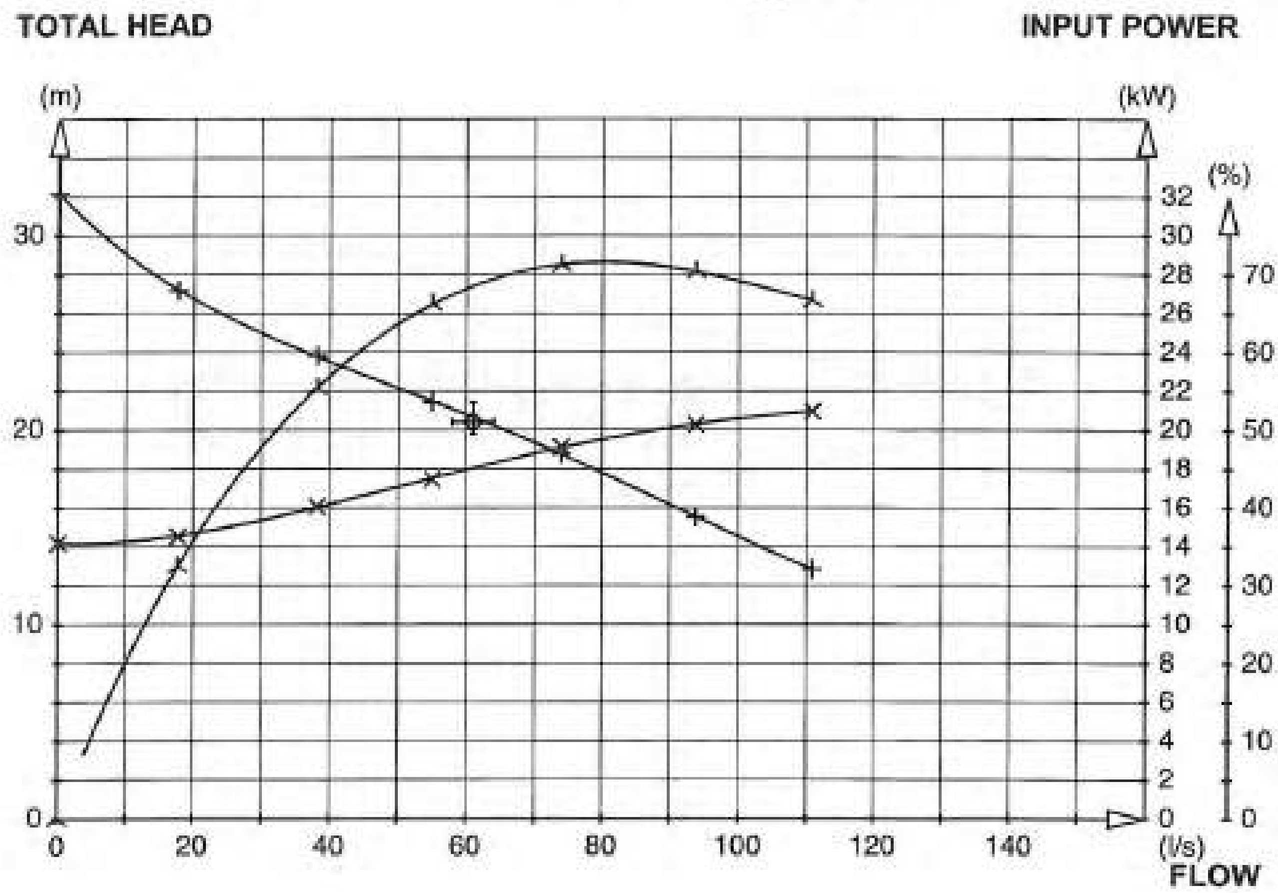
Pump total head H (m)	Volume rate of flow Q (l /s)	Motor input power P (kW)	Voltage U (V)	Current I (A)	Overall efficiency η (%)
32.16	0.00	14.19	597	18.6	0.00
27.17	17.74	14.54	597	18.8	32.52
23.82	38.15	16.07	596	20.1	55.45
21.43	55.02	17.46	596	21.3	66.23
18.77	73.97	19.12	596	22.8	71.22
15.53	93.78	20.29	596	23.9	70.42
12.84	110.93	20.96	595	24.5	66.68

Accepted after	Test facility	Test date	Time	Chief tester
HI/B	Lindas Sweden LS3	12-06-20	08:16	rbbd

ORDERNR 324421 POS 3

PLOTTED TEST RESULTS

Measured point : + = Q/H, × = Q/P Duty point : ◇ = Q/H, □ = Q/P, △ = Q/ETA overall Calculated point : ⅄ = Q/ETA overall 1



RMWB - Cornwall
Pump -001
Flow head at various speeds

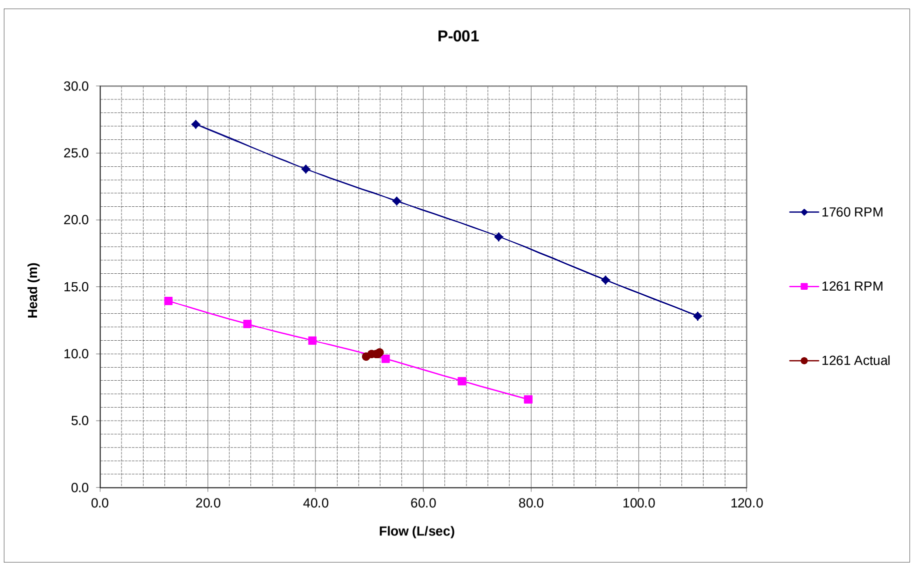
Curve			Calculated, from speed change			Calculated, from speed change			Actual reading			Calculated, from speed change			Calculated, from speed change		
Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.
1,760.0	17.7	27.2	1,261.0	12.7	13.9				1,261.0	51.9	10.1						
1,760.0	38.2	23.8	1,261.0	27.3	12.2				1,261.0	51.6	10.0						
1,760.0	55.0	21.4	1,261.0	39.4	11.0				1,261.0	51.2	10.0						
1,760.0	74.0	18.8	1,261.0	53.0	9.6				1,261.0	50.4	10.0						
1,760.0	93.8	15.5	1,261.0	67.2	8.0				1,261.0	49.4	9.8						
1,760.0	110.9	12.8	1,261.0	79.5	6.6												

Actual site readings			
Speed, rpm	Flow, USgpm	Head, ft.	Freq., Hz.
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!

Notes:
$(Q_1/Q_2) = (N_1/N_2)$

$(H_1/H_2) = (N_1/N_2)^2$

$(HP_1/HP_2) = (N_1/N_2)^3$



PRODUCT

Serial No.		Performance curve No.	Motor module/type	Voltage (V)
3171.181	1240153	63- 435-00-3030	152	600
Base module	Impeller No.		Imp.diam/Blade angle	Water temp °C
031	696 52 58		244	23.2

TEST RESULTS

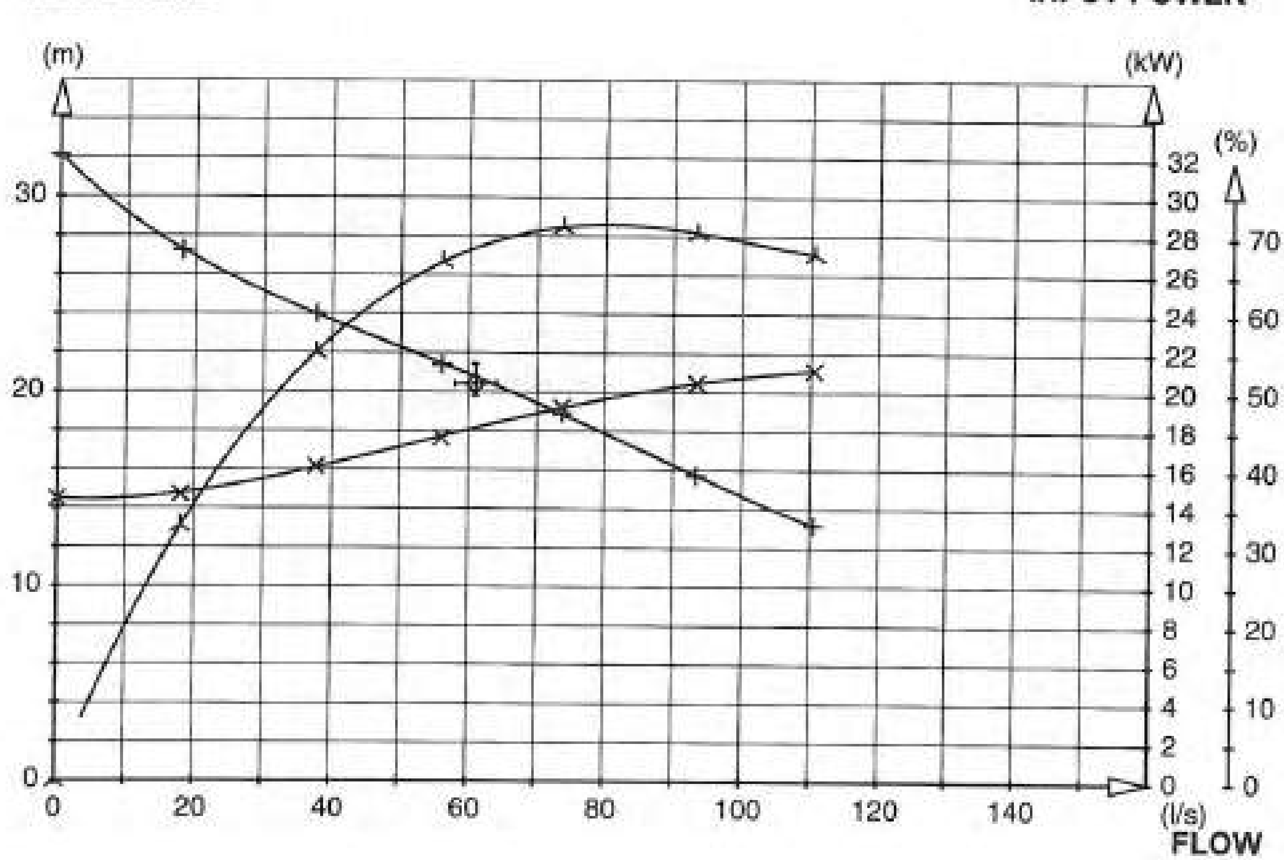
Pump total head H (m)	Volume rate of flow Q (l /s)	Motor input power P (kW)	Voltage U (V)	Current I (A)	Overall efficiency η (%)
32.13	0.00	14.48	595	18.8	0.00
27.23	18.05	14.72	596	19.0	32.75
24.00	37.74	16.15	595	20.2	55.01
21.40	56.07	17.64	595	21.5	66.73
18.91	73.70	19.21	595	22.9	71.17
15.73	93.38	20.46	594	24.0	70.46
13.18	110.53	21.11	594	24.6	67.69

Accepted after	Test facility		Test date	Time	Chief tester
HI/B	Lindas Sweden	LS3	12-06-19	15:18	ahkg

ORDERNR 324421 POS 3

PLOTTED TEST RESULTS

Measured point: + = Q/H, × = Q/P
Duty point: ◇ = Q/H, □ = Q/P, △ = Q/ETA overall
Calculated point: ⅄ = Q/ETA overall 1



RMWB - Cornwall
Pump -002
Flow head at various speeds

Curve			Calculated, from speed change			Calculated, from speed change			Actual reading			Calculated, from speed change			Calculated, from speed change		
Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.
1,760.0	18.1	27.2	1,261.0	12.9	14.0				1,261.0	52.0	10.1						
1,760.0	37.7	24.0	1,261.0	27.0	12.3				1,261.0	51.8	10.0						
1,760.0	56.1	21.4	1,261.0	40.2	11.0				1,261.0	50.9	9.9						
1,760.0	73.7	18.9	1,261.0	52.8	9.7				1,261.0	50.5	10.0						
1,760.0	93.4	15.7	1,261.0	66.9	8.1				1,261.0	49.4	9.8						
1,760.0	110.5	13.2	1,261.0	79.2	6.8												

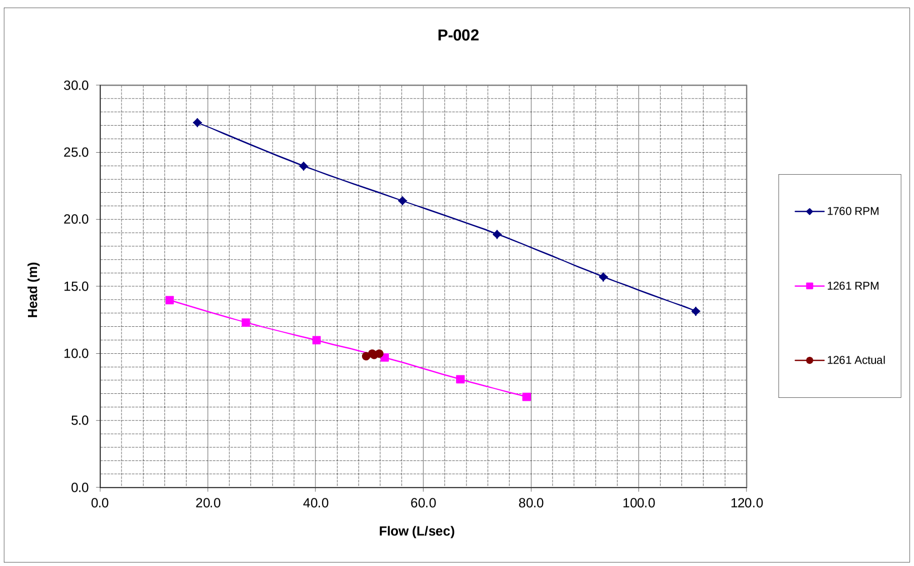
Actual site readings			
Speed, rpm	Flow, USgpm	Head, ft.	Freq., Hz.
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!

Notes:

$(Q_1/Q_2) = (N_1/N_2)$

$(H_1/H_2) = (N_1/N_2)^2$

$(HP_1/HP_2) = (N_1/N_2)^3$



P-003

PRODUCT

Serial No.		Performance curve No.	Motor module/type	Voltage (V)
3171.181	1240154	63- 435-00-3030	152	600
Base module	Impeller No.		Imp.diam/Blade angle	Water temp °C
031	696 52 58		244	23.2

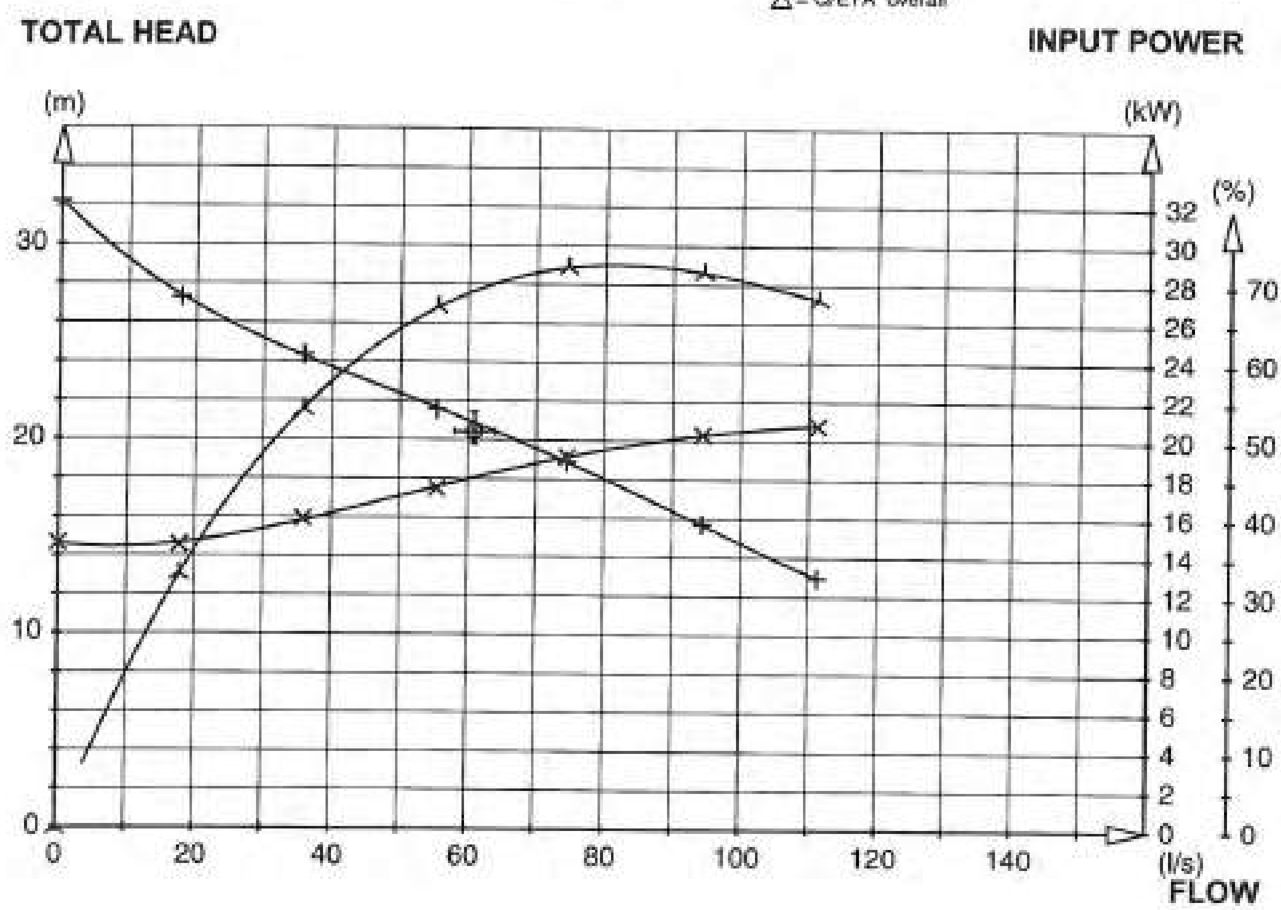
TEST RESULTS

Pump total head H (m)	Volume rate of flow Q (l /s)	Motor input power P (kW)	Voltage U (V)	Current I (A)	Overall efficiency η (%)
32.23	0.00	14.63	597	18.9	0.00
27.28	17.80	14.57	597	18.9	32.70
24.35	35.90	15.93	596	20.0	53.85
21.57	55.47	17.50	596	21.4	67.06
18.88	74.55	19.13	596	22.8	72.20
15.69	94.42	20.30	596	23.9	71.60
12.96	111.30	20.77	596	24.3	68.13

Accepted after	Test facility	Test date	Time	Chief tester
HI/B	Lindas LS3 Sweden	12-06-19	14:12	rbkg

ORDERNR 324421 POS 3

PLOTTED TEST RESULTS Measured point : + = Q/H ✕ = Q/P Duty point : ◇ = Q/H □ = Q/P △ = Q/ETA overall Calculated point : 人 = Q/ETA overall 1



RMWB - Cornwall
Pump -003
Flow head at various speeds

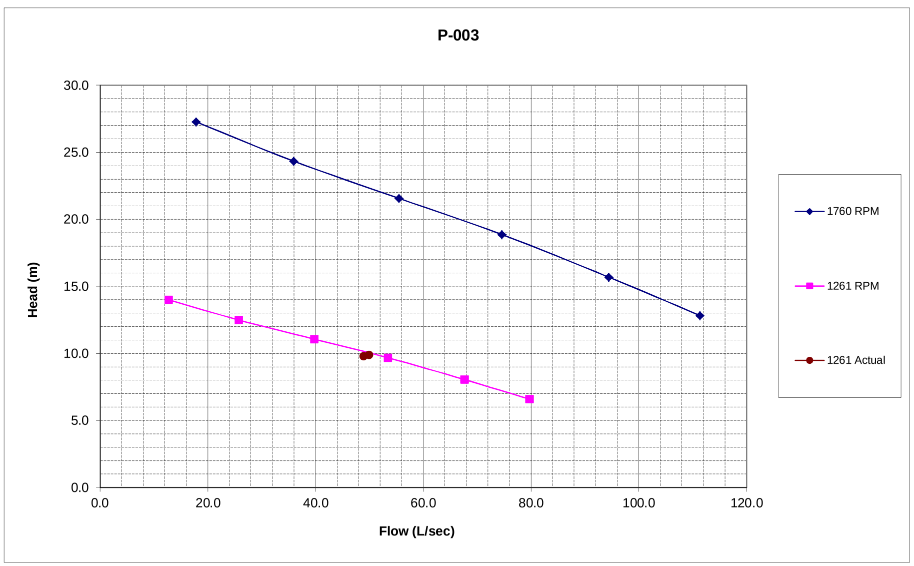
Curve			Calculated, from speed change			Calculated, from speed change			Calculated, from speed change			Calculated, from speed change			Calculated, from speed change		
Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.	Speed, rpm	Flow, L/sec.	Head, m.
1,760.0	17.8	27.3	1,261.0	12.8	14.0				1,261.0	49.9	9.9						
1,760.0	35.9	24.4	1,261.0	25.7	12.5				1,261.0	48.9	9.8						
1,760.0	55.5	21.6	1,261.0	39.7	11.1												
1,760.0	74.6	18.9	1,261.0	53.4	9.7												
1,760.0	94.4	15.7	1,261.0	67.6	8.1												
1,760.0	111.3	12.8	1,261.0	79.7	6.6												

Actual site readings			
Speed, rpm	Flow, USgpm	Head, ft.	Freq., Hz.
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!
#REF!	#REF!	#REF!	#REF!

Notes:
$(Q_1/Q_2) = (N_1/N_2)$

$(H_1/H_2) = (N_1/N_2)^2$

$(HP_1/HP_2) = (N_1/N_2)^3$



Cornwall Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.		
	(L/sec)	(kPa.)	(m.)	(m.)	P-001	P-002	P-003
1 (155)	51.9	69.2	7.1	1.3	43		
	51.6	68.9	7.0	1.2	43		
	51.2	68.9	7.0	1.1	43		
	50.4	68.4	7.0	1.0	43		
	49.4	67	6.8	0.8	43		
2 (153)	52.0	69.3	7.1	1.3		43	
	51.8	68.9	7.0	1.2		43	
	50.9	67.2	6.9	1.1		43	
	50.5	68.2	7.0	1.0		43	
	49.4	66.8	6.8	0.8		43	
3 (154)	49.9	67.4	6.9	0.96			43
	48.9	66.6	6.8	0.68			43

Cornwall Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.		
	(L/sec)	(kPa.)	(m.)	(m.)	P-001	P-002	P-003
2 + 1	72.0	94.0	9.6	1.37	48	43	
(first pump is lead)	80.0	93.0	9.5	1.32	48	43	
	80.0	93.9	9.6	1.27	48	43	
	79.5	94	9.6	1.2	48	43	
	78.8	97.3	9.9	1.1	48	43	
	78.2	92.4	9.4	1.0	48	43	
	76.5	89.6	9.2	0.8	48	43	
	75.9	89.5	9.1	0.7	48	43	
3 + 1	78.4	93.9	9.6	1.35	48		43
(first pump is lead)	78.6	93.7	9.6	1.25	48		43
	78.4	93	9.5	1.2	48		43
	77.9	92.6	9.5	1.1	48		43
	77.0	91.6	9.4	1.0	48		43
	76.5	92.2	9.4	0.9	48		43
	75.9	90.9	9.3	0.8	48		43
	75.1	89.7	9.2	0.7	48		43
2 + 3	97.6	116.6	11.9	1.35		43.05	60
(first pump is lead)	97.9	117.5	12.0	1.3		43.05	60
	97.0	114.5	11.7	1.2		43.05	60
	96.6	117.2	12.0	1.1		43.05	60
	95.9	115	11.7	1.0		43.05	60
	95.6	115	11.7	0.9		43.05	60

Cornwall Lift Station Pumps

Pump(s)	Flow	Head		Level	Frequency, Hz.		
	(L/sec)	(kPa.)	(m.)	(m.)	P-001	P-002	P-003
1 + 2 + 3	128.0	162.0	16.5	1.3	43.06	60	60
(first pump is lead)	127.8	164.0	16.7	1.2	43.06	60	60
	127.4	164.0	16.7	1.1	43.06	60	60
	126.9	162.5	16.6	1.0	43.06	60	60
	126.6	162.5	16.6	0.9	43.06	60	60
	125.7	162.5	16.6	0.8	43.06	60	60
2 + 3 + 1	107.4	130.0	13.3	1.3	48	43.05	60
(first pump is lead)	107.2	131.6	13.4	1.2	48	43.05	60
	106.7	129.3	13.2	1.1	48	43.05	60
	105.8	129.3	13.2	1.0	48	43.05	60
	105.1	134.2	13.7	0.9	48	43.05	60
	104.5	124.8	12.7	0.8	48	43.05	60
3 + 1 + 2	107.3	130.0	13.3	1.3	48	60	43.06
(first pump is lead)	107.0	129.1	13.2	1.2	48	60	43.06
	106.8	126.5	12.9	1.1	48	60	43.06
	105.8	126.3	12.9	1.0	48	60	43.06
	105.2	128.5	13.1	0.9	48	60	43.06
	104.7	125.5	12.8	0.8	48	60	43.06

Appendix H – Wood Buffalo Lift Station

Appendix H contains the following:

1. Infrastructure (Structural) Inspection Report
2. Process Mechanical Inspection Report
3. Instrumentation/Electrical Inspection Report
4. Pump curve(s) for installed pumps
5. Pump data

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 5
COMPONENT:	Infrastructure Assessment	DATE:	October 04, 2013		
LOCATION:	Wood Buffalo Sewage Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mike Yourechuk Richard Coldbeck	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Structural Comments, and Recommendations

We were on site at Wood Buffalo Sewage Lift Station on Friday October 04, 2013 to conduct a condition assessment of the station.
The general condition of the station structure is good with some repair and maintenance required.

The Lift Station building has metal cladding on the roof and walls with a single gable roof. The station is framed with hollow structural steel members and it is supported on a concrete foundation. The Dry Well and Wet Well are separated by a metal clad wall and there are separate entrance doors to each. Access to the doors is provided by structural steel stairs and platforms. The main floor is checker plate. There are metal hatches in the Wet Well floor. Access down into the Wet Well is by ladder with an intermediate platform provided. Precast concrete boxes form the walls of the Wet Well. The Wet Well has two monorails that are labelled with Safe Working Loads of 1650 lbs each.

The exterior metal wall cladding has some cuts and perforations in it that require repair. There is graffiti on the back exterior wall that requires paint. The door to the Dry Well has paint peeling off that requires repair. The handrail on the outside stairs that access the Wet Well is corroding and requires clean up and paint. The two monorails in the Wet Well are overdue for inspection and were last inspected on 02/09/2010 according to the CRS Crane inspection stickers. The ladder for access down into the Wet Well has paint peeling off and has significant corrosion. It requires clean up and paint. There is no safety cage around the ladder down into the Wet Well so a fall protection system is required for personnel to access the Wet Well.

Recommendations

1. Repair cuts and perforations in the exterior metal wall cladding.
2. Paint over the graffiti on the back exterior wall.
3. Clean up the peeling paint on the Dry Well door and touch up with paint.
4. Remove the corrosion from the handrail on the outside stairs to the Wet Well and repaint.
5. Certified inspection the monorail cranes is required. They were last inspected on 02/09/2013.
6. Remove the corrosion from the Wet Well ladder and repaint.
7. Ensure a fall protection system is in place for personnel using the ladder to access the Wet Well.

Photo 1: South Exterior Wall with damage to cladding.

Photo 2: Perforation in cladding.

Photo 3: Cuts in cladding.

Photo 4: Graffiti on the back exterior wall.

Photo 5: Corrosion on Wet Well outside stair handrail.

Photo 6: Wet Well Monorail.

Photo 7: The monorail inspection is expired.

Photo 8: Corrosion on Wet access ladder and platform. No safety cage around ladder.

		
Photo 9: Wet Well access hatch. Utilize fall protection system to access Wet Well.		Photo 10:
Photo 11:		Photo 12:

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	September 19, 2013		
LOCATION:	Wood Buffalo Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Bryan ?? - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Process mechanical comments and recommendations

We were on site at Wood Buffalo Sewage Lift Station to conduct a condition/capacity assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – ground = 363 + 0.89 m.to floor. No flood concern.
- Facility was constructed in 2000 (?).
- Facility is in good condition – minimal rusting evident.
- Facility has no flow or pressure monitoring; only wet well level indication. Flow was calculated by timing drawdown and refill level durations.
- Facility is a wet well configuration. Pumps, valves & piping are in the wet well. Electrical room is separate from the wet well entrance.
- There are 2 variable speed pumps installed. The design conditions are not available; each pump is running slightly left of the best efficiency point on the curves, producing approximately 50 L/sec.
- Combined flows with 2 pumps running = averages approx. 110 L/sec.

<u>Recommendations</u>

- Install flow and pressure monitoring.

		
Photo 1: Pumphouse, showing elevated floor		Photo 2: Wet well access hatches, including heater and ductwork.
		
Photo 3: Control panel in electrical room.		Photo 4:

INSPECTION REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	9WBLS
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 3
COMPONENT:		DATE:			
LOCATION:	Wood Buffalo	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Richard Coldbeck, Mike Yourechuk	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Richard - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT Electrical Comments, and Recommendations

Wood Buffalo Lift Station

General

There are separate entrance doors to the wet and dry wells and a wall between the areas so that segregation is achieved.
A visual and an inspection using a thermal camera was undertaken.
Electrical connections were visually checked for indication of overheating or hydrogen sulphide presence, which is indicated by blackening of the copper cables.
Visual check of grounding was undertaken.

Electrical room visual inspection

The electrical area is clean and tidy with new equipment.
There were no discoloured and burnt power cables which would indicate loose connections.
The variable frequency drive (VFD) and output filter cables have some black discoloration which indicates hydrogen sulfide presence. Other cables higher up the enclosure were not discoloured.
The grounds from the motors should be terminated on the respective VFD. Incorrect installation could result in premature pump failure.
Control panel panduit lids are not in place and some cables are hanging down.
UPS is mounted directly in front of communication equipment.

Electrical room thermal camera survey

No hot components were found with the thermal camera, although the intermittent duty of the pumps means that the camera would not indicate all faults.

Wet Well Area

All electrical apparatus, including receptacles, lights and infrared heaters are to be suitable and be wired in accordance with Class I, Zone 2 operation as Canadian Electrical Code Part 1 section 18 and section 22-700.
The existing receptacles, lights, disconnects and heaters do not have this rating and are not wired as required by code.

Recommendations

- Ensure Code Compliance with Canadian Electrical Code Part 1 section 18 and section 22-700
- Investigate reason for hydrogen sulfide ingress at the VFD terminals and seal ingress point.
- Terminate motor grounds to their respective VFD.
- Re-install panduit lids inside the PLC control panel and tidy up cabling.
- Consider mounting the UPS elsewhere.
- Replace and re-wire wet well equipment.

- Install intrinsically safe barriers on level switches.

Investigate reason for hydrogen sulfide ingress at the VFD terminals and seal ingress point.

Terminate motor grounds to their respective VFD.

Re-install panduit lids inside the PLC control panel and tidy up cabling.

Consider mounting the UPS elsewhere.

		
Replace and re-wire wet well equipment.		*Replace and re-wire wet well equipment.*
		
Replace and re-wire wet well equipment.		

R. Coldbeck

Nov 4, 2013

LL 3127 LT 3~ 411

Performance curve

Pump

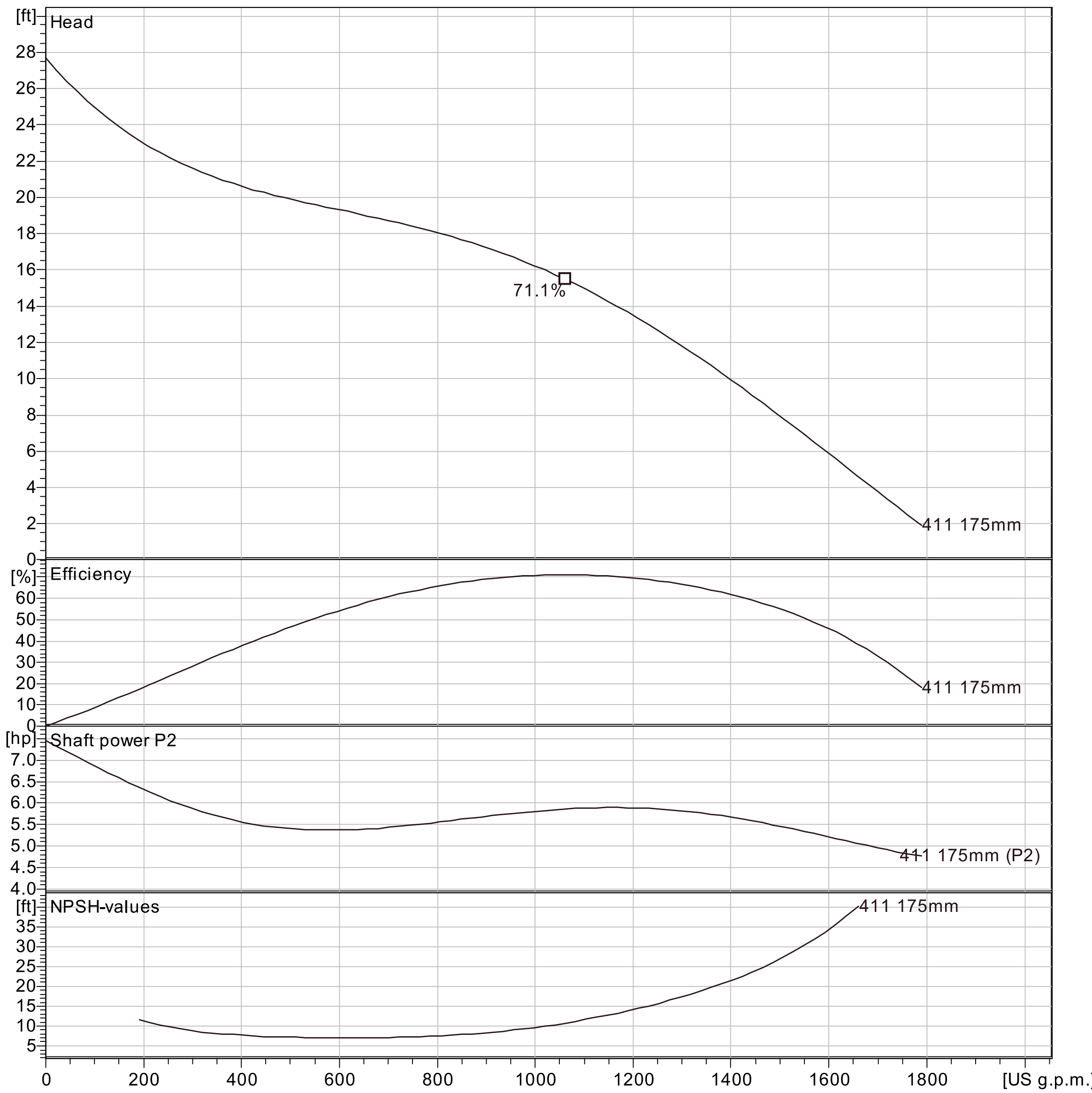
Inlet diameter	
Impeller diameter	175 mm
Number of blades	2
	76 mm

Motor

Motor #	L3127.181 21-12-4AL-W 7,5KW
Stator variant	
Frequency	50 Hz
Rated voltage	230 V
Number of poles	4
Phases	3~
Rated power	10.1 hp
Rated current	27 A
Starting current	133 A
Rated speed	1435 1/min

Power factor	
1/1 Load	0.86
3/4 Load	0.84
1/2 Load	0.76

Efficiency	
1/1 Load	81.5 %
3/4 Load	83.5 %
1/2 Load	83.0 %



Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-10-01	

Wood Buffalo Lift Station Pumps' Drawdowns

Pump(s)	WW area	Pumping					Filling					Pump rate
	m^2	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L/sec
1	7.20	1.80	0.80	7.20	182	39.56	0.84	1.80	6.91	597	11.58	51.14
2	7.20	1.80	0.80	7.20	176	40.91	0.80	1.80	7.20	723	9.96	50.87
1	7.20	1.80	0.80	7.20	181	39.78	0.80	1.80	7.20	586	12.29	52.07
2	7.20	1.80	0.80	7.20	171	42.11	0.80	1.80	7.20	703	10.24	52.35
2 + 1	7.20	1.80	0.80	7.20	81	88.89	0.80	1.80	7.20	440	16.36	105.25
1 + 2	7.20	1.80	0.80	7.20	73	98.63	0.80	1.80	7.20	472	15.25	113.88

Appendix I – Gregoire Park Lift Station

Appendix I contains the following:

1. Process Mechanical Inspection Report
2. Pump data

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	October 9, 2013		
LOCATION:	Gregoire Park Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave & John - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT

We were on site at Gregoire Park Sewage Lift Station to conduct a flow assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – floor = 364 m. No flood concern.
- Facility was constructed in 1976.
- Facility is in poor condition – substantial rusting on equipment, valves, fittings, piping.
- At the time of testing, pumps were cycling on/off every 1-2 minutes.
- Facility is scheduled for upgrading in the near future.
- Facility has no flow, pressure, or level monitoring. Flow was calculated by timing drawdown and refill level durations using a laser distance measuring tool.
- Facility is a wet well/dry configuration. Pumps, valves & piping are in the lower level of the dry well. Electrical room is separate from the wet well entrance.
- There are 2 constant speed pumps installed. Both have electric motors; one also has a natural gas engine drive. Neither the design conditions nor the pump curves are available; Pump #1 is producing an average flow of 34 L/sec' Pump #2 is averaging 33 L/sec.
- Pump #1 is leaking severely at its seals.
- Combined flows with 2 pumps running = averages approx. 32 L/sec. This is very inconsistent – may be due to inaccuracies in level measurement, or changes in influent flow.

<u>Recommendations</u>

- Upgrade pumps, valves, fitting, piping, etc.
- Install flow, pressure and level monitoring during upgrade.
- Re-test pumps' flow when commissioning upgrade.

Photo 1: Pumphouse, showing dry well & wet well access

Photo 2: Pump #1 – Leaking seals.

Photo 3: Dry well lower level – rusty fittings & equipment.

Photo 4: Main floor dry well - electrical and controls

Gregoire Pumps' Drawdowns

Pump(s)	WW area	Pumping					Filling					Pump rate
	m^2	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L/sec
1	5.39	0.30	0.40	0.57	60	9.52			0.00		#DIV/0!	#DIV/0!
2	5.39	0.33	0.89	3.04	180	16.89	0.89	0.52	1.97	120	16.44	33.33
1	5.39	0.52	0.77	1.32	60	22.01	0.77	0.37	2.17	180	12.07	34.08
2	5.39	0.37	0.45	0.44	60	7.28	0.45	0.33	0.61	60	10.15	17.43
1 + 2	5.39	0.33	0.60	1.41	60	23.45	0.60	0.42	0.96	60	16.08	39.53
1 + 2	5.39	0.42	0.79	2.03	180	11.29	0.79	0.34	2.47	180	13.71	25.00
1	5.39	0.34	0.51	0.94	60	15.72	0.51	0.37	0.75	60	12.58	28.30

Appendix J – Mackenzie Industrial Park Lift Station

Appendix J contains the following:

1. Process Mechanical Inspection Report
2. Pump data

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	October 9, 2013		
LOCATION:	Mackenzie Industrial Park Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave & John - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT

We were on site at Mackenzie Industrial Park Sewage Lift Station to conduct a flow assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – floor = 376 m. No flood concern.
- Facility was constructed in 1976.
- Facility is in poor condition – substantial rusting on equipment, valves, fittings, piping.
- Facility is scheduled for upgrading in the near future.
- Facility has no flow, pressure, or level monitoring. Flow was calculated by timing drawdown and refill level durations using a laser distance measuring tool.
- Facility is a wet well/dry configuration. Pumps, valves & piping are in the lower level of the dry well. Electrical room is separate from the wet well entrance.
- There are 2 constant speed pumps installed. Both have electric motors; one also has a natural gas engine drive. Neither the design conditions nor the pump curves are available; Pump #1 is producing an average flow of 51 L/sec' Pump #2 is averaging 46 L/sec.
- Pump #1 is leaking slightly at its seals.
- Combined flows with 2 pumps running = averages approx. 50 L/sec. This is very inconsistent – may be due to inaccuracies in level measurement, or changes in influent flow.

Recommendations

- Upgrade pumps, valves, fittings, piping, etc.
- Install flow, pressure, and level monitoring during upgrade.
- Re-test pumps' flow when commissioning upgrade.

Photo 1: Pumphouse, showing dry well & wet well access

Photo 2: Pump #1 – Leaking seals.

Photo 3: Dry well lower level – rusty fittings & equipment.

Photo 4: Main floor dry well - electrical and controls

Mackenzie Park Pumps' Drawdowns

Pump(s)	WW area	Pumping					Filling					Pump rate
	m^2	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L/sec
1	5.39	0.51	1.20	3.73	60	62.16			0.00		#DIV/0!	#DIV/0!
2	5.39	0.64	0.82	1.01	180	5.63	0.99	0.64	1.90	600	3.17	8.80
1	5.39	0.45	0.71	1.44	30	47.97	0.82	0.45	2.03	600	3.38	51.35
2	5.39	0.37	0.61	1.28	30	42.58	0.71	0.37	1.85	600	3.08	45.66
1 + 2	5.39	0.19	0.45	1.39	30	46.17	0.61	0.19	2.26	900	2.51	48.68
1	5.39	0.19	0.48	1.51	30	50.49	0.45	0.19	1.36	900	1.51	52.00
2	5.39			0.00		#DIV/0!	0.48	0.27	1.12	300	3.72	#DIV/0!
1 + 2				0.00		#DIV/0!			0.00		#DIV/0!	#DIV/0!

Appendix K – Waterways Lift Station

Appendix K contains the following:

1. Process Mechanical Inspection Report
2. Pump data

INSPECTION/SITE MEETING REPORT

OWNER:	Regional Municipality of Wood Buffalo	PROJECT NO.:	2012.3694	REPORT NO.:	1
PROJECT:	RMWB Wastewater Master Plan	FILE NO.:	2012.3694.01.E.03.00	SHEET:	1 OF 2
COMPONENT:	Process mechanical	DATE:	October 9, 2013		
LOCATION:	Waterways Park Lift Station	ISSUE COPIES TO:			
ASSOCIATED ENGINEERING REP.:	Mitch Lejeune	PROJ. MGR.:	Daniel Du Toit, Larry Bodnaruk		
OTHERS PRESENT:		OWNER CONTACT:	Regional Municipality of Wood Buffalo		
Dave & John - RMWB		CONTRACTOR:			
		OTHER:			

PROJECT REPORT

We were on site at Waterways Sewage Lift Station to conduct a flow assessment of the station as part of the RMWB Wastewater Master Plan.

- Elevation – GPS – floor = 252 m. Probable flood concern. Station is located near (west) of Athabasca River.
- Facility was constructed in 1976.
- Facility is in poor condition – substantial rusting on equipment, valves, fittings, piping.
- Facility is scheduled for upgrading in the near future.
- Facility has no flow, pressure, or level monitoring. Flow was calculated by timing drawdown and refill level durations using a laser distance measuring tool.
- Facility is a wet well/dry configuration. Pumps, valves & piping are in the lower level of the dry well. Electrical room is separate from the wet well entrance.
- There are 2 constant speed pumps installed. Both have electric motors; one also has a natural gas engine drive. Neither the design conditions nor the pump curves are available; Pump #1 is producing an average flow of 31 L/sec; Pump #2 is averaging 34 L/sec.
- Combined flows with 2 pumps running = averages approx. 39 L/sec. Combined flow should be higher than this – may be due to inaccuracies in level measurement, or changes in influent flow.
- Roof mounted heater is working, but small, yellow interior roof mounted electric heater is not functional. Wall mounted electric heater works.
- Lights in dry well do not work.

Recommendations
- Upgrade pumps, valves, fittings, piping, etc.
- Install flow, pressure, and level monitoring during upgrade.
- Re-test pumps' flow when commissioning upgrade.

Photo 1: Pumphouse, showing dry well & wet well access

Photo 2: Pump #2 – motor & engine drives.

Photo 3: Dry well lower level – rusty fittings & equipment.

Photo 4: Main floor dry well - electrical and controls.

Waterways Pumps' Drawdowns

Pump(s)	WW area	Pumping					Filling					Pump rate
	m^2	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L_{start}	L_{stop}	Vol. m^3	Time,sec.	Flow, L/sec	L/sec
1	5.39	0.87	1.20	1.79	60	29.82	1.49	0.87	3.37	1260	2.68	32.50
2	5.39	0.96	1.28	1.70	60	28.39	1.20	0.96	1.27	600	2.12	30.51
1	5.39	0.99	1.28	1.58	60	26.32	1.28	0.99	1.58	600	2.63	28.95
2	5.39	0.96	1.34	2.06	60	34.41	1.28	0.96	1.74	600	2.90	37.31
1 + 2	5.39	0.67	1.03	1.94	60	32.34	1.34	0.67	3.59	900	3.99	36.33
1 + 2	5.39	0.54	0.95	2.20	60	36.74	1.03	0.54	2.68	600	4.47	41.22

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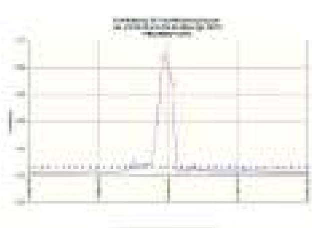
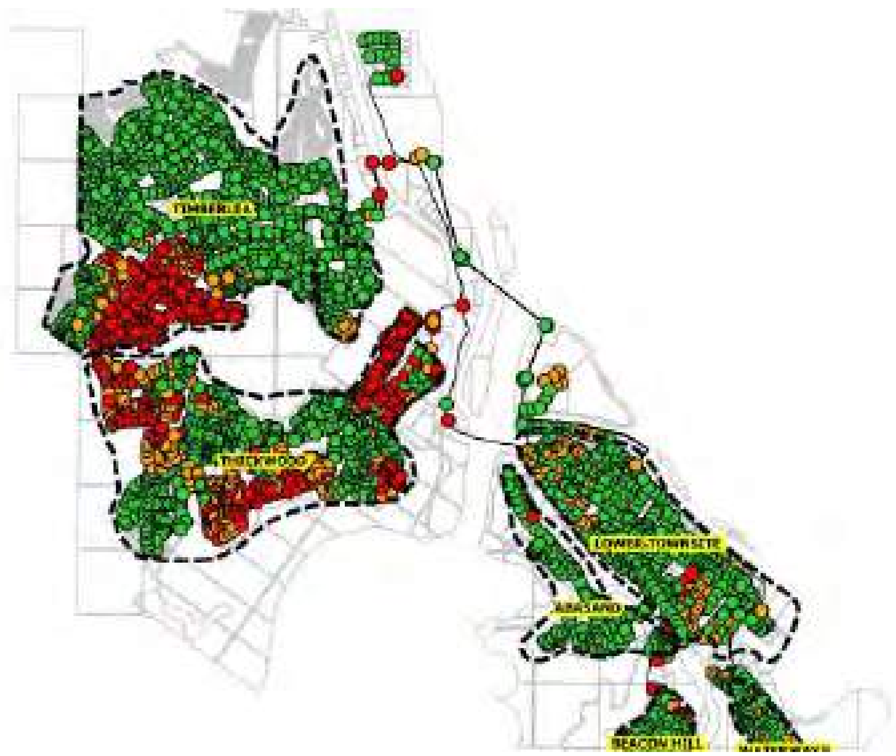
TECHNICAL MEMORANDUM B.2.5

Regional Municipality of Wood Buffalo

Wastewater Collection System Master Plan
Final Model and Upgrade Report





May 2014

CANADA'S BEST MANAGED COMPANIES

Executive Summary

The Regional Municipality of Wood Buffalo (RMWB) has requested Associated Engineering (AE) to develop a Wastewater Master Plan, which involved a number of tasks including Task B.2.5 - Final Model and Collection System Upgrades Report, the present report.

Objectives of this task are to use the updated and calibrated wastewater collection system model developed in previous tasks to assess the capacity of the wastewater collection system and to identify upgrade and expansion plans for existing and future development conditions.

This task involved:

- Simulating the existing system performance in the 1:25 year 4 hour duration design storm to identify capacity restrictions and bottlenecks.
- Identifying upgrade options to provide the additional capacity required to prevent flooding in the existing system.
- Developing a conceptual collection system upgrade and expansion plan to service future expansion areas as the Urban Service Area continues to grow.
- Develop planning-level cost estimates for the proposed work to enable the Municipality to include them in future Capital Budgets.

The analysis indicated that:

- Portions of the existing sewer system are overloaded in wet-weather flows, primarily in those older neighbourhoods that have weeping tiles connected to the sanitary sewer system.
- Trunk sewers through Gregoire and Mackenzie are overloaded in wet-weather flow conditions due to extraneous inflow and infiltration (I&I) in poorly-graded rear-yard utility lots.
- The Prairie Creek Lift Station is oversized for its catchment area and contributes to the high flows in the Mackenzie trunk.
- The existing Mackenzie Lift Station is overloaded in the 1:25 year storm under existing conditions. It is scheduled to be replaced with a larger pump station designed to service the existing catchment and additional development in Quarry Ridge. In the future, this lift station may be diverted away to the South Wastewater Treatment Facility which will reduce the flow in the Gregoire Trunk.
- Over the next 25 years, the population of Fort McMurray is expected to increase from 76,000 to 130,000 people (TM A.1.5 - Urban Development Sub-Region Population Projection, by Associated Engineering, January 2014). Full build-out of the identified expansion areas will provide for an ultimate population of 292,000 people and will not be completed for at least 50 years.
- Preliminary catchment areas and trunk alignments and sizes for the future expansion areas were delineated based on the general topography and land use concepts identified in previous planning documents. Large portions of the development areas have poor soils and poor drainage. Previous

studies have identified those portions as being un-developable, and this has been assumed in developing the sanitary collection system concept plan.

- A network of trunk sewers, pump stations, and force mains will be required to service the planned growth, mostly draining to the proposed South Regional Wastewater Facility being planned by the Municipality. Pumping of wastewater flow is required due to the fragmented topography of the Fort McMurray region caused by the regional river network.
- Infill, intensification, and re-development identified in previous studies will place further demands on the existing wastewater collection system in the North Catchment Area. However, additional upgrading required to accommodate these demands is relatively minor, with the exception of system upgrading to support the City Centre Area Re-Development Plan in the Lower Townsite (CCARP).

Associated Engineering recommends the following:

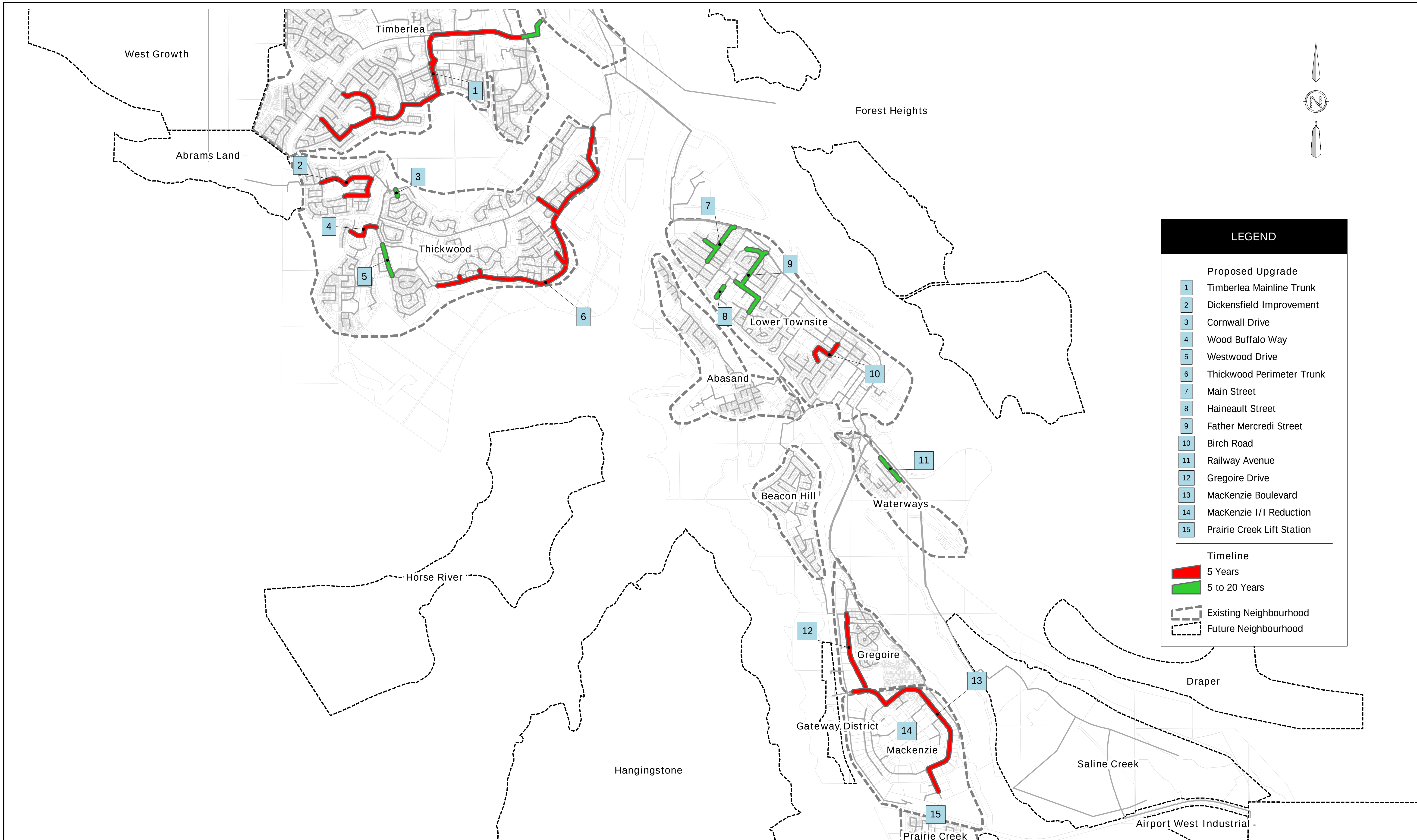
- That the existing wastewater collection system be upgraded as shown in **Figure 7-1** on a priority basis to prevent basement flooding and system overflows and to provide capacity for future population changes, infill and intensification, and the City Centre Re-development Plan (CCARP).
- That an I&I reduction program be carried out in Mackenzie, Timberlea, and Thickwood to reduce the sewer flows and increase the service levels to the 1:100 year storm.
- Flow monitoring is recommended to:
    - Confirm the effectiveness of the I&I reduction program.
    - Confirm design flows for system upgrading projects.
    - Confirm the I&I rates in new development areas to refine the design flows over time.
    - Monitor overall system performance for operational and capacity issues.
- That the wastewater collection system concept plan be updated as more detailed planning and design are carried out for the future development areas.

Figure 7-1 shows the upgrades to the existing wastewater collection system required in the near future (within 5 years) to prevent basement flooding and system overflows, at a planning-level cost estimate of $124 million.

Figure 7-1 also shows the additional upgrades that will be required in future to accommodate re-development, infill, and intensification, with a planning-level cost estimate of $34 million. Timing of these upgrades will depend on the pace of development and re-development and will likely be required in the 5-to-20 year time frame.

Figure 3-1 shows the conceptual servicing plan proposed to service the proposed expansion of the Urban Service Area, which has a planning-level cost estimate of $614 million.

Appendix B provides details of the required trunk sizes and flows for future expansion areas. **Appendix C** provides preliminary cost estimates. Note that all cost estimates are based on a high-level analysis and should be considered preliminary, subject to review with more detailed design. Cost estimates include engineering (10%) and contingencies (30%) and are expressed in 2014 dollars.



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Associated Engineering

PREPARED FOR:

Regional Municipality of Wood Buffalo

FIGURE 7-1
Wastewater Master Plan
Proposed Upgrades

TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694

DATE: May 2014

SCALE: 1:50,000

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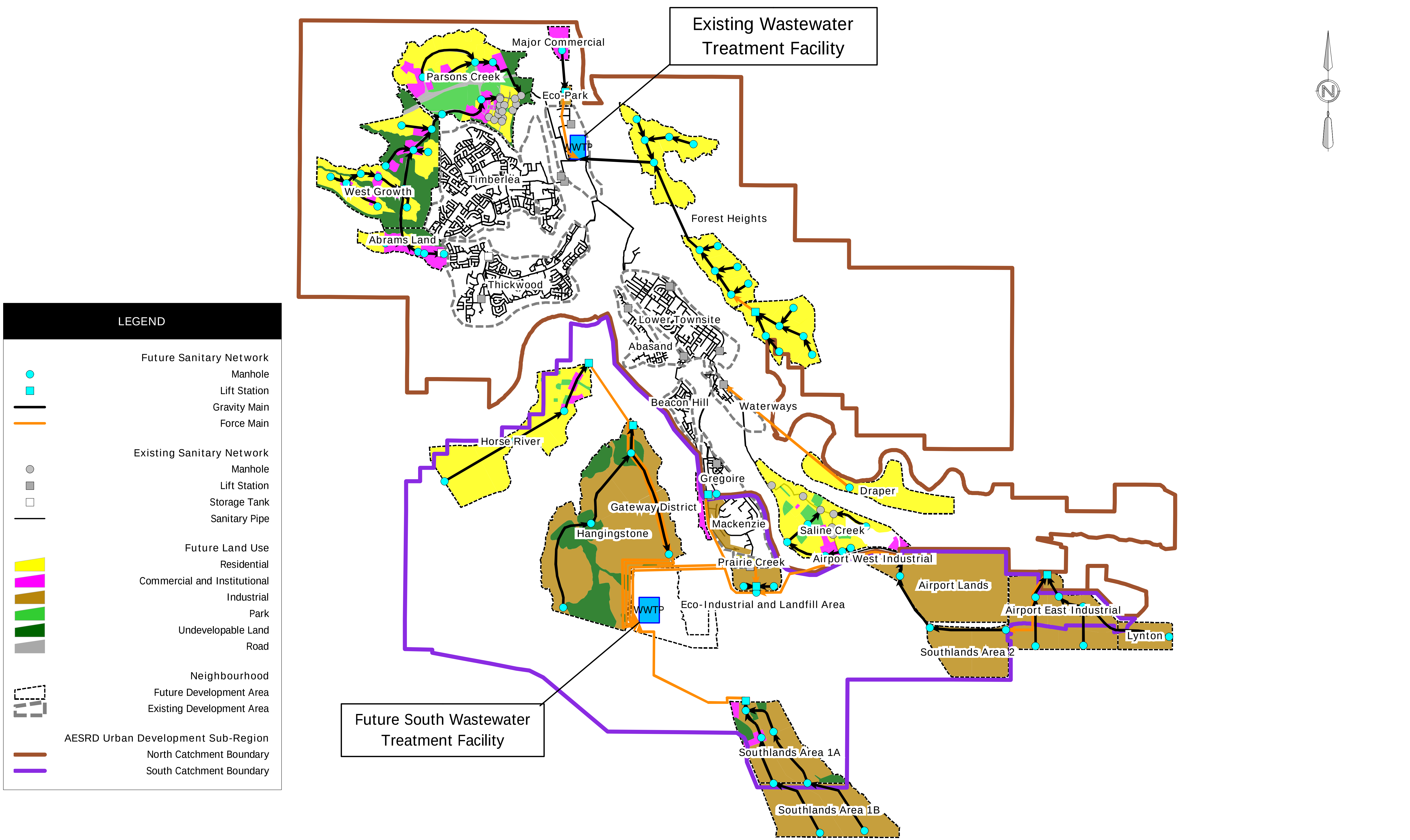

PREPARED BY: Associated Engineering

PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 3-1
Wastewater Master Plan
Ultimate Growth Areas

TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: March 2014
SCALE: 1:110,000

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List of Figures

1 Introduction

Associated Engineering (AE) prepared this Technical Memorandum (TM) to provide a summary of existing and future expansion plans for the wastewater collection system within the Regional Municipality of Wood Buffalo (the Municipality). This TM was completed for Task B.2.5 (Final Model and Collection System Upgrades Report) of the overall Wastewater Master Plan project.

A wastewater collection system master plan was completed in 2009 for the Municipality titled “Urban Service Area Wastewater Master Plan” (Master Plan) (Stantec, 2009). Since that report, the Municipality has completed extensive upgrades to its wastewater collection system based on the limited data available in 2009. Subsequently, there have been several complaints related to sanitary sewer backup and basement flooding from residents, especially in the Timberlea neighbourhood, which led to a number of studies and assessments throughout the Municipality to identify solutions to deficiencies in the system. These were not previously identified in the 2009 Master Plan.

In 2011, the Municipality initiated a three-year flow monitoring program to collect data required to review, analyse, and update the results of the 2009 Master Plan model. The program involved flow monitoring at as many as 13 sites and rainfall monitoring at 4 sites. Data collected in this program were used to refine and calibrate the computer model of the wastewater collection system, resulting in TM B.1.5 - Hydraulic Model and Design Criteria Update, issued in draft in January 2014.

That report summarized the information learned in the previous studies and provides an updated hydraulic model for the Urban Service Area. It included a summary of the model updates, calibration/validation in 2013, and a review of the design standards used for the existing and future sanitary sewer systems.

The present report will apply the updated and calibrated model to assess the capacity of the wastewater collection system and to identify an upgrade and expansion plan for existing and future development conditions.

The objectives of this Technical Memorandum are to:

- Finalize the hydraulic model of the current sanitary sewer system and assess the system’s capacity.
- Identify deficiencies in the existing sanitary sewer collection system for the Urban Service Area.
- Identify upgrades for the existing sanitary sewer collection system.
- Define a conceptual expansion plan to service future development areas including flows, pipe sizes, and costs.
- Model future upgrades and develop their conceptual cost estimates.

2 Existing System Assessment

AE assessed the existing system capacity and prepared upgrade plans based on the model simulation results for the 1:25 year 4-hour design storm event using the following two models:

- **Existing 2013 Model** – This model reflects the existing sanitary collection system in the Municipality and includes new sanitary sewers and forcemains that have been constructed since the 2009 Wastewater Master Plan was completed in 2009. This model was updated and calibrated as part of Task B.1.5 and reflects development conditions that existed in 2013. Future development conditions will be dealt with separately in subsequent sections of this report.

- **Upgraded 2013 Model** – This model contains proposed upgrades for the existing development of the Municipality. The upgrades were modelled to mitigate flood risk and deficiencies identified in the Existing 2013 Model. The upgrades provide a 1:25 year service level with the recommendation that an Inflow/Infiltration (I&I) reduction program be undertaken to reduce the wet-weather flow rates and thereby increase the service level provided to a 1:100 year storm event.

Figures 2-1 to 2-8 show the overall surcharge and flood loadings for existing development conditions (Existing 2013 Model) and the proposed upgrades (Upgraded 2013 Model) for each neighbourhood. These results will be discussed by individual neighbourhood below.

In these Figures, sewer performance is represented two ways:

- **Surcharge** – This performance measure refers to manholes within the sewer system where the water surface level has risen above the level of the top of the pipe. The level of surcharge indicates the risk of sewage back-up into basements through service connections (orange), or up through manhole lids on streets (red):
  - **Green Node** – Water level is greater than 2 m below ground surface.
  - **Orange Node** – Water level is within 2 m below ground surface.
  - **Red Node** – Water level is above ground surface.

- **Flow Loading** – This performance measure refers to sections of pipe within the sewer system where the estimated volume of flow meets or exceeds the capacity of the pipe:
  - **Green Pipe Section** – Estimated flow is within pipe capacity.
  - **Blue Pipe Section** – Estimated flow exceeds pipe capacity by 50%.
  - **Orange Pipe Section** – Estimated flow is up to 2 times pipe capacity.
  - **Red Pipe Section** – Estimated flow is greater than 2 times pipe capacity.

In essence, the red and orange lines show where there are capacity issues or bottlenecks, and the red and orange dots show locations where the sewer system is likely to back up into basements or spill out into the street.

Cost estimates for the proposed upgrades are provided in **Appendix C**. Note that all estimates are based on a high-level assessment and are subject to change with more detailed planning and engineering design.

2.1 TIMBERLEA

2.1.1 Existing 2013 Model

Figure 2-1 shows the 1:25 year 4-hour design storm event simulation results for the existing conditions. Surcharging to basement level occurs in southwest Timberlea. This area has high I&I rates due to weeping tile connections, and basement backup in this area has been reported in the past. The main trunk on Brett Drive, which runs through southwest Timberlea, is substantially overloaded.

2.1.2 Upgraded 2013 Model

The Municipality is currently planning on building a new trunk along the southwest perimeter to alleviate the flood risk in Timberlea. The new trunk will significantly reduce the risk of basement flooding in southwest Timberlea. However, some manholes in the vicinity of Barber Drive and Bury Road still surcharge to basement level with this single upgrade. Therefore AE proposes additional upgrading through the neighbourhood. Trunk sewers on Confederation Way also need to be upgraded to provide capacity for the increased flows conveyed generated by the upstream upgrades.

The 1:25 year 4-hour design storm simulation results for the Upgraded 2013 model that include these two upgrades are illustrated in **Figure 2-2** and are summarized in **Table 2-1**.

Table 2-1
Timberlea Upgrades

ID	Upgrade Name	Preliminary Pipe Diameter (mm)	Proposed Pipe Length (m)	Type	Note
1A	Timberlea Trunk Upgrade (Stage 1)	375	203	Gravity	Replacement - Bussieres Dr
		525	91	Gravity	Replacement - Bussieres Dr
		600	265	Gravity	Replacement - Bussieres Dr
		675	412	Gravity	Replacement - Brett Dr
		375	240	Gravity	Replacement - Bacon Pl & Barber Dr
		450	197	Gravity	Replacement - Barber Dr
		525	275	Gravity	Replacement - Barber Dr
		750	197	Gravity	Replacement - Brett Dr
		900	352	Gravity	Replacement - Brett Dr
		900	1,542	Gravity	Green Field Construction
1B	Timberlea Trunk Upgrade (Stage 2)	750	1,284	Gravity	Replacement - Confederation Way

Existing 2013 Model

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Associated Engineering

PREPARED FOR:

Regional Municipality of Wood Buffalo

FIGURE 2-1
Wastewater Master Plan
Existing 2013 Model - Timberlea
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

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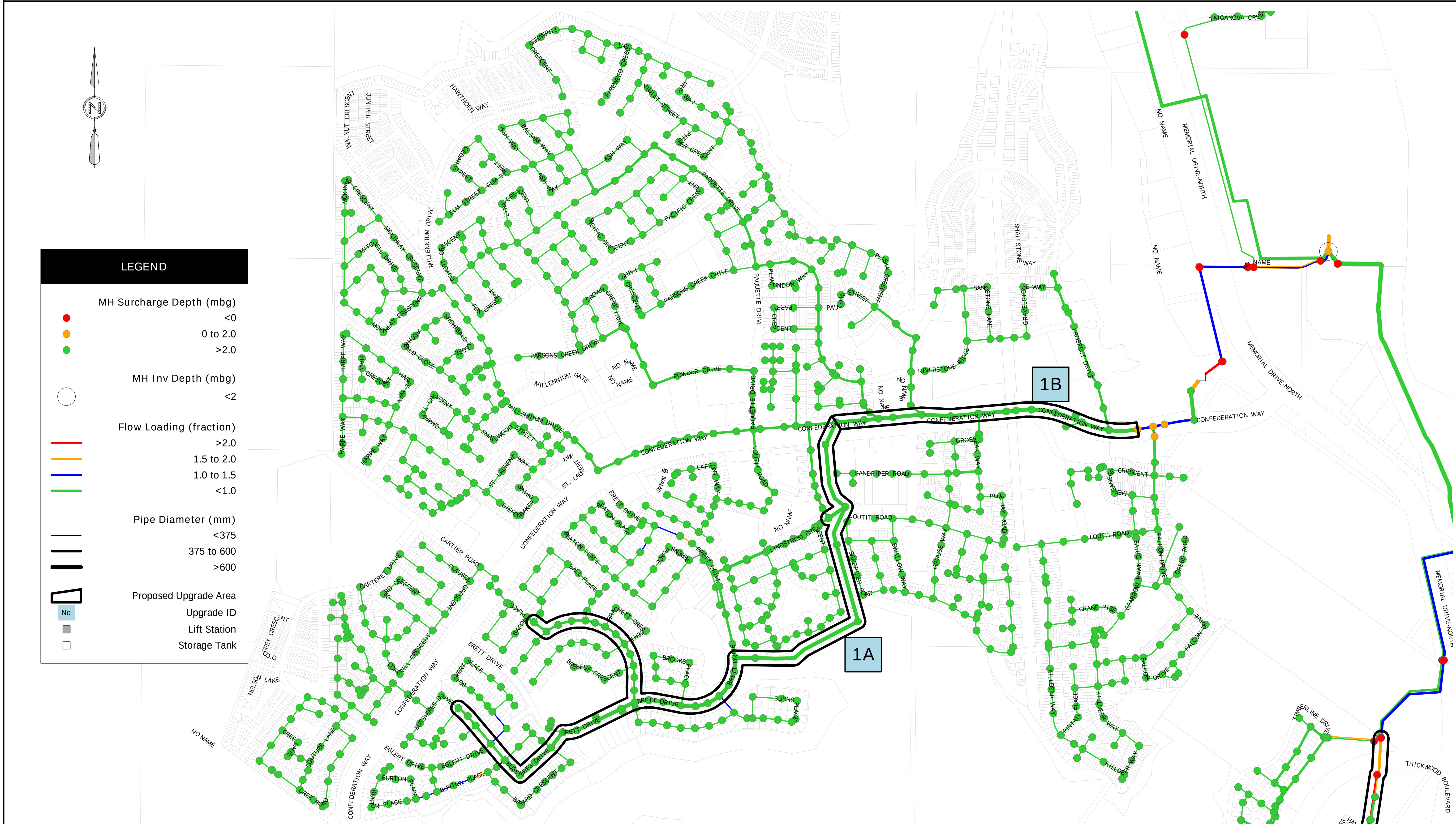
Upgraded 2013 Model



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PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 2-2
Wastewater Master Plan
Upgraded 2013 Model - Timberlea
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

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DATE: May 2014
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2.2 THICKWOOD

2.2.1 Existing 2013 Model

Figure 2-3 shows the 1:25 year 4-hour storm event simulation results with the Existing 2013 Model. Surcharging and basement flood risk occurs in five areas in Dickensfield, Wood Buffalo Way, Signal Road, Timberline Drive, and Ross Haven:

- Surcharging to basement level occurs in south Dickensfield (i.e. northwest corner of Thickwood) as indicated by orange nodes on the surcharge map in **Figure 2-3**.
- Surcharging occurs along Wood Buffalo Way for the 1:25 year design storm event. Manholes along Real Martin Drive would surcharge above ground if surcharging is not limited by basement flooding.
- The Signal Road area is at risk of flooding during the 1:25 year design storm event. The main trunk along Signal Road is overloaded. This trunk ties into the Thickwood Boulevard trunk downstream.
- Sanitary sewers along Timberline Drive in the northeast corner of Thickwood are overloaded and manholes surcharge to basement level in the 1:25 year design storm event. The Timberline Drive sanitary trunk carries the majority of the sanitary flows generated in Thickwood.
- Surcharging occurs in Ross Haven in the southeast corner of Thickwood and east of Signal Road. Sanitary pipes are overloaded along Ross Haven Drive, Thicket Drive and Silin Forest Road, and upstream of Silin Forest Road to the south.

2.2.2 Upgraded 2013 Model

Three upgrades are proposed to reduce the flood risk in as presented in **Figure 2-4** as summarized below:

- The Dickensfield Improvement (#2 in **Figure 2-4**) requires pipe upgrades on Dickins Drive, Leigh Crescent, McConachie Crescent, and Torrie Crescent.
- The Wood Buffalo Way Improvement (#4) requires pipe upgrade along Wood Buffalo Way from Real Martin Drive to Cornwall Drive.
- The Signal Road/Thicket Drive Upgrade (#6) starts from the southwest corner of the Signal Road loop and extends east along the south edge of the neighbourhood to Thicket Drive, and then along Thicket Drive to the east end of the neighbourhood.
- A new branch trunk sewer will intercept the existing trunk on Thickwood Boulevard to reduce the flows and water levels on Timberline Drive.

Table 2-2 summarizes the proposed upgrades in Thickwood.

Existing 2013 Model

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Regional Municipality of Wood Buffalo

FIGURE 2-3
Wastewater Master Plan
Existing 2013 Model - Thickwood
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

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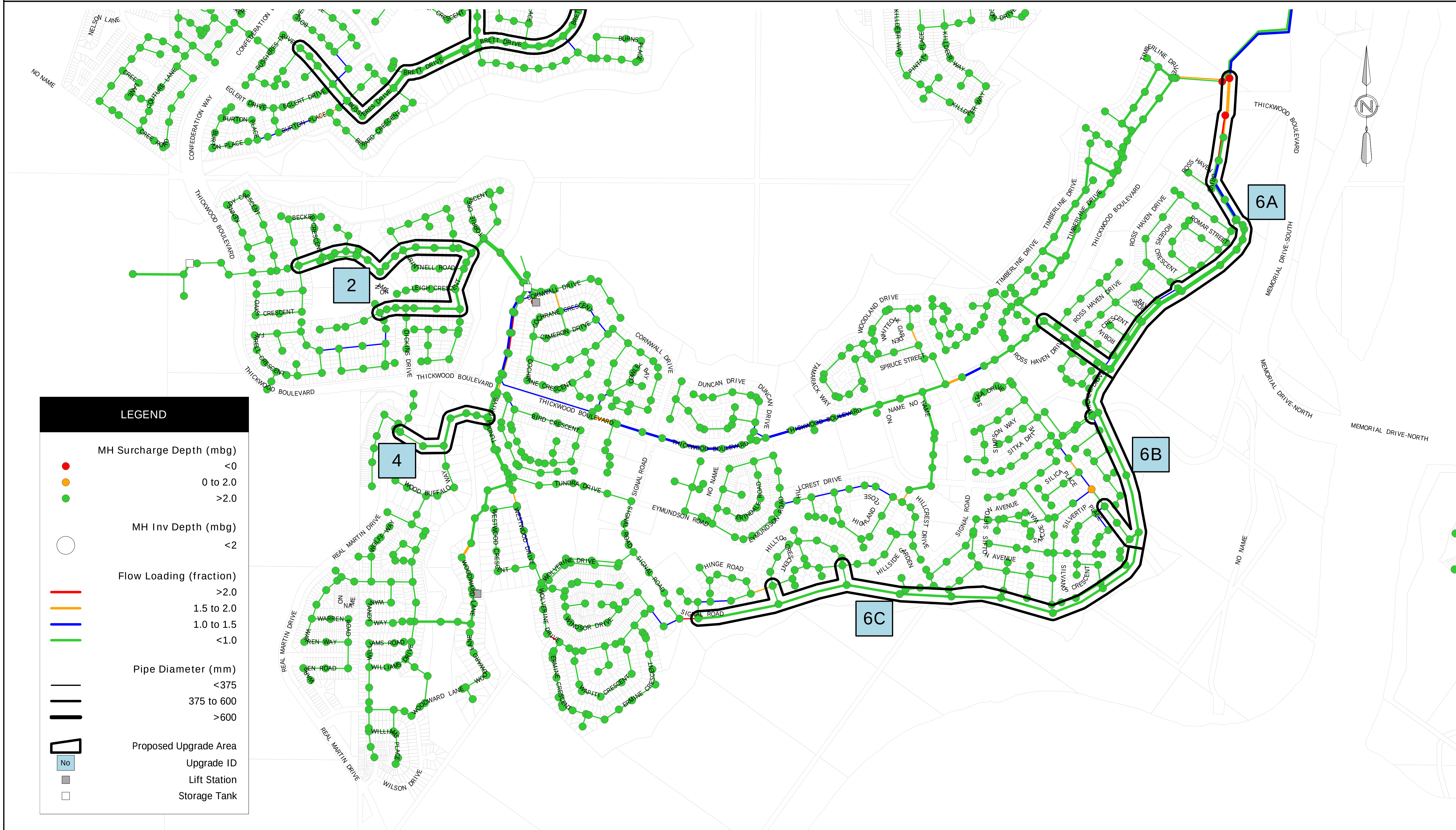
Upgraded 2013 Model



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Associated Engineering

PREPARED FOR:

Regional Municipality of Wood Buffalo

FIGURE 2-4
Wastewater Master Plan
Upgraded 2013 Model - Thickwood
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694

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Table 2-2
Thickwood Upgrades

ID	Upgrade Name	Proposed Pipe Diameter (mm)	Proposed Pipe Length (m)	Type	Note
2	Dickensfield Improvement	375	377	Gravity	Replacement – Dickins Dr
		450	671	Gravity	Replacement – Leigh Cr
		375	339	Gravity	Replacement – McConachie Cr
4	Wood Buffalo Way Improvement	300	111	Gravity	Replacement
		375	87	Gravity	Replacement
		450	277	Gravity	Replacement
6A	Thickwood Perimeter Trunk (Stage 1)	450	342	Gravity	New Construction – Romany St
		675	234	Gravity	Green Field Construction – Thicket Dr
		750	404	Gravity	Green Field Construction – Thicket Dr
		750	520	Gravity	Green Field Construction
		450	349	Force Main	Green Field Construction
6B	Thickwood Perimeter Trunk (Stage 2)	450	812	Gravity	Green Field Construction
		300	173	Gravity	Replacement – Silica Pl
6C	Thickwood Perimeter Trunk (Stage 3)	300	163	Gravity	Green Field Construction – Signal Rd
		375	635	Gravity	Green Field Construction – Signal Rd
		450	1,402	Gravity	Green Field Construction

2.3 ABASAND / LOWER TOWNSITE

2.3.1 Existing 2013 Model

The Existing 2013 Model results in **Figure 2-5** indicate that the Abasand Heights area has adequate capacity for the 1:25 year 4-hour design storm event. However, the Lower Townsite has one small area where surcharging to basement level occurs, around the intersection of Birch Road and Centennial Drive.

The surcharge map shows some orange nodes in the west of the Lower Townsite. Most of these indicate shallow pipes where the invert is within 2 m of ground and are not surcharged as indicated by the green sections of pipe on the flow loading map in **Figure 2-5**. This means that the existing pipes have limited freeboard and have little tolerance for surcharging.

2.3.2 Upgraded 2013 Model

A singe upgrade is proposed in the Birch Road area, involving approximately 200 m of pipe replacement on Birch Road and 200 m of pipe replacement on Centennial Drive as shown in **Figure 2-6** and summarized in **Table 2-3**. Note that additional upgrades will be required with the implementation of the City Centre Area Re-Development Plan (CCARP) as will be discussed later in this report.

Table 2-3
Lower Townsite Upgrade

ID	Upgrade Name	Proposed Pipe Diameter (mm)	Proposed Pipe Length (m)	Type	Note
10	Birch Road	300	419	Gravity	Replacement
		375	89	Gravity	Replacement
		250	110	Gravity	Replacement

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Existing 2013 Model

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PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 2-5
Wastewater Master Plan
Existing 2013 Model - Lower Townsite and Abasand
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

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Upgraded 2013 Model

PREPARED BY: Associated Engineering

PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 2-6
Wastewater Master Plan
Upgraded 2013 Model - Lower Townsite and Abasand
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

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2.4 BEACON HILLS / WATERWAYS / GREGOIRE / MACKENZIE

2.4.1 Existing 2013 Model

No flooding is indicated in Beacon Hill or Waterways under the existing conditions as shown in **Figure 2-7**. Note the three red dots on the north side of Waterways are on the pressure lines from Saline Creek and Gregoire, where pressure levels (hydraulic grade lines) rise above ground surface, which is not a concern as these pipes are sealed and are designed to operate under pressure.

The main trunk on Gregoire Drive is overloaded in the 1:25 year storm and backs up into the Mackenzie Industrial Area to the south of Gregoire. The main trunk through Mackenzie is also overloaded and is surcharged to ground level throughout the east side of the Mackenzie area.

A contributing factor is the extraneous I&I identified in the 2011 Mackenzie Industrial Area Inflow/Infiltration Study. Sewer lines were laid in back-of-lot utility lots which are poorly graded and carry extraneous inflow into the sanitary sewer manholes. One storm catchbasin was also found to be connected to the sanitary sewer system.

In addition, pump discharges from the Prairie Creek Lift Station exceed the capacity of the sewer line in the south of Mackenzie and contribute to high flows in the Mackenzie trunk. The Prairie Creek Lift Station appears to be oversized for its catchment area, which contributes to the high flows downstream.

The Mackenzie Lift Station is overloaded in the 1:25 year storm under existing conditions and is planned to be replaced with a larger pump station. The new pump station is being designed to service the Quarry Ridge area on the west side of Highway 63 as well as the West Mackenzie basin. Peak flows will increase over time as the Quarry Ridge basin is developed, to an ultimate capacity of 208 L/s, which will further increase the flows along Gregoire Drive.

2.4.2 Upgraded 2013 Model

Figure 2-8 shows the proposed pipe upgrades in Mackenzie and Gregoire, along with peak flows and surcharge levels with and without the proposed upgrades.

Table 2-4 summarizes the required upgrades in Gregoire and Mackenzie.

Existing 2013 Model

PREPARED BY:	PREPARED FOR:	FIGURE 2-7	
Associated Engineering	Regional Municipality of Wood Buffalo	Wastewater Master Plan Existing 2013 Model - Beacon Hill, Waterways, Gregoire and MacKenzie 1:25 Year 4 Hour Design Storm Simulation Results TM B.2.5 Final Model & Collection System Upgrades Report	PROJECT No.: 20123694 DATE: May 2014 SCALE: 1:15,000

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Upgraded 2013 Model

LEGEND

MH Surcharge Depth (mbg)
- <0
- 0 to 2.0
- >2.0

MH Inv Depth (mbg)
- <2

Flow Loading (fraction)
- >2.0
- 1.5 to 2.0
- 1.0 to 1.5
- <1.0

Pipe Diameter (mm)
- <375
- 375 to 600
- >600

Proposed Upgrade Area
No — Upgrade ID
Lift Station
Storage Tank

PREPARED BY: Associated Engineering

PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 2-8
Wastewater Master Plan
Upgraded 2013 Model - Beacon Hill, Waterways, Gregoire and MacKenzie
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: May 2014
SCALE: 1:15,000

Table 2-4
Gregoire / Mackenzie Upgrades

ID	Upgrade Name	Proposed Pipe Diameter (mm)	Proposed Pipe Length (m)	Sanitary Pipe Type	Proposal
12	Gregoire Drive Upgrade	675	1,165	Gravity	Replacement
13	Mackenzie Boulevard Upgrade	600	173	Force Main	Replacement
		525	366	Gravity	Replacement
		450	206	Gravity	Replacement
		375	1,074	Gravity	Replacement
		300	710	Gravity	Replacement
		250	354	Gravity	Replacement
14	I&I Reduction Program	—	—	—	Utility lot re-grading & manhole repairs
15	Prairie Creek Lift Station	—	—	—	Reduce pump capacity to 15 L/s

2.5 LIFT STATIONS

The performance of the existing lift stations in the UDSR was reviewed under Task B.2.4 - Lift Stations and Pump Performance. Table 2-5 summarizes the lift station capacities and the 1:25 year peak flows from the Existing 2013 model.

Table 2-5
Lift Station Summary

No.	Lift Station	1:25 Year Peak Flow (L/s)	Capacity (L/s)
1	TaigaNova/Eco-Park	28	48
2	Prairie Creek	10	32
3	Airport[1]	—	—
4	1B	110	400
5	Grayling Terrace	11	14
6	Abasand	9	34
7	1A	345	670

No.	Lift Station	1:25 Year Peak Flow (L/s)	Capacity (L/s)
8	Cornwall	214	145
9	Wood Buffalo	42	51
10	Gregoire	22	28
11	Mackenzie	58	48
12	Waterways	9	32

[1] Not modelled as it is to be abandoned.

The results confirm that the Mackenzie Lift Station is overloaded and needs to be replaced. The Prairie Creek Lift Station is oversized, which contributes to the peak flow conditions downstream. The Cornwall Lift Station has lower capacity than the peak inflow rate, but the excess runoff is stored in the Dickensfield storage tank, which has adequate capacity for the 1:25 year storm.

3 Future Expansion Plans

3.1 OVERVIEW

Over the next 25 years, the population of Fort McMurray is expected to increase from 76,000 to 130,000 people (TM A.1.5 - Urban Development Sub-Region Population Projection, by Associated Engineering, January 2014). This section identifies a conceptual wastewater collection system required to service the ultimate development of the proposed Urban Development Sub-Region (UDSR).

The future expansion plans for the Municipality include the future development areas defined by the UDSR. The UDSR consists of the following two catchment areas:

- **North Catchment** – Wastewater collected in this catchment will be treated in the existing North Regional Wastewater Treatment Facility (NRWWTF).
- **South Catchment** – Wastewater collected in this catchment will be treated in the proposed new South Regional Wastewater Treatment Facility (SRWWTF).

Figure 3-1 shows the future expansion districts within the north and south catchment areas of the UDSR and the ultimate wastewater collection system that will be required to convey wastewater to the two treatment facilities.

Table 3-1 provides a summary of the future development areas and land uses as extracted from various planning documents described below. The table shows the total area within each of the future expansion areas and the gross development area (GDA) available for residential, commercial, and industrial land uses. The GDA excludes those portions of the expansion areas that are assumed to be un-developable due to poor drainage and soils conditions. The GDA includes roadways, parks and stormwater management facilities, and the net developable area (the remaining area available for sub-division of residential, commercial, and industrial lots).

TM A.1.5 estimated the ultimate population in the expansion areas to be 292,000 people, not including industrial and commercial areas which are counted in TM A.1.5 as “equivalent” populations. The population is projected in various studies to range from 120,000 to 140,000 people in Year 2038 (a 25-year planning horizon) and 160,000 people by Year 2050. At these rates of growth, full build-out of the identified expansion areas will not be completed for at least 50 years.

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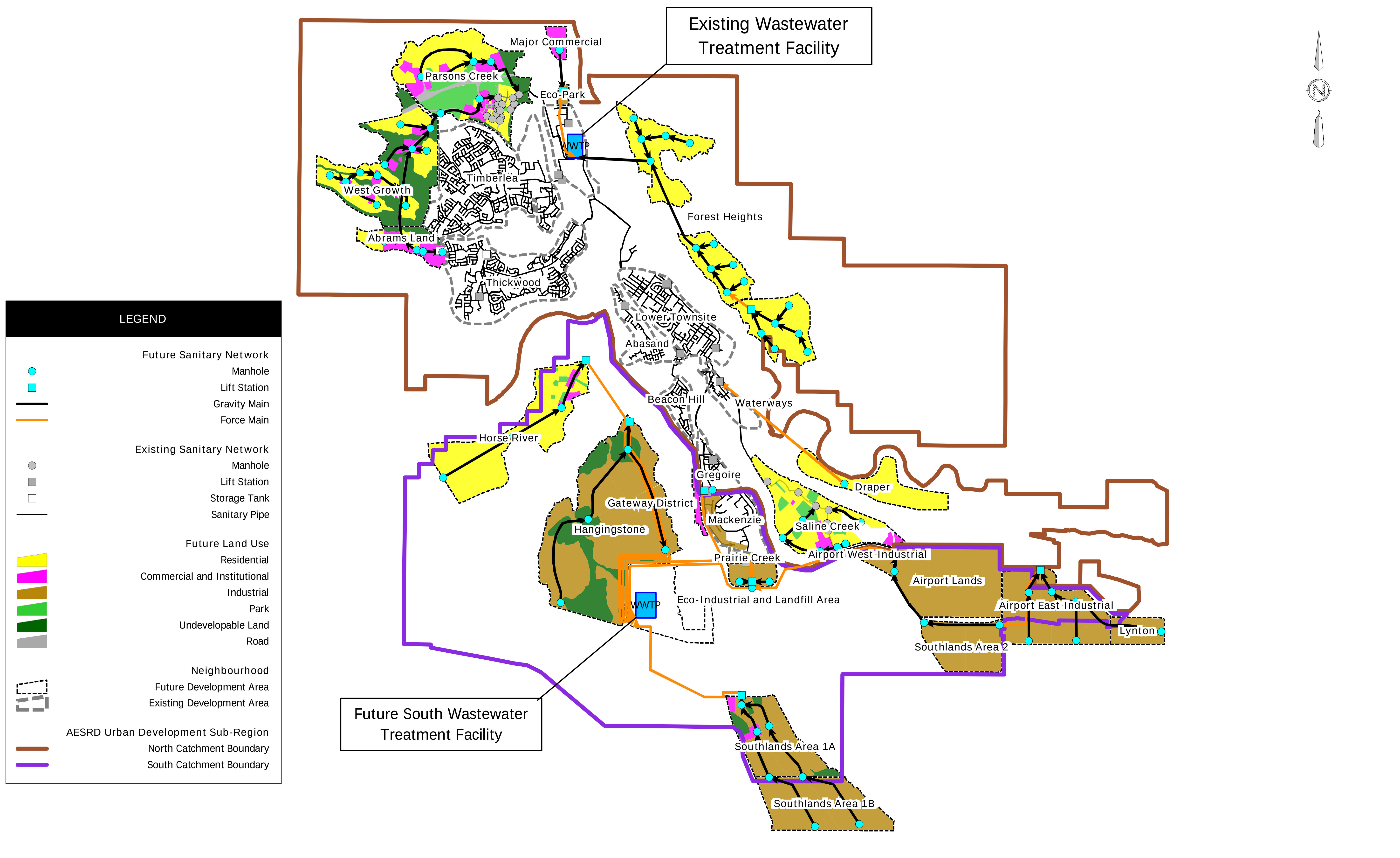


PREPARED BY: Associated Engineering

PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 3-1
Wastewater Master Plan
Ultimate Growth Areas

TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: March 2014
SCALE: 1:110,000

Table 3-1
Expansion Areas and Land Use

District	Total Area (ha)	Gross Developable Area (GDA, ha)			
		Residential (ha)	Commercial/ Industrial (ha)	Road and Park (ha)	Total
North Catchment					
Abrams Land	1,061	55	79	13	147
West Growth		562	68	38	668
Parsons Creek	837	521	138	243	901
Major Commercial and Eco-Park	72	0	72	0	72
Forest Heights	924	554	0	0	554
Draper Valley	293	9	0	0	9
Saline Creek	860	369	36	66	470
South Catchment					
Airport and East Industrial Lands	1,818	0	1,015	0	1,015
Southlands Areas 1A and 1B	1,000	0	657	0	657
Southlands Area 4	218	20	177	6	196
West Mackenzie	144	0	67	0	67
Quarry Ridge	67	106	38	0	144
Hangingstone	1,553	0	1,072	0	1,072
Horse River	678	317	24	21	341

Gross Developable Areas and residential areas were adjusted from the previous studies to generate comparable residential populations to the ultimate populations projected in TM A.1.5 Urban Development Sub-Region Population Projection study (AE, January 2014).

3.2 CATCHMENT DELINEATION

AE developed a land use concept map for the future growth areas based on various concept studies including the following:

- West of Abrams Servicing Concept (AE, April 2012)
- MacKenzie Lift Station Diversion Assessment (AE, September 2013)
- Parsons Creek Urban Design Plan (RMWB, April 2013)
- Prairie Creek Business Park Outline Plan (RMWB, June 2013)
- Riverbend Point Area Structure Plan (RMWB, September 2011)
- TM A.1.5 - Urban Development Sub-Region Population Projection (Associated Engineering, January 2014)

Catchment areas for the future growth areas were delineated based on the land use concept map and general topography to determine trunk sewer locations and sizes as shown on **Figure 3-2** to **Figure 3-7.**

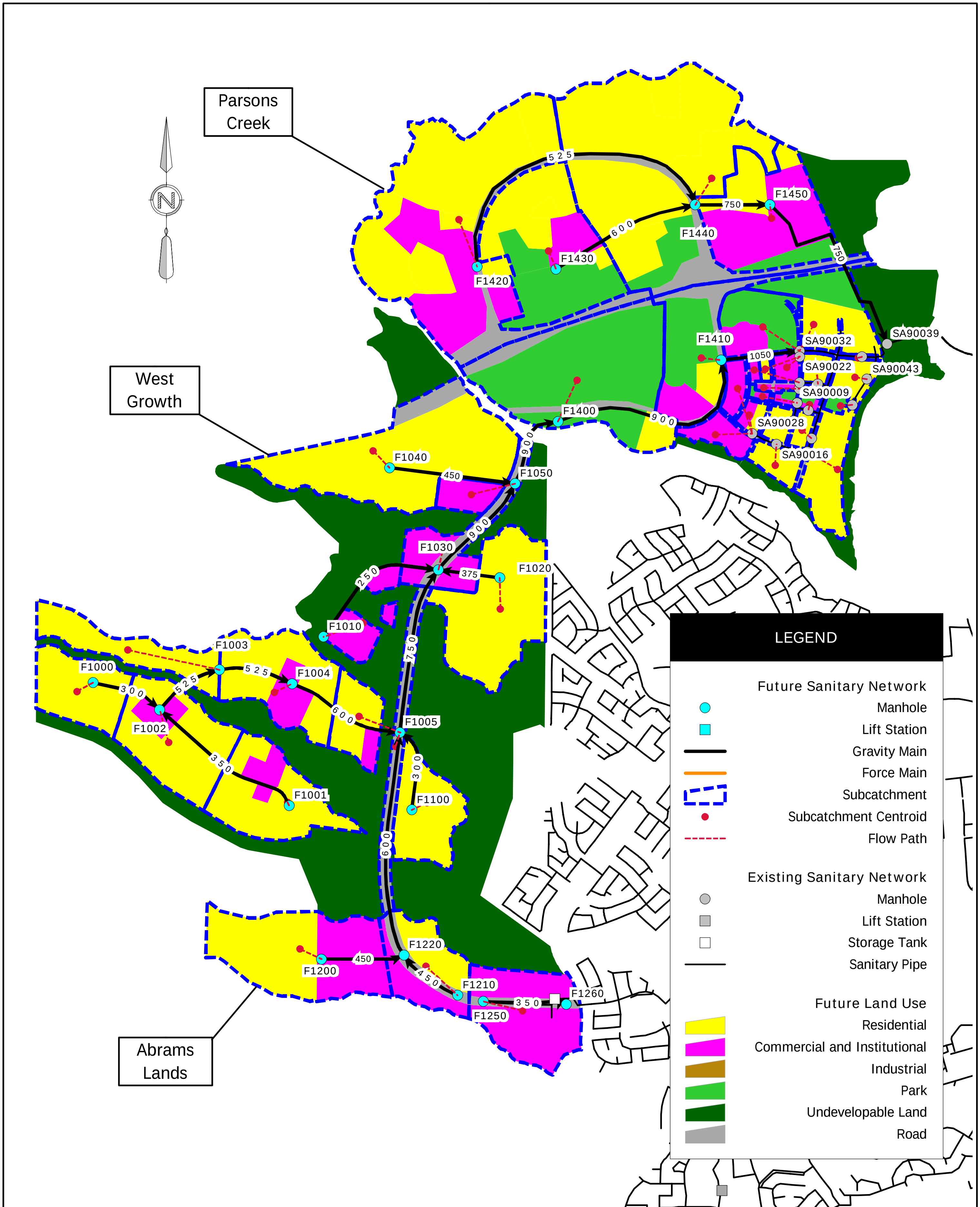
3.3 WASTEWATER FLOW PROJECTIONS

The hydraulic parameters shown in **Table 3-2** were used to project the future for the preliminary sizing of trunk wastewater facilities for future expansion areas. Note that the design criteria are slightly different from those in the Municipality's Engineering Servicing Standards and Development Standards but will produce similar peak flows and pipe sizes.

Table 3-2
Hydraulic Parameters for Future Expansion Areas

Population Density for Residential	50 people per gross hectare
Residential Generation Rate (L/cap/day)	300 L/cap/day
Non-Residential Rate (L/s/ha)	0.2 L/s/ha
Residential Peaking Factor (Modified Harmon's PF)	1 + 8/(4+(P/1000)^0.5) (Max 2.5)
Non-Residential Peaking Factor	2.0
I & I (L/s/ha)	0.38 L/s/ha
Pipefull Safety factor	1.2

The projected wastewater flows are summarized by district in **Table 3-3**, and **Appendix A** provides details.



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PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 3-2
Wastewater Master Plan
Abrams Lands, West Growth and Parsons Creek
TM B.2.5 Final Model & Collection System Upgrades Report

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SCALE: 1:35,000

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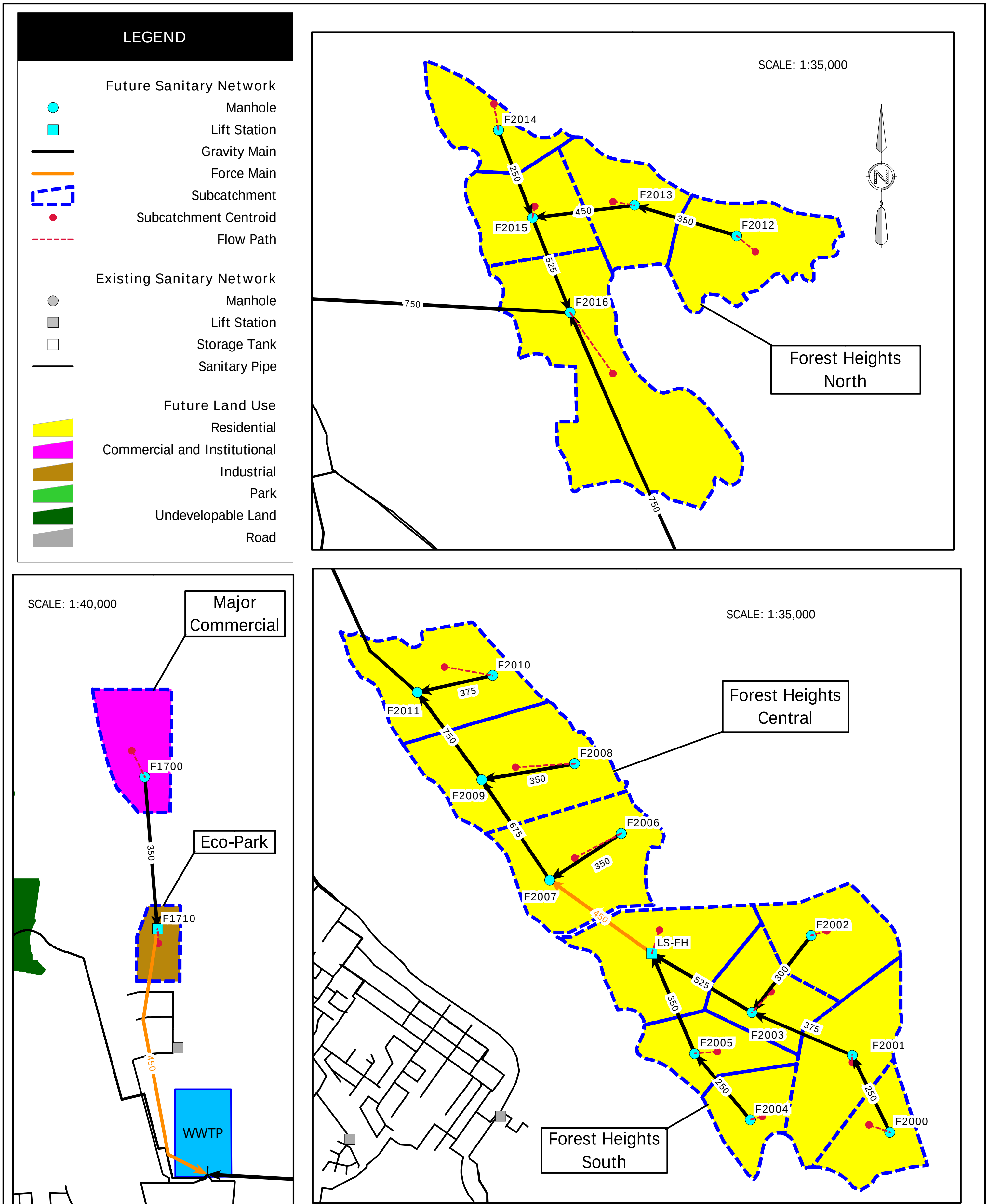

PREPARED BY:	PREPARED FOR:	FIGURE 3-3	PROJECT No.: 20123694
Associated Engineering	Regional Municipality of Wood Buffalo	Wastewater Master Plan Major Commercial, Eco-Park and Forest Heights TM B.2.5 Final Model & Collection System Upgrades Report	DATE: March 2014 SCALE: Varies

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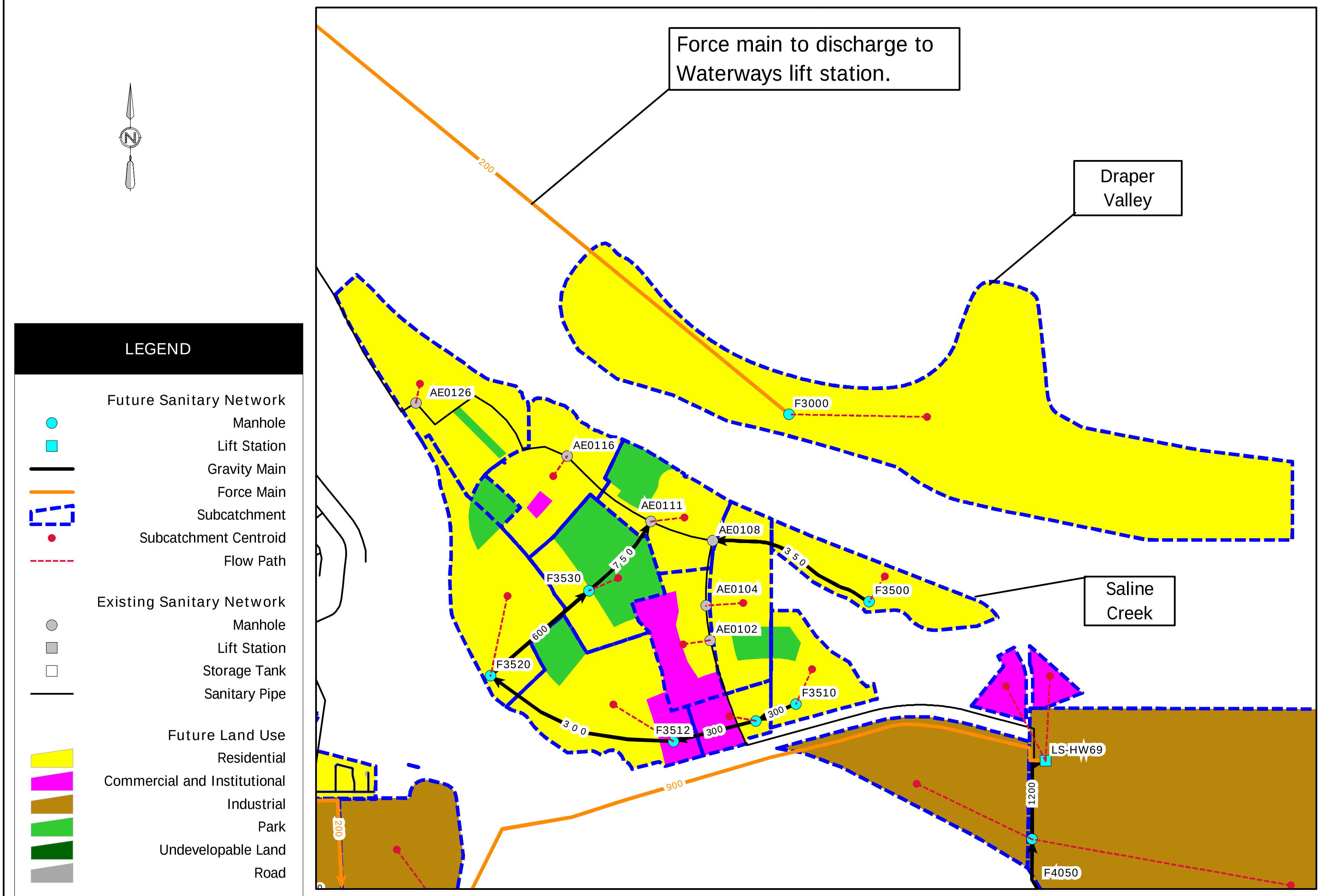

PREPARED BY

PREPARED FOR:

FIGURE 3-4
Wastewater Master Plan
Draper Valley and Saline Creek
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694

DATE: March 2014

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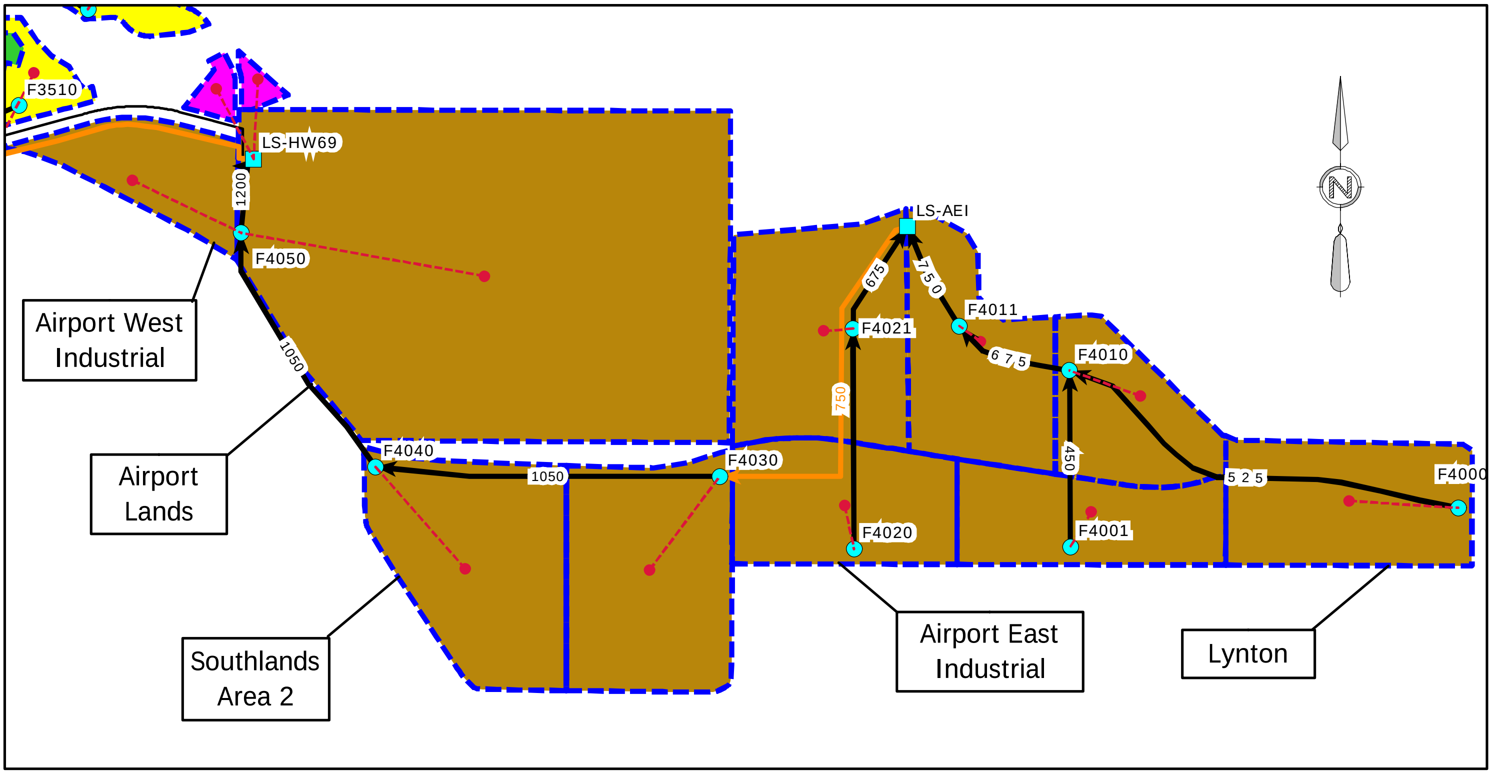

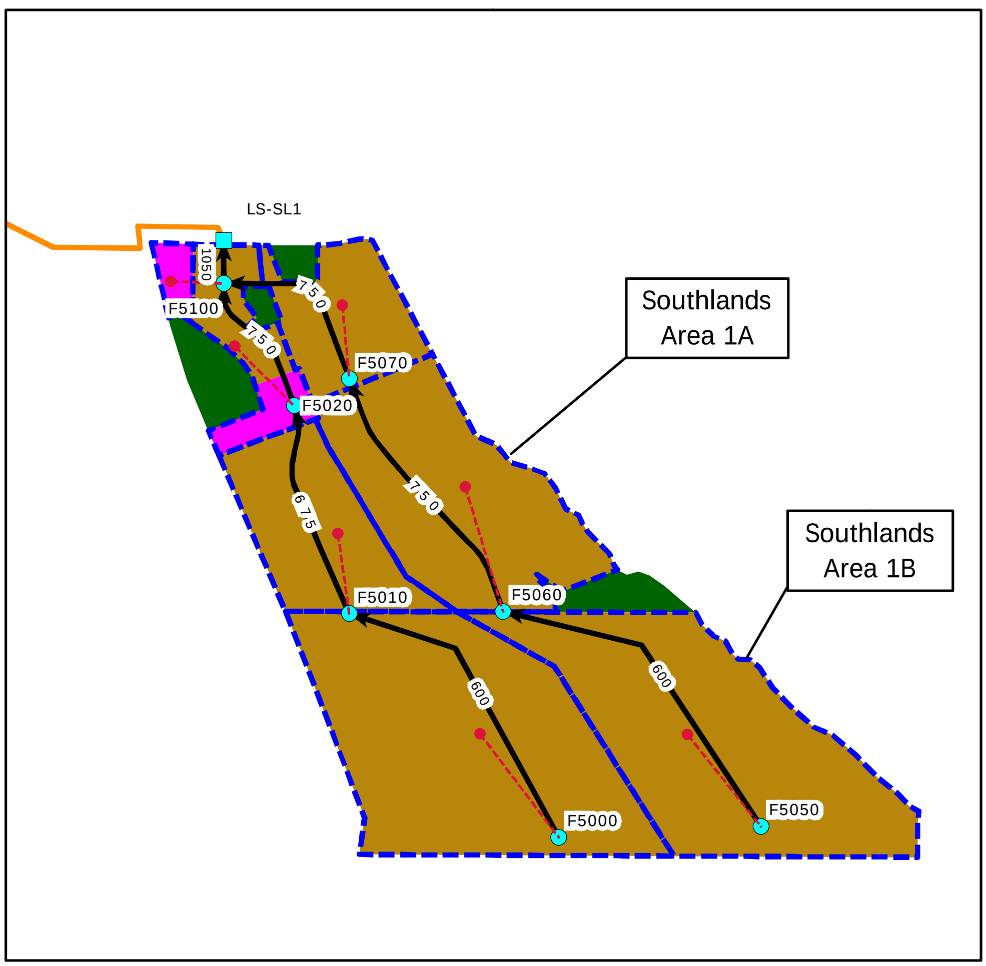

LEGEND

Future Sanitary Network
- Manhole
- Lift Station
- Gravity Main
- Force Main
- Subcatchment
- Subcatchment Centroid
- Flow Path

Existing Sanitary Network
- Manhole
- Lift Station
- Storage Tank
- Sanitary Pipe

Future Land Use
- Residential
- Commercial and Institutional
- Industrial
- Park
- Undevelopable Land
- Road

PREPARED BY:	PREPARED FOR:		
Associated Engineering	Regional Municipality of Wood Buffalo	FIGURE 3-5 Wastewater Master Plan Airport East Industrial Lands and Southlands Areas 1A and 1B TM B.2.5 Final Model & Collection System Upgrades Report	PROJECT No.: 20123694 DATE: March 2014 SCALE: 1:50,000

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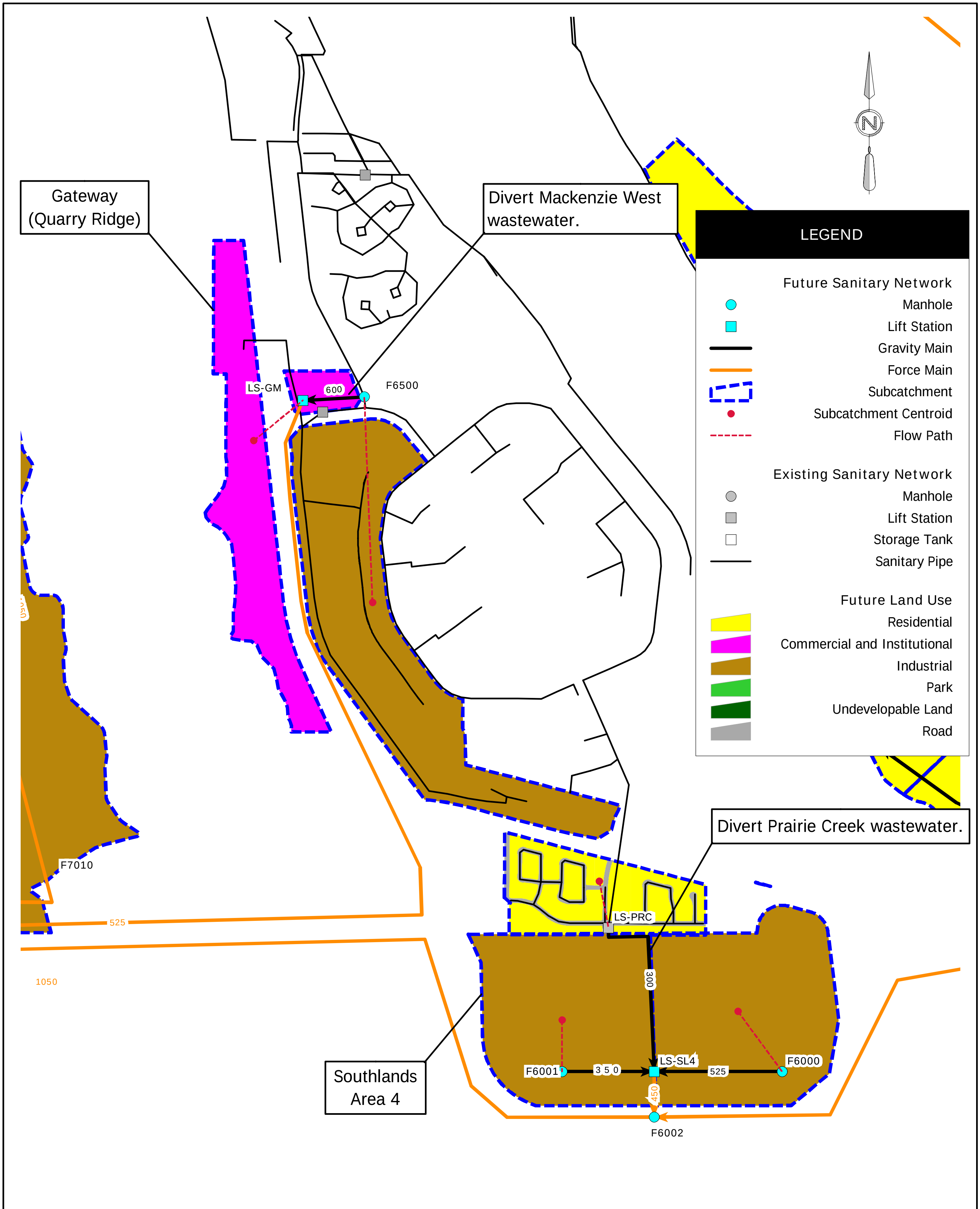

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PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 3-6
Wastewater Master Plan
Southlands Area 4, Gateway, Hangingstone and Horse River
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: March 2014
SCALE: 1:20,000

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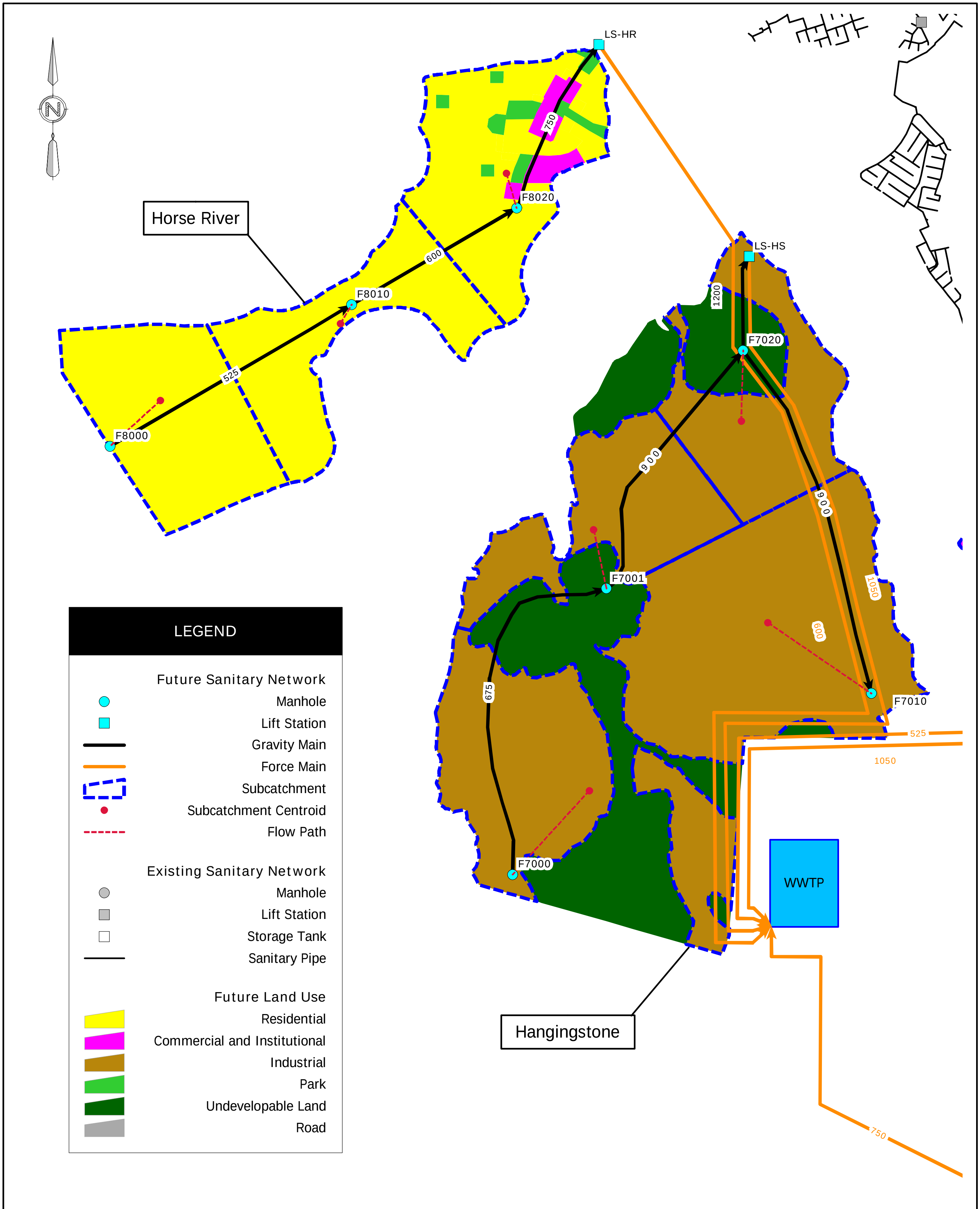

PREPARED BY:	PREPARED FOR:	FIGURE 3-7 Wastewater Master Plan Hangingstone and Horse River TM B.2.5 Final Model & Collection System Upgrades Report	PROJECT No.: 20123694 DATE: March 2014 SCALE: 1:43,000
Associated Engineering			

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Table 3-3
Projected Wastewater Flows for Future Development Areas

Future Neighbourhood	GDA [1] (ha)	Population [2]	Dry Weather Flow		Wet Weather Flow		Design Flow (L/s) [8]
			ADWF (L/s)	PDWF [3] (L/s)	I & I (L/s)	PWWF (L/s)	
North Catchment							
Abrams Land	147	2,746	25	59	56	115	138
West Growth	668	28,082	111	260	254	514	616
Parsons Creek	901	26,046	118	266	342	609	731
Major Commercial and Eco-Park	72	0	14	29	27	56	68
Forest Heights	554	27,723	96	236	211	447	536
Draper Valley	9	440	2	4	3	7	9
Saline Creek	470	18,443	71	175	179	354	425
South Catchment							
Airport and East Industrial Lands [4]	1,015	0	203	406	386	792	950
Southlands Areas 1A and 1B	657	0	131	263	250	513	615
Southlands Area 4 [5]	196	985	39	79	77	156	187
West Mackenzie	67	0	13	27	26	53	63
Quarry Ridge [6]	144	5,300	26	59	55	114	136
Hangingstone [7]	1,072	0	214	429	408	836	1004
Horse River	341	15,873	60	136	138	273	328

[1] Gross Developable Area (i.e. equivalent to sewershed area in Appendix A) = Residential + Commercial/Industrial + Road and Park.
[2] Residential only; projected at 50 cap/ha (gross).
[3] Modified Harmon's Peaking Factor (maximum 2.5) for residential areas; 2.0 for industrial and commercial areas.
[4] Includes Airport East Industrial Lands, Lynton, Southlands Area 2, Airport West Industrial, and Airport Lands.
[5] Includes diversion of Prairie Creek residential area.
[6] includes Quarry Ridge Commercial (30 ha) and Quarry Ridge Residential (106 ha).
[7] Assumed 100% industrial (most conservative scenario for wastewater flow).
[8] Includes pipefull safety factor of 1.20.

Refer to **Appendix A** for calculation details.

3.4 FUTURE TRUNK SIZING

The design criteria shown in **Table 3-4** were used to determine the preliminary sizing of future trunks.

Table 3-4
Pipe Sizing Criteria

Velocity (m/s)	Gravity Mains	Force Mains
Minimum	0.61	0.9
Maximum	3.0	2.5

Stream courses in the region breakup the future development areas into a number of discrete development cells. As a result, pumping will be required to convey the wastewater flows to the South Regional Facility. **Figures 3-2** to **3-7** provide the conceptual layouts of the future trunks, force mains, lift stations, and required pipe sizes. Note that details are subject to change in future with more detailed planning and design.

Appendix B provides calculation details of the hydraulic analysis. **Appendix C** provides cost estimates for the proposed trunks and lift stations.

4 Future Model

The Future Model was built to estimate the future wastewater flows in the existing sanitary sewer system and to determine any additional upgrading required to accommodate those flows resulting from anticipated population and land use changes.

The Future Model was based on the "Upgraded Existing Model" discussed in Section 2 of this Technical Memo, revised to include the following:

- Anticipated population increases due to infill, intensification, re-development, and changing demographics.
- All the upgrades proposed for existing development conditions as discussed previously in this report.
- Future expansion areas that drain to the existing collection system, modelled as lumped catchments without internal trunks and details, to generate inflows to the existing system.

It does not include those expansion areas that will drain to the South Regional Wastewater Treatment Facility and are dealt with in the System Expansion described in the previous section of this report.

4.1 DESIGN POPULATIONS

The 2012 municipal census provides the populations for the existing development areas within the proposed UDSR as shown in **Table 4-1**.

Technical Memorandum A.1.5 of this project titled "Urban Development Sub-Region Population Projection" (AE, January 2014) projected the ultimate populations for existing development areas. The ultimate population projections are shown in **Table 4-1**. Note that this table does not include the future expansion areas which are dealt with separately in the previous section of this report.

The population projections indicate that modest population increases of the order of 10-20% will occur in most neighbourhoods due to infill and intensification. Greater population increases are projected in the Lower Townsite, Gregoire, and Waterways due to the following:

- The Municipality adopted the City Centre Area Redevelopment Plan (CCARP) in February 2012 and amended the Land Use Bylaw to align with CCARP and enable future development and intensification within the City Centre Area.
- The Municipality has indicated that manufactured homes in Gregoire are likely to be replaced with medium-density condominium-style development.
- Significant expansion in the south of Waterways is indicated in the Municipality's Area Redevelopment Plan (April 2010). Draper is also expected to be connected to the existing wastewater collection system.

Table 4-1
Current and Ultimate Populations for Existing Development Areas

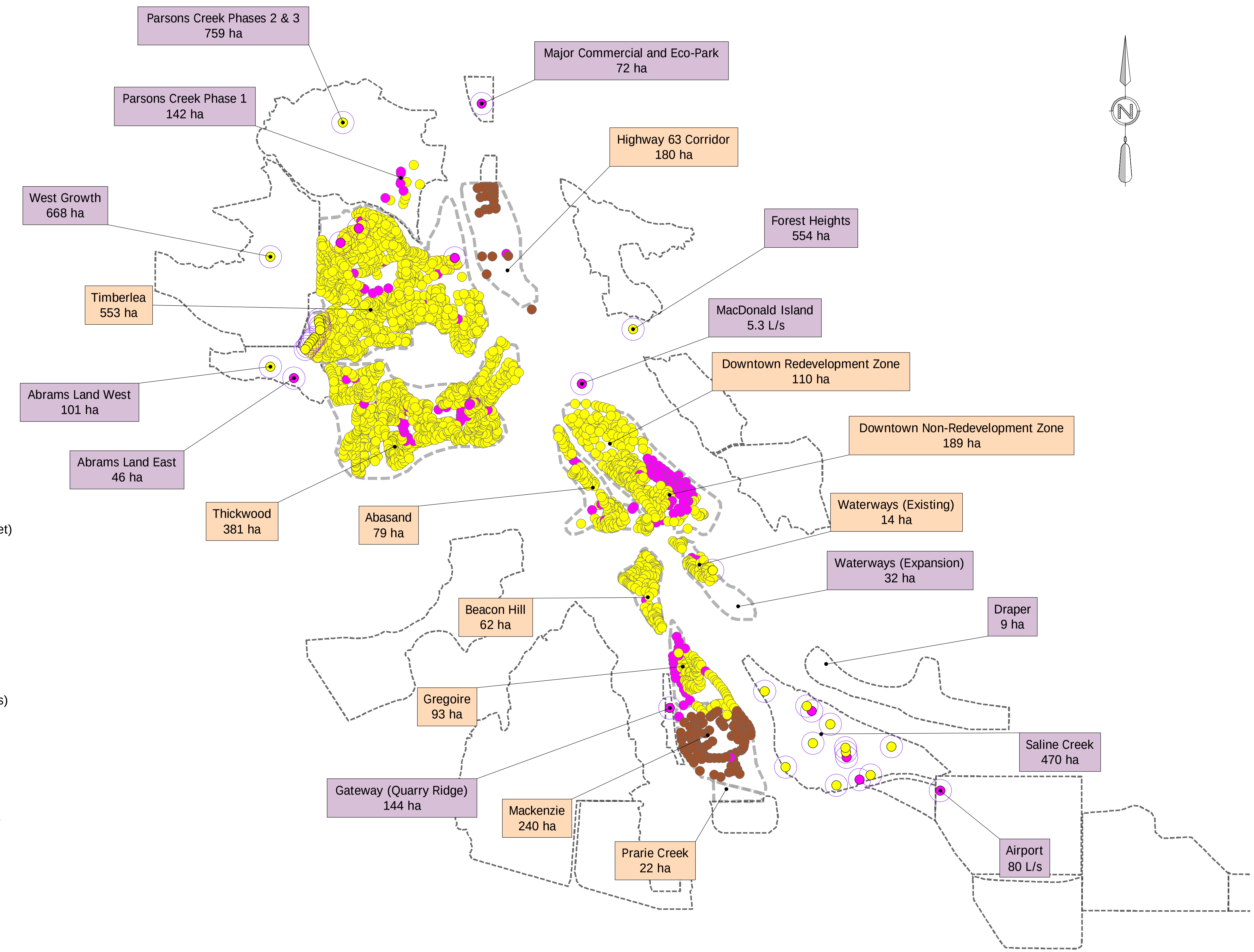
Existing Neighbourhood	Current Population (2102 Census)	Ultimate Population	Ratio (Ultimate / Current)	Notes
Timberlea	33,485	42,000	1.25	Intensification & infill
Thickwood	17,548	19,200	1.09	Intensification
Lower Townsite	10,785	48,000	4.45	Downtown major redevelopment & intensification (CCARP)
Abasand	5,239	6,000	1.15	Intensification
Beacon Hill	2,193	2,600	1.19	Intensification
Waterways	726	2,700	3.72	Intensification and expansion
Gregoire	4,053	7,400	1.83	Re-development
Prairie Creek	1,050	1,250	1.19	Intensification
Total	**75,079**	**129,150**	**1.72**	

Future populations in existing neighbourhoods were estimated for the Future Model as follows:

- Design populations for most existing neighbourhoods were based on 2012 Census data adjusted for infill and intensification in accordance with TM A.1.5 Urban Development Sub-Region Population Projection" (AE, January 2014).
- Design populations for the Lower Townsite were estimated according to the building heights (Floor Area Ratio of 5, 7.5, and 10) identified in CCARP.
- Re-development populations of 100 people per net hectare were assumed in Gregoire based on estimates in TM A.1.5 (AE, 2014).

Figure 4-1 provides a summary of population densities and other dry-weather flow parameters used for the Future Model. Note that population estimates for existing development are based on the net area which is the actual lot area available for development. Population estimates for future expansion areas are based on the gross development area, which additionally includes roadways, lanes, parks, utility lots, and stormwater management facilities and is typically about 30% greater than the net area. An average residential population density of 50 people per gross developable hectare was adopted for the future expansion areas.

Future Model - Dry Weather Flow



LEGEND

Existing Neighbourhood Net Area*

* Only includes lot area without road and park.

ADWF Parameters

1) Residential 300 L/cap/day
- Single Family Residential 4 cap/household
- Low Density Multi-Family 75 cap/ha (net)
- Medium Density Multi-Family 100 cap/ha (net)
- High Density Multi-Family 150 cap/ha (net)

2) Downtown Redvelopment Area
- 5 Storey 350 cap/ha (net)
- 7.5 Storey 525 cap/ha (net)
- 10 Storey 700 cap/ha (net)

3) Commercial and Industrial 0.2 L/s/ha (net)

Future Neighbourhood Gross Area*

1) Residential 300 L/cap/day
50 cap/ha (gross)

2) Commercial and Industrial 0.2 L/s/ha (gross)

* Excludes concept major road (eg. Abrams Land, West Growth & Parsons Creek), concept parks (eg. Parsons Creek, Saline Creek and Horse River), and concept non-developable land.

Future Model Network

- Node with Commercial - Future Diurnal Curve
- Node with Industrial - Future Diurnal Curve
- Node with Residential - Future Diurnal Curve
- Node with Lumped Catchment
- Sanitary Pipe
- Existing Neighbourhood
- Future Neighbourhood

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PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 4-1
Wastewater Master Plan
Future Model - Dry Weather Flow Parameters

TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: March 2014
SCALE: 1:100,000

4.2 DRY WEATHER FLOW GENERATION

Table 4-2 outlines the dry weather flow parameters used for developing the Future Model. Average dry-weather flows and peaking factors for existing neighbourhoods are based on analysis of flow monitoring data as documented in TM B.1.5 - Hydraulic Model & Design Criteria Update. They are somewhat lower than the ESS values would indicate. Conversely, Inflow/Infiltration rates are higher than the ESS would indicate).

For future expansion areas connected to the Future Model, the gross development areas, populations, and design flow parameters were adopted as outlined for the Future Expansion Plan described in the previous section of this report.

Table 4-2
Dry Weather Flow Design Criteria for Future Model

Land Use Class	Population per Net ha	Population per Gross ha	ADWF (L/c/d)	ADWF (L/s/ha)	Peaking Factor
Single Family Residential	4.0 people per dwelling unit (45-97/ha)		300		2.5
Low Density Multi-Family	75		300		2.5
Medium Density Multi-family	100		300		2.5
High Density Multi-family	150		300		2.5
Residential - Future		50	300		2.5
Industrial				0.2	2.0
Commercial				0.2	2.0
DTR5 [1]	350		300		2.5
DTR7.5 [2]	525		300		2.5
DTR10 [3]	700		300		2.5

[1] Downtown Major Redevelopment Zone with Maximum Floor Area Ratio of 5.
[2] Downtown Major Redevelopment Zone with Maximum Floor Area Ratio of 7.5.
[3] Downtown Major Redevelopment Zone with Maximum Floor Area Ratio of 10.

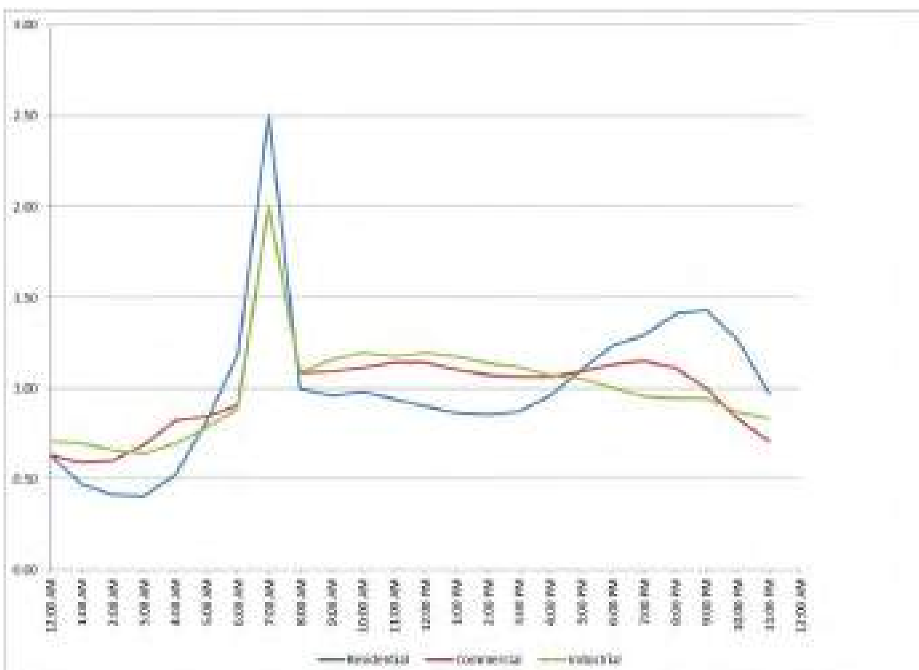
Figure 4-1 shows the model nodes to which the dry-weather flow parameters were applied in the Future Model. Note that the future expansion areas including Abrams Land, West Growth, Parsons Creek Phases 2 and 3, Major Commercial and Eco-Park, Waterways South, Draper, Saline Creek, Quarry Ridge, Macdonald Island, and the Airport have lumped sewershed areas.

An average dry-weather flow of 80 L/s is provided from the Airport and 5.3 L/s from Macdonald Island in accordance with pre-design reports for the two areas. Macdonald Island is being fitted with a new wastewater treatment plant that is being designed to supply treated irrigation water to the golf course but may be discharged to the existing trunk sewer system if necessary. The Airport lift station is being replaced and the existing lagoon is being abandoned. A new lift station will discharge to the new Highway 69 Lift Station and then to the Saline Plateau trunk sewer. The Highway 69 lift station has been designed for a service area of 390 ha and a dry-weather flow of 80 L/s which includes the Airport and immediate service area. It does not provide for the long-term development of the Airport Industrial area which will be diverted to the South Regional Wastewater Treatment Facility.

AE developed modified diurnal curves for residential, commercial, and industrial land use types for the Future Model, as shown on **Figure 4-2**. The diurnal curves represent the variation of dry-weather flow throughout the day. They were based on the diurnal curves developed from actual flow measurements, representing existing conditions, and were modified to increase the peaking factors to 2.5 for residential areas and 2.0 for commercial and industrial areas as recommended in TM B.1.5 - Hydraulic Model & Design Criteria Update. The diurnal curves for industrial and commercial areas were further modified to synchronize the peak dry-weather and wet-weather flows for all land uses, which is a conservative assumption.

The residential diurnal curve was used for all residential areas. The commercial/industrial diurnal curve was used for all commercial lots and the Downtown Major Redevelopment Zone (DTR5, DTR7.5, and DTR10).

Figure 4-2
Diurnal Curves for Future Model



4.3 WET WEATHER FLOW GENERATION

Rainfall Derived Inflow and Infiltration (RDII) sewersheds are the areas contributing rainfall runoff to the sanitary sewer system. They include lot areas, roads and back lanes and correspond to the Gross Development Area (GDA).

Table 4-3 outlines the wet weather flow parameters used in the Future Model and **Figure 4-3** shows the model nodes to which the various wet weather flow parameters are attached. Calibrated values are used in most neighbourhoods, except Mackenzie where the R values (percent of rainfall) were reduced by 50% to reflect the recommended I&I reduction program.

Table 4-3
Wet Weather Flow Parameters for Future Model

Land Use Description	Term	R	T (hours)	K (hours)	Total % of Rainfall Volume
Future Area	Short Term	0.01	1	5	1.2
	Medium Term	0	0	0	
	Long Term	0	0	0	
Timberlea Residential with Weeping Tiles	Short Term	0.03	1	5	18
	Medium Term	0.10	0.5	5	
	Long Term	0.05	10	5	
Thickwood Residential with Weeping Tiles	Short Term	0.01	1	5	10
	Medium Term	0.06	0.5	5	
	Long Term	0.03	10	5	
LTS/Abasand/Beacon Hill Residential with Weeping Tiles	Short Term	0.01	1	5	4
	Medium Term	0.02	0.5	5	
	Long Term	0.01	10	5	
Expansion Areas and Newer areas of Timberlea/Thickwood/LTS without Weeping Tiles	Short Term	0.01	1	5	1
	Medium Term	0	0	0	
	Long Term	0	0	0	
MacKenzie Commercial/Industrial[1]	Short Term	0.015	1	5	1.5
	Medium Term	0	0	0	
	Long Term	0	0	0	

[1] Reduced I&I in MacKenzie by 50% from the Existing 2013 Model.

4.4 FUTURE UPGRADING

AE simulated the 1:25 year 4 hour duration storm using the Future Model. Design storm intensities for the Future Model simulations were increased by 10% to allow for the potential effects of climate changes as recommended in TM B.1.5 - Hydraulic Model and Design Criteria Update.

Simulation results indicate the following:

- The downstream trunk along Confederation Way will become overloaded in the 1:25 year storm, causing localized flooding and overflow to Confederation Way. Localized flooding will also in two locations in Thickwood. As noted previously, an Inflow Infiltration reduction program is recommended in this neighbourhood to reduce the wet-weather flows and could potentially avoid or delay the need for upgrading. Other trunks which are proposed for upgrading for existing conditions have been oversized to accommodate future flows.
- The main trunks along Gregoire Drive and Mackenzie Boulevard will also be overloaded in the 1:25 year storm and will back up into the Mackenzie area. The existing trunk could be intercepted into the Mackenzie Lift Station and diverted to the South Regional Wastewater Treatment facility, which would avoid the need to upgrade the Gregoire Trunk.
- The main trunk along Railway Avenue/Saline Drive through Waterways will be overloaded and will need to be twinned or up-sized to accommodate the future expansion of its service area and Draper.
- Existing sanitary sewers in the Lower Townsite do not have capacity for the re-development proposed under CCARP and will need to be replaced.

Upgrading trunk sewers along Confederation Way, Gregoire Drive, Mackenzie Boulevard, Railway Avenue, and in the Lower Townsite will be required as shown in **Figures 4.4** to **4.7**. The need for, and the timing of these upgrades, will depend on the timing of development and re-development but generally will need to be implemented in the 5-20 year time frame. These are additional to the upgrades required for existing flows within the 0-5 year time frame.

Future upgrades are required before any significant re-development in the Lower Townsite or Gregoire occurs and should be coordinated with upgrading of streets or other utilities. Other upgrades related to infill and intensification are more difficult to predict; as a general guideline AE recommends that they be completed before:

- The population in the service area upstream of the work increases by more than 5%.
- Roadway improvements are planned in the affected streets.
- Within 20 years.

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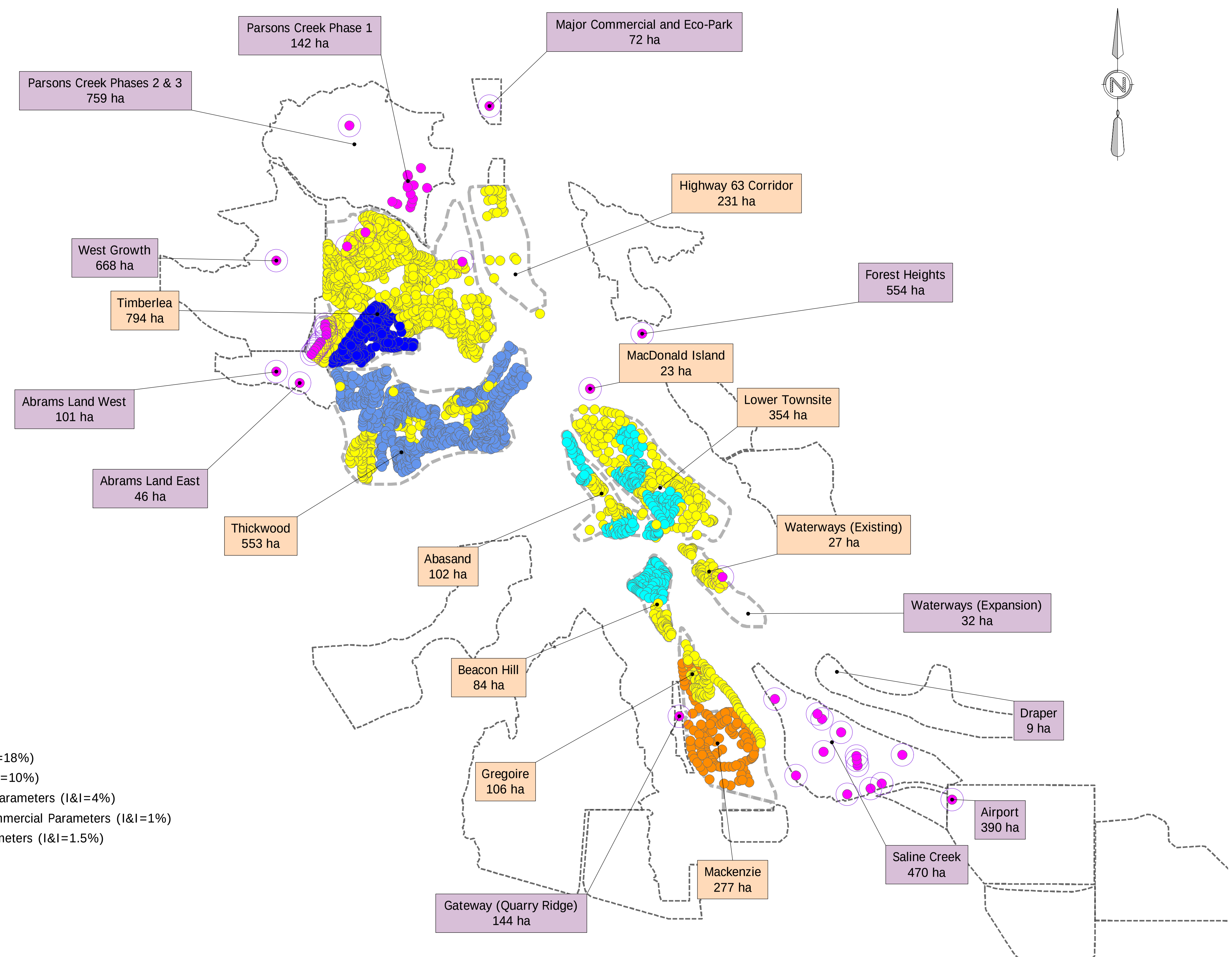
Future Model - Wet Weather Flow



LEGEND

Existing Neighbourhood Net Area*

* Only includes lot area without road and park.

Future Neighbourhood Gross Area*

* Excludes concept major road (eg. Abrams Land, West Growth & Parsons Creek), concept parks (eg. Parsons Creek, Saline Creek and Horse River), and concept non-developable land.

Future Model Network

- Node with Future I&I Parameters (I&I=1.0%)
- Node with Timberlea Residential with Weeping Tiles Parameters (I&I=18%)
- Node with Thickwood Residential with Weeping Tiles Parameters (I&I=10%)
- Node with LTS/Abasand/Beacon Hill Residential with Weeping Tiles Parameters (I&I=4%)
- Node with Newer areas of Timberlea/Thickwood/LTS Residential/Commercial Parameters (I&I=1%)
- Node with Mackenzie Commercial/Industrial 50% I/I Reduction Parameters (I&I=1.5%)
- Node with Lumped Catchment
- Sanitary Pipe
- Existing Neighbourhood
- Future Neighbourhood

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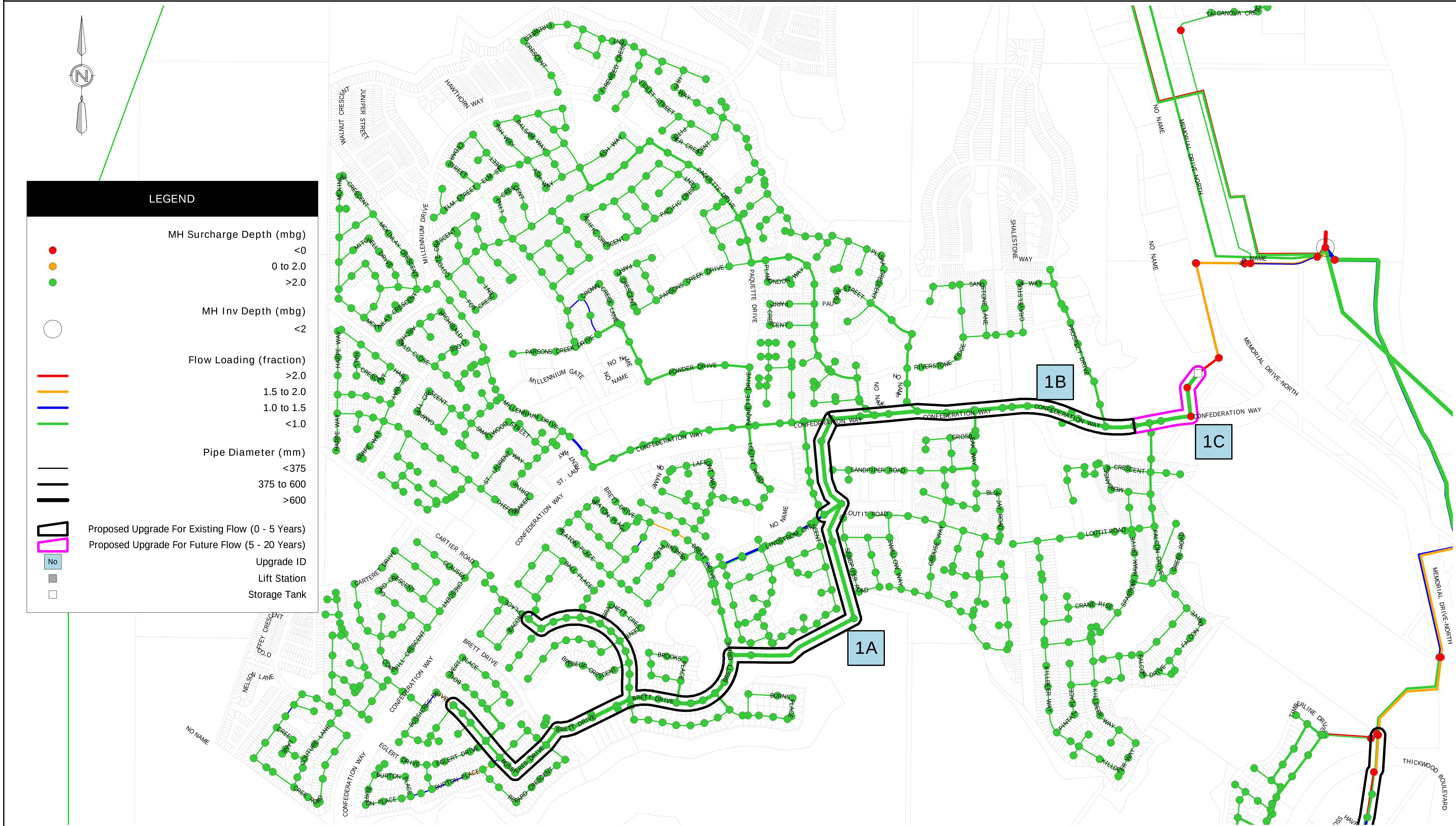
FIGURE 4-3
Wastewater Master Plan
Future Model - Wet Weather Flow Parameters

TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: March 2014
SCALE: 1:100,000

Upgraded Future Model



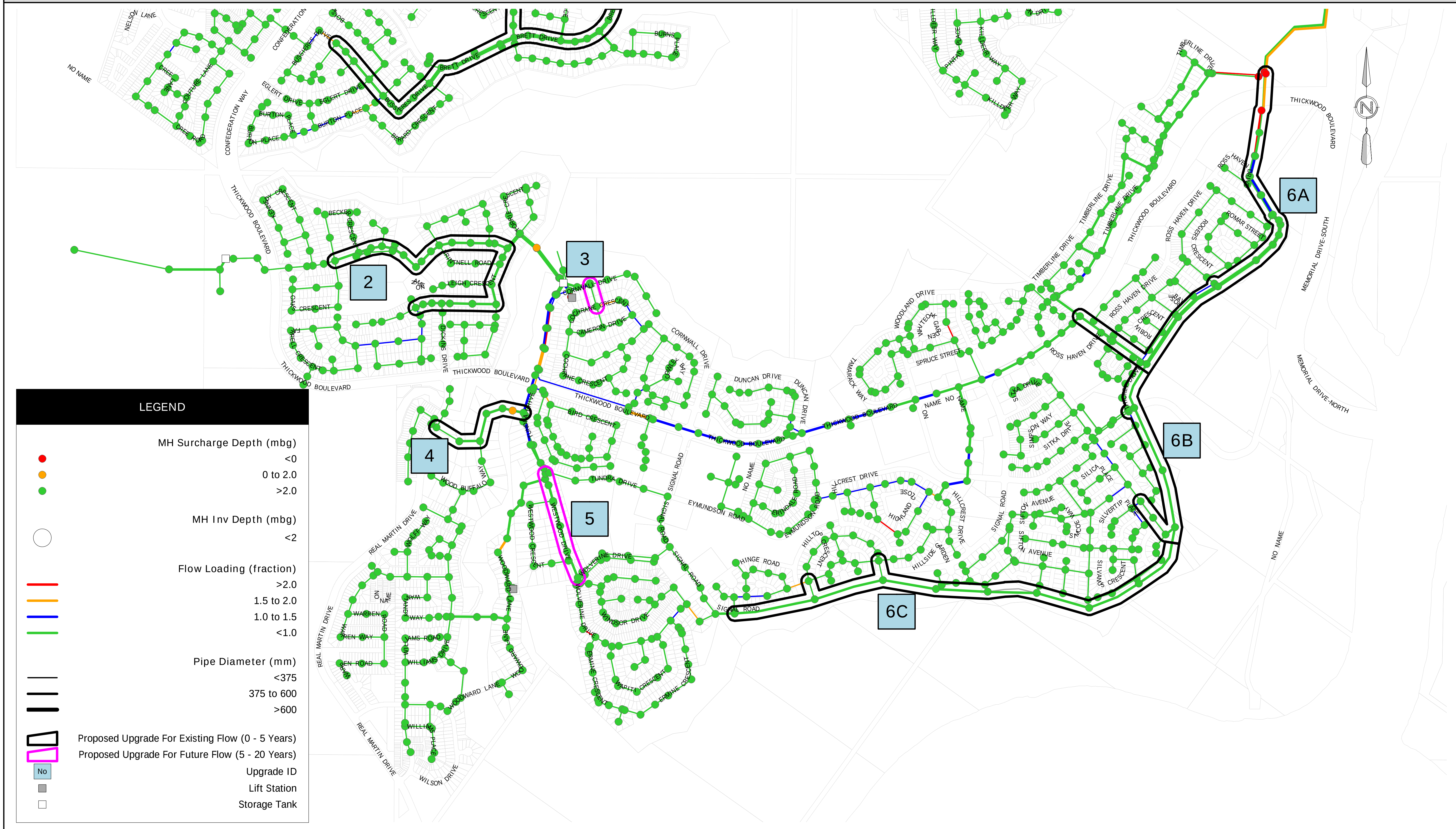
PREPARED BY: Associated Engineering

PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 4-4
Wastewater Master Plan
Upgraded Future Model - Timberlea
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: May 2014
SCALE: 1:15,000

Upgraded Future Model



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Regional Municipality of Wood Buffalo

FIGURE 4-5
Wastewater Master Plan
Future Upgraded Model - Thickwood
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694

DATE: May 2014

SCALE: 1:15,000

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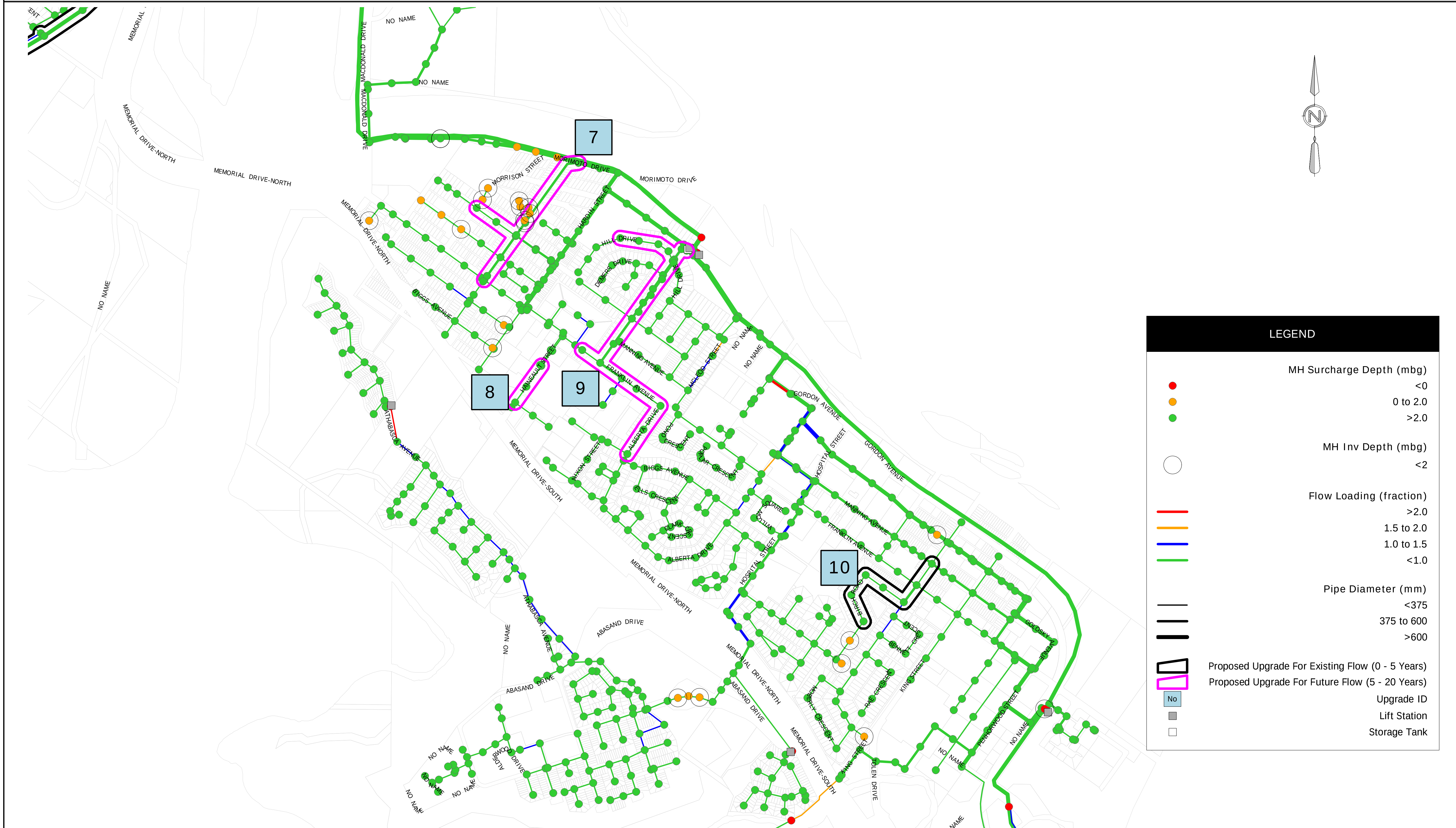
Upgraded Future Model



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Regional Municipality of Wood Buffalo

FIGURE 4-6
Wastewater Master Plan
Upgrade Future Model - Lower Townsite and Abasand
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: May 2014
SCALE: 1:15,000

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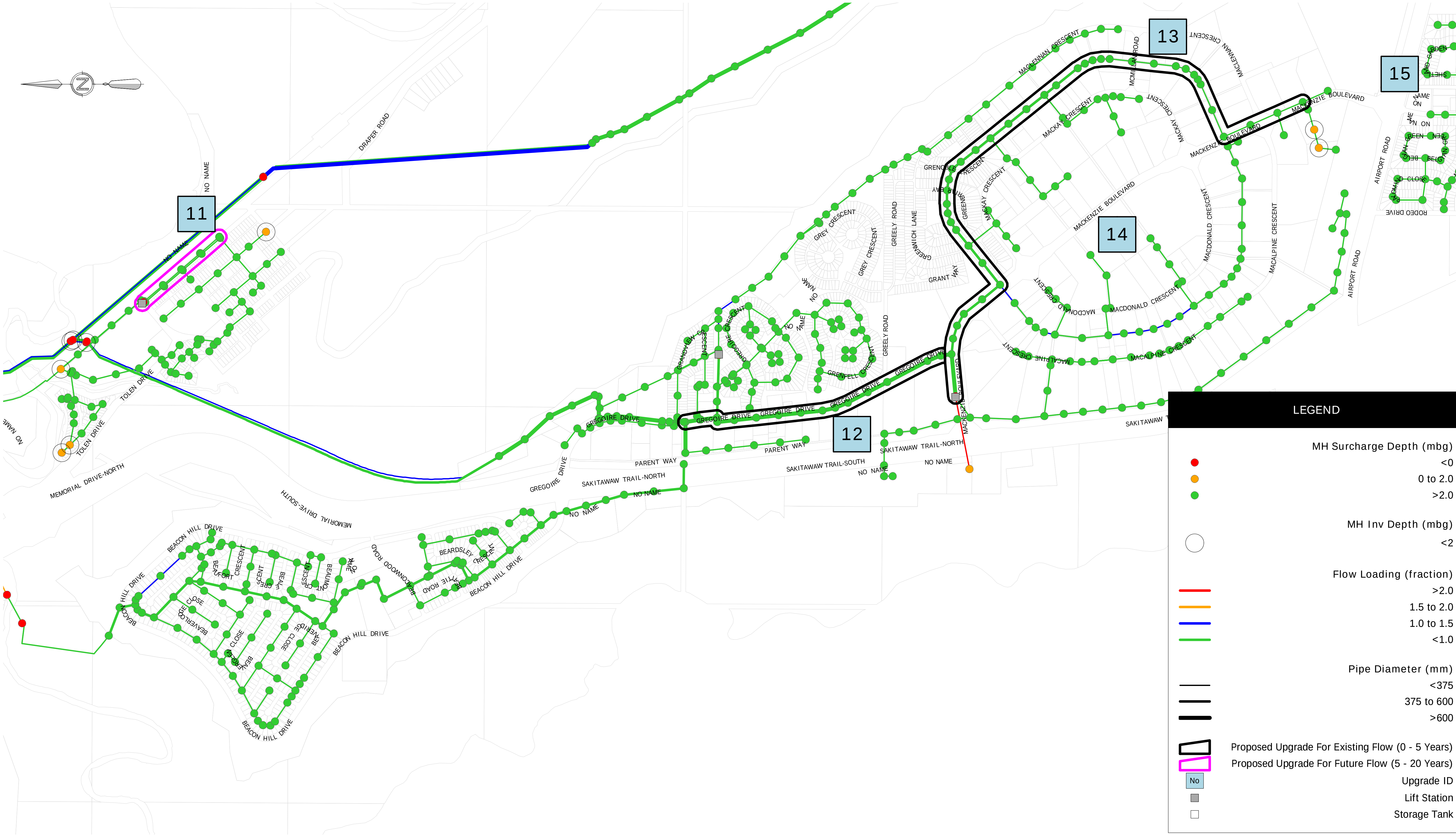
Printed 5/13/2014

Upgraded Future Model



PREPARED BY: Associated Engineering

PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 4-7
Wastewater Master Plan
Upgraded Future Model - Beacon Hill, Waterways, Gregoire and MacKenzie
1:25 Year 4 Hour Design Storm Simulation Results
TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694
DATE: May 2014
SCALE: 1:15,000

4.5 LIFT STATIONS

Table 4-4 summarizes the simulated peak flows and capacities of the lift stations modeled in the Future Model.

Table 4-4
Lift Stations for Future Model

No.	Lift Station	1:25 Year Peak Flow (L/s)	Existing Capacity (L/s)
1	TaigaNova/Eco-Park	47	48
4	1B	164	400
5	Grayling Terrace	16	14
6	Abasand	14	34
7	1A	1,023	670
8	Cornwall	247	145
9	Wood Buffalo	63	51
10	Gregoire	47	28 (planned to be upgraded)
11	Mackenzie	152	208 (planned capacity for upgrade)
12	Waterways	37	61 (being upgraded)

The Mackenzie Lift Station could be diverted to the South Regional Wastewater Treatment Facility, and it could be designed to intercept the Gregoire Drive Trunk Sewer, which would forego the need to upgrade that trunk.

Pump upgrades will be required at Graying Terrace, Lift Station 1A, Wood Buffalo, and Gregoire Lift Stations to accommodate the future flows. The Gregoire Lift Station is planned to be upgraded in the near future and should be designed for the ultimate flows.

Inflows to the Cornwall Lift Station are moderated in the Dickensfield storage tank. Model results confirm that the tank will have sufficient capacity for the 1:25 year storm.

The Prairie Creek Lift Station will be abandoned and drained to a new pump station that will serve the Prairie Creek Industrial area and will be discharged to the South Regional Wastewater Treatment Facility.

The timing of these upgrades will depend on the pace of development and infill/intensification but will likely be required within 20 years.

5 Conceptual Cost Estimate

Refer to Appendix C for the cost estimates for the proposed upgrade and expansion plans.

5.1 UPGRADE EXISTING SYSTEM

Table 5-1 provides the cost estimates of upgrades required to the existing wastewater collection system. Some are required immediately (within 5 years) and others can be implemented over time (5-20 years) depending on the pace of infill and re-development.

Note that all cost estimates are based on a high-level analysis and should be considered preliminary, subject to review with more detailed design. Cost estimates are in 2014 dollars and include engineering (10%) and contingencies (30%).

Table 5-1
Upgrade Cost Estimate

Upgrade Number	Location	Existing Flows (0-5 years)	Future Flows (5-20 years)	TOTAL
1	Timberlea Mainline Trunk Upgrade	$37,600,000	$3,800,000	$41,400,000
2	Dickensfield Improvement	$11,300,000	—	$11,300,000
3	Cornwall Drive	—	$800,000	$800,000
4	Wood Buffalo Way Improvement	$3,900,000	—	$3,900,000
5	Westwood Drive	—	$3,700,000	$3,700,000
6	Thickwood Perimeter Trunk	$23,300,000	—	$23,300,000
7	Main Street	—	$5,400,000	$5,400,000
8	Haineault Street	—	$1,500,000	$1,500,000
9	Father Mercredi Street	—	$12,100,000	$12,100,000
10	Birch Road	$4,900,000	—	$4,900,000
11	Railway Avenue	—	$3,200,000	$3,200,000
12	Gregoire Drive	$10,100,000	—	$10,100,000
13	Mackenzie Boulevard	$23,000,000	—	$23,000,000
14	I/I Reduction	$5,000,000	—	$5,000,000
15	Prairie Creek Lift Station	$5,000,000	—	$5,000,000
16	Grayling Terrace Lift Station	—	$500,000	$500,000
17	Lift Station 1a	—	$2,000,000	$2,000,000
18	Wood Buffalo Lift Station	—	$500,000	$500,000
	Totals	**$124,100,000**	**$33,500,000**	**$157,600,000**

5.2 FUTURE SYSTEM EXPANSION

Table 5-2 provides the cost estimate for trunk sewer facilities required to service future expansion areas. Note that pumping is required due to fragmentation of the future expansion areas, with the result that the municipality may need to front-end the lift stations and force mains to facilitate development. Trunk sewers could be constructed and financed by the individual developments they serve.

Figure 5-1
Cost Estimate for Future Expansion Areas

District	Gravity Sewers	Force Mains	Lift Stations	Total
Abrams Land	$6,900,000	—	—	$6,900,000
West Growth	$46,600,000	—	—	$46,600,000
Parsons Creek	$34,700,000	—	—	$34,700,000
Major Commercial/Eco-Park	$4,800,000	$7,100,000	$6,500,000	$18,400,000
Forest Heights	$57,300,000	$11,000,000	$10,700,000	$78,900,000
Draper Valley	—	$14,100,000	$6,500,000	$20,600,000
Saline Creek	$17,700,000	—	—	$17,700,000
Airport East Industrial Lands/Lynton	$55,300,000	$28,200,000	—	$83,500,000
Southlands Areas 1A/1B	$45,500,000	$1,000,000	$18,200,000	$64,800,000
Southlands Area 4	$3,600,000	$29,100,000	$19,300,000	$52,000,000
Quarry Ridge/Mackenzie	$1,000,000	$23,100,000	$500,000	$24,600,000
Hangingstone	$46,700,000	$30,800,000	$19,300,000	$96,800,000
Horse River	$24,100,000	$34,300,000	$10,700,000	$69,100,000
Total	**$344,200,000**	**$177,800,000**	**$91,700,000**	**$613,700,000**

6 Conclusions

The analysis indicated that:

- Portions of the existing sewer system are overloaded in wet-weather flows, primarily in those older neighbourhoods that have weeping tiles connected to the sanitary sewer system.

- Trunk sewers through Gregoire and Mackenzie are overloaded in wet-weather flow conditions due to extraneous inflow and infiltration (I&I) in poorly-graded rear-yard utility lots.

- The Prairie Creek Lift Station is oversized for its catchment area and contributes to the high flows in the Mackenzie trunk.

- The existing Mackenzie Lift Station is overloaded in the 1:25 year storm under existing conditions. It is scheduled to be replaced with a larger pump station designed to service the existing catchment and additional development in Quarry Ridge. In the future this lift station may be diverted away to the South Wastewater Treatment Facility which will reduce the flow in the Gregoire Trunk.

- Over the next 25 years, the population of Fort McMurray is expected to increase from 76,000 to 130,000 people (TM A.1.5 - Urban Development Sub-Region Population Projection, by Associated Engineering, January 2014). Full build-out of the identified expansion areas will provide for an ultimate population of 292,000 people and will not be completed for at least 50 years.

- A network of trunk sewers, pump stations and force mains will be required to service the planned growth, mostly draining to the proposed South Regional Wastewater Facility being planned by the Municipality. Pumping of wastewater flow is required due to the fragmented topography of the Fort McMurray region caused by the regional river network.

- Preliminary catchment areas and trunk alignments and sizes for the future expansion areas were delineated based on the general topography and land use concepts identified in previous planning documents. Large portions of the development areas have poor soils and poor drainage. Previous studies have identified those portions as being un-developable, and this has been assumed in developing the sanitary collection system concept plan.

- Infill, intensification, and re-development identified in previous studies will place further demands on the existing wastewater collection system in the North Catchment Area. However, additional upgrading required to accommodate these demands is relatively minor, with the exception of system upgrading to support the City Centre Area Re-Development Plan (CCARP) in the Lower Townsite.

7 Recommendations

Associated Engineering recommends the following:

- That the existing wastewater collection system be upgraded as shown in **Figure 7-1** on a priority basis to prevent basement flooding and system overflows and to provide capacity for future population changes, infill and intensification, and the City Centre Re-development Plan (CCARP).

- That an I&I reduction program be carried out in Mackenzie, Timberlea, and Thickwood to reduce the sewer flows and increase the service levels to the 1:100 year storm.

- Flow monitoring is recommended to:
  - Confirm the effectiveness of the I&I reduction program.
  - Confirm design flows for system upgrading projects.
  - Confirm the I&I rates in new development areas to refine the design flows over time.
  - Monitor overall system performance for operational and capacity issues.

- That the wastewater collection system concept plan be updated as more detailed planning and design are carried out for the future development areas.

Figure 7-1 shows the upgrades to the existing wastewater collection system required in the near future (within 5 years) to prevent basement flooding and system overflows, at a planning-level cost estimate of $124 million.

Figure 7-1 also shows the additional upgrades that will be required in future to accommodate re-development, infill, and intensification, with a planning-level cost estimate of $34 million. Timing of these upgrades will depend on the pace of development and re-development; they will likely be required in the 5-to-20 year time frame and should be coordinated with upgrading roadways and other utilities.

Figure 3-1 shows the conceptual servicing plan proposed to service the proposed expansion of the Urban Service Area, which has a planning-level cost estimate of $614 million.

Appendix B provides details of the required trunk sizes and flows for future expansion areas. **Appendix C** provides preliminary cost estimates. Note that all cost estimates are based on a high-level analysis and should be considered preliminary, subject to review with more detailed design. Cost estimates include engineering (10%) and contingencies (30%) and are expressed in 2014 dollars.

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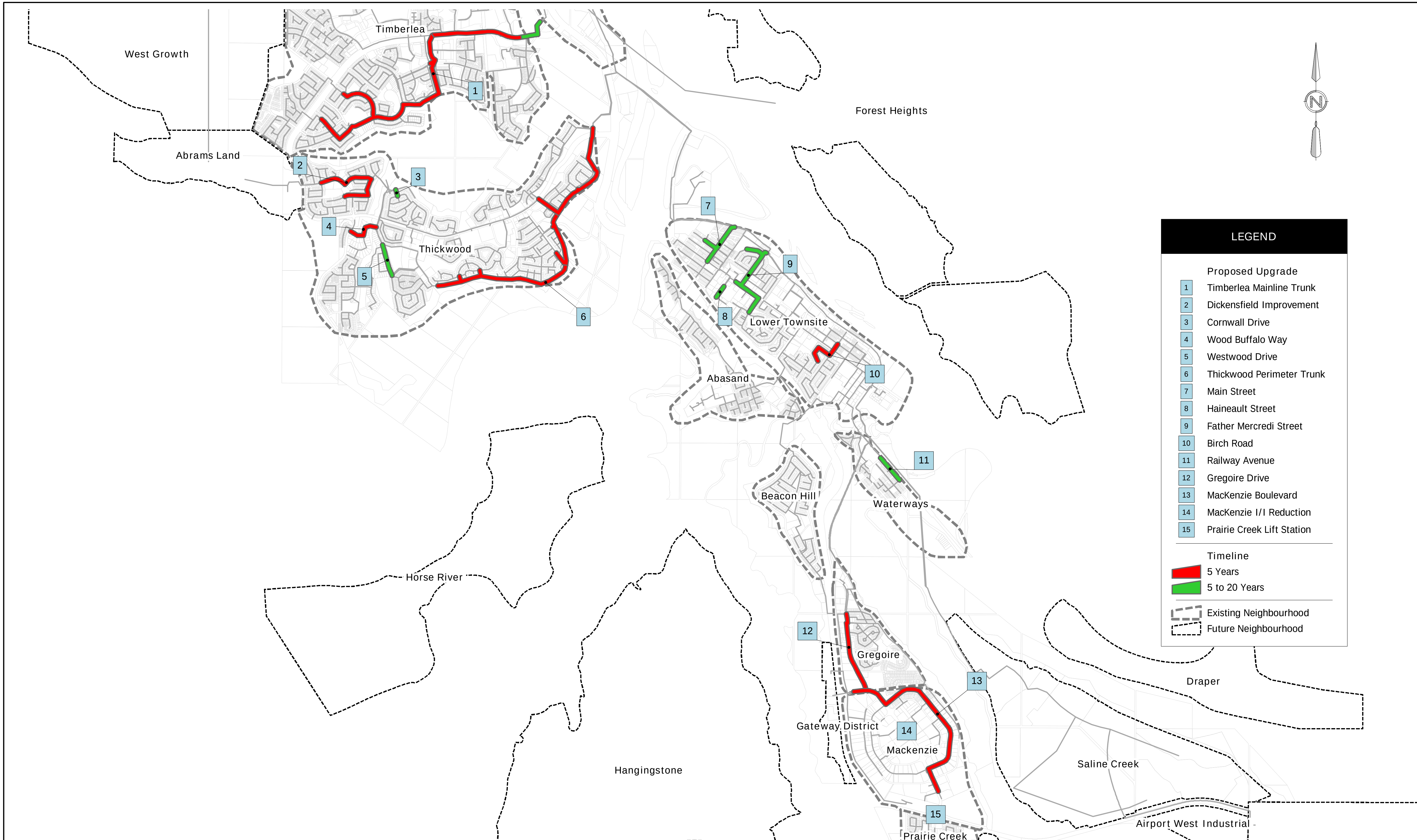

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PREPARED FOR: Regional Municipality of Wood Buffalo

FIGURE 7-1
Wastewater Master Plan
Proposed Upgrades

TM B.2.5 Final Model & Collection System Upgrades Report

PROJECT No.: 20123694

DATE: May 2014

SCALE: 1:50,000

REPORT

Closure

This report was prepared for the Regional Municipality of Wood Buffalo to provide an overall Wastewater Collection System Master Plan.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.

PROFESSIONAL ENGINEER
LARRY E. BODNARUK
ALBERTA

May 16, 2014

Larry Bodnaruk, P. Eng.
Project Manager

Jenna Lee, E.I.T., LEED AP
Project Engineer

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF

Signature:

Date: May 16, 2014

APEGA Permit to Practice P 3979

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Appendix A – Projected Wastewater Flows for Future Development Areas

Table A-1 Projected Wastewater Flows for Future Development Areas

MH ID	Dry Weather Flow									Wet Weather Flow					
	Residential			Non-Residential			Total ADWF (L/s)	Peaking Factor	PDWF (L/s)	Park (ha)	Road (ha)	Sewershed Area (ha)	I & I (L/s)	PWWF (L/s)	Accumulated PWWF (L/s)
	Area (ha)	Pop.	ADWF (L/s)	Comm/Inst Area (ha)	Industrial Area (ha)	ADWF (L/s)									
Abrams Land (Figure 3-2)															
F1200	40	2,006	7	28	0	6	12	2.5	31	0	0	68	26	57	57
F1210	15	740	3	11	0	2	5	2.5	12	0	7	33	13	25	81
F1220	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	138
F1250	0	0	0	41	0	8	8	2.0	16	0	5	46	17	34	34
F1260	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	34
Sum:	55	2,746	10	79	0	16	25	-	59	0	13	147	56	115	-
West Growth (Figure 3-2)															
F1000	46	2,281	8	0	0	0	8	2.5	19	0	0	46	17	37	37
F1001	59	2,928	10	7	0	1	12	2.4	28	0	0	66	25	53	53
F1002	66	3,304	11	6	0	1	13	2.4	30	0	0	73	28	58	148
F1003	44	2,202	8	0	0	0	8	2.5	19	0	0	44	17	36	183
F1004	56	2,811	10	11	0	2	12	2.4	29	0	0	67	25	54	237
F1100	47	2,345	8	0	0	0	8	2.4	20	0	0	47	18	38	38
F1005	24	1,179	4	3	0	1	5	2.5	12	0	20	47	18	30	442
F1010	0	0	0	15	0	3	3	2.0	6	0	0	15	6	11	11
F1020	91	4,559	16	0	0	0	16	2.3	36	0	0	91	35	71	71
F1030	0	0	0	16	0	3	3	2.0	7	0	12	28	11	17	542
F1040	129	6,473	22	0	0	0	22	2.2	50	0	7	137	52	102	102
F1050	0	0	0	10	0	2	2	2.0	4	0	0	10	4	8	652
Sum:	562	28,082	98	68	0	14	111	-	260	0	38	668	254	514	-
Parsons Creek (Figure 3-2)															
F1400	9	471	2	0	0	0	2	2.5	4	82	13	104	40	44	695
F1410	7	351	1	8	0	2	3	2.5	7	20	14	50	19	26	721
F1420	146	7,313	25	43	0	9	34	2.2	74	0	20	209	79	154	154
F1430	46	2,319	8	10	0	2	10	2.4	25	35	0	92	35	59	213
F1440	203	10,135	35	0	0	0	35	2.1	74	12	21	235	89	164	377
F1450	24	1,212	4	38	0	8	12	2.5	30	8	0	70	27	56	434
SA90039	85	4,245	15	39	0	8	22	2.3	52	18	0	142	54	106	539
Sum:	521	26,046	90	138	0	28	118	-	266	175	68	901	342	609	-
Major Commercial and Eco-Park (Figure 3-3)															
F1700	0	0	0	52	0	10	10	2.0	21	0	0	52	20	40	40
F1710	0	0	0	0	20	4	4	2.0	8	0	0	20	8	16	56
Sum:	0	0	0	52	20	14	14	-	29	0	0	72	27	56	-

Table A-1 Projected Wastewater Flows for Future Development Areas

MH ID	Dry Weather Flow									Wet Weather Flow					
	Residential			Non-Residential			Total ADWF (L/s)	Peaking Factor	PDWF (L/s)	Park (ha)	Road (ha)	Sewershed Area (ha)	I & I (L/s)	PWWF (L/s)	Accumulated PWWF (L/s)
	Area (ha)	Pop.	ADWF (L/s)	Comm/Inst Area (ha)	Industrial Area (ha)	ADWF (L/s)									
Forest Heights (Figure 3-3)															
F2000	22	1,079	4	0	0	0	4	2.5	9	0	0	22	8	18	18
F2001	39	1,948	7	0	0	0	7	2.5	17	0	0	39	15	32	49
F2002	32	1,595	6	0	0	0	6	2.5	14	0	0	32	12	26	26
F2003	25	1,235	4	0	0	0	4	2.5	11	0	0	25	9	20	95
F2004	19	949	3	0	0	0	3	2.5	8	0	0	19	7	15	15
F2005	22	1,098	4	0	0	0	4	2.5	10	0	0	22	8	18	33
LS-FH	43	2,146	7	0	0	0	7	2.5	18	0	0	43	16	35	189
F2006	47	2,346	8	0	0	0	8	2.4	20	0	0	47	18	38	38
F2007	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	227
F2008	52	2,616	9	0	0	0	9	2.4	22	0	0	52	20	42	42
F2009	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	269
F2010	43	2,140	7	0	0	0	7	2.5	18	0	0	43	16	35	35
F2011	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	303
F2012	40	1,992	7	0	0	0	7	2.5	17	0	0	40	15	32	32
F2013	30	1,504	5	0	0	0	5	2.5	13	0	0	30	11	24	57
F2014	22	1,096	4	0	0	0	4	2.5	10	0	0	22	8	18	18
F2015	31	1,552	5	0	0	0	5	2.5	13	0	0	31	12	25	100
F2016	89	4,427	15	0	0	0	15	2.3	36	0	0	89	34	69	472
Sum:	554	27,723	96	0	0	0	96	-	236	0	0	554	211	447	-
Draper Valley (Figure 3-4)															
F3000	9	440	2	0	0	0	2	2.5	4	0	0	9	3	7	7
Sum:	9	440	2	0	0	0	2	-	4	0	0	9	3	7	-
Saline Creek (Figure 3-4)															
AE0102	14	702	2	17	0	3	6	2.5	14	8	0	39	15	29	29
AE0104	34	1,704	6	0	0	0	6	2.5	15	0	0	34	13	28	28
AE0111	29	1,430	5	0	0	0	5	2.5	12	10	0	39	15	27	27
AE0116	42	2,075	7	1	0	0	7	2.5	18	5	0	48	18	37	37
AE0126	61	3,071	11	0	0	0	11	2.4	25	2	0	64	24	50	50
F3500	35	1,764	6	0	0	0	6	2.5	15	0	0	35	13	29	29
F3510	25	1,265	4	0	0	0	4	2.5	11	0	0	25	10	21	21
F3511	7	367	1	8	0	2	3	2.5	7	0	0	16	6	13	13
F3512	49	2,434	8	9	0	2	10	2.4	25	8	0	66	25	50	50
F3520	55	2,774	10	0	0	0	10	2.4	23	3	0	59	22	46	96
F3530	17	859	3	0	0	0	3	2.5	7	29	0	46	18	25	121
Sum:	369	18,443	64	36	0	7	71	-	175	66	0	470	179	354	-

Table A-1 Projected Wastewater Flows for Future Development Areas

MH ID	Dry Weather Flow									Wet Weather Flow					
	Residential			Non-Residential			Total ADWF (L/s)	Peaking Factor	PDWF (L/s)	Park (ha)	Road (ha)	Sewershed Area (ha)	I & I (L/s)	PWWF (L/s)	Accumulated PWWF (L/s)
	Area (ha)	Pop.	ADWF (L/s)	Comm/Inst Area (ha)	Industrial Area (ha)	ADWF (L/s)									
Airport East Industrial Lands and Lynton (Figure 3-5)															
F4000	0	0	0	0	106	21	21	2.0	42	0	0	106	40	83	83
F4001	0	0	0	0	83	17	17	2.0	33	0	0	83	32	65	65
F4010	0	0	0	0	72	14	14	2.0	29	0	0	72	28	57	204
F4011	0	0	0	0	99	20	20	2.0	40	0	0	99	38	78	282
F4020	0	0	0	0	94	19	19	2.0	37	0	0	94	36	73	73
F4021	0	0	0	0	132	26	26	2.0	53	0	0	132	50	103	176
LS-AEI	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	458
F4030	0	0	0	0	132	26	26	2.0	53	0	0	132	50	103	561
F4040	0	0	0	0	131	26	26	2.0	53	0	0	131	50	102	663
F4050	0	0	0	0	150	30	30	2.0	60	0	0	150	57	117	780
LS-HW69	0	0	0	15	0	3	3	2.0	6	0	0	15	6	12	792
Sum:	0	0	0	15	1,000	203	203	-	406	0	0	1,015	386	792	-
Southlands Areas 1A and 1B (Figure 3-5)															
F5000	0	0	0	0	193	39	39	2.0	77	0	0	193	73	150	150
F5010	0	0	0	0	69	14	14	2.0	28	0	0	69	26	54	204
F5020	0	0	0	13	25	7	7	2.0	15	0	0	37	14	29	233
F5050	0	0	0	0	175	35	35	2.0	70	0	0	175	67	137	137
F5060	0	0	0	0	125	25	25	2.0	50	0	0	125	48	98	234
F5070	0	0	0	0	50	10	10	2.0	20	0	0	50	19	39	273
F5100	0	0	0	7	0	1	1	2.0	3	0	0	7	3	6	513
LS-SL1	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	513
Sum:	0	0	0	20	637	131	131	-	263	0	0	657	250	513	-
Southlands Area 4 (Figure 3-6)															
LS-PRC	20	985	3	0	0	0	3	2.5	9	0	6	26	10	18	18
F6000	0	0	0	0	129	26	26	2.0	51	0	0	129	49	100	100
F6001	0	0	0	0	48	10	10	2.0	19	0	0	48	18	37	37
LS-SL4	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	156
F6002	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	948
Sum:	20	985	3	0	177	35	39	-	79	0	6	202	77	156	-

Table A-1 Projected Wastewater Flows for Future Development Areas

MH ID	Dry Weather Flow									Wet Weather Flow					
	Residential			Non-Residential			Total ADWF (L/s)	Peaking Factor	PDWF (L/s)	Park (ha)	Road (ha)	Sewershed Area (ha)	I & I (L/s)	PWWF (L/s)	Accumulated PWWF (L/s)
	Area (ha)	Pop.	ADWF (L/s)	Comm/Inst Area (ha)	Industrial Area (ha)	ADWF (L/s)									
Quarry Ridge and West Mackenzie (Figure 3-6)															
F6500	0	0	0	0	67	13	13	2.0	27	0	0	67	26	53	53
LS-GM	106	5,300	18	38	0	8	26	2.3	59	0	0	144	55	114	166
Sum:	106	5,300	18	38	67	21	39	-	86	0	0	211	80	166	-
Hagingstone (Figure 3-7)															
F7000	0	0	0	0	241	48	48	2.0	97	0	0	241	92	188	188
F7001	0	0	0	0	189	38	38	2.0	76	0	0	189	72	148	336
F7010	0	0	0	0	452	90	90	2.0	181	0	0	452	172	353	353
F7020	0	0	0	0	190	38	38	2.0	76	0	0	190	72	148	836
LS-HS	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	836
Sum:	0	0	0	0	1,072	214	214	-	429	0	0	1,072	408	836	-
Horse River (Figure 3-7)															
F8000	114	5,689	20	0	0	0	20	2.3	45	0	0	114	43	88	88
F8010	98	4,903	17	0	0	0	17	2.3	39	0	0	98	37	76	164
F8020	106	5,281	18	24	0	5	23	2.3	52	21	0	150	57	109	273
LS-HR	0	0	0	0	0	0	0	2.0	0	0	0	0	0	0	273
Sum:	317	15,873	55	24	0	5	60	-	136	21	0	362	138	273	-

Appendix B – Hydraulic Analysis for Future Trunk Sizing

Table B-1 Hydraulic Analysis for Future Trunk Sizing

From MH	To MH	Sanitary Pipe Type	Design Flow (L/s)	Min. Required Pipe Size (ID) (mm)	Required Pipe Size (ID) (mm)	Slope (%)	Length (m)	Full Capacity (L/s)	Capacity Used (%)	Full Flow Velocity (m/s)
Abrams Land (Figure 3-2)										
F1200	F1220	Gravity Main	68	381	450	0.2	600	127.5	53	0.8
F1210	F1220	Gravity Main	98	436	450	0.2	490	127.5	76	0.8
F1250	F1260	Gravity Main	41	314	350	0.2	640	65.2	62	0.7
West Growth (Figure 3-2)										
F1220	F1005	Gravity Main	166	531	600	0.2	1,630	274.6	60	1.0
F1000	F1002	Gravity Main	44	324	350	0.2	530	65	68	0.7
F1001	F1002	Gravity Main	63	371	375	0.2	1,180	78	81	0.7
F1002	F1003	Gravity Main	177	545	600	0.2	530	275	64	1.0
F1003	F1004	Gravity Main	220	591	600	0.2	540	275	80	1.0
F1004	F1005	Gravity Main	284	651	675	0.2	860	376	76	1.1
F1100	F1005	Gravity Main	45	327	350	0.2	620	65	69	0.7
F1005	F1030	Gravity Main	531	762	900	0.3	1,210	992	54	1.6
F1010	F1030	Gravity Main	14	209	250	0.2	1,070	27	52	0.5
F1020	F1030	Gravity Main	85	414	450	0.2	450	128	67	0.8
F1030	F1050	Gravity Main	651	888	900	0.2	840	810	80	1.3
F1040	F1050	Gravity Main	122	474	525	0.2	910	192	64	0.9
F1050	F1400	Gravity Main	782	951	1050	0.2	610	1221	64	1.4
Parsons Creek (Figure 3-2)										
F1400	F1410	Gravity Main	834	975	1050	0.2	1,560	1221	68	1.4
F1410	SA90032	Gravity Main	865	988	1050	0.2	570	1221	71	1.4
F1420	F1440	Gravity Main	185	554	600	0.2	2,260	275	67	1.0
F1430	F1440	Gravity Main	256	626	675	0.2	1,110	376	68	1.1
F1440	F1450	Gravity Main	453	775	900	0.2	540	810	56	1.3
F1450	SA90039	Gravity Main	520	816	900	0.2	1,532	810	64	1.3
Major Commercial and Eco-Park (Figure 3-3)										
F1700	F1710	Gravity Main	48	335	350	0.2	1,240	65	74	0.7
F1710	WWTP	Force Main	68	239	250	0.2	2,220	-	-	1.4

Table B-1 Hydraulic Analysis for Future Trunk Sizing

From MH	To MH	Sanitary Pipe Type	Design Flow (L/s)	Min. Required Pipe Size (ID) (mm)	Required Pipe Size (ID) (mm)	Slope (%)	Length (m)	Full Capacity (L/s)	Capacity Used (%)	Full Flow Velocity (m/s)
Forest Heights (Figure 3-3)										
F2000	F2001	Gravity Main	21	235	250	0.25	610	30	71	0.6
F2001	F2003	Gravity Main	59	361	375	0.2	780	78	75	0.7
F2002	F2003	Gravity Main	31	284	300	0.2	690	43	72	0.6
F2004	F2005	Gravity Main	19	224	250	0.25	620	30	62	0.6
F2005	LS-FH	Gravity Main	40	312	350	0.2	780	65	61	0.7
F2003	LS-FH	Gravity Main	114	462	525	0.2	830	192	59	0.9
LS-FH	F2007	Force Main	227	439	450	-	900	-	-	1.4
F2006	F2007	Gravity Main	45	327	350	0.2	610	65	69	0.7
F2007	F2009	Gravity Main	272	640	675	0.2	860	376	72	1.1
F2008	F2009	Gravity Main	50	340	350	0.2	670	65	77	0.7
F2009	F2011	Gravity Main	323	683	750	0.2	770	498	65	1.1
F2010	F2011	Gravity Main	41	316	350	0.2	880	65	64	0.7
F2011	F2016	Gravity Main	364	714	750	0.2	2,990	498	73	1.1
F2012	F2013	Gravity Main	39	308	350	0.2	760	65	59	0.7
F2013	F2015	Gravity Main	68	381	450	0.2	730	128	53	0.8
F2014	F2015	Gravity Main	21	237	250	0.25	670	30	72	0.6
F2015	F2016	Gravity Main	120	471	525	0.2	730	192	62	0.9
F2016	WWTP	Force Main	567	694	750	0.2	2,250	-	-	1.3
Draper Valley (Figure 3-4)										
F3000	LS-WW	Force Main	9	85	200	-	4,900	-	-	0.3
Saline Creek (Figure 3-4)										
F3500	AE0108	Gravity Main	34	311	350	0.15	1,080	56	61	0.6
F3510	F3520	Gravity Main	25	260	300	0.2	2,030	43	57	0.6
F3520	F3530	Gravity Main	115	489	525	0.15	810	167	69	0.8
F3530	AE0111	Gravity Main	145	534	600	0.15	580	238	61	0.8
Airport East Industrial Lands and Lynton (Figure 3-5)										
F4000	F4010	Gravity Main	99	463	525	0.15	2,850	167	60	0.8
F4001	F4010	Gravity Main	78	422	450	0.15	1,170	110	70	0.7
F4010	F4011	Gravity Main	245	650	675	0.15	820	326	75	0.9
F4011	LS-AEI	Gravity Main	338	733	750	0.15	750	431	78	1.0
F4020	F4021	Gravity Main	88	442	450	0.15	1,460	110	79	0.7
F4021	LS-AEI	Gravity Main	211	615	675	0.15	780	326	65	0.9
LS-AEI	F4030	Force Main	549	683	750	-	2,620	-	-	1.2
F4030	F4040	Gravity Main	673	949	1050	0.15	2,280	1058	64	1.2
F4040	F4050	Gravity Main	796	1011	1050	0.15	1,830	1058	75	1.2
F4050	LS-HW69	Gravity Main	936	1074	1200	0.15	570	1510	62	1.3
LS-HW69	F5002	Force Main	950	898	900	-	4,900	-	-	1.5

Table B-1 Hydraulic Analysis for Future Trunk Sizing

From MH	To MH	Sanitary Pipe Type	Design Flow (L/s)	Min. Required Pipe Size (ID) (mm)	Required Pipe Size (ID) (mm)	Slope (%)	Length (m)	Full Capacity (L/s)	Capacity Used (%)	Full Flow Velocity (m/s)
Southlands Areas 1A and 1B (Figure 3-5)										
F5000	F5010	Gravity Main	181	579	600	0.15	2,170	238	76	0.8
F5010	F5020	Gravity Main	245	650	675	0.15	1,460	326	75	0.9
F5020	F5100	Gravity Main	280	683	750	0.15	980	431	65	1.0
F5050	F5060	Gravity Main	164	559	600	0.15	2,380	238	69	0.8
F5060	F5070	Gravity Main	281	684	750	0.15	1,880	431	65	1.0
F5070	F5100	Gravity Main	328	725	750	0.15	1,240	431	76	1.0
F5100	LS-SL1	Gravity Main	615	918	1050	0.15	290	1058	58	1.2
LS-SL1	SWWTP	Force Main	615	723	750	0.15	290	-	-	1.4
Southlands Area 4 (Figure 3-6)										
LS-PRC	LS-SL4	Gravity Main	22	263	300	0.15	760	37	58	0.5
F6000	LS-SL4	Gravity Main	120	498	525	0.15	380	167	72	0.8
F6001	LS-SL4	Gravity Main	45	344	350	0.15	530	56	80	0.6
LS-SL4	F6002	Force Main	187	399	450	-	190	-	-	1.2
F6002	SWWTP	Force Main	1137	983	1050	-	5,850	-	-	1.3
Quarry Ridge and West Mackenzie (Figure 3-6)										
F6500	LS-GM	Gravity Main	322	599	600	0.4	240	388	83	1.4
LS-GM	SWWTP	Force Main	322	523	525	-	6,940	-	-	1.5
Hagingstone (Figure 3-7)										
F7000	F7001	Gravity Main	226	630	675	0.15	3,270	326	69	0.9
F7001	F7020	Gravity Main	403	783	900	0.15	2,540	701	57	1.1
F7010	F7020	Gravity Main	423	797	900	0.15	3,270	701	60	1.1
F7020	LS-HS	Gravity Main	1004	1102	1200	0.15	840	1510	66	1.3
LS-HS	SWWTP	Force Main	1004	923	1050	-	8,020	-	-	1.2
Horse River (Figure 3-7)										
F8000	F8010	Gravity Main	105	473	525	0.15	2,470	167	63	0.8
F8010	F8020	Gravity Main	197	598	600	0.15	1,690	238	83	0.8
F8020	LS-HR	Gravity Main	328	725	750	0.15	1,630	431	76	1.0
LS-HR	SWWTP	Force Main	328	528	600	-	10,450	-	-	1.2

Appendix C – Cost Estimates for Existing Upgrade Plan

Table C-1 Unit Cost Assumptions

Sanitary Pipe Diameter (mm)	Unit Costs			
	Replacements or New Construction in Existing Areas		New Construction, Green Field, Open Cut Installation	
	Gravity Main	Force Main	Gravity Main	Force Main
250	$7,800	$6,240	$3,700	$2,960
300	$7,900	$6,320	$3,800	$3,040
350	$8,000	$6,400	$3,900	$3,120
375	$8,100	$6,480	$3,950	$3,160
450	$8,200	$6,560	$4,000	$3,200
525	$8,300	$6,640	$4,100	$3,280
600	$8,500	$6,800	$4,200	$3,360
675	$8,700	$6,960	$4,500	$3,600
750	$8,800	$7,040	$4,500	$3,600
900	$8,900	$7,120	$4,800	$3,840
1050	$9,000	$7,200	$4,800	$3,840
1200	$10,000	$8,000	$4,900	$3,920

Lift Stations	
Design Flow (L/s)	Unit Cost
50	$6,500,000
100	$8,000,000
150	$9,400,000
200	$10,700,000
250	$11,900,000
300	$13,000,000
350	$14,100,000
400	$15,100,000
450	$16,000,000
500	$16,800,000
550	$17,500,000
600	$18,200,000
650	$18,800,000
700	$19,300,000

Note: For 2014 construction.
Unit cost includes 10% engineering and 30% contingency

Table C-2 Cost Estimates for Proposed Upgrades

Cost Estimates		Client: Regional Municipality of Wood Buffalo Project: RMWB Wastewater Master Plan Subject: Cost Estimates for Proposed Upgrades Project Number: 20123694 Date: May-14			
Item	Description	Unit	Quantity	Unit Price	Cost
1.0	TIMBERLEA MAINLINE TRUNK UPGRADE				
1A	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 375 mm Diameter PVC Pipe (Replacement and Gravity) - Bussieres Dr	l.m.	203	$8,100	$1,644,300
	.1 525 mm Diameter PVC Pipe (Replacement and Gravity) - Bussieres Dr	l.m.	91	$8,300	$755,300
	.2 600 mm Diameter PVC Pipe (Replacement and Gravity) - Bussieres Dr	l.m.	265	$8,500	$2,252,500
	.3 675 mm Diameter PVC Pipe (Replacement and Gravity) - Brett Dr	l.m.	412	$8,700	$3,584,400
	.4 375 mm Diameter PVC Pipe (Replacement and Gravity) - Bacon Pl & Barber Dr	l.m.	240	$8,100	$1,944,000
	.5 450 mm Diameter PVC Pipe (Replacement and Gravity) - Barber Dr	l.m.	197	$8,200	$1,615,400
	.6 525 mm Diameter PVC Pipe (Replacement and Gravity) - Barber Dr	l.m.	275	$8,300	$2,282,500
	.7 750 mm Diameter PVC Pipe (Replacement and Gravity) - Brett Dr	l.m.	197	$8,800	$1,733,600
	.8 900 mm Diameter PVC Pipe(Replacement and Gravity) - Brett Dr	l.m.	352	$8,900	$3,132,800
	.9 900 mm Diameter PVC Pipe (Green Field Construction and Gravity)	l.m.	1,542	$4,800	$7,401,600
	SUBTOTAL 1A				$26,346,400
1B	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.10 750 mm Diameter PVC Pipe (Replacement and Gravity) - Confederation Way	l.m.	1,284	$8,800	$11,299,200
	SUBTOTAL 1B				$11,299,200
1C	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 750 mm Diameter PVC Pipe (Replacement and Gravity) - Confederation Way	l.m.	437	$8,800	$3,845,600
	SUBTOTAL 1C				$3,845,600
2.0	DICKENSFIELD IMPROVEMENT				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 375 mm Diameter PVC Pipe (Replacement and Gravity) - Dickins Dr	l.m.	377	$8,100	$3,053,700
	.2 450 mm Diameter PVC Pipe (Replacement and Gravity) - Leigh Cr	l.m.	671	$8,200	$5,502,200
	.3 375 mm Diameter PVC Pipe (Replacement and Gravity) - McConachie Cr	l.m.	339	$8,100	$2,745,900
	SUBTOTAL 2.0				$11,301,800
3.0	CORNWALL DRIVE				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	95	$7,900	$750,500
	SUBTOTAL 3.0				$750,500
4.0	WOOD BUFFALO WAY IMPROVEMENT				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	111	$7,900	$876,900
	.2 375 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	87	$8,100	$704,700
	.3 450 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	277	$8,200	$2,271,400
	SUBTOTAL 4.0				$3,853,000
5.0	WESTWOOD DRIVE				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 375 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	118	$8,100	$955,800
	.2 450 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	219	$8,200	$1,795,800
	.3 525 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	118	$8,300	$979,400
	SUBTOTAL 5.0				$3,731,000

Table C-2 Cost Estimates for Proposed Upgrades

Cost Estimates

Client:
Regional Municipality of Wood Buffalo
Project:
RMWB Wastewater Master Plan
Subject:
Cost Estimates for Proposed Upgrades
Project Number:
20123694
Date:
May-14

Item	Description	Unit	Quantity	Unit Price	Cost
6.0	THICKWOOD PERIMETER TRUNK				
6A	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 450 mm Diameter PVC Pipe (New Construction and Gravity) - Romany St	l.m.	342	$4,000	$1,368,000
	.2 675 mm Diameter PVC Pipe (Green Field Construction and Gravity) - Thicket Dr	l.m.	234	$4,500	$1,053,000
	.3 750 mm Diameter PVC Pipe (Green Field Construction and Gravity) - Thicket Dr	l.m.	404	$4,500	$1,818,000
	.4 750 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	520	$8,800	$4,576,000
	.5 450 mm Diameter PVC Pipe (Green Field Construction and Force Main)	l.m.	349	$3,200	$1,116,800
	SUBTOTAL 6A				$9,931,800
6B	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 450 mm Diameter PVC Pipe (Green Field Construction and Gravity)	l.m.	812	$4,000	$3,248,000
	.2 300 mm Diameter PVC Pipe (Replacement and Gravity) - Silica Pl	l.m.	173	$7,900	$1,366,700
	SUBTOTAL 6B				$4,614,700
6C	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Green Field Construction and Gravity) - Signal Rd	l.m.	163	$3,800	$619,400
	.2 375 mm Diameter PVC Pipe (Green Field Construction and Gravity) - Signal Rd	l.m.	635	$3,950	$2,508,250
	.3 450 mm Diameter PVC Pipe (Green Field Construction and Gravity)	l.m.	1,402	$4,000	$5,608,000
	SUBTOTAL 6C				$8,735,650
7.0	MAIN STREET				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 250 mm Diameter PVC Pipe (Replacement and Gravity) - Fraser Ave	l.m.	200	$7,800	$1,560,000
	.2 375 mm Diameter PVC Pipe (Replacement and Gravity) - Main St	l.m.	20	$8,100	$162,000
	.3 450 mm Diameter PVC Pipe (Replacement and Gravity) - Main St	l.m.	272	$8,200	$2,230,400
	.4 450 mm Diameter PVC Pipe (New Construction and Gravity) - Main St	l.m.	350	$4,000	$1,400,000
	SUBTOTAL 7.0				$5,352,400
8.0	HAINEAULT STREET				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	188	$7,900	$1,485,200
	SUBTOTAL 8.0				$1,485,200
9.0	FATHER MERCREDI STREET				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Replacement and Gravity) - Franklin Ave & Alberta Dr	l.m.	532	$7,900	$4,202,800
	.2 450 mm Diameter PVC Pipe (Replacement and Gravity) - Franklin Ave	l.m.	111	$8,200	$910,200
	.3 525 mm Diameter PVC Pipe (Replacement and Gravity) - Father Mercredi St	l.m.	605	$8,300	$5,021,500
	.4 250 mm Diameter PVC Pipe (Replacement and Gravity) - Hill Dr	l.m.	161	$7,800	$1,255,800
	.5 300 mm Diameter PVC Pipe (Replacement and Gravity) - Hill Dr	l.m.	96	$7,900	$758,400
	SUBTOTAL 9.0				$12,148,700
10.0	BIRCH ROAD				
	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Replacement and Gravity) - Birch Rd	l.m.	419	$7,900	$3,310,100
	.2 375 mm Diameter PVC Pipe (Replacement and Gravity) - Centennial Dr	l.m.	89	$8,100	$720,900
	.3 250 mm Diameter PVC Pipe (Replacement and Gravity) - Centennial Dr	l.m.	110	$7,800	$858,000
	SUBTOTAL 10.0				$4,889,000

Table C-2 Cost Estimates for Proposed Upgrades

Cost Estimates		Client: Regional Municipality of Wood Buffalo Project: RMWB Wastewater Master Plan Subject: Cost Estimates for Proposed Upgrades Project Number: 20123694 Date: May-14			
Item	Description	Unit	Quantity	Unit Price	Cost
11.0	RAILWAY AVENUE Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 300 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	405	$7,900	$3,199,500
	SUBTOTAL 11.0				$3,199,500
12.0	GREGOIRE DRIVE Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 675 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	1,165	$8,700	$10,135,500
	SUBTOTAL 12.0				$10,135,500
13.0	MACKENZIE BOULEVARD Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering				
	.1 600 mm Diameter PVC Pipe (Replacement and Force Main)	l.m.	173	$6,800	$1,176,400
	.2 525 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	366	$8,300	$3,037,800
	.3 450 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	206	$8,200	$1,689,200
	.4 375 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	1,074	$8,100	$8,699,400
	.5 300 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	710	$7,900	$5,609,000
	.6 250 mm Diameter PVC Pipe (Replacement and Gravity)	l.m.	354	$7,800	$2,761,200
	SUBTOTAL 13.0				$22,973,000
14.0	MACKENZIE I/I REDUCTION 30% Contingency and 10% Engineering				
	.1 I/I Reduction Program	LS	1	$5,000,000	$5,000,000
	SUBTOTAL 14.0				$5,000,000
15.0	PRAIRIE CREEK LIFT STATION Supply and Install Pump, 30% Contingency and 10% Engineering				
	.1 Design Flow 15 L/s	LS	1	$5,000,000	$5,000,000
	SUBTOTAL 15.0				$5,000,000
16.0	GRAYLING TERRACE LIFT STATION Supply and Install Pumps, 30% Contingency and 10% Engineering				
	.1 Design Flow 16 L/s	LS	1	$500,000	$500,000
	SUBTOTAL 16.0				$500,000
17.0	LIFT STATION 1A Supply and Install Pump, 30% Contingency and 10% Engineering				
	.1 Design Flow 1,023 L/s	LS	1	$2,000,000	$2,000,000
	SUBTOTAL 17.0				$2,000,000
18.0	WOOD BUFFALO LIFT STATION Supply and Install Pumps, 30% Contingency and 10% Engineering				
	.1 Design Flow 63 L/s	LS	1	$500,000	$500,000
	SUBTOTAL 18.0				$500,000
	Upgrades required within 0 - 5 years TOTAL (1A + 1B + 2 + 4 + 6A + 6B + 6C + 10 + 12 + 13 + 14 + 15)				$124,080,050
	Upgrades required within 5 - 20 years TOTAL (1C + 3 + 5 + 7 + 8 + 9 + 11 + 16 + 17 + 18)				$33,512,900
	TOTAL				$157,592,950

Table C-3 Cost Estimates for Future Trunks

Cost Estimates

Associated Engineering

Client:
Regional Municipality of Wood Buffalo
Project:
RMWB Wastewater Master Plan
Subject:
Cost Estimates for Future Trunks
Project Number: 20123694
Date: Mar-14

Item	Description					Unit	Quantity	Unit Price	Cost
1.0	ABRAMS LAND								
1.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F1200	F1220	Gravity Main	450	l.m.	600	$4,000	$2,400,000
	.2	F1210	F1220	Gravity Main	450	l.m.	490	$4,000	$1,960,000
	.3	F1250	F1260	Gravity Main	350	l.m.	640	$3,900	$2,496,000
	SUBTOTAL 1.0								$6,856,000
2.0	WEST GROWTH								
2.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F1220	F1005	Gravity Main	600	l.m.	1,630	$4,200	$6,846,000
	.2	F1000	F1002	Gravity Main	350	l.m.	530	$3,900	$2,067,000
	.3	F1001	F1002	Gravity Main	375	l.m.	1,180	$3,950	$4,661,000
	.4	F1002	F1003	Gravity Main	600	l.m.	530	$4,200	$2,226,000
	.5	F1003	F1004	Gravity Main	600	l.m.	540	$4,200	$2,268,000
	.6	F1004	F1005	Gravity Main	675	l.m.	860	$4,500	$3,870,000
	.7	F1100	F1005	Gravity Main	350	l.m.	620	$3,900	$2,418,000
	.8	F1005	F1030	Gravity Main	900	l.m.	1,210	$4,800	$5,808,000
	.9	F1010	F1030	Gravity Main	250	l.m.	1,070	$3,700	$3,959,000
	.10	F1020	F1030	Gravity Main	450	l.m.	450	$4,000	$1,800,000
	.11	F1030	F1050	Gravity Main	900	l.m.	840	$4,800	$4,032,000
	.12	F1040	F1050	Gravity Main	525	l.m.	910	$4,100	$3,731,000
	.13	F1050	F1400	Gravity Main	1050	l.m.	610	$4,800	$2,928,000
	SUBTOTAL 2.0								$46,614,000
3.0	PARSONS CREEK								
3.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F1400	F1410	Gravity Main	1050	l.m.	1,560	$4,800	$7,488,000
	.2	F1410	SA90032	Gravity Main	1050	l.m.	570	$4,800	$2,736,000
	.3	F1420	F1440	Gravity Main	600	l.m.	2,260	$4,200	$9,492,000
	.4	F1430	F1440	Gravity Main	675	l.m.	1,110	$4,500	$4,995,000
	.5	F1440	F1450	Gravity Main	900	l.m.	540	$4,800	$2,592,000
	.6	F1450	SA90039	Gravity Main	900	l.m.	1,532	$4,800	$7,353,600
	SUBTOTAL 3.0								$34,656,600

Table C-3 Cost Estimates for Future Trunks

Cost Estimates

Associated Engineering

Client:
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Project:
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Cost Estimates for Future Trunks
Project Number: 20123694
Date: Mar-14

Item	Description					Unit	Quantity	Unit Price	Cost
4.0	MAJOR COMMERCIAL AND ECO-PARK								
4.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F1700	F1710	Gravity Main	350	l.m.	1,240	$3,900	$4,836,000
	.2	F1710	WWTP	Force Main	450	l.m.	2,220	$3,200	$7,104,000
4.2				Lift Station (68 L/s)					$6,500,000
	SUBTOTAL 4.0								$18,440,000
5.0	FOREST HEIGHTS								
5.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F2000	F2001	Gravity Main	250	l.m.	610	$3,700	$2,257,000
	.2	F2001	F2003	Gravity Main	375	l.m.	780	$3,950	$3,081,000
	.3	F2002	F2003	Gravity Main	300	l.m.	690	$3,800	$2,622,000
	.4	F2004	F2005	Gravity Main	250	l.m.	620	$3,700	$2,294,000
	.5	F2005	LS-FH	Gravity Main	350	l.m.	780	$3,900	$3,042,000
	.6	F2003	LS-FH	Gravity Main	525	l.m.	830	$4,100	$3,403,000
	.7	LS-FH	F2007	Force Main	450	l.m.	900	$3,200	$2,880,000
	.8	F2006	F2007	Gravity Main	350	l.m.	610	$3,900	$2,379,000
	.9	F2007	F2009	Gravity Main	675	l.m.	860	$4,500	$3,870,000
	.10	F2008	F2009	Gravity Main	350	l.m.	670	$3,900	$2,613,000
	.11	F2009	F2011	Gravity Main	750	l.m.	770	$4,500	$3,465,000
	.12	F2010	F2011	Gravity Main	350	l.m.	880	$3,900	$3,432,000
	.13	F2011	F2016	Gravity Main	750	l.m.	2,990	$4,500	$13,455,000
	.14	F2012	F2013	Gravity Main	350	l.m.	760	$3,900	$2,964,000
	.15	F2013	F2015	Gravity Main	450	l.m.	730	$4,000	$2,920,000
	.16	F2014	F2015	Gravity Main	250	l.m.	670	$3,700	$2,479,000
	.17	F2015	F2016	Gravity Main	525	l.m.	730	$4,100	$2,993,000
	.18	F2016	WWTP	Force Main	750	l.m.	2,250	$3,600	$8,100,000
5.2				Lift Station (227 L/s)					$10,700,000
	SUBTOTAL 5.0								$78,949,000
6.0	DRAPER VALLEY								
6.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F3000	LS-WW	Force Main	200	l.m.	4,900	$2,880	$14,112,000
6.2				Lift Station (9 L/s)					$6,500,000
	SUBTOTAL 6.0								$20,612,000

Table C-3 Cost Estimates for Future Trunks

Cost Estimates

Client:
Regional Municipality of Wood Buffalo
Project:
RMWB Wastewater Master Plan
Subject:
Cost Estimates for Future Trunks
Project Number: 20123694
Date: Mar-14

Item	Description					Unit	Quantity	Unit Price	Cost
7.0	SALINECREEK								
7.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F3500	AE0108	Gravity Main	350	l.m.	1,080	$3,900	$4,212,000
	.2	F3510	F3520	Gravity Main	300	l.m.	2,030	$3,800	$7,714,000
	.3	F3520	F3530	Gravity Main	525	l.m.	810	$4,100	$3,321,000
	.4	F3530	AE0111	Gravity Main	600	l.m.	580	$4,200	$2,436,000
	SUBTOTAL 7.0								$17,683,000
8.0	AIRPORT EAST INDUSTRIAL LANDS AND LYNTON								
8.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F4000	F4010	Gravity Main	525	l.m.	2,850	$4,100	$11,685,000
	.2	F4001	F4010	Gravity Main	450	l.m.	1,170	$4,000	$4,680,000
	.3	F4010	F4011	Gravity Main	675	l.m.	820	$4,500	$3,690,000
	.4	F4011	LS-AEI	Gravity Main	750	l.m.	750	$4,500	$3,375,000
	.5	F4020	F4021	Gravity Main	450	l.m.	1,460	$4,000	$5,840,000
	.6	F4021	LS-AEI	Gravity Main	675	l.m.	780	$4,500	$3,510,000
	.7	LS-AEI	F4030	Force Main	750	l.m.	2,620	$3,600	$9,432,000
	.8	F4030	F4040	Gravity Main	1050	l.m.	2,280	$4,800	$10,944,000
	.9	F4040	F4050	Gravity Main	1050	l.m.	1,830	$4,800	$8,784,000
	.10	F4050	LS-HW69	Gravity Main	1200	l.m.	570	$4,900	$2,793,000
	.11	LS-HW69	F5002	Force Main	900	l.m.	4,900	$3,840	$18,816,000
	SUBTOTAL 8.0								$83,549,000
9.0	SOUTHLANDS AREAS 1A AND 1B								
9.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F5000	F5010	Gravity Main	600	l.m.	2,170	$4,200	$9,114,000
	.2	F5010	F5020	Gravity Main	675	l.m.	1,460	$4,500	$6,570,000
	.3	F5020	F5100	Gravity Main	750	l.m.	980	$4,500	$4,410,000
	.4	F5050	F5060	Gravity Main	600	l.m.	2,380	$4,200	$9,996,000
	.5	F5060	F5070	Gravity Main	750	l.m.	1,880	$4,500	$8,460,000
	.6	F5070	F5100	Gravity Main	750	l.m.	1,240	$4,500	$5,580,000
	.7	F5100	LS-SL1	Gravity Main	1050	l.m.	290	$4,800	$1,392,000
	.8	LS-SL1	SWWTP	Force Main	750	l.m.	290	$3,600	$1,044,000
9.2				Lift Station (615 L/s)					$18,200,000
	SUBTOTAL 9.0								$64,766,000

Table C-3 Cost Estimates for Future Trunks

Cost Estimates

Associated Engineering

Client:
Regional Municipality of Wood Buffalo
Project:
RMWB Wastewater Master Plan
Subject:
Cost Estimates for Future Trunks
Project Number: 20123694
Date: Mar-14

Item	Description					Unit	Quantity	Unit Price	Cost
10.0	SOUTHLANDS AREA 4								
10.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	LS-PRC	LS-SL4	Gravity Main	300	l.m.	760	$7,900	$6,004,000
	.2	F6000	LS-SL4	Gravity Main	525	l.m.	380	$4,100	$1,558,000
	.3	F6001	LS-SL4	Gravity Main	350	l.m.	530	$3,900	$2,067,000
	.4	LS-SL4	F6002	Force Main	450	l.m.	190	$3,200	$608,000
	.5	F6002	SWWTP	Force Main	1050	l.m.	5,850	$3,840	$22,464,000
10.2				Lift Station (1137 L/s)					$19,300,000
	SUBTOTAL 10.0								$52,001,000
11.0	QUARRY RIDGE AND WEST MACKENZIE								
11.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
	.1	From MH	To MH	Type	Diameter (mm)				
	.2	F6500	LS-GM	Gravity Main	600	l.m.	240	$4,200	$1,008,000
	.3	LS-GM	SWWTP	Force Main	525	l.m.	6,940	$3,280	$22,763,200
11.1				Upgrade pumps					$500,000
	SUBTOTAL 11.0								$24,271,200
12.0	HANGINGSTONE								
12.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F7000	F7001	Gravity Main	675	l.m.	3,270	$4,500	$14,715,000
	.2	F7001	F7020	Gravity Main	900	l.m.	2,540	$4,800	$12,192,000
	.3	F7010	F7020	Gravity Main	900	l.m.	3,270	$4,800	$15,696,000
	.4	F7020	LS-HS	Gravity Main	1200	l.m.	840	$4,900	$4,116,000
	.5	LS-HS	SWWTP	Force Main	1050	l.m.	8,020	$3,840	$30,796,800
12.2				Lift Station (1004 L/s)					$19,300,000
	SUBTOTAL 12.0								$96,815,800
13.0	HORSE RIVER								
13.1	Supply and Install Pipe c/w Excavation, Manhole, Frame and Covers and Surface Restoration, 30% Contingency and 10% Engineering								
		From MH	To MH	Type	Diameter (mm)				
	.1	F8000	F8010	Gravity Main	473	l.m.	2,470	$4,000	$9,880,000
	.2	F8010	F8020	Gravity Main	598	l.m.	1,690	$4,100	$6,929,000
	.3	F8020	LS-HR	Gravity Main	725	l.m.	1,630	$4,500	$7,335,000
	.4	LS-HR	SWWTP	Force Main	528	l.m.	10,450	$3,280	$34,276,000
13.2				Lift Station (328 L/s)					$10,700,000
	SUBTOTAL 13.0								$69,120,000
	TOTAL								$614,333,600