KANATA Lakes

Report

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Design Brief
KNL Stage 9
Kanata Lakes North

IBI

Prepared for KNL Developments Inc.
by IBI Group

March 2018

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

List of Figures

FIGURES:

List of Appendices

Table of Contents (continued)

1 INTRODUCTION

1.1 Project and Site Description

Stage 9 of the KNL development in the Kanata Lakes area of Kanata North is a residential development consisting of single family lots and street townhouses. **Figure 1.1** shows the Stage 9 area which is located on the north side of the existing Beaver Pond stormwater management facility. The site is bounded by an existing railway line to the north, the Goulbourn Forced Road to the west, the Beaver Pond to the south and the Kizell Drain to the east. **Figure 1.1** also shows the location of the existing adjacent development and future Stages 7 and 8 of the Kanata Lakes development which are located northwest of the site.

This report deals with the design of water distribution, wastewater disposal, stormwater management and site grading for the proposed development. At the west end of the site the existing rural Goulbourn Forced Road will be realigned and upgraded to an urban roadway. At the east end the existing local collector road, Walden Drive will be extended from Kimmins Court through the Stage 9 site to connect with the realigned Goulbourn Forced Road.

1.2 Previous Studies

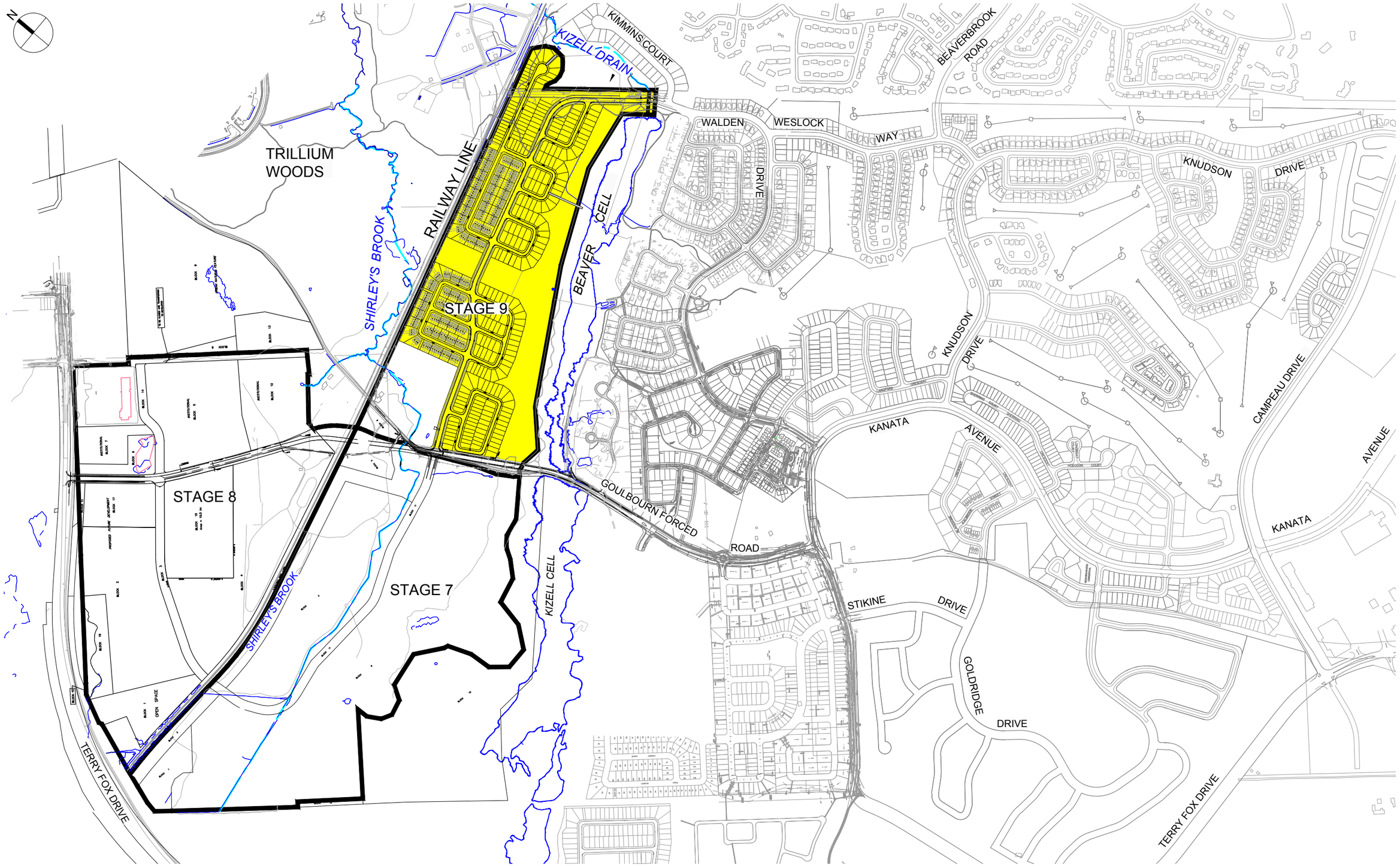
Design of this project has been undertaken in accordance with the following reports:

- **Kanata Lakes North Serviceability Study** prepared by IBI Group, June 2006 hereafter referred to as the Serviceability Study.
- **Goulbourn Forced Road Environmental Study Report, Kanata Avenue Environmental Study Report, Final Report, October 2007** prepared by Dillon Consulting Limited.
- **Kanata North Potable Water Servicing Analysis, March 15, 2016** prepared by Stantec Consulting Ltd.
- **Design Brief Goulbourn Forced Road Watermain, Keyrock Drive to Terry Fox Drive, Kanata Lakes North** prepared by IBI Group revised January 2017.
- **Kanata Lakes SWM Serviceability Study – Stage 9**, prepared by IBI Group, February 2017.
- **Geotechnical Investigation Residential Development Kanata Lakes – Phase 9**, Ottawa, Ontario prepared by Golder Associates, February 2017.

1.3 Geotechnical Considerations

In the geotechnical report identified in Section 1.2 the recommendations were based on the findings and observations from a combination of test pits, boreholes and auger holes completed between April 2012 and September 2016. Among other items, the report recommendations deal with:

- Site grading;
- Foundation design;
- Pavement structure;
- Seismic design;
- Basement excavation/backfill;
- Sewer and watermain construction;
- Frost protection;



J: \102101-KNLStg9\5.9 Drawings\59civil\current\Figures\102101base for figures.dwg Layout Name: FIGURE 1 Plot Scale: 1:5.13 Plotted At: 8/17/2017 Last Saved By: dsiurna Last Saved At: Feb. 15, 1

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	KNL STAGE 9 KANATA LAKES	LOCATION PLAN	FIGURE 1.1

- Tree considerations.

More precisely, the report notes site specific findings and provides recommendations which include but are not limited to the following:

- The maximum permissible grade raise for areas underlain by grey silty clay, assuming conventional backfill materials is 3.0 meters. As noted there are areas where the grade raise is exceeded. It is expected that lightweight fill in the building garage and porches will satisfy the grade raise restriction.
- A Permit To Take Water is expected to be required for this project.
- Impervious dykes or cut-off walls should be constructed at 100 meter intervals.
- Pavement structure:

All Roads in Bedrock Cut Sections

Wear Course	40 mm Superpave 12.5 mm asphaltic cement
Binder Course	50 mm Superpave 19.0 mm asphaltic cement
Base	150 mm OPSS Granular 'A' Crushed Stone
Sub-Base	300 mm OPSS Granular 'B' Type II

Local Road

Wear Course	40 mm Superpave 12.5 mm asphaltic cement
Binder Course	50 mm Superpave 19.0 mm asphaltic cement
Base	150 mm OPSS Granular 'A' Crushed Stone
Sub-Base	400 mm OPSS Granular 'B' Type II

Collector Road (Walden Drive)

Wear Course	40 mm Superpave 12.5 mm asphaltic cement
Binder Course	50 mm Superpave 19.0 mm asphaltic cement
Base	150 mm OPSS Granular 'A' Crushed Stone
Sub-Base	600 mm OPSS Granular 'B' Type II

Work on site should be performed under the supervision of a representative from Golder Associates where required.

2 WATER DISTRIBUTION

2.1 Existing Conditions

The Kanata Lakes North development including Stage 9 and Goulbourn Forced Road (GFR) are located within the **3W** water pressure zone. As part of the GFR realignment project, in 2011 a 400 mm watermain was extended from an existing 600 mm watermain on Kanata Avenue and capped at Keyrock Drive. As part of the current GFR realignment project the 400mm watermain will be extended to Terry Fox Drive. Another 400 mm watermain is capped on Walden Drive at Kimmon's Court east of Beaver Pond as part of the Campeau Corporation Kanata Lakes – 'The Pines' development in 1987.

2.2 Master Servicing Study

In the 2006 Serviceability Study, a 600 mm diameter watermain was proposed for the GFR; a population demand of 5000 persons for Morgan's Grant was to be supplied through Kanata Lakes, thus the need for a large watermain. The Serviceability Study also shows a 400mm through Stage 9 with a 300mm watermain extended north across the railway to connect to Solandt Road.

The Kanata North Potable Water Servicing Analysis was recently completed by Stantec Consulting. This analysis was conducted for the Kanata Lakes North development area and included recommendations for watermains on the GFR and Stage 9. In the Stantec report, the recommended watermains on the GFR is 400 mm and on Walden Drive through Stage 9 it is a 300 mm main.

2.3 Design Criteria

2.3.1 Water Demands

Water demands have been calculated for all of Kanata Lakes North Stage 9, the demands are based on Table 4.2 – Consumption Rates for Subdivision of 501 to 3,000 persons of the Ottawa Design Guidelines – Water Distribution. Residential units in Stage 9 consist of single family and street townhouses, an allowance for development north of the site is included in accordance with the Serviceability Study. Water demands for Kimmins Court and the Kanata Rockeries development are included. A watermain demand calculation sheet is included in **Appendix A** and the total water demands are summarized as follows:

Average Day	6.28 l/s
Maximum Day	15.63 l/s
Peak Hour	34.35 l/s

2.3.2 System Pressure

The 2010 City of Ottawa Water Distribution Guidelines state that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.

Maximum Pressure — Maximum pressure at any point in the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls may be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

2.3.3 Fire Flow Rates

In the recent Technical Bulletin 'ISDTB-2014-02, Revisions to Ottawa Design Guidelines – Water', the fire flow requirements for single detached dwellings and traditional town and row houses can be capped at 10,000 l/min providing that there is a minimum separation of 10 meters between the backs of adjacent units and that the town and row house blocks are limited to 600 square meters of building areas and seven dwelling units. As the residential units in Kanata Lakes North Stage 9 meet the requirements of ISDTB-2014-02, the fire flow rate of 10,000 l/min (166.7 l/s) is used in the fire flow analysis.

2.3.4 Boundary Conditions

The City of Ottawa has provided hydraulic boundary conditions at two locations in the existing Kanata Lakes Development. The boundary conditions are at the 400mm watermain on the GFR at Keyrock Drive and on Walden Drive at Hansen Avenue. A copy of the boundary condition is included in **Appendix A** and summarized as follows:

	CONNE-1 GFR AT KEYROCK	CONNE-2 HANSEN AT WALDEN
Max HGL (Basic Day)	161.5 m	161.4 m
Peak Hour	158.3 m	158.3 m
Max Day + Fire (167 l/s Fire Flow)	155.0 m	153.0 m
Max Day + Fire (217 l/s Fire Flow)	153.3 m	150.2 m

2.3.5 Hydraulic Model

A computer model for the Kanata Lakes North Lands has been developed using the H2O MAP version 6.0 program produced by MWH Soft Inc. Boundary conditions Conne-1 GFR at Keyrock Drive and Conne-2 Hansen at Walden Drive at the east end of the Beaver Pond are incorporated into the model.

2.4 Proposed Water Plan

2.4.1 Modeling Results

The hydraulic model was run under basic day, maximum day with fire flows and under peak hour conditions. Water pipes are sized to provide sufficient pressure and to deliver the required fire flows. A 300 mm diameter watermain is proposed on Walden Drive from the existing 400mm watermain at Kimmins Court, through the development connecting to the 400mm watermain that will soon be constructed on the GFR in accordance with the Kanata North Potable Water Servicing Analysis conducted by Stantec Consulting. A 300mm watermain is proposed on Tamworth Street and the serviceing blocks which will end at the railway for future extension to the existing 400mm watermain on Solandt Road per the Serviceability Study. All other mains in the development are tested at the minimum 150mm size, while the pressure criteria is met with the minimum pipe size,

the fire flow requirement is not achieved at all locations. The main sizes are increased in an interactive process until the fire flow requirement is satisfied.

Results of the hydraulic model are include in **Appendix A** and summarized as follows:

Scenario	Results
Basic Day (Max HGL) Pressure Range	569.0 to 688.7 kPa
Peak Hour Pressure Range	532.5 to 646.9 kPa
Max Day + 167 l/s Fire Flow Minimum Flow	160.9 l/s

A comparison of the results and design criteria is summarized as follows:

Maximum Pressure	All nodes in Stage 9 have pressures exceeding 552 kPa (80 psi) which require pressure reducing control at the residential units. The highest pressure is close to matching the maximum allowable value of 689 kPa (100 psi). The high pressure is due to the topography of the site; at the east end of Stage 9, the lowest road elevation is 91.00 which compares to the highest elevation of 116.30 in future Stage 7.
Minimum Pressure	All nodes in the model exceed the minimum value of 276 kPa (40 psi).
Fire Flow	Under the fire flow analysis, there is one node at 160.9 l/s which is marginally under the 167 l/s requirement, all other nodes in Stage 9 exceed the requirement.

2.4.2 Watermain Layout

As stated in Section 2.4.1 a 300mm watermain will be installed on Walden Drive from the existing 400mm main at Kimmins Court to the 400mm main that is planned to be constructed on the GFR. The Walden Drive main is the spine supplying water to all the streets in Stage 9. A 300mm main is placed on Tamworth Street for future extension to land north of the railway. On Briarpath Court a 200mm watermain is planned with a 50mm loop at the cul-de-sac. All other mains in Stage 9 are 150mm, on Akamina Circle a connection to the GFR watermain is required for looping purposes.

3 WASTEWATER SYSTEM (SANITARY SEWERS)

3.1 Existing Conditions

The KNL Stage 9 lands along with the future Stage 7 and 8 lands are all tributary to the existing 750mm Marchwood Lakeside Trunk Sanitary Sewer located east of the site starting at Kimmins Court. Currently the sanitary flows from the existing Kanata Lakes development outlets through a 675mm sanitary sewer on Kimmins Court to the Marchwood Lakeside trunk sewer.

3.2 Master Servicing Study

In the 2006 Serviceability Study, a 450 mm sanitary sewer is shown through Stage 9 outletting to the Marchwood Lakeside trunk sewer at the north end of Kimmins Court. The drainage area for the Stage 9 sanitary sewer includes the future Stages 7 and 8 and two external areas. The external area west of Stage 7, identified as EX2 in the Serviceability Study, is the Kanata Highlands site, population and drainage area information is taken from the "Functional Servicing Report for the Kanata Highlands" by DSEL December 20, 2016. External area EX3 is located north of the railway and will drain into Stage 9 at Tamworth Street and Briarpath Court.

A copy of the sanitary drainage area plan and sanitary sewer design sheets from the Serviceability Study is included in **Appendix B**.

3.3 Design Criteria

Sanitary Sewer design criteria used to evaluate sanitary draining from Stage 9 is as follows:

Population	3.4 persons per single family unit
	2.7 persons per townhouse unit
Domestic Flow:	350 L/p/d
Domestic Peak Factor:	Harmon Formula
Institutional and Commercial:	50,000 L/Ha/d
Institutional and Commercial Peak Factor:	1.5
Extraneous Flow:	0.28 L/s/Ha
Minimum Pipe Size:	200 mm diameter
Maximum Velocity	3.0 m/s
Minimum Velocity	0.6 m/s

A copy of the sanitary sewer design sheets and sanitary drainage area plans for Stage 9 is included in **Appendix B**.

3.4 Recommended Wastewater Plan

A 450mm sanitary sewer is proposed along Walden Drive from the Goulbourn Forced Road for future extension into Stages 7 and 8. The 450 mm sewer will travel along Tamworth Street and Briarpath Court and extend east to connect to the existing Marchwood Lakeside trunk sewer at the north end of Kimmins Court. A 300 mm sanitary sewer is proposed in a servicing block at the north end of Tamworth Street for future flow north of the railway per the Serviceability Study. All other sanitary sewers in Stage 9 are 200mm.

The peak sanitary sewer design flow for Stage 9 along with future Stages 7 and 8 and the external areas is calculated at 200.78 l/s while in the Serviceability Study, the corresponding peak design flow is 190.05 l/s. with the flows from Kimmins Court to the Marchwood Lakeside sewer has an available capacity of 14.3%.

The obvert of the Marchwood Lakeside collector sewer is seven meters below the lowest underside of footing elevation in Stage 9.

4 STORMWATER SYSTEM (STORM SEWERS)

4.1 Existing Conditions

Stage 9 is located beside the Beaver Cell of the Beaver Pond Stormwater Management Facility and an existing railway line to the north. At the north-west corner of the site, Shirley's Brook crosses the Goulbourn Forced Road and the railway line and at the east end the Beaver Pond outlets to the Kizell Drain which runs between the site and Kimmins Court. Topography of the site is very rugged with large rock outcrops throughout the site.

4.2 Master Servicing Study

In the 2006 Serviceability Study it was proposed that storm sewers for all the residential lands in Stage 9 including external lands north of the railway drain into the Beaver Pond. Storm drainage direction has since been revised in the 2017 SWM Serviceability Study. The lands at the west side of Stage 9 are now directed to Shirley's Brook while at the north east corner of Stage 9 the storm drainage outlets into the Kizell Drain. There is no allowance for drainage from external lands north of the railway.

4.3 Design Criteria

Storm sewer design criteria used to evaluate storm drainage from the collector roadway and school site is as follows:

Runoff Coefficients	-	Collector Roads	0.60
	-	Single Family	0.73 front yards
			0.50 rear yards
	-	Townhouses	0.76 front yards
			0.53 rear yards
	-	Existing Ground	0.25
Rainfall Return Period	-	2 years	local roads
	-	5 years	collector roads
	-	100 years	Newstead Cres, Hummock Way & Kitigan Street
Initial Time of Concentration	-	10 minutes	
Minimum Velocity	-	0.80 m/s	
Maximum Velocity	-	3.00 m/s	

A calculation is included in **Appendix C** supporting the runoff coefficients for the residential lands and collector roads. The runoff coefficients are based on zoning minimum set-backs and maximum driveway widths for an average of lot widths and townhouse units. Storm drainage area plans and storm sewer design sheets for Stage 9 are also included in **Appendix C**.

A separate storm sewer design sheet is included in **Appendix C** which compares the rational method flow for each drainage area with the inlet control device (ICD) flows contributing to the same drainage areas, this design sheet will be referred to as the comparison design sheet while the traditional storm sewer design sheet is referred to as the rational method design sheet. The 2 year rational method flow (5 year flow on Walden Drive) is calculated for each individual drainage area as shown on the storm sewer drainage area plan with a ten minute time of concentration.

The ICD flow is also provided for the same corresponding drainage area. The ICD flow is based on standard size orifices used in the catch basins with a head based on the top of grate elevation i.e. no surface ponding.

There can be several drainage areas contributing to a storm sewer however the comparison is between the individual drainage areas and the catch basin ICD's which are receiving the flows. On the comparisons design sheet it shows that all 2 year rational methods flows in the rear yard drainage areas are less than the ICD flow at the rear yard catch basins which demonstrates that the 2 year flow is being captured without any surface ponding.

On the roadway where there is a continuous grade the flow entering the street catch basins is restricted to the inlet capacity of the grate on the continuous slope. On the comparison design sheet the flow that is captured in the street CB's is calculated based on approach/capture curves while the amount that overflows the CB's is carried to the downstream the CB's in a road sag. In the rational method design sheet the flow on the continuous grade is assumed to enter the pipe without overflow and the storm sewer is sized based on this flow and not the reduced captured flow. In the comparison design sheet the overflows are added to the downstream flows in the Combined Rational Flow at Sags column which can be compared to the ICD flows at the sag locations.

As shown on the combined design sheet the ICD flows exceed the combined rational flows to demonstrate that there is no ponding at the 2 year event (5 year for Walden). There are 4 places where the rational flow exceeds the ICD flow by 1.6 to 3.9 l/s. As this exceedance is approximately 2% of the total flow at these locations it is not considered significant and is due to the use of standard ICD sizes.

An example of the overflow calculation on the comparison design sheet can be provided at Akamina Circle. Pipe run MH124 to MH125 has the rear yard drainage area 124B which produces a 2 year rational method flow of 10.68 l/s which compares with the ICD flow of 16 l/s in RYCB2 which receives the rear yard flow. The street segment drainage area 124A for this pipe run generates a 2 year rational flow of 73.26 l/s that is assigned to CB127 and CB128 that are on a continuous road grade. The catch basin capture for these CB's with the 2 year flow has been calculated at 25.0 l/s based on approach/capture curves. The 25.0 l/s capture results in an overflow of 48.26 l/s which is added to drainage area 123A in the pipe run MH 123 to MH 124. The combined rational flow at the corresponding road sag for drainage area 123A is 119.96 l/s while the total ICD flows for CB129A, 129B, 130A and 130B is 194.0 l/s at the top of grate elevation. With the combined catch basin ICD flows exceeding the combined rational flow at this sag location there is no surface ponding during the 2 year event. Please note that the total rational flow for pipe run MH123 to MH124 including the overflow from area 124A is 138.11 l/s and the capacity of the 450 mm diameter storm sewer is 188.11 l/s.

At the continuous road grade in the example above CB127 and CB128 captures 25.0 l/s of the 73.26 l/s 2 year flow while the ICD's in the CB's are sized to 38.0 l/s. The ICD's chosen at this location are standard sized ICD's with a flow rate above the 2 year capture. Theoretically the ICD's at this location could be sized to match the larger rational method flow rather than the captured flow, however during a much larger storm event more water could enter the catch basin and thus more could enter the pipe which could increase the HGL in the system more than expected. It is good engineering practice to limit the ICD flows in the CB's on continuous grade to protect the minor system while meeting the ponding objectives for 2 year storms. With the ICD's in place the major system is analysed during the 100 year event to ensure the velocity and depth criteria is met.

4.4 Recommended Stormwater Plan

Stormwater drainage for the project is separated into four areas based on the storm outlets.

4.4.1 Shirley's Brook

As shown in the 2017 SWM Serviceability Study the west end of the Stage 9 site is tributary to Shirley's Brook. Storm drainage from Akamina Circle, a portion of Walden Drive and a section of the Goulbourn Forced Road outlets directly into Shirley's Brook on the north side of Walden Drive. Drainage from the Goulbourn Forced Road is in accordance with the current design brief identified in Section 1.2. The north storm sewer stub at Goulbourn Forced Road is sized to accommodate a future grade separation over the railway so that the drainage area extends to the future railway crossing.

It is proposed to provide water quality treatment in a Vortechs Unit located in the storm sewer outletting into Shirley's Brook. The following table outlines the criteria provided to Contech Engineering Solutions LLC for sizing of the Vortech Unit.

Table 1 – Information Provided to Contech for Vortechs Unit Sizing – Shirley's Brook

INFORMATION PROVIDED TO CONTECH	
Location	Ottawa, Ontario, Canada
Area (ha)	5.00 ha
Impervious (%)	54%
2-5 year flow (l/s)	546.2
100 year flow (l/s)	680.0
TSS Removal	80% (Enhanced Level of Protection)
Pipe diameter (mm)	750

Contech has proposed a Vortechs on-line 16000 unit to protect the stormwater flow. Location and details for the Vortechs unit are shown on the design drawings and **Appendix C**.

4.4.2 Beaver Pond – Burrard Crescent

The majority of the residential lands in Stage 9 outlets through a block at Burrard Crescent to the Beaver Pond. In accordance with the 2017 SWM Serviceability report the storm sewers on Newstead Crescent and Hummock Way are sized to capture the 100 year flow. Due to the site topography it is not feasible to direct the major system flow to the Beaver Pond so that the 100 year capture is required on these streets.

An energy dissipater will be located within the Beaver Cell. The energy dissipator consists of a basin at the outlet of the storm sewer headwall constructed with rip rap for a length of 30 meters and with a bottom elevation of 90.50 meters. The basin is surrounded by a permeable rock berm that extends to a top elevation of 92.00 meters. The berm will be constructed with 2H:1V side slopes and will be comprised of blast-rock ranging in size from 450 mm to 600 mm. The basin allows for the dispersion of minor flow discharging to the Beaver Cell by dissipating energy through the permeable rock berm to the normal water level of the Beaver Cell which is at elevation 90.45.

While the Beaver Pond is a stormwater quality treatment facility a Vortech unit is proposed to be constructed on the storm outlet pipe to reduce sediment loading on the energy dissipator.

4.4.3 Kizell Drain

Due to the low existing grades at the north east corner of the Stage 9 site it is not feasible to raise the streets to drain to the Beaver Pond due to conflicts with overhead power lines and the adjacent railway and grade raise restrictions. A storm sewer outlet is proposed at the east end of Briarpath Court which drains into the Kizell Drain. Storm drainage from Briarpath Court, and the rear yards of Kitigan Street adjacent to the railway will outlet into the Kizell Drain. As the major system for

Kitigan Street is tributary to Briarpath Court, the storm sewers on Kitigan are sized to capture the 100 year flow in order to minimize flows to the Kizell Drain.

It is proposed to provide water quality treatment in a Vortechs Unit located in the storm sewer in the cul-de-sac of Briarpath Court. The following table outlines the criteria provided to Contech Engineering Solutions LLC for sizing the Vortechs Unit.

Table 2 – Information Provided to Contech for Vortechs Unit Sizing – Kizell Drain

INFORMATION PROVIDED TO CONTECH	
Location	Ottawa, Ontario, Canada
Area (ha)	4.26 ha
Impervious (%)	52%
2 year flow (l/s)	427.0
100 year flow (l/s)	540.0
TSS Removal	80% (Enhanced Level of Protection)
Pipe diameter (mm)	675

Contech has proposed a Vortechs on-line 11000 unit to protect the stormwater flow. Location and details for the Vortechs unit are shown on the design drawings and **Appendix C**.

4.4.4 Beaver Pond – Walden Drive

At the east end of the site, Walden Drive ties into the existing Walden Drive roadway adjacent to Kimmin's Court. The road grades are too low to provide a storm sewer that drains into the main Beaver Pond outlet described in **Section 4.4.2**. As this drainage area is relatively small, containing four street catchbasins, and a small area of existing natural land which would be trapped by Walden Drive, it is proposed to outlet the storm flow directly in the Beaver Pond through a 300mm storm sewer.

5 STORMWATER MANAGEMENT

5.1 Background

Kanata Lakes and its recipient stormwater facility, the Beaver Pond, are located within the old City of Kanata. IBI Group has been retained by KNL Developments Inc to evaluate and design the post-development stormwater solution for the final three stages (Stages 7, 8, and 9) of the development area in Kanata Lakes. These three stages are located between the existing stormwater management system, referred to as the Beaver Pond, and Terry Fox Drive to the north.

Although this stormwater management system is commonly referred to as the Beaver Pond, it is actually a two celled stormwater management pond. These two cells, called the Beaver Cell and Kizell Cell, act in series and are separated by Goulbourn Forced Road. This system outlets to the Kizell Drain through an outlet structure in Walden Drive at the east end of the Beaver Pond.

The subject site (Stage 9) is located between the Beaver Cell of the Beaver Pond, and the railway line to the north. It is bounded on the east by Walden Drive and on the west by Goulbourn Forced Road.

5.1.1 Synopsis of Previous Reports

5.1.1.1 Existing Conditions

In 2015, the City concluded their study of the Watt's Creek (Kizell Drain) Shirley's Brook watershed and approved an Existing Conditions Report (*Shirley's Brook and Watt's Creek Phase 2 Stormwater Management Study*, AECOM, April 2015). This report is herewith referred to as the 2015 Phase 2 Report.

The existing conditions Upper Kizell Drain model presented in the 2015 Phase 2 Report for single events was converted to a continuous model in 2015 (*Continuous Modeling of Beaver and Kizell Ponds Under Existing Conditions*, JFSA, September 2015). This report is herewith referred to as the 2015 Continuous Modeling Report. The continuous model was calibrated and verified using monitored data from the Beaver Pond. Excluding parameters specific to continuous modeling, the drainage areas, connectivity, and parameters remain unchanged from those in the single-event model.

The 2015 Phase 2 report (single-event models) and the 2015 Continuous Modeling report should be referred to with respect to the establishment of existing conditions drainage areas and parameters.

5.1.1.2 Interim and Post-Development Conditions

In March 2016, IBI Group prepared the report entitled *Stage 7, 8 and 9 Kanata Lakes Stormwater Management Requirements* that outlined several alternatives for servicing the future lands within the Beaver Pond complex. The post-development alternatives considered attempted to accommodate the stormwater management strategy as it was originally developed in the 1980's, retrofitted in the 1990's, and approved at the OMB to minimize the impact to the overall development, as well as accommodating the constraints which have recently been imposed by the City such as the PSW designation and the update of the total precipitation for the 100 year design storm from 88.6 mm to 106.7 mm. The report provides a description of the stormwater management alternatives considered as well as outlining assumptions and restrictions. The generally preferred alternative for interim conditions is Alternative 6. In this alternative, Stage 9 is developed while Stage 7 and 8 remain undeveloped.

In September 2016, IBI Group submitted the *Goulbourn Forced Road Watermain Keyrock Drive to Terry Fox Drive Design Brief*. Appendix F of that report design the SWM facility infrastructure within Goulbourn Forced Road.

In February 2017, IBI Group submitted the *SWM Serviceability Study – Stage 9* Report. That report outlined the overall stormwater management for the approximately 31 ha of the Stage 9 new development.

In March 2017, IBI Group submitted the March Road Culvert Replacement Design Brief. That report evaluated the replacement of the March Road culvert and the removal of the K4 culvert located in the vicinity of Nordion.

In November 2017, the MVCA completed the Watts Creek/Kizell Drain Flood Plain Mapping Study and the Shirley's Brook Flood Plain Mapping Study.

In December 2017, IBI Goup submitted the Kanata Lakes – Realignment of *Shirley's Brook Application* to the MVCA. That report documented the proposed realignment of Shirley's Brook.

5.1.2 Interim versus Ultimate Stormwater Management Solution

The interim drainage scheme consists of the development of Stage 9. The development of Stage 9 will be tributary to Beaver Pond, Shirley's Brook, and Kizell Drain as discussed in **Section 4**. Additional storage in the Beaver Pond is not required to provide the necessary quantity treatment to build out Stage 9. The SWM facility infrastructure within Goulbourn Forced Road also forms part of the interim conditions as well as the realignment of Shirley's Brook.

Ultimate post-development conditions consist of the development of Stages 7, 8, and 9. The generally preferred alternative for ultimate conditions is Alternative 5 (IBI Group, March 2016). This alternative assumes that the release rate from the Beaver Pond to Kizell drain, at Walden Drive, can be increased sufficiently to allow Stages 7, 8 and 9 to outlet to the Beaver Pond with no additional expansion required to the Beaver Cell.

5.2 Objective

The purpose of this evaluation is to prepare the dual drainage design, including the minor and major system, for the KNL Stage 9 development. The design includes the sizing of inlet control devices, maximum depth and velocity of flow on the surface, hydraulic grade line analysis and confirmation of the function of the existing Beaver Pond SWM facility.

5.3 Stormwater Management Design

5.3.1 Overview

The proposed Stage 9 development area has been modeled in detail to satisfy current City of Ottawa design criteria. The detailed model for the Stage 9 development has been incorporated with the Upper Kizell model from the 2015 Continuous Modeling Report.

The future north section of Goulbourn Forced Road has been modelled in accordance to **Section 4.4.1**.

5.3.2 Dual Drainage Design

The dual drainage system for the site tributary to Beaver Pond accommodates both major and minor stormwater runoff. During frequent storms, the effective runoff collected by catchment areas is directly released via catchbasin inlets into the network of storm sewers, called the minor system. During less frequent storms, the balance of the flow (in excess of the minor flow) is accommodated by a system of rear yard swales and street segments called the major system. The main advantage of this arrangement is its ability to adjust the rate of total inflow into the minor. The required total

inflow is typically maintained by the restriction of the capacity and the density of the inlets directly connected into this system. As noted above, this accommodation is achieved by the direct conveyance of the flow to a recipient and/or the attenuation on catchment surfaces called on-site detention.

The subject site was designed with dual drainage features, accommodating minor and major system flow. A sawtooth design is applied to street segments where possible to facilitate ponding in street sags or low points within the major system.

Inlet control devices are proposed to minimize the surcharge in the minor system during infrequent storm events and maximize use of available on-site storage. The minor system capture of ICDs is based on the required level of service, which is approximately equivalent to the 2 or 5 year storm event in residential development (refer to OSDG Guidelines) for individual catchments. Following discussions with the City, it was determined that for this site, the greater of the rational method flow (10 minute inlet time) or the simulated catchment flow would be used as the minor system capture rate. The balance of the surface flow not captured by the minor system will be conveyed via the major system.

The dual drainage system has been evaluated using the SMWHYMO hydrologic model, while the minor system hydraulic grade line analysis has been evaluated using the XPSWMM dynamic model.

5.3.2.1 Major System

The major system outlets are described in detail in **Section 4.4** and are shown on **Drawings 750 and 751**. There are three (3) overland flow drainage routes to:

- Beaver Pond,
- Shirley's Brook, and
- Kizell Drain.

The major system was evaluated with SWMHYMO and is discussed in **Section 5.4**.

5.3.2.2 Minor System

As show on **Drawings 750 and 751**, there are three (3) trunk sewers for Stage 9 outletting to:

- the stormwater management facility,
- Kizell Drain, and
- Shirley's Brook.

Minor flow generated by Stage 9 is tributary to the stormwater management facility via the proposed trunk sewer which outlets to the Beaver Cell. The minor system was designed to convey flows (up to the ICD restriction) to this stormwater management facility. The cul-de-sac in the north-east portion of the site does not tie into existing stormwater infrastructure and outflows to the Kizell Drain. To respect the drainage boundary for lands naturally draining to Shirley's Brook, a portion of the site has a trunk sewer which drains to Shirley's Brook.

The minor system analysis was evaluated with XPSWMM and is discussed in **Section 5.5**.

5.3.3 Design Criteria and Guidelines

The evaluation takes into consideration the City of Ottawa Sewer Design Guidelines (OSDG) (October 2012) and the February 2014 Technical Bulletin ISDTB-2014-01. Where applicable, the September 2016 Technical Bulletin PIEDTB-2016-01 has been considered.

Consistent with the September 2016 Technical Bulletin, the approach taken in the evaluation of the site's major system and sizing of ICDs to protect the minor system includes the following:

- Evaluation of all local streets using the 2 year storm event and providing full capture with no ponding utilized during the storm event.
- Evaluation of the collector road (Walden Drive) using the 5 year storm event and providing full capture without ponding during the storm event.
- Evaluation of the major system for the entire site using the 100 year storm event and adjusting minor system inflow as to not exceed 0.35 m of total storage depth (static + dynamic).
- Evaluation of the major system for the entire site using the 100 year + 20% storm event and check that the depth of cascading flow remains below the lowest building envelope.
- Evaluation of the minor system and check that the 0.3 m freeboard between USF and hydraulic grade line is met during the 100 year storm event.
- Evaluation of the minor system and check that the hydraulic grade line remains below the USF during the 100 year +20% storm event.

In addition to the criteria from the OSDG and Technical Bulletins, there is one limitation with respect to capture on-site. The portion of the site tributary to the culvert at Shirley's Brook rail line will have the 100 year flow fully captured in the minor system.

Further to the OSDG and the February 2014 and September 2016 Technical Bulletins, the City has requested that standard ICD sizes be used for the entire site (83 mm, 94 mm, 102 mm, 108 mm, 127 mm, 152 mm, 178 mm). The size of ICD has been selected to ensure that there is no ponding on the local and collector streets during the 2 year and 5 year storm events, respectively. In all instances, there is no storage utilized by the end of the design storm events.

5.3.4 Summary of Model Output Files

For ease of review, the model output file names and corresponding storm events are listed below. Model files are provided on the accompanying CD.

Stage 9 Interim Development Models:

Upper Kizell - SWMHYMO Model Files

- B_Stg9.dat/out (multi-run storm IDs noted in brackets)
    - 25 mm 4 hour Chicago (Storm.001)
    - 2, 5, 100 year, 24 hour SCS Type II (Storm.030, Storm.031, Storm.120)
    - 2, 5, 100 year, 3 hour Chicago (Storm.040, Storm.041, Storm.045)
    - July 1979 Historical storm event (Storm.080)
    - 100 year + 20%, 24 hour SCS Type II (Storm.121)
    - 100 year + 20%, 3 hour Chicago (Storm.090)
    - July 21, 2009, March Road Pumping Station Rain Gauge (Storm.129)
- Stg9VxD:dat/out (velocity by depth)

Upper Kizell - XPSWMM Model Files

- 102101_Stage9_C4H25M10.xp (25 mm 4 hour Chicago)
- 102101_Stage9_S2400212.xp (2 year, 24 hour SCS Type II)
- 102101_Stage9_S2400512.xp (5 year, 24 hour SCS Type II)
- 102101_Stage9_S2410612.xp (100 year, 24 hour SCS Type II)

- 102101_Stage9_C3H00510.xp (5 year, 3 hour Chicago)
- 102101_Stage9_C3H10010.xp (100 year, 3 hour Chicago)
- 102101_Stage9_HJU79.xp (July 1979 Historical storm event)
- 102101_Stage9_S2412612.xp (100 year + 20%, 24 hour SCS Type II)
- 102101_Stage9_C3H12010.xp (100 year + 20%, 3 hour Chicago)
- 102101_Stage9_20090724.xp (July 21, 2009 Historical storm event)

5.4 Hydrological Analysis

Hydrological analysis of the proposed dual drainage system of the subject site was conducted using SWMHYMO. The detailed model for the Stage 9 development has been incorporated with the Upper Kizell model from the 2015 Continuous Modeling Report.

Land use, selected modeling routines, and input parameters are discussed in the following sections. A drainage area plan is presented on **DRWG 500** and **501**. The SWMHYMO drainage area schematic is presented on **DRWG 750 and 751** respectively. The overall SWMHYMO model schematic is presented in **Figure 5.1**. The detailed SWMHYMO schematic for Stage 9 is presented in **Figure 5.1A**. Model files are included in **Appendix D**.

The hydrological analysis evaluates the surface flow and ponding conditions during the 100 year storm event in order to satisfy City of Ottawa Sewer Design Guidelines (October 2012) in terms of velocity by depth. Two and five year simulations were performed to ensure that after the storm is over there will be no ponding on the local and collector streets respectively. The parameters used to model the subject site are presented in **Section 5.4.1**.

5.4.1 Design Parameters

Stormwater modeling parameters for the future areas were developed based on the City of Ottawa approved parameters and conclusions from the 2015 Phase 2 Report in addition to the 2015 Continuous Modeling Report.

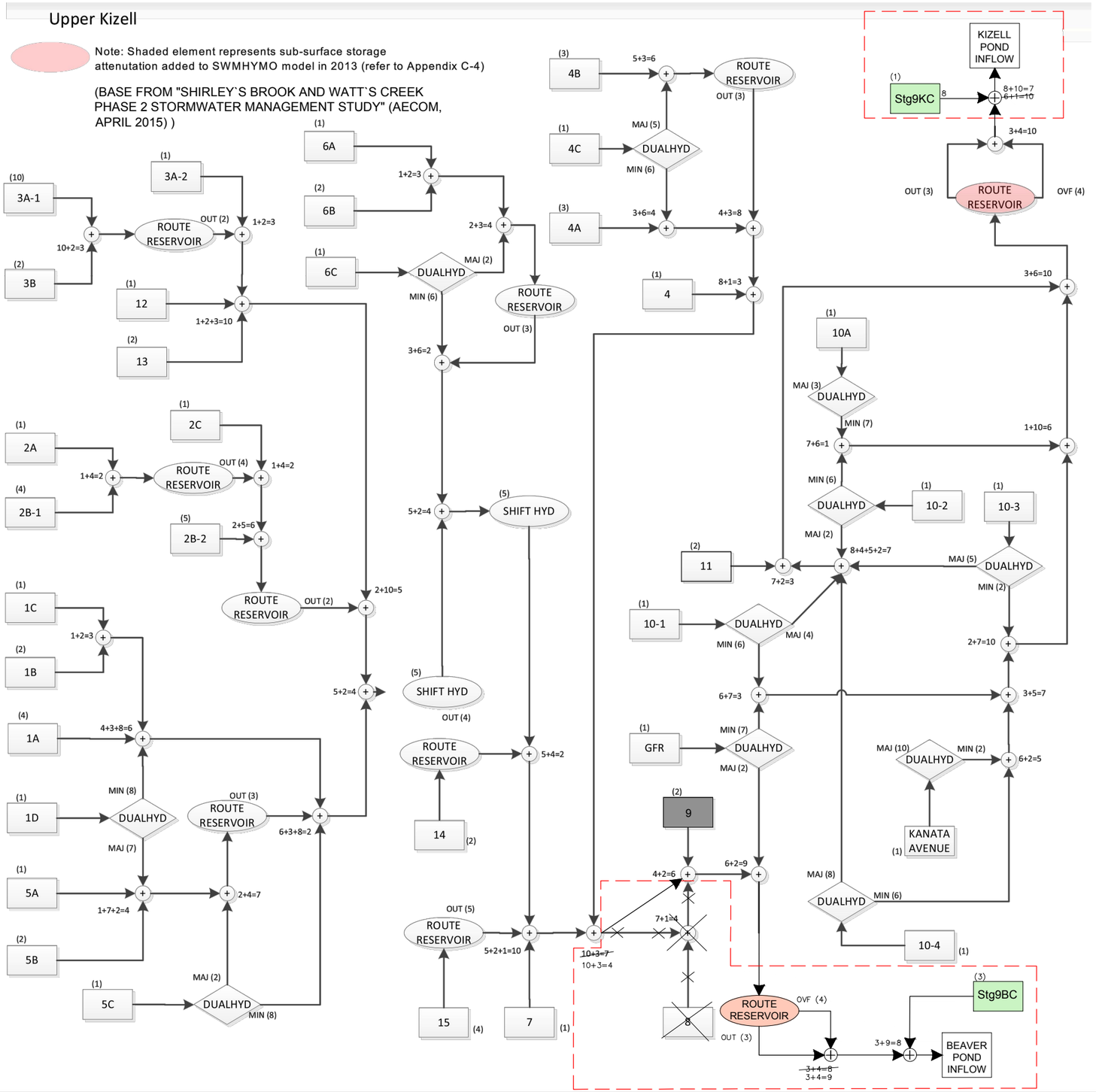
Parameters of existing areas tributary to the Beaver Pond remain unchanged with the exception of Area 9. This area was increased based on the updated legal plan to account for the rural area north of Beaver Cell up to Stage 9.

The following design parameters were used in the evaluation of the stormwater management system for the subject site.

5.4.1.1 Design Storms

The site was evaluated using the following design storms (as per the OSDG 2012):

- 25 mm 4 hour Chicago (for first flush sizing) [10 minute timestep]
- 2, 5 year 3 hour Chicago (for sizing of ICDs) [10 minute timestep]
- 100 year 3 hour Chicago [10 minute timestep]
- 2, 5, 100 year 24 hour SCS Type II [12 minute timestep]
- 100 year 3 hour Chicago + 20% (sensitivity for climate change) [10 minute timestep]
- 100 year 24 hour SCS Type II + 20% (sensitivity for climate change) [12 minute timestep]
- July 1st, 1979 (historical storm event) [5 minute timestep]



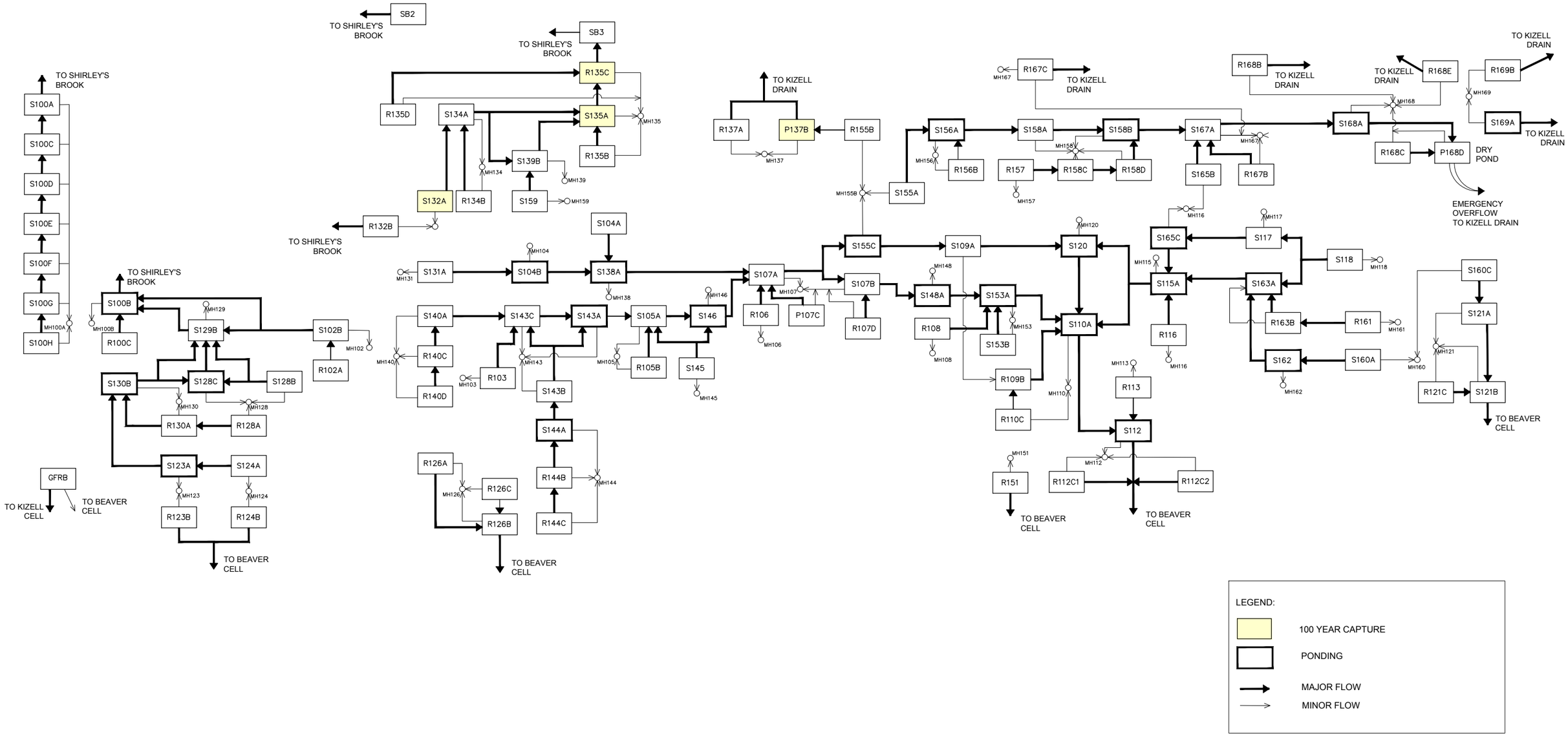
NOTE:

THE EXISTING CONDITIONS SINGLE EVENT UPPER KIZELL SWMHYMO MODEL CREATED FOR THE "SHIRLEY`S BROOK AND WATT`S CREEK PHASE 2 STORMWATER MANAGEMENT STUDY" (AECOM, APRIL 2015) WAS CONVERTED TO A CONTINUOUS SWMHYMO MODEL AND DOCUMENTED IN "CONTINUES MODELING OF BEAVER AND KIZELL PONDS UNDER EXISTING CONDITIONS" (JFSA, JUNE 2015).
FOR CONTINUOUS MODELING PURPOSES ALL URBAN DRAINAGE AREAS WERE CONVERTED INTO TWO NASHYD COMMANDS WHICH WERE ADDED TOGETHER BEFORE BEING INCLUDED IN THE SYSTEM. THE SWMHYMO SCHEMATIC FOR THE EXISTING AREA DOES NOT REFLECT THIS DIRECTLY.

LEGEND:

- EXISTING AREA MODIFIED FOR POST-DEVELOPMENT EVALUATION
- MODIFICATIONS / ADDITIONS TO REFLECT POST-DEVELOPMENT CONDITIONS
- STAGE 9 (SEE DRAWING 750 AND 751 FOR SWMHYMO SCHEMATIC)

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	KANATA LAKES-STAGE 9	OVERALL SWMHYMO SCHEMATIC UPPER KIZELL	FIGURE 5.1



J:\102101--KNLStg9\5.9 Drawings\39civil\swm\Figures\Submission 4\Figure 5.1A_Subm-4.dwg Layout Name: Figure 5.1A Plot Scale: 1:5.13 Plotted At: 1/24/2018 Last Saved By: svukic Last Saved At: Jan. 24, 18

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	KANATA LAKES-STAGE 9 DETAIL DESIGN	SWMHYMO SCHEMATIC STAGE 9	FIGURE 5.1A

- June 21, 2009 (historical storm event) [15 minute timestep]

5.4.1.2 Run-Off Coefficients

Runoff coefficients are described in **Section 4.3**.

5.4.1.3 Time of Concentration

Inlet times of 10 minutes for street segments and rear yard inlets were utilised as per the City of Ottawa Sewer Design Guidelines (October 2012).

5.4.1.4 Area and Imperviousness

The catchment areas and impervious values are based on the rational method spreadsheet. The total and directly connected imperviousness rations were based upon the pervious and impervious areas for the front yard and rear yard catchment areas.

5.4.1.5 Infiltration

As per the approved continuous model, CN values (under AMC II conditions) were converted to modified CN* values using the following formula:

$$CN^* = \frac{100}{1.879\ (100/CN - 1)^{1.15} + 1}$$

CN values for the development were adjusted from 67 to CN* values of 55.

5.4.1.6 Length Parameter

The impervious length parameter is based on the average of the measured length of the sewer through the catchment area and the calculated length from the SWMHYMO user's manual.

The calculated length based on area, is outlined below:

L_M = measured length of trunk sewer within the subwatershed area

$L_C = \sqrt{\frac{A}{1.5}}$ where: A = area in m^2

$L_{AVG} = L_M + L_C / 2$

The pervious length parameter is based on an average lot depth from the back of a typical lot to the centre line of the road, approximately 40 m. For street segments (i.e. Goulbourn Forced Road, and Walden Road) a pervious length of 6.5 m was utilised. These approaches are consistent with the OSDG.

5.4.1.7 Slope

The ground slope was based upon the average slope for both impervious and pervious area. Generally, the slope is approximately 2% (0.02 m/m). This assumes a slope of approximately 1% for impervious or road surfaces and 3% for pervious surfaces (lot grading).

5.4.1.8 Initial Abstraction (Depression Storage)

Depression storage depths of 1.57 mm and 4.67 mm were used for impervious and pervious areas, respectively. These values are consistent with the values presented in the OSDG.

5.4.1.9 Manning's roughness

Manning's roughness coefficients of 0.013 and 0.25 were used for impervious and pervious areas, respectively.

5.4.1.10 Baseflow

No baseflow components were assumed for any of the areas contributing runoff to the minor system within the SWMHYMO model.

5.4.1.11 Major System Storage and Routing

Continuous grade was applied to portions of the site and a sawtooth design to the streets and rear yards where possible. Flow is attenuated within these low points with potential overflow cascading to the next segment downstream. The total volume at each low point, up to the overflow depth, is the maximum static storage. Rear yard segments have a sawtooth pattern with some storage available, but the storage is not accounted for as part of the analysis.

Available surface storage was accounted for in the SWMHYMO model, and is summarized in **Table 5.1** and shown on **DRWGs 400** and **401** in **Appendix D**. The surface storage was considered in two parts: as a "static" storage and a "dynamic" storage. Each storage location was examined individually, at a depth of approximately 0.15 m to 0.25 m, designed as "static" storage with the outflow-storage curve based on the minor system capture and the "static" ponding volume. If the SWMHYMO simulation did not produce overflow, then the design of the low point was completed. If the SWMHYMO simulation indicated an overflow, the "dynamic" routing was performed to utilize the available storage. Dynamic routing was performed with a second route reservoir command.

The second outflow-storage curve was based on the normal depth of flow for the downstream street segment and available storage between the static ponding elevation and max depth of 0.35 m. The outflow from this command represents the major system flow cascading to the downstream segment. Any overflow from this second route reservoir would indicate that the max depth would be exceeded. In the event that overflow occurred during the "dynamic" storage routing, an additional iteration was performed in which the minor system capture was increased to ensure no overflow, and therefore the depth limited to below the max depth.

The above approach ensures that the City guideline of 0.35 m ponding depth is maintained at all locations. It should also be noted that if the approximate 0.35 m of ponding was designed as the "static" storage, then "dynamic" storage was not available and therefore not used.

5.4.1.12 Minor System Capture

Inlet control devices (ICDs) are proposed to control the surcharge in the minor system during infrequent storm events and maximize the use of available on site storage. The minor system inflow rate within the subject site was optimized to account for continuous grade. As such, the model incorporates the actual flow entering the minor system on continuous grade based on approach-capture curves derived from the MTO Manual (Chart E4-7D). At low points in the road, ICDs have been sized to capture overflow from upstream street segments while ensuring that there is no ponding during the design year storm event (2 year or 5 year).

The minor system flow restriction is based on the 2 or 5 year design storm event. As noted in Section **5.3.2**, for the Kanata Lakes Stage 9 site, the restriction is based on the greater of the

rational method flow (10 minute inlet time) or the SWMHYMO generated catchment flow for the 3 hour Chicago (10 minute time inlet) design storm. The minor system capture of ICDs for the Kanata Lakes Stage 9 site is based on the 2 year storm event. The exception is for collector streets where the 5 year design storm event is utilised.

Seven standard ICD sizes are proposed for the site to control the surcharge in the minor system during infrequent storm events (83 mm, 94 mm, 102 mm, 108 mm, 127 mm, 152 mm, and 178 mm). The selection of the ICD sizes and flow for the site ensures that there is no ponding on the local and collector streets during the 2 year and 5 year storm events, respectively. Further information on the ICDs can be found in the catchbasin table on **DRWG 010**.

5.4.1.13 Summary of Design Parameters

The below **Table 5.1** summarizes the main hydrological parameters used in the SWMHYMO model. The SWMHYMO model schematic (**DRWG 750** and **DRWG 751**) is provided within **Appendix D**, along with the model output files.

Table 5.1: Summary of Hydrological Parameters – Stage 9 Interim-Development Conditions

DRAINAGE AREA ID	AREA (HA)	D/S SEGMENT ID	XPSWMM NODE ID	IMP RATIO [TP (H)]	CALC. LENGTH (M)	MEASURED LENGTH (M)	AVERAGE LENGTH (M)	WIDTH (M)	STATIC STORAGE (M^3)	EXTENDED STORAGE (M^3)	TOTAL STORAGE (M^3)
Tributary to Shirley's Brook											
S100H	0.13	S100G	MH100	0.60	29	50	40	6.5			
S100G	0.13	S100F	MH100	0.60	29	52	41	6.5			
S100F	0.13	S100E	MH100	0.60	29	50	40	6.5			
S100E	0.13	S100D	MH100	0.60	29	50	40	6.5			
S100D	0.13	S100C	MH100	0.60	29	50	40	6.5			
S100C	0.13	S100A	MH100	0.60	29	50	40	6.5			
S100A	0.12	SB	MH100	0.60	28	45	37	6.5			
S124A	0.47	S123A	MH124	0.73	56	90	73	40			
S123A	0.46	S130B	MH123	0.73	55	118	87	40	62	34	96
R128A	0.21	R130A	MH128	0.50	37	59	48	40			
R130A	0.28	S130B	MH130	0.50	43	80	62	40			
S130B	0.33	S129B/S 128C	MH130	0.73	47	90	68	40	60	115	174
S128B	0.36	S128C/S 129B	MH128	0.73	49	84	66	40			
S128C	0.26	S129B	MH128	0.73	42	60	51	40	4	84	88
R102A	0.13	S102B		0.50	29	16	23	40			
S102B	0.18	S100B/S 129B	MH102	0.60	35	67	51	6.5			
S129B	0.34	S100B	MH129	0.73	48	111	79	40			
R100C	0.16	S100B		0.50	33	16	24	40			
S100B	0.32	SB	MH100B	0.60	46	124	85	6.5	34	113	147
SB2	0.11	SB		[0.057]							
Tributary to Beaver Pond											
R123B	0.17	BC	MH123	0.50	34	63	48	6.5			
R124B	0.10	BC	MH124	0.50	26	50	38	20			
GFRB	0.20	KC	BC	0.84	37	72	54	6.5			
R132B	0.20	SB	MH132	0.53	37	78	57	40			

DRAINAGE AREA ID	AREA (HA)	D/S SEGMENT ID	XPSWMM NODE ID	IMP RATIO [TP (H)]	CALC. LENGTH (M)	MEASURED LENGTH (M)	AVERAGE LENGTH (M)	WIDTH (M)	STATIC STORAGE (M^3)	EXTENDED STORAGE (M^3)	TOTAL STORAGE (M^3)
S132A	0.39	S134A	MH132	0.76	51	77	64	40	15	148	163
R135D	0.13	R135C	MH135	[0.25]							
R134B	0.43	S134A	MH134	0.53	54	129	91	40			
S134A	0.42	S135A/S 139B	MH134	0.76	53	92	72	40			
S159	0.36	S139B	MH159	0.76	49	72	60	40			
S139B	0.12	S135A	MH139	0.76	28	45	37	40	0.26	37	38
R135B	0.30	S135A	MH135	0.53	45	93	69	40			
S135A	0.85	R135C	MH135	0.76	75	181	128	40	101		101
R135C	0.70	SB3	MH135	0.53	68	192	130	40			
SB3	0.20	SB		[0.029]							
R126A	0.08	R126B	MH126	0.50	23	20	22	40			
R126C	0.15	R126B	MH126	0.50	32	72	52	40			
R126B	0.22	BC2	MH126	[0.25]							
R144C	0.10	R144B	MH144	[0.25]							
R144B	0.17	S144A	MH144	0.50	34	69	51	40			
S144A	0.32	S143B	MH144	0.73	46	60	53	40	3	49	52
S143B	0.18	S143C/S 143A	MH143	0.73	35	81	58	40			
R140D	0.16	R140C	MH140	0.50	33	55	44	40			
R140C	0.18	S140A	MH140	0.50	35	48	41	40			
S140A	0.60	S143C	MH140	0.73	63	108	86	40			
R103	0.24	S143C	MH103	0.50	40	71	56	40			
S143C	0.25	S143A	MH143	0.73	41	79	60	40			
S143A	0.19	S105A	MH143	0.73	36	79	57	40	0.09	39	39
R105B	0.30	S105A	MH105	0.50	45	91	68	40			
S145	0.34	S105A/S 146	MH145	0.73	48	64	56	40			
S105A	0.25	S146	MH105	0.73	41	80	60	40			
S146	0.19	S107A	MH146	0.73	36	79	57	40	0.13	34	34
S131A	0.23	S104A	MH131	0.73	39	86	63	40			
S104B	0.10	S138A	MH104	0.60	26	80	53	3.2	0.41	19	20
S104A	0.03	S138A	MH104	0.76	14	6	10	40			
S138A	0.16	S107A	MH138	0.60	33	92	62	40	0.62	49	50
R106	0.32	S107A	MH106	0.50	46	199	123	20			
P107C	1.38	S107A	MH107	[0.184]							
S107A	0.20	S155C/S 107B	MH107	0.60	37	78	57	6.5			
S155C	0.13	S109A	MH155B	0.60	29	88	59	6.5	0.77	24	25
R107D	0.20	S107B	MH107	0.50	37	125	81	40			
S107B	0.08	S148A	MH107	0.60	23	70	47	6.5			
S160A	0.39	S162	MH160	0.73	51	63	57	40			
S162	0.52	S163A	MH162	0.73	59	107	83	40	30	148	178
R161	0.23	R163B	MH161	0.50	39	66	53	40			
R163B	0.13	S163A	MH163	0.50	29	39	34	40			
S118	0.31	S117/S1 63A	MH118	0.73	45	78	62	40			
S163A	0.33	S115A	MH163	0.73	47	75	61	40	1	65	66
S117	0.20	S165C	MH117	0.73	37	67	52	40			

DRAINAGE AREA ID	AREA (HA)	D/S SEGMENT ID	XPSWMM NODE ID	IMP RATIO [TP (H)]	CALC. LENGTH (M)	MEASURED LENGTH (M)	AVERAGE LENGTH (M)	WIDTH (M)	STATIC STORAGE (M^3)	EXTENDED STORAGE (M^3)	TOTAL STORAGE (M^3)
R116	0.18	S115A	MH116	0.50	35	56	45	40			
S165C	0.31	S115A	MH165	0.73	45	115	80	40	28	51	79
S115A	0.45	S120/S110A	MH115	0.73	55	144	99	40	48	15	63
S109A	0.22	S120	MH109	0.76	38	88	63	40			
S120	0.39	S110A	MH120	0.76	51	135	93	40	12	113	125
S148A	0.46	S153A	MH148	0.73	55	93	74	40	0.25	103	103
R108	0.27	S153A	MH108	0.50	42	82	62	40			
S153B	0.47	S153A	MH153	0.73	56	101	78	40			
S153A	0.46	S110A	MH153	0.73	55	66	61	40	2	133	135
R110C	0.12	R109B	MH110	0.50	28	38	33	40			
R109B	0.15	S110A	MH109	0.50	32	42	37	40			
S110A	0.36	S112	MH110	0.73	49	127	88	6.5	37	90	127
R113	0.21	S112	MH113	0.50	37	62	50	40			
R112C1	0.20	BC	MH112C	0.50	37	110	73	40			
R112C2	0.23	BC	MH112C	0.50	39	132	86	40			
S112	0.54	BC	MH112	0.73	60	118	89	40	19	136	155
R151	0.16	BC	MH151	0.50	33	117	75	40			
S160C	0.04	S121A	MH160	0.73	16	51	34	6.5			
S121A	0.10	S121B	MH121	0.60	26	49	37	6.5			
R121C	0.45	S121B	MH121	[0.25]							
S121B	0.11	BC	MH121	0.60	27	60	44	6.5			
Tributary To Kizell Drain											
R137A	0.20	KD	MH137	0.53	37	132	84	40			
R155B	0.17	P137B	MH155B	0.53	34	76	55	40			
P137B	0.64	KD	MH137	[0.09]							
S155A	0.28	S156A	MH155B	0.76	43	54	49	40			
R156B	0.03	S156A	MH156	0.53	14	60	37	40			
S156A	0.51	S158A	MH156	0.76	58	106	82	40	25	160	185
R157	0.31	R158C	MH157	0.53	45	44	45	40			
R158C	0.37	R158D	MH158	0.53	50	78	64	40			
R158D	0.03	S158B	MH158	0.53	14	54	34	40			
S158A	0.37	S158B	MH158	0.76	50	72	61	40			
S158B	0.51	S167A	MH158	0.76	58	90	74	40	13	180	193
S165B	0.14	S167A	MH165	0.73	31	60	45	40			
R167B	0.10	S167A	MH167	0.5	26	65	45	40			
S167A	0.35	S168A	MH167	0.73	48	85	67	40			
S168A	0.60	P168D	MH168	0.73	63	134	99	40	41	119	160
R168C	0.51	P168D	MH168	0.5	58	159	109	40			
P168D	0.14	KD	MH168	[0.25]							
R168B	0.23	KD	MH168	0.50	39	136	88	40			
R168E	0.07	KD	MH168	0.50	22	65	43	40			
S169A	0.46	KD	MH169	0.73	55	56	56	40	10		10
R169B	0.14	KD	MH169	0.50	31	103	67	40			
R167C	0.73	KD	MH167	0.53	70	327	198	40			

5.4.2 Results of Hydrologic Modeling

The results of the SWMHYMO major system evaluation are summarised in the following tables. **Table 5.2** summarises the ICDs for each catchment area. The rational method flow and simulated flow for the design storm are provided for comparison. Notes relevant to the sizing of the ICD are also provided.

Table 5.2: ICD Sizing

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS/ SAG/REAR YARD)	ROAD TYPE	MINOR SYSTEM DESIGN TARGET (BASED ON ROAD TYPE)			ICD (L/S)	NOTES
			MINOR SYSTEM DESIGN STORM	GENERATED FLOW ON INDIVIDUAL SEGMENT RATIONAL METHOD (L/S)	GENERATED FLOW ON INDIVIDUAL SEGMENT SIMULATED (L/S)		
Tributary to Shirley's Brook							
S100H	Continuous	26 M ROW, 11.0m asphalt	5	23	21	12	CB on slope, captured in downstream sag
S100G	Continuous	26 M ROW, 11.0m asphalt	5	23	21	12	CB on slope, captured in downstream sag
S100F	Continuous	26 M ROW, 11.0m asphalt	5	23	21	12	CB on slope, captured in downstream sag
S100E	Continuous	26 M ROW, 11.0m asphalt	5	23	21	12	CB on slope, captured in downstream sag
S100D	Continuous	26 M ROW, 11.0m asphalt	5	23	21	12	CB on slope, captured in downstream sag
S100C	Continuous	26 M ROW, 11.0m asphalt	5	23	21	12	CB on slope, captured in downstream sag
S100A	Continuous	26 M ROW, 11.0m asphalt	5	21	20	12	CB on slope, captured in downstream sag
S124A	Continuous	18 M ROW, 8.5m asphalt	2	73	68	38	CB on grade, captured in downstream sag
S123A	Sag	18 M ROW, 8.5m asphalt	2	72	64	214	Optimised to limit max ponding depth
R128A	Rear Yard	Rear Yard	2	22	3	24	Adjusted for rational
R130A	Rear Yard	Rear Yard	2	30	4	31	Adjusted for rational
S130B	Sag	18 M ROW, 8.5m asphalt	2	51	48	52	No ponding/overflow during design storm
S128B	Continuous	18 M ROW, 8.5m asphalt	2	56	53	25	CB on slope, captured in downstream sag
S128C	Sag	18 M ROW, 8.5m asphalt	2	41	40	63	No ponding/overflow during design storm
R102A	Rear Yard	Rear Yard	2	14	2	n/a	Sheet flows to S102B
S102B	Continuous	26 M ROW, 11.0m asphalt	5	31	29	12	CB on slope, captured in downstream sag
S129B	Continuous	26 M ROW, 11.0m asphalt	5	72	68	38	CB on slope, captured in downstream sag
R100C	Rear Yard	Rear Yard	2	17	3	n/a	Sheet flows to S100B
S100B	Sag	26 M ROW, 11.0m asphalt	5	56	48	172	No ponding/overflow during design storm
SB2							n/a
				Total flow to Shirley's Brook		**753**	

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS/ SAG/REAR YARD)	ROAD TYPE	MINOR SYSTEM DESIGN TARGET (BASED ON ROAD TYPE)			ICD (L/S)	NOTES
			MINOR SYSTEM DESIGN STORM	GENERATED FLOW ON INDIVIDUAL SEGMENT RATIONAL METHOD (L/S)	GENERATED FLOW ON INDIVIDUAL SEGMENT SIMULATED (L/S)		
Tributary To Beaver Pond							
R123B	Rear Yard	Rear Yard	2	18	3	21	Adjusted for rational
R124B	Rear Yard	Rear Yard	2	11	2	16	Adjusted for rational
GFRB	Continuous	26 M ROW, 11.0m asphalt	5	49	51	25	CB on grade, captured in downstream sag
R132B	Rear Yard	Rear Yard	2	23	3	24	Adjusted for rational
S132A	Sag	18 M ROW, 8.5m asphalt	2	63	153	126	100 year capture
R135D	Rear Yard	Rear Yard	2	7	1	n/a	Sheet flows to R135C
R134B	Rear Yard	Rear Yard	2	49	7	64	Adjusted for rational
S134A	Continuous	18 M ROW, 8.5m asphalt	2	68	64	38	CB on slope, captured in downstream sag
S159	Continuous	18 M ROW, 8.5m asphalt	2	58	56	25	CB on slope, captured in downstream sag
S139B	Sag	18 M ROW, 8.5m asphalt	2	19	48	126	No ponding/overflow during design storm
R135B	Rear Yard	Rear Yard	2	34	5	43	Adjusted for rational
S135A	Sag	18 M ROW, 8.5m asphalt	2	138	305	252	100 year capture
R135C	Rear Yard	Rear Yard	2	79	86	93	100 year capture
SB3							n/a
R126A	Rear Yard	Rear Yard	2	9	1	n/a	Sheet flows to R126B
R126C	Rear Yard	Rear Yard	2	16	2	n/a	Sheet flows to R126B
R126B	Rear Yard	Rear Yard	2	12	2	38	Captures sheet flow from R126A and R126C
R144C	Rear Yard	Rear Yard	2	5	1	n/a	Sheet flows to R144B
R144B	Rear Yard	Rear Yard	2	18	3	24	Adjusted for rational and upstream sheet flow
S144A	Sag	18 M ROW, 8.5m asphalt	2	50	49	63	No ponding/overflow during design storm
S143B	Continuous	18 M ROW, 8.5m asphalt	2	28	27	12	CB on grade, captured in downstream sag
R140D	Rear Yard	Rear Yard	2	17	3	18	Adjusted for rational
R140C	Rear Yard	Rear Yard	2	19	3	24	Adjusted for rational
S140A	Continuous	18 M ROW, 8.5m asphalt	2	94	84	38	No ponding/overflow during design storm
R103	Rear Yard	Rear Yard	2	26	4	28	Adjusted for rational
S143C	Continuous	18 M ROW, 8.5m asphalt	2	39	37	28	CB on grade, captured in downstream sag
S143A	Sag	18 M ROW, 8.5m asphalt	2	30	28	126	No ponding/overflow during design storm
R105B	Rear Yard	Rear Yard	2	32	5	43	Adjusted for rational
S145	Continuous	18 M ROW, 8.5m asphalt	2	53	51	25	CB on grade, captured in downstream sag

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS/ SAG/REAR YARD)	ROAD TYPE	MINOR SYSTEM DESIGN TARGET (BASED ON ROAD TYPE)			ICD (L/S)	NOTES
			MINOR SYSTEM DESIGN STORM	GENERATED FLOW ON INDIVIDUAL SEGMENT RATIONAL METHOD (L/S)	GENERATED FLOW ON INDIVIDUAL SEGMENT SIMULATED (L/S)		
S105A	Continuous	26 M ROW, 11.0m asphalt	5	53	52	24	CB on grade, captured in downstream sag
S146	Sag	18 M ROW, 8.5m asphalt	2	30	28	107	No ponding/overflow during design storm
S131A	Continuous	18 M ROW, 8.5m asphalt	2	36	34	25	CB on grade, captured in downstream sag
S104B	Sag	26 M ROW, 11.0m asphalt	5	17	16	63	No ponding/overflow during design storm
S104A	Continuous	18 M ROW, 8.5m asphalt	2	5	5	n/a	Sheet flows to S138A
S138A	Sag	26 M ROW, 11.0m asphalt	5	28	25	44	No ponding/overflow during design storm
R106	Rear Yard	Rear Yard	2	34	5	43	Adjusted for rational
P107C	Rear Yard	Rear Yard	2	74	14	75	Adjusted for rational
S107A	Continuous	26 M ROW, 11.0m asphalt	5	35	32	12	CB on grade, captured in downstream sag
S155C	Sag	26 M ROW, 11.0m asphalt	5	23	21	86	No ponding/overflow during design storm
R107D	Rear Yard	Rear Yard	2	21	3	24	Adjusted for rational
S107B	Continuous	26 M ROW, 11.0m asphalt	5	14	13	6	CB on grade, captured in downstream sag
S160A	Continuous	18 M ROW, 8.5m asphalt	2	61	58	25	CB on grade, captured in downstream sag
S162	Sag	18 M ROW, 8.5m asphalt	2	81	74	126	No ponding/overflow during design storm
R161	Rear Yard	Rear Yard	2	25	4	28	Adjusted for rational
R163B	Rear Yard	Rear Yard	2	14	2	18	Adjusted for rational
S118	Continuous	26 M ROW, 11.0m asphalt	5	66	65	25	CB on grade, captured in downstream sag
S163A	Sag	26 M ROW, 11.0m asphalt	5	70	69	107	No ponding/overflow during design storm
S117	Continuous	26 M ROW, 11.0m asphalt	5	42	42	19	CB on grade, captured in downstream sag
R116	Rear Yard	Rear Yard	2	19	3	24	Adjusted for rational
S165C	Sag	26 M ROW, 11.0m asphalt	5	66	62	172	Optimised to limit max ponding depth
S115A	Sag	18 M ROW, 8.5m asphalt	2	70	61	344	Optimised to limit max ponding depth
S109A	Continuous	26 M ROW, 11.0m asphalt	5	48	48	19	CB on grade, captured in downstream sag
S120	Sag	26 M ROW, 11.0m asphalt	5	86	80	149	Optimised to limit max ponding depth
S148A	Sag	26 M ROW, 11.0m asphalt	5	97	93	344	Optimised to limit max ponding depth

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS/ SAG/REAR YARD)	ROAD TYPE	MINOR SYSTEM DESIGN TARGET (BASED ON ROAD TYPE)			ICD (L/S)	NOTES
			MINOR SYSTEM DESIGN STORM	GENERATED FLOW ON INDIVIDUAL SEGMENT RATIONAL METHOD (L/S)	GENERATED FLOW ON INDIVIDUAL SEGMENT SIMULATED (L/S)		
R108	Rear Yard	Rear Yard	2	29	4	31	Adjusted for rational
S153B	Continuous	18 M ROW, 8.5m asphalt	2	73	67	38	CB on grade, captured in downstream sag
S153A	Sag	18 M ROW, 8.5m asphalt	2	72	68	344	Optimised to limit max ponding depth
R110C	Rear Yard	Rear Yard	2	13	2	18	Adjusted for rational
R109B	Rear Yard	Rear Yard	2	16	2	18	Adjusted for rational
S110A	Sag	26 M ROW, 11.0m asphalt	5	76	71	344	Optimised to limit max ponding depth
R113	Rear Yard	Rear Yard	2	22	3	24	Adjusted for rational
R112C1	Rear Yard	Rear Yard	2	21	3	24	Adjusted for rational
R112C2	Rear Yard	Rear Yard	2	25	3	28	Adjusted for rational
S112	Sag	18 M ROW, 8.5m asphalt	2	84	75	88	No ponding/overflow during design storm
R151	Rear Yard	Rear Yard	2	17	2	18	Adjusted for rational
S160C	Continuous	26 M ROW, 11.0m asphalt	5	8	9	6	CB on grade, captured in downstream sag
S121A	Continuous	26 M ROW, 11.0m asphalt	5	17	17	218	Limited by lead size
R121C	Rear Yard	Rear Yard	2	24	4	46	Limited by lead size
S121B	Continuous	26 M ROW, 11.0m asphalt	5	19	18	218	Limited by lead size
Total flow to Beaver Pond						**4692**	
Tributary To Kizell Drain							
R137A	Rear Yard	Rear Yard	2	23	3	24	Adjusted for rational
R155B	Rear Yard	Rear Yard	2	19	3	21	Adjusted for rational
P137B	Rear Yard	Rear Yard	2	34	78	80	100 year capture
S155A	Continuous	18 M ROW, 8.5m asphalt	2	45	45	25	CB on grade, captured in downstream sag
R156B	Rear Yard	Rear Yard	2	3	1	6	Adjusted for rational
S156A	Sag	18 M ROW, 8.5m asphalt	2	83	76	126	No ponding/overflow during design storm
R157	Rear Yard	Rear Yard	2	35	6	43	Adjusted for rational
R158C	Rear Yard	Rear Yard	2	42	6	43	Adjusted for rational
R158D	Rear Yard	Rear Yard	2	3	1	6	Adjusted for rational
S158A	Continuous	18 M ROW, 8.5m asphalt	2	60	58	25	CB on grade, captured in downstream sag
S158B	Sag		5	112	108	174	No ponding/overflow during design storm
S165B	Continuous	20 M ROW, 8.5m asphalt	2	22	22	19	CB on grade, captured in downstream sag
R167B	Rear Yard	Rear Yard	2	11	2	18	Adjusted for rational

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS/ SAG/REAR YARD)	ROAD TYPE	MINOR SYSTEM DESIGN TARGET (BASED ON ROAD TYPE)			ICD (L/S)	NOTES
			MINOR SYSTEM DESIGN STORM	GENERATED FLOW ON INDIVIDUAL SEGMENT RATIONAL METHOD (L/S)	GENERATED FLOW ON INDIVIDUAL SEGMENT SIMULATED (L/S)		
S167A	Continuous	18 M ROW, 8.5m asphalt	2	55	51	25	CB on grade, captured in downstream sag
S168A	Sag	18 M ROW, 8.5m asphalt	2	94	82	149	No ponding/overflow during design storm
R168C	Rear Yard	Rear Yard	2	54	8	62	Adjusted for rational
R168B	Rear Yard	Rear Yard	2	25	3	27	Adjusted for rational
R168E	Rear Yard	Rear Yard	2	7	1	18	Adjusted for rational
S169A	Sag	CUL DE SAC	2	72	69	86	No ponding/overflow during design storm
R169B	Rear Yard	Rear Yard	2	15	2	18	Adjusted for rational
R167C	Rear Yard	Rear Yard	2	83	11	108	Adjusted for rational
					Total flow to Kizell Drain	**1114**	

Model results for the 2, 5, and 100 year Chicago storm events are provided below. Two sensitivity storm events are also summarised for the 100 year Chicago increased by 20% design storm event and the July 1, 1979 historical storm event. The SWMHYMO modeling output files are presented within **Appendix D**. The below **Table 5.3** summarises the amount of storage utilized within the subject site and the overflow from each catchment.

Table 5.3: Summary of SWMHYMO Modeling Results

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS /SAG/REAR YARD)	MINOR SYSTEM DESIGN STORM (CAPTURED)	TOTAL AVAILABLE STORAGE (M^3) (STATIC + EXTENDED)	2 YEAR CHICAGO		5 YEAR CHICAGO		100 YEAR CHICAGO		100 YEAR CHICAGO +20%		JULY 1979	
				Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)
Collector Roads: Walden Drive and Goulbourn Forced Road													
S100H	Continuous	5		0	14	0	19	0	35	0	45	0	26
S100G	Continuous	5		0	25	0	36	0	68	0	87	0	48
S100F	Continuous	5		0	36	0	51	0	100	0	129	0	70
S100E	Continuous	5		0	45	0	65	0	131	0	168	0	91
S100D	Continuous	5		0	54	0	79	0	160	0	208	0	111
S100C	Continuous	5		0	63	0	92	0	189	0	247	0	130
S100A	Continuous	5		0	70	0	104	0	214	0	282	0	147
GFRB	Continuous	5		0	23	0	37	0	76	0	94	0	42
S102B	Continuous	5		0	19	0	27	0	56	0	75	0	52
S129B	Continuous	5		0	48	0	94	0	270	0	357	0	140

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS /SAG/REAR YARD)	MINOR SYSTEM DESIGN STORM (CAPTURED)	TOTAL AVAILABLE STORAGE (M^3) (STATIC + EXTENDED)	2 YEAR CHICAGO		5 YEAR CHICAGO		100 YEAR CHICAGO		100 YEAR CHICAGO +20%		JULY 1979	
				Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)
S100B	Sag	5	147	0	0	0	0	63	168	84	285	39	37
S105A	Continuous	5		0	41	0	117	0	437	0	599	0	194
S104B	Sag	5	20	0	0	0	0	1	39	1	65	0	0
S138A	Sag	5	50	0	0	0	0	2	50	2	89	0	0
S107A	Continuous	5		0	19	0	98	0	551	0	789	0	268
S155C	Sag	5	25	0	0	0	0	1	223	2	359	2	78
S107B	Continuous	5		0	15	0	55	0	292	0	419	0	150
S118	Continuous	5		0	30	0	49	0	100	0	126	0	58
S163A	Sag	5	66	0	0	0	0	7	207	11	329	2	15
S117	Continuous	5		0	33	0	53	0	112	0	141	0	62
S165C	Sag	5	79	0	0	0	0	19	0	40	34	0	0
S109A	Continuous	5		0	24	0	38	0	292	0	445	0	115
S120	Sag	5	125	0	0	0	0	49	243	72	413	17	21
S148A	Sag	5	103	0	0	0	0	2	114	4	280	0	0
S110A	Sag	5	127	0	0	0	0	11	0	124	255	0	0
S160C	Continuous	5		0	3	0	5	0	12	0	16	0	7
S121A	Continuous	5		0	7	0	12	0	26	0	34	0	16
S121B	Continuous	5		0	11	0	16	0	37	0	49	0	24
S158B	Sag	5	193	0	0	0	0	29	253	36	396	14	1
Local Roads													
S124A	Continuous	2		0	48	0	74	0	151	0	190	0	88
S123A	Sag	2	96	0	0	0	0	42	0	82	13	0	0
S130B	Sag	2	174	0	0	6	0	40	0	94	0	45	0
S128B	Continuous	2		0	33	0	55	0	114	0	144	0	65
S128C	Sag	2	88	0	0	6	13	8	89	10	125	6	31
S132A	Sag	2 (100)	163	0	0	0	0	9	0	20	48	0	0
S134A	Continuous	2		0	39	0	64	0	136	0	194	0	76
S159	Continuous	2		0	42	0	65	0	127	0	158	0	74
S139B	Sag	2	38	0	0	0	0	2	114	2	174	1	16
S135A	Sag	2 (100)	101	0	0	0	0	100	0	101	388	2	0
S144A	Sag	2	52	0	0	1	0	5	57	5	83	4	19
S143B	Continuous	2		0	17	0	28	0	114	0	156	0	51
S140A	Continuous	2		0	57	0	88	0	187	0	236	0	116
S143C	Continuous	2		0	77	0	128	0	312	0	403	0	179

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS /SAG/REAR YARD)	MINOR SYSTEM DESIGN STORM (CAPTURED)	TOTAL AVAILABLE STORAGE (M^3) (STATIC + EXTENDED)	2 YEAR CHICAGO		5 YEAR CHICAGO		100 YEAR CHICAGO		100 YEAR CHICAGO +20%		JULY 1979	
				Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)
S143A	Sag	2	39	0	0	1	54	4	307	6	433	2	122
S145	Continuous	2		0	37	0	57	0	113	0	142	0	66
S105A	Continuous	5		0	41	0	117	0	437	0	599	0	194
S146	Sag	2	34	0	0	2	76	7	453	9	638	3	160
S131A	Continuous	2		0	21	0	34	0	72	0	91	0	41
S104A	Continuous	2		0	5	0	7	0	12	0	15	0	8
S160A	Continuous	2		0	37	0	57	0	121	0	155	0	67
S162	Sag	2	178	0	0	12	0	49	162	56	242	36	24
S115A	Sag	2	63	0	0	0	0	3	0	58	4	0	0
S153B	Continuous	2		0	42	0	69	0	146	0	184	0	83
S153A	Sag	2	135	0	0	0	0	11	56	21	300	0	0
S112	Sag	2	155	0	0	6	0	38	75	67	285	26	20
S155A	Continuous	2		0	26	0	43	0	91	0	116	0	49
S156A	Sag	2	185	0	0	7	0	44	137	52	204	27	1
S158A	Continuous	2		0	36	0	56	0	249	0	344	0	66
S165B	Continuous	2		0	12	0	20	0	43	0	54	0	23
S167A	Continuous	2		0	44	0	72	0	383	0	569	0	85
S168A	Sag	2	160	0	0	13	0	60	429	70	660	43	33
S169A	Sag	2	10	0	0	3	0	10	86	10	125	10	20
Rear Yards													
R123B	Rear Yard	2		0	0	0	0	0	15	0	34	0	13
R124B	Rear Yard	2		0	0	0	0	0	1	0	11	0	3
R128A	Rear Yard	2		0	0	0	0	0	3	0	20	0	13
R130A	Rear Yard	2		0	0	0	0	0	8	0	46	0	29
R102A	Rear Yard (Sheet flow)	2		0	2	0	5	0	18	0	29	0	24
R100C	Rear Yard (Sheet flow)	2		0	3	0	6	0	22	0	36	0	29
SB2		0		0	2	0	4	0	18	0	27	0	20
R132B	Rear Yard	2		0	0	0	0	0	3	0	21	0	12
R135D	Rear Yard (Sheet flow)	2		0	1	0	2	0	0	0	14	0	16
R134B	Rear Yard	2		0	0	0	0	0	0	0	26	0	11
R135B	Rear Yard	2		0	0	0	0	0	0	0	22	0	11
R135C	Rear Yard	2 (100)		0	0	0	0	0	0	0	374	0	41
SB3		0		0	5	0	11	0	47	0	448	0	79

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS /SAG/REAR YARD)	MINOR SYSTEM DESIGN STORM (CAPTURED)	TOTAL AVAILABLE STORAGE (M^3) (STATIC + EXTENDED)	2 YEAR CHICAGO		5 YEAR CHICAGO		100 YEAR CHICAGO		100 YEAR CHICAGO +20%		JULY 1979	
				Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)
R126A	Rear Yard	2		0	1	0	3	0	11	0	18	0	15
R126C	Rear Yard	2		0	2	0	5	0	19	0	31	0	26
R126B	Rear Yard	2		0	0	0	0	0	3	0	25	0	27
R144C	Rear Yard	2		0	1	0	2	0	7	0	11	0	12
R144B	Rear Yard	2		0	0	0	0	0	3	0	18	0	17
R140D	Rear Yard	2		0	0	0	0	0	3	0	17	0	10
R140C	Rear Yard	2		0	0	0	0	0	2	0	32	0	18
R103	Rear Yard	2		0	0	0	0	0	3	0	22	0	14
R105B	Rear Yard	2		0	0	0	0	0	0	0	18	0	8
R106	Rear Yard	2		0	0	0	0	0	1	0	27	0	13
P107C	Rear Yard	2		0	0	0	0	0	40	0	100	0	118
R107D	Rear Yard	2		0	0	0	0	0	0	0	16	0	10
R161	Rear Yard	2		0	0	0	0	0	2	0	20	0	12
R163B	Rear Yard	2		0	0	0	0	0	0	0	29	0	17
R116	Rear Yard	2		0	0	0	0	0	0	0	15	0	8
R108	Rear Yard	2		0	0	0	0	0	3	0	24	0	15
R110C	Rear Yard	2		0	0	0	0	0	0	0	9	0	4
R109B	Rear Yard	2		0	0	0	0	0	2	0	24	0	12
R113	Rear Yard	2		0	0	0	0	0	3	0	20	0	13
R112C1	Rear Yard	2		0	0	0	0	0	0	0	16	0	10
R112C2	Rear Yard	2		0	0	0	0	0	0	0	17	0	11
R151	Rear Yard	2		0	0	0	0	0	2	0	14	0	9
R121C	Rear Yard	2		0	0	0	0	0	0	0	2	0	10
R137A	Rear Yard	2		0	0	0	0	0	2	0	18	0	11
R155B	Rear Yard	2		0	0	0	0	0	2	0	18	0	10
P137B	Rear Yard	2 (100)		0	0	0	0	0	0	0	54	0	33
R156B	Rear Yard	2		0	0	0	0	0	0	0	1	0	0
R157	Rear Yard	2		0	0	0	0	0	1	0	29	0	14
R158C	Rear Yard	2		0	0	0	0	0	7	0	63	0	37
R158D	Rear Yard	2		0	0	0	0	0	5	0	64	0	37
R167B	Rear Yard	2		0	0	0	0	0	0	0	4	0	0
R168C	Rear Yard	2		0	0	0	0	0	0	0	34	0	23
R168B	Rear Yard	2		0	0	0	0	0	1	0	17	0	12
R168E	Rear Yard	2		0	0	0	0	0	0	0	0	0	0
R169B	Rear Yard	2		0	0	0	0	0	0	0	11	0	6

DRAINAGE AREA ID	GRADING TYPE (CONTINUOUS /SAG/REAR YARD)	MINOR SYSTEM DESIGN STORM (CAPTURED)	TOTAL AVAILABLE STORAGE (M^3) (STATIC + EXTENDED)	2 YEAR CHICAGO		5 YEAR CHICAGO		100 YEAR CHICAGO		100 YEAR CHICAGO +20%		JULY 1979	
				Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)	Storage Used (m^3)	Over flow (l/s)
R167C	Rear Yard	2		0	0	0	0	0	0	0	24	0	11

The analysis indicates that local streets and rear yards provide full capture during the 2 year storm event. Ponding during this event is negligible. Evaluation of the collector roads shows that full capture is provided during the 5 year storm event with negligible ponding.

5.4.2.1 Velocity by Depth

To determine velocity of the cascading overflow, a separate SWMHYMO model was created (Stg9VxD.dat/out and is enclosed in **Appendix D**). The applicable right-of-way (ROW) sections were entered into the model with the corresponding longitudinal slopes to obtain the maximum velocity of flow using the Route Channel routine.

The velocity and depth for major flow within the system was determined for the 100 year, 3 hour Chicago and the 100 Year Chicago plus 20% design storm events. The results are presented in **Table 5.4** and **Table 5.5**.

Table 5.4: Summary of Cascading Major Flow: 100 Year Chicago Design Storm Event

DRAINAGE AREA ID	ROAD ROW SECTION (M)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	DEPTH (M)	VELOCITY X DEPTH (M^2/S)	MAX STATIC PONDING DEPTH (M)	DYNAMIC PONDING DEPTH (M)	MAX PONDING DEPTH (M) (STATIC + DYNAMIC)
S100B	3*	2.00	168	0.481	0.04	0.02	0.22	0.04	0.26
S130B	18	0.60	0	0.000	0.00	0.00	0.24	0	0.24
S128C	18	1.50	89	1.005	0.07	0.07	0.12	0.07	0.19
S123A	18	0.60	0	0.000	0.00	0.00	0.25	0	0.25
S104B	26	0.60	39	0.583	0.06	0.04	0.07	0.06	0.13
S143A	18	0.60	307	1.006	0.14	0.14	0.03	0.14	0.17
S138A	26	0.60	50	0.622	0.07	0.04	0.08	0.07	0.15
S146	18	0.60	453	1.164	0.15	0.18	0.05	0.15	0.20
S155C	26	2.10	223	1.223	0.07	0.09	0.1	0.07	0.17
S144A	18	2.00	57	0.996	0.06	0.06	0.13	0.06	0.19
S132A	18	2.00	0	0.000	0.00	0.00	0.15	0	0.15
S139B	18	1.00	114	0.779	0.06	0.05	0.07	0.06	0.13
S135A	3*	6.00	0	0.000	0.00	0.00	0.28	0	0.28
S148A	26	2.10	114	1.028	0.06	0.06	0.06	0.06	0.12
S153A	18	0.60	56	0.545	0.06	0.03	0.12	0.06	0.18
S110A	26	0.60	0	0.000	0.00	0.00	0.22	0	0.22

DRAINAGE AREA ID	ROAD ROW SECTION (M)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	DEPTH (M)	VELOCITY X DEPTH (M^2/S)	MAX STATIC PONDING DEPTH (M)	DYNAMIC PONDING DEPTH (M)	MAX PONDING DEPTH (M) (STATIC + DYNAMIC)
S120	26	0.60	243	0.933	0.12	0.12	0.16	0.12	0.28
S112	3	1.66	75	0.215	0.02	0.00	0.18	0.02	0.20
S156A	18	0.60	137	0.678	0.08	0.05	0.17	0.08	0.25
S158B	18	1.50	253	1.111	0.08	0.09	0.14	0.08	0.22
S165C	26	0.50	0	0.000	0.00	0.00	0.24	0	0.24
S115A	18	0.50	0	0.000	0.00	0.00	0.32	0	0.32
S163A	26	0.70	207	0.950	0.11	0.11	0.09	0.11	0.20
S162	18	2.00	162	1.101	0.06	0.07	0.2	0.06	0.26
S168A	3*	33.00	429	1.230	0.03	0.03	0.21	0.03	0.24
S169A	3*	6.00	86	0.246	0.01	0.00	0.14	0.01	0.15

* As per DRWG 011

Table 5.5: Summary of Cascading Major Flow: 100 Year Chicago plus 20% Design Storm Event

DRAINAGE AREA ID	ROAD ROW SECTION (M)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	DEPTH (M)	VELOCITY X DEPTH (M^2/S)	MAX STATIC PONDING DEPTH (M)	DYNAMIC PONDING DEPTH (M)	MAX PONDING DEPTH (M) (STATIC + DYNAMIC)
S100B	3*	2.00	285	0.816	0.07	0.059	0.22	0.07	0.29
S130B	18	0.60	0	0.000	0	0.000	0.24	0	0.24
S128C	18	1.50	125	1.100	0.08	0.090	0.12	0.08	0.20
S123A	18	0.60	13	0.358	0.03	0.011	0.25	0.03	0.28
S104B	26	0.60	65	0.669	0.08	0.051	0.07	0.08	0.15
S143A	18	0.60	433	1.148	0.15	0.174	0.03	0.15	0.18
S138A	26	0.60	89	0.722	0.08	0.061	0.08	0.08	0.16
S146	18	0.60	638	1.297	0.17	0.227	0.05	0.17	0.22
S155C	26	2.10	359	1.371	0.09	0.120	0.10	0.09	0.19
S144A	18	2.00	83	1.109	0.07	0.075	0.13	0.07	0.20
S132A	18	2.00	48	0.950	0.04	0.036	0.15	0.04	0.19
S139B	18	1.00	174	0.872	0.08	0.067	0.07	0.08	0.15
S135A	3*	6.00	388	1.112	0.06	0.064	0.28	0.06	0.34
S148A	26	2.10	280	1.285	0.08	0.103	0.06	0.08	0.14
S153A	18	0.60	300	0.825	0.10	0.086	0.12	0.10	0.22
S110A	26	0.60	255	0.946	0.13	0.120	0.22	0.13	0.35
S120	26	0.60	413	1.063	0.15	0.161	0.16	0.15	0.31
S112	3*	1.66	285	0.817	0.08	0.065	0.18	0.08	0.26

DRAINAGE AREA ID	ROAD ROW SECTION (M)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	DEPTH (M)	VELOCITY X DEPTH (M^2/S)	MAX STATIC PONDING DEPTH (M)	DYNAMIC PONDING DEPTH (M)	MAX PONDING DEPTH (M) (STATIC + DYNAMIC)
S156A	18	0.60	204	0.751	0.09	0.067	0.17	0.09	0.26
S158B	18	1.50	396	1.247	0.10	0.121	0.14	0.10	0.24
S165C	26	0.50	34	0.529	0.06	0.032	0.24	0.06	0.30
S115A	18	0.50	4	0.296	0.03	0.008	0.32	0.03	0.35
S163A	26	0.70	329	1.067	0.14	0.144	0.09	0.14	0.23
S162	18	2.00	242	1.228	0.08	0.094	0.20	0.08	0.28
S168A	3*	33.00	660	1.892	0.04	0.078	0.21	0.04	0.25
S169A	3*	6.00	125	0.358	0.02	0.007	0.14	0.02	0.16

* As per DRWG 011

According to the City of Ottawa Sewer Design Guidelines (October 2012), the maximum depth of flow should not exceed 350 mm and the product of velocity x depth on all the street segments should not exceed 0.6 m^2/s during the 100 year storm event. The maximum total ponding depths (static plus dynamic) are noted in the above tables.

During the 100 year 3 hour Chicago and the 100 Year Chicago plus 20% design storms, the maximum depth of cascading flow on the street is less 0.35 m, and the velocity by depth product is less than the allowable 0.6 m^2/s.

5.4.3 Capacity of Culvert Crossing Rail Line

As indicated within **Section 5.3.2.1**, major system cascading overflow from Stage 9 will be conveyed via the existing 1200 mm diameter culvert of 8m in length, discharging to Shirley's Brook. The capacity of the culvert was evaluated as part of the SWM Servicing for Stage 9 (February 2017) to ensure that the existing culvert has the capacity to convey the flows from Stage 9. The most critical storm event (100 year + 20% Chicago design storm event) was used and showed that the culvert had the capacity to convey 569 l/s under free flow conditions.

The culvert has the capacity to convey the flow from the development of Stage 9. Detail design generates a maximum flow of 448 l/s to the culvert (100 year + 20% Chicago design storm event).

5.4.4 Dry Pond

On Briarpath Court a dry pond will be created in the existing Hydro One corridor which bisects the street. Briarpath Court slopes to a low point at the hydro corridor crossing. Storm flows in excess of a 2 year storm will overflow from the road sag into the corridor. As the road is approximately 1.5 m higher than existing ground at this location, the road and adjacent lots will trap the stormwater creating a pond. A ditch inlet catchbasin will be provided to drain this area and the flow will be restricted to provide the required storage during the larger storm events. After the storm events the stormwater stored in the dry pond area will drain through the ditch inlet catchbasin leaving no standing water.

The available storage in the dry pond is 424 m^3 with an outflow set to 10 l/s. Emergency overflow is provided to the Kizell Drain. **Table 5.6** summarises the function of the dry pond during large storm events. The dry pond provides adequate storage and there is no overflow to the Kizell Drain during stress test events.

Table 5.6: Summary of Dry Pond Results (Drainage Area P168D)

STORM EVENT	INFLOW (L/S)	OUTFLOW (L/S)	OVERFLOW (L/S)	STORAGE USED (M^3)
100 Year 3 Hour Chicago	432	10	0	163
100 Year 3 Hour Chicago + 20%	665	10	0	376
100 Year 24 Hour SCS	230	10	0	86
100 Year 24 Hour SCS +20%	526	10	0	303

5.5 Hydraulic Analysis

The hydraulic function of the interim SWM facility and hydraulic grade line (HGL) was evaluated using the XPSWMM hydraulic model. The existing conditions Beaver Pond model (from the 2015 Continuous Modeling Report) was extended to incorporate the detail design of the storm sewers within the Stage 9 development. In addition, the infrastructure within Goulbourn Forced Road was modeled. This includes:

- A beaver control structure – replacing the existing Goulbourn Forced Road culvert crossing,
- A wildlife crossing between Kizell and Beaver cells.

Hydrographs from the SWMHYMO model were exported into the XPSWMM model. The updated XPSWMM model files are provided within **Appendix D**. Minor system losses were accounted for in accordance with Appendix 6-B of the City of Ottawa Sewer Design Guidelines (October 2012). The XPSWMM model schematic for Stage 9 is provided in **Figure 5.2**.

The existing conditions model and the interim-development model incorporate the most up-to-date survey information (May 31, 2016) on the permanent water level in the Kizell Cell. The permanent water level has been set to 92.1 m (previously 92.02 m).

5.5.1 Boundary Conditions

Boundary conditions at the outlets to Shirley's Brook and Kizell Drain were obtained from the MVCA's Shirley's Brook and Watts Creek/Kizell Drain flood plain mapping studies. The three (3) outlets are:

- PONDOUT – outlet to Kizell Drain from stormwater management facility
- Headwall 3 – outlet to Shirley's Brook
- Headwall 2 – outlet to Kizell Drain from Briarpath Court

The water levels from the 12 Hr SCS 100 year design storm event from the closest cross-section in the floodplain mapping models were used as the boundary conditions in the XPSWMM models. This information is summarised in **Table 5.7**.

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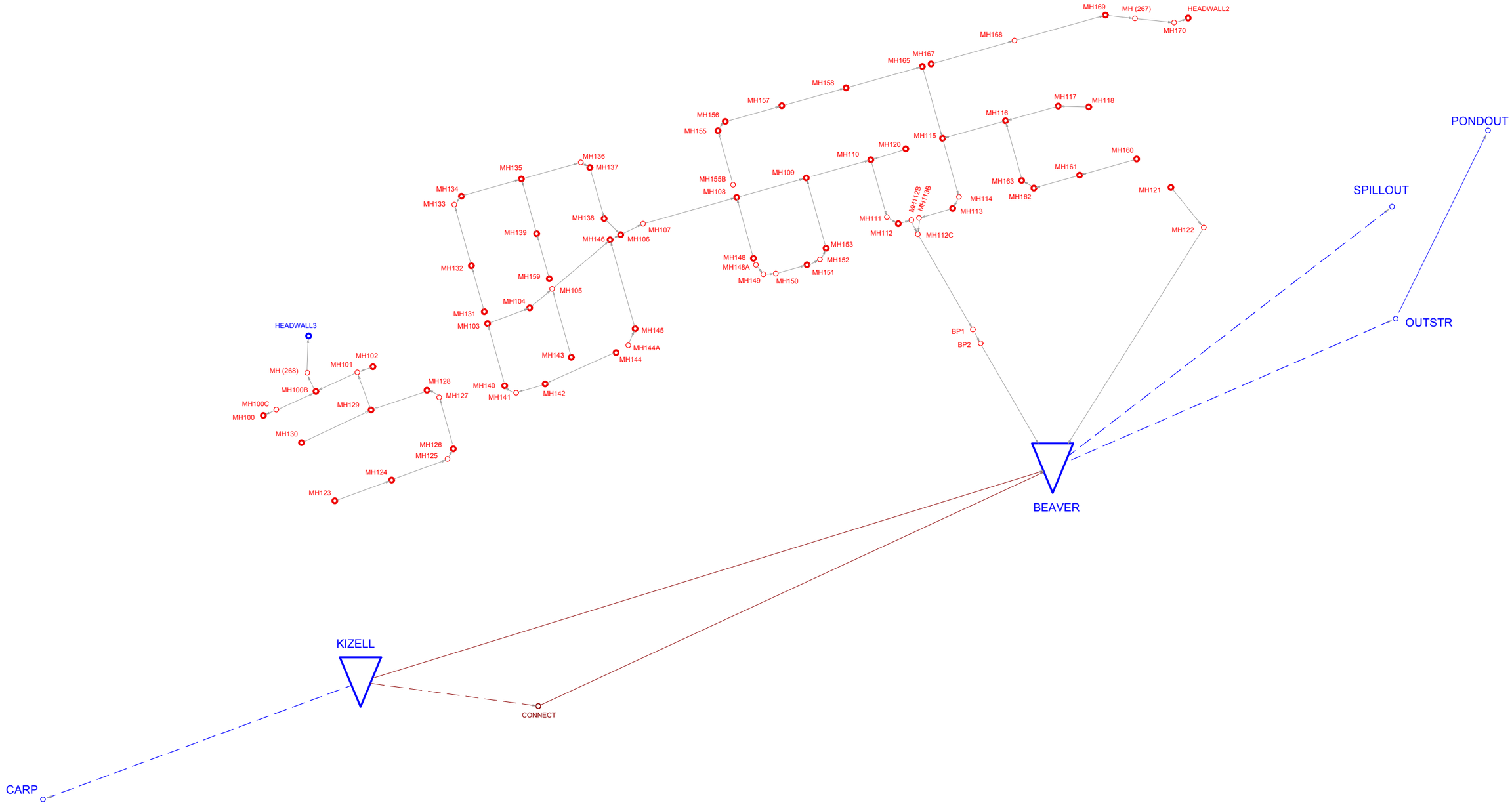


Scale	Project Title	Drawing Title	Sheet No.
IBI	KANATA LAKES - STAGE 9	XPSWMM SCHEMATIC	FIGURE 5.2

Table 5.7: XPSWMM Model Boundary Conditions

XPSWMM NODE ID	MVCA HEC-RAS CROSS-SECTION ASSOCIATED WATER LEVEL (M)	XPSWMM MODEL OUTFALL
PONDOUT	XS 24666 89.28 m	Fixed backwater of 89.4 m
Headwall 3	XS 10090 96.82 m	Fixed backwater of 96.82 m
Headwall 2	XS 24468 86.1 m	Fixed backwater of 86.1 m

5.5.2 Hydraulic Grade Line Analysis

XPSWMM simulations were conducted for various storm events. Hydraulic grade line elevations for the critical storm event, the 100 year 3 hour Chicago storm as well as sensitivity runs for the 100 year 3 hour Chicago increased by 20% storm and the July 1, 1979 historical storm are presented in **Table 5.8** below.

Table 5.8: Summary of Hydraulic Grade Line Analysis

PIPE NAME	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	USF ELEVATION (M)	100 YEAR 3 HOUR CHICAGO		SENSITIVITY ANALYSIS			
						100 YEAR 3 HOUR CHICAGO + 20%		JULY 1, 1979 MODEL	
				HGL (M)	USF-HGL (M)	HGL (M)	USF-HGL (M)	HGL (M)	FREE-BOARD (M)
Pipe - 123	MH123	MH124	100.07	99.71	0.36	99.78	0.29	99.55	0.52
Pipe - 124	MH124	MH125	100.47	99.50	0.97	99.55	0.92	99.39	1.08
Pipe - 125	MH125	MH126	101.2	99.21	1.99	99.23	1.97	99.15	2.05
Pipe - 126	MH126	MH127	101.35	99.14	2.21	99.16	2.19	99.08	2.27
Pipe - 127	MH127	MH128	101.02	98.95	2.07	98.97	2.05	98.93	2.09
Pipe - 128	MH128	MH129	100.88	98.90	1.98	98.91	1.97	98.88	2.00
Pipe - 122	MH129	MH101	100.27	98.54	1.73	98.55	1.72	98.53	1.74
Pipe - 129	MH130	MH129	100.23	99.20	1.03	99.20	1.03	99.20	1.03
Pipe - 101	MH102	MH101	N/A	98.46		98.46		98.46	
Link48	MH101	MH100B	N/A	97.70		97.73		97.67	
Pipe - 102	MH100B	MH (268)	N/A	97.29		97.33		97.28	
Pipe - 100	MH100	MH100B	N/A	97.29		97.33		97.29	
Link26	MH (268)	HEADWALL3	N/A	97.10		97.12		97.10	
Pipe - 130	MH131	MH132	99.69	98.62	1.07	98.62	1.07	98.62	1.07
Pipe - 131	MH132	MH133	99.19	98.22	0.97	98.22	0.97	98.19	1.00
Pipe - 132	MH133	MH134	99.04	97.31	1.73	97.31	1.73	97.29	1.75
Pipe - 133	MH134	MH135	98.6	96.96	1.64	96.98	1.62	96.96	1.64
Pipe - 134	MH135	MH136	94.4	93.49	0.91	94.00	0.40	93.49	0.91

PIPE NAME	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	USF ELEVATION (M)	100 YEAR 3 HOUR CHICAGO		SENSITIVITY ANALYSIS			
						100 YEAR 3 HOUR CHICAGO + 20%		JULY 1, 1979 MODEL	
				HGL (M)	USF-HGL (M)	HGL (M)	USF-HGL (M)	HGL (M)	FREE-BOARD (M)
Pipe - 135	MH136	MH137	96.2	93.30	2.90	93.90	2.30	93.31	2.89
Pipe - 136	MH137	MH138	96.4	93.26	3.14	93.87	2.53	93.27	3.13
Pipe - 137	MH138	MH106	97.24	93.19	4.05	93.79	3.45	93.21	4.03
Pipe - 138	MH139	MH135	97.14	96.05	1.09	96.05	1.09	96.05	1.09
Link28	MH159	MH139	98.54	97.29	1.25	97.29	1.25	97.29	1.25
Pipe - 143	MH144	MH142	102.06	100.90	1.16	100.90	1.16	100.90	1.16
Pipe - 141	MH142	MH141	102.06	100.36	1.70	100.36	1.70	100.36	1.70
Pipe - 140	MH141	MH140	101.55	100.17	1.38	100.17	1.38	100.17	1.38
Pipe - 139	MH140	MH103	101.4	100.09	1.31	100.09	1.31	100.09	1.31
Pipe - 103	MH103	MH104	99.92	94.07	5.85	94.54	5.38	94.14	5.78
Pipe - 104	MH104	MH105	N/A	93.91		94.40		94.01	
Pipe - 105	MH105	MH146	98.66	93.81	4.85	94.29	4.37	93.89	4.77
Pipe - 147	MH143	MH105	101.16	100.07	1.09	100.07	1.09	100.07	1.09
Pipe - 144	MH144A	MH145	102.06	100.56	1.50	100.56	1.50	100.56	1.50
Pipe - 145	MH145	MH146	101.28	100.08	1.20	100.08	1.20	100.08	1.20
Pipe - 146	MH146	MH106	97.83	93.23	4.60	93.77	4.06	93.25	4.58
Pipe - 106	MH106	MH107	97.49	93.14	4.35	93.73	3.76	93.17	4.32
Pipe - 107	MH107	MH108	N/A	93.04		93.62		93.08	
Pipe - 108	MH108	MH109	96.32	92.86	3.46	93.39	2.93	92.91	3.41
Pipe - 109	MH109	MH110	93.99	92.70	1.29	93.17	0.82	92.72	1.27
Pipe - 110	MH110	MH111	93.02	92.56	0.46	92.96	0.06	92.56	0.46
Link8	MH120	MH110	93.18	92.70	0.48	93.12	0.06	92.71	0.47
Pipe - 155	MH155B	MH155	95.54	94.88	0.66	94.89	0.65	94.88	0.66
Pipe - 156	MH155	MH156	94.14	93.10	1.04	93.40	0.74	93.10	1.04
Pipe - 157	MH156	MH157	94.19	92.62	1.57	93.15	1.04	92.62	1.57
Pipe - 158	MH157	MH158	93.3	92.59	0.71	93.11	0.19	92.59	0.71
Link21	MH158	MH165	93.10	92.55	0.55	93.05	0.05	92.55	0.55
Pipe - 164	MH165	MH115	93.05	92.52	0.53	93.01	0.04	92.52	0.53
Pipe - 117	MH118	MH117	94.8	93.97	0.83	93.97	0.83	93.97	0.83
Pipe - 116	MH117	MH116	94	92.79	1.21	93.20	0.80	92.80	1.20
Pipe - 115	MH116	MH115	93.73	92.68	1.05	93.15	0.58	92.70	1.03
Pipe - 114	MH115	MH114	93.33	92.48	0.85	92.94	0.39	92.49	0.84
Pipe - 113	MH114	MH113	94.18	92.41	1.77	92.82	1.36	92.43	1.75
Link17	MH113	MH113B	93.55	92.38	1.17	92.77	0.78	92.40	1.15

PIPE NAME	UPSTREAM MANHOLE	DOWNSTREAM MANHOLE	USF ELEVATION (M)	100 YEAR 3 HOUR CHICAGO		SENSITIVITY ANALYSIS			
						100 YEAR 3 HOUR CHICAGO + 20%		JULY 1, 1979 MODEL	
				HGL (M)	USF-HGL (M)	HGL (M)	USF-HGL (M)	HGL (M)	FREE-BOARD (M)
Link16	MH113B	MH112C	93.08	92.33	0.75	92.69	0.39	92.36	0.72
Pipe - 175	MH112C	BP1	N/A	92.29		92.62		92.32	
Pipe - 111	MH111	MH112	93.22	92.42	0.80	92.78	0.44	92.44	0.78
Pipe - 112	MH112	MH112B	92.93	92.39	0.54	92.74	0.19	92.41	0.52
Link61	MH112B	MH112C	92.93	92.33	0.60	92.68	0.26	92.36	0.57
Pipe - 161	MH160	MH161	94.6	93.69	0.91	93.81	0.79	93.69	0.91
Link11	MH161	MH162	94.05	93.27	0.78	93.76	0.29	93.31	0.74
Pipe - 162	MH162	MH163	93.75	93.20	0.55	93.70	0.05	93.24	0.51
Pipe - 163	MH163	MH116	93.75	93.13	0.62	93.62	0.13	93.17	0.58
Pipe - 148	MH148	MH108	98.77	98.32	0.45	98.32	0.45	97.65	1.12
Pipe - 149	MH148A	MH149	98.77	97.30	1.47	97.30	1.47	97.30	1.47
Pipe - 150	MH149	MH150	98.72	96.90	1.82	96.90	1.82	96.90	1.82
Pipe - 151	MH150	MH151	98.33	96.90	1.43	96.90	1.43	96.90	1.43
Pipe - 152	MH151	MH152	97.37	95.90	1.47	95.90	1.47	95.90	1.47
Pipe - 153	MH152	MH153	96.35	95.41	0.94	95.41	0.94	95.46	0.89
Pipe - 154	MH153	MH109	96.15	94.90	1.25	94.93	1.22	94.79	1.36
Pipe - 167	MH167	MH168	92.15	88.58	3.57	88.93	3.22	88.91	3.24
Pipe - 169	MH168	MH169	90.7	88.22	2.48	88.65	2.05	88.64	2.06
Pipe - 170	MH169	MH (267)	89.53	87.45	2.08	87.58	1.95	87.58	1.95
Pipe (245)	MH (267)	MH170	88.7	87.19	1.51	87.28	1.42	87.28	1.42
Pipe - 121	MH121	MH122	N/A	91.33		91.78		91.87	
Link6	MH122	BEAVER	N/A	91.33		91.78		91.87	
Pipe - 255	BP1	BP2	N/A	92.05		92.33		92.10	
Pipe - 256	BP2	Beaver	N/A	91.81		92.07		91.89	

The results indicate that the minimum 0.3 m clearance between the USF and HGL is maintained across the Stage 9 development site during the 100 year 3 hour Chicago design storm events. The results of the sensitivity runs (100 year Chicago plus 20% and the July 1, 1979 historical storm event) indicate that the HGL is below the USF elevation.

5.5.3 Existing Beaver Pond SWM Facility

The existing Beaver Pond stormwater management facility will be used to provide water quantity control. The Beaver Pond and the existing Walden Drive outlet structure will be maintained.

The following criteria for the facility have been used to evaluate the development of Stage 9 in addition to satisfying the OSDG:

- The historical 1:100 year maximum water level in the Beaver Cell is to be maintained at 92.60 m (as per the report by Oliver, Mangione, McCalla & Associates Limited, April 1990, *Kanata Lakes Dam & Outlet Structure Operation & Maintenance Manuals*).
- A maximum 1:100 year water level of 93.69 m is used for the Kizell Cell. This elevation is lower than the previously approved 2006 level of 94.30 m. The water level of 93.69 m has been agreed to by the MNR to assist in mitigating environmental issues in the Kizell Cell due to its PSW classification.
- The maximum outflow from the Beaver Pond is 0.96 cms during the 100 year storm event as per the Certificate of Approval obtained from the Ministry of the Environment on November 26, 2008.

The hydraulic function of the existing interim facility was evaluated using the XPSWMM hydraulic model. Parameters used for the model were based on the inflow hydrographs produced and exported from the SWMHYMO interim development model, stage/storage characteristics of the interim pond, outlet structure hydraulic losses, and tail water effect from the downstream water level at the Carp River. The results of the XPSWMM model including flow control of the outlet structure, storage volumes and resulting water levels are presented within the following **Table 5.9** and **Table 5.10**.

Table 5.9: Hydraulic Model Results for Beaver Pond – Existing Conditions

STORM EVENT		BEAVER CELL			KIZELL CELL		
		STORAGE* (M^3)	OUTFLOW (M^3/S)	WATER LEVEL (M)	STORAGE* (M^3)	OUTFLOW (M^3/S)	WATER LEVEL (M)
3 Hour Chicago	5 Year	17,725	0.18	90.83	136	0.19	92.31
	100 Year	42,928	0.46	91.22	3,810	1.25	92.99
24 Hour SCS Type II	2 Year	20,829	0.23	90.83	130	0.18	92.31
	5 Year	29,591	0.33	91.03	284	0.31	92.40
	100 Year	132,662	0.85	92.16	10,521	1.51	93.27
25 mm 4 hour Chicago		9,239	0.06	90.66	40	0.08	92.21
SENSITIVITY ANALYSIS							
July 1, 1979 Historical		88,133	0.70	91.75	12,330	2.48	93.33
100 year 3 hour Chicago + 20%		79,775	0.66	91.66	9,913	1.49	93.25
100 year 24 hour SCS Type II + 20%		196,494	1.15	92.67	16,954	1.66	93.45

*Extended storage only (Total Storage - Permanent Storage). In the Kizell Cell, the Permanent Water Level is 92.1 m with a permanent storage of 6 m^3. In the Beaver Cell, the Permanent Water Level is 90.42 m with a permanent storage of 35,209 m^3.

Table 5.10: Hydraulic Model Results for Beaver Pond – Stage 9 Interim Development Conditions

STORM EVENT		BEAVER CELL			KIZELL CELL		
		STORAGE* (M^3)	OUTFLOW (M^3/S)	WATER LEVEL (M)	STORAGE* (M^3)	OUTFLOW (M^3/S)	WATER LEVEL (M)
3 Hour Chicago	5 Year	19,211	0.20	90.85	53	1.05	92.21
	100 Year	50,728	0.52	91.32	898	1.94	92.63
	2 Year	22,306	0.25	90.91	52	1.05	92.21

STORM EVENT		BEAVER CELL			KIZELL CELL		
		STORAGE* (M^3)	OUTFLOW (M^3/S)	WATER LEVEL (M)	STORAGE* (M^3)	OUTFLOW (M^3/S)	WATER LEVEL (M)
24 Hour SCS Type II	5 Year	32,449	0.36	91.07	105	1.05	92.26
	100 Year	145,577	0.89	92.27	4,293	2.47	93.00
25 mm 4 hour Chicago		10,141	0.07	90.68	24	1.05	92.16
SENSITIVITY ANALYSIS							
July 1, 1979 Historical		99,232	0.74	91.86	6,769	2.58	93.11
100 year 3 hour Chicago + 20%		90,061	0.71	91.77	3,895	2.45	92.98
100 year 24 hour SCS Type II + 20%		205,685	1.30	92.74	11,677	2.68	93.28

*Extended storage only (Total Storage - Permanent Storage). In the Kizell Cell, the Permanent Water Level is 92.1 m with a permanent storage of 6 m^3. In the Beaver Cell, the Permanent Water Level is 90.42 m with a permanent storage of 35,209 m^3.

With the proposed beaver control structure, flow from the Kizell Cell to Beaver Cell has a higher peak flow but shorter duration compared to existing conditions. The timing of the peak flow through the structure occurs prior to the peak of the areas tributary to Beaver Cell. Consequently, the peak water levels in Beaver Pond are not impacted by the higher peak flow through the structure.

Water levels, storage and outflows with the development of Stage 9 remain within the water quantity design criteria as summarised in **Table 5.11**.

Table 5.11: Design Criteria Assessment for the 100 Year Storm Event

	CRITERIA	NOTES
Release Rate from Beaver Cell	< 0.96 cms	Maintained during all storm events with the exception of on one sensitivity run (100 year SCS Type II + 20% storm event)
Water Level in Beaver Cell	< 92.60 m	
Water Level in Kizell Cell	< 93.69 m	Maintained during all storm events

5.6 Quality Control

5.6.1 Shirley's Brook and Kizell Drain

Oil and grit separators are proposed for the minor system flow to Shirley's Brook and Kizell Drain. This is described in detail in **Section 4**.

5.6.2 Beaver Pond

Beaver Pond is a retrofit facility requiring water quality control targets as established in the MOE Certificate of Approval (November 2008). The Beaver Pond should provide an Enhanced Level of Protection which corresponds to 80% TSS removal as per the Ontario Ministry of the Environment (MOE) *Stormwater Management Planning and Design Manual* (March 2003).

According to MOE Stormwater Management Planning and Design Manual (March 2003), the treatment volume is a function of the drainage area, the urban imperiousness ratio (calculation provided in **Appendix A**) and the level of protection. The Enhanced Level of Protection corresponds to end-of-pipe storage volumes required for the long-term average removal of 80%

of total suspended solids. The storage requirement calculations for detention volume and permanent pool with the development of Stage 9 are provided within **Appendix D**, and summarised below.

Table 5.12: Water Quality Storage Volume Requirement

ENHANCED PROTECTION LEVEL (80% REMOVAL OF TSS)							
Tributary Urban Drainage Area (ha)	Impervious % Pond Type (Unit Storage)	STORAGE VOLUME (M^3)					
		PERMANENT		EXTENDED		TOTAL	
		REQUIRED	PROVIDED	REQUIRED	PROVIDED	REQUIRED	PROVIDED
444	31 % Hybrid Wet Pond/Wetland (103 m^3/ha)	27,864	35,210	17,753	154,657	45,617	189,857

The above calculations indicate that according to MOE Guidelines the required total storage is 45,617 m^3 consisting of permanent and extended storage volumes of 27,864 m^3 and 17,753 m^3 respectively. The total water quality storage provided by Beaver Pond is 189,857 m^3 consisting of a permanent storage volume of 35,210 m^3 and an extended detention storage volume of 154,647 m^3. The Beaver Pond provides the necessary storage for water quality.

Water quality within the Beaver Pond has been assessed using the criteria for a Hybrid Wet Pond/Wetland from the MOE Stormwater Management Planning and Design Manual (March 2003). Based on that criteria, the Beaver Pond provides the required water quality storage volume. As noted above, Beaver Pond is a retrofit facility for quality purposes and it is anticipated that the Certificate of Approval will be amended to reflect this.

5.7 Recipient Watercourses

As noted in **Section 5.3.2.1**, Stage 9 is tributary to Shirley's Brook and the Kizell Drain. The interconnection of model inputs and outputs for the Upper Kizell, Watt's Creek, and Shirley's Brook are provided in **Figures 5.3A** and **5.3B** for existing conditions models and interim conditions models. These models are discussed in further detail in the SWM Serviceability Report (February 2017).

5.7.1 Kizell Drain

5.7.1.1 Existing Conditions

The existing conditions hydrologic and hydraulic models from the 2015 Phase 2 Report have been used to compare to the results of the Stage 9 conditions. The existing conditions models have been re-run with the storm events and model timesteps listed in **Section 5.4.1.1** to allow for a direct comparison of the model results from the development of Stage 9.

The existing conditions models remain unchanged with the exception of two (2) updates to the hydraulic (HEC-RAS) model:

- Area 2P has been added to reflect the development of Kimmins Court and Areas KD-A-2 and KD-2A-3 have been adjusted accordingly.

Updated existing conditions models can be found on a CD in **Appendix D**.

FIGURE 5-3A: EXISTING CONDITIONS

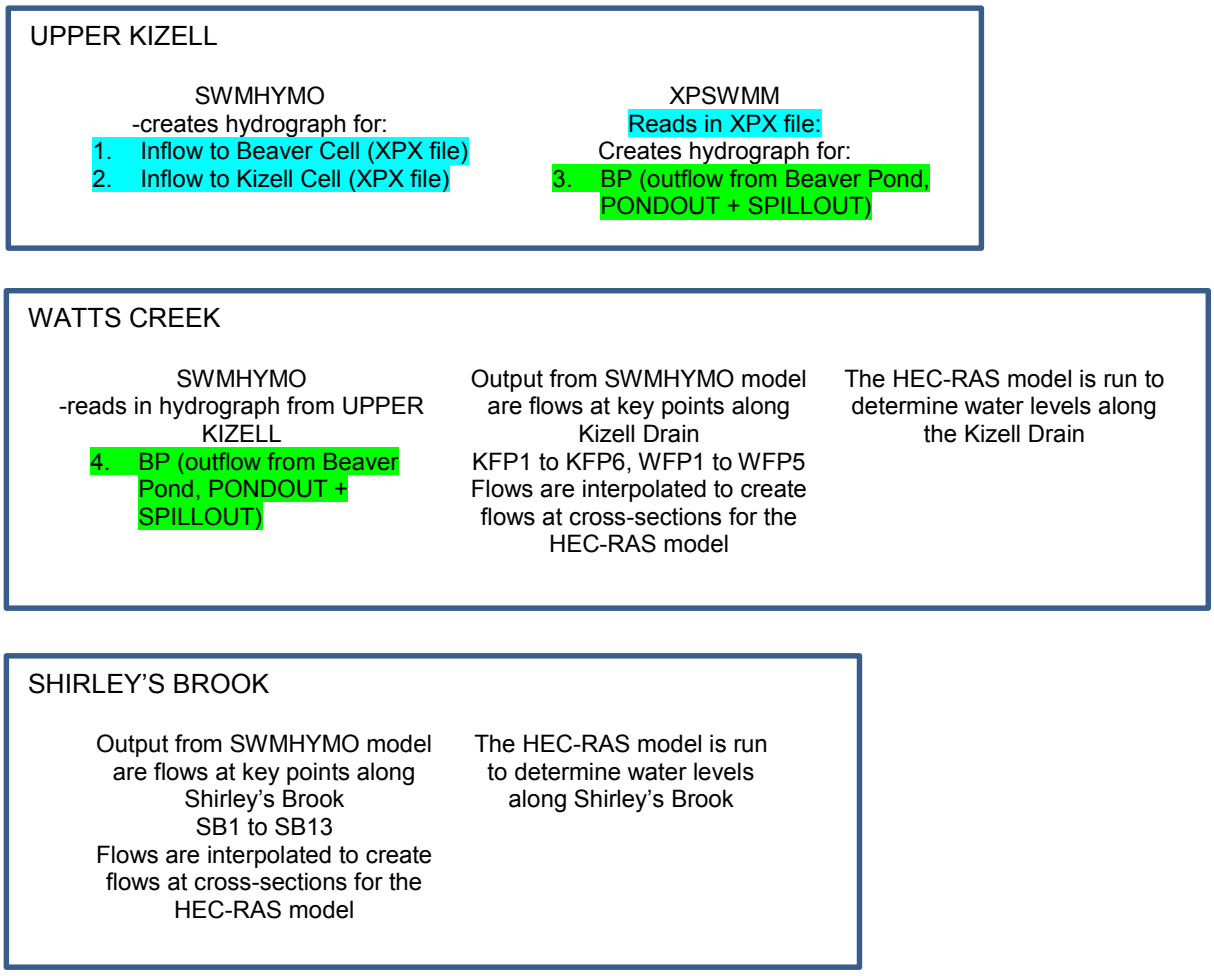
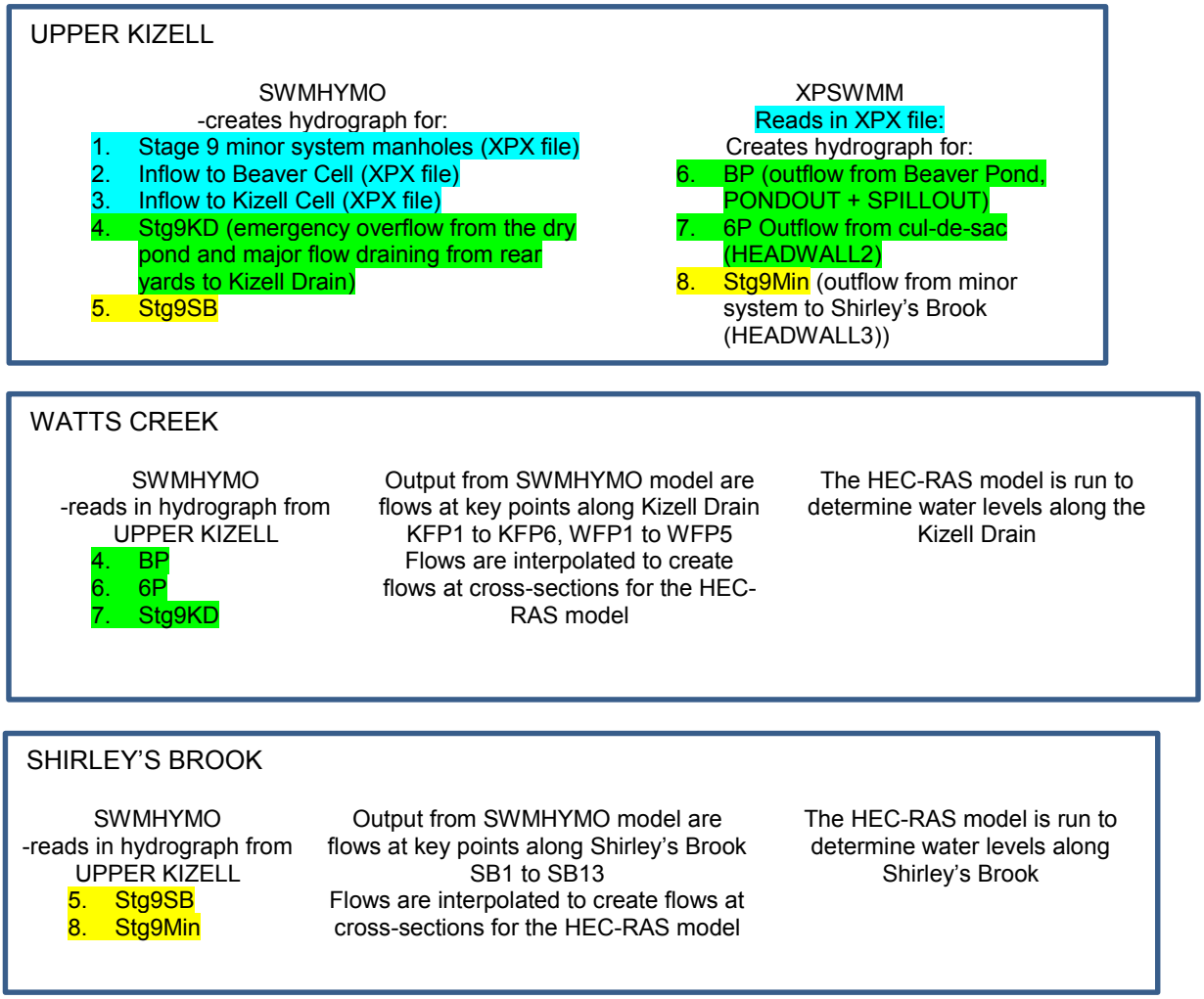


FIGURE 5-3B: INTERIM CONDITIONS



5.7.1.2 Interim Conditions

The Beaver Pond is tributary to the Kizell Drain. Outputs from the hydrologic and hydraulic models for the Upper Kizell were imported into the SWMHYMO model for Watt's Creek (see **Figure 5.4** for the SWMHYMO schematic).

Under existing conditions, there are three (3) areas which contribute flow at point KFP2: KD-1, KD-2A-1, and 2P. The development of Stage 9 encompasses a large portion of the KD-2A-1 area. Under interim conditions there are two (2) additional areas that contribute flow to the Kizell Drain at KFP2: 6P and Stg9KD. Flow contributions from each area are shown in **Table 5.13** and **Table 5.14** for existing and interim conditions respectively.

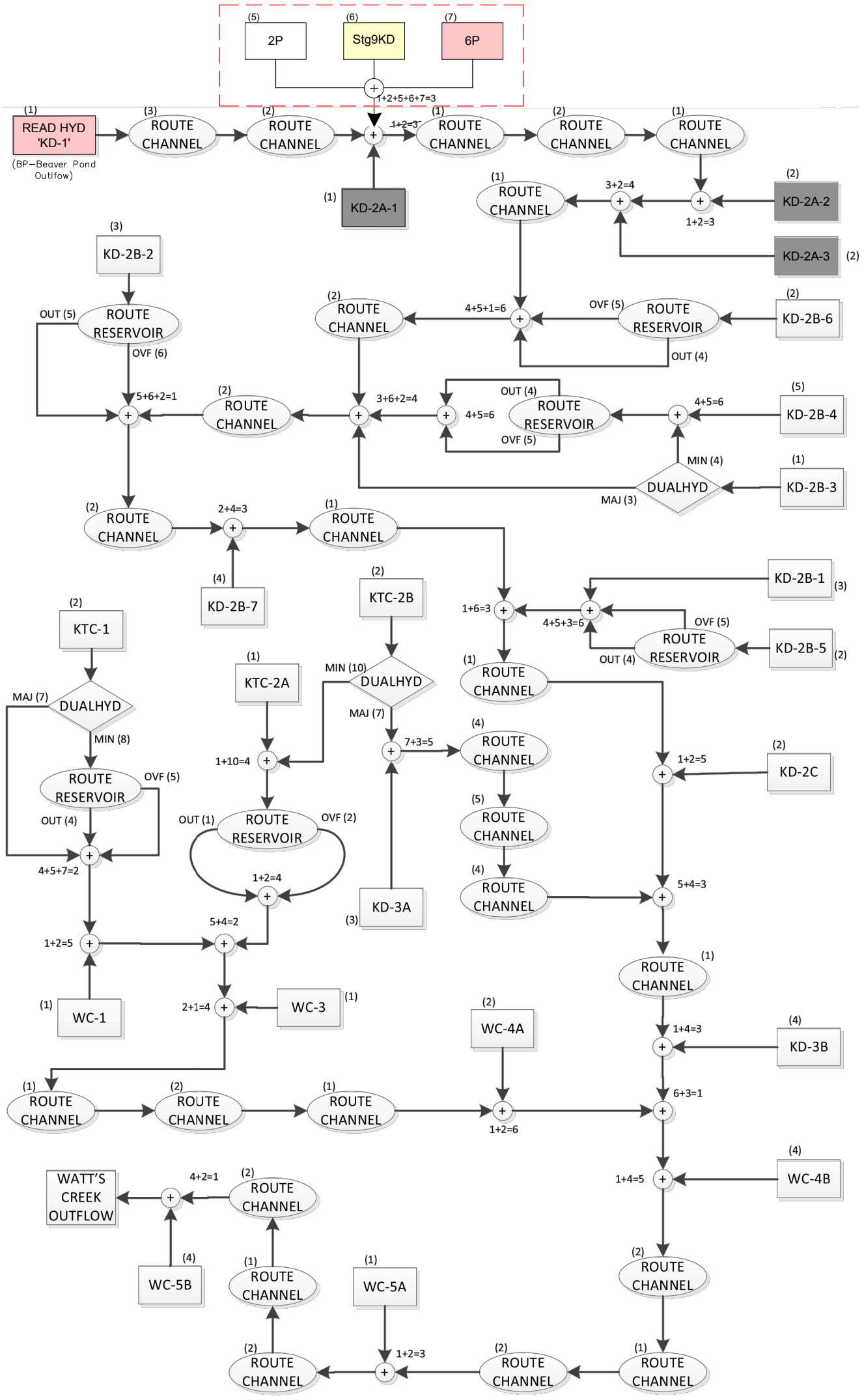
Table 5.13: Flow Rates along the Kizell Drain – Existing Conditions

DRAINAGE AREA	LOCATION	24 HOUR SCS TYPE II				100 YEAR CHICAGO FLOW (CMS) [PEAK TIMING] (HRS)	JULY 1, 1979 FLOW (CMS) [PEAK TIMING] (HRS)
		2 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	5 FLOW (CMS) [PEAK TIMING] (HRS)	FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR + 20% FLOW (CMS) [PEAK TIMING] (HRS)		
KD-1 (KFP1)	Outflow from Beaver Pond	0.23 [41.25]	0.33 [41.08]	0.85 [24.83]	1.33 [24.25]	0.46 [11.5]	0.70 [9.17]
KD-2A-1	Existing area encompassing the location of the Stage 9 development	0.032 [16.00]	0.055 (16.00)	0.153 [15.6]	0.212 [15.10]	0.105 [3.00]	0.16 [3.00]
2P	Kimmins Court	0.149 [12.10]	0.226 (12.10)	0.517 [12.05]	0.706 [12.05]	0.517 [1.06]	0.504 [1.67]
Total	**Flow Point KFP2**	**0.23 [41.55]**	**0.34 (40.35)**	**0.97 [23.25]**	**1.48 [24.05]**	**0.56 [1.06]**	**0.81 [7.67]**

Table 5.14: Contributing Flows to Flow Point KFP2 – Stage 9 Interim Conditions

DRAINAGE AREA	LOCATION	24 HOUR SCS TYPE II				100 YEAR CHICAGO FLOW (CMS) [PEAK TIMING] (HRS)	JULY 1, 1979 FLOW (CMS) [PEAK TIMING] (HRS)
		2 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	5 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR + 20% FLOW (CMS) [PEAK TIMING] (HRS)		
KD-1 (KFP1)	Outflow from Beaver Pond	0.25 [37.67]	0.36 [37.42]	0.89 [24.75]	1.77 [23.58]	0.52 [8.92]	0.74 [8.50]
KD-2A-1	Existing area encompassing the location of	0.008 [15.60]	0.01 [14.60]	0.04 [14.10]	0.06 [14.00]	0.03 [3.00]	0.04 [3.00]

WATT'S CREEK



LEGEND:

- FROM UPPER KIZELL SWMHYMO MODEL
- FROM UPPER KIZELL XPSWMM MODEL
- EXISTING AREA MODIFIED FOR POST-DEVELOPMENT EVALUATION
- MODIFICATIONS / ADDITIONS TO REFLECT POST-DEVELOPMENT CONDITIONS

NOTE:

THE EXISTING CONDITIONS SINGLE EVENT UPPER KIZELL SWMHYMO MODEL CREATED FOR THE "SHIRLEY`S BROOK AND WATT`S CREEK PHASE 2 STORMWATER MANAGEMENT STUDY" (AECOM, APRIL 2015) WAS CONVERTED TO A CONTINUOUS SWMHYMO MODEL AND DOCUMENTED IN "CONTINUOUS MODELING OF BEAVER AND KIZELL PONDS UNDER EXISTING CONDITIONS" (JFSA, JUNE 2015).
FOR CONTINUOUS MODELING PURPOSES ALL URBAN DRAINAGE AREAS WERE CONVERTED INTO TWO NASHYD COMMANDS WHICH WERE ADDED TOGETHER BEFORE BEING INCLUDED IN THE SYSTEM. THE SWMHYMO SCHEMATIC FOR THE EXISTING AREA DOES NOT REFLECT THIS DIRECTLY.

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	KANATA LAKES - STAGE 9	SWMHYMO SCHEMATIC WATT'S CREEK	FIGURE 5.4

DRAINAGE AREA	LOCATION	24 HOUR SCS TYPE II				100 YEAR CHICAGO FLOW (CMS) [PEAK TIMING] (HRS)	JULY 1, 1979 FLOW (CMS) [PEAK TIMING] (HRS)
		2 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	5 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR + 20% FLOW (CMS) [PEAK TIMING] (HRS)		
	the Stage 9 development						
2P	Kimmins Court	0.15 [12.10]	0.23 [12.10]	0.52 [12.05]	0.70 [12.05]	0.52 [1.06]	0.50 [1.67]
6P	Minor system outflow from cul-de-sac in Stage 9	0.19 [11.92]	0.28 [11.92]	0.51 [12.00]	0.52 [12.00]	0.45 [1.08]	0.51 [1.67]
Stg9KD	Emergency overflow from dry pond and major flow draining from rear yards to Kizell Drain	0 [0]	0.00 [0]	0.12 [12.03]	0.31 [12.03]	0.09 [1.00]	0.07 [1.68]
Total	**Flow Point KFP2**	**0.33 [12.00]**	**0.49 [12.00]**	**1.19 [12.03]**	**1.80 [23.40]**	**1.00 [1.05]**	**1.14 [1.67]**

Note: Timing of peak flows are shown in brackets

Flow rates for the various design storm events along the entire Kizell Drain are provided in **Table 5.15** and **Table 5.16** for existing and interim-development conditions. **Figure 2** from the 2015 Phase 2 report is provided in **Appendix D** and provides the locations of each of the flow points.

Table 5.15: Flow Rates along the Kizell Drain – Existing Conditions

FLOW POINT	LOCATION	24 HOUR SCS TYPE II				100 YEAR CHICAGO FLOW (CMS)	JULY 1, 1979 FLOW (CMS)
		2 YEAR FLOW (CMS)	5 YEAR FLOW (CMS)	100 YEAR FLOW (CMS)	100 YEAR +20% FLOW (CMS)		
KIZELL DRAIN							
KFP1	Outlet of Beaver Pond	0.23	0.33	0.85	1.33	0.46	0.70
KFP2	Rail Line	0.23	0.34	0.97	1.48	0.56	0.81
KFP3	March Road/Station Road	0.66	1.05	2.81	3.85	2.52	3.58
KFP4	Herzberg Road	3.04	4.81	11.71	15.90	10.99	15.54
KFP5	Carling Avenue	2.77	4.38	10.76	14.42	9.73	14.00
KFP6	Kizell Drain Outlet	4.90	7.69	17.80	23.83	15.81	22.90
WATT'S CREEK							
WFP1	U/S of confluence with Kizell Drain	5.28	7.26	17.44	23.80	18.00	23.43

FLOW POINT	LOCATION	24 HOUR SCS TYPE II				100 YEAR CHICAGO FLOW (CMS)	JULY 1, 1979 FLOW (CMS)
		2 YEAR FLOW (CMS)	5 YEAR FLOW (CMS)	100 YEAR FLOW (CMS)	100 YEAR +20% FLOW (CMS)		
KIZELL DRAIN							
WFP2	Downstream of confluence with Kizell Drain	9.65	14.90	35.24	47.63	32.04	46.33
WFP3	Watt's Creek	9.86	15.26	36.16	48.87	32.70	47.28
WFP4	Carling Avenue	9.79	15.12	35.66	47.98	32.20	45.71
WFP5	Outlet	7.64	11.51	27.53	36.83	21.99	31.35

Table 5.16: Flow Rates along the Kizell Drain – Interim Development Conditions

FLOW POINT	LOCATION	24 HOUR SCS TYPE II								SENSITVITY STORMS			
		2 YEAR FLOW (CMS)		5 YEAR FLOW (CMS)		100 YEAR FLOW (CMS)		100 YEAR +20% FLOW (CMS)		100 YEAR CHICAGO FLOW (CMS)		JULY 1, 1979 FLOW (CMS)	
		2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL
KIZELL DRAIN													
KFP1	Outlet of Beaver Pond	0.25	0.25	0.36	0.36	0.88	0.89	1.84	1.77	0.51	0.52	0.74	0.74
KFP2	Rail Line	0.32	0.32	0.47	0.49	0.93	1.19	1.90	1.82	0.86	1.00	1.11	1.14
KFP3	March Road/Station Road	0.70	0.71	1.12	1.13	2.97	3.02	4.03	4.11	2.67	2.71	3.78	3.86
KFP4	Herzberg Road	3.08	3.08	4.88	4.89	11.88	11.93	16.14	16.21	11.13	11.17	15.74	15.81
KFP5	Carling Avenue	2.81	2.81	4.45	4.45	10.88	10.93	14.60	14.66	9.84	9.87	14.12	14.17
KFP6	Kizell Drain Outlet	4.94	4.94	7.75	7.75	17.91	17.96	23.97	24.02	15.90	15.93	22.99	23.04
WATT'S CREEK													
WFP1	U/S of confluence with Kizell Drain	5.28	5.28	7.26	7.26	17.44	17.44	23.80	23.80	18.00	18.00	23.43	23.43
WFP2	Downstream of confluence with Kizell Drain	9.70	9.69	14.95	14.95	35.34	35.39	47.77	47.82	32.19	32.21	46.42	46.46
WFP3	Watt's Creek	9.91	9.91	15.31	15.31	36.27	36.32	49.01	49.05	32.85	32.87	47.73	47.41
WFP4	Carling Avenue	9.83	9.83	15.16	15.16	35.75	35.80	48.02	48.06	32.26	32.28	45.70	45.75
WFP5	Outlet	7.67	7.67	11.55	11.55	27.57	27.61	36.84	36.87	22.02	22.05	31.33	31.36

Notes: 2017 results are from the SWM Servicing Report (February 2017)
Detail results are from the detail design modeling

Fine grading at detailed design for Stage 9 has required that some major flow from rear yards be directed to Kizell Drain. Flows within the Kizell Drain are increased with the development of Stage

9 development however, further downstream of Beaver Pond outlet in Watt's Creek these differences become less significant.

5.7.1.3 Kizell Drain Assessment

Hydraulic evaluation of the Kizell Drain was completed in HEC-RAS using output flows from the hydrologic model. Peak flows generated at key locations along Kizell Drain and Watt's Creek were extracted from the SWMHYMO model and used to create the steady flow data used in the hydraulic model (HEC-RAS).

The methodology used in the 2015 Phase 2 Report to associate peak flows with HEC-RAS cross-sections has been utilised. This is summarised in **Appendix D** and an excel spreadsheet is also provided to show the interpolation of the flows between cross-sections.

The interim conditions HEC-RAS model includes the proposed Kizell Drain culvert updates as discussed in the *March Road Culvert Replacement Design Brief* (IBI Group, March 2017). The March Road culvert and the K4 culvert are recommended to be replaced and removed, respectively, to alleviate existing potential flooding at the adjacent Nordion property. **Table 5.17** provides the existing and proposed culvert dimensions.

Figures showing the location of cross-sections and the existing flood outlines as established with the 2015 Phase 2 Report are provided in **Appendix D** for reference.

Table 5.17: Culvert Updates in Kizell Drain

CULVERT	EXISTING CULVERT DIMENSIONS	PROPOSED CULVERT DIMENSIONS
March Road CSP (River Station 9086.378)	2.4 m x 1.5 m box culvert connected to a 1.2 m diameter CSP	2.4 m x 1.8 m box culvert
K4 Culvert (River Station 9161.24)	1.2 m diameter CSP	Culvert is removed and the area has been regraded

The design of the March Road culvert is presented in **Drawing 28661-FIG1** (see **Appendix D**). The culvert replacement proposed will involve removing the CSP portion of the crossing and installing a 2.4 x 1.8 m box. The alignment of the new box will be consistent with the existing CSP. It is proposed that 0.3 m of river gravel be installed within the bottom of the replaced culvert with the new culvert invert set 300 mm below the existing concrete box to accommodate the river gravel.

The replaced portion of the March Road culvert was modeled in HEC-RAS assuming the following characteristics:

- HEC-RAS ID: 640830
- Culvert size: 2.4 m span and 1.5 m rise box
- Culvert length: 46 m
- Upstream Invert: 78.15 m
- Downstream Invert: 78.10 m
- FHWA Chart #8 - Flared wingwalls
- FHWA Scale #1 - Wingwall flared 30 to 78 degrees
- Entrance Loss Coefficient: 0.2

- Exist Loss Coefficient: 0.26
- Manning's n for Top: 0.013
- Manning's n for Bottom: 0.013

The new culvert is 52 m long and 1.8 m high by 2.4 m wide. Since 0.3 m of sand is to be placed in the bottom of the culvert, it was assumed in the HEC-RAS evaluation that the bottom 0.3 m is unavailable capacity and a 1.5 m high box was used.

Also, the March Road crossing will have a bend at the interface of the new and old box culverts. Due to the limitations of HEC-RAS, the culvert was assumed to be straight. Therefore the length was shorten from the 52 m indicated on **Drawing 28661-FIG1** to 46 m in the HEC-RAS model. Consequently, the slope of the culvert was maintained and the inverts adjusted accordingly. Both above noted assumptions result in a slightly more conservative evaluation for the culvert replacement.

It should be noted that the downstream portion of the existing March Road crossing was modeled in the 2015 Phase 2 Report as a channel with an ineffective area representing the culvert. This approach is consistent within this current evaluation.

The removal of the culvert will involve disposing of the pathway and bedding along with some regrading. Modeling of the removal of the K4 culvert in HEC-RAS involved the deletion of the culvert with the cross sections upstream and downstream modified as per the proposed regrading.

5.7.1.3.1 Model Results

Hydraulic model results tables can be found in **Appendix D**. **Table 5.18** presents the resulting differences in peak flows and water elevations under existing conditions and interim conditions. Upstream of Herzberg Road there are increases in water level between 0.0 and 0.13 m. A comparison of HEC-RAS model outputs for all cross-sections where the water levels increased by greater than 0.02 m during the 100 year SCS storm event are provided in **Appendix D**. As shown in the model outputs, the resulting increases in water level do not appear to result in further encroachment of flood areas. The model results show that the difference in water levels downstream of Herzberg Road are negligible with differences in water levels less than 0.02 m.

Replacement of the March Road and K4 culverts significantly reduce water levels within the vicinity of the Nordion property between 0.75 m and 1.43 m during the 100 year SCS storm event. Water levels remain within the channel under interim development flows. This provides an improvement over existing conditions.

Table 5.18: Difference between Interim Conditions and Existing Conditions Flows and Water Elevations

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)
10234.89		0.09	0.06	0.16	0.07	0.22	0.05	0.34	0.06	0.44	0.11
10170.75		0.09	0.06	0.16	0.05	0.22	0.05	0.34	0.06	0.44	0.14
10089.35		0.09	0.05	0.16	0.06	0.22	0.05	0.34	0.06	0.44	0.13
10047.1		0.09	0.04	0.16	0.04	0.22	0.03	0.34	0.04	0.44	0.08
10018.26		0.09	0.03	0.16	0.05	0.22	0.03	0.34	0.05	0.44	0.08
9980.843		0.09	0.05	0.16	0.05	0.22	0.04	0.34	0.05	0.44	0.11
9957.698		0.09	0.03	0.16	0.05	0.22	0.02	0.34	0.02	0.44	0.04
9907.851		0.09	0.04	0.16	0.03	0.22	0.02	0.34	0.03	0.44	0.05
9854.606		0.09	0.04	0.16	0.05	0.22	0.03	0.34	0.05	0.44	0.09

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)
9806.144		0.09	0.03	0.16	0.05	0.22	0.04	0.34	0.04	0.44	0.09
9795.745		0.09	0.03	0.16	0.04	0.22	0.09	0.34	0.16	0.44	0.13
9793.271		0.09	0.08	0.16	0.1	0.22	0.1	0.34	0.14	0.44	0.22
9781.939	CNR Railway Culvert										
9771.594		0.09	0.05	0.16	0.05	0.22	0.07	0.34	0.15	0.44	0.11
9767.958		0.09	0.05	0.16	0.05	0.22	0.08	0.34	0.15	0.44	0.12
9759.191	Station Rd Culvert										
9746.919		0.08	0.03	0.13	0.03	0.22	0.01	0.33	0	0.39	0.01
9743.627		0.08	0.04	0.13	0.04	0.22	0.03	0.33	0.03	0.39	0.05
9657.568		0.08	0.04	0.12	0.03	0.21	-0.04	0.32	0.03	0.33	0.03
9573.048		0.08	0.02	0.12	0.05	0.21	0.13	0.32	-0.77	0.33	0.13
9442.479		0.06	0.02	0.11	0.02	0.22	-0.69	0.29	-1.12	0.29	-0.46
9363.261		0.06	0	0.1	0	0.22	-0.66	0.28	-1.13	0.24	-0.48
9339.857		0.06	0	0.1	0	0.22	-0.66	0.28	-1.13	0.24	-0.48
9338.062		0.06	-0.01	0.1	0	0.22	-0.67	0.28	-1.15	0.24	-0.48
9327.433	Nordion K5 Culvert										
9318.861		0.06	-0.01	0.1	-0.01	0.22	-0.74	0.28	-1.38	0.24	-0.55
9315.228		0.06	-0.01	0.1	-0.01	0.22	-0.73	0.28	-1.36	0.24	-0.55
9252.569		0.05	-0.03	0.08	-0.03	0.21	-0.81	0.26	-1.44	0.19	-0.62
9176.041		0.05	-0.11	0.08	-0.18	0.21	-1.05	0.26	-1.56	0.19	-0.85
9169.896		0.05	-0.22	0.08	-0.3	0.21	-1.12	0.26	-1.58	0.19	-0.94
9161.24	Nordion K4 Culvert										
9154.916		0.05	0	0.08	-0.07	0.21	-1.09	0.26	-1.56	0.19	-0.85
9151.77		0.05	-0.04	0.08	-0.14	0.21	-1.12	0.26	-1.58	0.19	-0.89
9131.887		0.05	-0.1	0.08	-0.18	0.21	-1.13	0.26	-1.59	0.19	-0.89
9096.603		0.05	-0.19	0.08	-0.25	0.21	-1.2	0.26	-1.62	0.19	-0.97
9094.472		0.05	-0.31	0.08	-0.41	0.21	-1.43	0.26	-1.74	0.19	-1.17
9086.378	March Road CSP										
9040.378		0.05	-0.05	0.08	0.02	0.21	0.1	0.26	0.08	0.19	0.08
8991.378		0.04	0.01	0.08	0	0.21	0.03	0.27	0.04	0.18	0.03
8985.021		0.04	0	0.08	0.01	0.21	0.02	0.27	0.02	0.18	0.02
8942.456		0.04	0.01	0.08	0.01	0.21	0.02	0.27	0.01	0.18	0.01
8884.583		0.04	0.01	0.08	0.02	0.21	0.02	0.27	0.01	0.18	0.02
8831.092		0.04	0.01	0.08	0.02	0.21	0.01	0.27	0.02	0.18	0.01
8796.271		0.04	0.01	0.08	0.01	0.21	0.02	0.27	0.02	0.18	0.02
8751.318		0.04	0.01	0.08	0.02	0.21	0.02	0.27	0.02	0.18	0.02
8748.076		0.04	0.01	0.08	0.02	0.21	0.01	0.27	0.03	0.18	0.01
8730.992	Legget Drive										
8712.486		0.04	0	0.08	0.01	0.21	0.02	0.27	0.06	0.18	0.01
8703.631		0.05	0.01	0.08	0.01	0.22	0.02	0.28	0.01	0.18	0.02
8616.693		0.05	0.01	0.08	0.01	0.22	0.02	0.28	0.01	0.18	0.01
8531.291		0.05	0	0.08	0.01	0.22	0.01	0.28	0.01	0.18	0.01
8512.276		0.05	0.01	0.08	0.01	0.22	0.02	0.28	0.02	0.18	0.01
8510.656	Pedestrian Bridge - Farrar Road										
8508.619		0.05	0.01	0.08	0.01	0.22	0.02	0.28	0.02	0.18	0.02
8470.617		0.05	0.01	0.08	0.01	0.22	0.01	0.28	0.01	0.18	0.01
8428.704		0.05	0	0.08	0	0.22	0.02	0.28	0.02	0.18	0.01
8329.198		0.05	0.01	0.08	0.01	0.22	0.02	0.28	0.01	0.18	0.01
8236.271		0.04	0.01	0.07	0.01	0.22	0.03	0.29	0.02	0.18	0.02
8115.263		0.04	0.01	0.07	0	0.22	0.06	0.29	0.02	0.18	0.04
8003.485		0.04	0.01	0.07	0.01	0.22	0.05	0.29	0.01	0.18	0.05
7903.683		0.04	0.01	0.07	0.01	0.22	0.05	0.29	0.02	0.18	0.05
7847.556		0.05	0.01	0.07	0.01	0.22	0.05	0.3	0.02	0.18	0.05
7747.399		0.05	0.01	0.07	0.01	0.22	0.05	0.3	0.02	0.18	0.05
7691.759		0.05	0.01	0.07	0.01	0.22	0.06	0.3	0.02	0.18	0.06
7640.349		0.05	0.01	0.07	0.01	0.22	0.06	0.3	0.02	0.18	0.06
7596.24		0.05	0.01	0.07	0.02	0.22	0.06	0.3	0.01	0.18	0.06
7588.42		0.05	0.01	0.07	0.01	0.22	0.05	0.3	0.01	0.18	0.06
7573.092	Marsh Sparrow Private										
7559.345		0.05	0	0.07	0.01	0.22	0.01	0.3	0.01	0.18	0.01

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)
7547.932		0.05	0	0.07	0.01	0.22	0.01	0.3	0.01	0.18	0.01
7489.235		0.05	0.01	0.07	0.02	0.22	0.01	0.3	0.01	0.18	0.01
7438.877		0.04	0.01	0.08	0.02	0.22	0	0.31	0.01	0.18	0.01
7386.879		0.04	0.01	0.08	0.01	0.22	0.01	0.31	0.01	0.18	0.01
7324.579		0.04	0	0.08	0.01	0.22	0	0.31	0.01	0.18	0.01
7280.889		0.04	0.01	0.08	0.02	0.22	0.01	0.31	0.01	0.18	0.02
7276.354		0.04	0.01	0.08	0.01	0.22	0	0.31	0.01	0.18	0.01
7259.491	Legget Drive										
7242.107		0.04	0	0.08	0	0.22	0.03	0.31	0.01	0.18	0.02
7229.969		0.04	0.01	0.08	0	0.22	0.03	0.31	0	0.18	0.03
7161.913		0.04	0	0.08	0.01	0.22	0.03	0.31	0.01	0.18	0.02
7125.073		0.04	0	0.08	0.01	0.22	0.03	0.31	0.01	0.18	0.02
7058.454		0.04	0.01	0.08	0.01	0.22	0.04	0.31	0.01	0.18	0.03
7025.94		0.04	0	0.08	0.02	0.22	0.03	0.31	0	0.18	0.03
7020.547		0.04	0.01	0.08	0.01	0.22	0.03	0.31	0	0.18	0.03
7000.502	Herzberg Road										
6984.227		0.04	0.01	0.07	0.01	0.17	0.01	0.24	0.01	0.14	0.01
6974.809		0.04	0	0.07	0.01	0.17	0.01	0.24	0.01	0.14	0.01
6834.839		0.04	0.01	0.07	0.01	0.17	0.01	0.24	0.01	0.14	0.01
6705.311		0.04	0.01	0.07	0.01	0.17	0.01	0.24	0.01	0.14	0.01
6550.151		0.04	0	0.07	0.01	0.17	0.02	0.24	0.01	0.14	0.01
6542.144		0.04	0.01	0.07	0.01	0.17	0.01	0.24	0.01	0.14	0.01
6522.792	Carling Avenue										
6500.704		0.04	0	0.06	0.01	0.17	0.01	0.23	0.01	0.13	0.01
6486.45		0.04	0.01	0.06	0.01	0.17	0	0.23	0.01	0.13	0.01
6384.713		0.04	0.01	0.06	0.01	0.17	0.01	0.22	0	0.13	0
6243.84		0.04	0.01	0.06	0.01	0.17	0	0.22	0	0.13	0
6137.62		0.04	0.01	0.06	0	0.17	0.01	0.2	0	0.12	0
6135.225		0.04	0.01	0.06	0.01	0.17	0.01	0.2	0	0.12	0.01
6129.747	Carling Avenue (K2)										
6126.151		0.04	0.01	0.06	0	0.17	0.01	0.2	0.01	0.12	0
6104.633		0.04	0	0.06	0	0.17	0.01	0.2	0.01	0.12	0
5934.876		0.04	0	0.06	0	0.16	0.01	0.2	0.01	0.13	0.01
5846.72		0.04	0.01	0.06	0	0.16	0.01	0.2	0.01	0.13	0.01
5691.871		0.04	0	0.06	0	0.16	0.01	0.19	0	0.12	0.01
5574.705		0.04	0	0.05	0	0.15	0.01	0.19	0	0.17	0.01
5432.364		0.05	0.01	0.05	0	0.16	0.01	0.18	0	0.17	0.01
5258.586		0.05	0	0.05	0	0.16	0.02	0.18	0.01	0.17	0
4958.865		0.04	0	0.04	0	0.13	0.02	0.09	0.01	0.08	0.01
4811.161		0.04	0	0.04	0	0.13	0.01	0.09	0.01	0.08	0.01
4746.21		0.04	0.01	0.04	0	0.13	0.01	0.09	0.01	0.08	0.01
4739.756		0.04	0	0.04	0.01	0.13	0.01	0.09	0.01	0.08	0
4717.456	Canadian National Railway (K4)										
4696.874		0.04	0	0.04	0.01	0.13	0	0.09	0	0.08	0
4677.806		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
4649.787		0.04	0	0.04	0.01	0.13	0.01	0.09	0	0.08	0
4623.083		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
4542.956		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
4446.172		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
4323.325		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
4298.712		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
4180.449		0.04	0.01	0.04	0	0.13	0	0.09	0	0.08	0
4071.257		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0
3897.472		0.04	0.01	0.04	0	0.13	0	0.09	0	0.08	0.01
3806.132		0.04	0	0.04	0	0.13	0	0.09	0	0.08	0.01
3736.303		0.04	0	0.04	0	0.13	0.01	0.09	0	0.08	0
3712.739		0.04	0	0.04	0	0.13	0.01	0.09	0	0.08	0
3691.656	Carling Road										
3669.048		0.04	0	0.04	0	0.13	0	0.08	0.01	0.09	0
3649.255		0.04	0	0.04	0	0.13	0	0.08	0	0.09	0

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)	FLOW (CMS)	ELEV (M)
3627.228		0.04	0	0.04	0.01	0.13	0	0.08	0	0.09	0
3469.421		0.04	0	0.04	0	0.13	0	0.08	0	0.09	0.01
3328.888		0.04	0	0.04	0	0.13	0	0.08	0	0.09	0
3227.732		0.04	0	0.04	0	0.13	0	0.08	0.01	0.09	0
3098.158		0.04	0	0.04	0	0.13	0	0.08	0	0.09	0
3020.422		0.04	0	0.04	0	0.13	0	0.08	0	0.09	0
2981.379		0.04	0	0.04	0	0.13	0	0.08	0	0.09	0
2964.234		0.04	0	0.04	0	0.11	0	0.06	0.01	0.08	0
2958.099	Sandhill Road										
2951.912		0.04	0	0.04	0	0.11	0	0.06	0	0.08	0
2920.728		0.04	0	0.04	0	0.11	0	0.06	0	0.08	0.01
2817.591		0.04	0	0.04	0	0.11	0	0.06	0	0.08	0
2743.763		0.04	0	0.04	0	0.11	0	0.06	0	0.08	0
2564.664		0.04	0	0.04	0	0.11	0.01	0.06	0	0.08	0
2444.164		0.04	0.01	0.04	0	0.11	0	0.06	0	0.08	0.01
2266.167		0.03	0	0.04	0	0.1	0	0.06	0	0.07	0
2205.163		0.03	0	0.04	0	0.1	0	0.06	0	0.07	0
2070.458		0.03	0	0.04	0	0.1	0	0.06	0	0.07	0
1958.025		0.03	0	0.04	0	0.1	0	0.06	0	0.07	0.01
1816.877		0.03	0	0.04	0	0.1	0	0.06	0	0.07	0.01
1752.297		0.03	0	0.04	0	0.1	0	0.06	0	0.07	0
1585.543		0.03	0.01	0.04	0	0.1	0	0.06	0	0.07	0
1491.815		0.03	0	0.04	0	0.1	0	0.06	0	0.06	0
1383.557		0.03	0	0.04	0	0.1	0	0.06	0	0.06	0
1269.687		0.03	0.01	0.04	0.01	0.1	0	0.06	0	0.06	0
1057.547		0.03	0	0.04	0	0.1	0	0.06	0	0.06	0.01
920.3455		0.03	0	0.04	0	0.1	0	0.06	0	0.06	0
673.4133		0.03	0	0.04	0	0.08	0	0.04	0.01	0.06	0.01
526.7829		0.03	0	0.04	0.01	0.08	0.01	0.04	0	0.06	0
517.7993		0.03	0.01	0.04	0.01	0.08	0.01	0.04	0	0.06	0
507.9618	Malibar Road										
497.982		0.03	0.01	0.04	0	0.08	0	0.04	0	0.06	0
482.8587		0.03	0	0.04	0.01	0.08	0	0.04	0	0.06	0.01
420.5432		0.03	0	0.04	0	0.08	0	0.04	0	0.06	0.01
381.5255		0.03	0	0.04	0	0.08	0	0.04	0	0.06	0
369.3561		0.03	0	0.04	0	0.08	0	0.04	0.01	0.06	0.01
357.438	Shirley Road										
343.1997		0.03	0	0.04	0	0.08	0	0.04	0	0.06	0.01
310.2693		0.03	0	0.04	0	0.08	0	0.04	0	0.06	0
129.4642		0.03	0	0.04	0	0.08	0	0.04	0	0.06	0
44.72172		0.03	0	0.04	0	0.08	0	0.04	0	0.06	0

5.7.1.3.2 Flood Vulnerable Structures

Flood vulnerable structures (FVS) are defined as structures that are susceptible to flooding during the 100 year SCS design storm event. There are five (5) flood vulnerable structures located on Watt's Creek / Kizell Drain as assessed in the 2015 Phase 2 Report. **Table 5.19** summarises the location of each FVS in relation to the river cross-sections. The changes in flows and water levels during the 100 year SCS design storm event under interim conditions in comparison to existing conditions are provided in the below table.

Table 5.19: Flood Vulnerable Structures and Interim Conditions Results

FLOOD VULNERABLE STRUCTURE	LOCATION	RIVER CROSS-SECTIONS	IMPACT ON FLOWS	IMPACT ON WATER LEVELS
FVS1	Between Herzberg Road and Legget Drive (See sheet 12 in **Appendix A**)	7025.94 – 7058.454	Increased by 0.22 cms under interim conditions	Increased between 0.03 to 0.04 m
FVS2		7161.913 – 7229.969		
FVS3		7280.889 – 7324.4579		Increased between 0.00 to 0.01 m
FVS4	Upstream of March Road on the Nordion property (See sheet 16 in **Appendix A**)	9094.472 – 9252.569	Increased by 0.21 cms under interim conditions	Decreased between 0.81 to 1.43 m under interim conditions
FVS5				

FVS1, FVS2, and FVS3 are located between Herzberg Road and Legget Drive. Under interim conditions flows and water levels are increased. A comparison of the HEC-RAS model outputs between existing and interim conditions is provided in **Appendix D** where the water levels increase by greater than 0.02 m. As seen in these figures, the increase in water level at these cross-sections is negligible. There is no increased risk of flooding at FVS1, FVS2, or FVS3 as a result of the development of Stage 9.

FVS4 and FVS5 are located upstream of March Road on the Nordion property. Under interim conditions flows are increased but the water levels are decreased as a result of replacing the March Road culvert and the K4 culvert. There is no increased risk of flooding at FVS4 or FVS5 as a result of the development of Stage 9.

5.7.2 Shirley's Brook

5.7.2.1 Existing Conditions

The existing conditions hydrologic and hydraulic models from the 2015 Phase 2 Report have been used to compare to the results of the Stage 9 conditions. The existing conditions models have been re-run with the storm events and model timesteps listed in **Section 5.4.1.1** to allow for a direct comparison of the model results from the development of Stage 9.

The existing conditions models remain unchanged with the exception of two (2) updates to the hydraulic (HEC-RAS) model:

- The culvert at the Canadian National Railway (cross-section 104463.11) has been updated to reflect the replacement of that culvert. Information on the replaced culvert is provided in **Appendix D**.
- The proposed Shirley's Brook realignment within the Phase 7 development between Terry Fox Drive Goulbourn Forced Road has been added.

The updated existing conditions models can be found on a CD in **Appendix D**.

5.7.2.2 Interim Conditions

A portion of the development of Stage 9 is within the Shirley's Brook catchment. As noted in the SWM Servicing report (February 2017), areas naturally draining to Shirley's Brook are required to remain tributary to the Brook.

The interim conditions model for Shirley's Brook has been modified to account for the area being developed by Stage 9. The development covers two (2) areas of Northtech Campus within the

existing conditions model. Areas Northtech-719 and Northtech-8a have been reduced to 56.81 ha (from 61.89 ha) and 378.11 ha (378.52 ha) respectively to account for this.

Hydrographs of major (Stg9SB) and minor (Stg9Min) flows from the Upper Kizell SWMHYMO model have been incorporated into the Interim Conditions Shirley's Brook model (see **Figure 5.5**). Flow from Stage 9 is added to Areas Northtech-8a and Northtech-791 at the location of SFP2. **Table 5.20** and **Table 5.21** show the flow contributing to SFP2 under existing and interim development conditions.

Table 5.20: Flows Contributing to Flow Point SFP2 – Existing Conditions

DRAINAGE AREA	LOCATION	24 HOUR SCS				100 YEAR CHICAGO FLOW (CMS) [PEAK TIMING] (HRS)	JULY 1, 1979 FLOW (CMS) [PEAK TIMING] (HRS)
		2 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	5 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR + 20% FLOW (CMS) [PEAK TIMING] (HRS)		
8a	Flow Point 1	0.29 [16.1]	1.05 [15.4]	5.8 [15.0]	8.95 [15.0]	3.34 [4.42]	6.62 [4.5]
719		0.08 [16.0]	0.14 [16.0]	0.39 [16.0]	0.54 [15.3]	0.27 [3.0]	0.41 [3.0]
Total	**Flow Point SFP2**	**0.37 [16.0]**	**1.19 [15.4]**	**6.19 [15.0]**	**9.49 [15.0]**	**3.59 [4.42]**	**7.00 [4.5]**

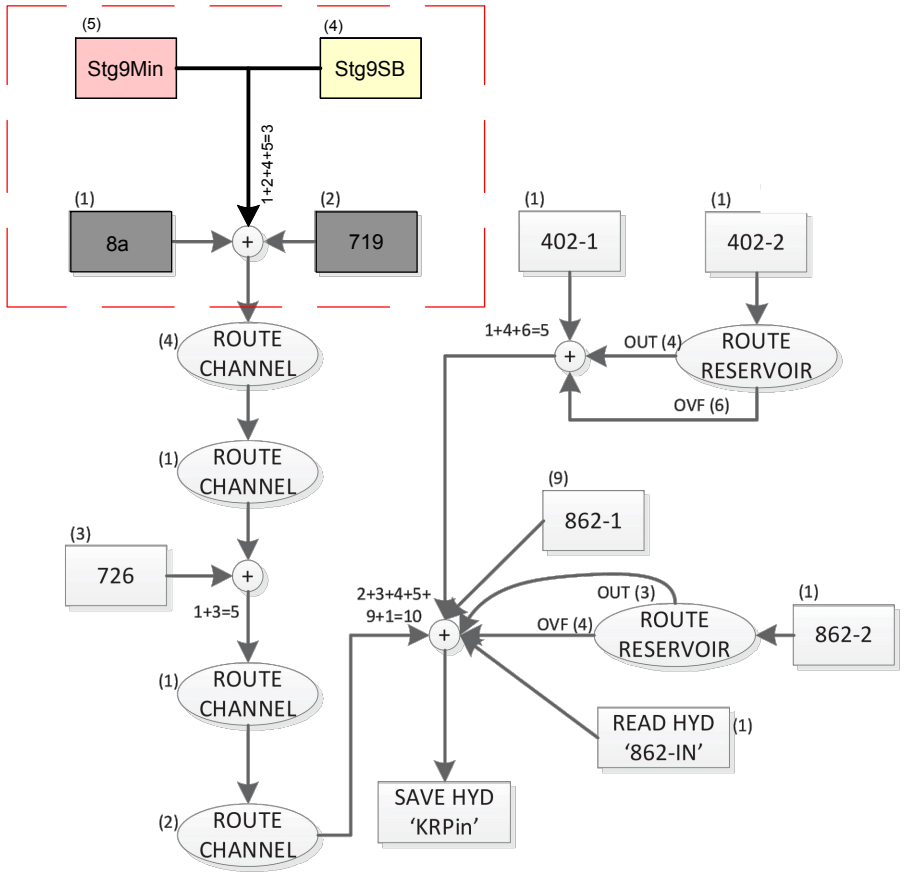
Note: Peak timing is shown in brackets

Table 5.21: Flows Contributing to Flow Point SFP2 – Interim Conditions

DRAINAGE AREA	LOCATION	24 HOUR SCS				100 YEAR CHICAGO FLOW (CMS) [PEAK TIMING] (HRS)	JULY 1, 1979 FLOW (CMS) [PEAK TIMING] (HRS)
		2 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	5 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR FLOW (CMS) [PEAK TIMING] (HRS)	100 YEAR + 20% FLOW (CMS) [PEAK TIMING] (HRS)		
8a	Flow Point 1	0.29 [16.1]	1.05 [15.4]	5.8 [15.0]	8.94 [15.0]	3.34 [4.4]	6.62 [4.5]
719		0.07 [16.0]	0.13 [16.0]	0.36 [16.0]	0.49 [15.3]	0.25 [3.0]	0.37 [3.0]
Stg9SB	Major flow from Stage 9	0.07 [12.0]	0.10 [12.0]	0.38 [12.0]	0.87 [12.0]	0.41 [1.0]	0.24 [1.7]
Stg9Min	Minor flow from Stage 9	0.32 [11.9]	0.45 [11.9]	0.74 [12.0]	0.75 [12.0]	0.72 [1.0]	0.72 [1.5]
Total	**Flow Point SFP2**	**0.42 [12.0]**	**1.20 [15.4]**	**6.19 [15.0]**	**9.49 [14.9]**	**3.57 [4.4]**	**6.96 [4.5]**

Note: Peak timing is shown in brackets

Flow rates for the various design storm events at flow points along Shirley's Brook are provided in **Table 5.22** and **Table 5.23** for existing and Interim-development conditions. **Figure 3** from the 2015 Phase 2 report is provided in **Appendix D** and provides the locations of each of the flow points.



LEGEND:

- FROM UPPER KIZELL SWMHYMO MODEL
- FROM UPPER KIZELL XPSWMM MODEL
- EXISTING AREA MODIFIED FOR POST-DEVELOPMENT EVALUATION
- MODIFICATIONS / ADDITIONS TO REFLECT POST-DEVELOPMENT CONDITIONS

NOTE:

THE EXISTING CONDITIONS SINGLE EVENT SHIRLEY'S BROOK SWMHYMO MODEL CREATED FOR THE "SHIRLEY`S BROOK AND WATT`S CREEK PHASE 2 STORMWATER MANAGEMENT STUDY" (AECOM, APRIL 2015) WAS USED AS THE BASIS FOR INTERIM CONDITIONS MODELING.

J: \102101--KNLStg9\5.9 Drawings\59civil\swm\layouts\Figure 5.5.dwg Layout Name: Figure 5.5 Plot Scale: 1:5.13 Plotted At: 2/14/2017 Last Saved By: Josee.Forget Last Saved At: Feb. 13, 17

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	KANATA LAKES - STAGE 9	SWMHYMO SCHEMATIC SHIRLEY'S BROOK	FIGURE 5.5

Table 5.22: Flow Rates along Shirley's Brook – Existing Conditions

FLOW POINT	24 HOUR SCS TYPE II				100 YEAR CHICAGO FLOW (CMS)	JULY 1, 1979 FLOW (CMS)
	2 YEAR FLOW (CMS)	5 YEAR FLOW (CMS)	100 YEAR FLOW (CMS)	100 YEAR +20% FLOW (CMS)		
SB1 (Flow Point 1)	0.29	1.05	5.80	8.95	3.34	6.62
SB2 (SFP2)	0.37	1.19	6.19	9.49	3.59	7.00
SB3 (SFP3)	0.36	1.13	6.09	9.45	3.41	6.68
SB4 (SFP4)	0.61	1.50	6.74	10.14	3.89	7.18
SB5 (SFP5)	1.19	1.93	7.17	10.68	3.96	7.21
SB6 (SFP6)	3.01	4.69	11.01	13.66	9.53	12.99
SB7 (SFP7)	4.30	4.89	12.99	17.94	10.29	16.17
SB8 (SFP8)	4.27	4.86	12.69	17.03	10.18	15.78
SB9 (SFP9)	5.74	7.18	18.48	24.31	15.18	22.99
SB10 (SFP10)	5.71	7.12	18.09	23.59	14.69	22.09
SB11 (SFP11)	5.83	7.38	18.87	25.16	15.25	23.51
SB12 (SFP12)	5.64	7.14	17.91	23.85	14.35	21.73
SB13 (SFP13)	5.77	7.55	18.68	25.10	14.77	22.10

Table 5.23: Flow Rates along Shirley's Brook – Interim Development Conditions

FLOW POINT	24 HOUR SCS TYPE II								SENSITIVITY STORMS			
	2 YEAR FLOW (CMS)		5 YEAR FLOW (CMS)		100 YEAR FLOW (CMS)		100 YEAR +20% FLOW (CMS)		100 YEAR CHICAGO FLOW (CMS)		JULY 1, 1979 FLOW (CMS)	
	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL
SB1 (Flow Point 1)	0.29	0.29	1.05	1.05	5.79	5.79	8.94	8.94	3.34	3.34	6.62	6.62
SB2 (SFP2)	0.48	0.42	1.20	1.20	6.18	6.19	9.49	9.49	3.57	3.57	6.96	6.96
SB3 (SFP3)	0.37	0.37	1.15	1.15	6.07	6.09	9.44	9.44	3.39	3.40	6.65	6.65
SB4 (SFP4)	0.63	0.62	1.53	1.52	6.72	6.75	10.14	10.14	3.88	3.88	7.16	7.16
SB5 (SFP5)	1.24	1.23	2.03	2.01	7.15	7.18	10.67	10.67	3.96	3.95	7.19	7.19
SB6 (SFP6)	3.04	3.04	4.74	4.73	11.22	11.18	14.05	13.97	9.55	9.55	13.26	13.21
SB7 (SFP7)	4.33	4.33	4.96	4.94	13.03	13.01	17.66	17.64	10.38	10.36	16.24	16.22
SB8 (SFP8)	4.31	4.30	4.92	4.91	12.79	12.76	17.04	17.02	10.27	10.25	15.86	15.84
SB9 (SFP9)	5.79	5.78	7.25	7.23	18.65	18.62	24.48	24.44	15.27	15.25	23.12	23.09
SB10 (SFP10)	5.75	5.74	7.19	7.18	18.29	18.25	23.83	23.78	14.77	14.75	22.32	22.28
SB11 (SFP11)	5.88	5.87	7.45	7.44	19.08	19.04	25.39	25.36	15.36	15.34	23.70	23.66

FLOW POINT	24 HOUR SCS TYPE II								SENSITIVITY STORMS			
	2 YEAR FLOW (CMS)		5 YEAR FLOW (CMS)		100 YEAR FLOW (CMS)		100 YEAR +20% FLOW (CMS)		100 YEAR CHICAGO FLOW (CMS)		JULY 1, 1979 FLOW (CMS)	
	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL	2017	DETAIL
SB12 (SFP12)	5.68	5.67	7.22	7.21	18.16	18.11	24.21	24.16	14.47	14.45	21.95	21.91
SB13 (SFP13)	5.82	5.81	7.64	7.62	18.87	18.83	25.44	25.38	14.91	14.88	22.34	22.30

Notes: 2017 results are from the SWM Servicing Report (February 2017)
Detail results are from the detail design modeling

As noted in **Table 5.22**, the hydrograph timing of the flows from Stage 9 does not significantly increased flows at flow point SFP2. The difference in flows at key points along Shirley's Brook are negligible between existing and under interim conditions (i.e. with the development of Stage 9).

5.7.2.2.1 Shirley's Brook Assessment

Hydraulic evaluation of Shirley's Brook was completed in HEC-RAS using output flows from the hydrologic model. Peak flows generated at key locations along Shirley's Brook were extracted from the SWMHYMO model and used to create the steady flow data used in the hydraulic model (HEC-RAS). Hydraulic model results tables can be found in **Appendix D** for existing conditions, and interim conditions.

The methodology used in the 2015 Phase 2 Report to associate peak flows with HEC-RAS cross-sections has been utilised. This is summarised in **Appendix D** and an excel spreadsheet is also provided to show the interpolation of the flows between cross-sections.

Table 5.23 compares the resulting water levels and flows under existing conditions and interim conditions downstream of the realignment. The model results show that the difference in water levels are negligible. The maximum change is an increase in water level elevation between 0.01 and 0.03 m.

Figures showing the location of cross-sections and the existing flood outlines as established with the 2015 Phase 2 Report are provided in **Appendix D** for reference.

Table 5.24: Difference between Interim Conditions and Existing Conditions Flows and Water Elevations

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)
10823.93		0.00	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00
10784.32		0.00	0.00	0.00	0.00	-0.01	0.01	-0.01	0.00	0.00	0.00
10781.03		0.00	0.00	0.00	0.00	-0.01	0.01	-0.01	0.00	0.00	0.00
10770.63	Culvert										
10758.25		0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00
10753.84		0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00
10709.87		0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00
10633.91		0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00
10574.15		0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	-0.02	0.00
10515.42		0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.00	-0.02	0.00
10473.51		0.05	0.01	0.01	0.00	0.00	-0.02	0.00	0.00	-0.02	-0.01

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)
10470.06		0.05	0.02	0.01	-0.01	0.00	-0.04	0.00	-0.03	-0.02	-0.02
10463.11	Bridge										
10453.9		0.01	0.00	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
10441.99		0.01	0.00	0.02	0.01	0.00	0.00	-0.01	0.00	-0.01	0.00
10343.18		0.01	0.01	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
10149.12		0.01	0.00	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
10028.23		0.01	0.01	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
9916.492		0.01	0.00	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
9837.811		0.01	0.01	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
9740.979		0.01	0.00	0.02	0.01	0.00	0.00	-0.01	0.00	-0.01	0.00
9623.555		0.01	0.00	0.02	0.01	0.00	0.00	-0.01	0.00	-0.01	0.00
9473.968		0.01	0.01	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
9379.995		0.01	0.00	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
9320.319		0.01	0.01	0.02	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00
9296.913		0.01	0.00	0.02	0.01	0.00	0.00	-0.01	0.00	-0.01	0.00
9269.78		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
9213.969		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
9087.692		0.01	0.01	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
9037.473		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8955.241		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8866.257		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8793.795		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8725.256		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8590.857		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8546.309		0.01	0.00	0.02	0.01	0.01	0.00	0.00	0.00	-0.01	0.00
8481.811		0.01	0.00	0.02	0.01	0.01	0.00	0.00	0.00	-0.01	0.00
8478.137		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8464.13	Culvert										
8451.362		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	0.00
8443.007		0.01	0.00	0.02	0.01	0.01	0.00	0.00	0.00	-0.01	0.00
8393.492		0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	-0.01	-0.01
8196.676		0.01	0.01	0.02	0.02	0.01	0.00	0.00	0.00	-0.01	0.00
8190.341		0.01	0.01	0.02	0.01	0.01	0.00	0.00	0.01	-0.01	0.00
8168.672	Culvert										
8147.386		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.01	-0.01	0.00
8134.654		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.01	-0.01	-0.01
7984.847		0.04	0.01	0.08	0.02	0.01	0.00	-0.01	0.01	-0.01	0.00
7921.126		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.01	-0.01	0.00
7867.032		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.01	-0.01	-0.01
7863.271		0.04	0.01	0.08	0.02	0.01	0.00	-0.01	0.01	-0.01	-0.01
7840.144	Culvert										
7818.661		0.04	0.01	0.08	0.00	0.01	0.01	-0.01	-0.01	-0.01	0.00
7809.326		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
7750.895		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
7692.484		0.04	0.01	0.08	0.02	0.01	0.00	-0.01	0.00	-0.01	0.00
7591.312		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	-0.01
7501.981		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)
7465.594		0.04	0.00	0.08	0.01	0.01	0.01	-0.01	0.00	-0.01	0.00
7451.432		0.04	0.00	0.08	0.00	0.01	0.00	-0.01	0.00	-0.01	0.00
7333.883		0.04	0.00	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
7207.136		0.04	0.00	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
7140.229		0.04	0.01	0.08	0.01	0.01	0.01	-0.01	0.00	-0.01	0.00
7047.343		0.04	0.01	0.08	0.01	0.01	0.01	-0.01	0.00	-0.01	0.00
6893.653		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
6812.767		0.04	0.01	0.08	0.01	0.01	0.01	-0.01	0.00	-0.01	0.00
6747.781		0.04	0.01	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
6683.657		0.04	0.00	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
6678.357		0.04	0.00	0.08	0.01	0.01	0.00	-0.01	0.00	-0.01	0.00
6662.563	Culvert										
6646.137		0.04	0.00	0.07	0.01	0.04	0.01	0.05	0.01	0.00	0.00
6631.114		0.04	0.00	0.07	0.01	0.04	0.00	0.05	0.00	0.00	0.01
6596.294		0.04	0.00	0.07	0.01	0.04	0.00	0.05	0.01	0.00	0.00
6565.697		0.04	0.00	0.07	0.01	0.04	0.01	0.05	0.01	0.00	0.00
6547.102		0.04	0.00	0.07	0.01	0.04	0.00	0.05	0.00	0.00	0.00
6518.839		0.03	0.00	0.07	0.01	0.07	0.00	0.12	0.01	0.00	0.00
6483.158		0.03	0.01	0.07	0.00	0.07	0.01	0.12	0.01	0.00	0.00
6410.477		0.03	0.00	0.07	0.01	0.07	0.00	0.12	0.01	0.00	0.00
6337.265		0.03	0.00	0.05	0.00	0.11	0.00	0.18	0.01	0.01	0.00
6258.598		0.03	0.00	0.05	0.00	0.11	0.01	0.18	0.00	0.01	0.00
6190.743		0.03	0.00	0.05	0.01	0.11	0.01	0.18	0.01	0.01	0.00
6178.128		0.03	0.00	0.05	0.01	0.14	0.00	0.25	0.00	0.01	0.00
6155.664	Culvert										
6136.349		0.03	0.00	0.05	0.00	0.14	0.00	0.25	0.00	0.01	0.01
6095.834		0.03	0.00	0.04	0.00	0.17	0.01	0.31	0.00	0.02	0.00
5983.689		0.03	0.01	0.04	0.00	0.17	0.00	0.31	0.00	0.02	0.00
5931.329		0.03	0.01	0.04	0.01	0.17	0.00	0.31	-0.01	0.02	0.00
5887.91		0.03	0.00	0.04	0.00	0.17	0.00	0.31	-0.01	0.02	0.00
5854.557		0.03	0.00	0.04	0.00	0.17	0.00	0.31	-0.01	0.02	0.00
5829.428		0.03	0.00	0.04	0.01	0.17	0.00	0.31	-0.01	0.02	0.01
5760.031		0.02	0.00	0.04	0.00	0.13	0.00	0.14	0.00	0.03	0.01
5688.408		0.02	0.00	0.04	0.00	0.13	0.00	0.14	0.00	0.03	0.01
5629.195		0.03	0.00	0.05	0.00	0.08	0.01	-0.05	0.00	0.05	0.00
5539.58		0.03	0.00	0.05	0.01	0.08	0.00	-0.05	-0.01	0.05	0.01
5536.916		0.02	0.01	0.05	0.01	0.04	0.01	-0.24	-0.01	0.06	0.01
5531.699	Culvert										
5527.413		0.02	0.01	0.05	0.01	0.04	0.00	-0.24	-0.01	0.06	0.01
5522.147		0.02	0.00	0.05	0.01	0.04	0.00	-0.24	-0.01	0.06	0.01
5435.197		0.03	0.00	0.05	0.01	0.02	0.00	-0.30	-0.01	0.07	0.01
5382.4		0.03	0.00	0.05	0.01	0.02	0.00	-0.30	-0.01	0.07	0.01
5373.434		0.03	0.00	0.05	0.01	0.02	0.00	-0.30	0.00	0.07	0.01
5361.118	Culvert										
5349.394		0.03	0.00	0.05	0.01	0.07	0.01	-0.01	0.01	0.07	0.00
5342.432		0.03	0.00	0.05	0.01	0.07	0.00	-0.01	0.00	0.07	0.00
5201.062		0.03	0.01	0.05	0.00	0.07	0.00	-0.01	0.00	0.07	0.00

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)
5126.834		0.03	0.01	0.05	0.00	0.07	0.00	-0.01	0.00	0.07	0.01
5062.261		0.03	0.00	0.05	0.00	0.07	0.00	-0.01	0.00	0.07	0.01
4998.115		0.03	0.01	0.05	0.00	0.07	0.01	-0.01	0.00	0.07	0.00
4901.173		0.04	0.01	0.05	0.00	0.14	0.01	0.13	0.00	0.07	0.00
4838.144		0.04	0.01	0.05	0.00	0.14	0.00	0.13	0.01	0.07	0.00
4751.767		0.04	0.00	0.05	0.01	0.14	0.00	0.13	0.00	0.07	0.00
4690.586		0.04	0.00	0.05	0.00	0.14	0.00	0.13	0.01	0.07	0.00
4635.215		0.04	0.00	0.05	0.00	0.14	0.01	0.13	0.01	0.07	0.01
4564.609		0.04	0.00	0.05	0.00	0.14	0.01	0.13	0.01	0.07	0.01
4535.882		0.04	0.00	0.05	0.00	0.14	0.01	0.13	0.02	0.07	0.00
4525.185		0.04	0.01	0.05	0.00	0.14	0.01	0.13	0.01	0.07	0.00
4507.086	Culvert										
4486.599		0.04	0.01	0.05	0.01	0.14	0.01	0.13	0.01	0.07	0.01
4462.663		0.04	0.00	0.05	0.01	0.14	0.02	0.13	0.01	0.07	0.00
4432.086		0.04	0.01	0.05	0.01	0.14	0.01	0.13	0.01	0.07	0.00
4334.765		0.04	0.00	0.05	0.00	0.14	0.01	0.13	0.01	0.07	0.00
4236.688		0.04	0.00	0.05	0.00	0.14	0.01	0.13	0.01	0.07	0.01
4167.088		0.04	0.00	0.05	0.00	0.14	0.01	0.13	0.02	0.07	0.00
4112.813		0.04	0.00	0.05	0.01	0.14	0.02	0.13	0.02	0.07	0.01
4110.796		0.04	0.00	0.05	0.01	0.14	0.02	0.13	0.02	0.07	0.00
4090.206	Culvert										
4079.661		0.04	0.00	0.06	0.01	0.17	0.00	0.20	0.00	0.09	0.00
4045.686		0.04	0.01	0.06	0.01	0.17	0.00	0.20	0.00	0.09	0.00
3964.183		0.04	0.00	0.06	0.00	0.17	0.00	0.20	0.01	0.09	0.00
3910.996		0.04	0.01	0.06	0.00	0.17	0.00	0.20	0.00	0.09	0.00
3852.352		0.04	0.00	0.06	0.00	0.17	0.00	0.20	0.00	0.09	0.00
3787.461		0.04	0.00	0.06	0.00	0.17	0.00	0.20	0.00	0.09	0.00
3713.495		0.04	0.00	0.06	0.01	0.17	0.01	0.20	0.01	0.09	0.00
3653.05		0.04	0.00	0.06	0.01	0.17	0.01	0.20	0.00	0.09	-0.01
3615.362		0.04	0.00	0.06	0.00	0.17	0.01	0.20	0.00	0.09	-0.01
3539.195		0.04	0.00	0.06	0.01	0.17	0.01	0.20	0.01	0.09	-0.01
3459.393		0.04	0.00	0.06	0.01	0.17	0.01	0.20	0.01	0.09	0.00
3361.237		0.04	0.00	0.06	0.01	0.17	0.01	0.20	0.00	0.09	-0.01
3330.8		0.04	0.01	0.06	0.01	0.17	0.00	0.20	0.01	0.09	-0.02
3320.636		0.04	0.01	0.06	0.01	0.17	0.01	0.20	0.00	0.09	-0.01
3308.937	Culvert										
3301.163		0.03	0.00	0.07	0.01	0.20	0.00	0.31	0.00	0.10	-0.07
3292.083		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.01	0.10	-0.08
3262.229		0.03	0.00	0.07	0.01	0.20	0.01	0.31	0.01	0.10	-0.08
3211.613		0.03	0.00	0.07	0.00	0.20	0.01	0.31	0.01	0.10	-0.11
3182.32		0.03	0.01	0.07	0.00	0.20	0.00	0.31	0.00	0.10	-0.16
3157.212		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.01	0.10	-0.18
3112.739		0.03	0.00	0.07	0.01	0.20	0.01	0.31	0.01	0.10	-0.21
3106.096		0.03	0.01	0.07	0.01	0.20	0.01	0.31	0.01	0.10	0.55
3100.236	Culvert										
3094.45		0.03	0.00	0.07	0.01	0.20	0.00	0.31	0.01	0.10	0.00
3086.02		0.03	0.00	0.07	0.01	0.20	0.01	0.31	0.00	0.10	0.00

RIVER STATION	LOCATION	24 HOUR SCS TYPE II								100 YEAR CHICAGO	
		2 YEAR		5 YEAR		100 YEAR		100 YEAR +20%			
		Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)	Q (CMS)	ELEV (M)
3065.567		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.00	0.10	0.00
2993.621		0.03	0.00	0.07	0.01	0.20	0.01	0.31	0.00	0.10	0.00
2926.23		0.03	0.00	0.07	0.00	0.20	0.01	0.31	0.01	0.10	0.00
2838.9		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.01	0.10	0.00
2716.764		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.01	0.10	0.00
2517.733		0.03	0.00	0.07	0.00	0.20	0.01	0.31	0.00	0.10	0.00
2400.535		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.00	0.10	0.00
2199.535		0.03	0.01	0.07	0.00	0.20	0.01	0.31	0.00	0.10	0.00
2073.74		0.03	0.01	0.07	0.00	0.20	0.00	0.31	0.00	0.10	0.00
2011.088		0.03	0.01	0.07	0.01	0.20	0.01	0.31	0.00	0.10	0.00
1869.72		0.03	0.00	0.07	0.00	0.20	0.00	0.31	0.00	0.10	0.01
1754.4		0.04	0.00	0.07	0.01	0.15	0.01	0.28	0.00	0.11	0.01
1600.626		0.04	0.00	0.07	0.00	0.15	0.00	0.28	-0.01	0.11	0.00
1476.175		0.04	0.00	0.07	0.00	0.15	0.01	0.28	-0.01	0.11	0.00
1299.13		0.04	0.00	0.07	0.00	0.15	0.00	0.28	0.03	0.11	0.00
1287.573		0.04	0.00	0.07	0.00	0.15	0.01	0.28	0.01	0.11	0.00
1276.827	Bridge										
1263.755		0.04	0.00	0.07	0.01	0.15	0.00	0.28	0.00	0.11	0.00
1247.371		0.04	0.00	0.07	0.00	0.15	0.01	0.28	0.01	0.11	0.00
1133.542		0.04	0.00	0.07	0.01	0.15	0.00	0.28	0.01	0.11	0.00
954.9156		0.04	0.00	0.07	0.00	0.15	0.00	0.28	0.00	0.11	0.00
846.8483		0.04	0.01	0.07	0.00	0.15	0.00	0.28	0.01	0.11	0.00
747.0098		0.04	0.00	0.07	0.01	0.15	0.00	0.28	0.01	0.11	0.01
632.3096		0.04	0.01	0.07	0.00	0.15	0.00	0.28	0.01	0.11	0.01
492.7144		0.04	0.00	0.07	0.01	0.15	0.00	0.28	0.00	0.11	0.00
414.3949		0.04	0.01	0.07	0.01	0.15	0.00	0.28	0.00	0.11	0.00
334.7006		0.04	0.01	0.07	0.01	0.15	0.00	0.28	0.01	0.11	0.00
246.4345		0.04	0.00	0.07	0.00	0.15	0.00	0.28	0.00	0.11	0.00
185.9653		0.04	0.00	0.07	0.01	0.15	0.01	0.28	0.01	0.11	0.00
78.72429		0.04	0.00	0.07	0.00	0.15	0.01	0.28	0.01	0.11	0.00
29.9602		0.04	0.00	0.07	0.01	0.15	0.00	0.28	0.00	0.11	0.00

5.7.2.2.2 Shirley's Brook Realignment

Modeling of the realignment (cross-section 12556.39 to cross-section 10947.39) shows that the channel has sufficient capacity to convey the flood flows. The low flow channel conveys water between the 2 and 5 year SCS design storm events. The main channel contains flows during the 100 year SCS design storm and stress tests (July 1979 historical storm event and SCS 100 year plus 20% design storm). Graphical outputs of the model results are provided in **Figure 5.6** for the 2 and 5 year design storms and the 100 year plus 20% stress test.

5.7.2.2.3 Flood Vulnerable Structures

Flood vulnerable structures (FVS) are defined as structures that are susceptible to flooding during the 100 year SCS design storm event. There are no flood vulnerable structures located on Shirley's Brook under existing conditions as assessed in the 2015 Phase 2 Report. However, there is a low point located on Shirley's Brook Drive that has potential to flood to the north if flows in this area are increased. Under interim conditions the flow at this low point increases by 0.01 cms (river

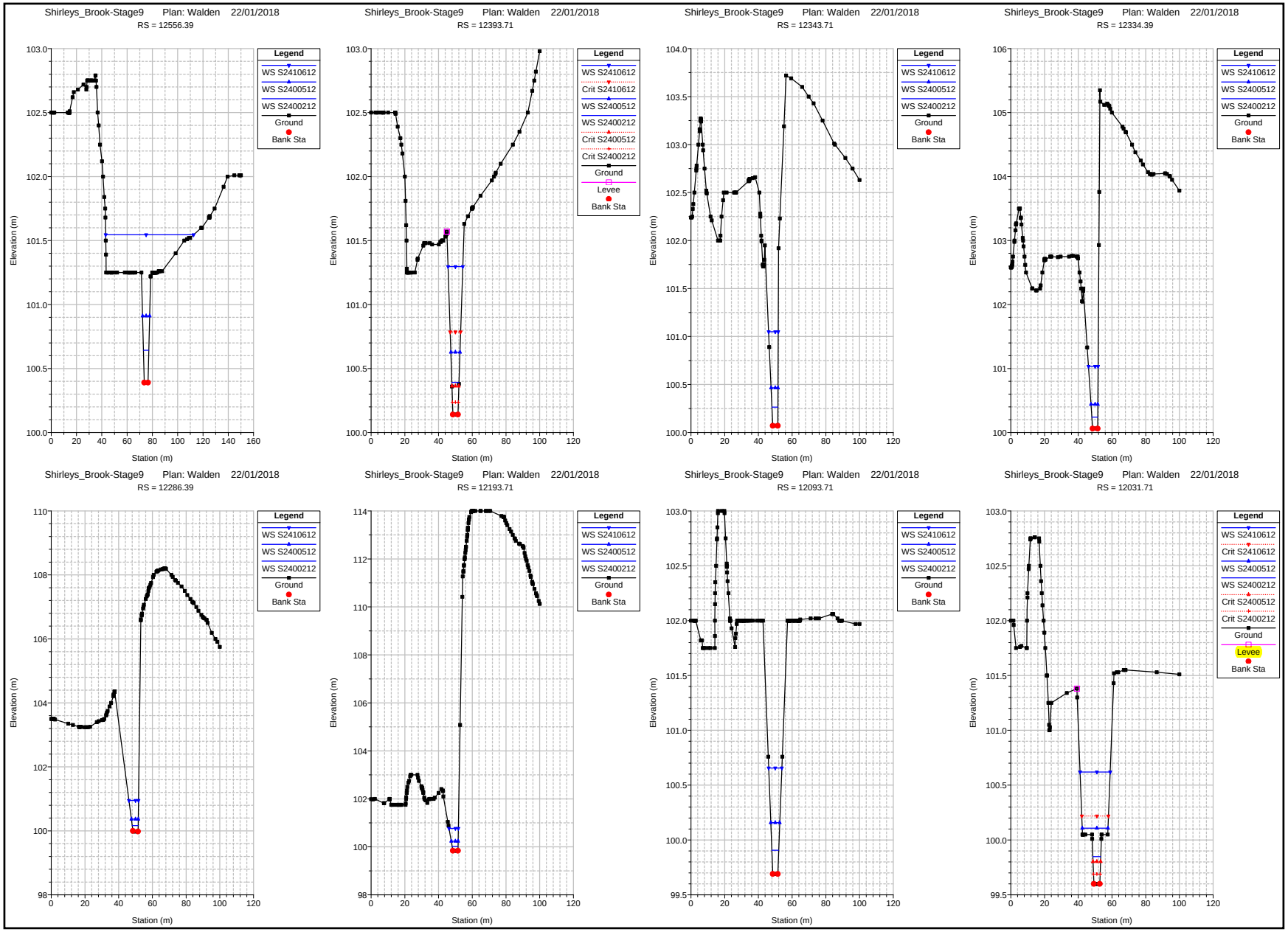


Figure 5.6: HEC-RAS Model Outputs

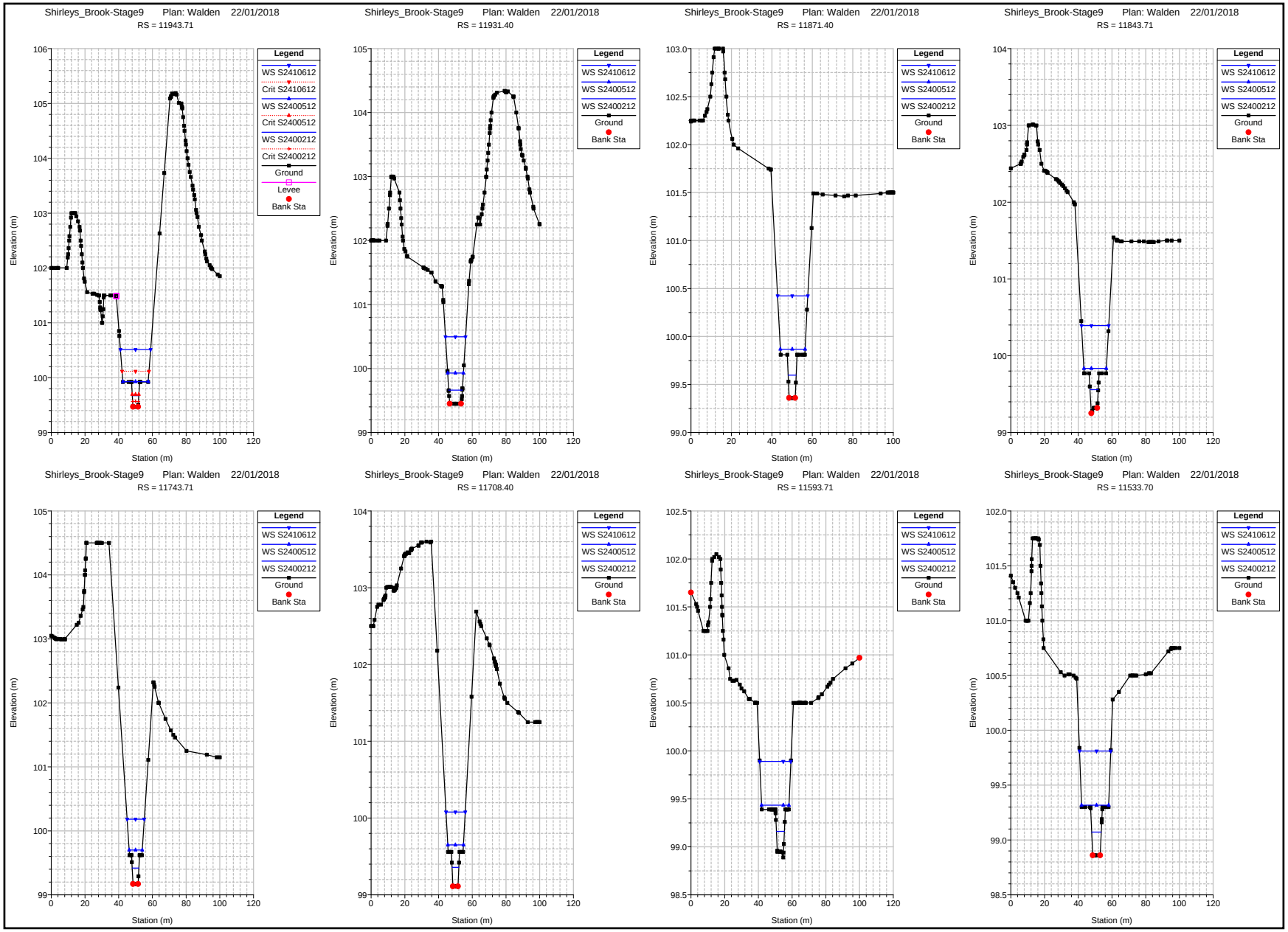


Figure 5.6: HEC-RAS Model Outputs

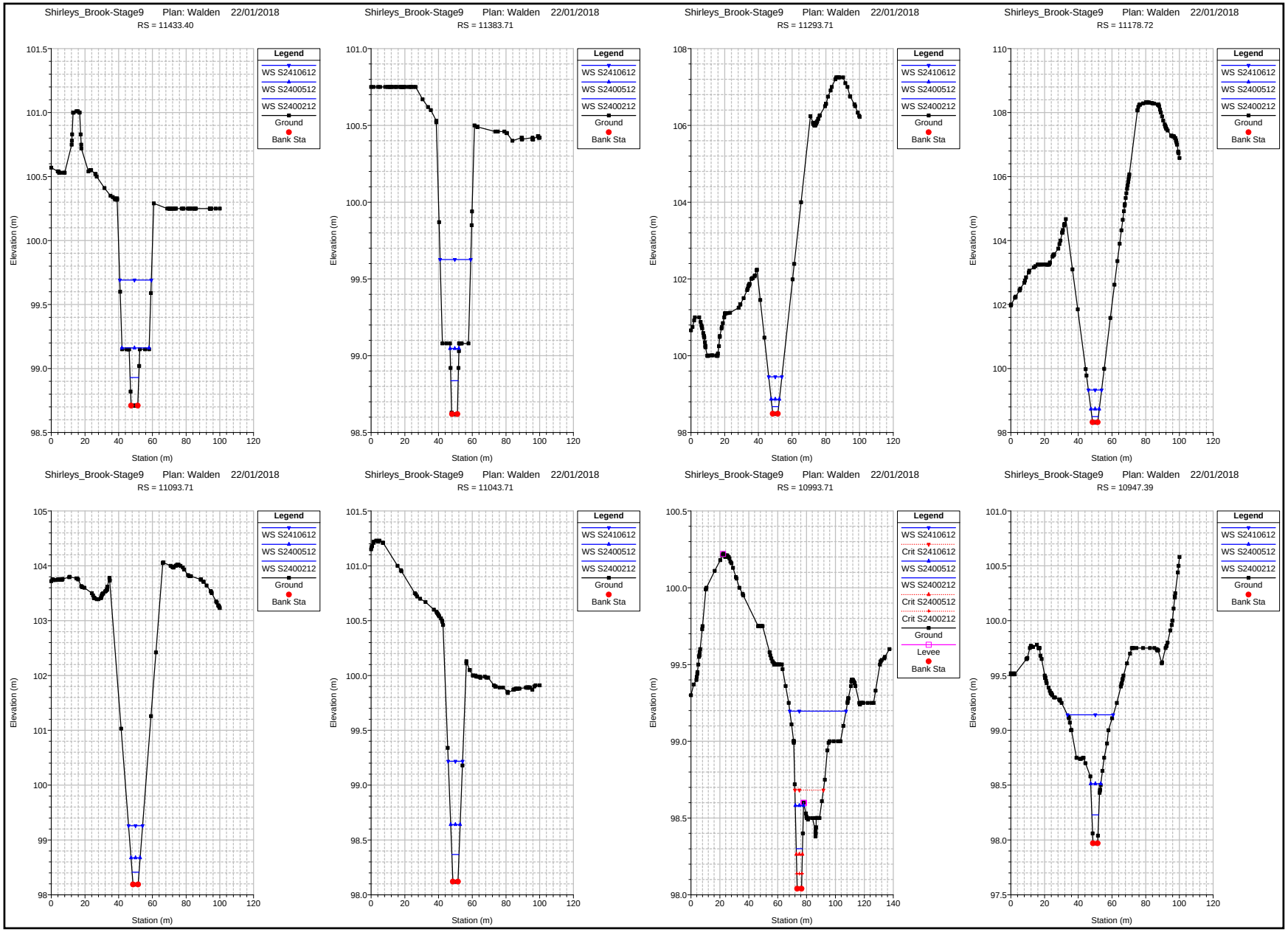


Figure 5.6: HEC-RAS Model Outputs

stations 6178.128 – 6136.349) which does not result in increased water levels for this area. There is no increased risk of flooding to the north as a result of the development of Stage 9.

6 SEDIMENT AND EROSION CONTROL PLAN

6.1 General

During construction, existing stream and conveyance systems can be exposed to significant sediment loadings. Although construction is only a temporary situation, it is proposed to introduce a number of mitigative construction techniques to reduce unnecessary construction sediment loadings. These will include:

- Groundwater in trenches will be pumped into a filter mechanism prior to release to the environment;
- bulkhead barriers will be installed at the nearest downstream manhole in each sewer which connects to an existing downstream sewer;
- seepage barriers will be constructed in any temporary drainage ditches;
- sediment capture filter socks will remain on open surface structures such as maintenance holes and catchbasins until these structures are commissioned and put into use; and
- silt fence on the site perimeter.

6.2 Trench Dewatering

Any trench dewatering using pumps will be discharged into a filter trap made up of geotextile filters and straw bales similar in design to the OPSD 219.240 Dewatering Trap. These will be constructed in a bowl shape with the fabric forming the bottom and the straw bales forming the sides. Any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filters as needed, including sediment removal and disposal and material replacement as needed.

6.3 Bulkhead Barriers

A ½ diameter bulkhead will be constructed over the lower half of the outletting sewers to reduce sediment loadings during construction. These bulkheads will trap any sediment laden flows, thus preventing any construction-related contamination into existing sewers. The bulkheads will be inspected and maintained including periodic sediment removal as needed.

6.4 Seepage Barriers

In order to further reduce sediment loading to the stormwater management facility and existing watercourses, seepage barriers will be installed on any surface water courses at appropriate locations that may become evident during construction. These barriers will be Light Duty Straw Bale Barriers per OPSD 219.100 and Heavy Duty Silt Fence Barriers per OPSD 219.130; locations are shown on the Sediment and Erosion Control Plan included in **Appendix E**. They are typically made of layers of straw bales or geotextile fabric staked in place. All seepage barriers will be inspected and maintained as needed.

6.5 Surface Structure Filters

All catchbasins, and to a lesser degree, manholes, convey surface water to sewers. Until streets are asphalted and curbed, all catchbasins and manholes will be constructed with sediment capture filter socks located between the structure frame and cover. These will stay in place and be maintained during construction and build until it is appropriate to remove same.

7 CONCLUSION

Water, wastewater and stormwater systems required to accommodate the development of Stage 9 of the Kanata Lakes development are available in the immediate vicinity of the subject site. The attached drawings and supporting analysis illustrate the lands will be developed in accordance with the City of Ottawa's current level of service requirements.

The use of lot level controls, conveyance controls and end of pipe controls outlined in the report will result in effective treatment of surface stormwater runoff from the site. Adherence to the proposed sediment and erosion control plan during construction will minimize harmful impacts on surface water.

This report outlined detailed servicing scheme to support the proposed development. The servicing schemes are subject to various governmental approvals prior to construction, including but not limited to the following:

- City of Ottawa Commence Work Order;
- Ministry of the Environment, Environmental Compliance Approval (ECA) for sewers, and drainage features and pertinent appurtenances;
- Mississippi Valley Conservation Authority.

Lance Erion, P. Eng.
Associate

Alanna Minogue
(Section 5.0)

APPENDIX A

- Watermain Boundary Condition
- Watermain Demand Calculation Sheet
- Water Model Schematic and Results

Lance Erion

From: Whittaker, Damien <Damien.Whittaker@ottawa.ca>
Sent: Friday, May 29, 2015 9:58 AM
To: Lance Erion
Cc: Bob Wingate
Subject: RE: KNL Phase 9 Request for Watermain Boundary Conditions

Lance,

Please find a boundary conditions response below.

- The servicing for the OCDSB Terry Fox School Site considers a fire demand of 9,000 L/min, not 13,000 L/min. (The water servicing plan for this site, prepared by Robinson Consultants has already been approved.)
- The Statewood connection is to the Morgan's Grant (MG) Pressure Zone, and is required for two purposes: (1) interim servicing of the Terry Fox School Site, and (2) emergency supply to MG from Zone 3W in the event of a complete failure of the MG Pump Station. This connection will not supply the KNL lands, beyond interim servicing of the Terry Fox School. Ultimately, the school is expected to be serviced from Zone 3W, as for the remainder of the KNL lands.
- Based on the KNL Master Servicing study work, three connections from the south are anticipated, not two. As such, we are providing boundary conditions for three locations as per the attached image. Note that existing downstream pipes will need to be accounted as part of the network design process.
- The proposed 406 watermain on realigned GFR and Terry Fox is not in accordance with the Master Servicing work that has been presented to the City. An update to the water master servicing plan for the KNL lands should be submitted for review, and must be coordinated with the ultimate servicing plan for the Terry Fox school site as described above. (The servicing plan for the school would have to be modified if the proposed 406 link is implemented. The plan had considered the link to turn east south of the school block, and then north on 2nd Line.)
- PRVs are expected to be required for much of the development and notation will be requested on appropriate future drawings.

Conne-1: (Goulbourn Forced Road at Keyrock)
Max HGL = 161.5m
PKHR = 158.3m
MXDY+Fire (167 L/s) = 155.0m
MXDY+Fire (217 L/s) = 153.3m

Conne-2: (Hansen at Walden)
Max HGL = 161.4m
PKHR = 158.3m
MXDY+Fire (167 L/s) = 153.0m
MXDY+Fire (217 L/s) = 150.2m

Conne-4: (Huntsville at Grainstone)
Max HGL = 161.5m
PKHR = 158.3m
MXDY+Fire (167 L/s) = 153.0m
MXDY+Fire (217 L/s) = 151.2m

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Please feel free to ask for clarification, or further information, on any of the comments above.

Regards,

Damien Whittaker, P.Eng.
Senior Engineer - Infrastructure Applications
Development Review Services Branch
Suburban West Sub-unit

PLANNING AND GROWTH MANAGEMENT
URBANISME ET GESTION DE LA CROISSANCE

City of Ottawa 110 Laurier Avenue West, Ottawa, Ontario K1P 1J1

From: Lance Erion [mailto:lerion@IBIGroup.com]
Sent: Wednesday, May 13, 2015 10:08 AM
To: Whittaker, Damien
Cc: Bob Wingate
Subject: KNL Phase 9 Request for Watermain Boundary Conditions

We are requesting hydraulic boundary conditions for our work on Phase 9 of the KNL development in Kanata Lakes which is located north of the Beaver Pond. As shown on the attached sketch connections are required to the existing 406 mm watermain on Walden Drive at Kimmins Court and at the Goulbourn Forced Road and Keyrock Drive. Further to Phase 9 there are 2 school sites on Terry Fox Drive requiring a third connection to the existing 406 watermain on Terry Fox at Statewood Drive in the Morgans Grant community. Water demands for Phase 9 and the school site have been calculated on the attached and summarised as follows;

	Phase 9	Schools
Basic Day	5.89 l/s	2.31
Max Day	14.74	3.46
Peak Hour	32.42	6.23

The fire flow demand for Phase 9 is 10,000 l/min as the single family and townhouse units fall under Technical Bulletin ISDTB-2014-01, the fire demand for the schools sites is anticipated to be 13,000 l/min.

Thank you for your assistance with this project and if you have any questions or require further information please do not hesitate to contact us.

Regards,

Lance Erion P.Eng

Associate
email lerion@IBIGroup.com web www.ibigroup.com

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OTTAWA, ON
K1S 5N4

WATERMAIN DEMAND CALCULATION SHEET

PROJECT : KANATA NORTH STAGE 9
LOCATION : KANATA LAKES

FILE: 102101.5.7
DATE: Aug. 2017
DESIGN: LE

NODE	RESIDENTIAL UNITS SF	SD	TH	APT	GROSS RES. (Ha)	POP'N	NON-RESIDENTIAL COM (Ha)	IND (Ha)	SCHOOL (Students)	AVERAGE DAILY DEMAND (l/s) Res.	Non-res.	Total	MAXIMUM DAILY DEMAND (l/s) Res.	Non-res.	Total	MAXIMUM HOURLY DEMAND (l/s) Res.	Non-res.	Total
STAGE 9																		
P9-005	7					24				0.10	0.00	0.10	0.24	0.00	0.24	0.53	0.00	0.53
P9-008	8					27				0.11	0.00	0.11	0.28	0.00	0.28	0.61	0.00	0.61
P9-010	13					44				0.18	0.00	0.18	0.45	0.00	0.45	0.98	0.00	0.98
P9-015	7		4			35				0.14	0.00	0.14	0.35	0.00	0.35	0.77	0.00	0.77
P9-020	4		12			46				0.19	0.00	0.19	0.47	0.00	0.47	1.02	0.00	1.02
P9-025	5		8			39				0.16	0.00	0.16	0.39	0.00	0.39	0.86	0.00	0.86
P9-028	4		13			49				0.20	0.00	0.20	0.49	0.00	0.49	1.09	0.00	1.09
P9-030	7		7			43				0.17	0.00	0.17	0.43	0.00	0.43	0.95	0.00	0.95
P9-035	3		4			21				0.09	0.00	0.09	0.21	0.00	0.21	0.47	0.00	0.47
P9-040	8		8			49				0.20	0.00	0.20	0.49	0.00	0.49	1.09	0.00	1.09
P9-045	4					14				0.06	0.00	0.06	0.14	0.00	0.14	0.30	0.00	0.30
P9-100	14					48				0.19	0.00	0.19	0.48	0.00	0.48	1.06	0.00	1.06
P9-200	15		8			73				0.29	0.00	0.29	0.74	0.00	0.74	1.62	0.00	1.62
P9-210	9					31				0.12	0.00	0.12	0.31	0.00	0.31	0.68	0.00	0.68
P9-215	23					78				0.32	0.00	0.32	0.79	0.00	0.79	1.74	0.00	1.74
P9-220	7					24				0.10	0.00	0.10	0.24	0.00	0.24	0.53	0.00	0.53
P9-300	9					31				0.12	0.00	0.12	0.31	0.00	0.31	0.68	0.00	0.68
P9-305	9					31				0.12	0.00	0.12	0.31	0.00	0.31	0.68	0.00	0.68
P9-400	11					37				0.15	0.00	0.15	0.38	0.00	0.38	0.83	0.00	0.83
P9-405	10					34				0.14	0.00	0.14	0.34	0.00	0.34	0.76	0.00	0.76
P9-500			29			78				0.32	0.00	0.32	0.79	0.00	0.79	1.74	0.00	1.74
P9-505			16			43				0.18	0.00	0.18	0.44	0.00	0.44	0.96	0.00	0.96
P9-510			26			70				0.28	0.00	0.28	0.71	0.00	0.71	1.56	0.00	1.56
P9-600	11					37				0.15	0.00	0.15	0.38	0.00	0.38	0.83	0.00	0.83
P9-605	8					27				0.11	0.00	0.11	0.28	0.00	0.28	0.61	0.00	0.61
P9-610	7					24				0.10	0.00	0.10	0.24	0.00	0.24	0.53	0.00	0.53
P9-615	6					20				0.08	0.00	0.08	0.21	0.00	0.21	0.45	0.00	0.45

ASSUMPTIONS

RESIDENTIAL DENSITIES

- Single Family (SF) 3.4 p/p/u
- Semi Detached (SD) 2.7 p/p/u
- Townhouse (TH) 2.7 p/p/u
- Apartment (APT) 1.8 p/p/u

AVERAGE DAILY DEMAND

- Residential 350 l/cap/day
- Commercia 50,000 l/ha/day
- Light Indust 35,000 l/ha/day
- School 70 l/student/d

MAXIMUM DAILY DEMAND

- Residential 875 l/cap/day
- Commercia 75,000 l/ha/day
- Light Indust 52,500 l/ha/day
- Institutional 105 l/student/d

MAXIMUM HOURLY DEMAND

- Residential 1,925 l/cap/day
- Commercia 135,000 l/ha/day
- Light Indust 94,500 l/ha/day
- Institutional 189 l/student/d

IBI GROUP
333 PRESTON STREET
OTTAWA, ON
K1S 5N4

WATERMAIN DEMAND CALCULATION SHEET

PROJECT : KANATA NORTH STAGE 9
LOCATION : KANATA LAKES

FILE: 102101.5.7
DATE: Aug. 2017
DESIGN: LE

NODE	RESIDENTIAL UNITS SF	SD	TH	APT	GROSS RES. (Ha)	POP'N	NON-RESIDENTIAL COM (Ha)	IND (Ha)	SCHOOL (Students)	AVERAGE DAILY DEMAND (l/s) Res.	Non-res.	Total	MAXIMUM DAILY DEMAND (l/s) Res.	Non-res.	Total	MAXIMUM HOURLY DEMAND (l/s) Res.	Non-res.	Total
STAGE 9																		
P9-700			21			57				0.23	0.00	0.23	0.57	0.00	0.57	1.26	0.00	1.26
P9-705			22			59				0.24	0.00	0.24	0.60	0.00	0.60	1.32	0.00	1.32
P9-710			26			70				0.28	0.00	0.28	0.71	0.00	0.71	1.56	0.00	1.56
P9-715			16			43				0.18	0.00	0.18	0.44	0.00	0.44	0.96	0.00	0.96
P9-720			18			49				0.20	0.00	0.20	0.49	0.00	0.49	1.08	0.00	1.08
P9-800	5					17				0.07	0.00	0.07	0.17	0.00	0.17	0.38	0.00	0.38
P9-805	12					41				0.17	0.00	0.17	0.41	0.00	0.41	0.91	0.00	0.91
P9-810	15					51				0.21	0.00	0.21	0.52	0.00	0.52	1.14	0.00	1.14
P9-815	11					37				0.15	0.00	0.15	0.38	0.00	0.38	0.83	0.00	0.83
P9-820	13					44				0.18	0.00	0.18	0.45	0.00	0.45	0.98	0.00	0.98
TOTAL	265		238			1,544						6.28			15.63			34.35
Future Development																		
P9-205			831			2,244				9.09	0.00	9.09	22.72	0.00	22.72	49.99	0.00	49.99
Kimmins Court																		
B02	35					119				0.48	0.00	0.48	1.21	0.00	1.21	2.65	0.00	2.65
Kanata Rockeries																		
GFR-01	9					31				0.12	0.00	0.12	0.31	0.00	0.31	0.68	0.00	0.68

ASSUMPTIONS

RESIDENTIAL DENSITIES

- Single Family (SF) 3.4 p/p/u
- Semi Detached (SD) 2.7 p/p/u
- Townhouse (TH) 2.7 p/p/u
- Apartment (APT) 1.8 p/p/u

AVERAGE DAILY DEMAND

- Residential 350 l/cap/day
- Commercia 50,000 l/ha/day
- Light Indust 35,000 l/ha/day
- School 70 l/student/d

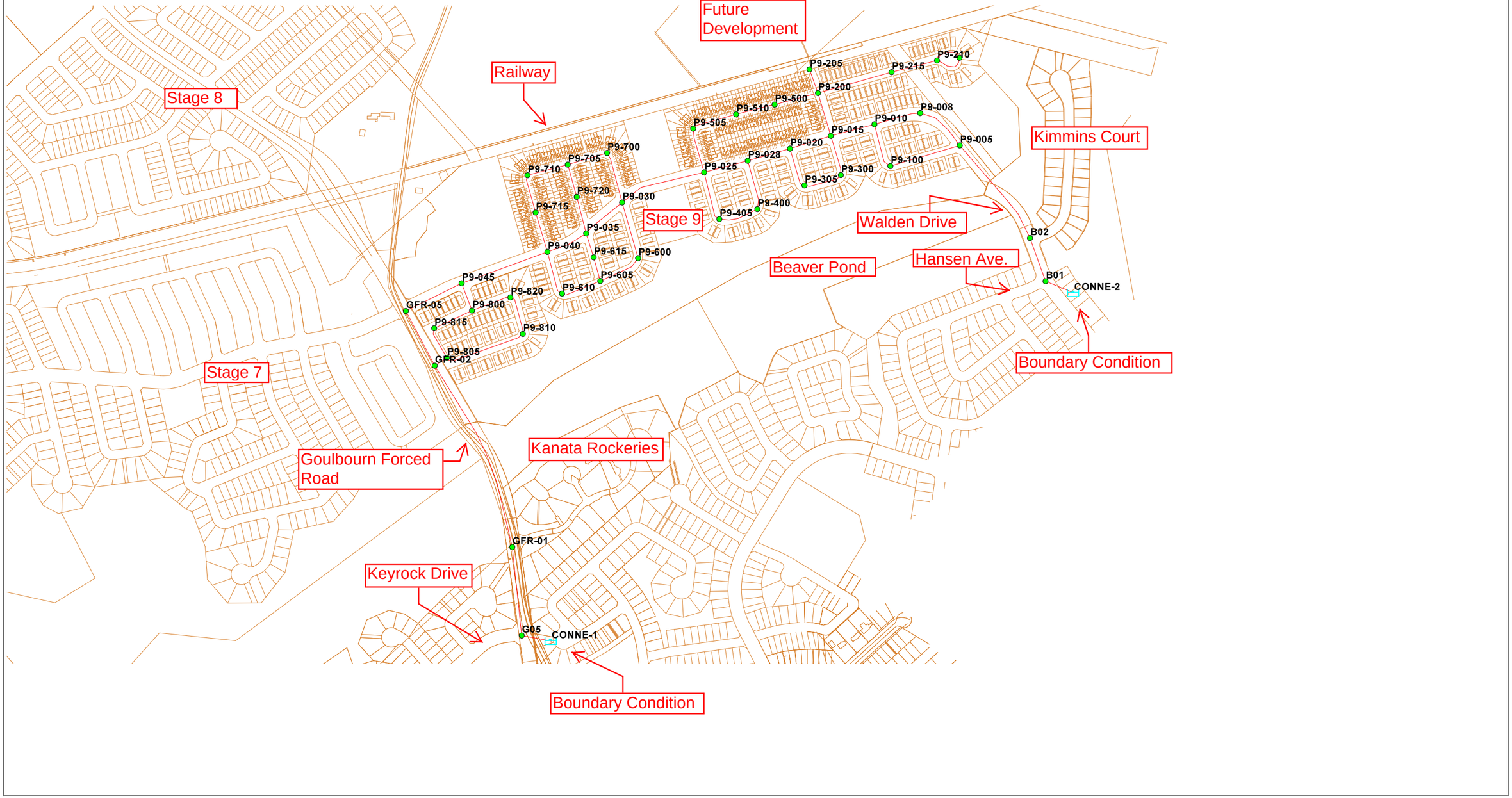
MAXIMUM DAILY DEMAND

- Residential 875 l/cap/day
- Commercia 75,000 l/ha/day
- Light Indust 52,500 l/ha/day
- Institutional 105 l/student/d

MAXIMUM HOURLY DEMAND

- Residential 1,925 l/cap/day
- Commercia 135,000 l/ha/day
- Light Indust 94,500 l/ha/day
- Institutional 189 l/student/d

STAGE 9 - NODE ID's

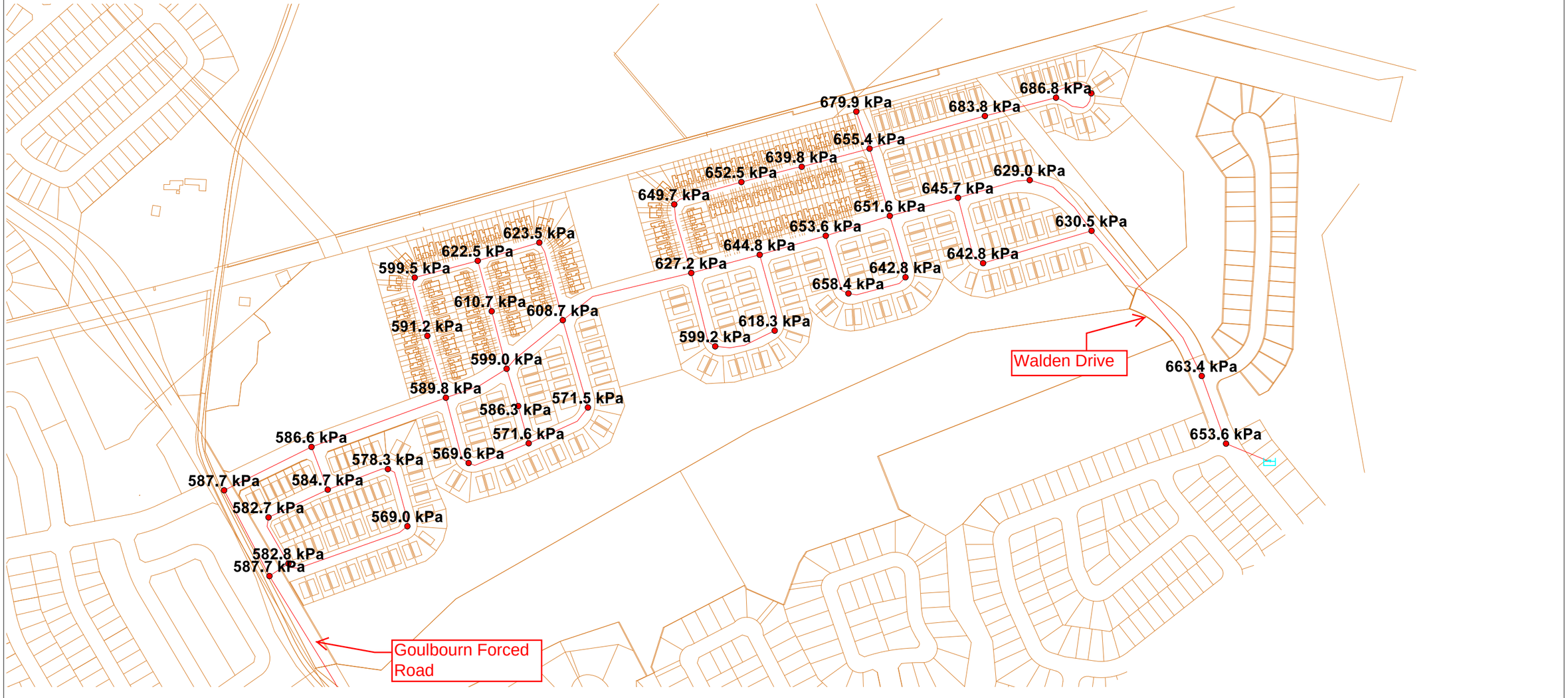


Date: Friday, August 11, 2017

STAGE 9 - PIPE SIZES

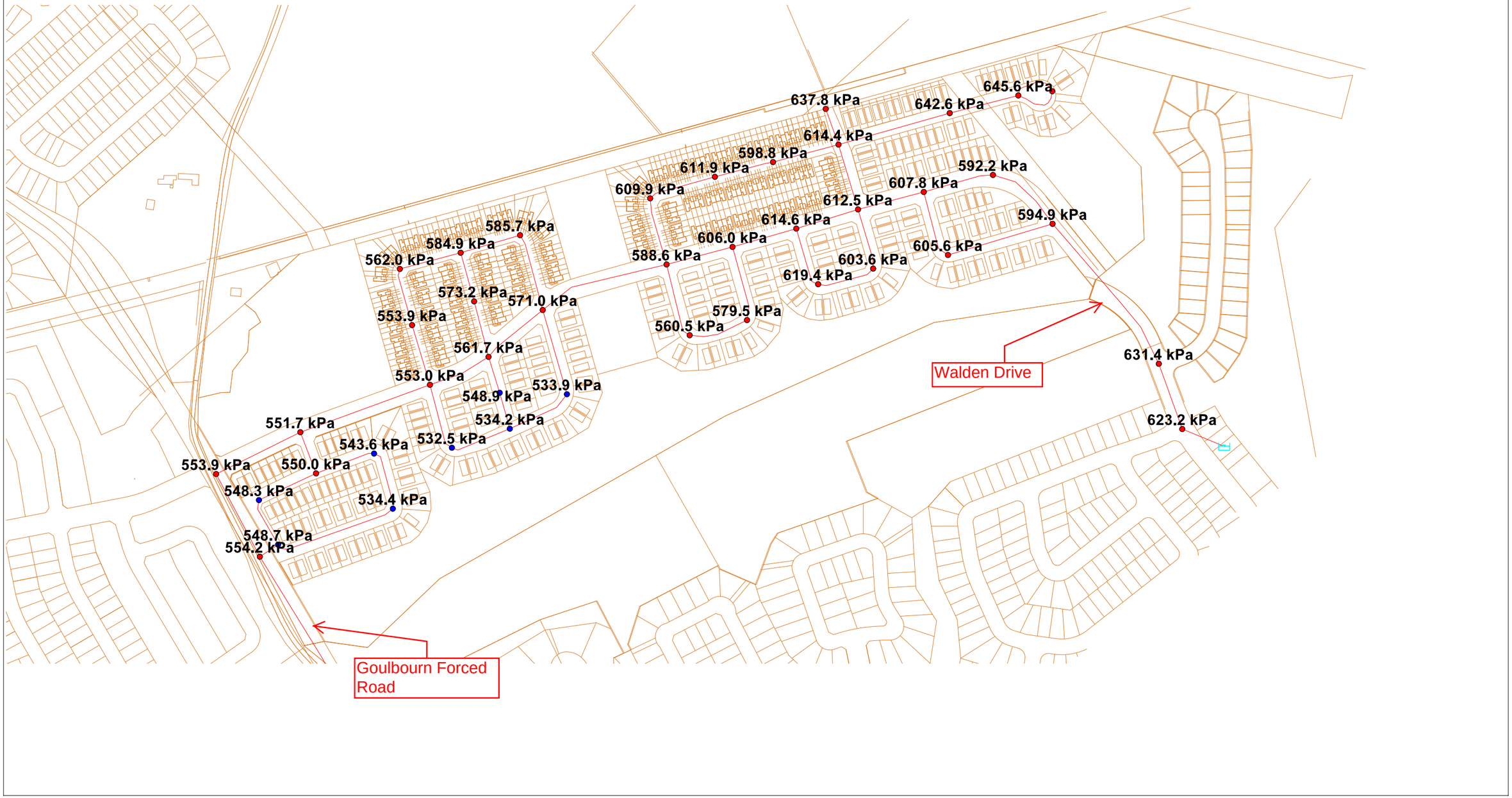
Date: Friday, August 11, 2017

STAGE 9 - BASIC DAY PRESSURES



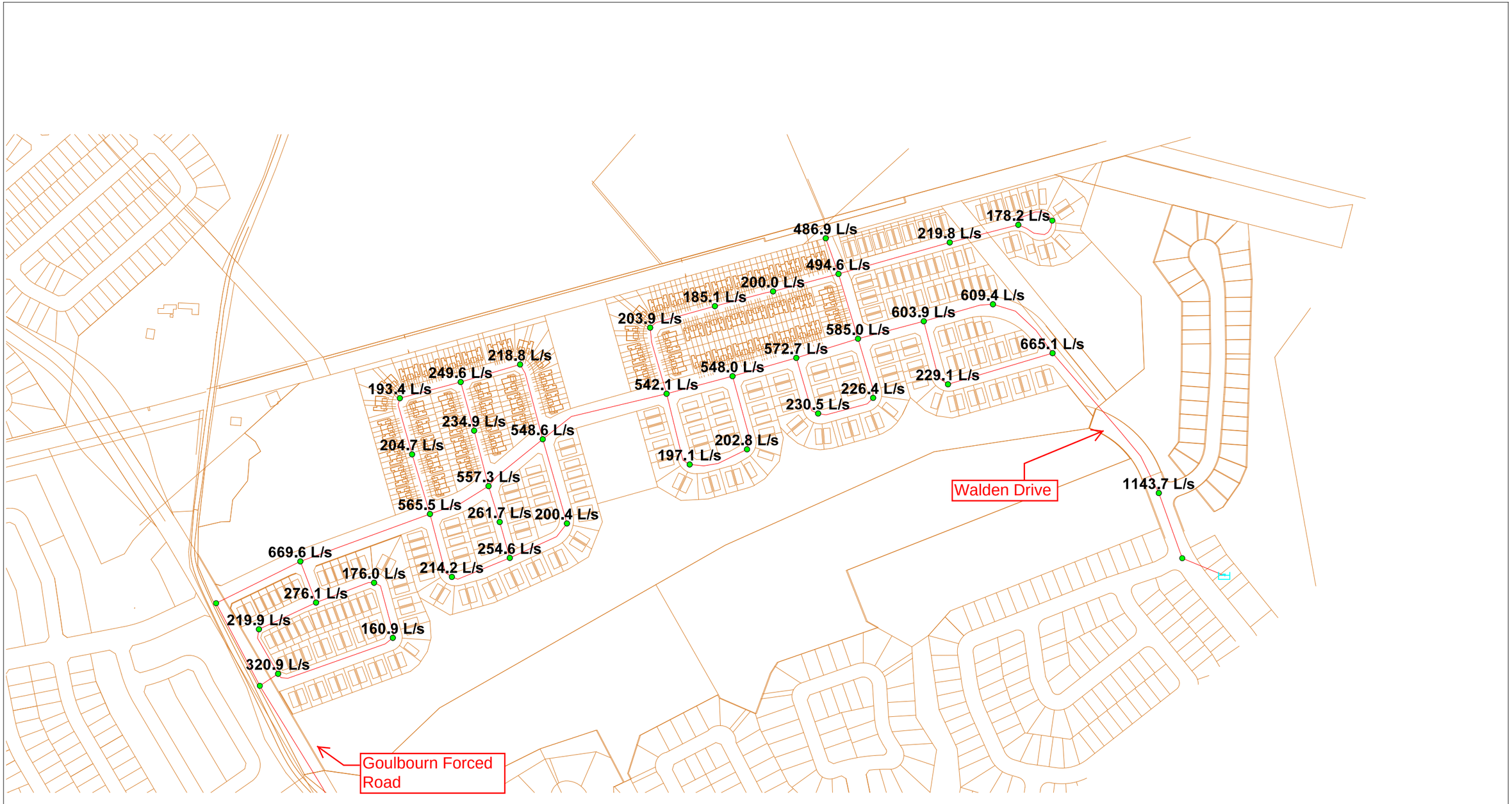
Date: Friday, August 11, 2017

STAGE 9 - PEAK HOUR PRESSURES



Date: Friday, August 11, 2017

STAGE 9 - MAX DAY + FIRE - FIREFLOWS



Date: Friday, August 11, 2017

Basic Day (Max HGL) HGL 161.4m & 161.5m - Junction Report

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		B01	0.00	94.70	161.40	653.61
2		B02	0.48	93.70	161.40	663.39
3		G05	0.00	103.00	161.50	573.23
4		GFR-01	0.00	96.50	161.49	636.86
5		GFR-02	0.12	101.50	161.48	587.71
6		GFR-05	0.00	101.50	161.47	587.68
7		P9-005	0.10	97.05	161.39	630.53
8		P9-008	0.11	97.20	161.39	629.05
9		P9-010	0.18	95.50	161.39	645.70
10		P9-015	0.14	94.90	161.39	651.57
11		P9-020	0.19	94.70	161.40	653.57
12		P9-025	0.16	97.40	161.41	627.20
13		P9-028	0.20	95.60	161.40	644.79
14		P9-030	0.17	99.30	161.42	608.74
15		P9-035	0.09	100.30	161.43	599.01
16		P9-040	0.20	101.25	161.44	589.77
17		P9-045	0.06	101.60	161.46	586.57
18		P9-100	0.19	95.80	161.39	642.76
19		P9-200	0.29	94.50	161.38	655.41
20		P9-205	9.09	92.00	161.38	679.86
21		P9-210	0.12	91.30	161.38	686.76
22		P9-215	0.32	91.60	161.38	683.82
23		P9-220	0.10	91.10	161.38	688.69
24		P9-300	0.12	95.80	161.39	642.76
25		P9-305	0.12	94.20	161.39	658.45
26		P9-400	0.15	98.30	161.40	618.35
27		P9-405	0.14	100.25	161.40	599.25
28		P9-500	0.32	96.10	161.39	639.75
29		P9-505	0.18	95.10	161.40	649.65
30		P9-510	0.28	94.80	161.39	652.53
31		P9-600	0.15	103.10	161.42	571.53
32		P9-605	0.11	103.10	161.43	571.57
33		P9-610	0.10	103.30	161.43	569.64
34		P9-615	0.08	101.60	161.43	586.27
35		P9-700	0.23	97.80	161.42	623.46
36		P9-705	0.24	97.90	161.43	622.50
37		P9-710	0.28	100.25	161.43	599.49
38		P9-715	0.18	101.10	161.43	591.19
39		P9-720	0.20	99.10	161.43	610.75
40		P9-800	0.07	101.80	161.46	584.65
41		P9-805	0.17	102.00	161.47	582.76
42		P9-810	0.21	103.40	161.47	568.99
43		P9-815	0.15	102.00	161.47	582.73
44		P9-820	0.18	102.45	161.46	578.29

Peak Hour HGL 158.3m - Junction Report

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		B01	0.00	94.70	158.30	623.21
2		B02	2.65	93.70	158.14	631.41
3		G05	0.00	103.00	158.28	541.67
4		GFR-01	0.00	96.50	158.21	604.69
5		GFR-02	0.68	101.50	158.06	554.20
6		GFR-05	0.00	101.50	158.02	553.89
7		P9-005	0.53	97.05	157.76	594.94
8		P9-008	0.61	97.20	157.64	592.22
9		P9-010	0.98	95.50	157.53	607.80
10		P9-015	0.77	94.90	157.40	612.46
11		P9-020	1.02	94.70	157.42	614.57
12		P9-025	0.86	97.40	157.46	588.57
13		P9-028	1.09	95.60	157.44	605.97
14		P9-030	0.95	99.30	157.57	571.00
15		P9-035	0.47	100.30	157.62	561.70
16		P9-040	1.09	101.25	157.68	553.01
17		P9-045	0.30	101.60	157.90	551.68
18		P9-100	1.06	95.80	157.60	605.56
19		P9-200	1.62	94.50	157.19	614.35
20		P9-205	49.99	92.00	157.09	637.82
21		P9-210	0.68	91.30	157.18	645.57
22		P9-215	1.74	91.60	157.18	642.65
23		P9-220	0.53	91.10	157.12	646.92
24		P9-300	0.68	95.80	157.40	603.65
25		P9-305	0.68	94.20	157.41	619.36
26		P9-400	0.83	98.30	157.44	579.52
27		P9-405	0.76	100.25	157.45	560.47
28		P9-500	1.74	96.10	157.21	598.80
29		P9-505	0.96	95.10	157.34	609.89
30		P9-510	1.56	94.80	157.25	611.93
31		P9-600	0.83	103.10	157.59	533.95
32		P9-605	0.61	103.10	157.62	534.23
33		P9-610	0.53	103.30	157.64	532.52
34		P9-615	0.45	101.60	157.62	548.94
35		P9-700	1.26	97.80	157.57	585.73
36		P9-705	1.32	97.90	157.59	584.89
37		P9-710	1.56	100.25	157.60	561.95
38		P9-715	0.96	101.10	157.63	553.93
39		P9-720	1.08	99.10	157.60	573.21
40		P9-800	0.38	101.80	157.92	549.98
41		P9-805	0.91	102.00	157.99	548.70
42		P9-810	1.14	103.40	157.94	534.43
43		P9-815	0.83	102.00	157.96	548.32
44		P9-820	0.98	102.45	157.93	543.63

Max Day + Fire (167 l/s) - HGL 155.0m & 153.0m - Fireflow Design Report

		ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
1		B02	167.88	P9-610	490.16	143.72	1,757.02	1,143.69	B02	139.98	107.98	1,143.71	1,143.71
2		GFR-01	166.67	P9-610	488.22	146.32	1,449.99	1,363.06	P9-810	106.67	107.39	1,298.12	1,298.12
3		P9-005	166.91	P9-600	478.66	145.90	924.89	665.07	P9-005	139.97	111.33	665.07	665.07
4		P9-008	166.95	P9-600	475.22	145.70	836.63	609.36	P9-008	139.97	111.48	609.36	609.36
5		P9-010	167.12	P9-600	472.04	143.67	771.45	603.91	P9-010	139.97	109.78	603.91	603.91
6		P9-015	167.02	P9-600	468.43	142.70	711.58	585.11	P9-300	139.75	109.16	584.95	584.95
7		P9-020	167.14	P9-600	465.96	142.25	676.83	572.72	P9-020	139.97	108.98	572.72	572.72
8		P9-025	167.06	P9-600	460.57	144.40	616.48	556.37	P9-405	121.95	109.85	542.12	542.12
9		P9-028	167.16	P9-600	463.24	142.87	646.45	562.72	P9-405	121.59	108.01	548.04	548.04
10		P9-030	167.10	P9-600	452.04	145.43	548.62	559.02	P9-600	127.79	112.34	548.62	548.62
11		P9-035	166.88	P9-600	452.80	146.51	558.38	560.78	P9-605	135.93	114.17	557.26	557.26
12		P9-040	167.16	P9-610	453.07	147.49	565.51	575.14	P9-610	129.07	114.42	565.51	565.51
13		P9-045	166.81	P9-610	466.62	149.22	710.15	669.61	P9-045	139.97	115.88	669.61	669.61
14		P9-100	167.15	P9-100	325.53	129.02	229.12	229.12	P9-100	139.96	110.08	229.12	229.12
15		P9-200	167.41	P9-600	467.85	142.24	704.89	494.64	P9-200	139.96	108.78	494.64	494.64
16		P9-205	189.39	P9-600	467.85	139.74	726.91	486.92	P9-205	139.96	106.28	486.92	486.92
17		P9-210	166.98	P9-210	192.01	110.89	178.19	178.19	P9-210	139.96	105.58	178.19	178.19
18		P9-215	167.46	P9-215	320.45	124.30	219.75	219.76	P9-215	139.96	105.88	219.76	219.75
19		P9-300	166.98	P9-300	320.26	128.48	226.39	226.39	P9-300	139.96	110.08	226.39	226.39
20		P9-305	166.98	P9-305	335.10	128.40	230.49	230.49	P9-305	139.96	108.48	230.49	230.49
21		P9-400	167.05	P9-400	259.49	124.78	202.84	202.84	P9-400	139.96	112.58	202.84	202.84
22		P9-405	167.01	P9-405	239.61	124.70	197.14	197.14	P9-405	139.96	114.53	197.14	197.14
23		P9-500	167.46	P9-500	256.18	122.24	200.03	200.03	P9-500	139.96	110.38	200.03	200.03
24		P9-505	167.11	P9-505	270.96	122.75	203.90	203.90	P9-505	139.96	109.38	203.90	203.90
25		P9-510	167.38	P9-510	212.77	116.51	185.12	185.12	P9-510	139.96	109.08	185.12	185.12
26		P9-600	167.05	P9-600	240.74	127.67	200.36	200.36	P9-600	139.96	117.38	200.36	200.36
27		P9-605	166.95	P9-605	330.84	136.86	254.55	254.56	P9-605	139.96	117.38	254.56	254.55
28		P9-610	166.91	P9-610	269.77	130.83	214.21	214.21	P9-610	139.96	117.58	214.21	214.21
29		P9-615	166.88	P9-615	347.32	137.04	261.70	261.70	P9-615	139.96	115.88	261.70	261.70
30		P9-700	167.24	P9-700	298.21	128.23	218.78	218.78	P9-700	139.96	112.08	218.78	218.78
31		P9-705	167.27	P9-705	350.46	133.66	249.56	249.57	P9-705	139.96	112.18	249.57	249.56
32		P9-710	167.38	P9-710	229.26	123.65	193.42	193.42	P9-710	139.96	114.53	193.42	193.42
33		P9-715	167.11	P9-715	256.38	127.26	204.69	204.69	P9-715	139.96	115.38	204.69	204.69
34		P9-720	167.16	P9-720	322.69	132.03	234.90	234.91	P9-720	139.96	113.38	234.91	234.90
35		P9-800	166.84	P9-800	364.28	138.97	276.06	276.06	P9-800	139.96	116.08	276.06	276.06
36		P9-805	167.08	P9-805	398.57	142.67	320.91	320.92	P9-805	139.96	116.28	320.92	320.91
37		P9-810	167.19	P9-810	113.86	115.02	160.89	160.89	P9-810	139.96	117.68	160.89	160.89
38		P9-815	167.05	P9-815	286.94	131.28	219.88	219.88	P9-815	139.96	116.28	219.88	219.88
39		P9-820	167.12	P9-820	173.32	120.14	176.04	176.03	P9-820	139.96	116.73	176.04	176.04

Peak Hour HGL 158.3m - Pipe Report

		ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
1		429	CONNE-1	G05	58.40	393.00	120.00	41.87	0.35	0.02	0.40
2		437	B01	B02	88.43	297.00	120.00	45.80	0.66	0.16	1.84
3		439	B02	P9-005	225.48	297.00	120.00	43.15	0.62	0.37	1.65
4		441	CONNE-2	B01	1.00	297.00	120.00	45.80	0.66	0.00	1.84
5		443	P9-005	P9-008	101.79	297.00	120.00	37.15	0.54	0.13	1.25
6		445	P9-010	P9-015	86.80	297.00	120.00	39.97	0.58	0.12	1.43
7		447	P9-015	P9-020	82.50	297.00	120.00	-13.27	0.19	0.02	0.19
8		449	P9-020	P9-028	84.63	297.00	120.00	-15.98	0.23	0.02	0.26
9		451	P9-028	P9-025	87.09	297.00	120.00	-16.67	0.24	0.02	0.28
10		453	P9-025	P9-030	171.53	297.00	120.00	-25.54	0.37	0.11	0.62
11		455	P9-030	P9-035	91.70	297.00	120.00	-23.92	0.35	0.05	0.55
12		457	P9-035	P9-040	83.31	297.00	120.00	-28.22	0.41	0.06	0.75
13		459	P9-040	P9-045	176.03	297.00	120.00	-36.65	0.53	0.21	1.22
14		461	P9-045	GFR-05	120.03	297.00	120.00	-33.66	0.49	0.13	1.04
15		463	P9-005	P9-100	139.25	155.00	100.00	5.46	0.29	0.17	1.20
16		465	P9-100	P9-010	89.16	155.00	100.00	4.40	0.23	0.07	0.80
17		467	P9-015	P9-200	86.29	297.00	120.00	52.80	0.76	0.21	2.40
18		469	P9-200	P9-205	48.38	297.00	120.00	49.99	0.72	0.10	2.17
19		471	P9-200	P9-215	147.57	204.00	110.00	2.95	0.09	0.01	0.08
20		473	P9-300	P9-015	78.29	155.00	100.00	0.33	0.02	0.000	0.01
21		475	P9-305	P9-300	75.41	155.00	100.00	1.01	0.05	0.00	0.05
22		477	P9-500	P9-200	86.41	155.00	100.00	1.76	0.09	0.01	0.15
23		479	P9-500	P9-510	76.63	155.00	100.00	-3.50	0.19	0.04	0.52
24		481	P9-025	P9-505	87.14	155.00	100.00	6.02	0.32	0.12	1.43
25		483	P9-028	P9-400	96.26	155.00	100.00	-0.40	0.02	0.000	0.01
26		485	P9-400	P9-405	77.74	155.00	100.00	-1.23	0.07	0.01	0.08
27		487	P9-030	P9-700	100.07	155.00	100.00	-0.69	0.04	0.00	0.03
28		489	P9-700	P9-705	78.99	155.00	100.00	-1.95	0.10	0.01	0.18
29		491	P9-035	P9-720	73.08	155.00	100.00	2.79	0.15	0.03	0.34
30		493	P9-705	P9-710	80.28	155.00	100.00	-1.57	0.08	0.01	0.12
31		495	P9-710	P9-715	74.50	155.00	100.00	-3.13	0.17	0.03	0.43
32		497	P9-030	P9-600	111.86	155.00	100.00	-1.88	0.10	0.02	0.17
33		499	P9-600	P9-605	87.01	155.00	100.00	-2.71	0.14	0.03	0.33
34		501	P9-605	P9-610	79.69	155.00	100.00	-2.72	0.14	0.03	0.33
35		503	P9-610	P9-040	87.44	155.00	100.00	-3.25	0.17	0.04	0.46
36		505	P9-605	P9-615	47.55	155.00	100.00	-0.60	0.03	0.000	0.02
37		507	P9-045	P9-800	56.27	155.00	100.00	-3.30	0.17	0.03	0.47
38		509	P9-820	P9-800	78.68	155.00	100.00	0.72	0.04	0.00	0.03
39		511	P9-805	P9-815	64.05	155.00	100.00	3.79	0.20	0.04	0.61
40		513	G05	GFR-01	171.58	393.00	120.00	41.87	0.35	0.07	0.40
41		515	GFR-01	GFR-02	383.63	393.00	120.00	41.87	0.35	0.15	0.40
42		785	P9-215	P9-210	90.29	204.00	110.00	1.21	0.04	0.00	0.02
43		787	P9-025	P9-405	97.35	155.00	100.00	1.99	0.11	0.02	0.18
44		789	P9-810	P9-805	159.18	155.00	100.00	-2.84	0.15	0.06	0.36
45		791	P9-800	P9-815	80.47	155.00	100.00	-2.96	0.16	0.03	0.38
46		819	P9-008	P9-010	91.18	297.00	120.00	36.54	0.53	0.11	1.21
47		821	P9-510	P9-505	87.94	155.00	100.00	-5.06	0.27	0.09	1.04
48		823	P9-305	P9-020	79.12	155.00	100.00	-1.69	0.09	0.01	0.14
49		825	P9-220	P9-210	56.48	50.00	100.00	-0.27	0.14	0.06	1.10
50		827	P9-210	P9-220	57.76	50.00	100.00	0.26	0.13	0.06	1.08
51		829	P9-715	P9-040	79.35	155.00	100.00	-4.09	0.22	0.06	0.70
52		831	P9-720	P9-705	64.36	155.00	100.00	1.71	0.09	0.01	0.14
53		833	P9-615	P9-035	48.01	155.00	100.00	-1.05	0.06	0.00	0.06
54		835	P9-810	P9-820	77.71	155.00	100.00	1.70	0.09	0.01	0.14
55		837	GFR-02	GFR-05	119.23	393.00	120.00	33.66	0.28	0.03	0.27
56		841	P9-805	GFR-02	27.94	155.00	100.00	-7.54	0.40	0.06	2.17

APPENDIX B

- Sanitary Drainage Areas Serviceability Study Figure 3
- Sanitary Sewer Design Serviceability Study
- Sanitary Sewer Design Sheets
- Sanitary Drainage Area Plan Drawing No. 102101-500A
- Sanitary Drainage Area Plan Drawing No. 102101-501A

NO.	DATE	BY	REVISION
1.	02:11:20		GENERAL REVISIONS
2	02:11:26		REVISED AS PER NEW CONCEPT PLAN
3.	03:04:08		REVISED AS PER NEW CONCEPT PLAN
4.	05:08:16		REVISED AS PER NEW CONCEPT PLAN
5.	06:02:14		REVISED AS PER NEW CONCEPT PLAN
6.	06:06:15		REVISED AS PER NEW CONCEPT PLAN

Legend:

- 11.7 / 310 / 5 — Area in hectares; Area Number; Tributary Node
- Proposed Trunk Sanitary Sewer
- (20) Sanitary Identification Node
- Sanitary Drainage Area
- DEVELOPMENT LIMITS

KNL DEVELOPMENTS INC.

Ottawa

CCL/IBI
Cumming Cockburn Limited
1770 WOODWARD DR., OTTAWA (613)225-1311

KANATA LAKES NORTH
SANITARY DRAINAGE AREAS
SERVICEABILITY STUDY

SCALE:	1:5000		
DRAWN:	M.M.	DATE:	SEPT '02
DESIGN:	L.E.	DATE:	SEPT '02
CHECKED:	R.W.W.	DATE:	SEPT '02

PROJECT NO.	DRAWING NO.
3433-LD	5000

FIGURE 3

IBI GROUP
1770 WOODWARD DRIVE
OTTAWA, ONTARIO
K2C OP8

APPENDIX A - SANITARY SEWER DESIGN

KANATA LAKES NORTH
SERVICEABILITY STUDY

JOB #: 3343-LD
DATE: JUN 06
DESIGN: LME

LOCATION			INDIVIDUAL							CUM. RES. FLOW			CUM. COM. & INST. FLOW			INFILTRATION			TOTAL	PROPOSED SEWER						AREA
			RESID. UNITS			MEDIUM DEN.		TOTAL	COMM										DESIGN						ID
AREA	FROM MH	TO MH	Singles	Towns	POP	AREA (Ha)	POP	POP	INST (Ha)	POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (Ha)	PEAK FACT.	PEAK FLOW (l/s)	INCR. AREA (Ha)	CUM. AREA (Ha)	FLOW (l/s)	FLOW (l/s)	CAP. l/s	PIPE (mm)	LGTH. (m)	SLOPE %	VEL. (full) m/s	AVAIL. CAP. (%)	
PHASE 1	50	40	122		414.8	16.90	1,436.5	1,851.3		1,851.3	3.61	27.41		1.50		42.69	42.69	11.95	**39.37**	**48.04**	250	370.0	0.60	0.95	18.05%	EX 2, 4
	60	40	130	200	982.0	18.50	1,572.5	2,554.5		2,554.5	3.50	36.67		1.50		16.12	16.12	4.51	**41.18**	**43.88**	250	380.0	0.50	0.87	6.16%	EX 1, 1, 3
	40	20	73		248.2			248.2		4,654.0	3.27	62.47		1.50		4.77	63.58	17.80	**80.27**	**91.44**	375	300.0	0.25	0.80	12.21%	5
	30	20	100	277	1,087.9			1,087.9		1,087.9	3.78	16.84		1.50		16.81	16.81	4.71	**21.55**	**39.01**	200	250.0	1.30	**1.20**	44.76%	2, 6
	20	10	46		156.4			156.4	3.00	5,898.3	3.18	76.85	3.00	1.50	2.61	5.80	86.19	24.13	**103.59**	**132.98**	450	300.0	0.20	0.81	22.10%	7
	10	EX-A								5,898.3	3.18	76.85	3.00	1.50	2.61		86.19	24.13	**103.59**	**132.98**	450	300.0	0.20	0.81	22.10%	
	EX-A	EX-B	26		88.4			88.4		5,986.7	3.17	77.85	3.00	1.50	2.61	5.30	91.49	25.62	**106.08**	**358.23**	450	105.0	1.45	2.18	70.39%	
	EX-B	EX-C								5,986.7	3.17	77.85	3.00	1.50	2.61		91.49	25.62	**106.08**	**197.01**	500	450.0	0.25	0.97	46.16%	
	EX-C	EX-D			1,637.0			1,637.0	5.60	7,623.7	3.07	95.98	8.60	1.50	7.48	48.90	140.39	39.31	**142.77**	**224.35**	525	750.0	0.25	1.00	36.36%	
	EX-D	EX-E			17,313.0			17,313.0	9.80	24,936.7	2.56	261.39	18.40	1.50	16.01	253.20	393.59	110.21	**387.61**	**480.21**	675	500.0	0.30	1.30	19.28%	
																	Population and area data taken from the Cluster 9 Sanitary Sewer by J.L Richards Feb. 1987									
PHASE 4	310	300							6.40		4.00		6.40	1.50	5.57	6.40	6.40	1.79	**7.36**	**26.49**	200	180.0	0.60	0.82	72.22%	16
	300	280	34		115.6			115.6	5.35	115.6	4.00	1.90	11.75	1.50	10.22	8.41	14.81	4.15	**16.27**	**26.49**	200	260.0	0.60	0.82	38.61%	17
	290	280	94	108	611.2			611.2		611.2	3.93	9.84		1.50		10.50	10.50	2.94	**12.78**	**26.49**	200	170.0	0.60	0.82	51.75%	18
	280	260		165	445.5			445.5		1,172.3	3.75	18.05	11.75	1.50	10.22	4.95	30.26	8.47	**36.74**	**43.88**	250	290.0	0.50	0.87	16.27%	20
	270	260		215	580.5			580.5		580.5	3.94	9.38		1.50		6.95	6.95	1.95	**11.32**	**26.49**	200	320.0	0.60	0.82	57.26%	19
	260	190								1752.8	3.63	26.08	11.75	1.50	10.22		37.21	10.42	**46.73**	**48.04**	250	340.0	0.60	0.95	2.73%	
	250	240	197		669.8			669.8		669.8	3.91	10.73		1.50		15.30	15.30	4.28	**15.01**	**26.49**	200	310.0	0.60	0.82	43.35%	15
	240	230		210	567.0			567.0		1,236.8	3.74	18.96		1.50		9.10	24.40	6.83	**25.79**	**26.49**	200	230.0	0.60	0.82	2.66%	14
PHASE 3	230	210		300	810.0			810.0		2,046.8	3.58	30.03		1.50		11.26	35.66	9.98	**40.01**	**43.88**	250	240.0	0.50	0.87	8.82%	13
	220	210	77		261.8	19.3	1,636.3	1,898.1		1,898.1	3.60	28.04		1.50		24.36	24.36	6.82	**34.86**	**43.88**	250	430.0	0.50	0.87	20.55%	EX 3, 12
	210	200	81		275.4			275.4		4,220.3	3.31	57.31		1.50		6.34	66.36	18.58	**75.90**	**115.72**	375	170.0	0.40	1.02	34.41%	11
	200	190	117	352	1348.2			1,348.2		5,568.5	3.20	73.09		1.50		18.61	84.97	23.79	**96.88**	**115.72**	375	260.0	0.40	1.02	16.28%	10
	190	180								7,321.3	3.09	92.69	11.75	1.50	10.22		122.18	34.21	**137.12**	**162.86**	450	80.0	0.30	0.99	15.81%	

Average daily residential flow = 350 l/cap/day
Residential peaking factor = 1+(14/(4+P^0.5)) , where P = population in thousands
Commercial, Office and School average daily flow = 50,000 l/ha/day
Commercial, Office and School peaking factor = 1.5
Extraneous flow = 0.28 l/s/ha

RESIDENTIAL POPULATION DENSITIES

Residential Medium Density = 25 units/net hectare with 3.4 persons/unit = 85 persons/gross hectare

IBI GROUP
1770 WOODWARD DRIVE
OTTAWA, ONTARIO
K2C OP8

APPENDIX A - SANITARY SEWER DESIGN

KANATA LAKES NORTH
SERVICEABILITY STUDY

JOB #: 3343-LD
DATE: JUN 06
DESIGN: LME

LOCATION			INDIVIDUAL							CUM. RES. FLOW			CUM. COM. & INST. FLOW			INFILTRATION			TOTAL	PROPOSED SEWER						AREA
			RESID. UNITS			MEDIUM DEN.		TOTAL	COMM										DESIGN						ID
STREET	FROM MH	TO MH	Singles	Towns	POP	AREA (Ha)	POP	POP	INST (Ha)	POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (Ha)	PEAK FACT.	PEAK FLOW (l/s)	INCR. AREA (Ha)	CUM. AREA (Ha)	FLOW (l/s)	FLOW (l/s)	CAP. l/s	PIPE (mm)	LGTH. (m)	SLOPE %	VEL. (full) m/s	AVAIL. CAP. (%)	
PHASE 2	180	170	75	116	568.2			568.2		7,889.5	3.06	98.86	11.75	1.50	10.22	9.73	131.91	36.93	**146.01**	**162.86**	450	160.0	0.30	0.99	10.34%	9
	170	160		130	351.0	2.25	191.3	542.3		8,431.7	3.03	104.67	11.75	1.50	10.22	8.81	140.72	39.40	**154.30**	**162.86**	450	160.0	0.30	0.99	5.26%	8
	160	150	37		125.8			125.8		8,557.5	3.02	106.01	11.75	1.50	10.22	3.75	144.47	40.45	**156.69**	**162.86**	450	270.0	0.30	0.99	3.79%	21
	150	140	41	138	512.0			512.0		9,069.5	3.00	111.43	11.75	1.50	10.22	8.24	152.71	42.76	**164.41**	**188.14**	450	260.0	0.40	1.15	12.61%	22
	140	130	56	140	568.4			568.4		9,637.9	2.97	117.38	11.75	1.50	10.22	9.22	161.93	45.34	**172.95**	**188.14**	450	340.0	0.40	1.15	8.08%	23
	130	110	106		360.4			360.4		9,998.3	2.95	121.12	11.75	1.50	10.22	8.60	170.53	47.75	**179.10**	**188.14**	450	80.0	0.40	1.15	4.81%	24
	120	110				9.5	807.5	807.5		807.5	3.86	12.77		1.50		9.50	9.50	2.66	**15.43**	**26.49**	200	320.0	0.60	0.82	41.75%	EX 4
	110	100								10,805.8	2.92	129.42	11.75	1.50	10.22		180.03	50.41	**190.05**	**210.31**	450	290.0	0.50	1.28	9.63%	
	100	EX-E								10,805.8	2.92	129.42	11.75	1.50	10.22		180.03	50.41	**190.05**	**210.31**	450	190.0	0.50	1.28	9.63%	

Average daily residential flow = 350 l/cap/day
Residential peaking factor = 1+(14/(4+P^0.5)) , where P = population in thousands
Commercial, Office and School average daily flow = 50,000 l/ha/day
Commercial, Office and School peaking factor = 1.5
Extraneous flow = 0.28 l/s/ha

RESIDENTIAL POPULATION DENSITIES

Residential Medium Density = 25 units/net hectare with 3.4 persons/unit = 85 persons/gross hectare

KANATA LAKES NORTH - SERVICEABILITY STUDY
SANITARY DRAINAGE AREAS

Area No.	Area (Ha)	Land Use	Population
1	11.46	Single Family - 98 Townhouse Units - 135	698
2	14.15	Single Family - 100 Townhouse Units - 187	845
3	4.66	Single Family - 32 Townhouse Units - 65	284
4	7.34	Single Family - 122	415
5	4.77	Single Family - 73	248
6	2.66	Townhouse Units - 90	243
7	5.80	Single Family - 46 Institutional - 3.0 ha	156
8	8.81	Medium Density - 2.25 Townhouse Units - 130	542
9	9.73	Single Family - 75 Townhouse Units - 116	568
10	18.61	Single Family - 117 Townhouse Units - 352	1,348
11	6.34	Single Family - 81	275
12	5.11	Single Family - 77	262
13	11.26	Townhouse Units - 300	810
14	9.10	Townhouse Units - 210	567
15	15.30	Single Family - 197	670
16	6.40	Institutional - 6.4 ha	
17	8.41	Single Family - 34 Institutional - 5.35 ha	116
18	10.50	Single Family - 94 Townhouse Units - 108	611
19	6.95	Townhouse Units - 215	581
20	4.95	Townhouse Units - 165	446
21	3.75	Single Family - 37	126
22	8.24	Single Family - 41 Townhouse Units - 138	512
23	9.22	Single Family - 56 Townhouse Units - 140	568
24	8.60	Single Family - 106	360
EX. 1	18.50	Medium Density	1,573
EX. 2	16.90	Medium Density	1,437
EX. 3	19.25	Medium Density	1,636
EX. 4	9.50	Medium Density	808

IBI GROUP
400-333 Preston Street
Ottawa, Ontario K1S 5N4 Canada
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SANITARY SEWER DESIGN SHEET

KNL Stage 9
City of Ottawa

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			FIXED	TOTAL	PROPOSED SEWER DESIGN						
				AREA	UNIT TYPES				AREA	POPULATION				AREA (Ha)						PEAK	AREA (Ha)										
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL													
STREET	AREA ID	FROM MH	TO MH	w/ Units (Ha)	SF	SD	TH	APT	w/o Units (Ha)	IND	CUM	PEAK FACTOR	PEAK FLOW (L/s)	IND	CUM	IND	CUM	IND	CUM	FLOW (L/s)	IND	CUM	FLOW (L/s)	FLOW (L/s)	FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	DIA (mm)	SLOPE (%)	VELOCITY (full) (m/s)	AVAILABLE CAPACITY L/s	AVAILABLE CAPACITY (%)
Kanata Highlands				18.30						1,287.0											18.30			from the "Functional Servicing Report for the Kanata Highlands" by DSEL December 20, 2016								
KNL Stage 7				59.86	350		898	106		3,805.4											59.86										
KNL Stage 8				61.61	325		698			2,989.6				11.75	11.75						73.36			from the "Kanata Lakes North Serviceability Study" by IBI Group June 2006							
		CAP	MH100A								8,082.0	3.05	99.72		11.75					10.20		151.52	42.43		152.35	210.32	32.45	450	0.50	1.281	57.97	27.56%
Walden Drive	100A	MH100A	MH101A	0.31						0.0	8,082.0	3.05	99.72		11.75		0.00		0.00	10.20	0.31	151.83	42.51	0.00	152.43	210.32	109.00	450	0.50	1.281	57.88	27.52%
Akamina Circle	123A	MH123A	MH124A	0.56	10					34.0	34.0	4.00	0.55		0.00		0.00		0.00	0.00	0.56	0.56	0.16	0.00	0.71	27.59	70.50	200	0.65	0.851	26.88	97.43%
	124A	MH124A	MH125A	0.68	12					40.8	74.8	4.00	1.21		11.75		0.00		0.00	10.20	0.68	1.24	0.35	0.00	11.76	20.24	75.57	200	0.35	0.624	8.48	41.91%
	125A	MH125A	MH126A	0.16	2					6.8	81.6	4.00	1.32		11.75		0.00		0.00	10.20	0.16	1.40	0.39	0.00	11.91	20.24	10.91	200	0.35	0.624	8.33	41.15%
	126A	MH126A	MH127A	0.43	6					20.4	102.0	4.00	1.65		11.75		0.00		0.00	10.20	0.43	1.83	0.51	0.00	12.36	20.24	67.98	200	0.35	0.624	7.88	38.92%
	127A	MH127A	MH128A	0.22	2					6.8	108.8	4.00	1.76		11.75		0.00		0.00	10.20	0.22	2.05	0.57	0.00	12.54	20.24	12.04	200	0.35	0.624	7.71	38.07%
	128A	MH128A	MH129A	0.63	13					44.2	153.0	4.00	2.48		11.75		0.00		0.00	10.20	0.63	2.68	0.75	0.00	13.43	20.24	74.96	200	0.35	0.624	6.81	33.66%
Akamina Circle	130A	MH130A	MH129A	0.85	15					51.0	51.0	4.00	0.83		0.00		0.00		0.00	0.00	0.85	0.85	0.24	0.00	1.06	39.01	93.34	200	1.30	1.203	37.95	97.27%
Akamina Circle	129A	MH129A	MH101A	0.08						0.0	204.0	4.00	3.31		0.00		0.00		0.00	0.00	0.08	3.61	1.01	0.00	4.32	41.91	53.38	200	1.50	1.292	37.59	89.70%
Walden Drive	101A	MH101A	MH102A	0.21						0.0	8,286.0	3.04	101.88		11.75		0.00		0.00	10.20	0.21	155.65	43.58	0.00	155.66	210.32	84.43	450	0.50	1.281	54.65	25.99%
	102A	MH102A	MH103A	0.21						0.0	8,286.0	3.04	101.88		11.75		0.00		0.00	10.20	0.21	155.86	43.64	0.00	155.72	210.32	87.80	450	0.50	1.281	54.59	25.96%
Ominik Crescent	144A	MH144A	MH142A	0.57	7					23.8	23.8	4.00	0.39		0.00		0.00		0.00	0.00	0.57	0.57	0.16	0.00	0.55	27.59	107.69	200	0.65	0.851	27.04	98.02%
	142A	MH142A	MH141A	0.24	3					10.2	34.0	4.00	0.55		0.00		0.00		0.00	0.00	0.24	0.81	0.23	0.00	0.78	21.64	38.38	200	0.40	0.667	20.86	96.41%
	141A	MH141A	MH140A	0.15	2					6.8	40.8	4.00	0.66		0.00		0.00		0.00	0.00	0.15	0.96	0.27	0.00	0.93	21.64	11.04	200	0.40	0.667	20.71	95.70%
	140A	MH140A	MH103A	0.60	11					37.4	78.2	4.00	1.27		0.00		0.00		0.00	0.00	0.60	1.56	0.44	0.00	1.70	53.01	81.71	200	2.40	1.635	51.30	96.79%
Walden Drive	103A	MH103A	MH104A	0.15						0.0	8,364.2	3.03	102.71		11.75		0.00		0.00	10.20	0.15	157.57	44.12	0.00	157.03	210.32	52.70	450	0.50	1.281	53.29	25.34%
	104A	MH104A	MH105A	0.07						0.0	8,364.2	3.03	102.71		11.75		0.00		0.00	10.20	0.07	157.64	44.14	0.00	157.05	210.32	34.62	450	0.50	1.281	53.27	25.33%
Point Grey Terrace	143A	MH143A	MH105A	0.67	11					37.4	37.4	4.00	0.61		0.00		0.00		0.00	0.00	0.67	0.67	0.19	0.00	0.79	68.43	85.83	200	4.00	2.110	67.64	98.84%
Walden Drive	105A	MH105A	MH146A	0.24						0.0	8,401.6	3.03	103.10		11.75		0.00		0.00	10.20	0.24	158.55	44.39	0.00	157.70	210.32	92.37	450	0.50	1.281	52.62	25.02%
Ominik Crescent	144B	MH144A	MH145A	0.24	3					10.2	10.2	4.00	0.17		0.00		0.00		0.00	0.00	0.24	0.24	0.07	0.00	0.23	54.10	24.39	200	2.50	1.668	53.87	99.57%
	145A	MH145A	MH146A	0.85	13					44.2	54.4	4.00	0.88		0.00		0.00		0.00	0.00	0.85	1.09	0.31	0.00	1.19	68.43	112.03	200	4.00	2.110	67.25	98.27%
Walden Drive		MH146A	MH106A							0.0	8,456.0	3.03	103.68		11.75		0.00		0.00	10.20	0.00	159.64	44.70	0.00	158.58	210.32	5.00	450	0.50	1.281	51.74	24.60%
Newstead Crescent	131A	MH131A	MH132A	0.49			16			43.2	43.2	4.00	0.70		0.00		0.00		0.00	0.00	0.49	0.49	0.14	0.00	0.84	35.89	59.00	200	1.10	1.107	35.05	97.67%
	132A	MH132A	MH133A	0.61			19			51.3	94.5	4.00	1.53		0.00		0.00		0.00	0.00	0.61	1.10	0.31	0.00	1.84	35.89	73.50	200	1.10	1.107	34.05	94.87%
	133A	MH133A	MH134A	0.20			3			8.1	102.6	4.00	1.66		0.00		0.00		0.00	0.00	0.20	1.30	0.36	0.00	2.03	54.10	11.08	200	2.50	1.668	52.07	96.25%
	134A	MH134A	MH135A	0.58			14			37.8	140.4	4.00	2.28		0.00		0.00		0.00	0.00	0.58	1.88	0.53	0.00	2.80	58.27	76.05	200	2.90	1.797	55.47	95.19%
Hummock Street	159A	MH159A	MH139A	0.44			13			35.1	35.1	4.00	0.57		0.00		0.00		0.00	0.00	0.44	0.44	0.12	0.00	0.69	50.75	57.00	200	2.20	1.565	50.06	98.64%
	139A	MH139A	MH135A	0.44			14			37.8	72.9	4.00	1.18		0.00		0.00		0.00	0.00	0.44	0.88	0.25	0.00	1.43	50.75	69.00	200	2.20	1.565	49.32	97.19%
Newstead Crescent	135A	MH135A	MH136A	0.57			13			35.1	248.4	4.00	4.03		0.00		0.00		0.00	0.00	0.57	3.33	0.93	0.00	4.96	21.64	74.38	200	0.40	0.667	16.68	77.09%
	136A	MH136A	MH137A	0.13			2			5.4	253.8	4.00	4.11		0.00		0.00		0.00	0.00	0.13	3.46	0.97	0.00	5.08	21.64	13.48	200	0.40	0.667	16.56	76.52%
	137A	MH137A	MH138A	0.71			20			54.0	307.8	4.00	4.99		0.00		0.00		0.00	0.00	0.71	4.17	1.17	0.00	6.16	21.64	68.17	200	0.40	0.667	15.49	71.56%
		MH138A	MH106A							0.0	307.8	4.00	4.99		0.00		0.00		0.00	0.00	0.00	4.17	1.17	0.00	6.16	21.64	18.67	200	0.40	0.667	15.49	71.56%
Walden Drive	106A	MH106A	MH107A	0.10						0.0	8,763.8	3.01	106.91		11.75		0.00		0.00	10.20	0.10	163.91	45.89	0.00	163.00	220.58	41.36	450	0.55	1.344	57.58	26.10%
	107A	MH107A	MH108A	0.30						0.0	8,763.8	3.01	106.91		11.75		0.00		0.00	10.20	0.30	164.21	45.98	0.00	163.09	220.58	120.00	450	0.55	1.344	57.50	26.07%
Athabasca Heights	148A	MH148A	MH108A	0.73	11					37.4	37.4	4.00	0.61		0.00		0.00		0.00	0.00	0.73	0.73	0.20	0.00	0.81	64.01	92.83	200	3.50	1.974	63.20	98.73%
Walden Drive	108A	MH108A	MH109A	0.35			6			16.2	8,817.4	3.01	107.47		11.75		0.00		0.00	10.20	0.35	165.29	46.28	0.00	163.95	220.58	84.99	450	0.55	1.344	56.63	25.67%

Design Parameters:

Residential			ICI Areas			
						Peak Factor
SF	3.4	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.7	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Other	60	p/p/Ha		17000	L/Ha/day	

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

Designed: LME

Checked:

Dwg. Reference: 102101-500A
102101-501A

No.	Revision	Date
1.	City submission No. 1	2/15/2017
2.	City submission No. 2	8/29/2017
3.	City submission No. 3	10/25/2017
4.	City submission No. 4	1/24/2018
5.	City submission No. 5	3/9/2018

File Reference:	Date:	Sheet No:
102101.5.7.1	3/9/2018	1 of 2

IBI GROUP
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Ottawa, Ontario K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
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SANITARY SEWER DESIGN SHEET

KNL Stage 9
City of Ottawa

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			FIXED	TOTAL	PROPOSED SEWER DESIGN						
				AREA	UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE CAPACITY	
														INSTITUTIONAL		COMMERCIAL		INDUSTRIAL		FLOW									(full)		
STREET	AREA ID	FROM MH	TO MH	w/ Units (Ha)	SF	SD	TH	APT	w/o Units (Ha)	IND	CUM	FACTOR	FLOW (L/s)	IND	CUM	IND	CUM	IND	CUM	FLOW (L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
Athabasca Heights	148A1	MH148A	MH149A	0.10	1					3.4	3.4	4.00	0.06		0.00		0.00		0.00	0.00	0.10	0.10	0.03	0.00	0.08	34.22	9.96	200	1.00	1.055	34.13	99.76%
	149A	MH149A	MH150A	0.16	2					6.8	10.2	4.00	0.17		0.00		0.00		0.00	0.00	0.16	0.26	0.07	0.00	0.24	54.10	13.62	200	2.50	1.668	53.86	99.56%
	150A	MH150A	MH151A	0.17	2					6.8	17.0	4.00	0.28		0.00		0.00		0.00	0.00	0.17	0.43	0.12	0.00	0.40	54.10	38.99	200	2.50	1.668	53.71	99.27%
	151A	MH151A	MH152A	0.24	3					10.2	27.2	4.00	0.44		0.00		0.00		0.00	0.00	0.24	0.67	0.19	0.00	0.63	54.10	21.66	200	2.50	1.668	53.47	98.84%
	152A	MH152A	MH153A	0.09	1					3.4	30.6	4.00	0.50		0.00		0.00		0.00	0.00	0.09	0.76	0.21	0.00	0.71	54.10	9.61	200	2.50	1.668	53.39	98.69%
	153A	MH153A	MH109A	0.67	10					34.0	64.6	4.00	1.05		0.00		0.00		0.00	0.00	0.67	1.43	0.40	0.00	1.45	74.18	90.45	200	4.70	2.287	72.73	98.05%
Walden Drive	109A	MH109A	MH110A	0.51			13			35.1	8,917.1	3.00	108.51		11.75		0.00		0.00	10.20	0.51	167.23	46.82	0.00	165.53	220.58	85.99	450	0.55	1.344	55.05	24.96%
Burrard Crescent	114A1	MH114A	MH113A	0.09	1					3.4	3.4	4.00	0.06		0.00		0.00		0.00	0.00	0.09	0.09	0.03	0.00	0.08	37.48	13.48	200	1.20	1.156	37.40	99.79%
	113A	MH113A	MH112A	0.42	5					17.0	20.4	4.00	0.33		0.00		0.00		0.00	0.00	0.42	0.51	0.14	0.00	0.47	30.60	66.29	200	0.80	0.944	30.13	98.45%
	112A	MH112A	MH111A	0.15	2					6.8	27.2	4.00	0.44		0.00		0.00		0.00	0.00	0.15	0.66	0.18	0.00	0.63	20.24	13.48	200	0.35	0.624	19.62	96.91%
	111A	MH111A	MH110A	0.58	9					30.6	57.8	4.00	0.94		0.00		0.00		0.00	0.00	0.58	1.24	0.35	0.00	1.28	20.24	74.22	200	0.35	0.624	18.96	93.66%
Walden Drive	110A	MH110A	MH115A	0.34			6			16.2	8,991.1	3.00	109.28		11.75		0.00		0.00	10.20	0.34	168.81	47.27	0.00	166.75	220.58	84.99	450	0.55	1.344	53.83	24.41%
Burrard Crescent	114A	MH114A	MH115A	0.58	9					30.6	30.6	4.00	0.50		0.00		0.00		0.00	0.00	0.58	0.58	0.16	0.00	0.66	27.59	74.20	200	0.65	0.851	26.93	97.61%
Walden Drive	118A	MH118A	MH117A	0.46	5					17.0	17.0	4.00	0.28		0.00		0.00		0.00	0.00	0.46	0.46	0.13	0.00	0.40	59.26	35.00	200	3.00	1.828	58.86	99.32%
	117A	MH117A	MH116A	0.58	10					34.0	51.0	4.00	0.83		0.00		0.00		0.00	0.00	0.58	1.04	0.29	0.00	1.12	35.89	65.46	200	1.10	1.107	34.77	96.89%
Iron Bridge Place	160A	MH160A	MH161A	0.59	9					30.6	30.6	4.00	0.50		0.00		0.00		0.00	0.00	0.59	0.59	0.17	0.00	0.66	28.63	68.25	200	0.70	0.883	27.97	97.69%
	161A	MH161A	MH162A	0.56	9					30.6	61.2	4.00	0.99		0.00		0.00		0.00	0.00	0.56	1.15	0.32	0.00	1.31	26.50	61.50	200	0.60	0.817	25.19	95.04%
	162A	MH162A	MH163A	0.09	1					3.4	64.6	4.00	1.05		0.00		0.00		0.00	0.00	0.09	1.24	0.35	0.00	1.39	54.10	11.48	200	2.50	1.668	52.71	97.42%
	163A	MH163A	MH116A	0.40	5					17.0	81.6	4.00	1.32		0.00		0.00		0.00	0.00	0.40	1.64	0.46	0.00	1.78	21.64	79.95	200	0.40	0.667	19.86	91.77%
Walden Drive	116A	MH116A	MH115A	0.33	3					10.2	142.8	4.00	2.31		0.00		0.00		0.00	0.00	0.33	3.01	0.84	0.00	3.16	34.22	83.99	200	1.00	1.055	31.06	90.77%
Tamworth Street	115A	MH115A	MH165A	0.54	6		7			39.3	9,203.8	2.99	111.49		11.75		0.00		0.00	10.20	0.54	172.94	48.42	0.00	170.12	230.39	87.99	450	0.60	1.403	60.27	26.16%
Kitigan Crescent	155C	MH155C	MH155A	0.55			17			45.9	45.9	4.00	0.74		0.00		0.00		0.00	0.00	0.55	0.55	0.15	0.00	0.90	55.17	64.50	200	2.60	1.701	54.27	98.37%
	155A	MH155A	MH156A	0.18			3			8.1	54.0	4.00	0.88		0.00		0.00		0.00	0.00	0.18	0.73	0.20	0.00	1.08	68.43	11.48	200	4.00	2.110	67.35	98.42%
	156A	MH156A	MH157A	0.67			19			51.3	105.3	4.00	1.71		0.00		0.00		0.00	0.00	0.67	1.40	0.39	0.00	2.10	21.64	74.95	200	0.40	0.667	19.54	90.30%
	157A	MH157A	MH158A	0.72			23			62.1	167.4	4.00	2.71		0.00		0.00		0.00	0.00	0.72	2.12	0.59	0.00	3.31	21.64	78.29	200	0.40	0.667	18.33	84.72%
	158A	MH158A	MH165A	0.65			19			51.3	218.7	4.00	3.54		0.00		0.00		0.00	0.00	0.65	2.77	0.78	0.00	4.32	35.89	94.62	200	1.10	1.107	31.57	87.96%
Block	166A	MH166A	MH165A	9.60			831			2,243.7	2,243.7	3.55	32.23		0.00		0.00		0.00	0.00	9.60	9.60	2.69	0.00	34.92	55.26	46.63	300	0.30	0.757	20.33	36.80%
Briarpath Court	165A	MH165A	MH168A	0.82	18					61.2	11,727.4	2.89	137.09		11.75		0.00		0.00	10.20	0.82	186.13	52.12	0.00	199.40	257.58	118.03	450	0.75	1.569	58.18	22.59%
	168A	MH168A	MH169A	0.79	14					47.6	11,775.0	2.88	137.56		11.75		0.00		0.00	10.20	0.79	186.92	52.34	0.00	200.10	257.58	112.00	450	0.75	1.569	57.49	22.32%
	170A	MH169A	MH171A	0.86	10					34.0	11,809.0	2.88	137.90		11.75		0.00		0.00	10.20	0.86	187.78	52.58	0.00	200.68	257.58	89.92	450	0.75	1.569	56.91	22.09%
		MH171A	MH172A	0.21						0.0	11,809.0	2.88	137.90		11.75		0.00		0.00	10.20	0.21	187.99	52.64	0.00	200.73	257.58	119.96	450	0.75	1.569	56.85	22.07%
		MH172A	MH173A	0.07						0.0	11,809.0	2.88	137.90		11.75		0.00		0.00	10.20	0.07	188.06	52.66	0.00	200.75	257.58	44.40	450	0.75	1.569	56.83	22.06%
Kimmins Court		EXMH21	MH173A							24,936.7	24,936.7	2.56	258.26	18.40	18.40		0.00		0.00	15.97	393.59	393.59	110.21	0.00	384.44	636.13	7.00	750	0.30	1.395	251.69	39.57%
Marchwood Lakeside Trunk Sanitary Sewer		MH173A	EXMH13A								36,745.7	2.39	355.97		30.15		0.00		0.00	26.17	0.00	581.65	162.86	0.00	545.00	636.13	93.27	750	0.30	1.395	91.13	14.33%
																					from the "Kanata Lakes North Serviceability Study" by IBI Group June 2006										

Design Parameters:

Residential			ICI Areas			
						Peak Factor
SF	3.4	p/p/u				
TH/SD	2.7	p/p/u	INST	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	COM	50,000	L/Ha/day	1.5
Other	60	p/p/Ha	IND	35,000	L/Ha/day	MOE Chart
				17000	L/Ha/day	

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

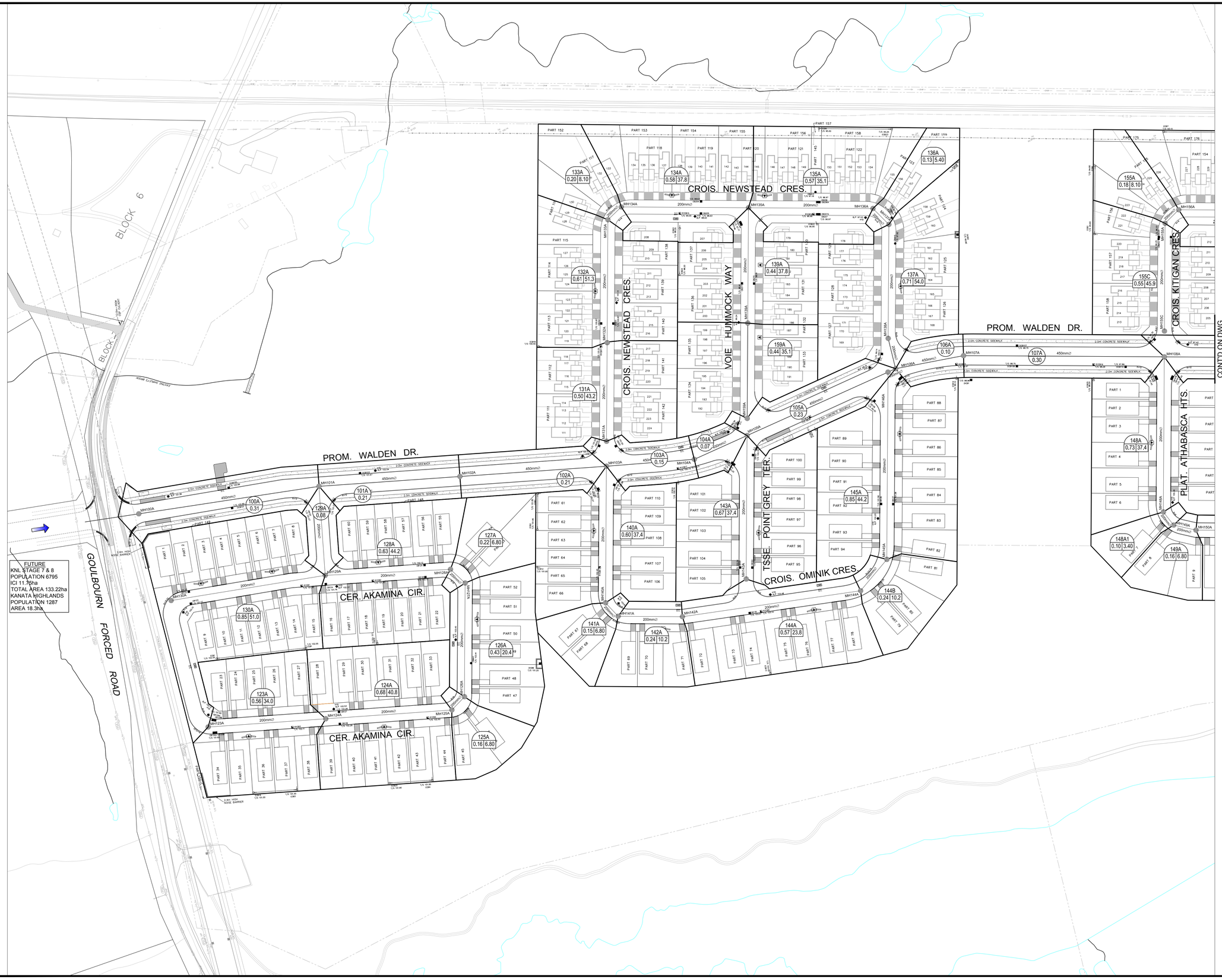
Designed: LME

Checked:

Dwg. Reference: 102101-500A
102101-501A

No.	Revision	Date
1.	City submission No. 1	2/15/2017
2.	City submission No. 2	8/29/2017
3.	City submission No. 3	10/25/2017
4.	City submission No. 4	1/24/2018
5.	City submission No. 5	3/9/2018

File Reference: 102101.5.7.1
Date: 3/9/2018
Sheet No: 2 of 2



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed _____

Date _____ 2018

Plan Number _____

KEY PLAN
NTS

FOR LEGEND AND DETAILS SEE DRAWING 102101-010

LEGEND :

- 6115A / 0.81 / 43.2 — AREA NUMBER; POPULATION; AREA IN HECTARES
- 107A / 0.30 — AREA NUMBER; AREA IN HECTARES
- FUTURE FLOW DIRECTION

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6	REVISED AS PER CITY COMMENTS	LME	2018.02.23
5	ISSUED FOR 4TH SUBMISSION	LME	2018.01.24
4	REVISED AS PER CITY COMMENTS	LME	2017.10.27
3	ISSUED FOR 2ND SUBMISSION	LME	2017.08.30
2	REVISED AS PER CITY COMMENTS	LME	2017.08.18
1	ISSUED TO CITY FOR REVIEW	LME	2017.02.15

KANATA LAKES

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
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Project Title
KNL STAGE 9

LICENSED PROFESSIONAL ENGINEER
L. M. ENNIS
13379508
2018/02/23
PROVINCE OF ONTARIO

N

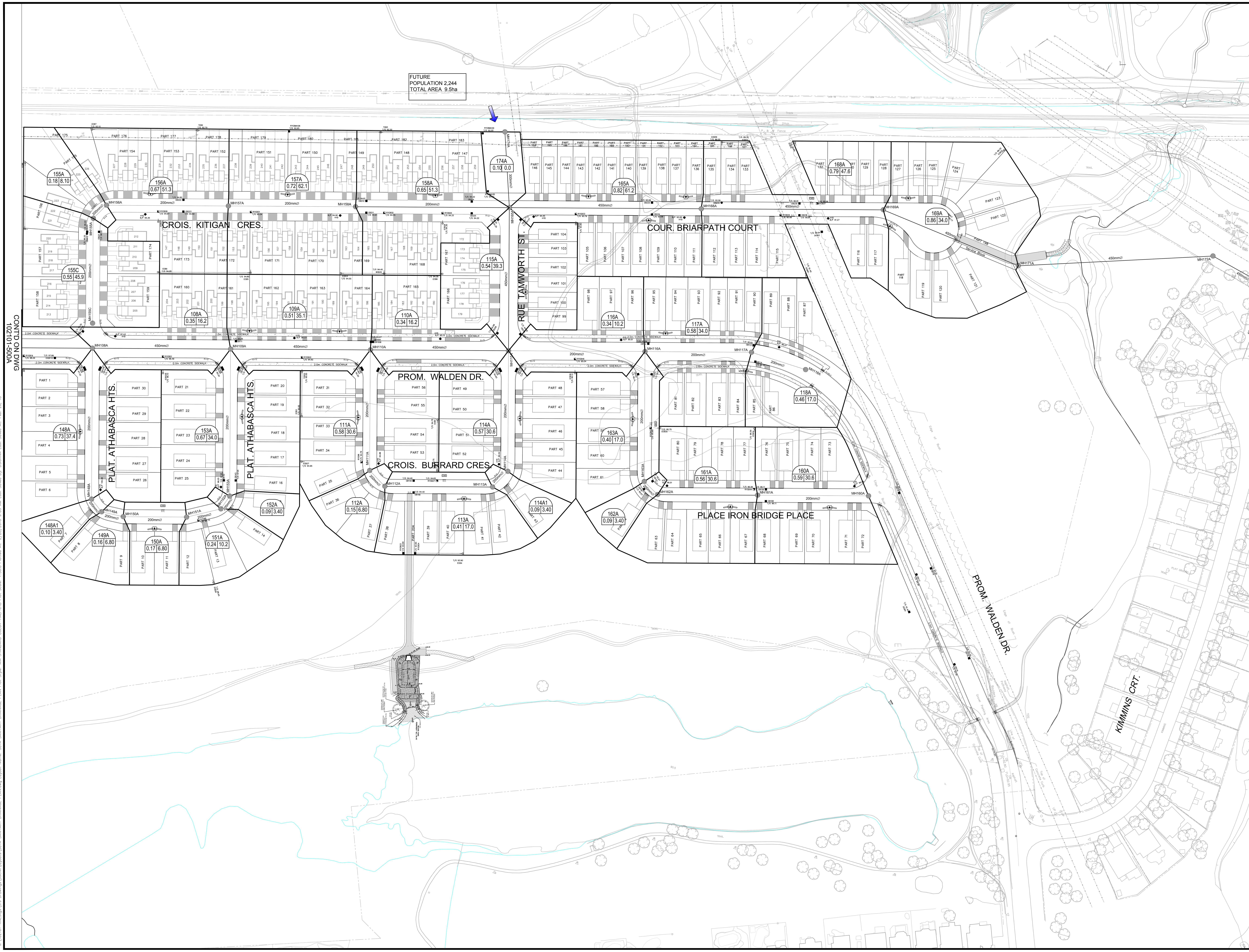
Drawing Title
SANITARY DRAINAGE
AREA PLAN

Scale
1:1000

Design	Date
L.E.	FEB. 2017
Drawn	Checked
D.S./C.C./M.M.	T.R.B.
Project No.	Drawing No.
102101	500A

D07-XX-XX-XXXX

#XXXXX



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2018

Plan Number ______________________

KEY PLAN
NTS

FOR LEGEND AND DETAILS SEE DRAWING 102101-010

LEGEND :

6115A — AREA NUMBER
0.81 | 43.2 — POPULATION / AREA IN HECTARES

107A / 0.30 — AREA NUMBER / AREA IN HECTARES

FUTURE FLOW DIRECTION

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6	REVISED AS PER CITY COMMENTS	LME	2018:02:23
5	ISSUED FOR 4TH SUBMISSION	LME	2018:01:24
4	REVISED AS PER CITY COMMENTS	LME	2017:10:27
3	ISSUED FOR 2ND SUBMISSION	LME	2017:08:30
2	REVISED AS PER CITY COMMENTS	LME	2017:08:18
1	ISSUED TO CITY FOR REVIEW	LME	2017:02:15

KANATA LAKES

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Project Title
KNL STAGE 9

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
13379508
2018/02/23
PROVINCE OF ONTARIO

N

Drawing Title
SANITARY DRAINAGE
AREA PLAN

Scale
1:1000

Design	Date
L.E.	FEB. 2017
Drawn	Checked
D.S./C.C./M.M.	T.R.B.
Project No.	Drawing No.
102101	501A

D07-XX-XX-XXXX

#XXXXX

APPENDIX C

- Storm Sewer Design Sheets
- Comparison of Individual Pipe Rational Flows and ICD Flows
- Runoff Coefficient Calculations
- Vortechs Unit 16000 Information
- Vortechs Unit 11000 Information
- Storm Drainage Area Plan Drawing No. 102101-500
- Storm Drainage Area Plan Drawing No. 102101-501

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STORM SEWER DESIGN SHEET

KNL Stage 9
City of Ottawa

LOCATION				AREA (Ha)						RATIONAL DESIGN FLOW													SEWER DATA						
				Existing	Single Family		Townhouse		Walden	2 Year		5 Year		100 Year															
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.50	C= 0.73	C= 0.53	C= 0.76	C= 0.60	IND 2.78AC	CUM 2.78AC	IND 2.78AC	CUM 2.78AC	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PE SIZE (m DIA	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (L/s)	AVAIL CAP (%)
GFR	GFR1	CAP	MH100						0.27	0.00	0.00	0.45	0.45	0.00	0.00	10.00	0.13	10.13	76.81	104.19	178.56	0.00	46.92	0.00		46.92	87.74	13.58	250	2.00	1.731	40.81	46.52%
GFR	GFR2	STUB	MH100						0.64	0.00	0.00	1.07	1.52	0.00	0.00	10.00	0.22	10.22	76.81	104.19	178.56	0.00	158.15	0.00		158.15	182.91	21.00	375	1.00	1.604	24.76	13.54%
Walden Drive		MH100	MH100C							0.00	0.00	0.00	1.52	0.00	0.00	10.00	0.15	10.15	76.81	104.19	178.56	0.00	158.15	0.00		158.15	317.25	12.38	525	0.50	1.420	159.10	50.15%
		MH100C	MH100B							0.00	0.00	0.00	1.52	0.00	0.00	10.15	0.68	10.83	76.25	103.43	177.24	0.00	157.00	0.00		157.00	317.25	58.00	525	0.50	1.420	160.25	50.51%
Akamina Circle	123 A,B	MH123	MH124		0.17	0.46				1.17	1.17	0.00	0.00	0.00	0.00	10.00	1.07	11.07	76.81	104.19	178.56	89.85	0.00	0.00		89.85	188.11	73.50	450	0.40	1.146	98.27	52.24%
	124 A,B	MH124	MH125		0.10	0.47				1.09	2.26	0.00	0.00	0.00	0.00	11.07	1.40	12.47	72.93	98.87	169.34	165.01	0.00	0.00		165.01	200.65	75.49	525	0.20	0.898	35.63	17.76%
		MH125	MH126							0.00	2.26	0.00	0.00	0.00	0.00	12.47	0.20	12.67	68.46	92.73	158.74	154.91	0.00	0.00		154.91	200.65	11.01	525	0.20	0.898	45.74	22.79%
	126 A,B,C	MH126	MH127	0.22	0.23					0.47	2.74	0.00	0.00	0.00	0.00	12.67	1.39	14.06	67.86	91.91	157.32	185.62	0.00	0.00		185.62	248.09	70.64	600	0.15	0.850	62.47	25.18%
		MH127	MH128							0.00	2.74	0.00	0.00	0.00	0.00	14.06	0.24	14.30	64.08	86.72	148.36	175.27	0.00	0.00		175.27	248.09	12.42	600	0.15	0.850	72.81	29.35%
	128 A,B,C	MH128	MH129		0.21	0.62				1.55	4.29	0.00	0.00	0.00	0.00	14.30	1.36	15.66	63.46	85.88	146.90	271.96	0.00	0.00		271.96	339.63	74.80	675	0.15	0.919	67.67	19.93%
Akamina Circle	130 A,B	MH130	MH129		0.28	0.33				1.06	1.06	0.00	0.00	0.00	0.00	10.00	1.25	11.25	76.81	104.19	178.56	81.33	0.00	0.00		81.33	141.68	93.49	375	0.60	1.243	60.35	42.60%
Akamina Circle	129 A,B	MH129	MH101			0.30			0.04	0.61	5.95	0.07	0.07	0.00	0.00	15.66	0.28	15.94	60.25	81.49	139.32	358.70	5.44	0.00		364.14	1,074.02	48.73	675	1.50	2.908	709.88	66.10%
Walden Drive	102 A,B	MH102	MH101		0.13				0.18	0.00	0.00	0.48	0.48	0.00	0.00	10.00	0.16	10.16	76.81	104.19	178.56	0.00	50.11	0.00		50.11	107.45	20.00	250	3.00	2.121	57.34	53.37%
Walden Drive	100 A,C	MH101	MH100B		0.16				0.14	0.00	5.95	0.46	1.00	0.00	0.00	15.94	0.62	16.55	59.64	80.64	137.87	355.03	80.93	0.00		435.96	554.62	55.51	675	0.40	1.501	118.66	21.39%
	100 B	MH100B	VORTECTS						0.18	0.00	5.95	0.30	2.82	0.00	0.00	16.55	0.20	16.75	58.33	78.85	134.77	347.22	222.49	0.00		569.71	734.54	19.36	750	0.40	1.611	164.83	22.44%
Outlet to Shirleys Brook		VORTECHS	HEADWALL							0.00	5.95	0.00	2.82	0.00	0.00	16.75	0.46	17.22	57.91	78.29	133.80	344.77	220.90	0.00		565.66	734.54	44.80	750	0.40	1.611	168.88	22.99%
Ominik Crescent	144 A,B,C	MH144	MH142	0.10	0.17	0.32				0.96	0.96	0.00	0.00	0.00	0.00	10.00	1.60	11.60	76.81	104.19	178.56	73.36	0.00	0.00		73.36	129.34	109.13	375	0.50	1.134	55.97	43.28%
		MH142	MH141							0.00	0.96	0.00	0.00	0.00	0.00	11.60	0.65	12.26	71.15	96.42	165.12	67.97	0.00	0.00		67.97	115.68	39.82	375	0.40	1.015	47.72	41.25%
		MH141	MH140							0.00	0.96	0.00	0.00	0.00	0.00	12.26	0.19	12.44	69.10	93.61	160.26	66.01	0.00	0.00		66.01	115.68	11.28	375	0.40	1.015	49.68	42.94%
	140 A,B,C,D	MH140	MH103		0.34	0.49			0.11	1.47	2.42	0.18	0.18	0.00	0.00	12.44	0.55	12.99	68.55	92.85	158.94	166.03	17.04	0.00		183.07	283.36	81.44	375	2.40	2.485	100.30	35.39%
Walden Drive	103	MH103	MH104		0.24					0.33	2.76	0.00	0.18	0.00	0.00	12.99	0.77	13.75	66.96	90.67	155.18	184.53	16.64	0.00		201.17	265.43	54.59	525	0.35	1.188	64.26	24.21%
	104 A,B	MH104	MH105					0.03	0.10	0.00	2.76	0.23	0.41	0.00	0.00	13.75	0.50	14.26	64.87	87.81	150.23	178.77	36.32	0.00		215.10	265.43	35.84	525	0.35	1.188	50.33	18.96%
Point Grey Terrace	143 A,B,C,D	MH143	MH105			0.52			0.10	1.06	1.06	0.17	0.17	0.00	0.00	10.00	0.52	10.52	76.81	104.19	178.56	81.05	17.38	0.00		98.43	201.76	86.40	300	4.00	2.765	103.33	51.21%
Walden Drive	105 A,B,C	MH105	MH146		0.30	0.15			0.10	0.72	4.53	0.17	0.75	0.00	0.00	14.26	1.11	15.37	63.58	86.04	147.17	288.16	64.29	0.00		352.45	405.13	92.38	600	0.40	1.388	52.67	13.00%
Ominik Crescent		MH144	MH145							0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.21	10.21	76.81	104.19	178.56	0.00	0.00	0.00		0.00	98.09	24.34	250	2.50	1.936	98.09	100.00%
	145	MH145	MH146			0.34				0.69	0.69	0.00	0.00	0.00	0.00	10.21	0.76	10.97	76.01	103.10	176.67	52.45	0.00	0.00		52.45	124.08	112.39	250	4.00	2.449	71.63	57.73%
Walden Drive	146	MH146	MH106			0.19				0.39	5.61	0.00	0.75	0.00	0.00	15.37	0.09	15.45	60.92	82.39	140.88	341.62	61.57	0.00		403.19	518.80	7.26	675	0.35	1.404	115.62	22.29%
Newstead Crescent	131 A,B	MH131	MH132					0.11	0.12	0.23	0.23	0.20	0.20	0.00	0.00	10.00	1.02	11.02	76.81	104.19	178.56	17.85	20.86	0.00		38.71	48.06	58.00	250	0.60	0.948	9.35	19.46%
	132 A,B	MH132	MH133				0.20	0.39		0.00	0.23	0.00	0.20	1.12	1.12	11.02	0.68	11.70	73.10	99.10	169.75	16.99	19.84	189.89		226.72	311.95	77.28	450	1.10	1.900	85.23	27.32%
		MH133	MH134							0.00	0.23	0.00	0.20	0.00	1.12	11.70	0.07	11.76	70.85	96.01	164.40	16.47	19.22	183.91		219.60	470.28	11.32	450	2.50	2.865	250.69	53.31%
	134 A,B	MH134	MH135				0.43	0.42		0.00	0.23	0.00	0.20	1.52	2.64	11.76	0.44	12.20	70.64	95.72	163.90	16.42	19.16	432.64		468.22	665.47	78.87	525	2.20	2.978	197.25	29.64%
Hummock Street		MH159	MH139							0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.52	10.52	76.81	104.19	178.56	0.00	0.00	0.00		0.00	92.02	57.00	250	2.20	1.816	92.02	100.00%
	139 A,B	MH139	MH135					0.48		0.00	0.00	0.00	0.00	1.01	1.01	10.52	0.48	11.01	74.85	101.51	173.91	0.00	0.00	176.37		176.37	271.30	69.00	375	2.20	2.380	94.93	34.99%
Newstead Crescent	135 A,B,C,D	MH135	MH136	0.13			1.00	0.85		0.00	0.23	0.00	0.20	3.36	7.01	12.20	0.65	12.86	69.26	93.83	160.64	16.10	18.78	1,126.63		1,161.50	1,478.65	74.92	975	0.40	1.919	317.15	21.45%
		MH136	MH137							0.00	0.23	0.00	0.20	0.00	7.01	12.86	0.11	12.97	67.34	91.19	156.08	15.65	18.25	1,094.66		1,128.56	1,478.65	12.72	975	0.40	1.919	350.09	23.68%
	137 A,B	MH137	MH138	0.64			0.20			0.00	0.23	0.00	0.20	0.74	7.75	12.97	0.62	13.58	67.03	90.76	155.34	15.58	18.17	1,204.30		1,238.04	1,560.35	64.52	1050	0.30	1.746	322.31	20.66%
	138 A,B	MH138	MH106					0.04	0.12	0.08	0.32	0.20	0.40	0.00	7.75	13.58	0.25	13.83	65.33	88.44	151.32	20.70	35.40	1,173.17		1,229.28	1,560.35	26.48	1050	0.30	1.746	331.07	21.22%
Walden Drive	106	MH106	MH107		0.32					0.44	6.37	0.00	1.15	0.00	7.75	15.45	0.36	15.81	60.72	82.12	140.42	386.77	94.24	1,088.63		1,569.64	2,033.65	37.43	1200	0.25	1.742	464.01	22.82%
	107 A,B,C,D	MH107	MH108	1.38	0.20				0.28	1.24	7.61	0.47	1.61	0.00	7.75	15.81	1.13	16.94	59.92	81.03	138.53	455.79	130.83	1,073.97		1,660.58	2,033.65	118.17	1200	0.25	1.742	373.07	18.35%
Athabasca Heights	148 A,B	MH148	MH108			0.42			0.04	0.85	0.85	0.07	0.07	0.00	0.00	10.00	0.66	10.66	76.81	104.19	178.56	65.46	6.95	0.00		72.42	116.06	91.15	250	3.50	2.291	43.65	37.61%
Walden Drive	108	MH108	MH109		0.27					0.38	8.83	0.00	1.68	0.00	7.75	16.94	0.84	17.78	57.53	77.77	132.91	508.30	130.75	1,030.40		1,669.45	2,033.65	87.99	1200	0.25	1.742	364.21	17.91%

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 732.951 / (TC+6.199)^0.810] 2 YEAR
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: LME
Checked:
Dwg. Reference: 102101-500
102101-501

No.	Revision	Date
1.	City submission No. 1	15-02-2017
2.	City submission No. 2	29-08-2017
3.	City submission No. 3	10/25/2017
4.	City submission No. 4	1/24/2018
5.	City submission No. 5	3/9/2018

File Reference:	Date:	Sheet No:
102101.5.7.1	3/9/2018	1 of 2

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STORM SEWER DESIGN SHEET

KNL Stage 9
City of Ottawa

LOCATION				AREA (Ha)						RATIONAL DESIGN FLOW														SEWER DATA						
				Existing	Single Family		Townhouse		Walden	2 Year		5 Year		100 Year																
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.50	C= 0.73	C= 0.53	C= 0.76	C= 0.60	IND 2.78AC	CUM 2.78AC	IND 2.78AC	CUM 2.78AC	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PE SIZE (m DIA	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (L/s)	AVAIL CAP (%)
Athabasca Heights		MH148	MH149							0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.13	10.13	76.81	104.19	178.56	0.00	0.00	0.00		0.00	62.04	9.77	250	1.00	1.224	62.04	100.00%
		MH149	MH150							0.00	0.00	0.00	0.00	0.00	0.00	10.13	0.13	10.26	76.30	103.50	177.35	0.00	0.00	0.00		0.00	98.09	15.11	250	2.50	1.936	98.09	100.00%
		MH150	MH151							0.00	0.00	0.00	0.00	0.00	0.00	10.26	0.40	10.66	75.81	102.82	176.19	0.00	0.00	0.00		0.00	98.09	46.44	250	2.50	1.936	98.09	100.00%
	151	MH151	MH152		0.16					0.22	0.22	0.00	0.00	0.00	0.00	10.66	0.14	10.80	74.35	100.82	172.72	16.54	0.00	0.00		16.54	98.09	16.35	250	2.50	1.936	81.56	83.14%
		MH152	MH153							0.00	0.22	0.00	0.00	0.00	0.00	10.80	0.07	10.87	73.85	100.13	171.53	16.42	0.00	0.00		16.42	159.51	9.36	300	2.50	2.186	143.08	89.70%
	153 A,B,C	MH153	MH109			0.82			0.11	1.66	1.89	0.18	0.18	0.00	0.00	10.87	0.50	11.37	73.60	99.79	170.94	138.85	18.31	0.00		157.16	488.73	88.80	450	2.70	2.977	331.57	67.84%
Walden Drive	109 A,B	MH109	MH110		0.15			0.22		0.21	10.93	0.46	2.33	0.00	7.75	17.78	0.93	18.71	55.89	75.52	129.04	610.89	175.94	1,000.41		1,787.24	2,156.55	81.49	1350	0.15	1.460	369.30	17.12%
Walden Drive	120	MH120	MH110					0.39		0.00	0.00	0.82	0.82	0.00	0.00	10.00	0.58	10.58	76.81	104.19	178.56	0.00	85.85	0.00		85.85	210.32	44.55	450	0.50	1.281	124.46	59.18%
Burrard Crescent	110 A,B,C	MH110	MH111		0.12	0.19			0.17	0.55	11.48	0.28	3.44	0.00	7.75	18.71	0.94	19.66	54.20	73.21	125.04	622.28	251.62	969.43		1,843.33	2,332.02	72.43	1500	0.10	1.278	488.69	20.96%
		MH111	MH112							0.00	11.48	0.00	3.44	0.00	7.75	19.66	0.20	19.85	52.59	71.01	121.26	603.81	244.07	940.09		1,787.98	3,006.86	15.96	1650	0.10	1.362	1218.89	40.54%
	112	MH112	MH112B			0.54				1.10	12.58	0.00	3.44	0.00	7.75	19.85	0.20	20.06	52.27	70.57	120.51	657.42	242.58	934.27		1,834.26	3,006.86	16.62	1650	0.10	1.362	1172.60	39.00%
		MH112B	MH112C							0.00	12.58	0.00	3.44	0.00	7.75	20.06	0.09	20.15	51.94	70.13	119.74	653.29	241.04	928.29		1,822.62	3,006.86	7.40	1650	0.10	1.362	1184.24	39.38%
Kitigan Crescent	155 A,B,C	MH155B	MH155				0.17	0.28	0.13	0.25	0.25	0.22	0.22	0.59	0.59	10.00	0.51	10.51	76.81	104.19	178.56	19.24	22.59	105.63		147.46	162.67	68.21	300	2.60	2.229	15.20	9.35%
		MH155	MH156							0.00	0.25	0.00	0.22	0.00	0.59	10.51	0.09	10.60	74.90	101.57	174.03	18.76	22.03	102.95		143.74	162.67	11.72	300	2.60	2.229	18.93	11.64%
	156 A,B	MH156	MH157				0.03	0.51		0.00	0.25	0.00	0.22	1.12	1.71	10.60	1.45	12.05	74.58	101.14	173.27	18.68	21.93	296.87		337.49	473.55	74.68	825	0.10	0.858	136.06	28.73%
	157	MH157	MH158				0.31			0.00	0.25	0.00	0.22	0.46	2.17	12.05	1.58	13.63	69.74	94.49	161.78	17.47	20.49	351.07		389.03	473.55	81.21	825	0.10	0.858	84.52	17.85%
	158 A,B,C,D	MH158	MH165				0.41	0.73		0.00	0.25	0.00	0.22	2.15	4.32	13.63	1.46	15.08	65.22	88.28	151.05	16.33	19.14	652.00		687.47	1,286.19	96.30	1200	0.10	1.102	598.72	46.55%
Tamworth Street	165 A,B	MH165				0.14		0.15		0.28	0.53			0.32	4.63																	
	165 C		MH115			0.31				0.00	0.53	0.63	0.85	0.00	4.63	15.08	1.38	16.46	61.57	83.29	142.44	32.92	70.46	659.98		763.36	1,286.19	90.99	1200	0.10	1.102	522.83	40.65%
Walden Drive	118	MH118	MH117			0.31				0.00	0.00	0.63	0.63	0.00	0.00	10.00	0.29	10.29	76.81	104.19	178.56	0.00	65.55	0.00		65.55	107.45	37.00	250	3.00	2.121	41.90	39.00%
	117	MH117	MH116			0.20				0.00	0.00	0.41	1.03	0.00	0.00	10.29	0.89	11.19	75.71	102.68	175.94	0.00	106.27	0.00		106.27	141.68	66.73	375	0.60	1.243	35.41	24.99%
Iron Bridge Place	160	MH160	MH161			0.32			0.11	0.65	0.65	0.18	0.18	0.00	0.00	10.00	1.12	11.12	76.81	104.19	178.56	49.88	19.12	0.00		69.00	78.14	72.00	300	0.60	1.071	9.15	11.71%
	161 B,C	MH161	MH162		0.23					0.32	0.97	0.00	0.18	0.00	0.00	11.12	0.81	11.93	72.75	98.62	168.93	70.51	18.10	0.00		88.60	141.68	60.67	375	0.60	1.243	53.08	37.46%
	162	MH162	MH163			0.52				1.06	2.02	0.00	0.18	0.00	0.00	11.93	0.14	12.07	70.10	94.98	162.62	141.91	17.43	0.00		159.33	230.39	11.72	450	0.60	1.403	71.06	30.84%
	163A	MH163				0.19						0.39	0.57																			
	163 B,C		MH116		0.13	0.14				0.46	2.49	0.00	0.57	0.00	0.00	12.07	1.05	13.12	69.67	94.38	161.59	173.41	53.71	0.00		227.12	283.76	79.78	525	0.40	1.270	56.63	19.96%
Walden Drive	116	MH116	MH115		0.18					0.25	2.74	0.00	1.60	0.00	0.00	16.46	1.25	17.71	58.53	79.12	135.24	160.33	126.92	0.00		287.25	392.18	79.54	675	0.20	1.062	104.93	26.76%
Burrard Crescent	115 A,B	MH115	MH114			0.31			0.14	0.63	3.90	0.23	2.68	0.00	4.63	17.71	1.12	18.83	56.04	75.72	129.38	218.72	203.20	599.46		1,021.39	1,286.19	73.90	1200	0.10	1.102	264.81	20.59%
	114 A,B,C	MH114	MH113							0.00	3.90	0.00	2.68	0.00	4.63	18.83	0.24	19.07	54.00	72.94	124.58	210.77	195.74	577.25		983.76	1,286.19	15.97	1200	0.10	1.102	302.44	23.51%
	113	MH113	MH113B		0.21					0.29	4.20	0.00	2.68	0.00	4.63	19.07	0.64	19.71	53.58	72.37	123.60	224.78	194.20	572.68		991.66	1,286.19	42.50	1200	0.10	1.102	294.53	22.90%
		MH113B	MH112C							0.00	4.20	0.00	2.68	0.00	4.63	19.71	0.16	19.87	52.50	70.89	121.06	220.25	190.25	560.92		971.42	1,286.19	10.29	1200	0.10	1.102	314.78	24.47%
	112 C1, C2	MH112C	BP1		0.43					0.60	17.37	0.00	6.12	0.00	12.39	19.87	0.51	20.38	52.25	70.55	120.46	907.59	431.80	1,492.07		2,831.47	3,006.86	41.97	1650	0.10	1.362	175.39	5.83%
		BP1	BP2							0.00	17.37	0.00	6.12	0.00	12.39	20.38	0.05	20.43	51.43	69.43	118.54	893.36	424.96	1,468.23		2,786.56	3,006.86	4.25	1650	0.10	1.362	220.31	7.33%
Outlet Beaver Pond		BP2	HEADWALL							0.00	17.37	0.00	6.12	0.00	12.39	20.43	0.69	21.12	51.35	69.32	118.35	891.95	424.28	1,465.86		2,782.09	3,006.86	56.37	1650	0.10	1.362	224.77	7.48%
Service Block	167C	RYCBMH29	RYCBMH30				0.73			1.08	1.08	0.00	0.00	0.00	0.00	10.00	0.43	10.43	76.81	104.19	178.56	82.61	0.00	0.00		82.61	100.88	35.75	300	1.00	1.383	18.27	18.11%
Briarpath Court		RYCBMH30	MH167							0.00	1.08	0.00	0.00	0.00	0.00	10.43	0.24	10.67	75.19	101.97	174.71	80.87	0.00	0.00		80.87	142.67	28.57	300	2.00	1.955	61.80	43.31%
	167 A,B	MH167	MH168		0.10	0.35				0.85	1.92	0.00	0.00	0.00	0.00	10.67	1.25	11.93	74.31	100.76	172.62	143.03	0.00	0.00		143.03	230.39	105.30	450	0.60	1.403	87.36	37.92%
	168 A,B,C,D,E	MH168	MH169	0.14	0.81	0.60				2.44	4.37	0.00	0.00	0.00	0.00	11.93	1.23	13.16	70.13	95.02	162.69	306.16	0.00	0.00		306.16	347.53	115.00	525	0.60	1.555	41.37	11.90%
	169 A,B	MH169	VORTECTS		0.14	0.46				1.13	5.49	0.00	0.00	0.00	0.00	13.16	0.32	13.48	66.49	90.02	154.06	365.28	0.00	0.00		365.28	475.05	31.07	600	0.55	1.628	109.77	23.11%
		VORTECHS	MH170							0.00	5.49	0.00	0.00	0.00	0.00	13.48	0.49	13.97	65.62	88.83	152.00	360.49	0.00	0.00		360.49	475.05	47.83	600	0.55	1.628	114.57	24.12%
Outlet to Kizell Drain		MH170	HEADWALL							0.00	5.49	0.00	0.00	0.00	0.00	13.97	0.20	14.16	64.32	87.06	148.93	353.38	0.00	0.00		353.38	475.05	19.09	600	0.55	1.628	121.68	25.61%
Walden Drive	112 A,B,C	MH121	MH122	0.45					0.21	0.31	0.31	0.35	0.35	0.00	0.00	10.00	1.31	11.31	76.81	104.19	178.56	24.02	36.50	0.00		60.52	91.46	63.00	375	0.25	0.802	30.94	33.83%
Outlet to Beaver Pond		MH122	HEADWALL							0.00	0.31	0.00	0.35	0.00	0.00	11.31	1.01	12.32	72.12	97.75	167.42	22.56	34.24	0.00		56.80	91.46	48.58	375	0.25	0.802	34.66	37.90%

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 732.951 / (TC+6.199)^0.810] 2 YEAR
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: LME

Checked:

Dwg. Reference: 102101-500
102101-501

No.	Revision	Date
1.	City submission No. 1	15-02-2017
2.	City submission No. 2	29-08-2017
3.	City submission No. 3	10/25/2017
4.	City submission No. 4	1/24/2018
5.	City submission No. 5	3/9/2018

File Reference: 102101.5.7.1
Date: 3/9/2018
Sheet No: 2 of 2

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STORM SEWER DESIGN SHEET
COMARISION OF INDIVDUAL PIPE RATIONAL METHOD FLOWS AND ICD FLOWS

KNL Stage 9
City of Ottawa

LOCATION				AREA (Ha)						RATIONAL METHOD FLOW																
				Existing	Single Family		Townhouse		Walden	2 Year	5 Year	100 Year							INDIVIDUAL RATIONAL METHOD	PONDS	COMBINED ICD FLOW (L/s)		CB CAPTURE	OVERFLOW	OVERFLOW	COMBINED RATIONAL FLOW	CATCHBASINS
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.50	C= 0.73	C= 0.53	C= 0.76	C= 0.60	2.78AC	2.78AC	2.78AC	INLET (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FLOW (L/s)		WITH PONDING	WITHOUT PONDING	(L/s)	(L/s)	TO	AT SAG	
GFR	GFR1	CAP	MH100						0.27	0.00	0.45	0.00	10.00	76.81	104.19	178.56	0.00	46.92	0.00	46.92		25.00	25.00	18.00	28.92	FUTURE		
GFR	GFR2	STUB	MH100						0.64	0.00	1.07	0.00	10.00	76.81	104.19	178.56	0.00	111.23	0.00	111.23		84.00	84.00	46.00	65.23	FUTURE		
Walden Drive		MH100	MH100C							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
		MH10	MH100B							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
Akamina Circle	123 A	MH123	MH124			0.46				0.93	0.00	0.00	10.00	76.81	104.19	178.56	71.70	0.00	0.00	71.70	POND 4	214.00	194.10				119.96	**CB129A CB129B CB130A CB130B**
	123 B	MH123	MH124		0.17					0.24	0.00	0.00	10.00	76.81	104.19	178.56	18.15	0.00	0.00	18.15		21.00	21.00					RYCB 3
	124 A	MH124	MH125			0.47				0.95	0.00	0.00	10.00	76.81	104.19	178.56	73.26	0.00	0.00	73.26		38.00	38.00	25.00	48.26	POND 4		CB127 CB128
	124 B	MH124	MH125		0.10					0.14	0.00	0.00	10.00	76.81	104.19	178.56	10.68	0.00	0.00	10.68		16.00	16.00					RYCB4
		MH125	MH126							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	126 A,B,C	MH126	MH127	0.22	0.23					0.47	0.00	0.00	10.00	76.81	104.19	178.56	36.30	0.00	0.00	36.30		38.00	38.00					CBMH1
		MH127	MH128							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	128 B	MH128	MH129			0.36				0.73	0.00	0.00	10.00	76.81	104.19	178.56	56.11	0.00	0.00	56.11		25.00	25.00	21.00	35.11	POND 1/3		CB125 CB126
	128 C	MH128	MH129			0.26				0.53	0.00	0.00	10.00	76.81	104.19	178.56	40.53	0.00	0.00	40.53	POND 3	63.00	59.70				58.08	**CB124**
	128 A	MH128	MH129		0.21					0.29	0.00	0.00	10.00	76.81	104.19	178.56	22.42	0.00	0.00	22.42		24.00	24.00					RYCB2
Akamina Circle	130 B	MH130	MH129			0.33				0.67	0.00	0.00	10.00	76.81	104.19	178.56	51.44	0.00	0.00	51.44	POND 2	52.00	47.70				51.44	**CB122 CB123**
	130 A	MH130	MH129		0.28					0.39	0.00	0.00	10.00	76.81	104.19	178.56	29.89	0.00	0.00	29.89		31.00	31.00					RYCB1
Akamina Circle	129 A,B	MH129	MH101			0.30			0.04	0.61	0.07	0.00	10.00	76.81	104.19	178.56	46.76	6.95	0.00	53.71		38.00	38.00	34.00	19.71	POND 1		CB120 CB121
Walden Drive	102 A,B	MH102	MH101		0.13				0.18	0.00	0.48	0.00	10.00	76.81	104.19	178.56	0.00	50.11	0.00	50.11		12.00	12.00	4.00	46.11	POND 1		CICB103 CICB104
Walden Drive	100 A,C	MH101	MH100B		0.16				0.14	0.00	0.46	0.00	10.00	76.81	104.19	178.56	0.00	47.50	0.00	47.50	POND 1	86.00	79.15					**CICB101**
	100 B	MH100B	VORTECTS						0.18	0.00	0.30	0.00	10.00	76.81	104.19	178.56	0.00	31.28	0.00	31.28	POND 1	86.00	79.15					**CICB100**
Outlet to Shirleys Brook		VORTECHS	HEADWALL							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
																					TOTAL POND 1		158.30				162.17	
Totals										5.95	2.82	0.00	10.00	76.81	104.19	178.56	457.23	294.00	0.00	**751.23**		**853.00**	**811.80**					
Ominik Crescent	144 A	MH144	MH142			0.32				0.65	0.00	0.00	10.00	76.81	104.19	178.56	49.88	0.00	0.00	49.88	POND 6	63.00	59.50				49.88	**CB135**
	144 B,C	MH144	MH142	0.10	0.17					0.31	0.00	0.00	10.00	76.81	104.19	178.56	23.49	0.00	0.00	23.49		24.00	24.00					RYCB9
		MH142	MH141							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
		MH141	MH140							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	140 A,B	MH140	MH103			0.49			0.11	0.99	0.18	0.00	10.00	76.81	104.19	178.56	76.38	19.12	0.00	95.49		38.00	38.00	26.00	69.49	POND 5		CB131 CB132
	140 C	MH140	MH103		0.18					0.25	0.00	0.00	10.00	76.81	104.19	178.56	19.22	0.00	0.00	19.22		24.00	24.00					RYCB7
	140 D	MH140	MH103		0.16					0.22	0.00	0.00	10.00	76.81	104.19	178.56	17.08	0.00	0.00	17.08		24.00	24.00					RYCB5
Walden Drive	103	MH103	MH104		0.24					0.33	0.00	0.00	10.00	76.81	104.19	178.56	25.62	0.00	0.00	25.62		28.00	28.00					RYCB17
	104 A,B	MH104	MH105					0.03	0.10	0.00	0.23	0.00	10.00	76.81	104.19	178.56	0.00	23.98	0.00	23.98	POND 9	63.00	60.60				48.69	**CB216**
Point Grey Terrace	143 B	MH143	MH105			0.18				0.37	0.00	0.00	10.00	76.81	104.19	178.56	28.06	0.00	0.00	28.06		12.00	12.00	12.00	16.06	POND 5/7		CB161 CB162
	143 C,D	MH143	MH105			0.15			0.10	0.30	0.17	0.00	10.00	76.81	104.19	178.56	23.38	17.38	0.00	40.76	POND 5	126.00	122.80				118.28	**CB160A CB160B**
	143 A	MH143	MH105			0.19				0.39	0.00	0.00	10.00	76.81	104.19	178.56	29.61	0.00	0.00	29.61		28.00	28.00	26.00	3.61	POND 7		CB106
Walden Drive	105 A,C	MH105	MH146			0.15			0.10	0.30	0.17	0.00	10.00	76.81	104.19	178.56	23.38	17.38	0.00	40.76		24.00	24.00	20.00	20.76	POND 7		CB138
	105 B	MH105	MH146		0.30					0.42	0.00	0.00	10.00	76.81	104.19	178.56	32.03	0.00	0.00	32.03		43.00	43.00					RYCB18
Ominik Crescent		MH144	MH145							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	145	MH145	MH146			0.34				0.69	0.00	0.00	10.00	76.81	104.19	178.56	53.00	0.00	0.00	53.00		25.00	25.00	21.00	32.00	POND 7		CB136 CB137
Walden Drive	146	MH146	MH106			0.19				0.39	0.00	0.00	10.00	76.81	104.19	178.56	29.61	0.00	0.00	29.61	POND 7	107.00	103.60				94.01	**CB139A CB139B**
Newstead Crescent	131 A,B	MH131	MH132					0.11	0.12	0.23	0.20	0.00	10.00	76.81	104.19	178.56	17.85	20.86	0.00	38.71		25.00	25.00	14.00	24.71	POND 9		CB200 CB201
	132 A	MH132	MH133					0.39		0.82	0.00	0.00	10.00	76.81	104.19	178.56	63.29	0.00	0.00	63.29	POND 8	126.00	118.10				63.29	**CB202 CB203**
	132 B	MH132	MH133				0.20			0.29	0.00	0.00	10.00	76.81	104.19	178.56	22.63	0.00	0.00	22.63		24.00	24.00					RYCB11
		MH133	MH134							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	134 A	MH134	MH135					0.42		0.89	0.00	0.00	10.00	76.81	104.19	178.56	68.15	0.00	0.00	68.15		38.00	38.00	27.00	41.15	POND 10/11		CB204 CB205
	134 B	MH134	MH135				0.43			0.63	0.00	0.00	10.00	76.81	104.19	178.56	48.66	0.00	0.00	48.66		64.00	64.00					RYCB15
Hummock Street		MH159	MH139							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	139 A	MH139	MH135					0.36		0.76	0.00	0.00	10.00	76.81	104.19	178.56	58.42	0.00	0.00	58.42		25.00	25.00	24.00	34.42	POND 10/11		CB215 CB217
	139 B	MH139	MH135					0.12		0.25	0.00	0.00	10.00	76.81	104.19	178.56	19.47	0.00	0.00	19.47	POND 10	126.00	121.20				57.26	**CB214A CB214B**
Newstead Crescent	135 A	MH135	MH136					0.85		1.80	0.00	0.00	10.00	76.81	104.19	178.56	137.93	0.00	0.00	137.93	POND 11	252.00	225.80				175.72	**CB206 CB206A CB207 CB207A**
	135 B	MH135	MH136				0.30			0.44	0.00	0.00	10.00	76.81	104.19	178.56	33.95	0.00	0.00	33.95		43.00	43.00					RYCB16
	135 C,D	MH135	MH136	0.13			0.70			1.12	0.00	0.00	10.00	76.81	104.19	178.56	86.15	0.00	0.00	86.15		93.00	93.00					CBMH3
		MH136	MH137							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								
	137 A	MH137	MH138				0.20			0.29	0.00	0.00	10.00	76.81	104.19	178.56	22.63	0.00	0.00	22.63		24.00	24.00					CBMH4
	137 B	MH137	MH138	0.64						0.44	0.00	0.00	10.00	76.81	104.19	178.56	34.16	0.00	0.00	34.16		80.00	80.00					CBMH5
	138 A,B	MH138	MH106					0.04	0.12	0.08	0.20	0.00	10.00	76.81	104.19	178.56	6.49	20.86	0.00	27.35	POND 12	44.00	42.20				27.35	**CB213**
Walden Drive	106	MH106	MH107		0.32					0.44	0.00	0.00	10.00	76.81	104.19	178.56	34.16	0.00	0.00	34.16		43.00	43.00					RYCB10
	107 A	MH107	MH108						0.20	0.00	0.33	0.00	10.00	76.81	104.19	178.56	0.00	34.76	0.00	34.76		12.00	12.00	4.00	30.76	POND 13/14		CICB107 CICB108
	107 B	MH107	MH108						0.08	0.00	0.13	0.00	10.00	76.81	104.19	178.56	0.00	13.90	0.00	13.90		6.00	6.00	6.00	7.90	POND 13		CICB110
	107 C	MH107	MH108	1.38						0.96	0.00	0.00	10.00	76.81	104.19	178.56	73.66	0.00	0.00	73.66		75.00	75.00					DICB1
	107 C	MH107	MH108		0.20					0.28	0.00	0.00	10.00	76.81	104.19	178.56	21.35	0.00	0.00	21.35		24.00	24.00					RYCB19
Athabasca Heights	148 A,B	MH148	MH108			0.42			0.04	0.85	0.07	0.00	10.00	76.81	104.19	178.56	65.46	6.95	0.00	72.42	POND 13	344.00	338.80				95.70	**CB140A CB140B** CB141A CB141B
Walden Drive	108	MH108	MH109		0.27					0.38	0.00	0.00	10.00	76.81	104.19	178.56	28.82	0.00	0.00	28.82		31.00	31.00					

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 732.951 / (TC+6.199)^0.810] 2 YEAR
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed:

Checked:

Dwg. Refer 102101-500
102101-501

No.	Revision
1.	City submission No. 5

File Reference: 102101.5.7.1

Date: 2/26/2018

IBI GROUP
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STORM SEWER DESIGN SHEET
COMARISION OF INDIVDUAL PIPE RATIONAL METHOD FLOWS AND ICD FLOWS

KNL Stage 9
City of Ottawa

LOCATION				AREA (Ha)						RATIONAL METHOD FLOW																
				Existing	Single Family		Townhouse		Walden	2 Year	5 Year	100 Year									INDIVIDUAL RATIONAL METHOD FLOW (L/s)	PONDS	COMBINED ICD FLOW (L/s)		CB CAPTURE (L/s)	OVERFLOW (L/s)	OVERFLOW TO	COMBINED RATIONAL FLOW AT SAG	CATCHBASINS
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.50	C= 0.73	C= 0.53	C= 0.76	C= 0.60	2.78AC	2.78AC	2.78AC	INLET (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)			WITH PONDING	WITHOUT PONDING				
Athabasca Heights		MH148	MH149							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
		MH149	MH150							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
		MH150	MH151							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	151	MH151	MH152		0.16					0.22	0.00	0.00	10.00	76.81	104.19	178.56	17.08	0.00	0.00	17.08		24.00	24.00				RYCB6
		MH152	MH153							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	153 B	MH153	MH109			0.47				0.95	0.00	0.00	10.00	76.81	104.19	178.56	73.26	0.00	0.00	73.26		38.00	38.00	27.00	46.26	POND 15		CB142 CB143
	153 A,C	MH153	MH109			0.35			0.11	0.71	0.18	0.00	10.00	76.81	104.19	178.56	54.55	19.12	0.00	73.67	POND 15	344.00	335.60				119.93	**CB144A CB144B** CB145A CB145B
Walden Drive	109 A	MH109	MH110					0.22		0.00	0.46	0.00	10.00	76.81	104.19	178.56	0.00	48.43	0.00	48.43		19.00	19.00	16.00	32.43	POND 16	48.43	CB111
	109 B	MH109	MH110		0.15					0.21	0.00	0.00	10.00	76.81	104.19	178.56	16.01	0.00	0.00	16.01		18.00	19.00					RYCB22
Walden Drive	120	MH120	MH110					0.39		0.00	0.82	0.00	10.00	76.81	104.19	178.56	0.00	85.85	0.00	85.85	POND 16	149.00	139.60				118.28	**CB150A CB150B**
Burrard Crescent	110 A,B	MH110	MH111			0.19			0.17	0.39	0.28	0.00	10.00	76.81	104.19	178.56	29.61	29.54	0.00	59.16	POND 17	344.00	316.30				59.16	**CB146A CB146B CB147A CB147B**
	110 C	MH110	MH111		0.12					0.17	0.00	0.00	10.00	76.81	104.19	178.56	12.81	0.00	0.00	12.81		18.00	18.00					CBMH6
		MH111	MH112							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	112	MH112	MH112B			0.54				1.10	0.00	0.00	10.00	76.81	104.19	178.56	84.17	0.00	0.00	84.17	POND 18	88.00	81.60				84.17	**CB148 CB149**
		MH112B	MH112C							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
Kitigan Crescent	155 C	MH155B	MH155						0.13	0.00	0.22	0.00	10.00	76.81	104.19	178.56	0.00	22.59	0.00	22.59	POND 14	86.00	82.30				37.97	**CB109**
	155 A	MH155B	MH155					0.28		0.59	0.00	0.00	10.00	76.81	104.19	178.56	45.44	0.00	0.00	45.44		25.00	25.00	19.00	26.44	POND 24		CB220 CB221
	155 C	MH155B	MH155				0.17			0.25	0.00	0.00	10.00	76.81	104.19	178.56	19.24	0.00	0.00	19.24		21.00	21.00					CBMH2
		MH155	MH156							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	156 A	MH156	MH157					0.51		1.08	0.00	0.00	10.00	76.81	104.19	178.56	82.76	0.00	0.00	82.76	POND 24	126.00	117.30				109.20	**CB222 CB223**
	156 B	MH156	MH157				0.03			0.04	0.00	0.00	10.00	76.81	104.19	178.56	3.39	0.00	0.00	3.39		6.00	6.00					RYCB26
	157	MH157	MH158				0.31			0.46	0.00	0.00	10.00	76.81	104.19	178.56	35.08	0.00	0.00	35.08		43.00	43.00					RYCB31
	158 A	MH158	MH165					0.37		0.78	0.00	0.00	10.00	76.81	104.19	178.56	60.04	0.00	0.00	60.04		25.00	25.00	21.00	39.04	POND 25		CB210 CB211
	158 B	MH158	MH165					0.36		0.76	0.00	0.00	10.00	76.81	104.19	178.56	58.42	0.00	0.00	58.42	POND 25	130.00	122.60				97.46	**CB224 CB225**
	158 C	MH158	MH165				0.38			0.56	0.00	0.00	10.00	76.81	104.19	178.56	43.00	0.00	0.00	43.00		43.00	43.00					RYCB32
	158 D	MH158	MH165				0.03			0.04	0.00	0.00	10.00	76.81	104.19	178.56	3.39	0.00	0.00	3.39		6.00	6.00					RYCB25
Tamworth Street	165 A	MH165	MH115					0.15		0.32	0.00	0.00	10.00	76.81	104.19	178.56	24.34	0.00	0.00	24.34	POND 25	44.00	41.80				24.34	**CB230**
	165 B	MH165	MH115			0.14				0.28	0.00	0.00	10.00	76.81	104.19	178.56	21.82	0.00	0.00	21.82		19.00	19.00	9.00	12.82	POND 26		CB231
	165 C	MH165	MH115			0.31				0.00	0.63	0.00	10.00	76.81	104.19	178.56	0.00	65.55	0.00	65.55	POND 19	172.00	157.10				112.61	**CB228 CB229**
Walden Drive	118	MH118	MH117			0.31				0.00	0.63	0.00	10.00	76.81	104.19	178.56	0.00	65.55	0.00	65.55		25.00	25.00	24.00	41.55	POND 19/22		CB113 CB114
	117	MH117	MH116			0.20				0.00	0.41	0.00	10.00	76.81	104.19	178.56	0.00	42.29	0.00	42.29		19.00	19.00	16.00	26.29	POND 19		CB112
Iron Bridge Place	160 A,B	MH160	MH161			0.32			0.07	0.65	0.12	0.00	10.00	76.81	104.19	178.56	49.88	12.17	0.00	62.04		25.00	25.00		37.04	POND 23		CB158 CB159
	160 C	MH160	MH161						0.04	0.00	0.07	0.00	10.00	76.81	104.19	178.56	0.00	6.95	0.00	6.95		6.00	6.00	4.00	2.95	121A		CB115
	161	MH161	MH162		0.23					0.32	0.00	0.00	10.00	76.81	104.19	178.56	24.55	0.00	0.00	24.55		28.00	28.00					RYCB44
	162	MH162	MH163			0.52				1.06	0.00	0.00	10.00	76.81	104.19	178.56	81.05	0.00	0.00	81.05	POND 23	126.00	116.50				118.09	**CB156 CB157**
	163 A	MH163				0.19					0.39																	
	163 C		MH116			0.14				0.28	0.00	0.00	10.00	76.81	104.19	178.56	21.82	40.18	0.00	62.00	POND 21/22	107.00	101.60				82.77	**CB155 CB154**
	163 B		MH116		0.13					0.18	0.00	0.00	10.00	76.81	104.19	178.56	13.88	0.00	0.00	13.88		18.00						RYCB43
Walden Drive	116	MH116	MH115		0.18					0.25	0.00	0.00	10.00	76.81	104.19	178.56	19.22	0.00	0.00	19.22		24.00	24.00					RYCB46
Burrard Crescent	115 A,B	MH115	MH114			0.31			0.14	0.63	0.23	0.00	10.00	76.81	104.19	178.56	48.32	24.33	0.00	72.65	POND 20	344.00	305.10				72.65	**CB152A CB152B CB153A CB153B**
		MH114	MH113							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	113	MH113	MH113B		0.21					0.29	0.00	0.00	10.00	76.81	104.19	178.56	22.42	0.00	0.00	22.42		28.00	28.00					RYCB27
		MH113B	MH112C							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	112 C1	MH112C	BP1		0.20					0.28	0.00	0.00	10.00	76.81	104.19	178.56	21.35	0.00	0.00	21.35		24.00	24.00					RYCB23
	112 C2	MH112C	BP1		0.23					0.32	0.00	0.00	10.00	76.81	104.19	178.56	24.55	0.00	0.00	24.55		28.00	28.00					RYCB24
		BP1	BP2							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
Outlet Beaver Pond		BP2	HEADWALL							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
Totals										29.76	6.12	0.00	10.00	76.81	104.19	178.56	2,285.47	637.74	0.00	2,923.21		4,718.00	4,500.00					
Service Block	167C	RYCBMH29	RYCBMH30				0.73			1.08	0.00	0.00	10.00	76.81	104.19	178.56	82.61	0.00	0.00	82.61		108.00	108.00					RYCBMH 30
Briarpath Court		RYCBMH30	MH167							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	167 A	MH167	MH168			0.35				0.71	0.00	0.00	10.00	76.81	104.19	178.56	54.55	0.00	0.00	54.55		25.00	25.00	24.00	30.55	POND 26		CB233 CB234
	167 B	MH167	MH168		0.10					0.14	0.00	0.00	10.00	76.81	104.19	178.56	10.68	0.00	0.00	10.68		18.00	18.00					RYCB33
	168 A	MH168	MH169			0.60				1.22	0.00	0.00	10.00	76.81	104.19	178.56	93.52	0.00	0.00	93.52	POND 26	149.00	137.20				136.90	**CB235 CB236**
	168 B	MH168	MH169		0.23					0.32	0.00	0.00	10.00	76.81	104.19	178.56	24.55	0.00	0.00	24.55		27.00	27.00					CBMH8
	168 C	MH168	MH169		0.51					0.71	0.00	0.00	10.00	76.81	104.19	178.56	54.45	0.00	0.00	54.45		62.00	62.00					RYCB34
	168 D	MH168	MH169	0.14						0.10	0.00	0.00	10.00	76.81	104.19	178.56	7.47	0.00	0.00	7.47		11.00	11.00					DICB3
	168 E	MH168	MH169		0.07					0.10	0.00	0.00	10.00	76.81	104.19	178.56	7.47	0.00	0.00	7.47		18.00	18.00					RYCB37
	169 A	MH169	VORTECTS							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
	169 B	MH169	VORTECTS		0.14					0.19	0.00	0.00	10.00	76.81	104.19	178.56	14.95	0.00	0.00	14.95		18.00	18.00					CBMH7
		VORTECHS	MH170			0.46				0.93	0.00	0.00	10.00	76.81	104.19	178.56	71.70	0.00	0.00	71.70	POND 27	86.00	81.30				71.70	**CB239**
Outlet to Kizell Drain		MH170	HEADWALL							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00							
Totals										5.49	0.00	0.00	10.00	76.81	104.19	178.56	421.95	0.00	0.00	421.95		522.00	505.50					
Walden Drive	121 A	MH121	MH122						0.10	0.00	0.17	0.00	10.00	76.81	104.19	178.56	0.00	17.38	0.00	17.38								CB116 CB117
	121 B	MH121	MH122						0.11	0.00	0.18	0.00	10.00	76.81	104.19	178.56	0.00	19.12	0.00	19.12								CB118 CB119
	121 C	MH121	MH122	0.45						0.31	0.00	0.00	10.00	76.81	104.19	178.56	24.02	0.00	0.00	24.02								DICB4
Outlet to Beaver Pond		MH122	HEADWALL							0.00	0.00	0.00	10.00	76.81	104.19	178.56	0.00	0.00	0.00	0.00								

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[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed:

Checked:

Dwg. Refer 102101-500
102101-501

No.	Revision
1.	City submission No. 5

File Reference: 102101.5.7.1

Date: 2/26/2018

Lot Runoff Coefficient Calculation
KNL Stage 9

Single Family

18 m ROW		**18 m ROW**		**18 m ROW**		**18 m ROW**	
Half ROW	9.00	Half ROW	9.00	Half ROW	9.00	Half ROW	9.00
Road	4.25	Road	4.25	Road	4.25	Road	4.25
Half Sidewalk	1.00	Half Sidewalk	1.00	Half Sidewalk	1.00	Sidewalk	1.00
Boulevard	3.50	Boulevard	3.50	Boulevard	3.50	Boulevard	3.50
Driveway Width	6.82	Driveway Width	5.34	Driveway Width	7.62	Driveway Width	4.78
Front Yard	3.00	Front Yard	3.00	Front Yard	3.00	Front Yard	3.00
Rear Yard	7.50	Rear Yard	7.50	Rear Yard	7.50	Rear Yard	7.50
Side Yard	1.20	Side Yard	1.20	Side Yard	1.20	Side Yard	1.20
Lot Width	**13.63**	**Lot Width**	**10.67**	**Lot Width**	**15.24**	**Lot Width**	**9.56**
Lot Depth	**33.00**	**Lot Depth**	**33.00**	**Lot Depth**	**33.00**	**Lot Depth**	**33.00**
Front		Front		Front		Front	
Total Area	347.57	Total Area	272.09	Total Area	388.62	Total Area	243.78
Impervious Area	267.46	Impervious Area	202.34	Impervious Area	302.88	Impervious Area	177.92
C front	**0.74**	**C front**	**0.72**	**C front**	**0.75**	**C front**	**0.71**
Rear		Rear		Rear		Rear	
Total Area	224.90	Total Area	176.06	Total Area	251.46	Total Area	157.74
Impervious Area	101.07	Impervious Area	74.43	Impervious Area	115.56	Impervious Area	64.44
C rear	**0.51**	**C rear**	**0.50**	**C rear**	**0.52**	**C rear**	**0.49**
Overall		Overall		Overall		Overall	
Total Area	572.46	Total Area	448.14	Total Area	640.08	Total Area	401.52
Impervious Area	368.53	Impervious Area	276.77	Impervious Area	418.44	Impervious Area	242.36
C overall	**0.65**	**C overall**	**0.63**	**C overall**	**0.66**	**C overall**	**0.62**
Average Single Family		**C front**	**0.73**	**C rear**	**0.50**	**C overall**	**0.64**

Townhouse 4 Units		Townhouse 3 Units		Townhouse 4 Units		Townhouse 3 Units	
18 m ROW		**18 m ROW**		**26 m ROW**		**26 m ROW**	
Half ROW	9.00	Half ROW	9.00	Half ROW	13.00	Half ROW	13.00
Road	4.25	Road	4.25	Road	5.50	Road	5.50
Half Sidewalk	0.90	Half Sidewalk	0.90	One Sidewalk	2.00	One Sidewalk	2.00
Boulevard	3.85	Boulevard	3.85	Boulevard	5.50	Boulevard	5.50
Driveway Width	13.50	Driveway Width	10.50	Driveway Width	13.50	Driveway Width	10.50
Front Yard	3.00	Front Yard	3.00	Front Yard	3.00	Front Yard	3.00
Rear Yard	7.50	Rear Yard	7.50	Rear Yard	7.50	Rear Yard	7.50
Side Yard	1.50	Side Yard	1.50	Side Yard	1.50	Side Yard	1.50
Lot Width	**27.00**	**Lot Width**	**21.00**	**Lot Width**	**27.00**	**Lot Width**	**21.00**
Lot Depth	**33.00**	**Lot Depth**	**33.00**	**Lot Depth**	**33.00**	**Lot Depth**	**33.00**
Front		Front		Front		Rear	
Total Area	688.50	Total Area	535.50	Total Area	796.50	Total Area	619.50
Impervious Area	555.53	Impervious Area	423.08	Impervious Area	641.25	Impervious Area	489.75
C front	**0.76**	**C front**	**0.75**	**C front**	**0.76**	**C rear**	**0.75**
Rear		Rear		Rear		Front	
Total Area	445.50	Total Area	346.50	Total Area	445.50	Total Area	346.50
Impervious Area	216.00	Impervious Area	162.00	Impervious Area	216.00	Impervious Area	162.00
C rear	**0.54**	**C rear**	**0.53**	**C rear**	**0.54**	**C front**	**0.53**
Overall		Overall		Overall		Overall	
Total Area	1134.00	Total Area	882.00	Total Area	1242.00	Total Area	966.00
Impervious Area	771.53	Impervious Area	585.08	Impervious Area	857.25	Impervious Area	651.75
C overall	**0.68**	**C overall**	**0.66**	**C overall**	**0.68**	**C overall**	**0.67**
Average Townhouse		**C front**	**0.76**	**C rear**	**0.53**	**C overall**	**0.67**

PROJECT: KANATA LAKES STAGE 9	PROJECT NO.: 102101.57	SHEET: 1 OF: 1
CLIENT: HNL DEVELOPMENTS	PREPARED BY: L.E.	DATE: 2017-02-13
DESCRIPTION: RUNOFF CALCULATIONS	CHECKED BY:	OTHER:

WALDEN DRIVE & GOULBOURN FORCED ROAD

26m ROW - FROM CROSS SECTION

PERVIOUS	ROADWAY	11.0 m
	SIDEWALK	4.0 m
	TOTAL	15.0 m

$$C = \frac{15.0 \times 0.9 + (26-15) \times 0.2}{26} = 0.604$$

USE C = 0.60

VORTECHS SYSTEM® ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON AN AVERAGE PARTICLE SIZE OF 50 MICRONS
KANATA LAKES NORTH STAGE 9
OTTAWA, ON
MODEL 16000 IN-LINE
SITE DESIGNATION SHIRLEY'S BROOK OUTLET

CONTECH ENGINEERED SOLUTIONS

Design Ratio[1] = $\frac{\text{(5 hectares) x (0.624) x (2.775)}}{\text{(10.5 m2)}}$ **= 0.82**

Rainfall Intensity mm/hr	Operating Rate[2] % of capacity	Flow Treated (l/s)	% Total Rainfall Volume[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.5	0.6	4.3	9.2%	100.0%	9.2%
1.0	1.2	8.5	10.6%	98.0%	10.4%
1.5	1.8	12.8	9.9%	98.0%	9.7%
2.0	2.4	17.1	8.4%	97.0%	8.1%
2.5	3.0	21.3	7.7%	95.8%	7.4%
3.0	3.6	25.6	5.9%	95.8%	5.7%
3.5	4.2	29.9	4.4%	94.1%	4.1%
4.0	4.8	34.1	4.7%	94.1%	4.4%
4.5	5.4	38.4	3.3%	92.6%	3.1%
5.0	6.0	42.6	3.0%	91.2%	2.8%
6.0	7.2	51.2	5.4%	90.0%	4.8%
7.0	8.4	59.7	4.4%	88.3%	3.8%
8.0	9.6	68.2	3.5%	87.1%	3.1%
9.0	10.8	76.8	2.8%	85.8%	2.4%
10.0	12.0	85.3	2.2%	82.2%	1.8%
15.0	18.1	127.9	7.0%	72.3%	5.1%
20.0	24.1	170.6	4.5%	64.2%	2.9%
25.0	30.1	213.2	1.4%	57.1%	0.8%
30.0	36.1	255.9	0.7%	50.7%	0.3%
35.0	42.2	298.5	0.5%	43.7%	0.2%
40.0	48.2	341.2	0.5%	36.0%	0.2%
					90.3%

Predicted Annual Runoff Volume Treated = 93.5%
Assumed Removal Efficiency of remaining % = 0.0%
Removal Efficiency Adjustment[5] = 6.5%
Predicted Net Annual Load Removal Efficiency = **84%**

1 - Design Ratio = (Total Drainage Area) x (Runoff Coefficient) x (Rational Method Conversion) / Grit Chamber Area
- The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
- The rational method conversion based on the units in the above equation is 2.775.

2 - Operating Rate (% of capacity) = percentage of peak operating rate of 68 l/s/m^2.

3 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa CDA, ON

4 - Based on Contech Construction Products laboratory verified removal of an average particle size of 50 microns (see Technical Bulletin #1).

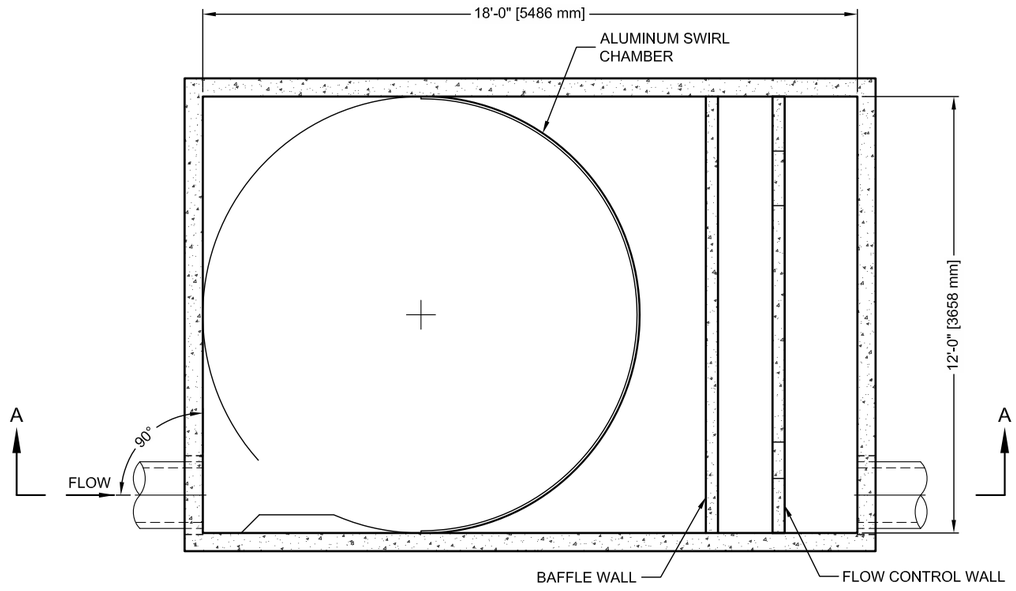
5- Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: JAK 2/3 | Checked by:

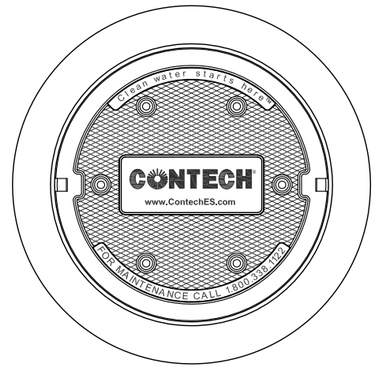
VORTECHS 16000 DESIGN NOTES

VORTECHS 16000 RATED TREATMENT CAPACITY IS 25 CFS, OR PER LOCAL REGULATIONS. IF THE SITE CONDITIONS EXCEED RATED TREATMENT CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD INLET/OUTLET CONFIGURATION IS SHOWN. FOR OTHER CONFIGURATION OPTIONS , PLEASE CONTACT YOUR CONTECH CONSTRUCTION PRODUCTS REPRESENTATIVE. www.ContechES.com



SECTION B-B



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (CFS)	*
PEAK FLOW RATE (CFS)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*

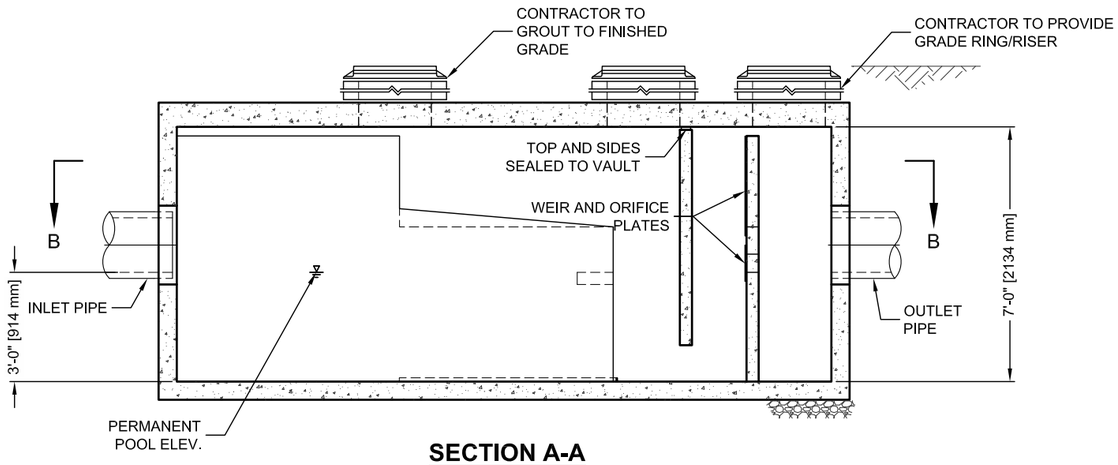
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD



SECTION A-A

GENERAL NOTES

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4. VORTECHS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET AASHTO M306 LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. INLET PIPE(S) MUST BE PERPEDICULAR TO THE VAULT AND AT THE CORNER TO INTRODUCE THE FLOW TANGENTIALLY TO THE SWIRL CHAMBER. DUAL INLETS NOT TO HAVE OPPOSING TANGENTIAL FLOW DIRECTIONS.
7. OUTLET PIPE(S) MUST BE DOWN STREAM OF THE FLOW CONTROL BAFFLE AND MAY BE LOCATED ON THE SIDE OR END OF THE VAULT. THE FLOW CONTROL WALL MAY BE TURNED TO ACCOMODATE OUTLET PIPE KNOCKOUTS ON THE SIDE OF THE VAULT.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE VORTECHS STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

Vortechs®

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

VORTECHS 16000
STANDARD DETAIL

VORTECHS SYSTEM® ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON AN AVERAGE PARTICLE SIZE OF 50 MICRONS
KANATA LAKES NORTH STAGE 9
OTTAWA, ON
MODEL 11000 IN-LINE
SITE DESIGNATION KIZELL DRAIN OUTLET

Design Ratio[1] = $\frac{\text{(4.26 hectares) x (0.61) x (2.775)}}{\text{(7.3 m2)}}$ **= 0.98**

Rainfall Intensity mm/hr	Operating Rate[2] % of capacity	Flow Treated (l/s)	% Total Rainfall Volume[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.5	0.7	3.6	9.2%	100.0%	9.2%
1.0	1.4	7.2	10.6%	98.0%	10.4%
1.5	2.2	10.7	9.9%	97.0%	9.6%
2.0	2.9	14.3	8.4%	97.0%	8.1%
2.5	3.6	17.9	7.7%	95.8%	7.4%
3.0	4.3	21.5	5.9%	94.1%	5.6%
3.5	5.1	25.1	4.4%	92.6%	4.0%
4.0	5.8	28.6	4.7%	92.6%	4.3%
4.5	6.5	32.2	3.3%	91.2%	3.0%
5.0	7.2	35.8	3.0%	90.0%	2.7%
6.0	8.7	43.0	5.4%	88.3%	4.8%
7.0	10.1	50.1	4.4%	85.8%	3.7%
8.0	11.6	57.3	3.5%	84.0%	3.0%
9.0	13.0	64.4	2.8%	80.3%	2.3%
10.0	14.4	71.6	2.2%	79.1%	1.7%
15.0	21.7	107.4	7.0%	68.1%	4.8%
20.0	28.9	143.2	4.5%	59.5%	2.7%
25.0	36.1	179.0	1.4%	50.7%	0.7%
30.0	43.3	214.8	0.7%	42.2%	0.3%
35.0	50.6	250.6	0.5%	33.4%	0.2%
40.0	57.8	286.4	0.5%	24.4%	0.1%
					88.6%

Predicted Annual Runoff Volume Treated = 93.5%
Assumed Removal Efficiency of remaining % = 0.0%
Removal Efficiency Adjustment[5] = 6.5%
Predicted Net Annual Load Removal Efficiency = **82%**

1 - Design Ratio = (Total Drainage Area) x (Runoff Coefficient) x (Rational Method Conversion) / Grit Chamber Area
- The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
- The rational method conversion based on the units in the above equation is 2.775.

2 - Operating Rate (% of capacity) = percentage of peak operating rate of 68 l/s/m^2.

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Calculated by: JAK 2/3 | Checked by:

VORTECHS 11000 DESIGN NOTES

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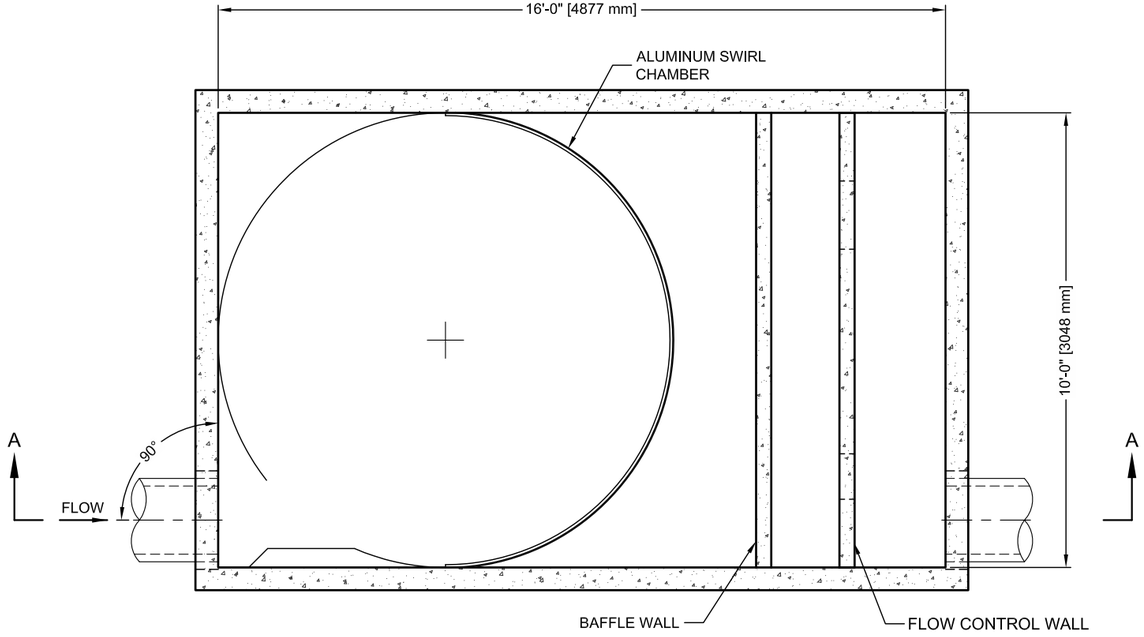
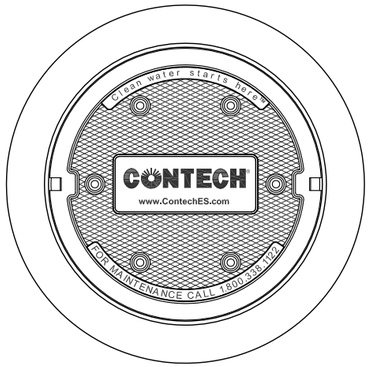


SECTION B-B



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			*
WATER QUALITY FLOW RATE (CFS)			*
PEAK FLOW RATE (CFS)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

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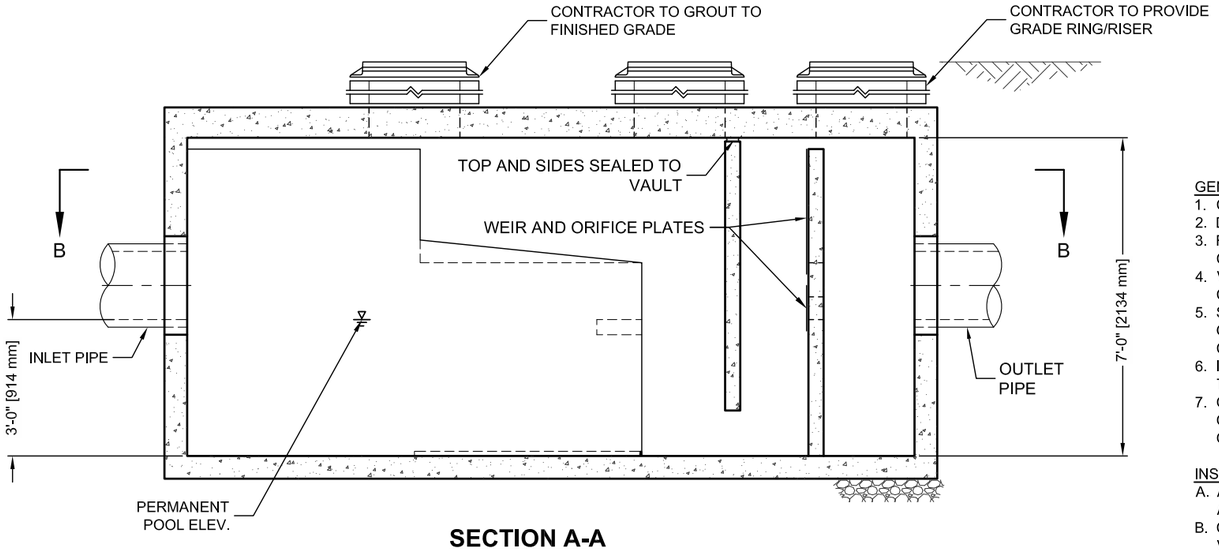

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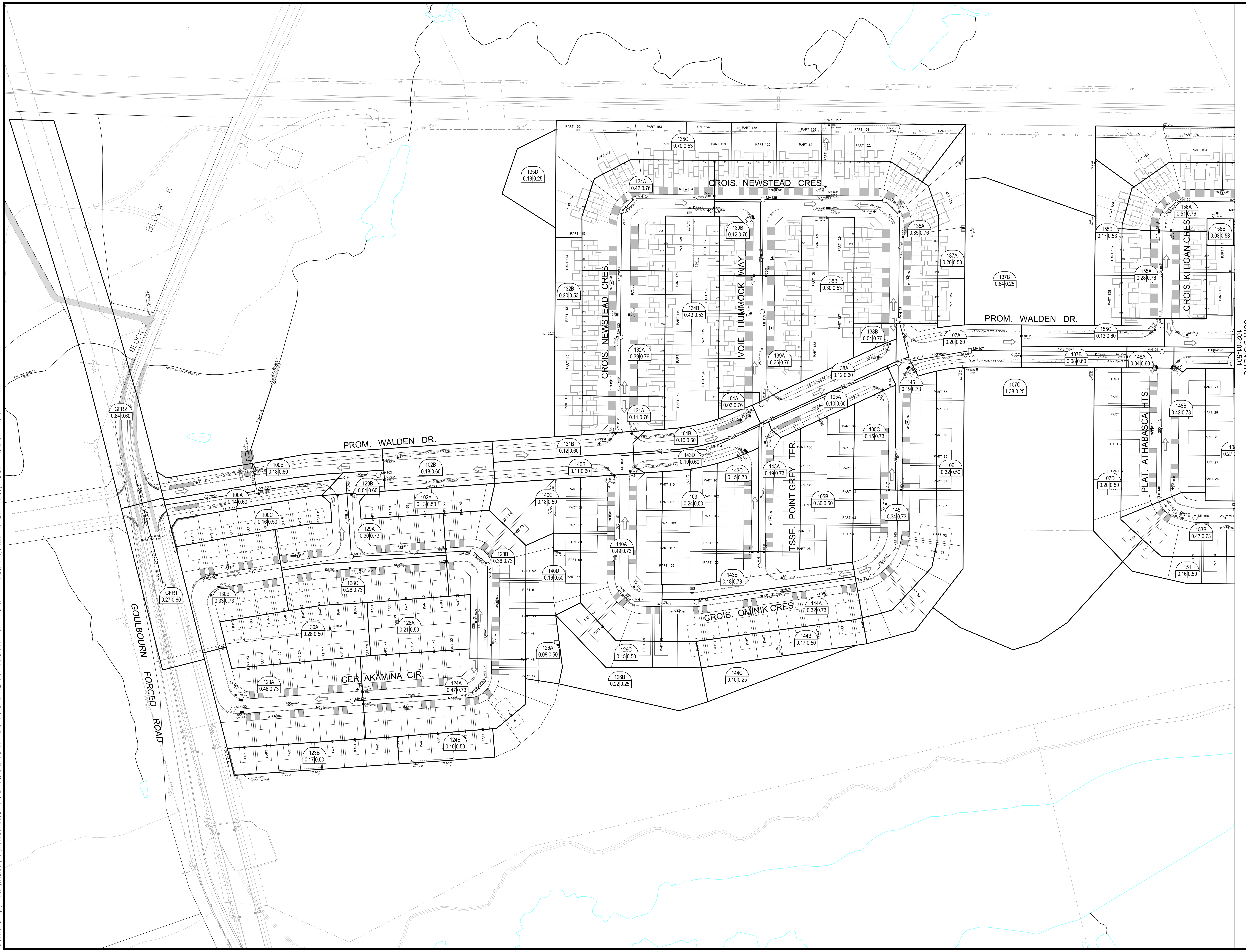
VORTECHS 11000
STANDARD DETAIL



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2018

Plan Number ____________________

KEY PLAN
NTS

FOR LEGEND AND DETAILS SEE DRAWING 102101-010

LEGEND :

S168	AREA NUMBER
0.69	RUNOFF COEFFICIENT
2.01	AREA IN HECTARES
⇨	MAJOR FLOW ROUTE

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6	REVISED AS PER CITY COMMENTS	LME	2018:02:23
5	ISSUED FOR 4TH SUBMISSION	LME	2018:01:24
4	REVISED AS PER CITY COMMENTS	LME	2017:10:27
3	ISSUED FOR 2ND SUBMISSION	LME	2017:08:30
2	REVISED AS PER CITY COMMENTS	LME	2017:08:18
1	ISSUED TO CITY FOR REVIEW	LME	2017:02:15

KANATA LAKES

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

KNL STAGE 9

LICENSED PROFESSIONAL ENGINEER
L. M. ERION
13379508
2018/02/23
PROVINCE OF ONTARIO

N

Drawing Title

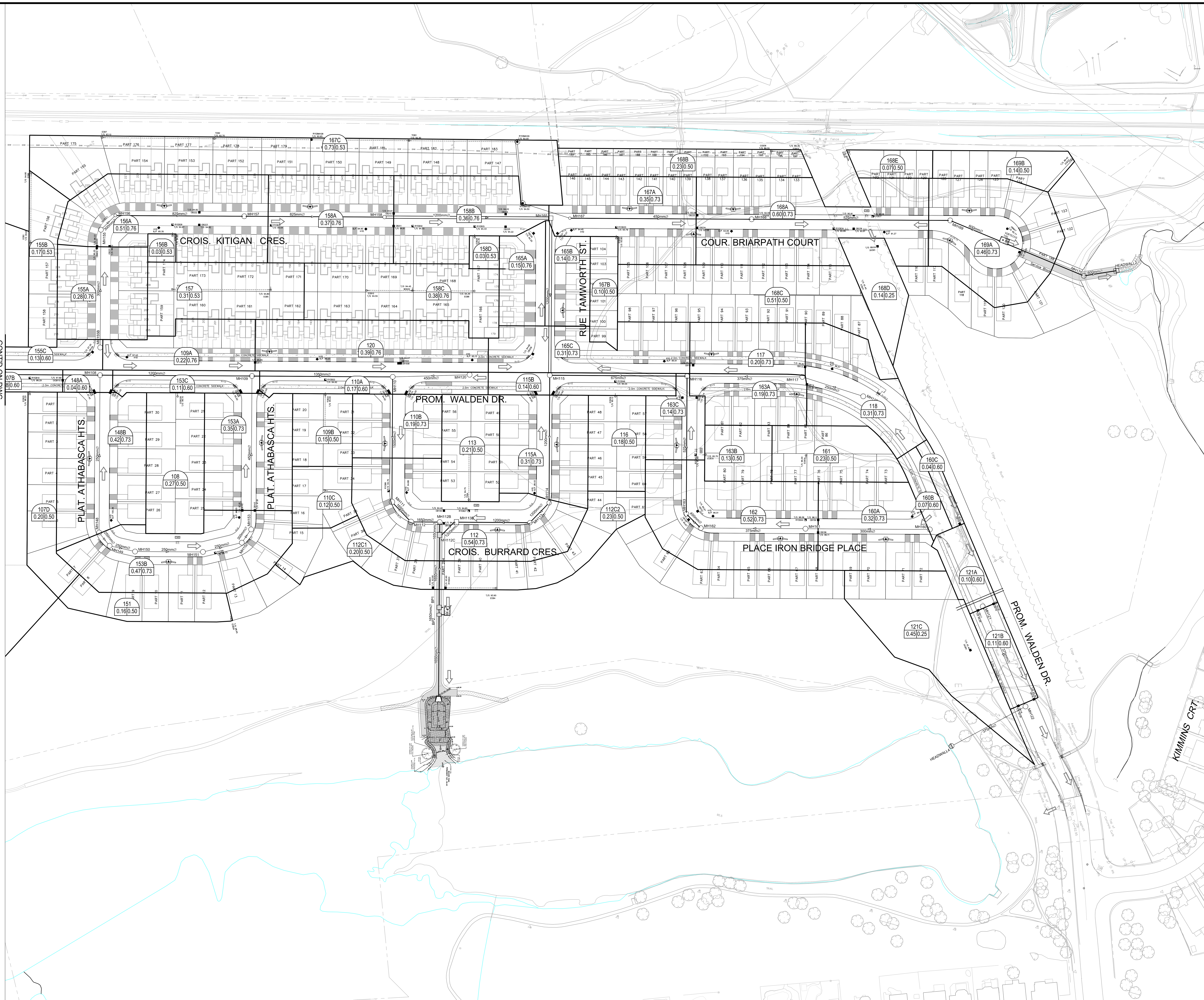
STORM DRAINAGE AREA PLAN

Scale: 1:1000

Design	Date
L.E.	FEB. 2017
Drawn	**Checked**
D.S./C.C./M.M.	T.R.B.
Project No.	**Drawing No.**
102101	500

D07-XX-XX-XXXX

#XXXXX



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2018

Plan Number ____________________

KEY PLAN
NTS

FOR LEGEND AND DETAILS SEE DRAWING 102101-010

LEGEND :

S168	AREA NUMBER
0.69	RUNOFF COEFFICIENT
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14			
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12			
11			
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9			
8			
7			
6	REVISED AS PER CITY COMMENTS	LME	2018:02:23
5	ISSUED FOR 4TH SUBMISSION	LME	2018:01:24
4	REVISED AS PER CITY COMMENTS	LME	2017:10:27
3	ISSUED FOR 2ND SUBMISSION	LME	2017:08:30
2	REVISED AS PER CITY COMMENTS	LME	2017:08:18
1	ISSUED TO CITY FOR REVIEW	LME	2017:02:15

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AREA PLAN

Scale
1:1000

Design	Date
L.E.	FEB. 2017
Drawn	**Checked**
D.S./C.C./M.M.	T.R.B.
Project No.	**Drawing No.**
102101	501

D07-XX-XX-XXXX

#XXXXX

APPENDIX D

- Water Quality Calculations
- Flow Points along Watt's Creek and Kizell Drain
- Extract from 2015 Phase 2 Report: Watts Creek Flood Outlines
- Kizell Drain Interpolation of Flows Points to HEC-RAS Cross-Sections
- Watt's Creek Hydraulic Model Results: Existing and Interim
- Watt's Creek Comparison of Interim Versus Existing Water Levels
- As Built of Rail Line Culvert, Shirley's Brook
- Flow Points along Shirley's Brook
- Extract from 2015 Phase 2 Report: Shirley's Brook Flood Outlines
- Shirley's Brook Interpolation of Flows Points to HEC-RAS Cross-Sections
- Shirley's Brook Hydraulic Model Results: Existing and Interim
- Drainage Area Schematic Drawing No. 102101-750
- Drainage Area Schematic Drawing No. 102101-751
- Ponding Plan Drawing No. 102101-400
- Ponding Plan Drawing No. 102101-401
- Nordion Culvert Modifications Figure 28661-Fig1
- CD with model files and excel spreadsheets

Water Quality Calculations - Interim Conditions - Hybrid

- includes Stage 9, existing and remainder rural

Total Drainage Area to the Beaver Pond for Water Quality Treatment: 444 ha

(*)Total weighted TIMP for Drainage Areas to Beaver Pond for Water Quality Treatment: 31 %

Enhanced Level of Treatment (80% TSS removal)

Permanent Storage required for Wet Pond (from MOE Manual p3-10 Table 3.2):

IMP (%)	Storage Volume (m^3/ha)
30	100
35	110

For Beaver Pond: 103

Calculated storage volume minus 40 m^3/ha extended storage: 63 m^3/ha

Total Permanent Storage Required in Beaver Pond: 27864 m^3

Existing permanent storage in Beaver Pond as per AECOM stage-area curve at permanent water elevation of 90.42 m: 35210 m^3

Deficit of Permanent Storage in Beaver Pond: -7346 m^3

Extended Storage Required in Beaver Pond: 17753 m^3

Notes: (*) The weighted TIMP assumes rural areas (AECOM existing condition areas modeled with NASHYD) have a TIMP equal to 0.

Water Quality Calculations - Interim Conditions - Weighted Imperviousness Calculations

	Area (ha)	Weighted TIMP
Total to Beaver Pond	**443.82**	**31.39**

ID	Area (ha)			TIMP	Area x TIMP
1a	11.4				
1b	9.3				
1c	17.8		STANDHYD	51	907.8
1d	15.8		STANDHYD	55	869
2A	29.3		STANDHYD	45	1318.5
2b-1	13				
2b-2	15.7				
2c	13.8		STANDHYD	52	717.6
3a-1	2.7		STANDHYD	47	126.9
3a-2	33.4		STANDHYD	41	1369.4
3b	6.3				
4	21.2		STANDHYD	38	805.6
4a	15.8		STANDHYD	66	1042.8
4b	6.2		STANDHYD	57	353.4
4c	5.8		STANDHYD	53	307.4
5a	2.5		STANDHYD	50	125
5b	9.5				
5c	6.2		STANDHYD	50	310
6a	4.1		STANDHYD	52	213.2
6b	5.9				
6c	5.3		STANDHYD	50	265
7	19.6		STANDHYD	44	862.4
9	*25.36*				
10-1	9.8		STANDHYD	51	499.8
10-2	18.6		STANDHYD	51	948.6
10-3	4.3		STANDHYD	55	236.5
10-4	13.9		STANDHYD	51	708.9
10A	9.9		STANDHYD	44	435.6
11	46.2				
12	2.27				
13	2.9				
14	2.38				
15	2.5				
goulbourn	1.6		STANDHYD	71	113.6
kanata	2.8		STANDHYD	32	89.6
Phase 9 - ultimate area					
S100H	0.13			60	
S100G	0.13			60	
S100F	0.13			60	
S100E	0.13			60	
S100D	0.13			60	
S100C	0.13			60	
S100A	0.12			60	
R123B	0.17		STANDHYD	50	*8.50*
GFRB	0.2		STANDHYD	84	*16.80*
S124A	0.47			73	
S123A	0.46			73	
R128A	0.21			50	
R130A	0.28			50	
R102A	0.13			50	
S102B	0.18			60	
S129B	0.34			73	
R100C	0.16			50	
S100B	0.32			60	
SB2	0.11				

Water Quality Calculations - Interim Conditions - Weighted Imperviousness Calculations

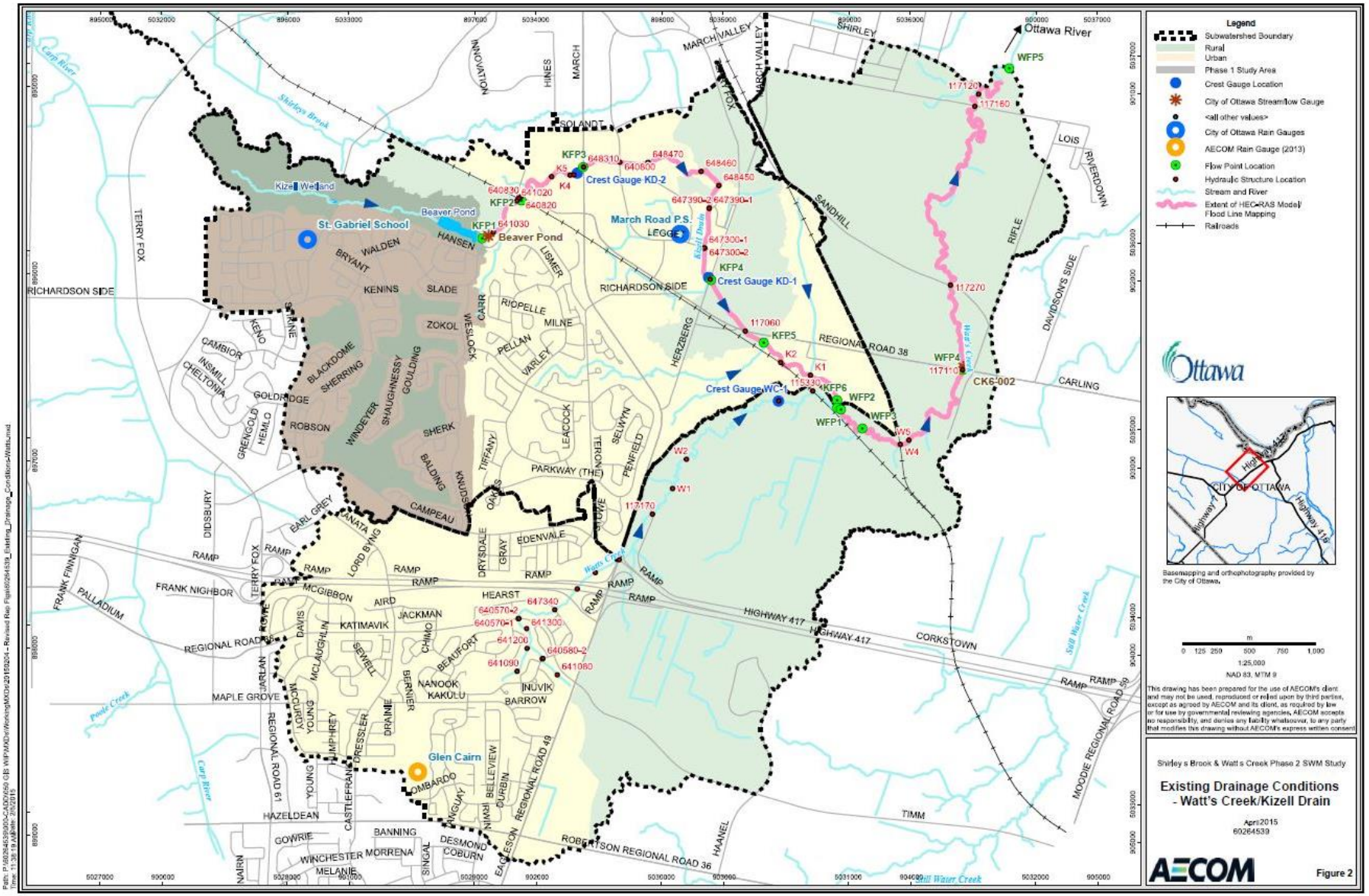
	Area (ha)	Weighted TIMP
Total to Beaver Pond	**443.82**	**31.39**

ID	Area (ha)			TIMP	Area x TIMP
R132B	0.2		STANDHYD	53	*10.60*
S132A	0.39		STANDHYD	76	*29.64*
R135D	0.13				
R134B	0.43		STANDHYD	53	*22.79*
S134A	0.42		STANDHYD	76	*31.92*
S139A	0.36		STANDHYD	76	*27.36*
S139B	0.12		STANDHYD	76	*9.12*
R135B	0.3		STANDHYD	53	*15.90*
S135A	0.85		STANDHYD	76	*64.60*
R135C	0.7		STANDHYD	53	*37.10*
SB3	0.2				
R126A	0.08		STANDHYD	50	*4.00*
R126C	0.15		STANDHYD	50	*7.50*
R126B	0.22				
R144C	0.1				
R144B	0.17		STANDHYD	50	*8.50*
S144A	0.32		STANDHYD	73	*23.36*
S143B	0.18		STANDHYD	73	*13.14*
R140D	0.16		STANDHYD	50	*8.00*
R140C	0.18		STANDHYD	50	*9.00*
S140A	0.6		STANDHYD	73	*43.80*
R103	0.24		STANDHYD	50	*12.00*
S143C	0.25		STANDHYD	73	*18.25*
S143A	0.19		STANDHYD	73	*13.87*
R105B	0.3		STANDHYD	50	*15.00*
S145	0.34		STANDHYD	73	*24.82*
S105A	0.25		STANDHYD	73	*18.25*
S146	0.19		STANDHYD	73	*13.87*
S131A	0.23		STANDHYD	73	*16.79*
S104B	0.1		STANDHYD	60	*6.00*
S104A	0.03		STANDHYD	76	*2.28*
S138A	0.16		STANDHYD	60	*9.60*
R106	0.32		STANDHYD	50	*16.00*
P107C	1.38				
S107A	0.2		STANDHYD	60	*12.00*
S155C	0.13		STANDHYD	60	*7.80*
R107D	0.2		STANDHYD	50	*10.00*
S107B	0.08		STANDHYD	60	*4.80*
S160A	0.39		STANDHYD	73	*28.47*
S162	0.52		STANDHYD	73	*37.96*
R161	0.23		STANDHYD	50	*11.50*
R163B	0.13		STANDHYD	50	*6.50*
S118	0.31		STANDHYD	73	*22.63*
S163A	0.33		STANDHYD	73	*24.09*
S117	0.2		STANDHYD	73	*14.60*
R116	0.18		STANDHYD	50	*9.00*
S165C	0.31		STANDHYD	73	*22.63*
S115A	0.45		STANDHYD	73	*32.85*
S109A	0.22		STANDHYD	76	*16.72*
S120	0.39		STANDHYD	76	*29.64*
S148A	0.46		STANDHYD	73	*33.58*
R108	0.27		STANDHYD	50	*13.50*
S153B	0.47		STANDHYD	73	*34.31*
S153A	0.46		STANDHYD	73	*33.58*
R110C	0.12		STANDHYD	50	*6.00*

Water Quality Calculations - Interim Conditions - Weighted Imperviousness Calculations

	Area (ha)	Weighted TIMP
Total to Beaver Pond	**443.82**	**31.39**

ID	Area (ha)			TIMP	Area x TIMP
R109B	0.15		STANDHYD	50	*7.50*
S110A	0.36		STANDHYD	73	*26.28*
R113	0.21		STANDHYD	50	*10.50*
R112C1	0.2		STANDHYD	50	*10.00*
R112C2	0.23		STANDHYD	50	*11.50*
S112	0.54		STANDHYD	73	*39.42*
R151	0.16		STANDHYD	50	*8.00*
S160C	0.04		STANDHYD	73	*2.92*
S121A	0.1		STANDHYD	60	*6.00*
R121C	0.45				
S121B	0.11		STANDHYD	60	*6.60*
R137A	0.2		STANDHYD	53	*10.60*
R155B	0.17		STANDHYD	53	*9.01*
P137B	0.64				
S155A	0.28		STANDHYD	76	*21.28*
R156B	0.03		STANDHYD	53	*1.59*
S156A	0.51		STANDHYD	76	*38.76*
R157	0.31		STANDHYD	53	*16.43*
R158C	0.37		STANDHYD	53	*19.61*
R158D	0.03		STANDHYD	53	*1.59*
S158A	0.37		STANDHYD	76	*28.12*
S158B	0.51		STANDHYD	76	*38.76*
S165B	0.14		STANDHYD	73	*10.22*
R167B	0.1		STANDHYD	50	*5.00*
S167A	0.35			73	
S168A	0.6			73	
R168C	0.51			50	
P168D	0.14				
R168B	0.23			50	
R168E	0.07			50	
S169A	0.46			73	
R169B	0.14			50	
R167C	0.73			53	


Legend
Subwatershed Boundary
Rural
Urban
Phase 1 Study Area
Crest Gauge Location
City of Ottawa Streamflow Gauge
<all other values>
City of Ottawa Rain Gauges
AECOM Rain Gauge (2013)
Flow Point Location
Hydraulic Structure Location
Stream and River
Extent of HEC-RAS Model/ Flood Line Mapping
Railroads
Ottawa River
Carp River
Shirleys Brook
Kizell Wetland
Beaver Pond
St. Gabriel School
March Road P.S.
Crest Gauge KD-2
Crest Gauge KD-1
Crest Gauge WC-1
Glen Cairn
KFP1
KFP2
KFP3
KFP4
KFP5
KFP6
WFP1
WFP2
WFP3
WFP4
WFP5
CK6-002
RICHARDSON SIDE
REGIONAL ROAD 38
HIGHWAY 417
CARLING
CORKSTOWN
MAPLE GROVE
HAZELDEAN
TIMM
Watts Creek
Still Water Creek
Poole Creek
Basemapping and orthophotography provided by the City of Ottawa.
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NAD 83, MTM 9
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Shirley s Brook & Watt s Creek Phase 2 SWM Study
Existing Drainage Conditions
- Watt's Creek/Kizell Drain
April 2015
60264539
AECOM
Figure 2

Watt's Creek

STUDY LIMIT

44.72172

129.4642

310.2693

343.1997

5025000

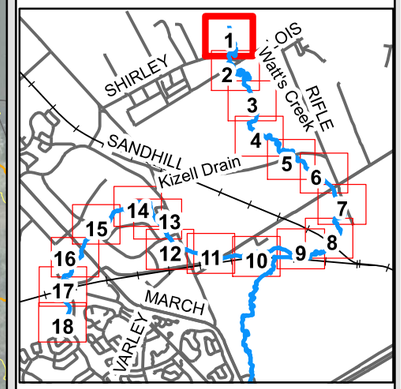
Note: The flood lines delineated on this map have been prepared for the purposes of informing the design of the stormwater management solution for Phase 7, 8 and 9 of the KNL development and are subject to change.They will not be used for the purposes of regulating areas subject to flooding until Mississippi Valley Conservation (MVC) completes a full update that will include additional public consultation. For more information about MVC's floodplain mapping update, please contact John Price, P. Eng., at (613) 259-2421.

Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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Sheet No. 1 of 18

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Shirley Boulevard

Malibar Boulevard

Watt's Creek

129.4642
343.1997
310.2693
369.3561
117120
381.5255
420.5432
117160
482.8587
497.982
517.7993
526.7829
673.4133
920.3455
1057.547
1269.687

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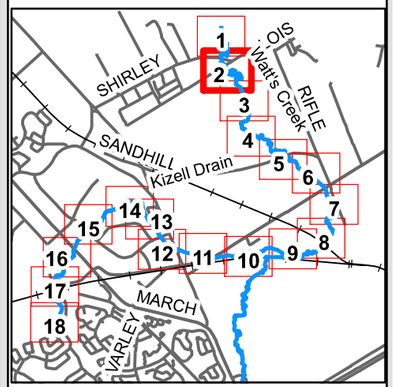
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

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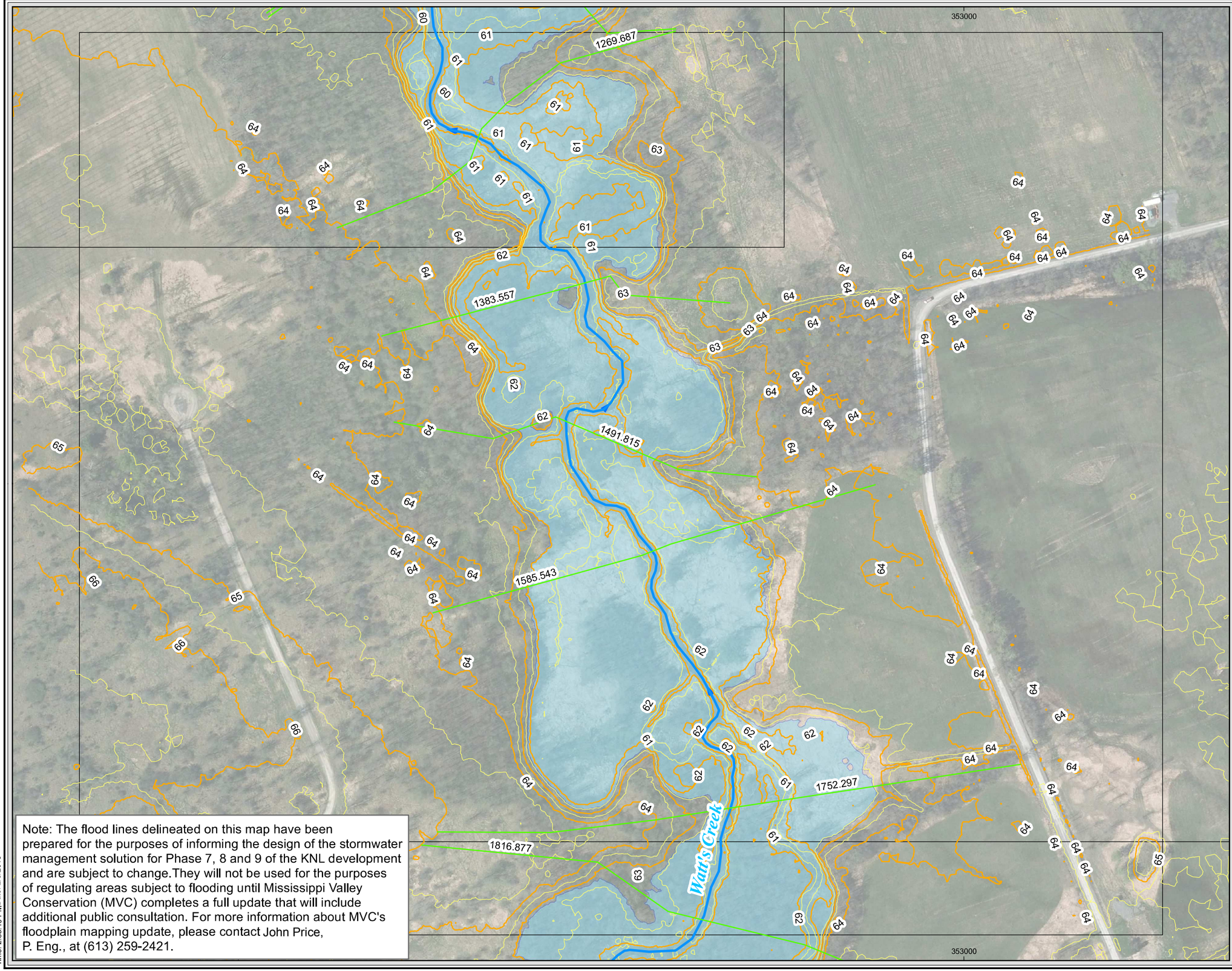

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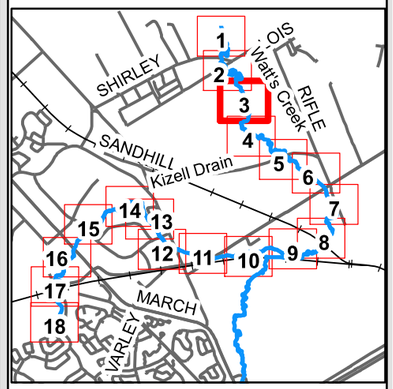
Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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Sheet No. 3 of 18

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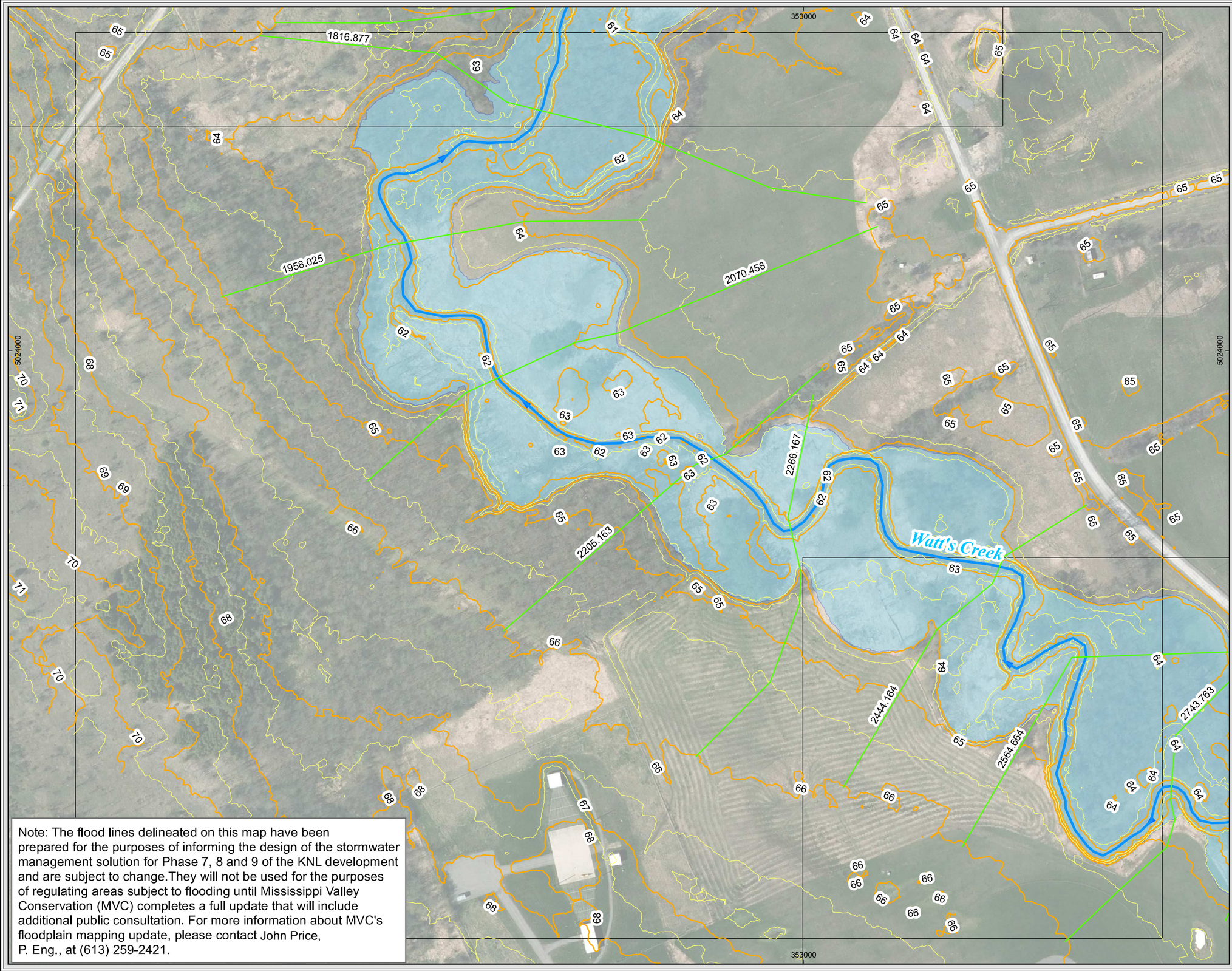

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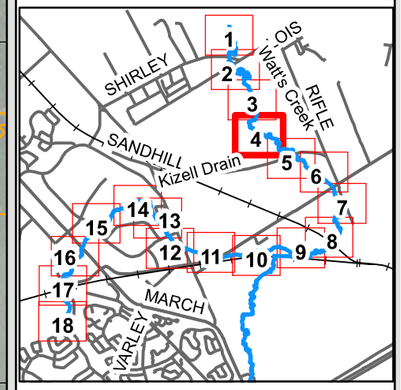
Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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Sheet No. 4 of 18

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353000

Watt's Creek

Sandhill Road

2266.167
2444.164
2564.664
2743.763
2817.591
2920.728
2951.912
117270
2964.234
2981.379
3020.422
3098.158
3227.732
3328.888
3469.421

Note: The flood lines delineated on this map have been prepared for the purposes of informing the design of the stormwater management solution for Phase 7, 8 and 9 of the KNL development and are subject to change.They will not be used for the purposes of regulating areas subject to flooding until Mississippi Valley Conservation (MVC) completes a full update that will include additional public consultation. For more information about MVC's floodplain mapping update, please contact John Price, P. Eng., at (613) 259-2421.

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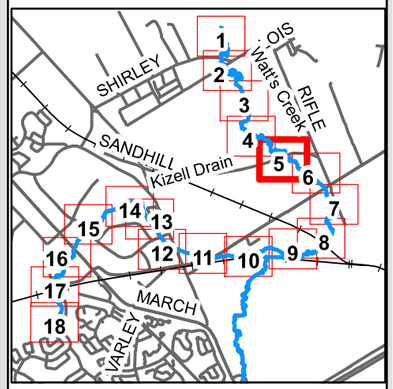
Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
60264539

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Sandhill Road

Rifle Road

Watt's Creek

Carling Avenue

SPILL

2964.234
2981.379
3020.422
3227.732
3328.888
3098.158
3469.421
3627.228
3649.255
3669.048
3712.739
3736.303
117110

354000

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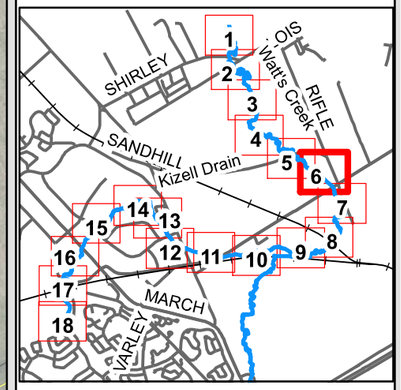
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

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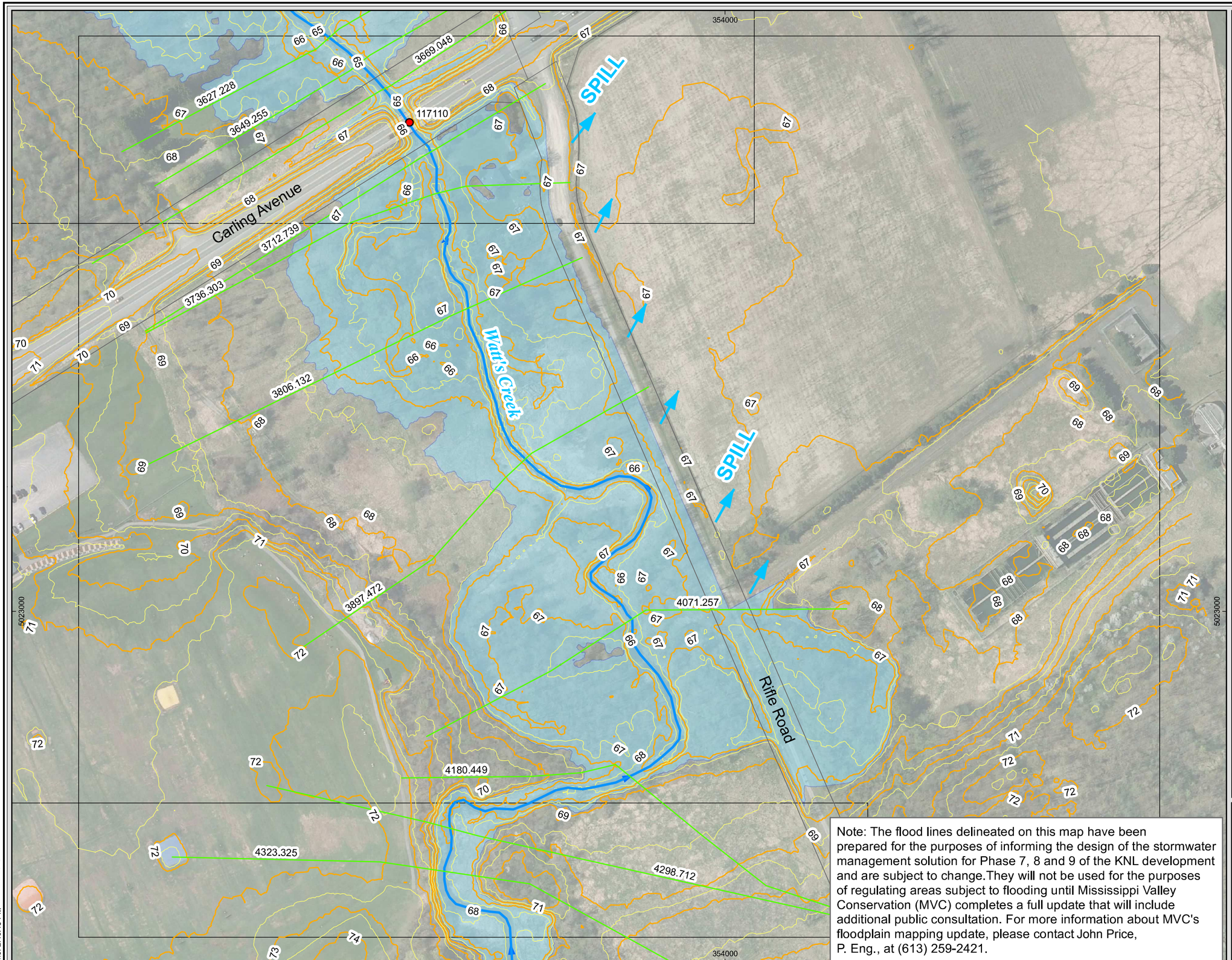

Legend

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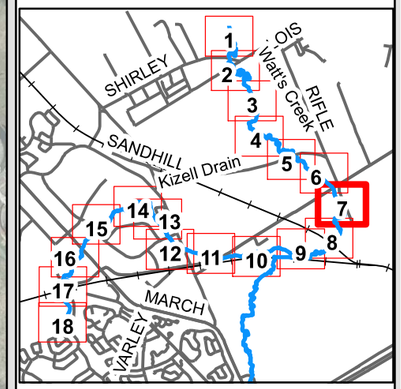
Sheet Index



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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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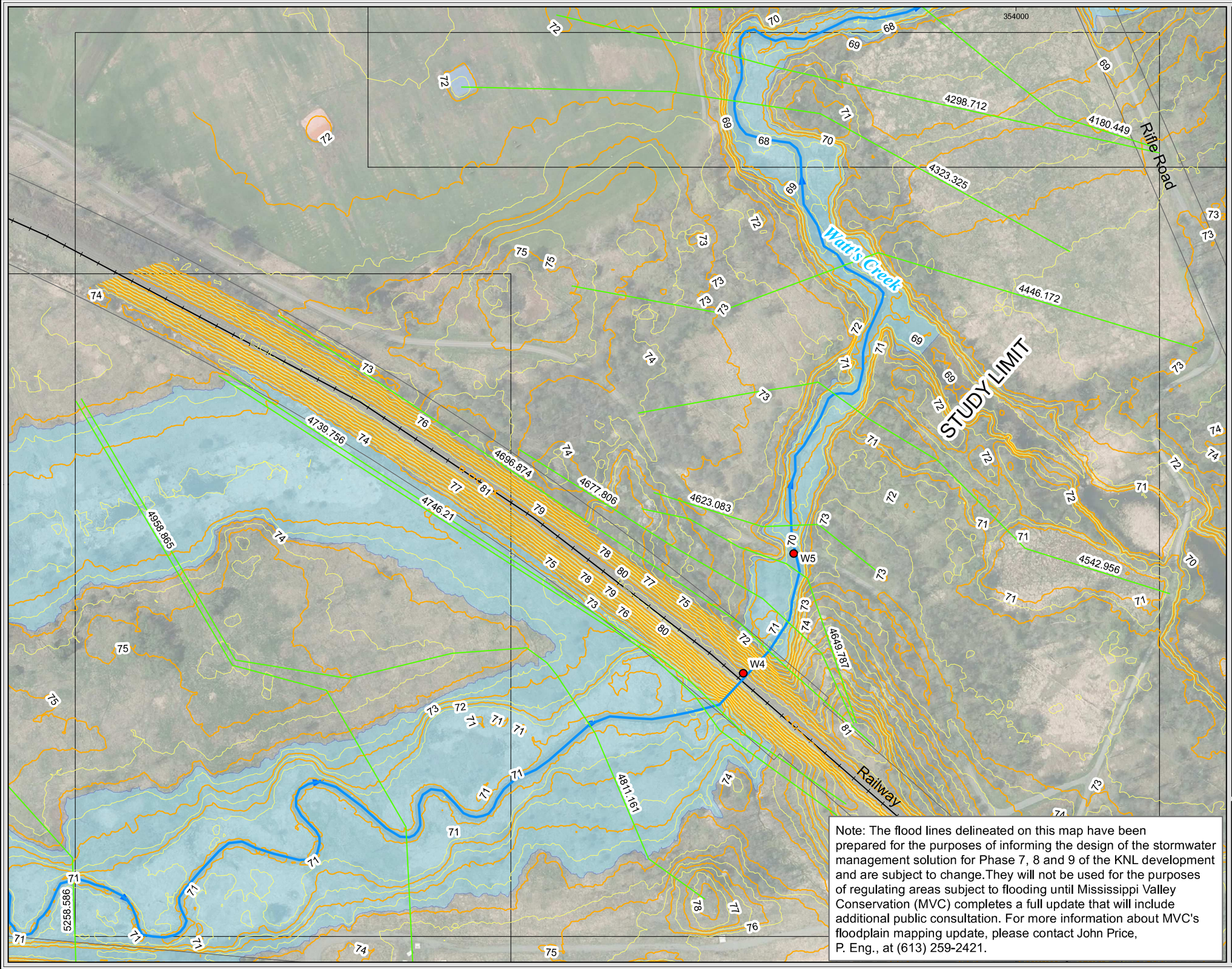

Legend

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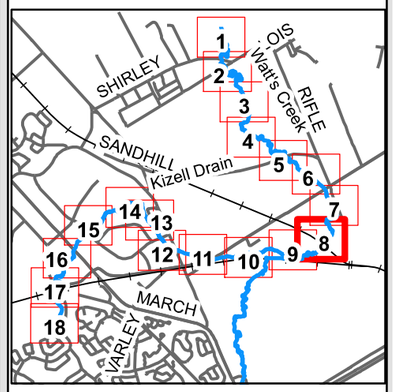
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

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Railway

Kizell Drain

Watt's Creek

115330

5574.705

5432.364

5258.586

4911.161

4958.865

4739.756

4746.21

4696.874

4677.806

5691.871

STUDY LIMIT

Railway

Legend

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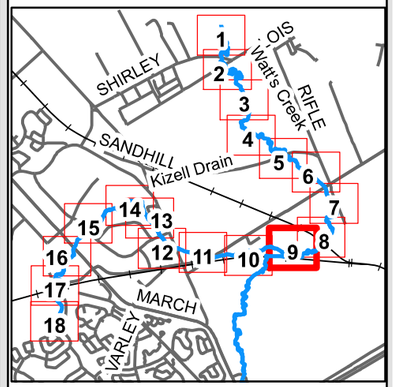
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

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Carling Avenue
Burke Road
Kizell Drain
Watt's Creek
Railway
STUDY LIMIT
K1
K2
W3
115330
353000
6550.151
6542.144
6500.704
6486.45
6384.713
6135.225
6104.693
6243.84
6137.62
6126.151
5934.876
5846.72
5691.871

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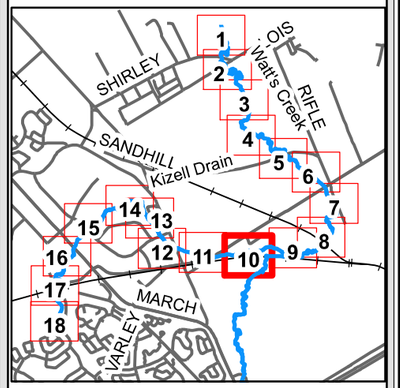
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

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Sheet No. 10 of 18

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352000

Kizell Drain

Herzberg Road

Carling Avenue

Railway

Bayfield Avenue

STUDY LIMIT

117060

6984.227
6974.809
6834.839
7020.547
7025.94
6705.311
6550.151
6542.144
6486.45
6384.713
6500.704

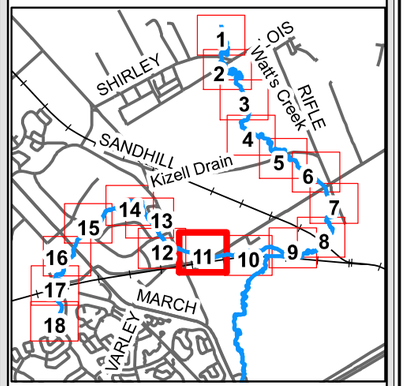
Note: The flood lines delineated on this map have been prepared for the purposes of informing the design of the stormwater management solution for Phase 7, 8 and 9 of the KNL development and are subject to change.They will not be used for the purposes of regulating areas subject to flooding until Mississippi Valley Conservation (MVC) completes a full update that will include additional public consultation. For more information about MVC's floodplain mapping update, please contact John Price, P. Eng., at (613) 259-2421.

Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



Topographic information and digital orthophotography provided by the City of Ottawa

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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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Legget Drive

Kizell Drain

Schneider Road

Herzberg Road

Railway

FVS1

FVS2

FVS3

647300-1

647300-2

117100

7489.235

7438.877

7386.879

7324.579

7276.354

7280.889

7242.107

7058.454

7229.969

7161.913

7125.073

7020.547

6974.809

6984.227

7025.94

6834.839

6705.311

6550.151

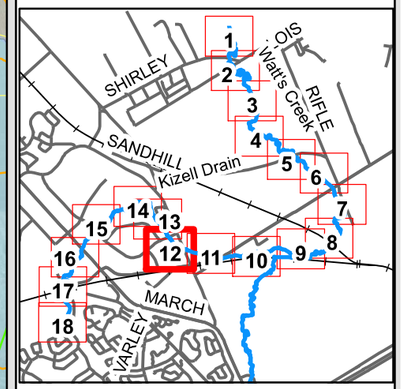
352000

Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location
- Flood Vulnerable Structure Location & ID

Ottawa

Sheet Index



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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
60264539

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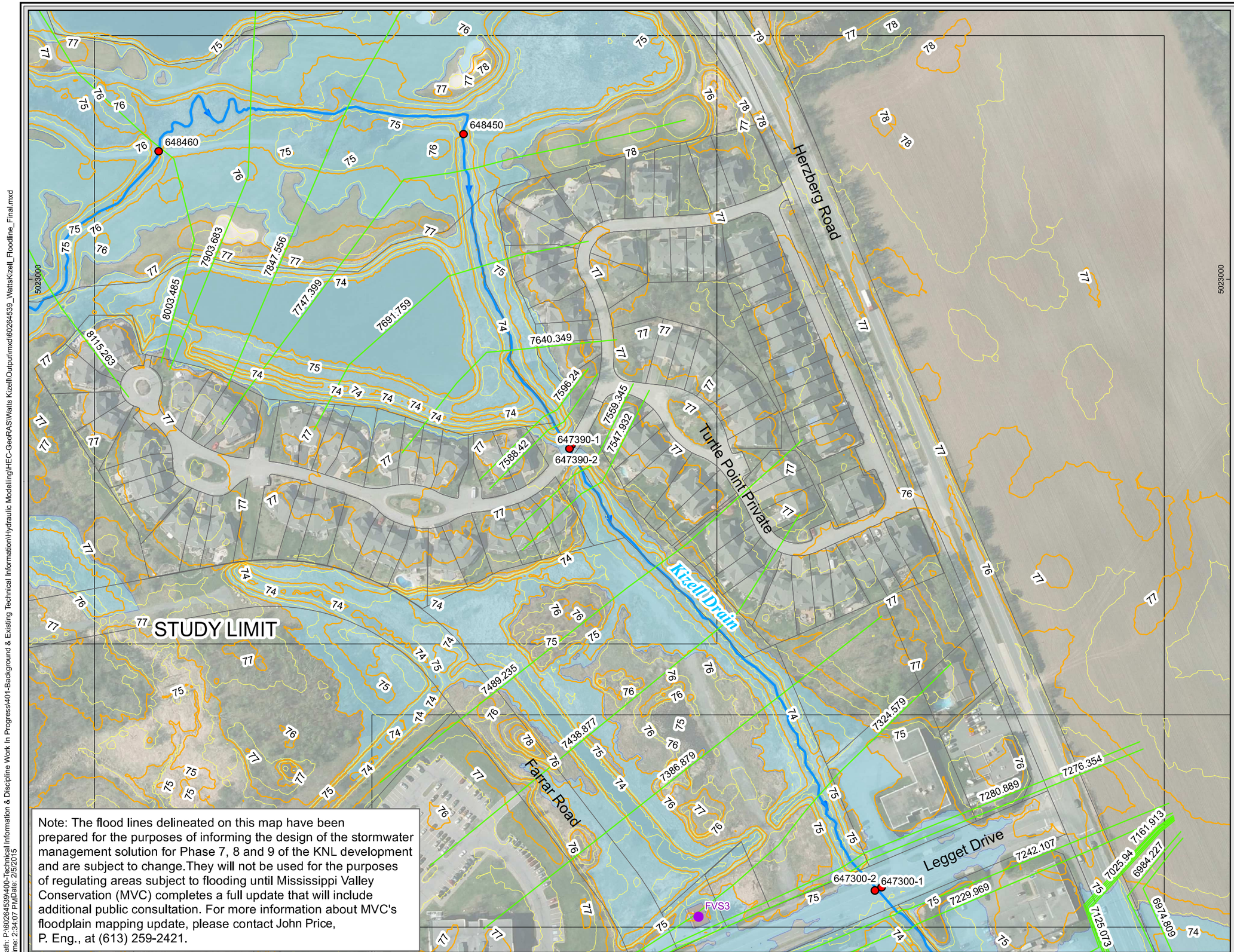

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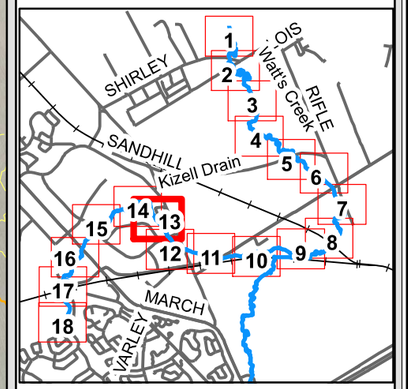
Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location
- Flood Vulnerable Structure Location & ID

Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
60264539

AECOM

STUDY LIMIT

Terry Fox Drive

Turtle Point Private

Kizell Drain

8003.485

8115.263

8329.198

8428.704

8470.617

8236.271

7903.683

7847.556

7747.399

7691.759

7640.349

7596.24

7588.42

7559.345

7547.932

7489.235

7438.877

648460

648450

647390-1

647390-2

5023000

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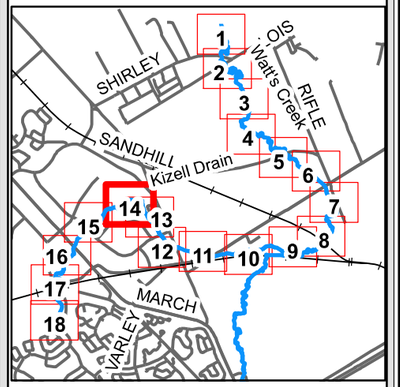
Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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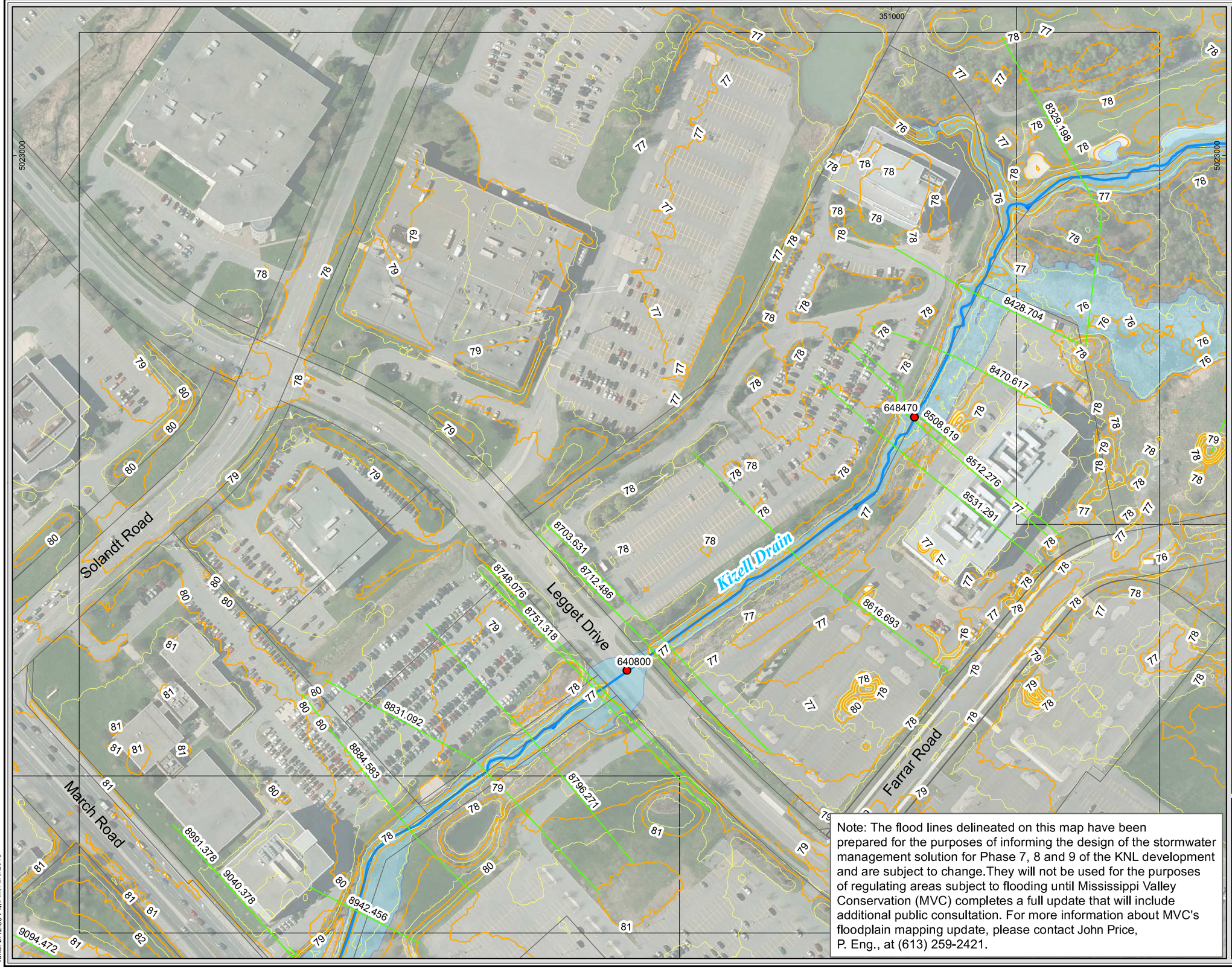
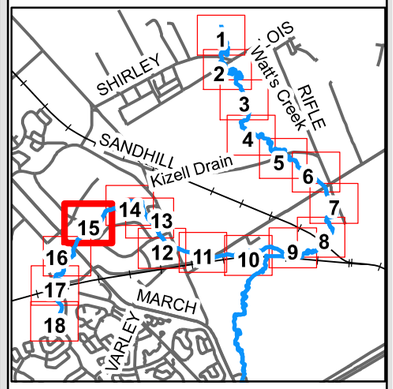


Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
60264539

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Hines Road
Solandt Road
March Road
Kizell Drain
Watt's Creek
SHIRLEY
SANDHILL
MARCH
VARLEY
RIFLE
STO
8884.583
8751.318
8796.271
8831.092
8991.378
8942.456
9094.472
9096.603
9151.77
9169.896
9154.916
9131.887
9176.041
9252.569
9315.228
9318.861
9338.062
9339.857
9363.261
9442.479
9573.048
8985.021
9040.378
648310
K3
K4
K5
FVS4
FVS5

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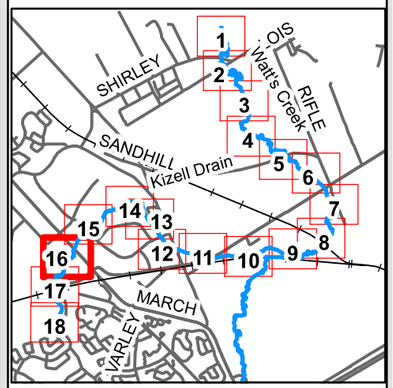
Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Extent of 100-Year Flood Line (Routed Water Level)
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location
- Flood Vulnerable Structure Location & ID

Sheet Index



Topographic information and digital orthophotography provided by the City of Ottawa

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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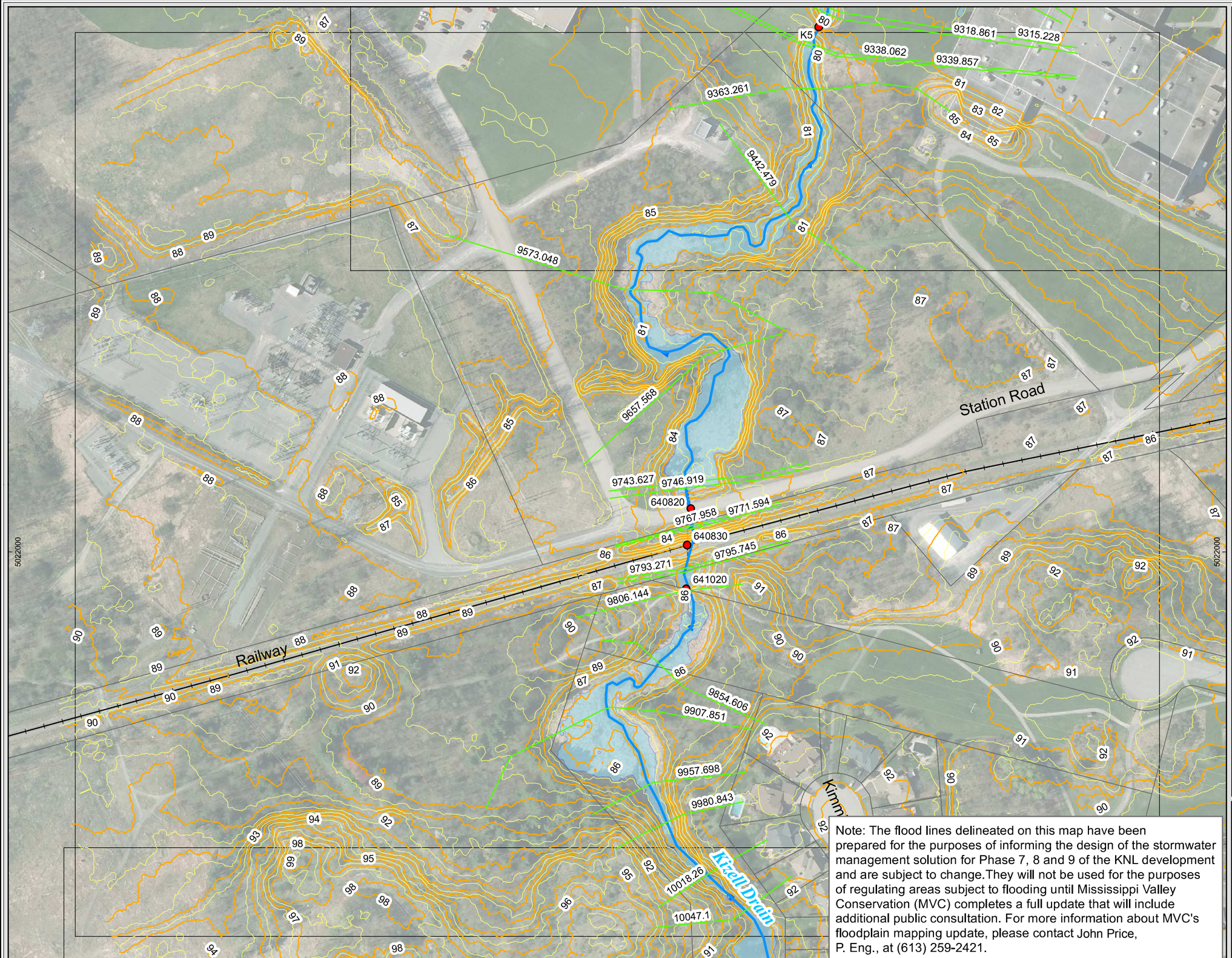

Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
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- 1.0 m Contour Interval
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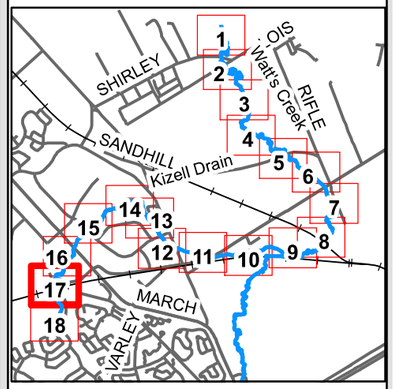
Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
60264539

AECOM

Sheet No. 17 of 18

Kizell Drain

10018.26

10047.1

10089.35

10170.75

641030

10234.89

Kimmins Court

Lismer Crescent

STUDY LIMIT

Hansen Avenue

Vermeer Way

Walden

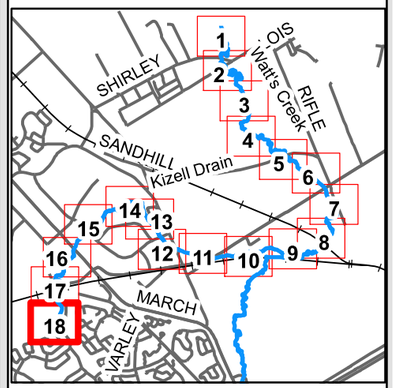
Carmi

Legend

- Watt's Creek & Kizell Drain
- HEC-RAS Cross Section Location & ID
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Watt's Creek & Kizell Drain Flood Line Delineation

February 2015
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Watts Creek - Interim Conditions

Flows from SWMHYMO Model

	Peak Flow (cms)								
Flow Point	**C4H25M10**	**S2400212**	**S2400512**	**C3H00510**	**C3H10010**	**HJU79**	**C3H12010**	**S2410612**	**S2412612**
KFP1	0.071	0.247	0.363	0.201	0.515	0.742	0.707	0.89	1.766
KFP2	0.223	0.323	0.487	0.492	1.001	1.137	1.289	1.191	1.821
KFP3	0.588	0.705	1.127	1.07	2.708	3.857	3.689	3.021	4.11
KFP4	1.922	3.081	4.885	4.381	11.165	15.807	15.174	11.934	16.214
KFP5	1.791	2.812	4.447	4.128	9.865	14.172	13.189	10.933	14.66
KFP6	3.241	4.939	7.752	7.713	15.928	23.036	21.536	17.955	24.017
WFP1	3.385	5.278	7.258	7.646	17.996	23.426	25.09	17.435	23.804
WFP2	6.593	9.692	14.949	15.332	32.214	46.461	44.217	35.389	47.817
WFP3	6.66	9.907	15.314	15.573	32.873	47.414	45.101	36.316	49.054
WFP4	6.388	9.832	15.156	15.173	32.284	45.753	43.73	35.795	48.061
WFP5	4.539	7.666	11.554	9.867	22.046	31.358	29.965	27.609	36.868

Flows to be used as steady state in HECRAS model

Flow Point	**River**	**Reach**	**RS**	**C4H25M10**	**S2400212**	**S2400512**	**C3H00510**	**C3H10010**	**HJU79**	**C3H12010**	**S2410612**	**S2412612**
KFP2	WattsKizell	Main Channe	10234.89	0.223	0.323	0.487	0.492	1.001	1.137	1.289	1.191	1.821
	WattsKizell	Main Channe	9746.919	0.296	0.399	0.615	0.608	1.342	1.681	1.769	1.557	2.279
	WattsKizell	Main Channe	9657.568	0.369	0.476	0.743	0.723	1.684	2.225	2.249	1.923	2.737
	WattsKizell	Main Channe	9442.479	0.442	0.552	0.871	0.839	2.025	2.769	2.729	2.289	3.194
	WattsKizell	Main Channe	9363.261	0.515	0.629	0.999	0.954	2.367	3.313	3.209	2.655	3.652
KFP3	WattsKizell	Main Channe	9252.569	0.588	0.705	1.127	1.070	2.708	3.857	3.689	3.021	4.110
	WattsKizell	Main Channe	8991.378	0.855	1.180	1.879	1.732	4.399	6.247	5.986	4.804	6.531
	WattsKizell	Main Channe	8703.631	1.122	1.655	2.630	2.394	6.091	8.637	8.283	6.586	8.952
	WattsKizell	Main Channe	8236.271	1.388	2.131	3.382	3.057	7.782	11.027	10.580	8.369	11.372
	WattsKizell	Main Channe	7847.556	1.655	2.606	4.133	3.719	9.474	13.417	12.877	10.151	13.793
KFP4	WattsKizell	Main Channe	7438.877	1.922	3.081	4.885	4.381	11.165	15.807	15.174	11.934	16.214
KFP5	WattsKizell	Main Channe	6984.227	1.791	2.812	4.447	4.128	9.865	14.172	13.189	10.933	14.660
	WattsKizell	Main Channe	6500.704	2.081	3.237	5.108	4.845	11.078	15.945	14.858	12.337	16.531
	WattsKizell	Main Channe	6384.713	2.371	3.663	5.769	5.562	12.290	17.718	16.528	13.742	18.403
	WattsKizell	Main Channe	6137.62	2.661	4.088	6.430	6.279	13.503	19.490	18.197	15.146	20.274
	WattsKizell	Main Channe	5934.876	2.951	4.514	7.091	6.996	14.715	21.263	19.867	16.551	22.146
KFP6	WattsKizell	Main Channe	5691.871	3.241	4.939	7.752	7.713	15.928	23.036	21.536	17.955	24.017
WFP2	WattsKizell	Main Channe	5574.705	6.593	9.692	14.949	15.332	32.214	46.461	44.217	35.389	47.817
WFP3	WattsKizell	Main Channe	5432.364	6.660	9.907	15.314	15.573	32.873	47.414	45.101	36.316	49.054
WFP4	WattsKizell	Main Channe	4958.865	6.388	9.832	15.156	15.173	32.284	45.753	43.730	35.795	48.061
	WattsKizell	Main Channe	3669.048	6.018	9.399	14.436	14.112	30.236	42.874	40.977	34.158	45.822
	WattsKizell	Main Channe	2964.234	5.648	8.966	13.715	13.051	28.189	39.995	38.224	32.521	43.584
	WattsKizell	Main Channe	2266.167	5.279	8.532	12.995	11.989	26.141	37.116	35.471	30.883	41.345
	WattsKizell	Main Channe	1491.815	4.909	8.099	12.274	10.928	24.094	34.237	32.718	29.246	39.107
WFP5	WattsKizell	Main Channe	673.4133	4.539	7.666	11.554	9.867	22.046	31.358	29.965	27.609	36.868

Watts Creek - Interim Conditions

Interpolation of Flows between cross-sections (as per AECOM)

River Station	Flow Pt	C3H00510	C3H10010	C3H12010	C4H25M10	HJU79	S2400212	S2400512	S2410012	S2412012
10234.89	KFP-1	0.071	0.247	0.363	0.201	0.515	0.742	0.707	0.89	1.766
9793.271	KFP-2	0.223	0.323	0.487	0.492	1.001	1.137	1.289	1.191	1.821
9781.939										
9759.191										
9746.919										
9657.568		0.296	0.3994	0.615	0.6076	1.3424	1.681	1.769	1.557	2.2788
9442.479		0.369	0.4758	0.743	0.7232	1.6838	2.225	2.249	1.923	2.7366
9363.261		0.442	0.5522	0.871	0.8388	2.0252	2.769	2.729	2.289	3.1944
9327.433										
9252.569		0.515	0.6286	0.999	0.9544	2.3666	3.313	3.209	2.655	3.6522
9169.896										
9094.472	KFP-3	0.588	0.705	1.127	1.07	2.708	3.857	3.689	3.021	4.11
9086.378										
8991.378										
8730.992										
8703.631		0.8548	1.1802	1.8786	1.7322	4.3994	6.247	5.986	4.8036	6.5308
8510.656										
8236.271		1.1216	1.6554	2.6302	2.3944	6.0908	8.637	8.283	6.5862	8.9516
7847.556		1.3884	2.1306	3.3818	3.0566	7.7822	11.027	10.58	8.3688	11.3724
7573.092										
7438.877		1.6552	2.6058	4.1334	3.7188	9.4736	13.417	12.877	10.1514	13.7932
7259.491										
7020.547	KFP-4	1.922	3.081	4.885	4.381	11.165	15.807	15.174	11.934	16.214
7000.502										
6984.227										
6542.144	KFP-5	1.791	2.812	4.447	4.128	9.865	14.172	13.189	10.933	14.66
6522.792										
6500.704										
6384.713		2.081	3.2374	5.108	4.845	11.0776	15.9448	14.8584	12.3374	16.5314
6137.62		2.371	3.6628	5.769	5.562	12.2902	17.7176	16.5278	13.7418	18.4028
6127.747										
5934.876		2.661	4.0882	6.43	6.279	13.5028	19.4904	18.1972	15.1462	20.2742
5846.72		2.951	4.5136	7.091	6.996	14.7154	21.2632	19.8666	16.5506	22.1456
5691.871										
5574.705	KFP-6	3.241	4.939	7.752	7.713	15.928	23.036	21.536	17.955	24.017
5432.364	WFP-2	6.593	9.692	14.949	15.332	32.214	46.461	44.217	35.389	47.817
4958.865	WFP-3	6.66	9.907	15.314	15.573	32.873	47.414	45.101	36.316	49.054
4717.456										
3691.656	WFP-4	6.388	9.832	15.156	15.173	32.284	45.753	43.73	35.795	48.061
3669.048										
2964.234		6.0182	9.3988	14.4356	14.1118	30.2364	42.874	40.977	34.1578	45.8224
2958.099										
2266.167		5.6484	8.9656	13.7152	13.0506	28.1888	39.995	38.224	32.5206	43.5838
1491.815		5.2786	8.5324	12.9948	11.9894	26.1412	37.116	35.471	30.8834	41.3452
673.4133		4.9088	8.0992	12.2744	10.9282	24.0936	34.237	32.718	29.2462	39.1066
507.9618										
357.438										
44.72172	WFP-5	4.539	7.666	11.554	9.867	22.046	31.358	29.965	27.609	36.868

Flows used in model are shifted up (as per AECOM)

C3H00510	C3H10010	C3H12010	C4H25M10	HJU79	S2400212	S2400512	S2410012	S2412012
0.223	0.323	0.487	0.492	1.001	1.137	1.289	1.191	1.821
0.296	0.399	0.615	0.608	1.342	1.681	1.769	1.557	2.279
0.369	0.476	0.743	0.723	1.684	2.225	2.249	1.923	2.737
0.442	0.552	0.871	0.839	2.025	2.769	2.729	2.289	3.194
0.515	0.629	0.999	0.954	2.367	3.313	3.209	2.655	3.652
0.588	0.705	1.127	1.070	2.708	3.857	3.689	3.021	4.110
0.855	1.180	1.879	1.732	4.399	6.247	5.986	4.804	6.531
1.122	1.655	2.630	2.394	6.091	8.637	8.283	6.586	8.952
1.388	2.131	3.382	3.057	7.782	11.027	10.580	8.369	11.372
1.655	2.606	4.133	3.719	9.474	13.417	12.877	10.151	13.793
1.922	3.081	4.885	4.381	11.165	15.807	15.174	11.934	16.214
1.791	2.812	4.447	4.128	9.865	14.172	13.189	10.933	14.660
2.081	3.237	5.108	4.845	11.078	15.945	14.858	12.337	16.531
2.371	3.663	5.769	5.562	12.290	17.718	16.528	13.742	18.403
2.661	4.088	6.430	6.279	13.503	19.490	18.197	15.146	20.274
2.951	4.514	7.091	6.996	14.715	21.263	19.867	16.551	22.146
3.241	4.939	7.752	7.713	15.928	23.036	21.536	17.955	24.017
6.593	9.692	14.949	15.332	32.214	46.461	44.217	35.389	47.817
6.660	9.907	15.314	15.573	32.873	47.414	45.101	36.316	49.054
6.388	9.832	15.156	15.173	32.284	45.753	43.730	35.795	48.061
6.018	9.399	14.436	14.112	30.236	42.874	40.977	34.158	45.822
5.648	8.966	13.715	13.051	28.189	39.995	38.224	32.521	43.584
5.279	8.532	12.995	11.989	26.141	37.116	35.471	30.883	41.345
4.909	8.099	12.274	10.928	24.094	34.237	32.718	29.246	39.107
4.539	7.666	11.554	9.867	22.046	31.358	29.965	27.609	36.868

Watts Creek - Existing Conditions

Flows from SWMHYMO Model

	Peak Flow (cms)								
Flow Point	C4H25M10	S2400212	S2400512	C3H00510	C3H10010	HJU79	C3H12012	S2410612	S2412612
KFP1	0.06	0.23	0.33	0.18	0.46	0.70	0.66	0.85	1.33
KFP2	0.11	0.23	0.34	0.25	0.56	0.81	0.77	0.97	1.48
KFP3	0.53	0.66	1.05	0.98	2.52	3.58	3.45	2.81	3.85
KFP4	1.92	3.04	4.81	4.29	10.99	15.54	14.92	11.71	15.90
KFP5	1.76	2.77	4.38	4.06	9.73	14.00	13.02	10.76	14.42
KFP6	3.22	4.90	7.69	7.65	15.81	22.90	21.40	17.80	23.83
WFP1	3.39	5.28	7.26	7.65	18.00	23.43	25.09	17.44	23.80
WFP2	6.57	9.65	14.90	15.28	32.04	46.33	44.05	35.24	47.63
WFP3	6.64	9.86	15.26	15.52	32.70	47.28	44.93	36.16	48.87
WFP4	6.37	9.79	15.12	15.14	32.20	45.71	43.69	35.66	47.98
WFP5	4.53	7.64	11.51	9.84	21.99	31.35	29.93	27.53	36.83

Flows to be used as steady state in HECRAS model

Flow Point	River	Reach	RS	C4H25M10	S2400212	S2400512	C3H00510	C3H10010	HJU79	C3H12012	S2410612	S2412612
KFP2	WattsKizell	Main Channe	10234.89	0.113	0.229	0.335	0.250	0.560	0.807	0.765	0.970	1.476
	WattsKizell	Main Channe	9746.919	0.197	0.315	0.477	0.396	0.953	1.362	1.303	1.337	1.950
	WattsKizell	Main Channe	9657.568	0.281	0.401	0.620	0.542	1.345	1.916	1.840	1.705	2.424
	WattsKizell	Main Channe	9442.479	0.366	0.487	0.762	0.688	1.738	2.471	2.378	2.072	2.899
	WattsKizell	Main Channe	9363.261	0.450	0.573	0.905	0.834	2.130	3.025	2.915	2.440	3.373
KFP3	WattsKizell	Main Channe	9252.569	0.534	0.659	1.047	0.980	2.523	3.580	3.453	2.807	3.847
	WattsKizell	Main Channe	8991.378	0.811	1.135	1.800	1.642	4.215	5.973	5.747	4.587	6.258
	WattsKizell	Main Channe	8703.631	1.089	1.610	2.553	2.304	5.908	8.365	8.040	6.366	8.669
	WattsKizell	Main Channe	8236.271	1.366	2.086	3.306	2.965	7.600	10.758	10.334	8.146	11.080
	WattsKizell	Main Channe	7847.556	1.644	2.561	4.059	3.627	9.293	13.150	12.627	9.925	13.491
KFP4	WattsKizell	Main Channe	7438.877	1.921	3.037	4.812	4.289	10.985	15.543	14.921	11.705	15.902
KFP5	WattsKizell	Main Channe	6984.227	1.758	2.769	4.384	4.061	9.733	13.996	13.024	10.756	14.421
	WattsKizell	Main Channe	6500.704	2.051	3.195	5.046	4.779	10.947	15.777	14.700	12.165	16.302
	WattsKizell	Main Channe	6384.713	2.343	3.621	5.708	5.497	12.162	17.557	16.376	13.574	18.183
	WattsKizell	Main Channe	6137.62	2.636	4.048	6.370	6.215	13.376	19.338	18.052	14.984	20.065
	WattsKizell	Main Channe	5934.876	2.928	4.474	7.032	6.933	14.591	21.118	19.728	16.393	21.946
KFP6	WattsKizell	Main Channe	5691.871	3.221	4.900	7.694	7.651	15.805	22.899	21.404	17.802	23.827
WFP2	WattsKizell	Main Channe	5574.705	6.570	9.648	14.896	15.280	32.037	46.325	44.049	35.237	47.632
WFP3	WattsKizell	Main Channe	5432.364	6.636	9.862	15.261	15.521	32.696	47.278	44.931	36.164	48.869
WFP4	WattsKizell	Main Channe	4958.865	6.365	9.791	15.123	15.136	32.196	45.714	43.691	35.659	47.975
	WattsKizell	Main Channe	3669.048	5.998	9.361	14.401	14.077	30.154	42.841	40.939	34.032	45.745
	WattsKizell	Main Channe	2964.234	5.630	8.931	13.679	13.019	28.112	39.968	38.188	32.406	43.515
	WattsKizell	Main Channe	2266.167	5.263	8.500	12.956	11.960	26.071	37.094	35.436	30.779	41.285
	WattsKizell	Main Channe	1491.815	4.895	8.070	12.234	10.902	24.029	34.221	32.685	29.153	39.055
WFP5	WattsKizell	Main Channe	673.4133	4.528	7.640	11.512	9.843	21.987	31.348	29.933	27.526	36.825

Watts Creek - Existing Conditions

Interpolation of Flows between cross-sections (as per AECOM)

River Station	Flow Pt	C3H00510	C3H10010	C3H12010	C4H25M10	HJU79	S2400212	S2400512	S2410012	S2412012
10234.89	KFP-1	0.06	0.225	0.328	0.178	0.46	0.699	0.662	0.852	1.329
9793.271	KFP-2	0.113	0.229	0.335	0.25	0.56	0.807	0.765	0.97	1.476
9781.939										
9759.191										
9746.919										
9657.568		0.1972	0.315	0.4774	0.396	0.9526	1.3616	1.3026	1.3374	1.9502
9442.479		0.2814	0.401	0.6198	0.542	1.3452	1.9162	1.8402	1.7048	2.4244
9363.261		0.3656	0.487	0.7622	0.688	1.7378	2.4708	2.3778	2.0722	2.8986
9327.433										
9252.569		0.4498	0.573	0.9046	0.834	2.1304	3.0254	2.9154	2.4396	3.3728
9169.896										
9094.472	KFP-3	0.534	0.659	1.047	0.98	2.523	3.58	3.453	2.807	3.847
9086.378										
8991.378										
8730.992										
8703.631		0.8114	1.1346	1.8	1.6418	4.2154	5.9726	5.7466	4.5866	6.258
8510.656										
8236.271		1.0888	1.6102	2.553	2.3036	5.9078	8.3652	8.0402	6.3662	8.669
7847.556		1.3662	2.0858	3.306	2.9654	7.6002	10.7578	10.3338	8.1458	11.08
7573.092										
7438.877		1.6436	2.5614	4.059	3.6272	9.2926	13.1504	12.6274	9.9254	13.491
7259.491										
7020.547	KFP-4	1.921	3.037	4.812	4.289	10.985	15.543	14.921	11.705	15.902
7000.502										
6984.227										
6542.144	KFP-5	1.758	2.769	4.384	4.061	9.733	13.996	13.024	10.756	14.421
6522.792										
6500.704										
6384.713		2.0506	3.1952	5.046	4.779	10.9474	15.7766	14.7	12.1652	16.3022
6137.62		2.3432	3.6214	5.708	5.497	12.1618	17.5572	16.376	13.5744	18.1834
6127.747										
5934.876		2.6358	4.0476	6.37	6.215	13.3762	19.3378	18.052	14.9836	20.0646
5846.72		2.9284	4.4738	7.032	6.933	14.5906	21.1184	19.728	16.3928	21.9458
5691.871										
5574.705	KFP-6	3.221	4.9	7.694	7.651	15.805	22.899	21.404	17.802	23.827
5432.364	WFP-2	6.57	9.648	14.896	15.28	32.037	46.325	44.049	35.237	47.632
4958.865	WFP-3	6.636	9.862	15.261	15.521	32.696	47.278	44.931	36.164	48.869
4717.456										
3691.656	WFP-4	6.365	9.791	15.123	15.136	32.196	45.714	43.691	35.659	47.975
3669.048										
2964.234		5.9976	9.3608	14.4008	14.0774	30.1542	42.8408	40.9394	34.0324	45.745
2958.099										
2266.167		5.6302	8.9306	13.6786	13.0188	28.1124	39.9676	38.1878	32.4058	43.515
1491.815		5.2628	8.5004	12.9564	11.9602	26.0706	37.0944	35.4362	30.7792	41.285
673.4133		4.8954	8.0702	12.2342	10.9016	24.0288	34.2212	32.6846	29.1526	39.055
507.9618										
357.438										
44.72172	WFP-5	4.528	7.64	11.512	9.843	21.987	31.348	29.933	27.526	36.825

Flows used in model are shifted up (as per AECOM)

C3H00510	C3H10010	C3H12010	C4H25M10	HJU79	S2400212	S2400512	S2410012	S2412012
0.113	0.229	0.335	0.250	0.560	0.807	0.765	0.970	1.476
0.197	0.315	0.477	0.396	0.953	1.362	1.303	1.337	1.950
0.281	0.401	0.620	0.542	1.345	1.916	1.840	1.705	2.424
0.366	0.487	0.762	0.688	1.738	2.471	2.378	2.072	2.899
0.450	0.573	0.905	0.834	2.130	3.025	2.915	2.440	3.373
0.534	0.659	1.047	0.980	2.523	3.580	3.453	2.807	3.847
0.811	1.135	1.800	1.642	4.215	5.973	5.747	4.587	6.258
1.089	1.610	2.553	2.304	5.908	8.365	8.040	6.366	8.669
1.366	2.086	3.306	2.965	7.600	10.758	10.334	8.146	11.080
1.644	2.561	4.059	3.627	9.293	13.150	12.627	9.925	13.491
1.921	3.037	4.812	4.289	10.985	15.543	14.921	11.705	15.902
1.758	2.769	4.384	4.061	9.733	13.996	13.024	10.756	14.421
2.051	3.195	5.046	4.779	10.947	15.777	14.700	12.165	16.302
2.343	3.621	5.708	5.497	12.162	17.557	16.376	13.574	18.183
2.636	4.048	6.370	6.215	13.376	19.338	18.052	14.984	20.065
2.928	4.474	7.032	6.933	14.591	21.118	19.728	16.393	21.946
3.221	4.900	7.694	7.651	15.805	22.899	21.404	17.802	23.827
6.570	9.648	14.896	15.280	32.037	46.325	44.049	35.237	47.632
6.636	9.862	15.261	15.521	32.696	47.278	44.931	36.164	48.869
6.365	9.791	15.123	15.136	32.196	45.714	43.691	35.659	47.975
5.998	9.361	14.401	14.077	30.154	42.841	40.939	34.032	45.745
5.630	8.931	13.679	13.019	28.112	39.968	38.188	32.406	43.515
5.263	8.500	12.956	11.960	26.071	37.094	35.436	30.779	41.285
4.895	8.070	12.234	10.902	24.029	34.221	32.685	29.153	39.055
4.528	7.640	11.512	9.843	21.987	31.348	29.933	27.526	36.825

Watt's Creek **Hydraulic Model Results - Existing Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
10234.89		0.25	89.43	0.56	89.56	0.77	89.62	89.31	0.11	0.81	89.63	0.23	89.41	0.33	89.47	0.97	89.66	1.48	89.76
10170.75		0.25	89.21	0.56	89.31	0.77	89.38	89.12	0.11	0.81	89.4	0.23	89.18	0.33	89.24	0.97	89.44	1.48	89.55
10089.35		0.25	88.89	0.56	89.02	0.77	89.09	88.79	0.11	0.81	89.1	0.23	88.88	0.33	88.94	0.97	89.14	1.48	89.25
10047.1		0.25	88.73	0.56	88.81	0.77	88.85	88.64	0.11	0.81	88.86	0.23	88.72	0.33	88.76	0.97	88.89	1.48	88.95
10018.26		0.25	87.83	0.56	87.93	0.77	87.97	87.74	0.11	0.81	87.98	0.23	87.82	0.33	87.86	0.97	88.01	1.48	88.08
9980.843		0.25	86.44	0.56	86.55	0.77	86.61	86.36	0.11	0.81	86.62	0.23	86.42	0.33	86.48	0.97	86.65	1.48	86.74
9957.698		0.25	86.26	0.56	86.35	0.77	86.37	86.18	0.11	0.81	86.37	0.23	86.26	0.33	86.29	0.97	86.39	1.48	86.44
9907.851		0.25	85.95	0.56	86.02	0.77	86.04	85.84	0.11	0.81	86.05	0.23	85.94	0.33	85.98	0.97	86.06	1.48	86.11
9854.606		0.25	85.63	0.56	85.74	0.77	85.79	85.55	0.11	0.81	85.8	0.23	85.62	0.33	85.67	0.97	85.83	1.48	85.9
9806.144		0.25	85.16	0.56	85.27	0.77	85.31	85.1	0.11	0.81	85.32	0.23	85.16	0.33	85.2	0.97	85.35	1.48	85.43
9795.745		0.25	84.46	0.56	84.56	0.77	84.64	84.4	0.11	0.81	84.65	0.23	84.46	0.33	84.5	0.97	84.68	1.48	84.94
9793.271		0.25	84.23	0.56	84.44	0.77	84.55	84.1	0.11	0.81	84.57	0.23	84.21	0.33	84.3	0.97	84.65	1.48	84.87
9781.939	CNR Railway Culvert																		
9771.594		0.25	82.69	0.56	82.87	0.77	82.95	82.57	0.11	0.81	82.96	0.23	82.63	0.33	82.72	0.97	82.97	1.48	83.16
9767.958		0.25	82.69	0.56	82.88	0.77	82.96	82.58	0.11	0.81	82.98	0.23	82.64	0.33	82.73	0.97	82.99	1.48	83.18
9759.191	Station Rd Culvert																		
9746.919		0.4	82.67	0.95	82.79	1.3	82.82	82.57	0.2	1.36	82.82	0.32	82.62	0.48	82.69	1.34	82.8	1.95	82.78
9743.627		0.4	82.66	0.95	82.81	1.3	82.87	82.56	0.2	1.36	82.88	0.32	82.61	0.48	82.69	1.34	82.86	1.95	82.94
9657.568		0.54	82.07	1.35	82.22	1.84	82.26	81.98	0.28	1.92	82.27	0.4	82.01	0.62	82.09	1.71	82.31	2.42	82.31
9573.048		0.54	80.95	1.35	81.08	1.84	81.84	80.84	0.28	1.92	81.92	0.4	80.89	0.62	80.98	1.71	81.1	2.42	82.01
9442.479		0.69	79.89	1.74	80.6	2.38	81.83	79.81	0.37	2.47	81.92	0.49	79.84	0.76	79.92	2.07	80.93	2.9	82
9363.261		0.83	79.53	2.13	80.6	2.92	81.83	79.33	0.45	3.03	81.91	0.57	79.4	0.9	79.56	2.44	80.92	3.37	82
9339.857		0.83	79.51	2.13	80.6	2.92	81.83	79.27	0.45	3.03	81.91	0.57	79.35	0.9	79.54	2.44	80.92	3.37	82
9338.062		0.83	79.51	2.13	80.59	2.92	81.83	79.28	0.45	3.03	81.91	0.57	79.36	0.9	79.54	2.44	80.92	3.37	82
9327.433	Nordion K5 Culvert																		
9318.861		0.83	79.47	2.13	80.28	2.92	81.24	79.26	0.45	3.03	81.28	0.57	79.34	0.9	79.49	2.44	80.51	3.37	81.32
9315.228		0.83	79.47	2.13	80.29	2.92	81.24	79.26	0.45	3.03	81.28	0.57	79.34	0.9	79.49	2.44	80.52	3.37	81.32
9252.569		0.98	79.42	2.52	80.28	3.45	81.24	79.21	0.53	3.58	81.28	0.66	79.29	1.05	79.45	2.81	80.51	3.85	81.32
9176.041		0.98	79.34	2.52	80.27	3.45	81.24	79.09	0.53	3.58	81.28	0.66	79.17	1.05	79.37	2.81	80.51	3.85	81.32
9169.896		0.98	79.26	2.52	80.27	3.45	81.24	79.04	0.53	3.58	81.28	0.66	79.11	1.05	79.29	2.81	80.51	3.85	81.32
9161.24	Nordion K4 Culvert																		
9154.916		0.98	79.09	2.52	80.22	3.45	81.24	78.9	0.53	3.58	81.28	0.66	78.95	1.05	79.12	2.81	80.51	3.85	81.32
9151.77		0.98	79.13	2.52	80.22	3.45	81.24	78.91	0.53	3.58	81.28	0.66	78.97	1.05	79.16	2.81	80.51	3.85	81.32
9131.887		0.98	79.12	2.52	80.21	3.45	81.24	78.87	0.53	3.58	81.28	0.66	78.94	1.05	79.15	2.81	80.51	3.85	81.32
9096.603		0.98	79.1	2.52	80.21	3.45	81.24	78.83	0.53	3.58	81.28	0.66	78.91	1.05	79.13	2.81	80.5	3.85	81.32
9094.472		0.98	79.06	2.52	80.17	3.45	81.24	78.81	0.53	3.58	81.28	0.66	78.89	1.05	79.1	2.81	80.47	3.85	81.32
9086.378	March Road CSP																		
9040.378		0.98	78.51	2.52	79.03	3.45	79.34	78.37	0.53	3.58	79.45	0.66	78.42	1.05	78.53	2.81	79.1	3.85	79.51
8991.378		1.64	78.37	4.22	78.38	5.75	78.63	78.23	0.81	5.97	78.67	1.14	78.3	1.8	78.39	4.59	78.45	6.26	78.71
8985.021		1.64	78.41	4.22	78.7	5.75	78.81	78.24	0.81	5.97	78.82	1.14	78.32	1.8	78.43	4.59	78.73	6.26	78.84
8942.456		1.64	78.28	4.22	78.6	5.75	78.72	78.13	0.81	5.97	78.74	1.14	78.2	1.8	78.31	4.59	78.63	6.26	78.76
8884.583		1.64	78	4.22	78.4	5.75	78.52	77.8	0.81	5.97	78.54	1.14	77.9	1.8	78.03	4.59	78.43	6.26	78.56
8831.092		1.64	77.78	4.22	78.26	5.75	78.36	77.56	0.81	5.97	78.37	1.14	77.67	1.8	77.81	4.59	78.29	6.26	78.39
8796.271		1.64	77.54	4.22	78.22	5.75	78.32	77.3	0.81	5.97	78.33	1.14	77.4	1.8	77.59	4.59	78.25	6.26	78.34
8751.318		1.64	77.52	4.22	78.22	5.75	78.32	77.26	0.81	5.97	78.33	1.14	77.38	1.8	77.57	4.59	78.25	6.26	78.34
8748.076		1.64	77.52	4.22	78.22	5.75	78.32	77.26	0.81	5.97	78.32	1.14	77.38	1.8	77.56	4.59	78.25	6.26	78.33
8730.992																			
8712.486	Legget Drive	1.64	77.45	4.22	77.8	5.75	77.94	77.25	0.81	5.97	77.96	1.14	77.35	1.8	77.49	4.59	77.83	6.26	77.97
8703.631		2.3	77.41	5.91	77.72	8.04	77.85	77.22	1.09	8.37	77.87	1.61	77.31	2.55	77.44	6.37	77.75	8.67	77.89
8616.693		2.3	77.22	5.91	77.48	8.04	77.59	77.03	1.09	8.37	77.61	1.61	77.13	2.55	77.25	6.37	77.5	8.67	77.63
8531.291		2.3	76.72	5.91	77.09	8.04	77.22	76.57	1.09	8.37	77.24	1.61	76.63	2.55	76.75	6.37	77.12	8.67	77.26
8512.276		2.3	76.77	5.91	77.12	8.04	77.26	76.57	1.09	8.37	77.27	1.61	76.66	2.55	76.8	6.37	77.15	8.67	77.29
8510.656																			
8508.619	Pedestrian Bridge - Farrar Road	2.3	76.76	5.91	77.11	8.04	77.25	76.56	1.09	8.37	77.27	1.61	76.65	2.55	76.79	6.37	77.14	8.67	77.28
8470.617		2.3	76.46	5.91	76.77	8.04	76.92	76.28	1.09	8.37	76.94	1.61	76.35	2.55	76.49	6.37	76.83	8.67	76.95
8428.704		2.3	76.39	5.91	76.76	8.04	76.95	76.18	1.09	8.37	76.97	1.61	76.29	2.55	76.43	6.37	76.8	8.67	76.99
8329.198		2.3	76.24	5.91	76.62	8.04	76.83	76.02	1.09	8.37	76.85	1.61	76.13	2.55	76.28	6.37	76.66	8.67	76.87
8236.271		2.97	76.05	7.6	76.42	10.33	76.72	75.82	1.37	10.76	76.75	2.09	75.94	3.31	76.09	8.15	76.48	11.08	76.76

Watt's Creek **Hydraulic Model Results - Existing Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
8115.263		2.97	75.5	7.6	76.13	10.33	76.69	75.32	1.37	10.76	76.71	2.09	75.41	3.31	75.53	8.15	76.28	11.08	76.73
8003.485		2.97	75.34	7.6	76.12	10.33	76.69	75.11	1.37	10.76	76.71	2.09	75.22	3.31	75.38	8.15	76.29	11.08	76.73
7903.683		2.97	75.19	7.6	76.1	10.33	76.68	74.91	1.37	10.76	76.71	2.09	75.05	3.31	75.24	8.15	76.28	11.08	76.72
7847.556		3.63	75.11	9.29	76.1	12.63	76.68	74.8	1.64	13.15	76.71	2.56	74.95	4.06	75.16	9.93	76.28	13.49	76.72
7747.399		3.63	74.99	9.29	76.08	12.63	76.68	74.63	1.64	13.15	76.7	2.56	74.8	4.06	75.05	9.93	76.27	13.49	76.72
7691.759		3.63	74.93	9.29	76.07	12.63	76.67	74.56	1.64	13.15	76.7	2.56	74.74	4.06	75.01	9.93	76.26	13.49	76.71
7640.349		3.63	74.9	9.29	76.07	12.63	76.67	74.51	1.64	13.15	76.7	2.56	74.71	4.06	74.98	9.93	76.26	13.49	76.71
7596.24		3.63	74.89	9.29	76.06	12.63	76.67	74.49	1.64	13.15	76.69	2.56	74.69	4.06	74.96	9.93	76.25	13.49	76.71
7588.42		3.63	74.85	9.29	75.99	12.63	76.67	74.47	1.64	13.15	76.69	2.56	74.66	4.06	74.92	9.93	76.19	13.49	76.71
7573.092																			
7559.345	Marsh Sparrow Private	3.63	74.45	9.29	74.98	12.63	75.18	74.09	1.64	13.15	75.19	2.56	74.27	4.06	74.48	9.93	75.01	13.49	75.2
7547.932		3.63	74.46	9.29	75.06	12.63	75.19	74.09	1.64	13.15	75.21	2.56	74.28	4.06	74.5	9.93	75.1	13.49	75.22
7489.235		3.63	74.44	9.29	75.05	12.63	75.19	74.05	1.64	13.15	75.2	2.56	74.24	4.06	74.47	9.93	75.09	13.49	75.21
7438.877		4.29	74.4	10.99	75.01	14.92	75.13	74	1.92	15.54	75.14	3.04	74.2	4.81	74.43	11.71	75.05	15.9	75.15
7386.879		4.29	74.37	10.99	74.98	14.92	75.09	73.95	1.92	15.54	75.11	3.04	74.16	4.81	74.4	11.71	75.02	15.9	75.11
7324.579		4.29	74.32	10.99	74.94	14.92	75.04	73.87	1.92	15.54	75.04	3.04	74.1	4.81	74.35	11.71	74.98	15.9	75.05
7280.889		4.29	74.3	10.99	74.92	14.92	75.02	73.82	1.92	15.54	75.02	3.04	74.07	4.81	74.32	11.71	74.96	15.9	75.03
7276.354		4.29	74.29	10.99	74.93	14.92	75.02	73.82	1.92	15.54	75.03	3.04	74.06	4.81	74.31	11.71	74.97	15.9	75.03
7259.491																			
7242.107	Legget Drive	4.29	74.06	10.99	74.45	14.92	74.86	73.74	1.92	15.54	74.89	3.04	73.93	4.81	74.01	11.71	74.69	15.9	74.94
7229.969		4.29	74.07	10.99	74.45	14.92	74.86	73.74	1.92	15.54	74.89	3.04	73.92	4.81	74	11.71	74.69	15.9	74.95
7161.913		4.29	73.98	10.99	74.45	14.92	74.86	73.67	1.92	15.54	74.89	3.04	73.84	4.81	74.01	11.71	74.68	15.9	74.94
7125.073		4.29	73.92	10.99	74.45	14.92	74.86	73.62	1.92	15.54	74.89	3.04	73.78	4.81	73.97	11.71	74.68	15.9	74.94
7058.454		4.29	73.7	10.99	74.4	14.92	74.85	73.44	1.92	15.54	74.87	3.04	73.58	4.81	73.75	11.71	74.66	15.9	74.93
7025.94		4.29	73.51	10.99	74.35	14.92	74.84	73.1	1.92	15.54	74.87	3.04	73.2	4.81	73.55	11.71	74.66	15.9	74.93
7020.547		4.29	73.51	10.99	74.22	14.92	74.84	73.04	1.92	15.54	74.86	3.04	73.24	4.81	73.55	11.71	74.52	15.9	74.93
7000.502																			
6984.227	Herzberg Road	4.06	73.45	9.73	74.03	13.02	74.53	73.01	1.76	14	74.62	2.77	73.19	4.38	73.48	10.76	74.26	14.42	74.85
6974.809		4.06	73.48	9.73	74.13	13.02	74.54	73.02	1.76	14	74.62	2.77	73.21	4.38	73.51	10.76	74.26	14.42	74.85
6834.839		4.06	73.48	9.73	74.13	13.02	74.53	72.99	1.76	14	74.62	2.77	73.19	4.38	73.51	10.76	74.26	14.42	74.85
6705.311		4.06	73.48	9.73	74.13	13.02	74.53	72.98	1.76	14	74.62	2.77	73.19	4.38	73.51	10.76	74.26	14.42	74.85
6550.151		4.06	73.48	9.73	74.13	13.02	74.53	72.97	1.76	14	74.62	2.77	73.19	4.38	73.5	10.76	74.25	14.42	74.85
6542.144		4.06	73.47	9.73	74.09	13.02	74.53	72.97	1.76	14	74.62	2.77	73.18	4.38	73.49	10.76	74.22	14.42	74.85
6522.792																			
6500.704	Carling Avenue	4.78	73.42	10.95	73.78	14.7	74.41	72.96	2.05	15.78	74.61	3.2	73.16	5.05	73.43	12.17	73.83	16.3	74.85
6486.45		4.78	73.42	10.95	73.81	14.7	74.41	72.96	2.05	15.78	74.61	3.2	73.16	5.05	73.44	12.17	73.87	16.3	74.85
6384.713		5.5	73.42	12.16	73.81	16.38	74.41	72.93	2.34	17.56	74.61	3.62	73.14	5.71	73.43	13.57	73.86	18.18	74.85
6243.84		5.5	73.37	12.16	73.77	16.38	74.4	72.85	2.34	17.56	74.6	3.62	73.07	5.71	73.39	13.57	73.83	18.18	74.85
6137.62		6.22	73.26	13.38	73.66	18.05	74.38	72.7	2.64	19.34	74.59	4.05	72.93	6.37	73.29	14.98	73.72	20.07	74.84
6135.225		6.22	73.17	13.38	73.56	18.05	74.38	72.68	2.64	19.34	74.59	4.05	72.89	6.37	73.19	14.98	73.69	20.07	74.84
6129.747																			
6126.151	Carling Avenue (K2)	6.22	72.9	13.38	73.45	18.05	74.38	72.63	2.64	19.34	74.58	4.05	72.77	6.37	72.9	14.98	73.69	20.07	74.83
6104.633		6.22	72.91	13.38	73.37	18.05	74.36	72.62	2.64	19.34	74.57	4.05	72.77	6.37	72.91	14.98	73.59	20.07	74.83
5934.876		6.93	72.76	14.59	73.4	19.73	74.36	72.45	2.93	21.12	74.58	4.47	72.6	7.03	72.77	16.39	73.63	21.95	74.83
5846.72		6.93	72.6	14.59	73.34	19.73	74.36	72.32	2.93	21.12	74.57	4.47	72.44	7.03	72.6	16.39	73.6	21.95	74.83
5691.871		7.65	72.53	15.81	73.35	21.4	74.36	72.28	3.22	22.9	74.57	4.9	72.39	7.69	72.53	17.8	73.6	23.83	74.83
5574.705		15.28	72.49	32.04	73.34	44.05	74.36	72.22	6.57	46.33	74.57	9.65	72.34	14.9	72.48	35.24	73.6	47.63	74.83
5432.364		15.52	72.35	32.7	73.31	44.93	74.34	72.04	6.64	47.28	74.56	9.86	72.17	15.26	72.34	36.16	73.57	48.87	74.82
5258.586		15.52	72.12	32.7	73.28	44.93	74.33	71.7	6.64	47.28	74.55	9.86	71.84	15.26	72.12	36.16	73.54	48.87	74.81
4958.865		15.14	72.04	32.2	73.26	43.69	74.33	71.47	6.36	45.71	74.54	9.79	71.68	15.12	72.04	35.66	73.53	47.97	74.8
4811.161		15.14	72	32.2	73.25	43.69	74.32	71.35	6.36	45.71	74.54	9.79	71.6	15.12	72	35.66	73.53	47.97	74.8
4746.21		15.14	71.97	32.2	73.23	43.69	74.31	71.31	6.36	45.71	74.53	9.79	71.56	15.12	71.97	35.66	73.51	47.97	74.79
4739.756		15.14	71.88	32.2	73.08	43.69	74.15	71.29	6.36	45.71	74.37	9.79	71.52	15.12	71.88	35.66	73.35	47.97	74.63
4717.456																			
4696.874	Canadian National Railway (K4)	15.14	71.3	32.2	71.52	43.69	71.66	71.14	6.36	45.71	71.71	9.79	71.23	15.12	71.3	35.66	71.53	47.97	71.77
4677.806		15.14	71.21	32.2	71.69	43.69	71.97	70.98	6.36	45.71	72.02	9.79	71.11	15.12	71.21	35.66	71.78	47.97	72.08
4649.787		15.14	70.81	32.2	71.17	43.69	71.37	70.5	6.36	45.71	71.41	9.79	70.64	15.12	70.8	35.66	71.23	47.97	71.42
4623.083		15.14	70.66	32.2	71.11	43.69	71.38	70.37	6.36	45.71	71.42	9.79	70.48	15.12	70.66	35.66	71.19	47.97	71.45

Watt's Creek **Hydraulic Model Results - Existing Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
4542.956		15.14	69.8	32.2	70.2	43.69	70.38	69.42	6.36	45.71	70.42	9.79	69.61	15.12	69.8	35.66	70.26	47.97	70.49
4446.172		15.14	69.5	32.2	69.95	43.69	70.17	69.1	6.36	45.71	70.21	9.79	69.28	15.12	69.5	35.66	70.02	47.97	70.25
4323.325		15.14	68.89	32.2	69.22	43.69	69.38	68.55	6.36	45.71	69.4	9.79	68.72	15.12	68.89	35.66	69.27	47.97	69.43
4298.712		15.14	68.77	32.2	69.14	43.69	69.34	68.4	6.36	45.71	69.34	9.79	68.58	15.12	68.77	35.66	69.2	47.97	69.39
4180.449		15.14	67.68	32.2	68.25	43.69	68.41	67.37	6.36	45.71	68.49	9.79	67.5	15.12	67.68	35.66	68.32	47.97	68.5
4071.257		15.14	67.29	32.2	67.59	43.69	67.77	66.95	6.36	45.71	67.81	9.79	67.14	15.12	67.29	35.66	67.64	47.97	67.85
3897.472		15.14	66.9	32.2	67.28	43.69	67.58	66.57	6.36	45.71	67.63	9.79	66.72	15.12	66.9	35.66	67.37	47.97	67.69
3806.132		15.14	66.66	32.2	67.16	43.69	67.51	66.31	6.36	45.71	67.57	9.79	66.48	15.12	66.67	35.66	67.26	47.97	67.63
3736.303		15.14	66.53	32.2	67.09	43.69	67.45	66.07	6.36	45.71	67.52	9.79	66.29	15.12	66.54	35.66	67.19	47.97	67.59
3712.739		15.14	66.42	32.2	66.85	43.69	67.14	66.02	6.36	45.71	67.19	9.79	66.22	15.12	66.43	35.66	66.92	47.97	67.25
3691.656																			
3669.048	Carling Road	14.08	66.3	30.15	66.5	40.94	66.43	65.96	6	42.84	66.45	9.36	66.14	14.4	66.31	34.03	66.49	45.74	66.5
3649.255		14.08	66.3	30.15	66.56	40.94	66.65	65.95	6	42.84	66.65	9.36	66.13	14.4	66.31	34.03	66.59	45.74	66.66
3627.228		14.08	66.3	30.15	66.61	40.94	66.72	65.93	6	42.84	66.74	9.36	66.11	14.4	66.31	34.03	66.65	45.74	66.77
3469.421		14.08	66.16	30.15	66.46	40.94	66.55	65.81	6	42.84	66.57	9.36	65.98	14.4	66.17	34.03	66.48	45.74	66.59
3328.888		14.08	66.01	30.15	66.25	40.94	66.41	65.69	6	42.84	66.43	9.36	65.84	14.4	66.02	34.03	66.33	45.74	66.46
3227.732		14.08	65.22	30.15	65.61	40.94	65.86	64.99	6	42.84	65.9	9.36	65.12	14.4	65.23	34.03	65.71	45.74	65.96
3098.158		14.08	64.69	30.15	65.21	40.94	65.47	64.18	6	42.84	65.51	9.36	64.44	14.4	64.71	34.03	65.32	45.74	65.58
3020.422		14.08	64.52	30.15	64.98	40.94	65.25	64.04	6	42.84	65.29	9.36	64.3	14.4	64.54	34.03	65.1	45.74	65.37
2981.379		14.08	64.47	30.15	64.97	40.94	65.26	63.98	6	42.84	65.31	9.36	64.24	14.4	64.5	34.03	65.09	45.74	65.39
2964.234		13.02	64.44	28.11	64.79	38.19	64.95	63.97	5.63	39.97	64.98	8.93	64.23	13.68	64.46	32.41	64.86	43.52	65.35
2958.099																			
2951.912	Sandhill Road	13.02	64.42	28.11	64.7	38.19	64.77	63.97	5.63	39.97	64.77	8.93	64.22	13.68	64.44	32.41	64.74	43.52	64.78
2920.728		13.02	64.41	28.11	64.75	38.19	64.9	63.95	5.63	39.97	64.92	8.93	64.2	13.68	64.44	32.41	64.82	43.52	64.96
2817.591		13.02	64.21	28.11	64.51	38.19	64.66	63.75	5.63	39.97	64.68	8.93	63.99	13.68	64.24	32.41	64.58	43.52	64.73
2743.763		13.02	64.04	28.11	64.33	38.19	64.46	63.56	5.63	39.97	64.48	8.93	63.81	13.68	64.07	32.41	64.39	43.52	64.53
2564.664		13.02	63.73	28.11	64.09	38.19	64.24	63.26	5.63	39.97	64.27	8.93	63.51	13.68	63.77	32.41	64.16	43.52	64.32
2444.164		13.02	63.52	28.11	63.92	38.19	64.06	63.06	5.63	39.97	64.08	8.93	63.31	13.68	63.57	32.41	63.99	43.52	64.13
2266.167		11.96	63.21	26.07	63.57	35.44	63.74	62.82	5.26	37.09	63.77	8.5	63.06	12.96	63.24	30.78	63.66	41.29	63.83
2205.163		11.96	63.13	26.07	63.45	35.44	63.59	62.76	5.26	37.09	63.61	8.5	62.99	12.96	63.16	30.78	63.52	41.29	63.67
2070.458		11.96	62.89	26.07	63.25	35.44	63.4	62.51	5.26	37.09	63.43	8.5	62.75	12.96	62.93	30.78	63.33	41.29	63.49
1958.025		11.96	62.69	26.07	63.01	35.44	63.16	62.32	5.26	37.09	63.18	8.5	62.59	12.96	62.72	30.78	63.09	41.29	63.23
1816.877		11.96	62.42	26.07	62.64	35.44	62.76	62.02	5.26	37.09	62.78	8.5	62.32	12.96	62.45	30.78	62.71	41.29	62.82
1752.297		11.96	62.33	26.07	62.4	35.44	62.47	61.9	5.26	37.09	62.49	8.5	62.2	12.96	62.36	30.78	62.43	41.29	62.53
1585.543		11.96	61.65	26.07	61.96	35.44	62.12	61.28	5.26	37.09	62.15	8.5	61.49	12.96	61.71	30.78	62.06	41.29	62.22
1491.815		10.9	61.42	24.03	61.79	32.69	61.96	61.05	4.9	34.22	61.98	8.07	61.28	12.23	61.47	29.15	61.89	39.05	62.06
1383.557		10.9	61.21	24.03	61.59	32.69	61.76	60.85	4.9	34.22	61.78	8.07	61.08	12.23	61.26	29.15	61.69	39.05	61.86
1269.687		10.9	60.95	24.03	61.33	32.69	61.46	60.6	4.9	34.22	61.48	8.07	60.82	12.23	61	29.15	61.42	39.05	61.55
1057.547		10.9	60.42	24.03	60.93	32.69	61.22	60.01	4.9	34.22	61.25	8.07	60.26	12.23	60.5	29.15	61.15	39.05	61.37
920.3455		10.9	60.14	24.03	60.9	32.69	61.2	59.77	4.9	34.22	61.23	8.07	60	12.23	60.24	29.15	61.13	39.05	61.35
673.4133		9.84	59.95	21.99	60.86	29.93	61.18	59.65	4.53	31.35	61.21	7.64	59.82	11.51	60.05	27.53	61.11	36.83	61.32
526.7829		9.84	59.91	21.99	60.85	29.93	61.16	59.62	4.53	31.35	61.19	7.64	59.78	11.51	60.01	27.53	61.09	36.83	61.32
517.7993		9.84	59.87	21.99	60.85	29.93	61.16	59.61	4.53	31.35	61.19	7.64	59.75	11.51	59.95	27.53	61.09	36.83	61.32
507.9618																			
497.982	Malibar Road	9.84	59.78	21.99	60.25	29.93	60.52	59.59	4.53	31.35	60.57	7.64	59.7	11.51	59.84	27.53	60.44	36.83	60.75
482.8587		9.84	59.81	21.99	60.25	29.93	60.52	59.6	4.53	31.35	60.57	7.64	59.72	11.51	59.87	27.53	60.44	36.83	60.75
420.5432		9.84	59.76	21.99	60.2	29.93	60.49	59.58	4.53	31.35	60.54	7.64	59.68	11.51	59.82	27.53	60.4	36.83	60.73
381.5255		9.84	59.72	21.99	60.16	29.93	60.44	59.56	4.53	31.35	60.49	7.64	59.65	11.51	59.78	27.53	60.35	36.83	60.68
369.3561		9.84	59.61	21.99	59.86	29.93	60.05	59.53	4.53	31.35	60.09	7.64	59.57	11.51	59.64	27.53	59.99	36.83	60.24
357.438																			
343.1997	Shirley Road	9.84	59.58	21.99	59.74	29.93	59.81	59.53	4.53	31.35	59.82	7.64	59.56	11.51	59.61	27.53	59.8	36.83	59.82
310.2693		9.84	59.59	21.99	59.8	29.93	59.94	59.53	4.53	31.35	59.97	7.64	59.56	11.51	59.61	27.53	59.9	36.83	60.06
129.4642		9.84	59.54	21.99	59.63	29.93	59.72	59.52	4.53	31.35	59.74	7.64	59.53	11.51	59.54	27.53	59.69	36.83	59.81
44.72172		9.84	59.51	21.99	59.51	29.93	59.51	59.51	4.53	31.35	59.51	7.64	59.51	11.51	59.51	27.53	59.51	36.83	59.52

Watt's Creek **Hydraulic Model Results - Interim Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
10234.89		0.49	89.54	1	89.67	1.29	89.73	0.22	89.41	1.14	89.7	0.32	89.47	0.49	89.54	1.19	89.71	1.82	89.82
10170.75		0.49	89.29	1	89.45	1.29	89.51	0.22	89.18	1.14	89.48	0.32	89.24	0.49	89.29	1.19	89.49	1.82	89.61
10089.35		0.49	89	1	89.15	1.29	89.21	0.22	88.88	1.14	89.18	0.32	88.93	0.49	89	1.19	89.19	1.82	89.31
10047.1		0.49	88.8	1	88.89	1.29	88.93	0.22	88.72	1.14	88.91	0.32	88.76	0.49	88.8	1.19	88.92	1.82	88.99
10018.26		0.49	87.91	1	88.01	1.29	88.06	0.22	87.81	1.14	88.03	0.32	87.85	0.49	87.91	1.19	88.04	1.82	88.13
9980.843		0.49	86.53	1	86.66	1.29	86.71	0.22	86.42	1.14	86.69	0.32	86.47	0.49	86.53	1.19	86.69	1.82	86.79
9957.698		0.49	86.34	1	86.39	1.29	86.42	0.22	86.25	1.14	86.4	0.32	86.29	0.49	86.34	1.19	86.41	1.82	86.46
9907.851		0.49	86.01	1	86.07	1.29	86.09	0.22	85.94	1.14	86.08	0.32	85.98	0.49	86.01	1.19	86.08	1.82	86.14
9854.606		0.49	85.73	1	85.83	1.29	85.88	0.22	85.62	1.14	85.86	0.32	85.66	0.49	85.72	1.19	85.86	1.82	85.95
9806.144		0.49	85.25	1	85.36	1.29	85.4	0.22	85.15	1.14	85.38	0.32	85.19	0.49	85.25	1.19	85.39	1.82	85.47
9795.745		0.49	84.54	1	84.69	1.29	84.84	0.22	84.46	1.14	84.73	0.32	84.49	0.49	84.54	1.19	84.77	1.82	85.1
9793.271		0.49	84.4	1	84.66	1.29	84.79	0.22	84.21	1.14	84.73	0.32	84.29	0.49	84.4	1.19	84.75	1.82	85.01
9781.939	CNR Railway Culvert																		
9771.594		0.49	82.77	1	82.98	1.29	83.09	0.22	82.62	1.14	83.05	0.32	82.68	0.49	82.77	1.19	83.04	1.82	83.31
9767.958		0.49	82.78	1	83	1.29	83.12	0.22	82.63	1.14	83.07	0.32	82.69	0.49	82.78	1.19	83.07	1.82	83.33
9759.191	Station Rd Culvert																		
9746.919		0.61	82.72	1.34	82.8	1.77	82.8	0.3	82.61	1.68	82.81	0.4	82.65	0.61	82.72	1.56	82.81	2.28	82.78
9743.627		0.61	82.72	1.34	82.86	1.77	82.92	0.3	82.6	1.68	82.92	0.4	82.65	0.61	82.73	1.56	82.89	2.28	82.97
9657.568		0.72	82.11	1.68	82.25	2.25	82.3	0.37	82.01	2.23	82.3	0.48	82.05	0.74	82.12	1.92	82.27	2.74	82.34
9573.048		0.72	81.02	1.68	81.21	2.25	81.23	0.37	80.87	2.23	81.22	0.48	80.91	0.74	81.03	1.92	81.23	2.74	81.24
9442.479		0.84	79.94	2.03	80.14	2.73	80.59	0.44	79.83	2.77	80.67	0.55	79.86	0.87	79.94	2.29	80.24	3.19	80.88
9363.261		0.95	79.54	2.37	80.12	3.21	80.58	0.51	79.36	3.31	80.66	0.63	79.4	1	79.56	2.66	80.26	3.65	80.87
9339.857		0.95	79.52	2.37	80.12	3.21	80.58	0.51	79.29	3.31	80.66	0.63	79.35	1	79.54	2.66	80.26	3.65	80.87
9338.062		0.95	79.52	2.37	80.11	3.21	80.57	0.51	79.29	3.31	80.64	0.63	79.35	1	79.54	2.66	80.25	3.65	80.85
9327.433	Nordion K5 Culvert																		
9318.861		0.95	79.47	2.37	79.73	3.21	79.87	0.51	79.28	3.31	79.9	0.63	79.33	1	79.48	2.66	79.77	3.65	79.94
9315.228		0.95	79.47	2.37	79.74	3.21	79.89	0.51	79.28	3.31	79.91	0.63	79.33	1	79.48	2.66	79.79	3.65	79.96
9252.569		1.07	79.41	2.71	79.66	3.69	79.8	0.59	79.22	3.86	79.83	0.71	79.26	1.13	79.42	3.02	79.7	4.11	79.88
9176.041		1.07	79.18	2.71	79.42	3.69	79.64	0.59	79.01	3.86	79.69	0.71	79.06	1.13	79.19	3.02	79.46	4.11	79.76
9169.896		1.07	78.98	2.71	79.33	3.69	79.61	0.59	78.88	3.86	79.66	0.71	78.89	1.13	78.99	3.02	79.39	4.11	79.74
9154.916		1.07	79.04	2.71	79.37	3.69	79.63	0.59	78.92	3.86	79.68	0.71	78.95	1.13	79.05	3.02	79.42	4.11	79.76
9151.77		1.07	79.01	2.71	79.33	3.69	79.6	0.59	78.91	3.86	79.65	0.71	78.93	1.13	79.02	3.02	79.39	4.11	79.74
9131.887		1.07	78.95	2.71	79.32	3.69	79.6	0.59	78.8	3.86	79.65	0.71	78.84	1.13	78.97	3.02	79.38	4.11	79.73
9096.603		1.07	78.86	2.71	79.24	3.69	79.55	0.59	78.68	3.86	79.61	0.71	78.72	1.13	78.88	3.02	79.3	4.11	79.7
9094.472		1.07	78.68	2.71	79	3.69	79.43	0.59	78.53	3.86	79.49	0.71	78.58	1.13	78.69	3.02	79.04	4.11	79.58
9086.378	March Road CSP																		
9040.378		1.07	78.51	2.71	79.11	3.69	79.47	0.59	78.28	3.86	79.53	0.71	78.37	1.13	78.55	3.02	79.2	4.11	79.59
8991.378		1.73	78.38	4.4	78.41	5.99	78.67	0.86	78.24	6.25	78.71	1.18	78.31	1.88	78.39	4.8	78.48	6.53	78.75
8985.021		1.73	78.42	4.4	78.72	5.99	78.82	0.86	78.25	6.25	78.84	1.18	78.32	1.88	78.44	4.8	78.75	6.53	78.86
8942.456		1.73	78.3	4.4	78.61	5.99	78.74	0.86	78.14	6.25	78.76	1.18	78.21	1.88	78.32	4.8	78.65	6.53	78.77
8884.583		1.73	78.02	4.4	78.42	5.99	78.54	0.86	77.81	6.25	78.56	1.18	77.91	1.88	78.05	4.8	78.45	6.53	78.57
8831.092		1.73	77.8	4.4	78.27	5.99	78.38	0.86	77.58	6.25	78.39	1.18	77.68	1.88	77.83	4.8	78.3	6.53	78.41
8796.271		1.73	77.56	4.4	78.24	5.99	78.33	0.86	77.31	6.25	78.35	1.18	77.41	1.88	77.6	4.8	78.27	6.53	78.36
8751.318		1.73	77.54	4.4	78.24	5.99	78.33	0.86	77.27	6.25	78.35	1.18	77.39	1.88	77.59	4.8	78.27	6.53	78.36
8748.076		1.73	77.54	4.4	78.23	5.99	78.33	0.86	77.27	6.25	78.35	1.18	77.39	1.88	77.58	4.8	78.26	6.53	78.36
8730.992	Legget Drive																		
8712.486		1.73	77.47	4.4	77.81	5.99	77.95	0.86	77.25	6.25	78.01	1.18	77.35	1.88	77.5	4.8	77.85	6.53	78.03
8703.631		2.39	77.42	6.09	77.74	8.28	77.87	1.12	77.22	8.64	77.88	1.66	77.32	2.63	77.45	6.59	77.77	8.95	77.9
8616.693		2.39	77.23	6.09	77.49	8.28	77.61	1.12	77.04	8.64	77.62	1.66	77.14	2.63	77.26	6.59	77.52	8.95	77.64
8531.291		2.39	76.73	6.09	77.1	8.28	77.24	1.12	76.57	8.64	77.26	1.66	76.63	2.63	76.76	6.59	77.13	8.95	77.27
8512.276		2.39	76.78	6.09	77.13	8.28	77.27	1.12	76.58	8.64	77.29	1.66	76.67	2.63	76.81	6.59	77.17	8.95	77.31
8510.656	Pedestrian Bridge - Farrar Road																		
8508.619		2.39	76.77	6.09	77.13	8.28	77.26	1.12	76.56	8.64	77.28	1.66	76.66	2.63	76.8	6.59	77.16	8.95	77.3
8470.617		2.39	76.47	6.09	76.78	8.28	76.93	1.12	76.28	8.64	76.95	1.66	76.36	2.63	76.5	6.59	76.84	8.95	76.96
8428.704		2.39	76.4	6.09	76.77	8.28	76.97	1.12	76.19	8.64	76.99	1.66	76.29	2.63	76.43	6.59	76.82	8.95	77.01
8329.198		2.39	76.25	6.09	76.63	8.28	76.85	1.12	76.02	8.64	76.87	1.66	76.14	2.63	76.29	6.59	76.68	8.95	76.88
8236.271		3.06	76.06	7.78	76.44	10.58	76.74	1.39	75.83	11.03	76.76	2.13	75.95	3.38	76.1	8.37	76.51	11.37	76.78
8115.263		3.06	75.5	7.78	76.17	10.58	76.7	1.39	75.32	11.03	76.73	2.13	75.42	3.38	75.53	8.37	76.34	11.37	76.75

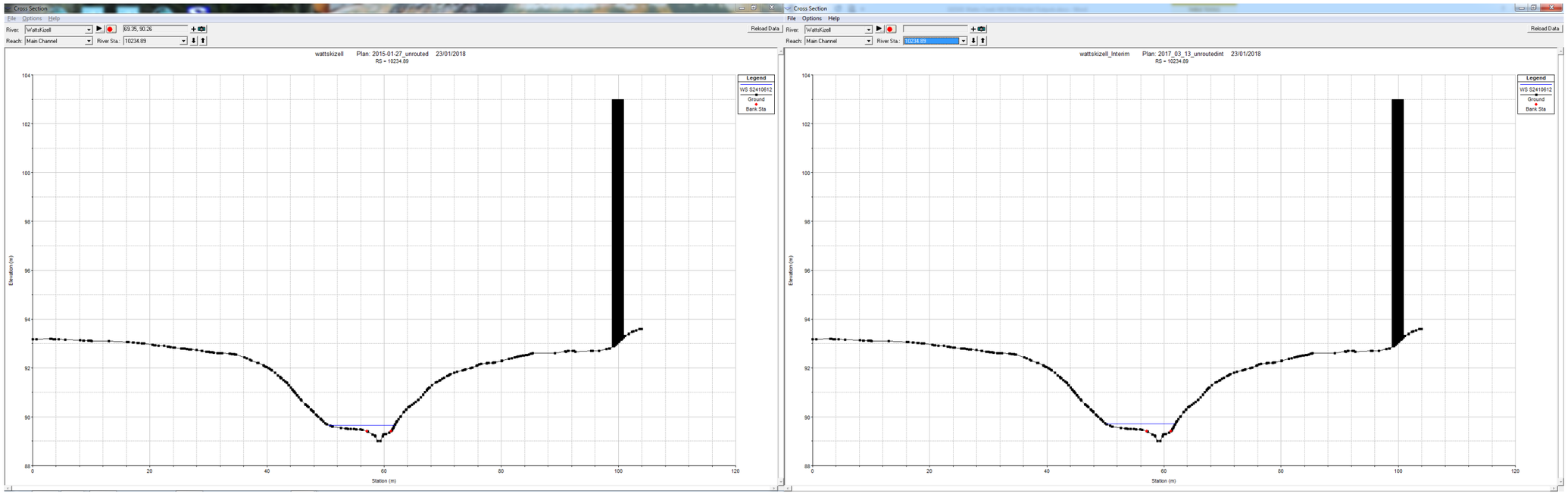
Watt's Creek **Hydraulic Model Results - Interim Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
8003.485		3.06	75.35	7.78	76.17	10.58	76.7	1.39	75.11	11.03	76.73	2.13	75.23	3.38	75.39	8.37	76.34	11.37	76.74
7903.683		3.06	75.2	7.78	76.15	10.58	76.7	1.39	74.91	11.03	76.72	2.13	75.06	3.38	75.25	8.37	76.33	11.37	76.74
7847.556		3.72	75.12	9.47	76.15	12.88	76.7	1.66	74.8	13.42	76.72	2.61	74.96	4.13	75.17	10.15	76.33	13.79	76.74
7747.399		3.72	75	9.47	76.13	12.88	76.69	1.66	74.63	13.42	76.72	2.61	74.81	4.13	75.06	10.15	76.32	13.79	76.74
7691.759		3.72	74.95	9.47	76.13	12.88	76.69	1.66	74.56	13.42	76.71	2.61	74.75	4.13	75.02	10.15	76.32	13.79	76.73
7640.349		3.72	74.92	9.47	76.13	12.88	76.69	1.66	74.52	13.42	76.71	2.61	74.72	4.13	74.99	10.15	76.32	13.79	76.73
7596.24		3.72	74.9	9.47	76.12	12.88	76.68	1.66	74.5	13.42	76.7	2.61	74.7	4.13	74.98	10.15	76.31	13.79	76.72
7588.42		3.72	74.86	9.47	76.05	12.88	76.68	1.66	74.48	13.42	76.7	2.61	74.67	4.13	74.93	10.15	76.24	13.79	76.72
7573.092	Marsh Sparrow Private																		
7559.345		3.72	74.46	9.47	74.99	12.88	75.19	1.66	74.09	13.42	75.2	2.61	74.27	4.13	74.49	10.15	75.02	13.79	75.21
7547.932		3.72	74.48	9.47	75.07	12.88	75.2	1.66	74.09	13.42	75.22	2.61	74.28	4.13	74.51	10.15	75.11	13.79	75.23
7489.235		3.72	74.45	9.47	75.06	12.88	75.2	1.66	74.05	13.42	75.21	2.61	74.25	4.13	74.49	10.15	75.1	13.79	75.22
7438.877		4.38	74.41	11.17	75.02	15.17	75.14	1.92	74	15.81	75.15	3.08	74.21	4.89	74.45	11.93	75.05	16.21	75.16
7386.879		4.38	74.38	11.17	74.99	15.17	75.1	1.92	73.96	15.81	75.11	3.08	74.17	4.89	74.41	11.93	75.03	16.21	75.12
7324.579		4.38	74.33	11.17	74.95	15.17	75.04	1.92	73.87	15.81	75.05	3.08	74.1	4.89	74.36	11.93	74.98	16.21	75.06
7280.889		4.38	74.32	11.17	74.94	15.17	75.03	1.92	73.82	15.81	75.03	3.08	74.08	4.89	74.34	11.93	74.97	16.21	75.04
7276.354		4.38	74.3	11.17	74.94	15.17	75.03	1.92	73.82	15.81	75.03	3.08	74.07	4.89	74.32	11.93	74.97	16.21	75.04
7259.491	Legget Drive																		
7242.107		4.38	74.06	11.17	74.47	15.17	74.87	1.92	73.74	15.81	74.89	3.08	73.93	4.89	74.01	11.93	74.72	16.21	74.95
7229.969		4.38	74.05	11.17	74.48	15.17	74.87	1.92	73.74	15.81	74.89	3.08	73.93	4.89	74	11.93	74.72	16.21	74.95
7161.913		4.38	73.99	11.17	74.47	15.17	74.86	1.92	73.67	15.81	74.89	3.08	73.84	4.89	74.02	11.93	74.71	16.21	74.95
7125.073		4.38	73.93	11.17	74.47	15.17	74.86	1.92	73.62	15.81	74.89	3.08	73.78	4.89	73.98	11.93	74.71	16.21	74.95
7058.454		4.38	73.71	11.17	74.43	15.17	74.85	1.92	73.44	15.81	74.87	3.08	73.59	4.89	73.76	11.93	74.7	16.21	74.94
7025.94		4.38	73.52	11.17	74.38	15.17	74.84	1.92	73.1	15.81	74.87	3.08	73.2	4.89	73.57	11.93	74.69	16.21	74.93
7020.547		4.38	73.52	11.17	74.25	15.17	74.84	1.92	73.05	15.81	74.87	3.08	73.25	4.89	73.56	11.93	74.55	16.21	74.93
7000.502	Herzberg Road																		
6984.227		4.13	73.46	9.87	74.04	13.19	74.53	1.79	73.02	14.17	74.62	2.81	73.2	4.45	73.49	10.93	74.27	14.66	74.86
6974.809		4.13	73.49	9.87	74.14	13.19	74.53	1.79	73.02	14.17	74.62	2.81	73.21	4.45	73.52	10.93	74.27	14.66	74.86
6834.839		4.13	73.49	9.87	74.14	13.19	74.53	1.79	72.99	14.17	74.62	2.81	73.2	4.45	73.52	10.93	74.27	14.66	74.86
6705.311		4.13	73.49	9.87	74.14	13.19	74.53	1.79	72.99	14.17	74.62	2.81	73.2	4.45	73.52	10.93	74.27	14.66	74.86
6550.151		4.13	73.49	9.87	74.14	13.19	74.53	1.79	72.98	14.17	74.62	2.81	73.19	4.45	73.51	10.93	74.27	14.66	74.86
6542.144		4.13	73.48	9.87	74.1	13.19	74.53	1.79	72.97	14.17	74.62	2.81	73.19	4.45	73.5	10.93	74.23	14.66	74.86
6522.792	Carling Avenue																		
6500.704		4.84	73.42	11.08	73.79	14.86	74.41	2.08	72.96	15.95	74.61	3.24	73.16	5.11	73.44	12.34	73.84	16.53	74.86
6486.45		4.84	73.43	11.08	73.82	14.86	74.41	2.08	72.96	15.95	74.61	3.24	73.17	5.11	73.45	12.34	73.87	16.53	74.86
6384.713		5.56	73.42	12.29	73.81	16.53	74.41	2.37	72.94	17.72	74.61	3.66	73.15	5.77	73.44	13.74	73.87	18.4	74.85
6243.84		5.56	73.38	12.29	73.77	16.53	74.4	2.37	72.86	17.72	74.6	3.66	73.08	5.77	73.4	13.74	73.83	18.4	74.85
6137.62		6.28	73.27	13.5	73.66	18.2	74.39	2.66	72.7	19.49	74.59	4.09	72.94	6.43	73.29	15.15	73.73	20.27	74.84
6135.225		6.28	73.18	13.5	73.57	18.2	74.38	2.66	72.68	19.49	74.59	4.09	72.9	6.43	73.2	15.15	73.7	20.27	74.84
6129.747	Carling Avenue (K2)																		
6126.151		6.28	72.9	13.5	73.45	18.2	74.38	2.66	72.63	19.49	74.59	4.09	72.78	6.43	72.9	15.15	73.7	20.27	74.84
6104.633		6.28	72.91	13.5	73.37	18.2	74.36	2.66	72.62	19.49	74.58	4.09	72.77	6.43	72.91	15.15	73.6	20.27	74.84
5934.876		7	72.77	14.72	73.41	19.87	74.37	2.95	72.46	21.26	74.58	4.51	72.6	7.09	72.77	16.55	73.64	22.15	74.84
5846.72		7	72.6	14.72	73.35	19.87	74.36	2.95	72.32	21.26	74.58	4.51	72.45	7.09	72.6	16.55	73.61	22.15	74.84
5691.871		7.71	72.53	15.93	73.36	21.54	74.36	3.24	72.29	23.04	74.58	4.94	72.39	7.75	72.53	17.96	73.61	24.02	74.83
5574.705		15.33	72.49	32.21	73.35	44.22	74.36	6.59	72.23	46.46	74.57	9.69	72.34	14.95	72.48	35.39	73.61	47.82	74.83
5432.364		15.57	72.35	32.87	73.32	45.1	74.35	6.66	72.04	47.41	74.56	9.91	72.18	15.31	72.34	36.32	73.58	49.05	74.82
5258.586		15.57	72.12	32.87	73.28	45.1	74.34	6.66	71.7	47.41	74.55	9.91	71.84	15.31	72.12	36.32	73.56	49.05	74.82
4958.865		15.17	72.04	32.28	73.27	43.73	74.33	6.39	71.47	45.75	74.55	9.83	71.68	15.16	72.04	35.79	73.55	48.06	74.81
4811.161		15.17	72	32.28	73.26	43.73	74.33	6.39	71.35	45.75	74.55	9.83	71.6	15.16	72	35.79	73.54	48.06	74.81
4746.21		15.17	71.97	32.28	73.24	43.73	74.32	6.39	71.31	45.75	74.54	9.83	71.57	15.16	71.97	35.79	73.52	48.06	74.8
4739.756		15.17	71.89	32.28	73.08	43.73	74.15	6.39	71.29	45.75	74.37	9.83	71.52	15.16	71.89	35.79	73.36	48.06	74.64
4717.456	Canadian National Railway (K4)																		
4696.874		15.17	71.31	32.28	71.52	43.73	71.66	6.39	71.14	45.75	71.71	9.83	71.23	15.16	71.31	35.79	71.53	48.06	71.77
4677.806		15.17	71.21	32.28	71.69	43.73	71.97	6.39	70.98	45.75	72.02	9.83	71.11	15.16	71.21	35.79	71.78	48.06	72.08
4649.787		15.17	70.81	32.28	71.17	43.73	71.38	6.39	70.5	45.75	71.41	9.83	70.64	15.16	70.81	35.79	71.24	48.06	71.42
4623.083		15.17	70.66	32.28	71.11	43.73	71.38	6.39	70.37	45.75	71.42	9.83	70.48	15.16	70.66	35.79	71.19	48.06	71.45
4542.956		15.17	69.8	32.28	70.2	43.73	70.38	6.39	69.42	45.75	70.42	9.83	69.61	15.16	69.8	35.79	70.26	48.06	70.49

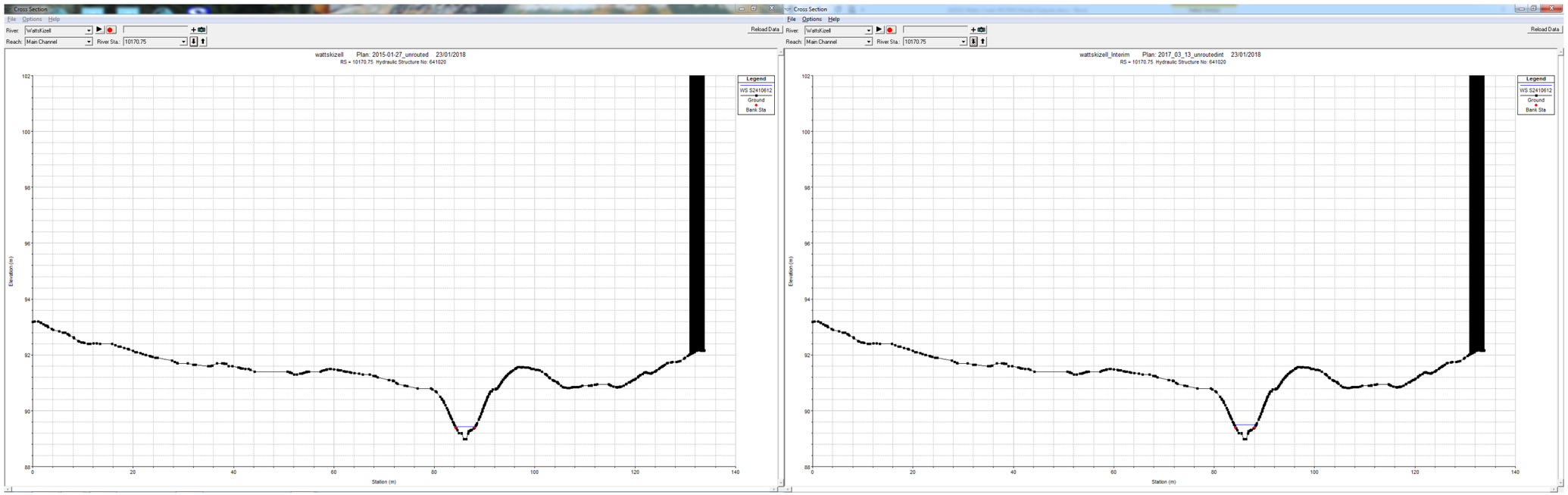
Watt's Creek **Hydraulic Model Results - Interim Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
4446.172		15.17	69.5	32.28	69.95	43.73	70.17	6.39	69.1	45.75	70.21	9.83	69.28	15.16	69.5	35.79	70.02	48.06	70.25
4323.325		15.17	68.89	32.28	69.22	43.73	69.38	6.39	68.56	45.75	69.4	9.83	68.72	15.16	68.89	35.79	69.27	48.06	69.43
4298.712		15.17	68.77	32.28	69.14	43.73	69.34	6.39	68.4	45.75	69.35	9.83	68.58	15.16	68.77	35.79	69.2	48.06	69.39
4180.449		15.17	67.68	32.28	68.25	43.73	68.42	6.39	67.37	45.75	68.49	9.83	67.51	15.16	67.68	35.79	68.32	48.06	68.5
4071.257		15.17	67.29	32.28	67.59	43.73	67.77	6.39	66.95	45.75	67.81	9.83	67.14	15.16	67.29	35.79	67.64	48.06	67.85
3897.472		15.17	66.9	32.28	67.29	43.73	67.58	6.39	66.57	45.75	67.63	9.83	66.73	15.16	66.9	35.79	67.37	48.06	67.69
3806.132		15.17	66.67	32.28	67.17	43.73	67.51	6.39	66.31	45.75	67.57	9.83	66.48	15.16	66.67	35.79	67.26	48.06	67.63
3736.303		15.17	66.53	32.28	67.09	43.73	67.45	6.39	66.07	45.75	67.52	9.83	66.29	15.16	66.54	35.79	67.2	48.06	67.59
3712.739		15.17	66.43	32.28	66.85	43.73	67.14	6.39	66.02	45.75	67.2	9.83	66.22	15.16	66.43	35.79	66.93	48.06	67.25
3691.656	Carling Road																		
3669.048		14.11	66.3	30.24	66.5	40.98	66.43	6.02	65.96	42.87	66.44	9.4	66.14	14.44	66.31	34.16	66.49	45.82	66.51
3649.255		14.11	66.3	30.24	66.56	40.98	66.65	6.02	65.95	42.87	66.65	9.4	66.13	14.44	66.31	34.16	66.59	45.82	66.66
3627.228		14.11	66.3	30.24	66.61	40.98	66.72	6.02	65.93	42.87	66.74	9.4	66.11	14.44	66.32	34.16	66.65	45.82	66.77
3469.421		14.11	66.16	30.24	66.47	40.98	66.55	6.02	65.81	42.87	66.57	9.4	65.98	14.44	66.17	34.16	66.48	45.82	66.59
3328.888		14.11	66.01	30.24	66.25	40.98	66.41	6.02	65.69	42.87	66.43	9.4	65.84	14.44	66.02	34.16	66.33	45.82	66.46
3227.732		14.11	65.22	30.24	65.61	40.98	65.86	6.02	65	42.87	65.9	9.4	65.12	14.44	65.23	34.16	65.71	45.82	65.97
3098.158		14.11	64.69	30.24	65.21	40.98	65.47	6.02	64.18	42.87	65.51	9.4	64.44	14.44	64.71	34.16	65.32	45.82	65.58
3020.422		14.11	64.52	30.24	64.98	40.98	65.25	6.02	64.04	42.87	65.29	9.4	64.3	14.44	64.54	34.16	65.1	45.82	65.37
2981.379		14.11	64.47	30.24	64.97	40.98	65.26	6.02	63.98	42.87	65.31	9.4	64.24	14.44	64.5	34.16	65.09	45.82	65.39
2964.234		13.05	64.44	28.19	64.79	38.22	64.95	5.65	63.98	40	64.98	8.97	64.23	13.72	64.46	32.52	64.86	43.58	65.36
2958.099	Sandhill Road																		
2951.912		13.05	64.42	28.19	64.7	38.22	64.77	5.65	63.97	40	64.77	8.97	64.22	13.72	64.44	32.52	64.74	43.58	64.78
2920.728		13.05	64.41	28.19	64.76	38.22	64.9	5.65	63.95	40	64.92	8.97	64.2	13.72	64.44	32.52	64.82	43.58	64.96
2817.591		13.05	64.22	28.19	64.51	38.22	64.66	5.65	63.75	40	64.68	8.97	63.99	13.72	64.24	32.52	64.58	43.58	64.73
2743.763		13.05	64.04	28.19	64.33	38.22	64.46	5.65	63.56	40	64.48	8.97	63.81	13.72	64.07	32.52	64.39	43.58	64.53
2564.664		13.05	63.73	28.19	64.09	38.22	64.25	5.65	63.26	40	64.27	8.97	63.51	13.72	63.77	32.52	64.17	43.58	64.32
2444.164		13.05	63.52	28.19	63.93	38.22	64.06	5.65	63.06	40	64.08	8.97	63.32	13.72	63.57	32.52	63.99	43.58	64.13
2266.167		11.99	63.21	26.14	63.57	35.47	63.74	5.28	62.82	37.12	63.77	8.53	63.06	13	63.24	30.88	63.66	41.35	63.83
2205.163		11.99	63.13	26.14	63.45	35.47	63.59	5.28	62.76	37.12	63.61	8.53	62.99	13	63.16	30.88	63.52	41.35	63.67
2070.458		11.99	62.89	26.14	63.25	35.47	63.4	5.28	62.52	37.12	63.43	8.53	62.75	13	62.93	30.88	63.33	41.35	63.49
1958.025		11.99	62.69	26.14	63.02	35.47	63.16	5.28	62.32	37.12	63.18	8.53	62.59	13	62.72	30.88	63.09	41.35	63.23
1816.877		11.99	62.42	26.14	62.65	35.47	62.76	5.28	62.02	37.12	62.78	8.53	62.32	13	62.45	30.88	62.71	41.35	62.82
1752.297		11.99	62.33	26.14	62.4	35.47	62.47	5.28	61.9	37.12	62.49	8.53	62.2	13	62.36	30.88	62.43	41.35	62.53
1585.543		11.99	61.65	26.14	61.96	35.47	62.12	5.28	61.29	37.12	62.15	8.53	61.5	13	61.71	30.88	62.06	41.35	62.22
1491.815		10.93	61.42	24.09	61.79	32.72	61.96	4.91	61.05	34.24	61.98	8.1	61.28	12.27	61.47	29.25	61.89	39.11	62.06
1383.557		10.93	61.21	24.09	61.59	32.72	61.76	4.91	60.85	34.24	61.78	8.1	61.08	12.27	61.26	29.25	61.69	39.11	61.86
1269.687		10.93	60.95	24.09	61.33	32.72	61.46	4.91	60.6	34.24	61.48	8.1	60.83	12.27	61.01	29.25	61.42	39.11	61.55
1057.547		10.93	60.42	24.09	60.94	32.72	61.22	4.91	60.01	34.24	61.26	8.1	60.26	12.27	60.5	29.25	61.15	39.11	61.37
920.3455		10.93	60.14	24.09	60.9	32.72	61.2	4.91	59.77	34.24	61.24	8.1	60	12.27	60.24	29.25	61.13	39.11	61.35
673.4133		9.87	59.95	22.05	60.87	29.97	61.18	4.54	59.65	31.36	61.21	7.67	59.82	11.55	60.05	27.61	61.11	36.87	61.33
526.7829		9.87	59.91	22.05	60.85	29.97	61.16	4.54	59.62	31.36	61.2	7.67	59.78	11.55	60.02	27.61	61.1	36.87	61.32
517.7993		9.87	59.87	22.05	60.85	29.97	61.16	4.54	59.61	31.36	61.2	7.67	59.76	11.55	59.96	27.61	61.1	36.87	61.32
507.9618	Malibar Road																		
497.982		9.87	59.78	22.05	60.25	29.97	60.52	4.54	59.59	31.36	60.57	7.67	59.71	11.55	59.84	27.61	60.44	36.87	60.75
482.8587		9.87	59.81	22.05	60.26	29.97	60.52	4.54	59.6	31.36	60.57	7.67	59.72	11.55	59.88	27.61	60.44	36.87	60.75
420.5432		9.87	59.76	22.05	60.21	29.97	60.49	4.54	59.58	31.36	60.54	7.67	59.68	11.55	59.82	27.61	60.4	36.87	60.73
381.5255		9.87	59.72	22.05	60.16	29.97	60.44	4.54	59.56	31.36	60.49	7.67	59.65	11.55	59.78	27.61	60.35	36.87	60.68
369.3561		9.87	59.61	22.05	59.87	29.97	60.05	4.54	59.53	31.36	60.09	7.67	59.57	11.55	59.64	27.61	59.99	36.87	60.25
357.438	Shirley Road																		
343.1997		9.87	59.58	22.05	59.75	29.97	59.81	4.54	59.53	31.36	59.82	7.67	59.56	11.55	59.61	27.61	59.8	36.87	59.82
310.2693		9.87	59.59	22.05	59.8	29.97	59.94	4.54	59.53	31.36	59.97	7.67	59.56	11.55	59.61	27.61	59.9	36.87	60.06
129.4642		9.87	59.54	22.05	59.63	29.97	59.72	4.54	59.52	31.36	59.74	7.67	59.53	11.55	59.54	27.61	59.69	36.87	59.81
44.72172		9.87	59.51	22.05	59.51	29.97	59.51	4.54	59.51	31.36	59.51	7.67	59.51	11.55	59.51	27.61	59.51	36.87	59.52

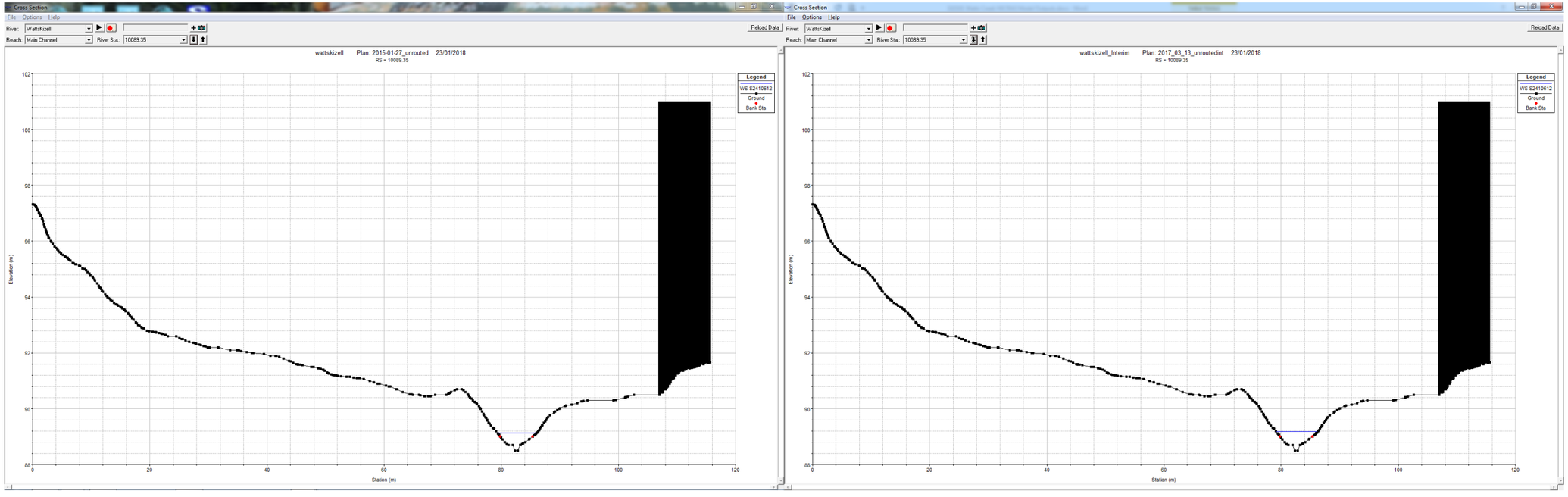
Comparison of Watts Creek /Kizell Drain HEC-RAS Model Outputs (Left side – Existing Conditions, Right side – Interim Conditions)



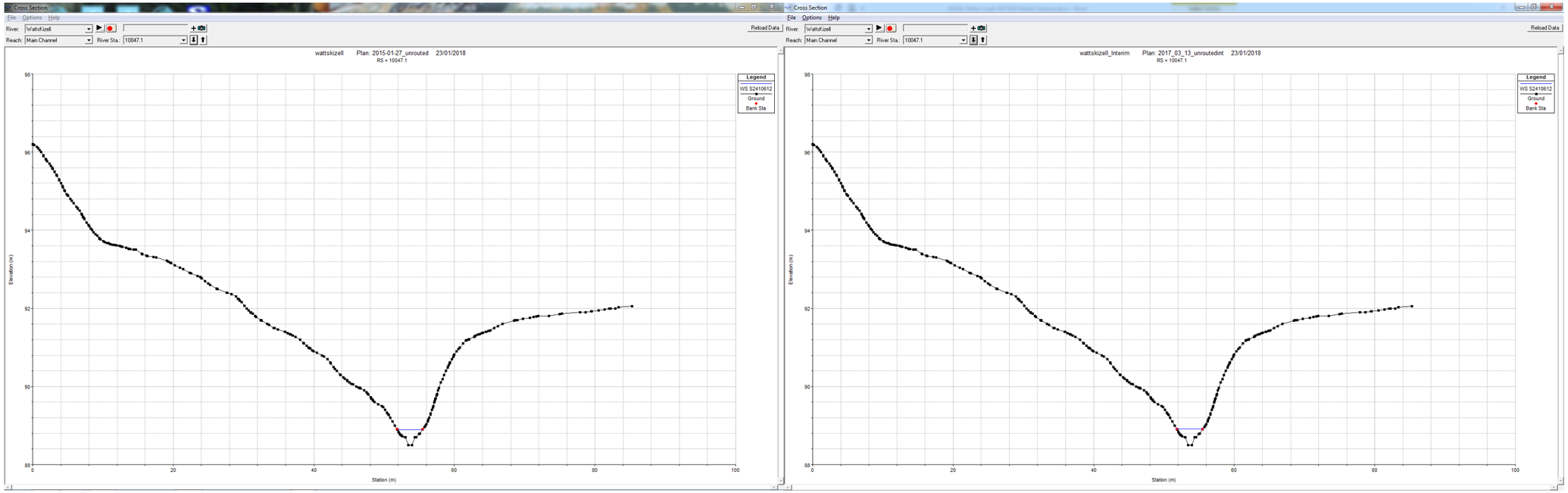
Cross-section 10234.89 (Upstream of CNR Railway Culvert) – 0.05 m increase in water level under interim conditions (right side)



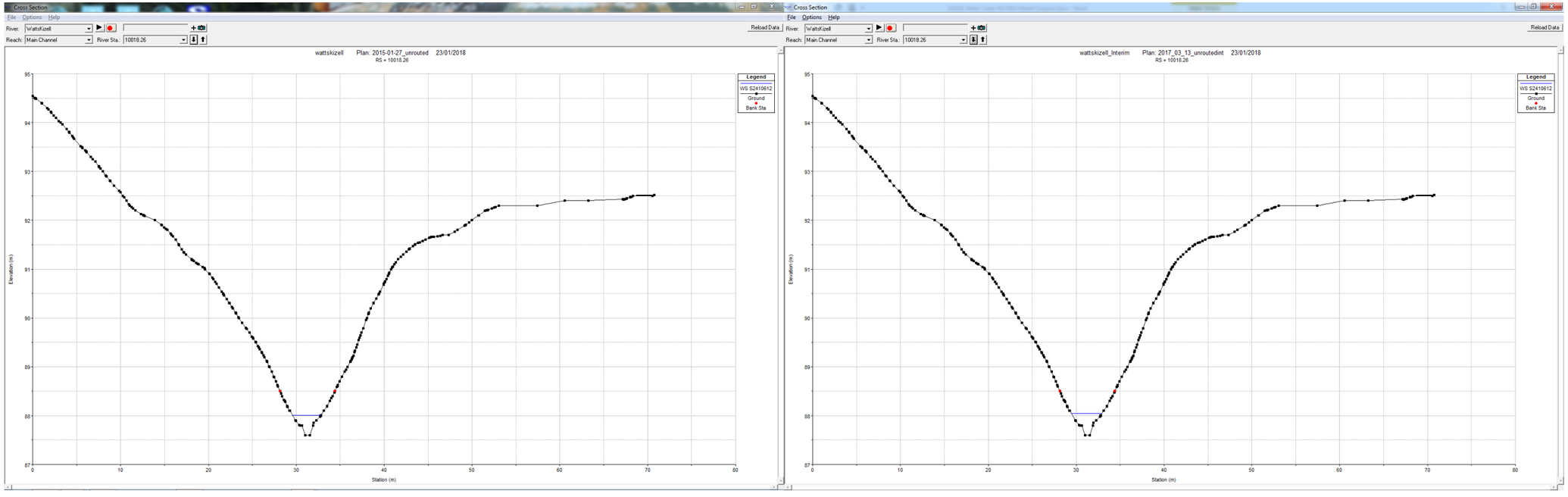
Cross-section 10170.75 (Upstream of CNR Railway Culvert) – 0.05 m increase in water level under interim conditions (right side)



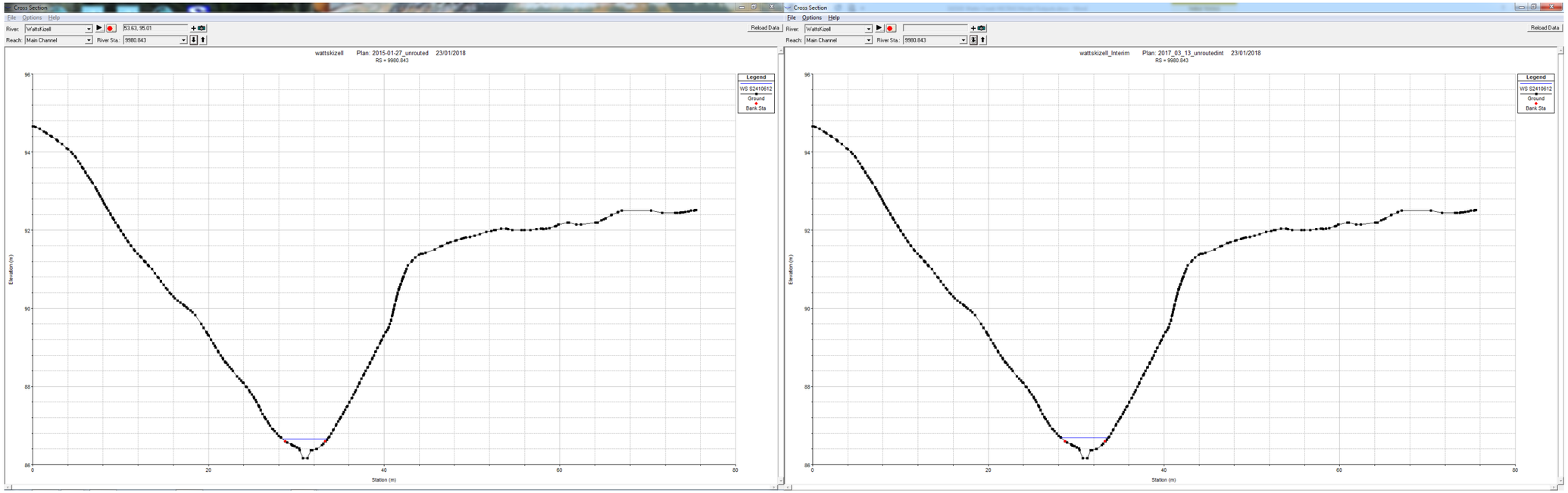
Cross-section 10089.35 (Upstream of CNR Railway Culvert) – 0.05 m increase in water level under interim conditions (right side)



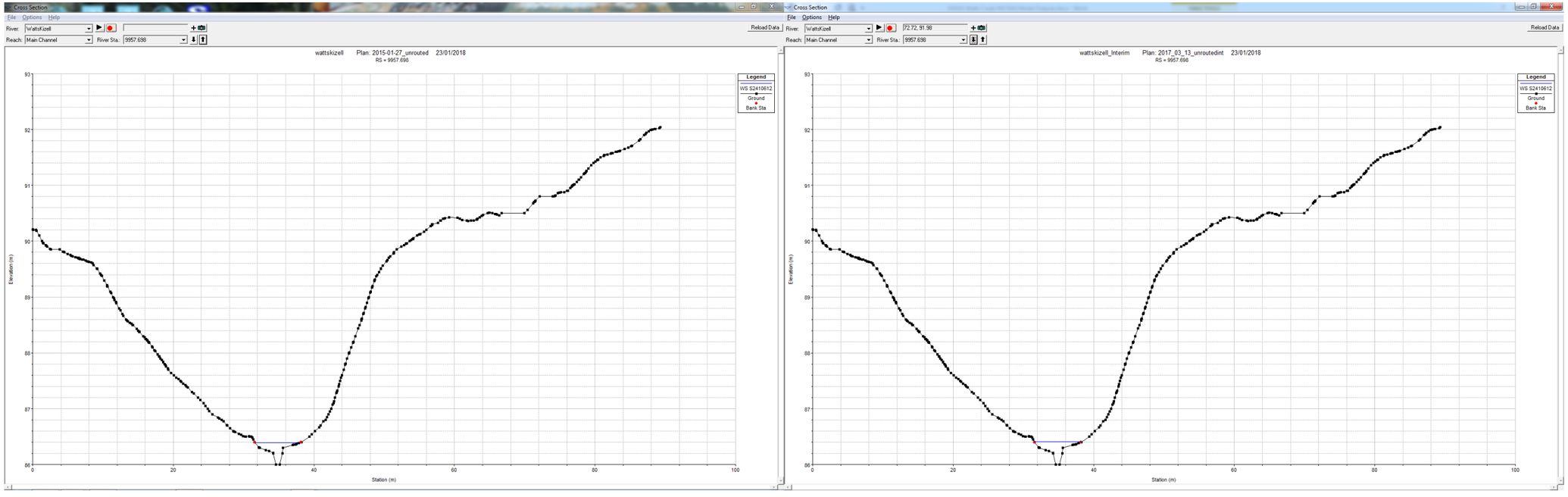
Cross-section 10047.1 (Upstream of CNR Railway Culvert) – 0.03 m increase in water level under interim conditions (right side)



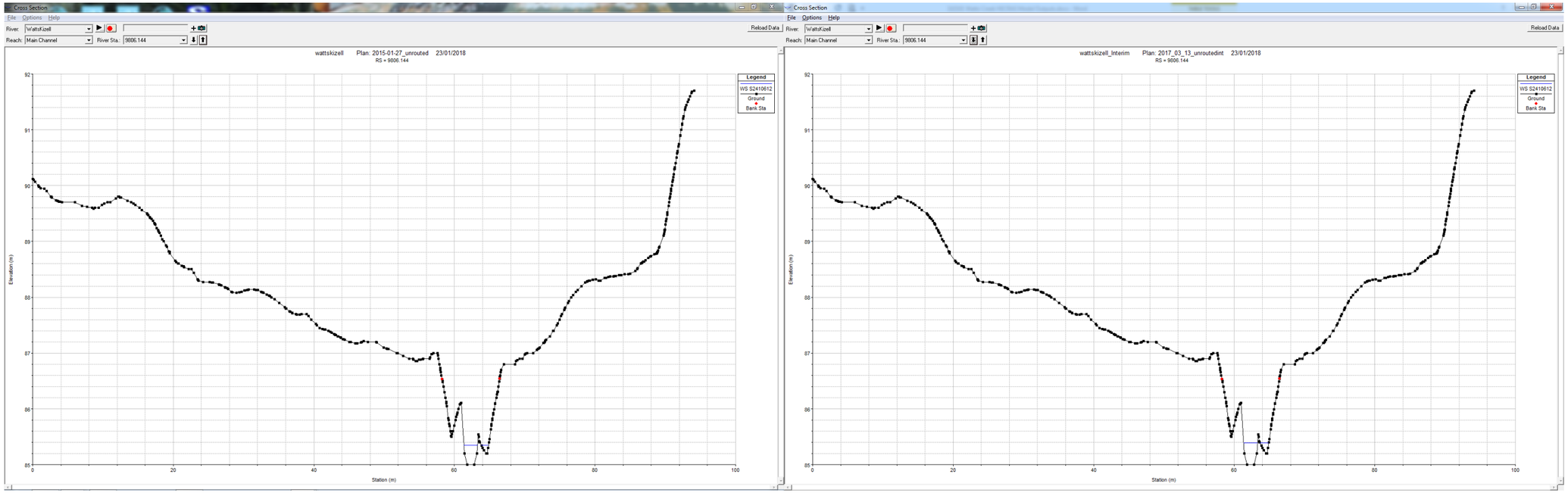
Cross-section 10018.26 (Upstream of CNR Railway Culvert) – 0.03 m increase in water level under interim conditions (right side)



Cross-section 9980.843 (Upstream of CNR Railway Culvert) – 0.04 m increase in water level under interim conditions (right side)

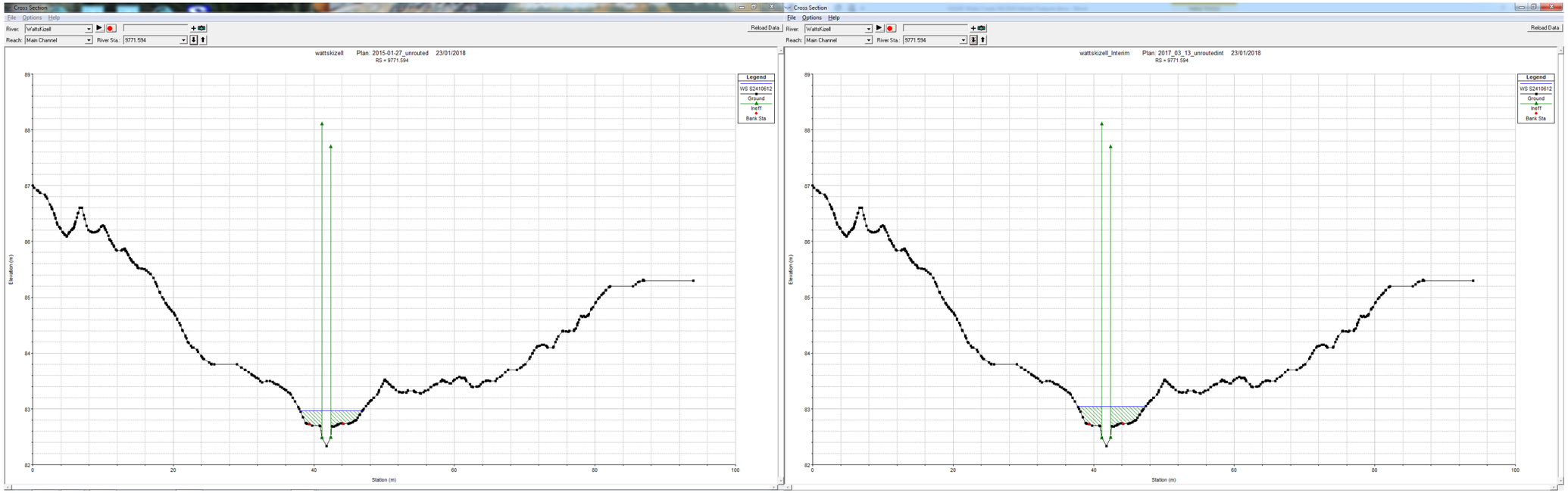


Cross-section 9854.606 (Upstream of CNR Railway Culvert) – 0.03 m increase in water level under interim conditions (right side)

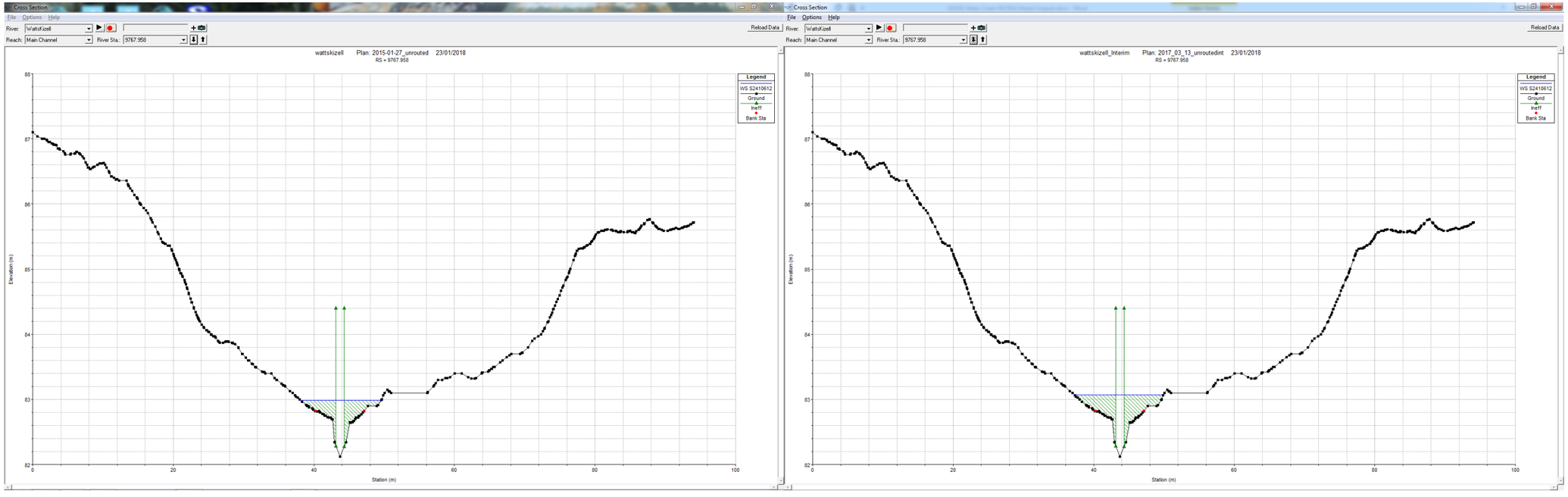


Cross-section 9806.144 (Upstream of CNR Railway Culvert) – 0.04 m increase in water level under interim conditions (right side)

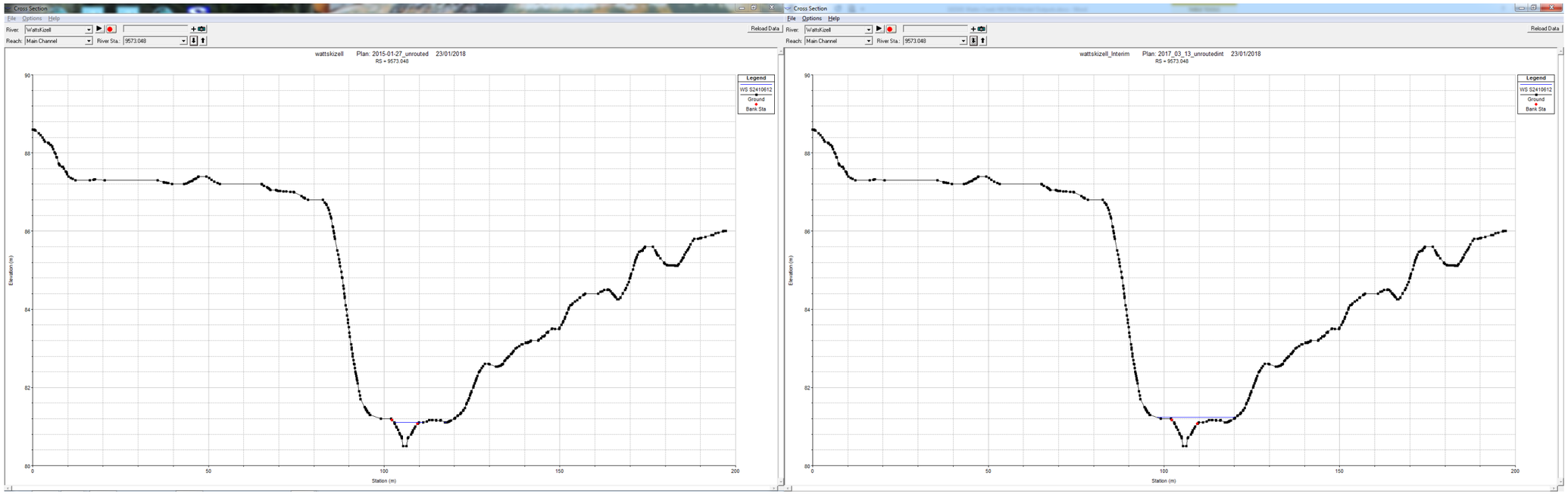
Cross-section 9795.745 (Upstream of CNR Railway Culvert) – 0.09 m increase in water level under interim conditions (right side)



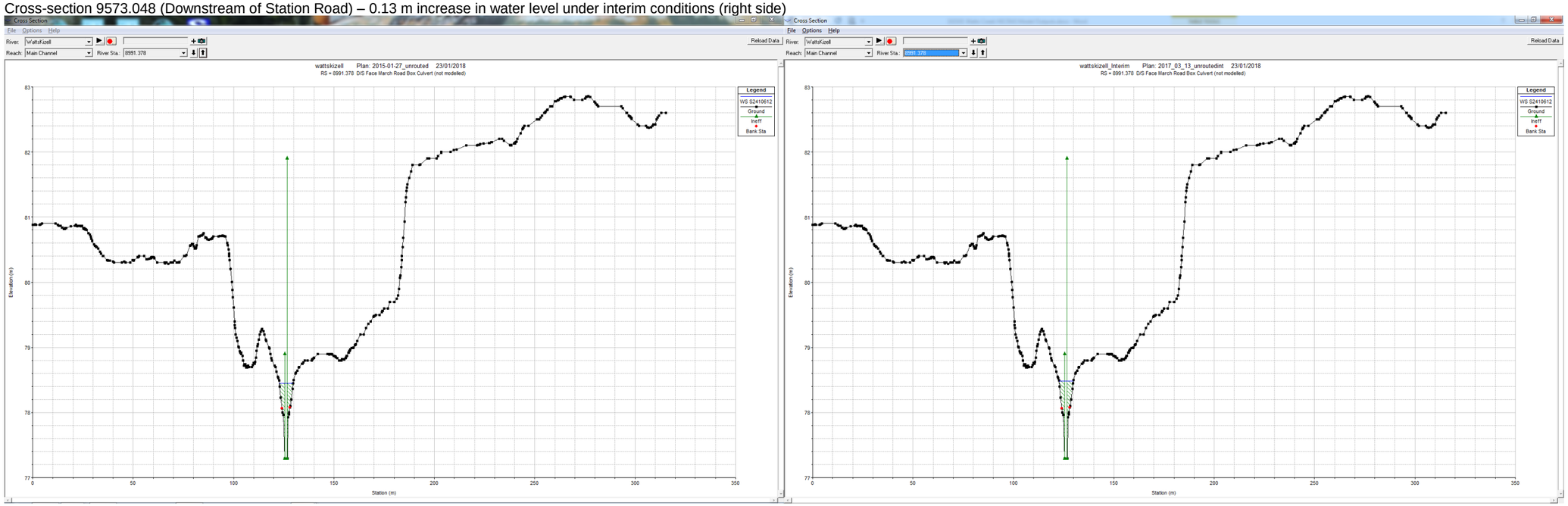
Cross-section 9771.594 (Upstream of Station Road) – 0.07 m increase in water level under interim conditions (right side)



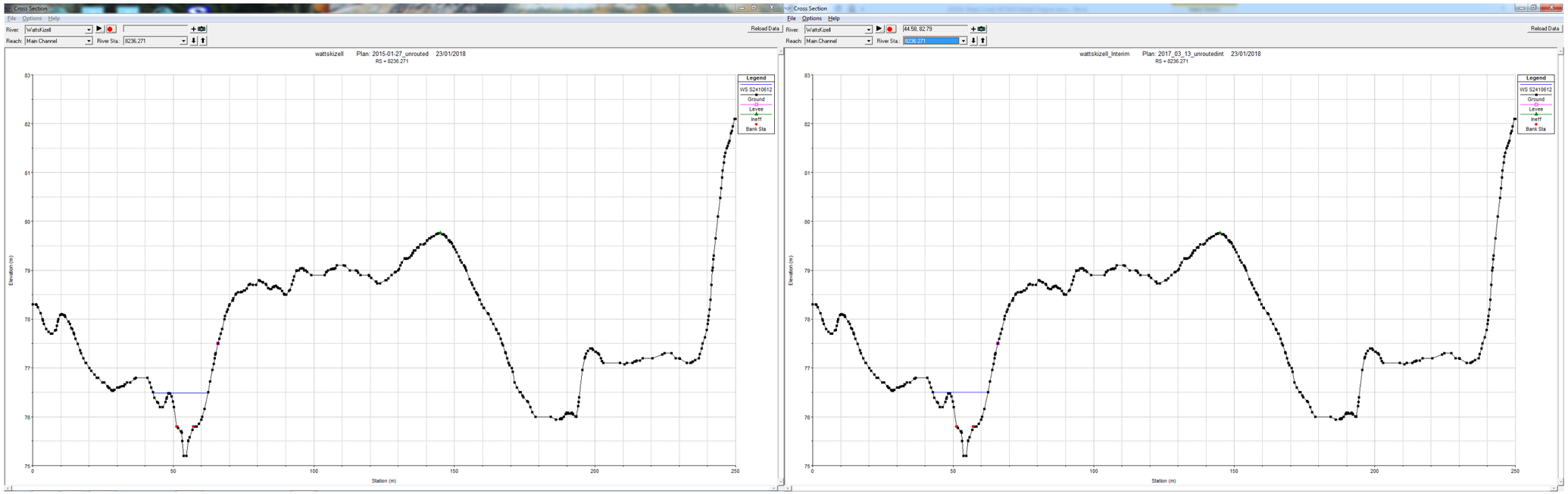
Cross-section 9767.958 (Upstream of Station Road) – 0.08 m increase in water level under interim conditions (right side)



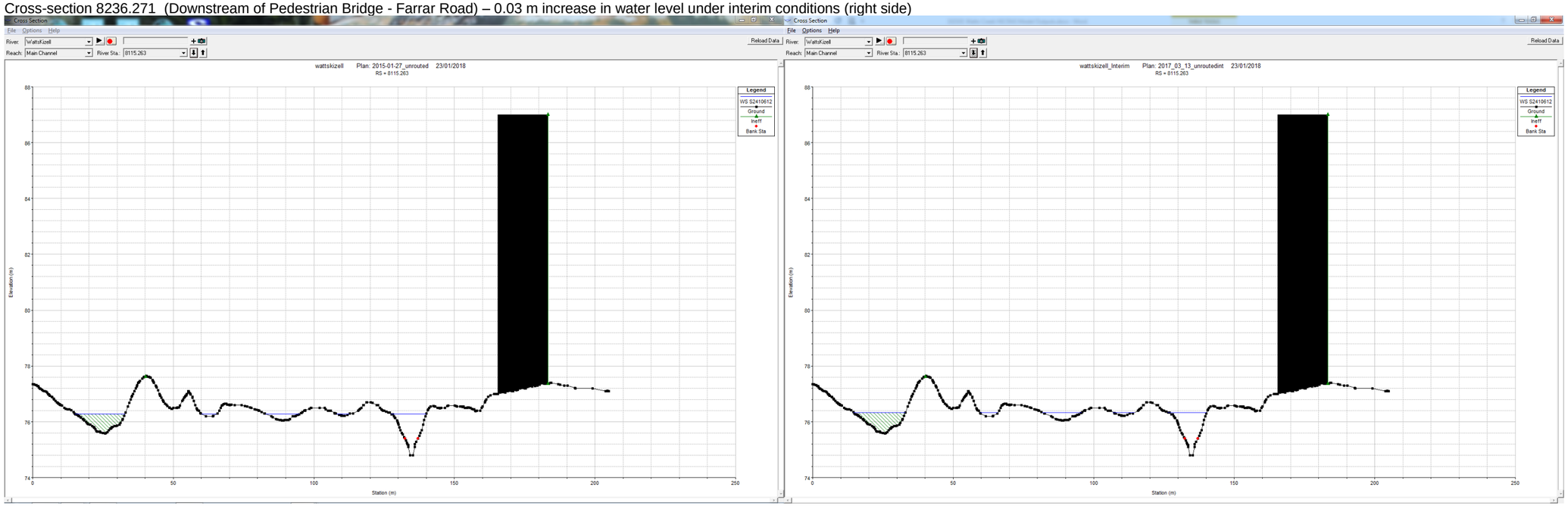
Cross-section 9573.048 (Downstream of Station Road) – 0.13 m increase in water level under interim conditions (right side)



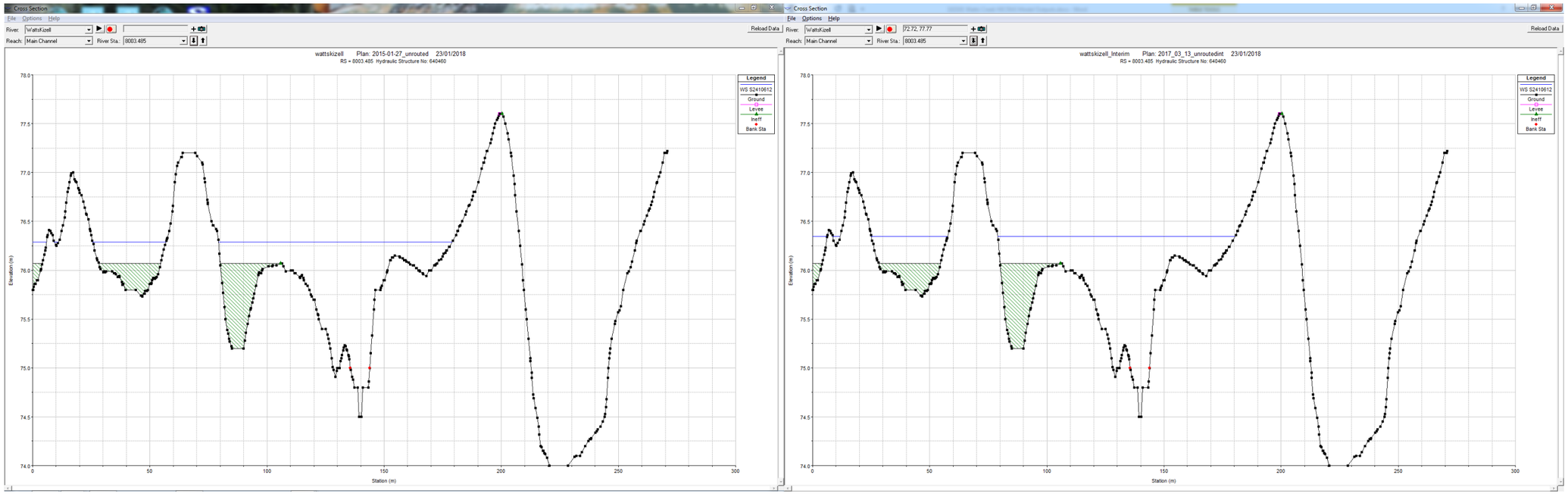
Cross-section 8991.378 (Downstream of March Road) – 0.03 m increase in water level under interim conditions (right side)



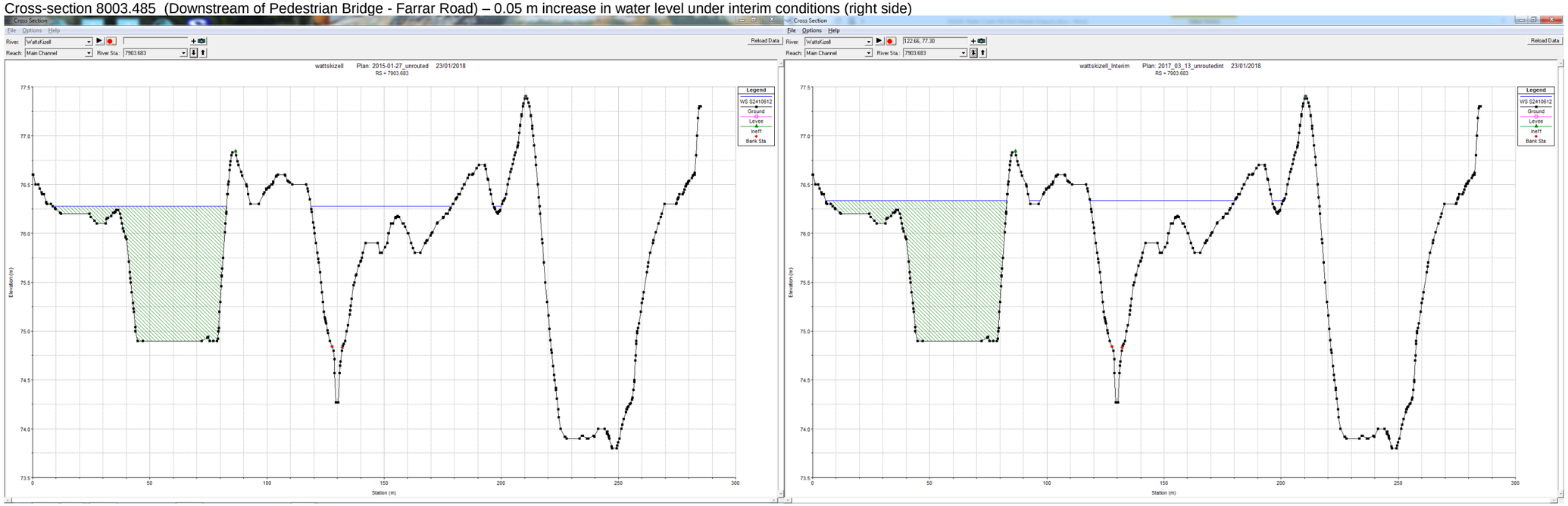
Cross-section 8236.271 (Downstream of Pedestrian Bridge - Farrar Road) – 0.03 m increase in water level under interim conditions (right side)



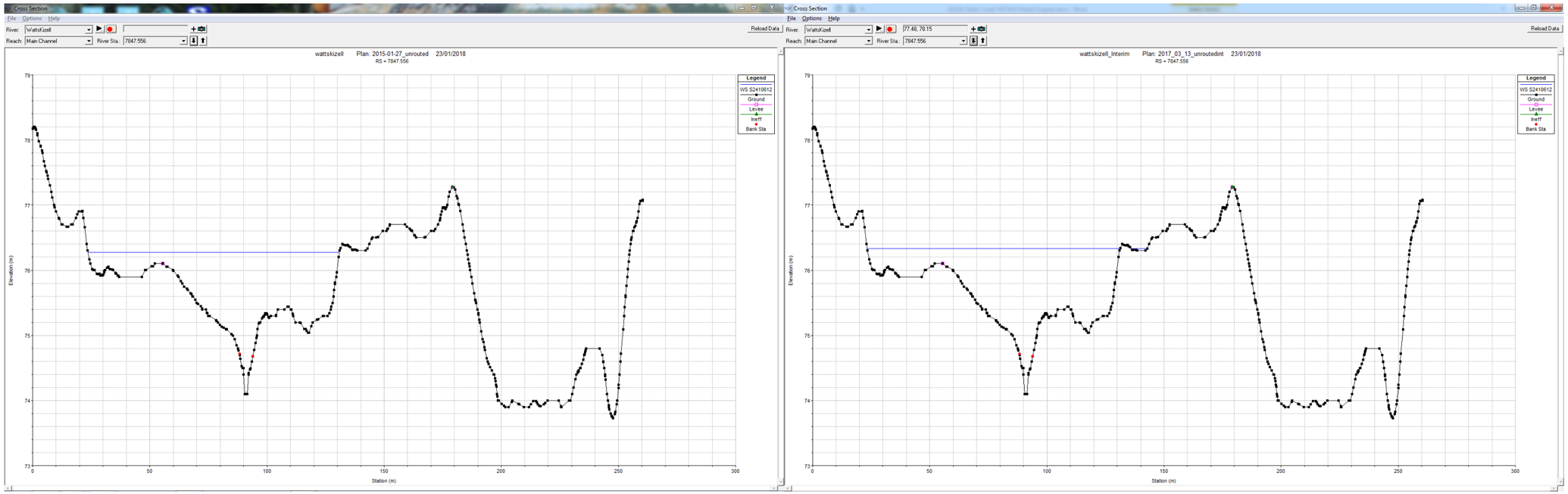
Cross-section 8115.23 (Downstream of Pedestrian Bridge - Farrar Road) – 0.06 m increase in water level under interim conditions (right side)



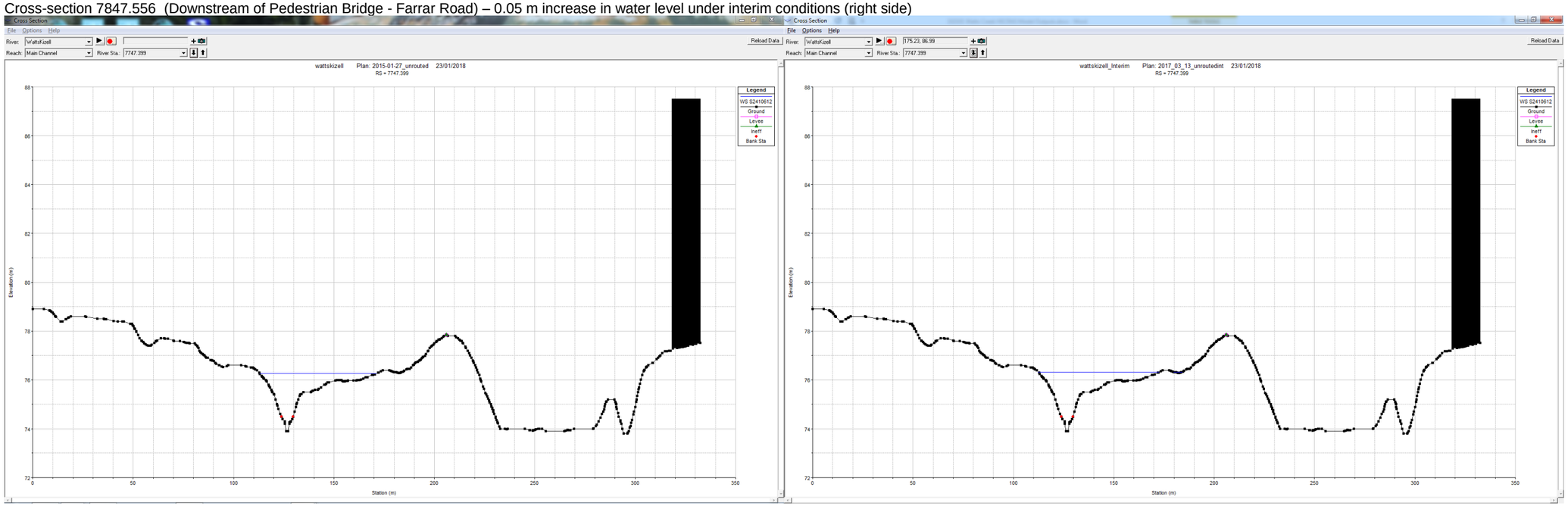
Cross-section 8003.485 (Downstream of Pedestrian Bridge - Farrar Road) – 0.05 m increase in water level under interim conditions (right side)



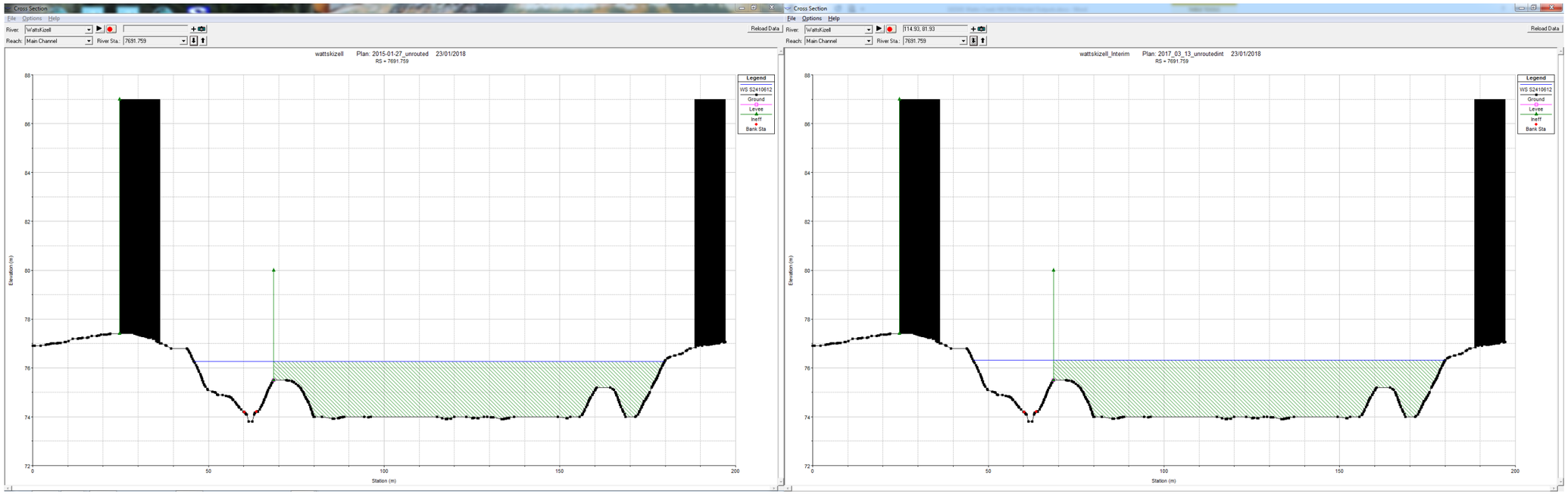
Cross-section 7903.683 (Downstream of Pedestrian Bridge - Farrar Road) – 0.05 m increase in water level under interim conditions (right side)



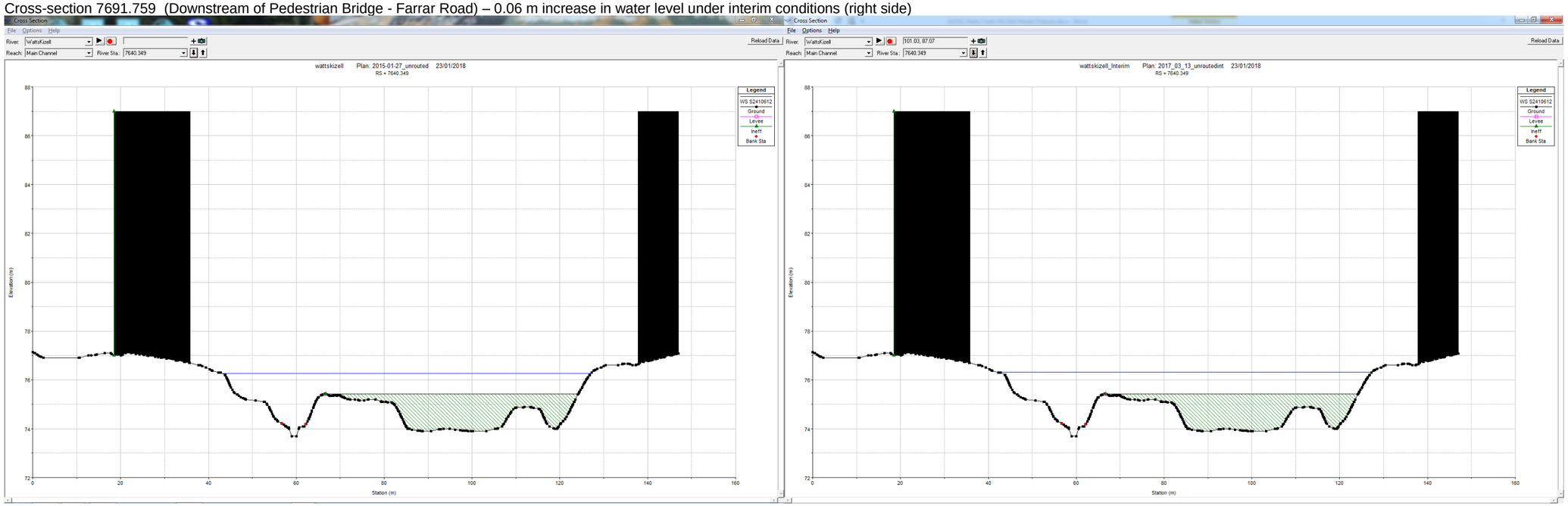
Cross-section 7847.556 (Downstream of Pedestrian Bridge - Farrar Road) – 0.05 m increase in water level under interim conditions (right side)



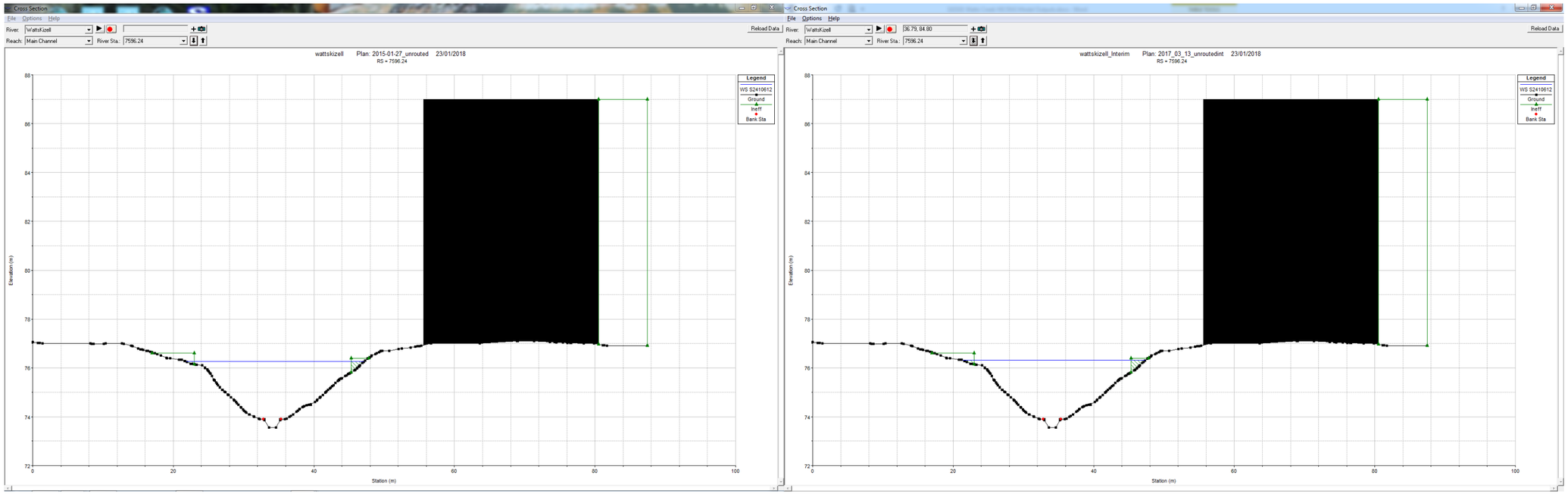
Cross-section 7747.399 (Downstream of Pedestrian Bridge - Farrar Road) – 0.05 m increase in water level under interim conditions (right side)



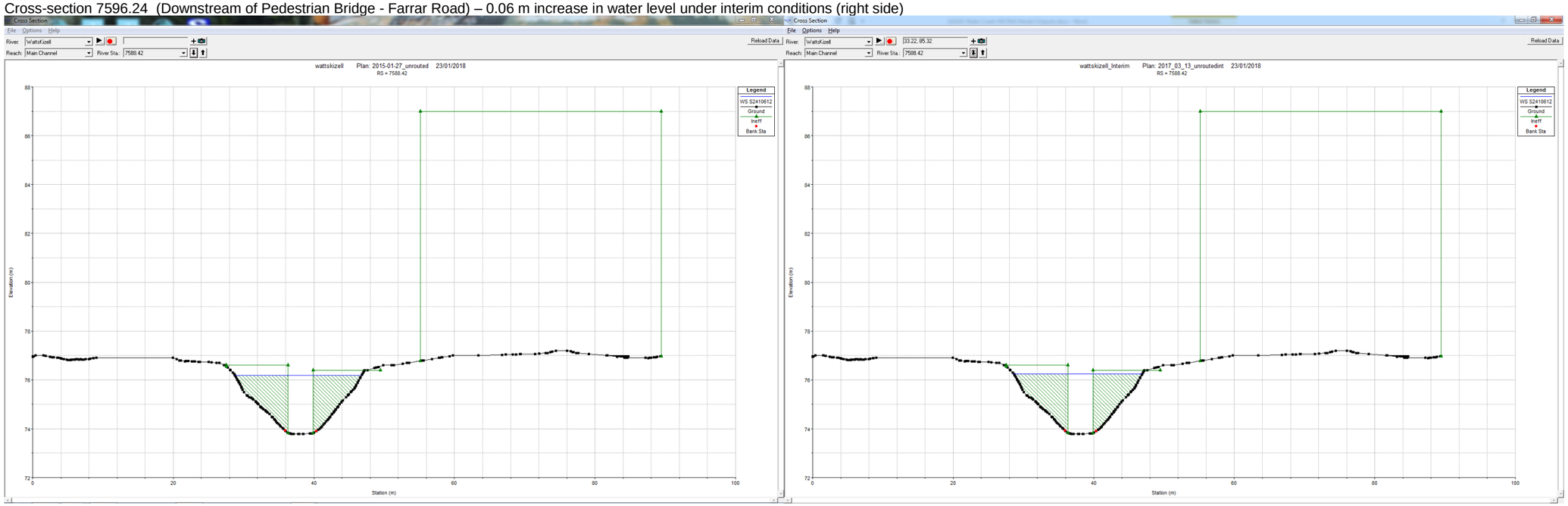
Cross-section 7691.759 (Downstream of Pedestrian Bridge - Farrar Road) – 0.06 m increase in water level under interim conditions (right side)



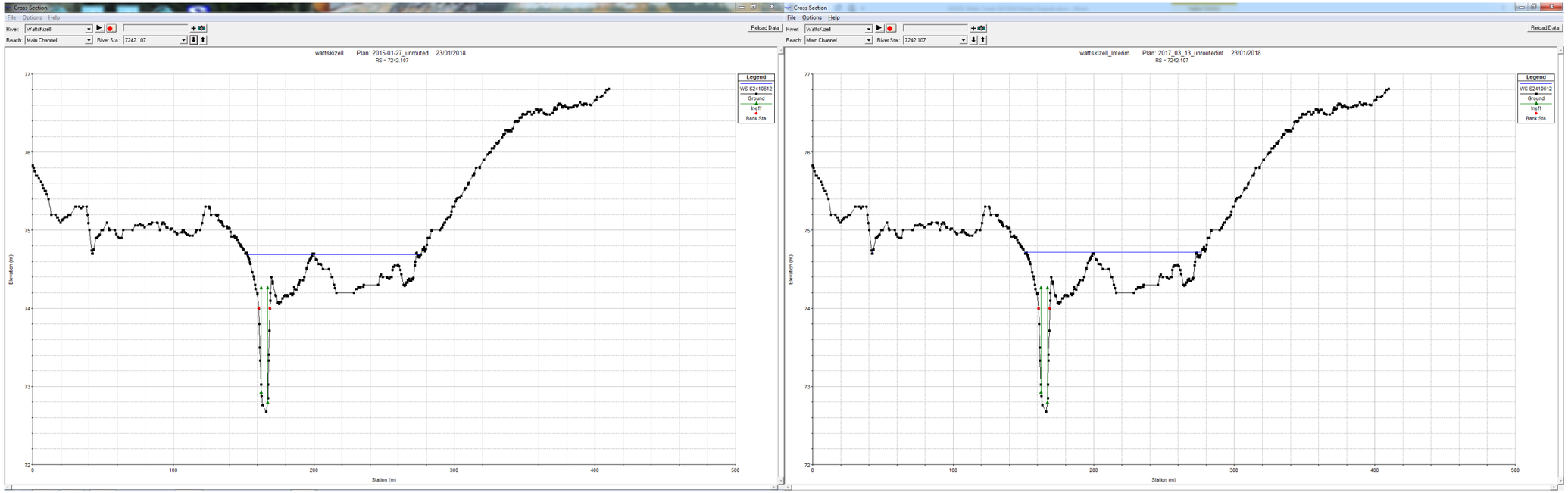
Cross-section 7640.349 (Downstream of Pedestrian Bridge - Farrar Road) – 0.06 m increase in water level under interim conditions (right side)



Cross-section 7596.24 (Downstream of Pedestrian Bridge - Farrar Road) – 0.06 m increase in water level under interim conditions (right side)

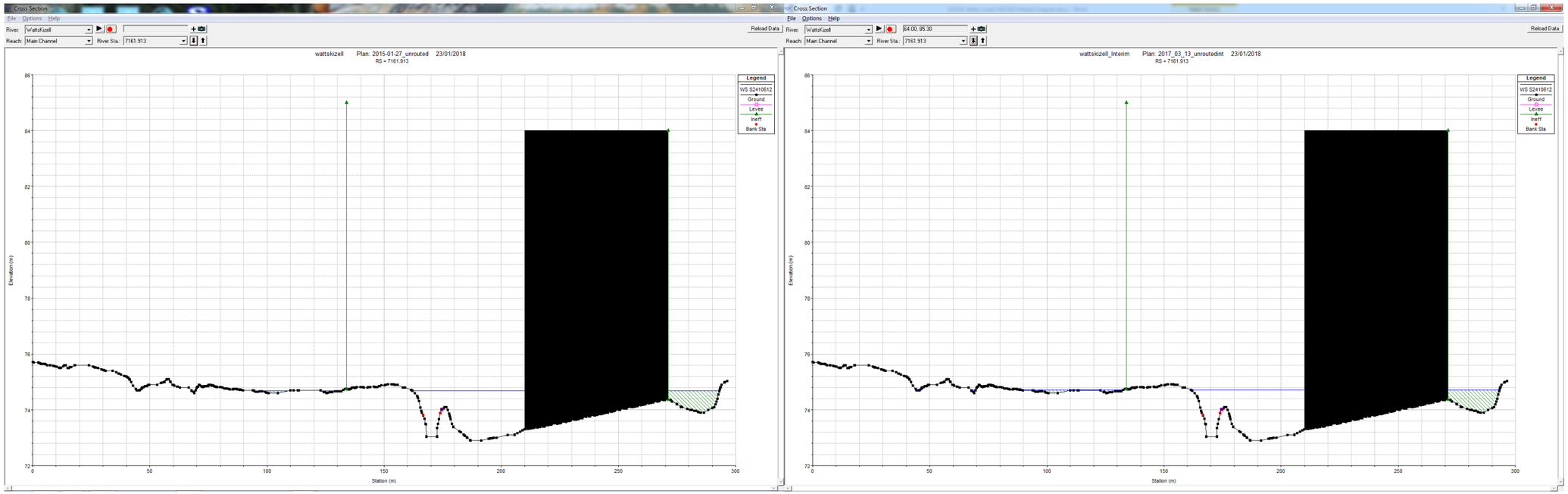


Cross-section 7588.42 (Downstream of Pedestrian Bridge - Farrar Road) – 0.05 m increase in water level under interim conditions (right side)

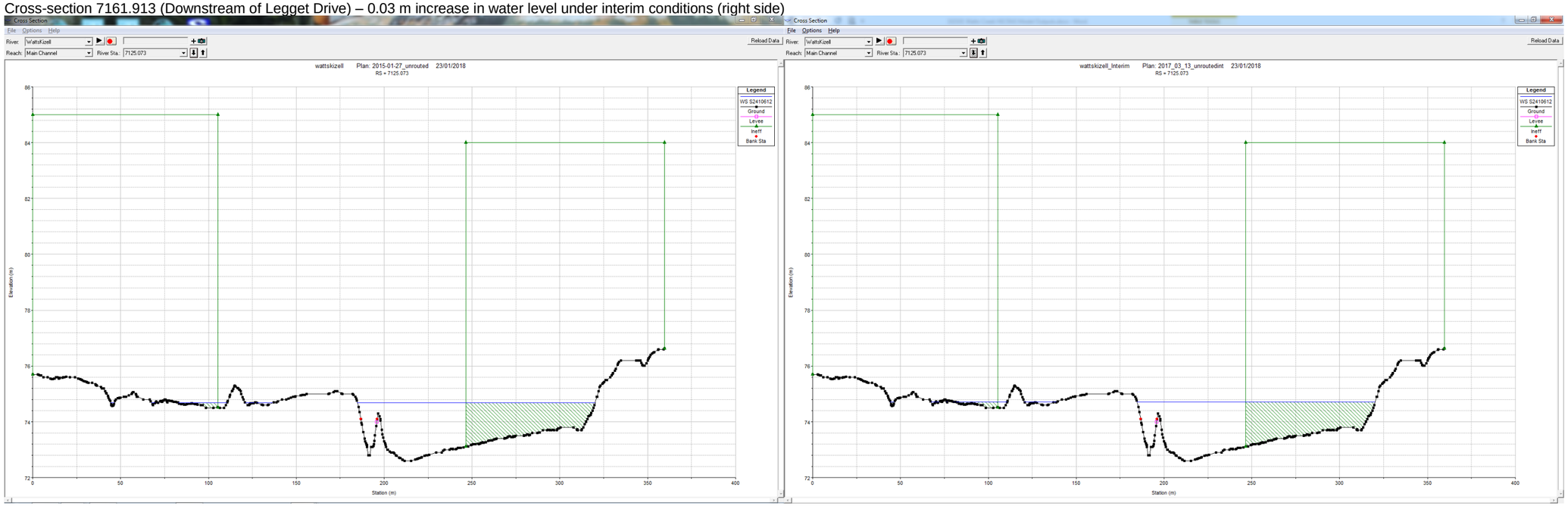


Cross-section 7242.107 (Downstream of Legget Drive) – 0.03 m increase in water level under interim conditions (right side)

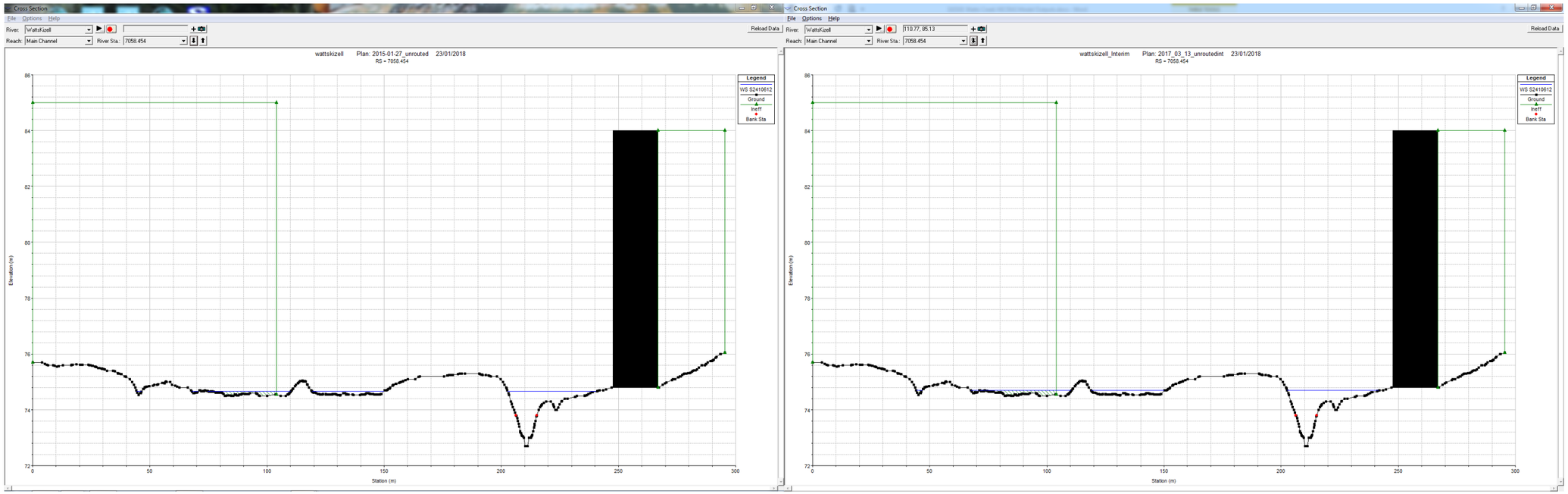
Cross-section 7229.959 (Downstream of Legget Drive) – 0.03 m increase in water level under interim conditions (right side)



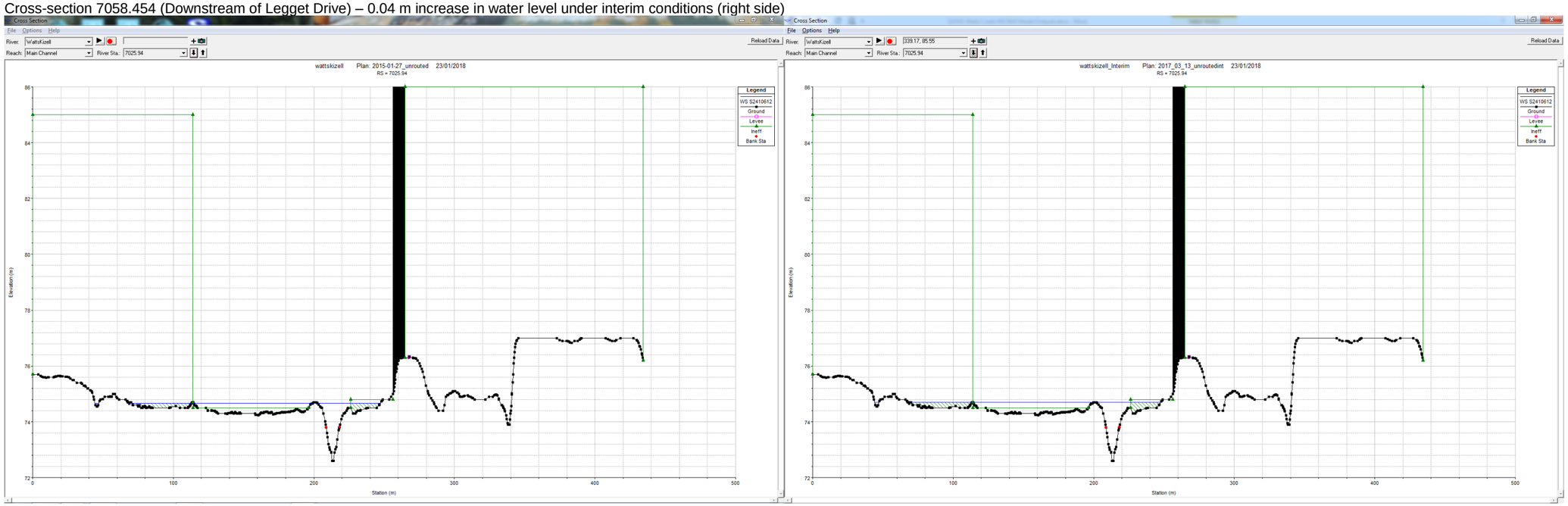
Cross-section 7161.913 (Downstream of Legget Drive) – 0.03 m increase in water level under interim conditions (right side)



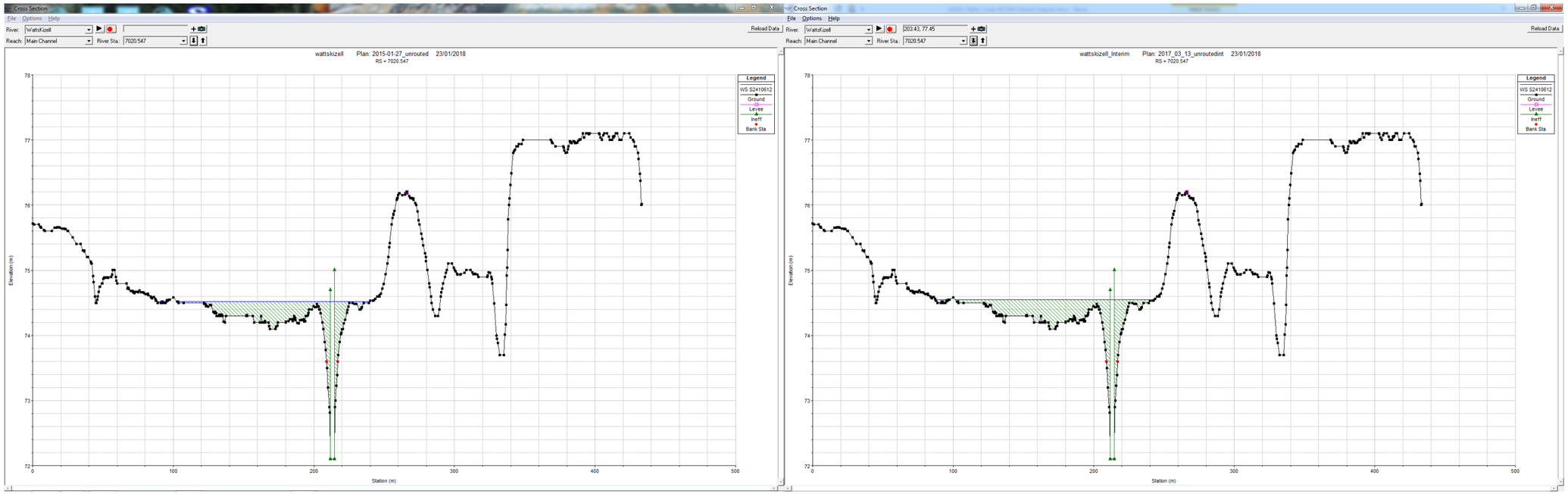
Cross-section 7125.073 (Downstream of Legget Drive) – 0.03 m increase in water level under interim conditions (right side)



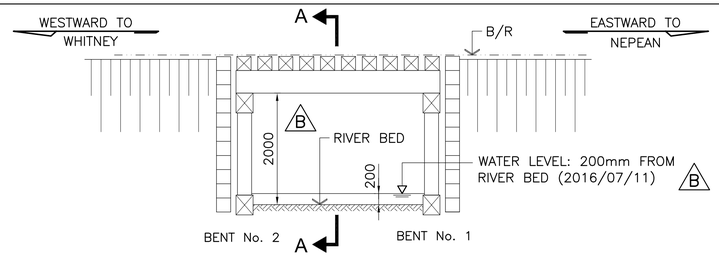
Cross-section 7058.454 (Downstream of Legget Drive) – 0.04 m increase in water level under interim conditions (right side)



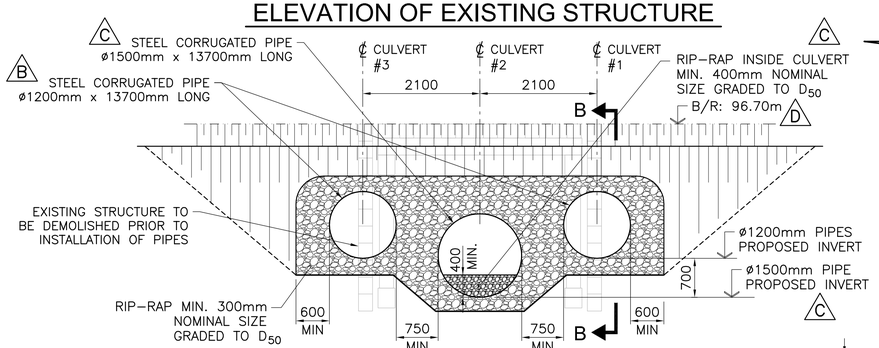
Cross-section 7025.94 (Downstream of Legget Drive) – 0.03 m increase in water level under interim conditions (right side)



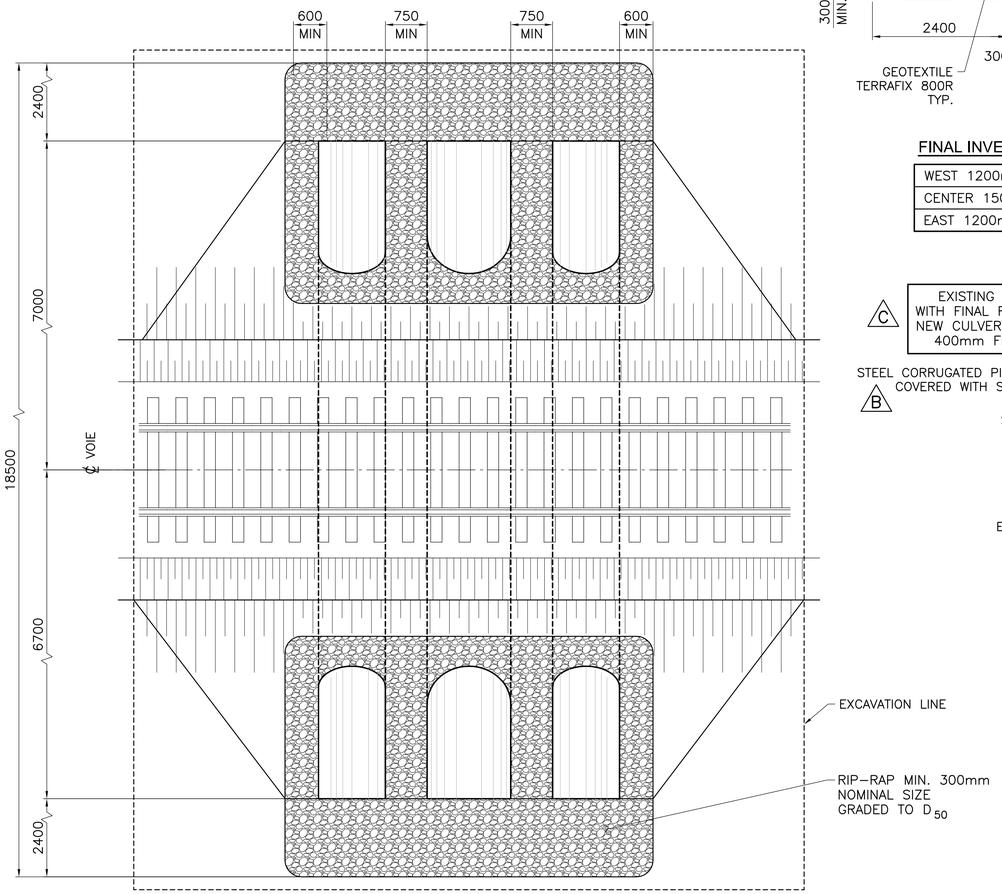
Cross-section 7020.547 (Downstream of Legget Drive) – 0.03 m increase in water level under interim conditions (right side)



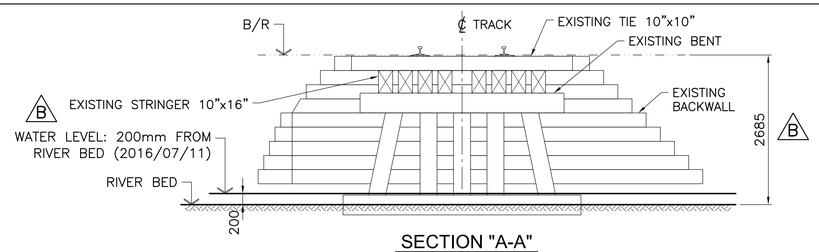
ELEVATION OF EXISTING STRUCTURE



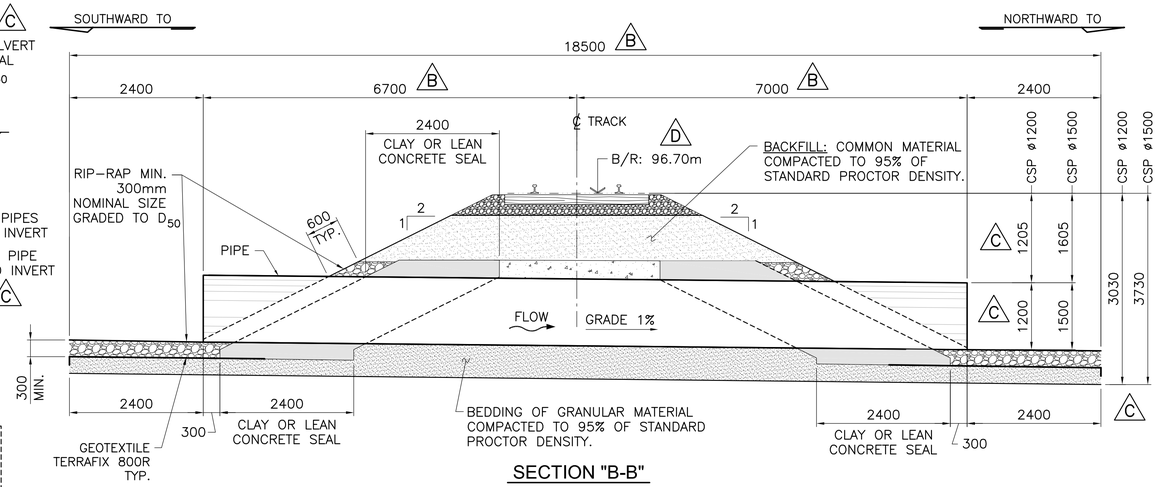
ELEVATION OF PROPOSED STRUCTURE



PLAN OF PROPOSED STRUCTURE



SECTION "A-A"
WEST BACKWALL (LOOKING WEST)

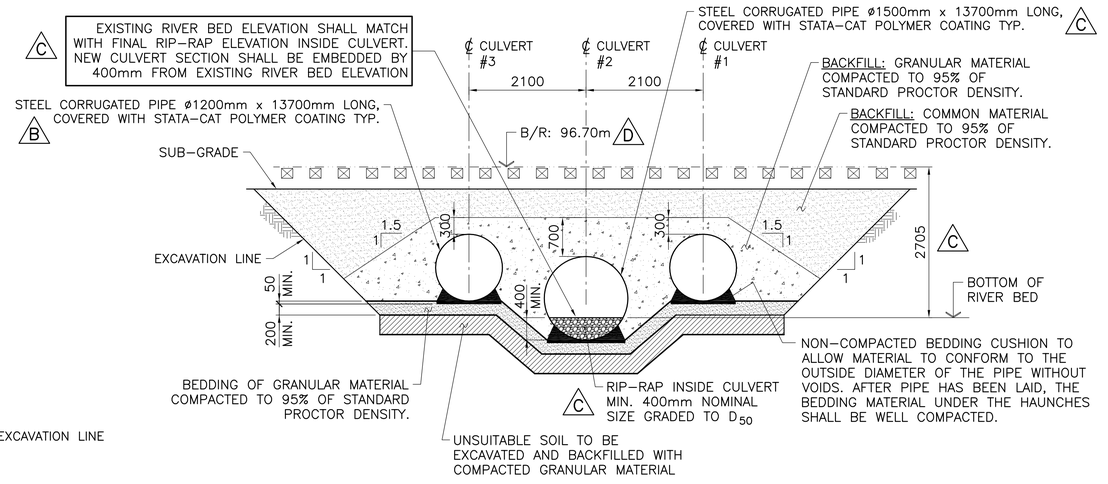


SECTION "B-B"

FINAL INVERT ELEVATIONS: (BOTTOM OF STEEL PIPE) D

WEST 1200mm CULVERT	NORTH INVERT: 94.24	SOUTH INVERT: 94.44
CENTER 1500mm CULVERT	NORTH INVERT: 93.73	SOUTH INVERT: 93.86
EAST 1200mm CULVERT	NORTH INVERT: 94.25	SOUTH INVERT: 94.45

14.40m @ 0.96% SLOPE



GRANULAR MATERIAL FOR BEDDING AND BACKFILLING TO BE APPROVED BY THE ENGINEER. IN GENERAL, PIT-RUN SAND AND GRAVEL, REASONABLY WELL GRADED FROM MAXIMUM SIZE 100mm TO NOT MORE THAN 8% FINER THAN SIEVE No. 200.

INSTALLATION OF CULVERT

NOTE:
THE CONTRACTOR SHOULD PROVIDE AN ISOLATION AND BYPASS PLAN AS WELL AS A SEDIMENT AND EROSION CONTROL PLAN TO MVCA FOR REVIEW AND WRITTEN APPROVAL PRIOR TO COMMENCING WORK. THE CONTRACTOR MUST BE MADE AWARE THAT THE ENVIRONMENTAL PERMIT IS NOT VALID UNTIL THIS CONDITION HAS BEEN MET.

LEGEND:

- N.S. = NEAR SIDE
- F.S. = FAR SIDE
- B.S. = BOTH SIDE
- B/R = BASE OF RAIL

INDICATES LENGTH OF FIELD BOLTS.

GENERAL NOTES:

- IT IS PROPOSE TO REPLACE THE EXISTING BRIDGE WITH TWO NEW GALVANIZED CORRUGATED STEEL PIPE BY ARMTEC
- ALIGNEMENT AND TRACK PROFILE SHALL REMAIN UNCHANGED
- ALL DIMENSIONS SHOWN MUST BE VERIFIED IN THE FIELD BEFORE THE START OF WORK
- ENGINEER MUST BE INFORMED OF ALL DISCREPANCIES TO THE DIMENSIONS SHOWN ON THIS DRAWING
- THE CULVERT HAVE BEEN DESIGN ACCORDING TO THE REQUIREMENTS OF THE AREMA FOR ASPECT OF HYDROLIC AND STRUCTURAL
- DESIGN LOAD: E80 + IMPACT
- CULVERT:
  THE CORRUGATED STEEL PIPE MUST BE IN ACCORDANCE WITH STANDARD CSA-G401, AASHTO M-218 OR ASMT A929. THEY SHALL HAVE A PROFILE WITH ONDULATIONS OF 68 MM X 13 MM AND A THICKNESS OF 3.5 MM.
  ALL STEEL COMPONENTS SHALL BE COVERT WITH COPOLYMERE COATING TYPE STRATA-CAT FROM ARMTEC OR APPROVED EQUAL. DURABILITY BASED ON 75 YEAR SERVICE LIFE.
- GEOTEXTILE FILTER FABRIC:
  WOVEN GEOTEXTILE FILTER FABRIC MUST BE INSTALLED AT THE BASE OF THE EXCAVATION AND MUST BE CONFORM WITH THE FOLLOWING SPECIFICATIONS:
  - -GRAB STRENGTH: 1275 N
  - -ELONGATION (FAILURE): 15%
  - -PONCTURE STRENGTH: 275 N
  - -BURST STRENGTH: 3.5 Mpa
  - -TRAPEZOIDAL TEAR: 475 N
  - -MINIMUM FABRIC LAP: 1m
- GEOTEXTILE UNDER RIP-RAP: TERRAFIX 800R
- INFRASTRUCTURE:
  THE INFRASTRUCTURE SHALL BE BUILT ACCORDING AREMA STANDARD

No.	AAAA-MM-JJ	Modification (nature)	Dessiné par	Verifié par
D	2017/04/17	AS BUILT	A.M.	
C	2017/03/06	ø1500mm STEEL CORRUGATED PIPE ADDED	A.M.	
B	2016/11/25	ISSUED FOR CONSTRUCTION	A.M.	
A	2016/11/10	ISSUED FOR TENDER	A.M.	

DATE D'ÉMISSION DU PLAN :

Client:
Nylene CANADA INC

Contrat No:

Logo et information du consultant:
RAIL◆TERM
TECHNI-GESTION

Sceau:
LICENSED PROFESSIONAL ENGINEER E. R. GAGNON 100216114 PROVINCE OF ONTARIO

Conçu par : ERG
Dessiné par : A.M.
Vérifié par:
Approuvé par:

Projet:
3.20 RENFREW

Titre:
BRIDGE REPLACEMENT
GENERAL PLAN

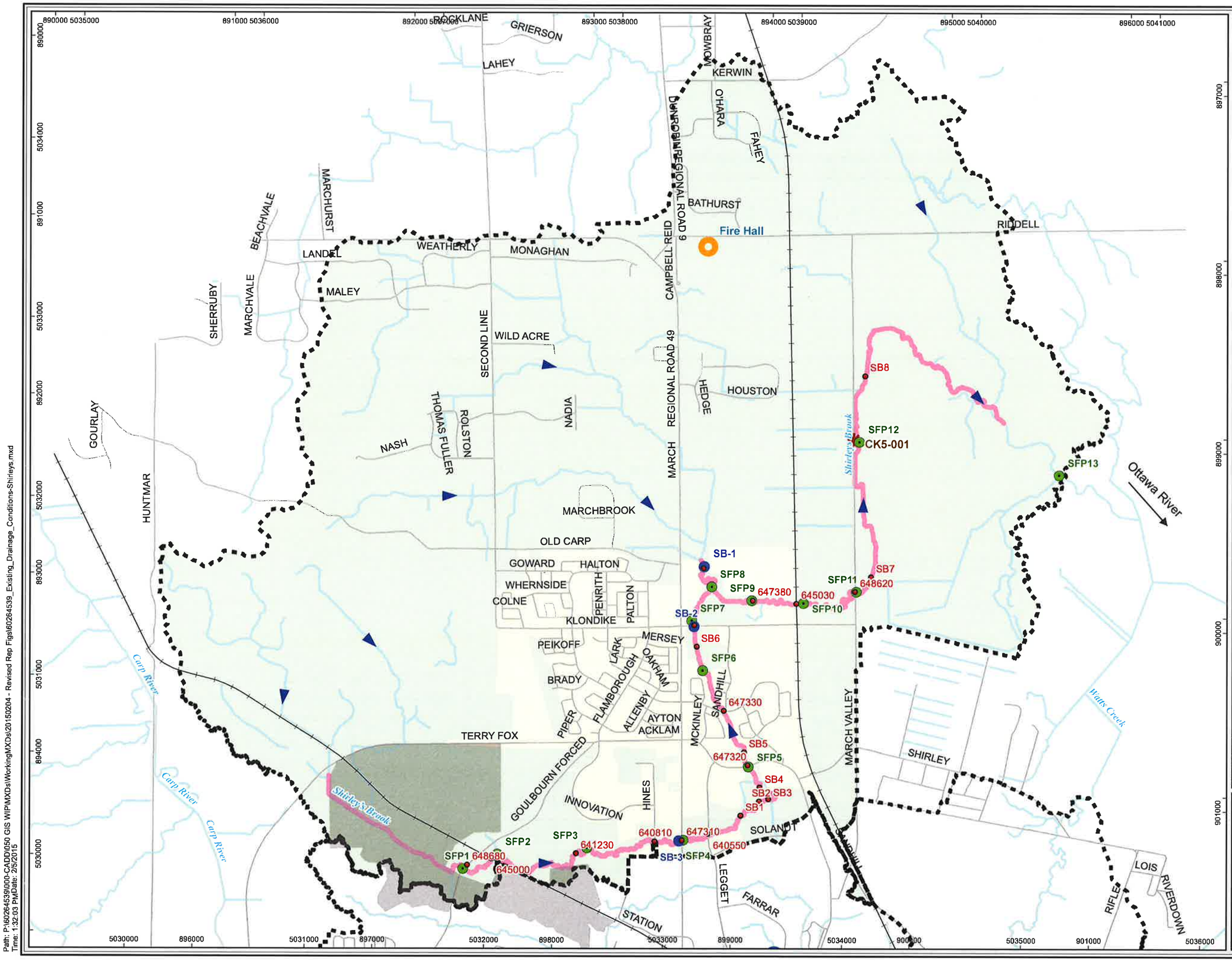
Format D
Échelles: Horizontale 1:50, Verticale
0m 0.5m

Discipline : CIVIL

Dessin No: AA860-3.20-1.1
Discip.
Révision No. D

Codification AMT :

Révision No. | Discip. | Codification Consultant: | Codification AMT:



Legend

- Subwatershed Boundary
- Rural
- Urban
- Crest Gauge Location
- City of Ottawa Streamflow Gauge
- AECOM Rain Gauges (2013)
- City of Ottawa Rain Gauges
- Flow Point Location
- Hydraulic Structures Location
- Stream and River
- Extent of HEC-RAS Model/ Flood Line Mapping
- Railroads

Basemapping and orthophotography provided by the City of Ottawa.

m
0 125 250 500 750 1,000

1:28,000

NAD 83, MTM 9

Shirley s Brook & Watt s Creek Phase 2 SWM Study

Existing Drainage Conditions - Shirley's Brook

April 2015
60264539

AECOM

Figure 3

Path: P:\60264539\000-CADD\050 GIS WIP\MXDs\WorkingMXDs\20150204 - Revised Rep Figs\60264539_Existing_Drainage_Conditions-Shirleys.mxd
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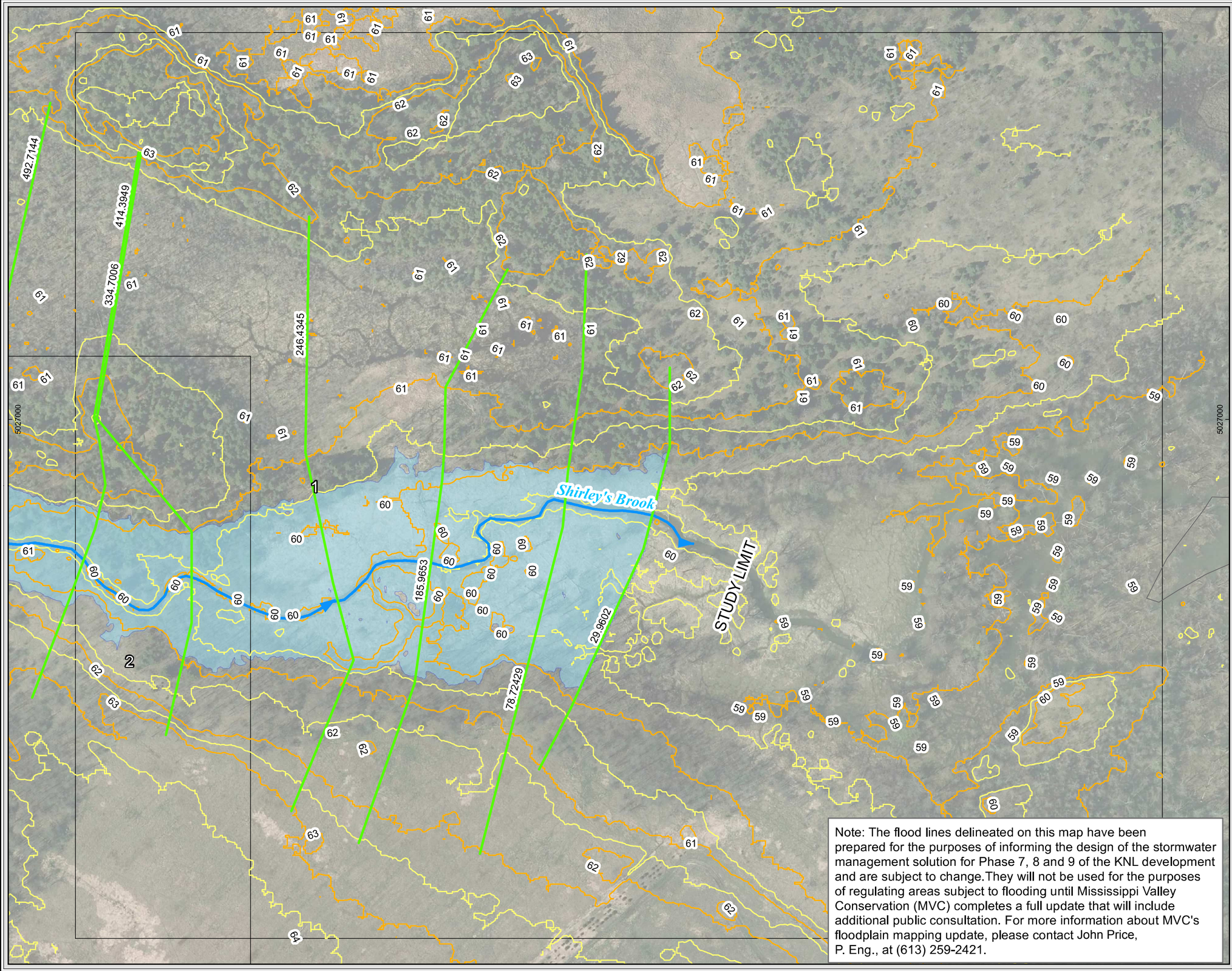


Legend

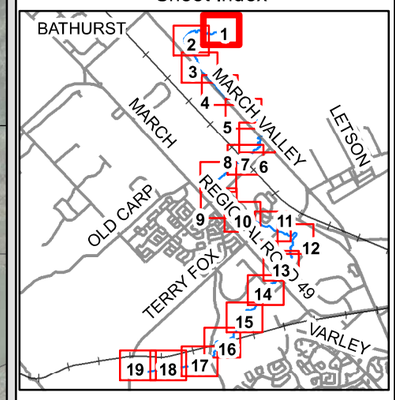
- Shirley's Brook

HEC-RAS Cross Sections

- X-Sections (LiDAR)
- X-Sections (Design Infomation)
- X-Sections (Contours)
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



Topographic information and digital orthophotography provided by the City of Ottawa

N
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NAD 83, MTM 9

Note: The flood lines delineated on this map have been prepared for the purposes of informing the design of the stormwater management solution for Phase 7, 8 and 9 of the KNL development and are subject to change.They will not be used for the purposes of regulating areas subject to flooding until Mississippi Valley Conservation (MVC) completes a full update that will include additional public consultation. For more information about MVC's floodplain mapping update, please contact John Price, P. Eng., at (613) 259-2421.

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

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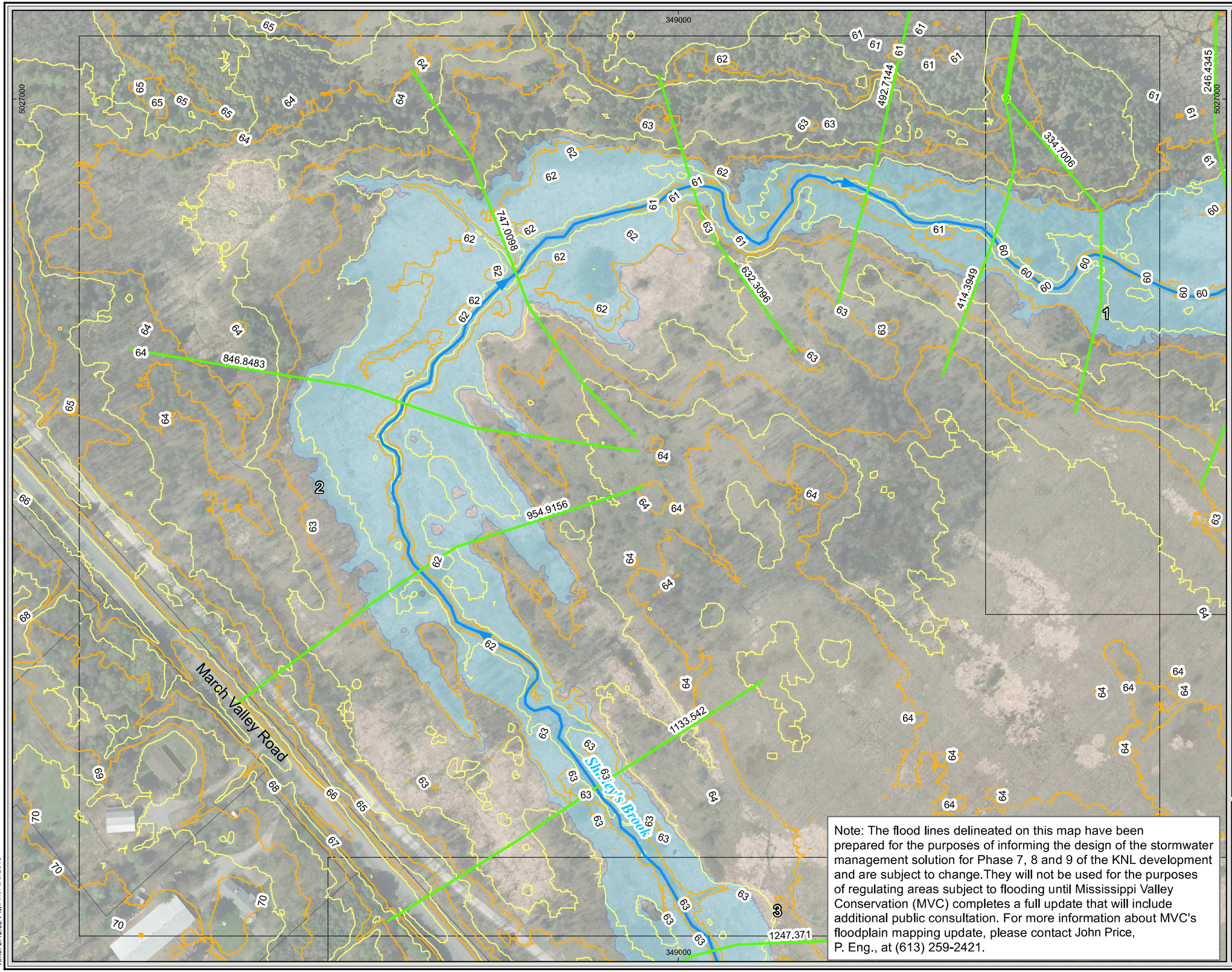


Legend

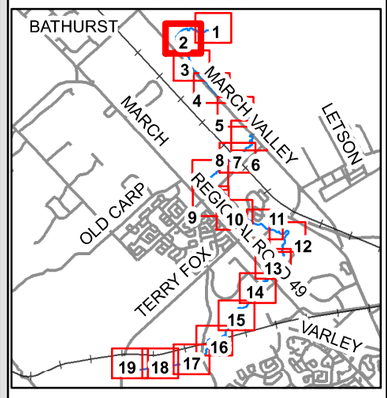
- Shirley's Brook

HEC-RAS Cross Sections

- X-Sections (LiDAR)
- X-Sections (Design Infomation)
- X-Sections (Contours)
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



Topographic information and digital orthophotography provided by the City of Ottawa

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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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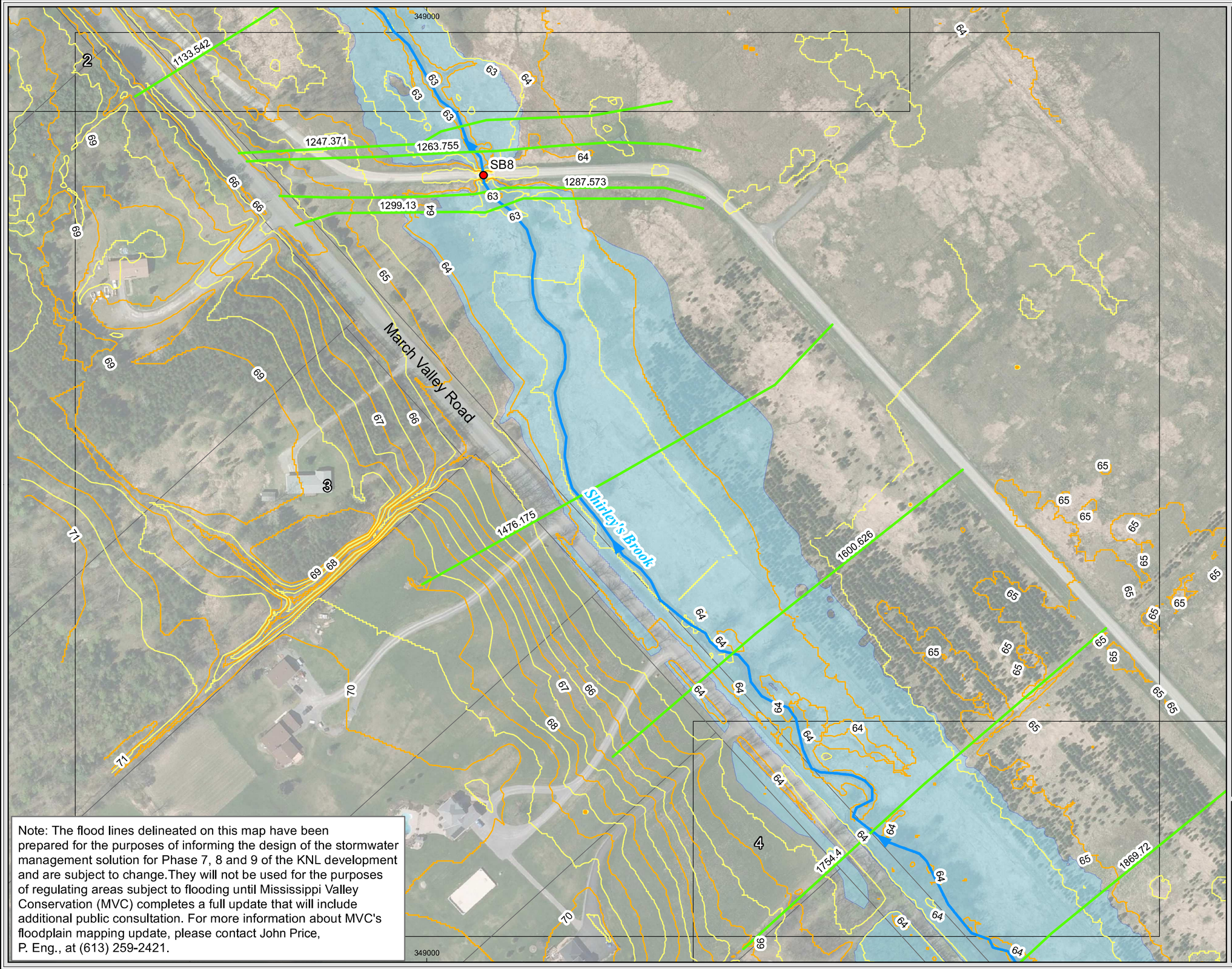

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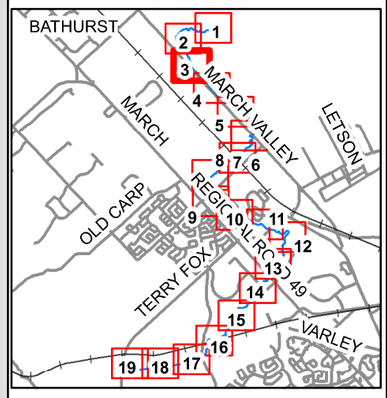
- Spill Location

Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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AECOM

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March Valley Road

Shirley's Brook

STUDY LIMIT

1754.4

1869.72

2011.088

2073.74

2199.535

2400.535

2517.733

5026000

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MISSING BASE MAPPING CROSS SECTION
2199.535 TO 2716.764
FLOOD LINE ESTIMATED

Legend

- Shirley's Brook

HEC-RAS Cross Sections

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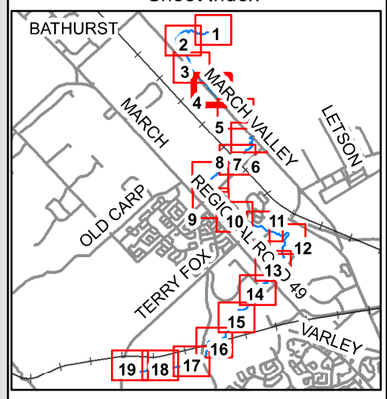
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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MISSING BASE MAPPING CROSS SECTION
2199.535 TO 2716.764
FLOOD LINE ESTIMATED

STUDY LIMIT

STUDY LIMIT

STUDY LIMIT

SPILL

SPILL

SPILL

2400.535

2517.733

2716.764

2838.9

2926.23

2993.621

3065.567

3086.02

3106.096

3112.739

3094.45

3157.212

March Valley Road

Shirley's Brook

SB7

350000

350000

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Legend

- Shirley's Brook

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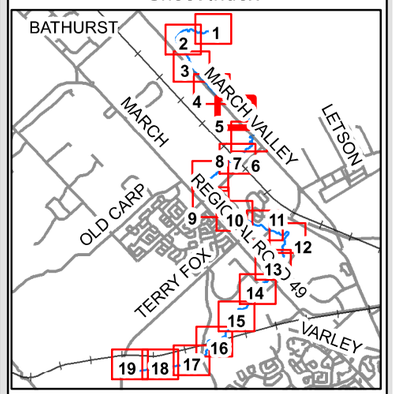
Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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March Valley Road

Shirley's Brook

STUDY LIMIT

SB7

SPILL

648620

Klondike Road

5

6

7

2926.23
2993.621
3065.567
3086.02
3094.45
3106.096
3112.739
3157.212
3182.32
3211.613
3262.229
3292.083
3301.163
3320.636
3330.8
3361.237
3459.393
3539.195
3615.362
3653.05
3713.495
3787.461
3852.352
3910.996
3964.183

350000
5025000

Legend

- Shirley's Brook

HEC-RAS Cross Sections

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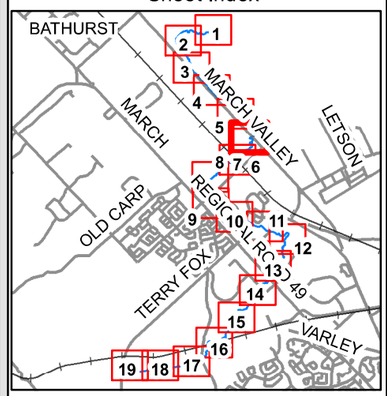
Ottawa

Sheet Index



Topographic information and digital orthophotography provided by the City of Ottawa

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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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Railway

STUDY LIMIT

SPILL

Klondike Road

Shirley's Brook

350000

5025000

645030

647380

3615.362

3653.05

3713.495

3787.461

3852.352

3910.996

3964.183

4045.686

4079.661

4110.796

4112.813

4167.088

4236.688

4334.765

4432.086

4462.663

4486.599

4525.185

4535.882

Legend

- Shirley's Brook

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- 0.5 m Contour Interval
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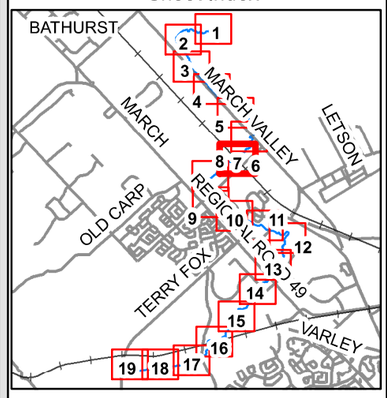
Ottawa

Sheet Index



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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

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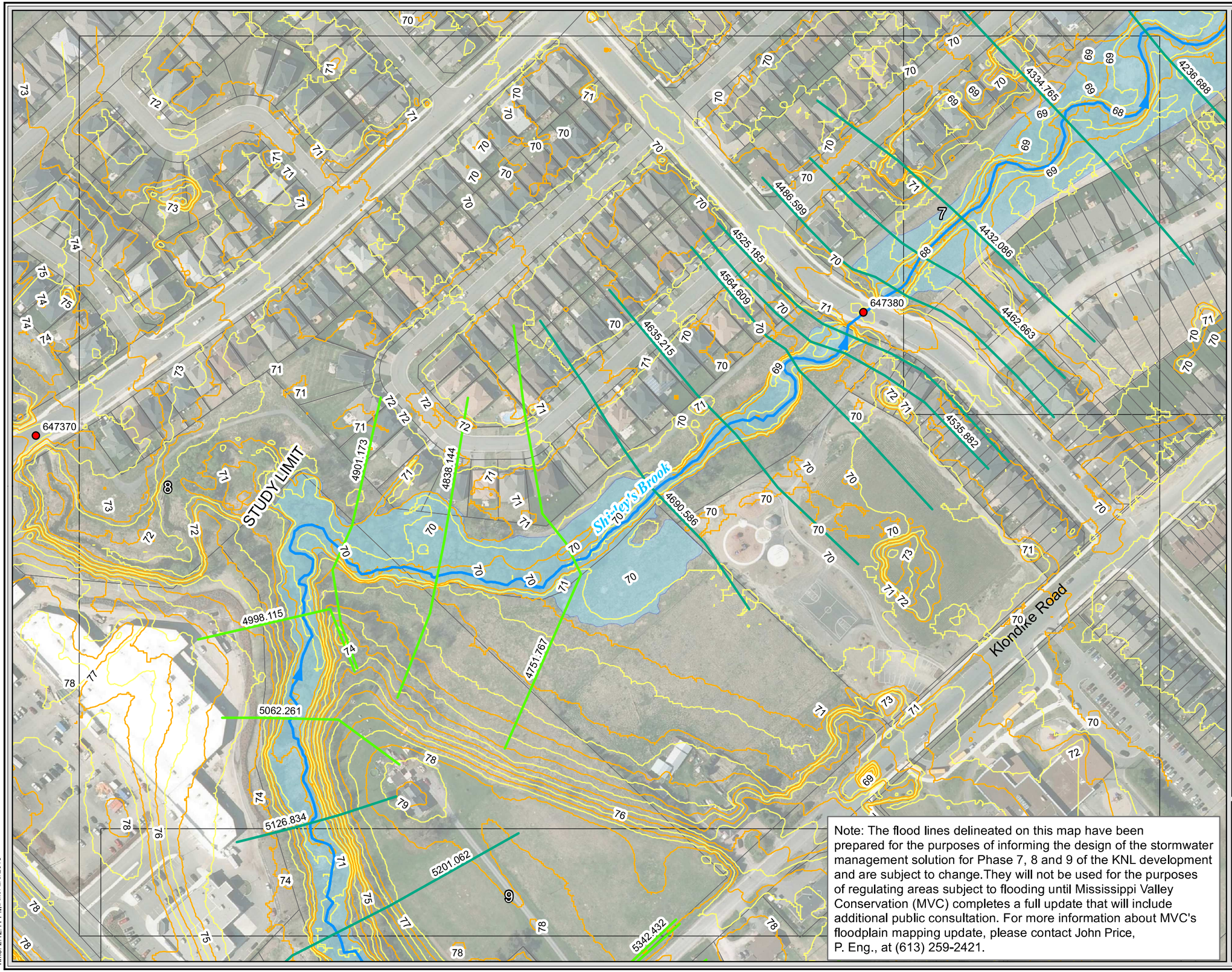

Legend

- Shirley's Brook

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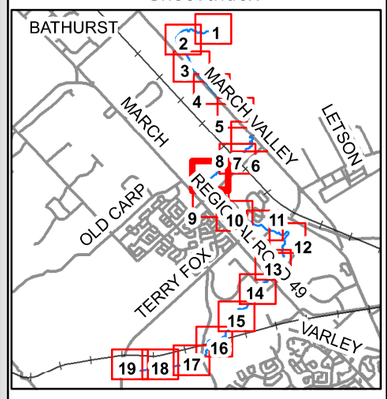
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

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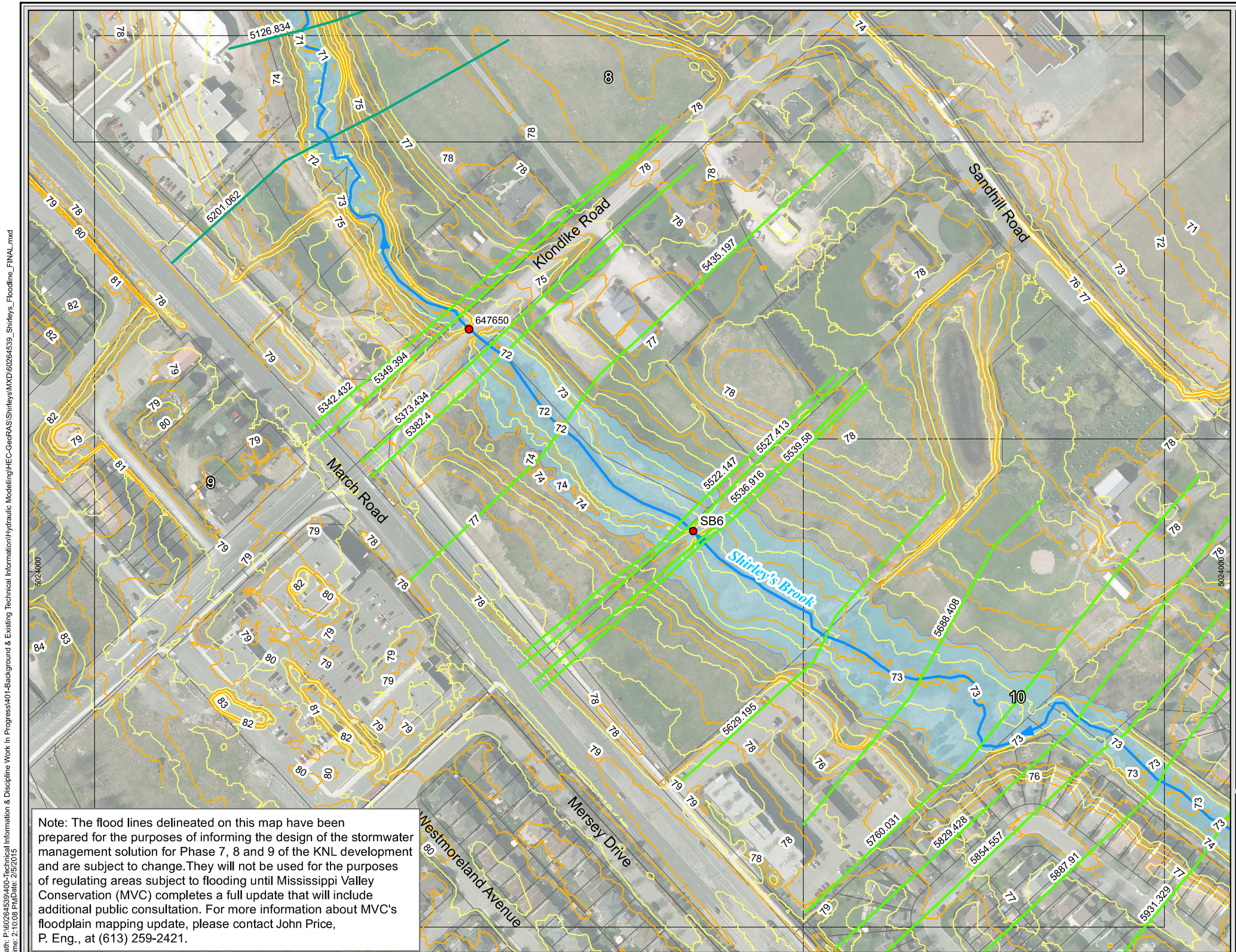

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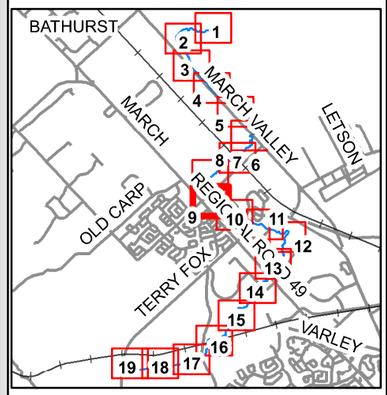
Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

Sandhill Road
Billingham Crescent
Kinross Drive
Helmsdale Drive
Shirley's Brook
Inverary Drive
Marc Road
Westmeath Crescent
Shirley's Brook Drive
Morgan's Grant Way
Banchory Crescent
Mckinley Drive
SPILL
5527.413
5539.58
5629.195
5688.408
5760.031
5829.428
5854.557
5887.91
5931.329
5983.689
6095.834
6136.349
6178.128
6190.743
6258.598
6410.477
647330
350000
5024000
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10
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Legend

- Shirley's Brook

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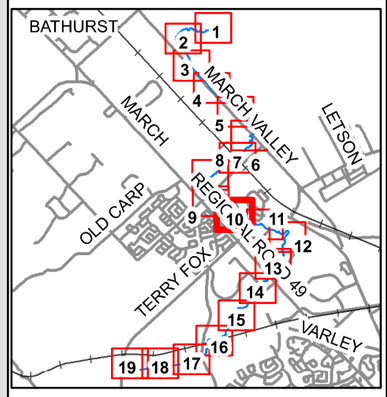
Ottawa

Sheet Index



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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

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Shirley's Brook Drive
Kimbolton Crescent
Shirley's Brook Drive
Helmsdale Drive
Shirley's Brook
Banchory Crescent
SB5
SB4
SB2
647320
10
11
12
6337.265
6190.743
6410.477
6258.598
6518.839
6565.697
6646.137
6678.357
6483.158
6547.102
6596.294
6631.114
6683.657
6747.781
6812.767
6893.653
7047.343
7140.229
7207.136

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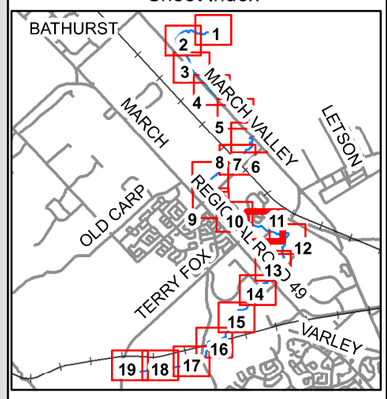
Ottawa

Sheet Index



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NAD 83, MTM 9

Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

Sheet No. 11 of 19

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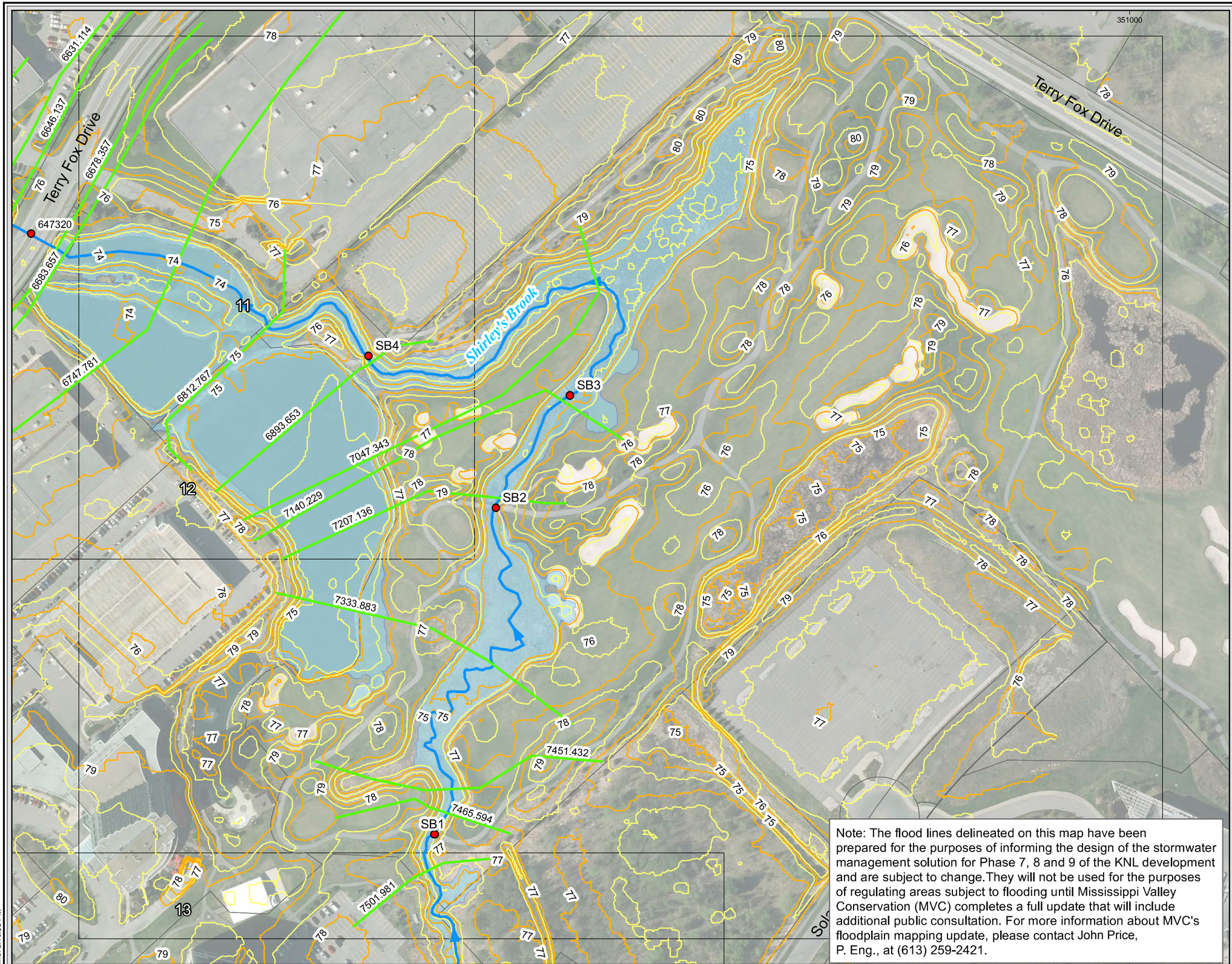

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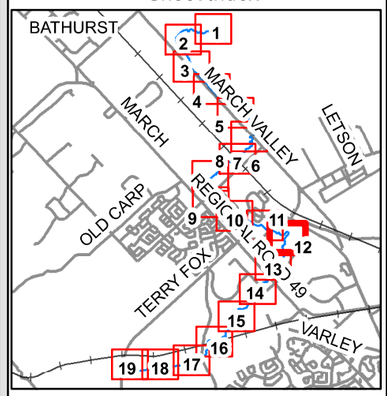
Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
60264539

AECOM

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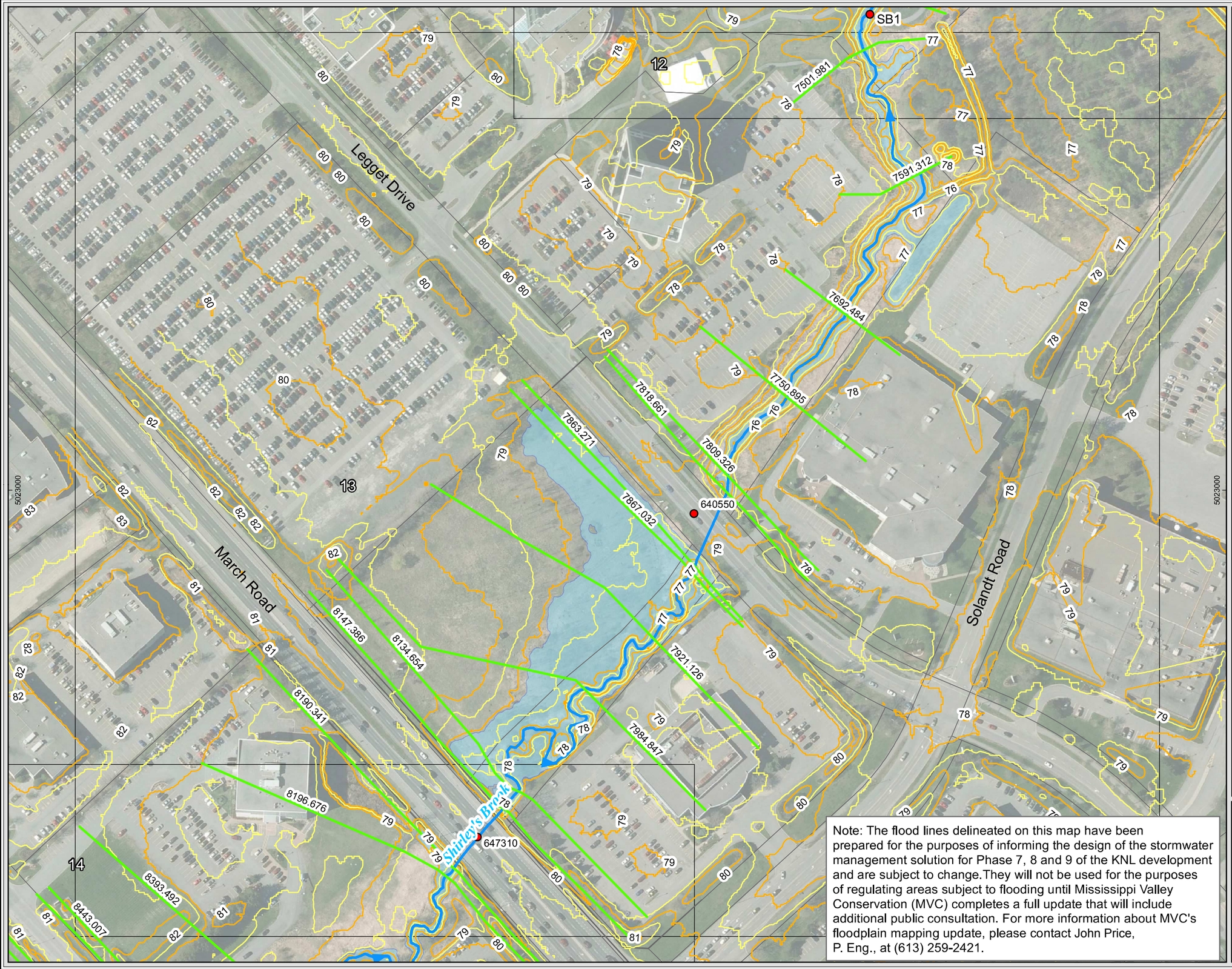

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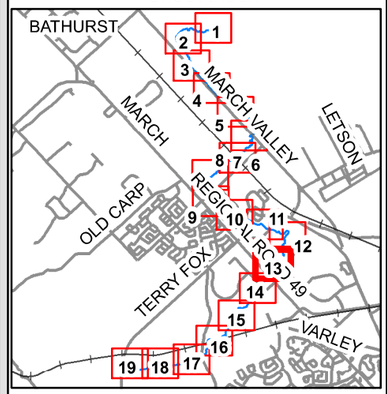
Ottawa

Sheet Index



Topographic information and digital orthophotography provided by the City of Ottawa

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NAD 83, MTM 9

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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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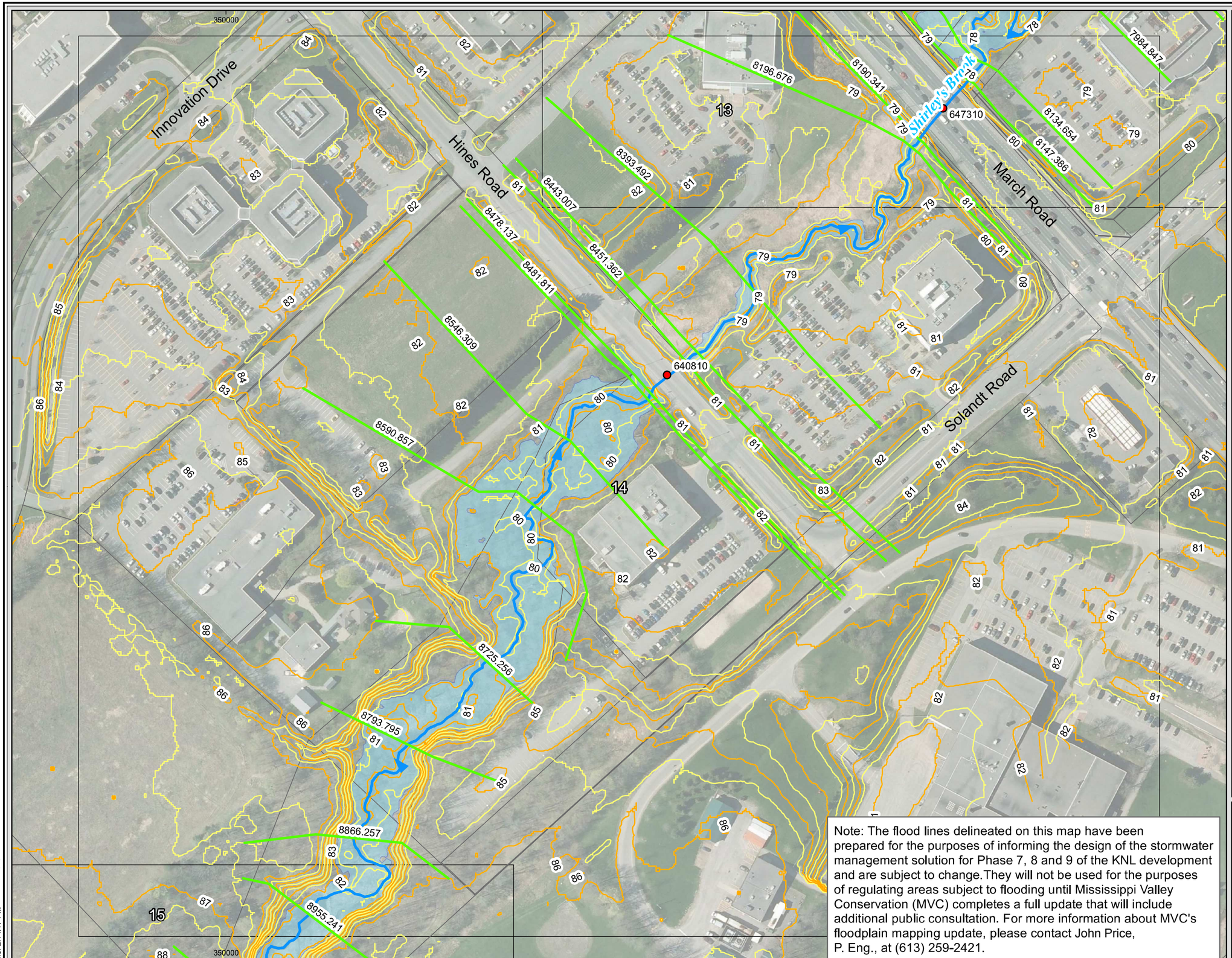


Legend

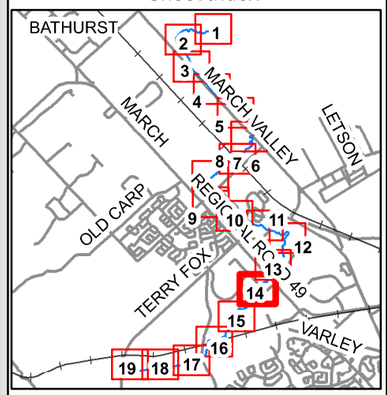
- Shirley's Brook

HEC-RAS Cross Sections

- X-Sections (LiDAR)
- X-Sections (Design Infomation)
- X-Sections (Contours)
- Hydraulic Structure Location & ID
- Extent of 100-Year Flood Line
- Match Lines
- 1.0 m Contour Interval
- 0.5 m Contour Interval
- Parcel Fabric
- Spill Location

Ottawa

Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

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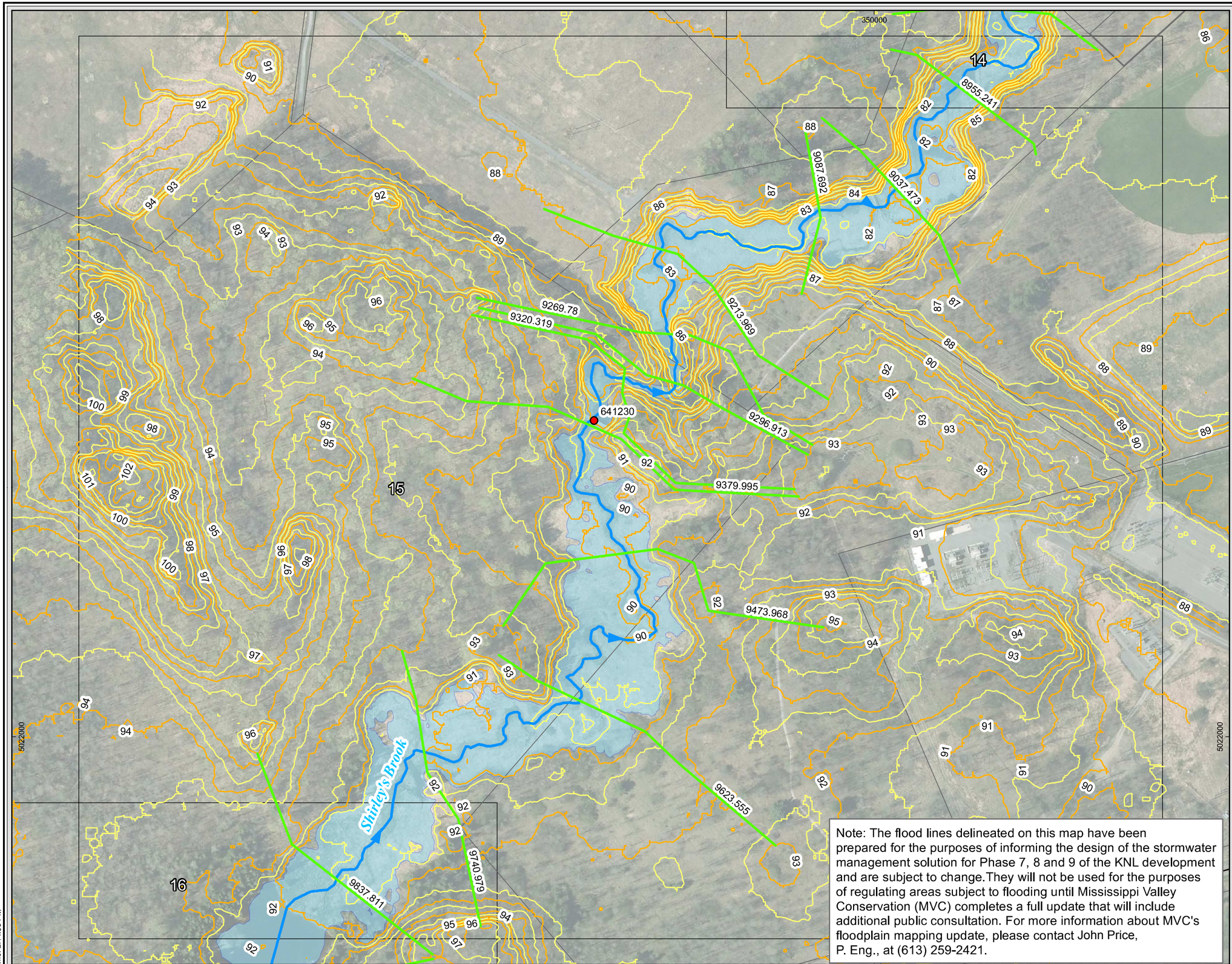

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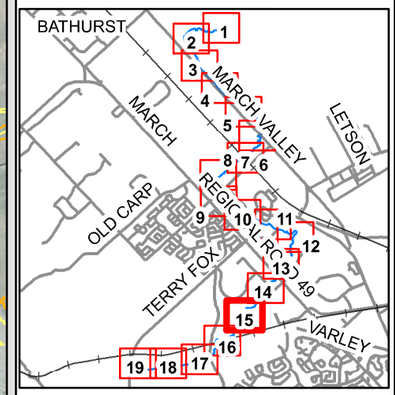

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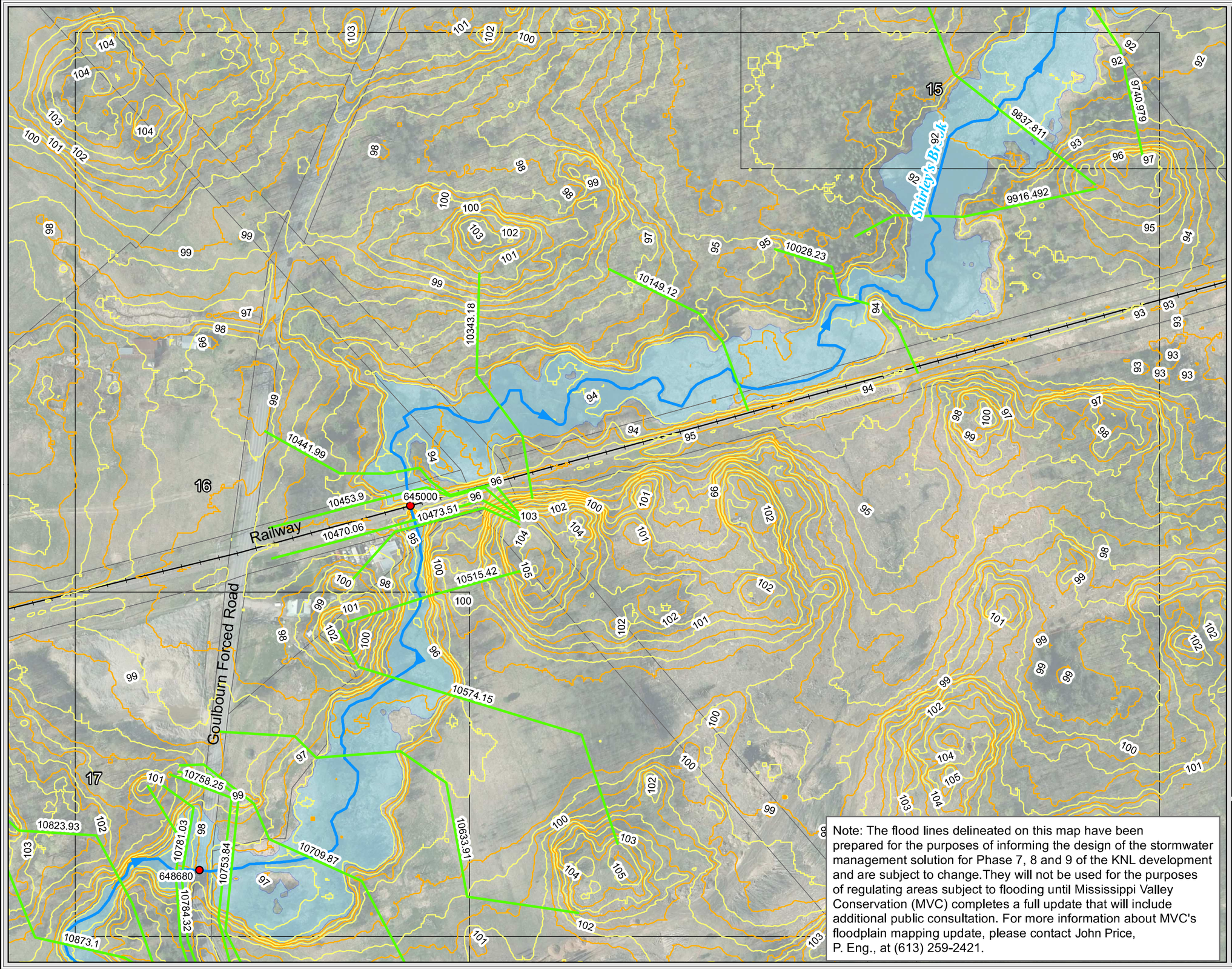

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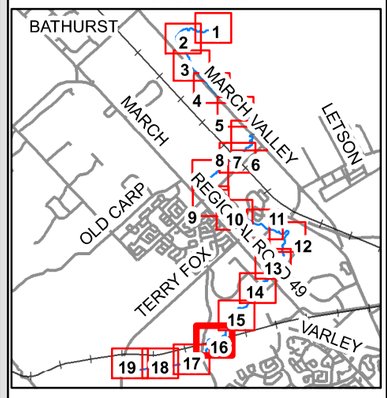

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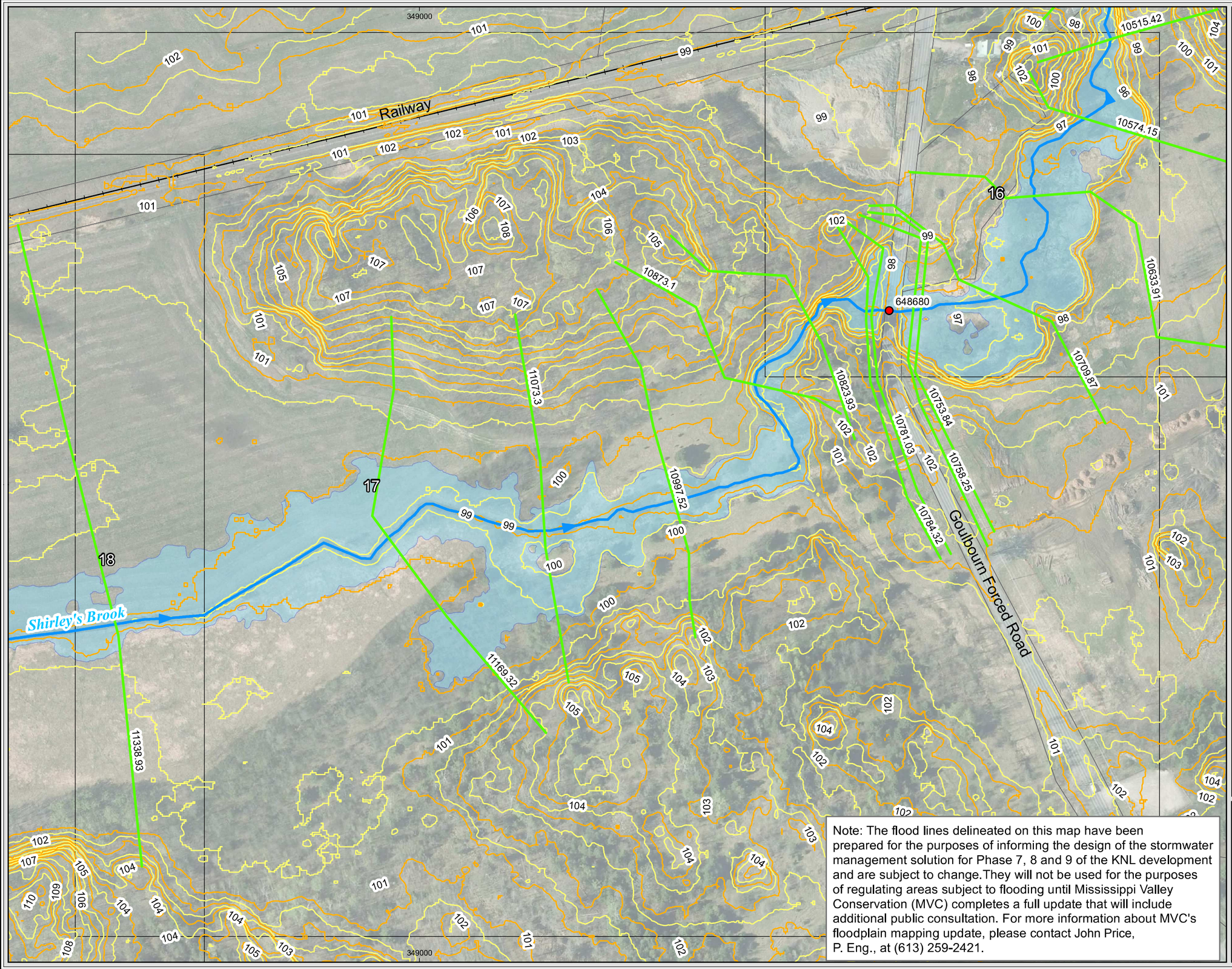

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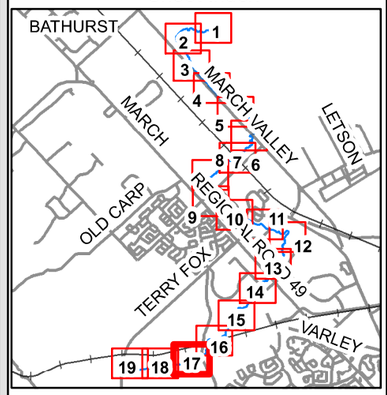

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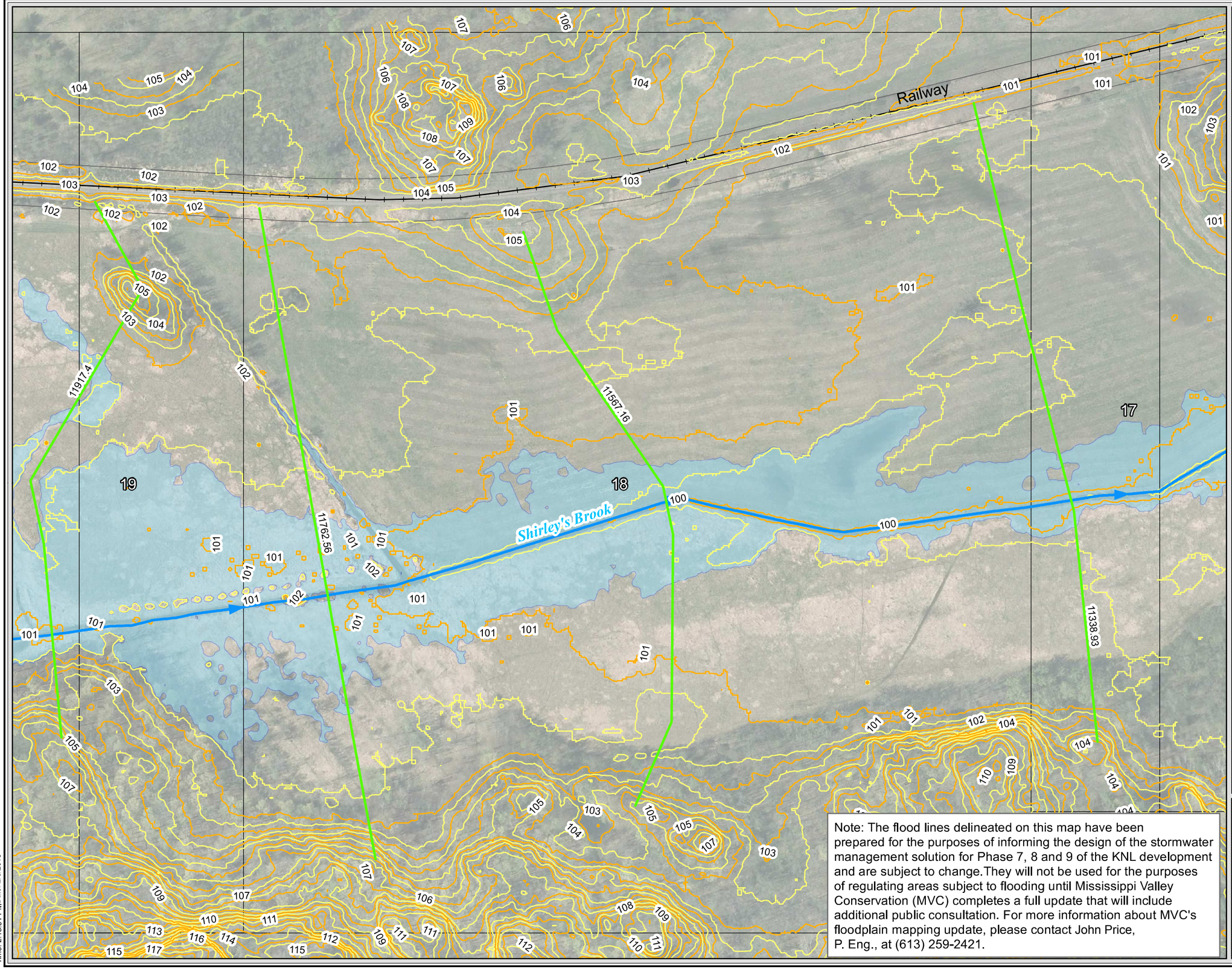

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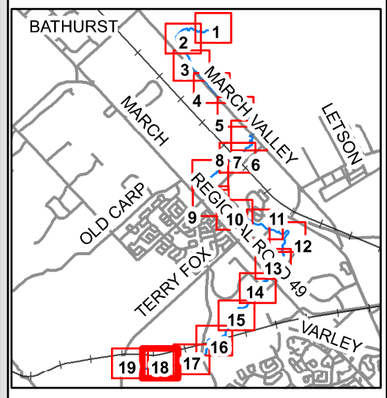
Sheet Index



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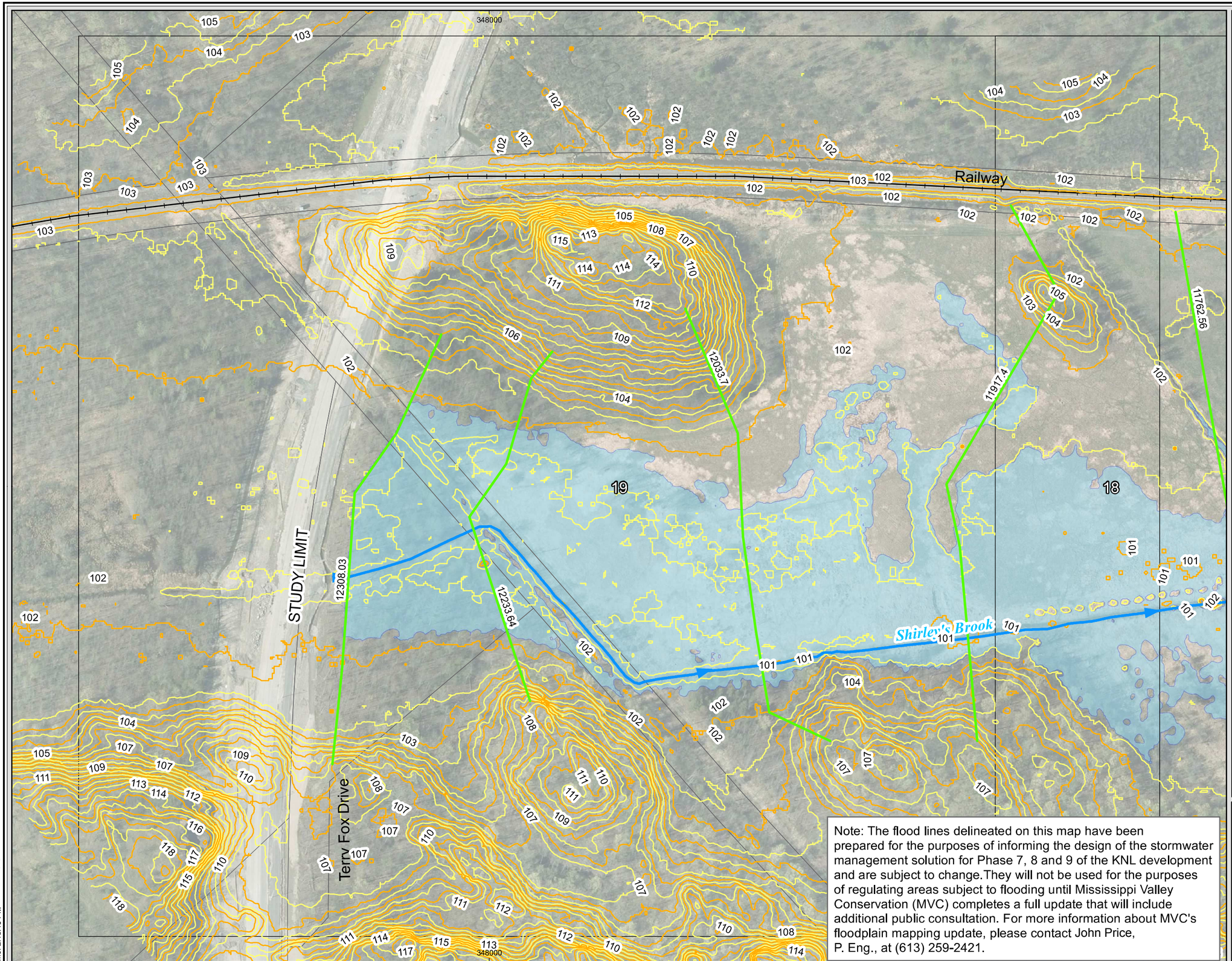

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- Shirley's Brook

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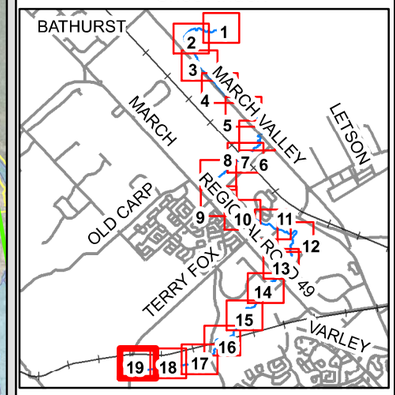
Sheet Index



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Shirley's Brook & Watt's Creek Phase 2 SWM Study

Shirley's Brook Flood Line Delineation

February 2015
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Sheet No. 19 of 19

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Shirley's Brook - Interim Conditions

Flows from SWMHYMO Model

		Peak Flow (cms)								
	Flow Point	**C4H25M10**	**S2400212**	**S2400512**	**C3H00510**	**C3H10010**	**HJU79**	**C3H12012**	**S2410612**	**S2412612**
SB1	**Flow Point 1**	0.00	0.29	1.05	0.45	3.34	6.62	5.48	5.79	8.94
SB2	**SFP2**	0.34	0.42	1.20	0.63	3.57	6.96	5.81	6.19	9.49
SB3	**SFP3**	0.12	0.37	1.15	0.44	3.40	6.65	5.59	6.09	9.44
SB4	**SFP4**	0.21	0.62	1.52	0.70	3.88	7.16	6.15	6.75	10.14
SB5	**SFP5**	0.58	1.23	2.01	1.52	3.95	7.19	6.23	7.18	10.67
SB6	**SFP6**	1.63	3.04	4.73	4.19	9.55	13.21	11.67	11.18	13.97
SB7	**SFP7**	2.45	4.33	4.94	4.32	10.36	16.22	14.12	13.01	17.64
SB8	**SFP8**	2.43	4.30	4.91	4.28	10.25	15.84	13.84	12.76	17.02
SB9	**SFP9**	3.26	5.78	7.23	6.23	15.25	23.09	19.92	18.62	24.44
SB10	**SFP10**	3.20	5.74	7.18	6.17	14.75	22.28	19.57	18.25	23.78
SB11	**SFP11**	3.19	5.87	7.44	6.33	15.34	23.66	20.58	19.04	25.36
SB12	**SFP12**	3.02	5.67	7.21	6.03	14.45	21.91	19.29	18.11	24.16
SB13	**SFP13**	2.99	5.81	7.62	6.14	14.88	22.30	19.87	18.83	25.38

Shirley's Brook - Interim Conditions

Flows to be used as steady state in HECRAS model

Realigned RS	Flow Point	River	Reach	RS	C4H25M10	S2400212	S2400512	C3H00510	C3H10010	HJU79	C3H12012	S2410612	S2412612
12556.39	Flow Point 1	Shirley	Tributary1	12308.03	0.00	0.29	1.05	0.45	3.34	6.62	5.48	5.79	8.94
10758.25	SFP2	Shirley	Tributary1	10758.25	0.34	0.42	1.20	0.63	3.57	6.96	5.81	6.19	9.49
	SFP3	Shirley	Tributary1	10453.9	0.12	0.37	1.15	0.44	3.40	6.65	5.59	6.09	9.44
	SFP4	Shirley	Tributary1	9269.78	0.21	0.62	1.52	0.70	3.88	7.16	6.15	6.75	10.14
	SFP5	Shirley	Tributary1	8147.386	0.58	1.23	2.01	1.52	3.95	7.19	6.23	7.18	10.67
		Shirley	Tributary1	6646.137	0.79	1.59	2.55	2.05	5.07	8.40	7.32	7.98	11.33
		Shirley	Tributary1	6518.839	1.00	1.95	3.10	2.59	6.19	9.60	8.41	8.78	11.99
		Shirley	Tributary1	6337.265	1.21	2.31	3.64	3.12	7.31	10.80	9.50	9.58	12.65
		Shirley	Tributary1	6178.128	1.42	2.68	4.19	3.65	8.43	12.00	10.58	10.38	13.31
	SFP6	Shirley	Tributary1	6095.834	1.63	3.04	4.73	4.19	9.55	13.21	11.67	11.18	13.97
		Shirley	Tributary1	5760.031	1.87	3.42	4.79	4.23	9.79	14.11	12.40	11.73	15.07
		Shirley	Tributary1	5629.195	2.12	3.81	4.86	4.26	10.03	15.01	13.14	12.27	16.16
		Shirley	Tributary1	5536.916	2.36	4.19	4.92	4.30	10.27	15.91	13.87	12.82	17.25
	SFP7	Shirley	Tributary1	5435.197	2.45	4.33	4.94	4.32	10.36	16.22	14.12	13.01	17.64
	SFP8	Shirley	Tributary1	5349.394	2.43	4.30	4.91	4.28	10.25	15.84	13.84	12.76	17.02
	SFP9	Shirley	Tributary1	4901.173	3.26	5.78	7.23	6.23	15.25	23.09	19.92	18.62	24.44
	SFP10	Shirley	Tributary1	4486.599	3.26	5.78	7.23	6.23	15.25	23.09	19.92	18.62	24.44
	SFP11	Shirley	Tributary1	4079.661	3.19	5.87	7.44	6.33	15.34	23.66	20.58	19.04	25.36
	SFP12	Shirley	Tributary1	3301.163	3.02	5.67	7.21	6.03	14.45	21.91	19.29	18.11	24.16
	SFP13	Shirley	Tributary1	1754.4	2.99	5.81	7.62	6.14	14.88	22.30	19.87	18.83	25.38

Shirley's Brook - Existing Conditions

Flows from SWMHYMO Model

		Peak Flow (cms)								
	Flow Point	**C4H25M10**	**S2400212**	**S2400512**	**C3H00510**	**C3H10010**	**HJU79**	**C3H12012**	**S2410612**	**S2412612**
SB1	**Flow Point 1**	0.00	0.29	1.05	0.45	3.34	6.62	5.49	5.80	8.95
SB2	**SFP2**	0.02	0.37	1.19	0.54	3.59	7.00	5.84	6.19	9.49
SB3	**SFP3**	0.06	0.36	1.13	0.43	3.41	6.68	5.62	6.09	9.45
SB4	**SFP4**	0.17	0.61	1.50	0.69	3.89	7.18	6.17	6.74	10.14
SB5	**SFP5**	0.57	1.19	1.93	1.47	3.96	7.21	6.25	7.17	10.68
SB6	**SFP6**	1.63	3.01	4.69	4.18	9.53	12.99	11.63	11.01	13.66
SB7	**SFP7**	2.44	4.30	4.89	4.31	10.29	16.17	14.08	12.99	17.94
SB8	**SFP8**	2.42	4.27	4.86	4.27	10.18	15.78	13.78	12.69	17.03
SB9	**SFP9**	3.26	5.74	7.18	6.21	15.18	22.99	19.85	18.48	24.31
SB10	**SFP10**	3.19	5.71	7.12	6.14	14.69	22.09	19.47	18.09	23.59
SB11	**SFP11**	3.18	5.83	7.38	6.30	15.25	23.51	20.50	18.87	25.16
SB12	**SFP12**	3.01	5.64	7.14	5.98	14.35	21.73	19.12	17.91	23.85
SB13	**SFP13**	2.98	5.77	7.55	6.09	14.77	22.10	19.63	18.68	25.10

Shirley's Brook - Existing Conditions

Flows to be used as steady state in HECRAS model

Flow Point	River	Reach	RS	C4H25M10	S2400212	S2400512	C3H00510	C3H10010	HJU79	C3H12012	S2410612	S2412612
Flow Point 1	Shirley	Tributary1	12308.03	0.00	0.29	1.05	0.45	3.34	6.62	5.49	5.80	8.95
SFP2	Shirley	Tributary1	10758.25	0.02	0.37	1.19	0.54	3.59	7.00	5.84	6.19	9.49
SFP3	Shirley	Tributary1	10453.9	0.06	0.36	1.13	0.43	3.41	6.68	5.62	6.09	9.45
SFP4	Shirley	Tributary1	9269.78	0.17	0.61	1.50	0.69	3.89	7.18	6.17	6.74	10.14
SFP5	Shirley	Tributary1	8147.386	0.57	1.19	1.93	1.47	3.96	7.21	6.25	7.17	10.68
	Shirley	Tributary1	6646.137	0.78	1.55	2.48	2.01	5.07	8.37	7.32	7.94	11.28
	Shirley	Tributary1	6518.839	0.99	1.92	3.03	2.55	6.19	9.52	8.40	8.71	11.87
	Shirley	Tributary1	6337.265	1.20	2.28	3.59	3.10	7.30	10.68	9.48	9.47	12.47
	Shirley	Tributary1	6178.128	1.41	2.65	4.14	3.64	8.42	11.83	10.55	10.24	13.06
SFP6	Shirley	Tributary1	6095.834	1.63	3.01	4.69	4.18	9.53	12.99	11.63	11.01	13.66
	Shirley	Tributary1	5760.031	1.87	3.40	4.75	4.22	9.76	13.94	12.36	11.60	14.93
	Shirley	Tributary1	5629.195	2.11	3.78	4.81	4.26	9.98	14.89	13.09	12.19	16.21
	Shirley	Tributary1	5536.916	2.35	4.17	4.87	4.29	10.21	15.84	13.82	12.78	17.49
SFP7	Shirley	Tributary1	5435.197	2.44	4.30	4.89	4.31	10.29	16.17	14.08	12.99	17.94
SFP8	Shirley	Tributary1	5349.394	2.42	4.27	4.86	4.27	10.18	15.78	13.78	12.69	17.03
SFP9	Shirley	Tributary1	4901.173	3.26	5.74	7.18	6.21	15.18	22.99	19.85	18.48	24.31
SFP10	Shirley	Tributary1	4486.599	3.26	5.74	7.18	6.21	15.18	22.99	19.85	18.48	24.31
SFP11	Shirley	Tributary1	4079.661	3.18	5.83	7.38	6.30	15.25	23.51	20.50	18.87	25.16
SFP12	Shirley	Tributary1	3301.163	3.01	5.64	7.14	5.98	14.35	21.73	19.12	17.91	23.85
SFP13	Shirley	Tributary1	1754.4	2.98	5.77	7.55	6.09	14.77	22.10	19.63	18.68	25.10

Shirley's Brook **Hydraulic Model Results - Existing Conditions with Updated Rail Line Culvert**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
12308.03		0.45	101.48	3.34	101.75	5.49	101.83	0.00	101.01	6.62	101.88	0.29	101.41	1.05	101.59	5.80	101.85	8.95	101.94
12233.64		0.45	101.44	3.34	101.71	5.49	101.80	0.00	100.91	6.62	101.84	0.29	101.37	1.05	101.55	5.80	101.81	8.95	101.90
12033.7		0.45	101.25	3.34	101.55	5.49	101.67	0.00	100.91	6.62	101.70	0.29	101.20	1.05	101.38	5.80	101.68	8.95	101.76
11917.4		0.45	101.17	3.34	101.42	5.49	101.55	0.00	100.91	6.62	101.58	0.29	101.14	1.05	101.25	5.80	101.56	8.95	101.63
11762.56		0.45	101.03	3.34	101.16	5.49	101.21	0.00	100.91	6.62	101.23	0.29	101.03	1.05	101.07	5.80	101.21	8.95	101.26
11567.16		0.45	100.19	3.34	100.61	5.49	100.72	0.00	99.81	6.62	100.76	0.29	100.12	1.05	100.35	5.80	100.73	8.95	100.84
11338.93		0.45	99.60	3.34	100.06	5.49	100.18	0.00	99.34	6.62	100.22	0.29	99.53	1.05	99.77	5.80	100.20	8.95	100.25
11169.32		0.45	99.33	3.34	99.76	5.49	99.90	0.00	98.91	6.62	99.96	0.29	99.26	1.05	99.49	5.80	99.92	8.95	100.03
11073.3		0.45	99.13	3.34	99.51	5.49	99.66	0.00	98.82	6.62	99.72	0.29	99.08	1.05	99.26	5.80	99.67	8.95	99.82
10997.52		0.45	98.95	3.34	99.29	5.49	99.44	0.00	98.61	6.62	99.51	0.29	98.89	1.05	99.06	5.80	99.46	8.95	99.63
10873.1		0.45	98.47	3.34	98.89	5.49	99.07	0.00	98.11	6.62	99.16	0.29	98.40	1.05	98.62	5.80	99.10	8.95	99.31
10823.93		0.45	97.73	3.34	98.19	5.49	98.38	0.00	97.51	6.62	98.45	0.29	97.68	1.05	97.88	5.80	98.40	8.95	98.60
10784.32		0.45	97.38	3.34	98.25	5.49	98.34	0.00	96.81	6.62	98.37	0.29	97.26	1.05	97.72	5.80	98.34	8.95	98.43
10781.03		0.45	97.35	3.34	98.24	5.49	98.34	0.00	96.81	6.62	98.37	0.29	97.24	1.05	97.66	5.80	98.34	8.95	98.43
10770.63	Culvert																		
10758.25		0.54	96.60	3.59	97.06	5.84	97.19	0.02	96.36	7.00	97.24	0.37	96.57	1.19	96.75	6.19	97.20	9.49	97.32
10753.84		0.54	96.58	3.59	96.85	5.84	96.93	0.02	96.35	7.00	96.97	0.37	96.54	1.19	96.70	6.19	96.95	9.49	97.04
10709.87		0.54	96.42	3.59	96.63	5.84	96.69	0.02	96.17	7.00	96.72	0.37	96.38	1.19	96.49	6.19	96.70	9.49	96.77
10633.91		0.54	96.07	3.59	96.24	5.84	96.33	0.02	95.85	7.00	96.37	0.37	96.04	1.19	96.14	6.19	96.34	9.49	96.47
10574.15		0.54	95.81	3.59	96.05	5.84	96.16	0.02	95.57	7.00	96.21	0.37	95.77	1.19	95.88	6.19	96.18	9.49	96.37
10515.42		0.54	95.48	3.59	95.64	5.84	95.72	0.02	95.26	7.00	95.76	0.37	95.46	1.19	95.55	6.19	95.73	9.49	96.20
10473.51		0.54	94.75	3.59	95.24	5.84	95.58	0.02	94.53	7.00	95.74	0.37	94.73	1.19	94.83	6.19	95.63	9.49	96.18
10470.06		0.54	94.64	3.59	95.24	5.84	95.56	0.02	94.32	7.00	95.72	0.37	94.58	1.19	94.82	6.19	95.61	9.49	96.15
10463.11	Bridge																		
10453.9		0.43	94.49	3.41	94.73	5.62	94.82	0.06	94.30	6.68	94.86	0.36	94.47	1.13	94.59	6.09	94.84	9.45	94.92
10441.99		0.43	94.44	3.41	94.7	5.62	94.82	0.06	94.27	6.68	94.86	0.36	94.43	1.13	94.52	6.09	94.84	9.45	94.96
10343.18		0.43	93.75	3.41	93.93	5.62	94.00	0.06	93.55	6.68	94.02	0.36	93.73	1.13	93.83	6.09	94.01	9.45	94.09
10149.12		0.43	92.99	3.41	93.23	5.62	93.34	0.06	92.83	6.68	93.39	0.36	92.97	1.13	93.07	6.09	93.36	9.45	93.50
10028.23		0.43	92.46	3.41	92.81	5.62	92.94	0.06	92.26	6.68	93.00	0.36	92.43	1.13	92.60	6.09	92.97	9.45	93.12
9916.492		0.43	91.94	3.41	92.06	5.62	92.11	0.06	91.91	6.68	92.13	0.36	91.94	1.13	91.98	6.09	92.12	9.45	92.18
9837.811		0.43	91.54	3.41	91.7	5.62	91.76	0.06	91.43	6.68	91.79	0.36	91.53	1.13	91.60	6.09	91.78	9.45	91.85
9740.979		0.43	91.04	3.41	91.21	5.62	91.28	0.06	90.90	6.68	91.30	0.36	91.03	1.13	91.09	6.09	91.29	9.45	91.37
9623.555		0.43	90.34	3.41	90.62	5.62	90.70	0.06	90.16	6.68	90.73	0.36	90.33	1.13	90.45	6.09	90.71	9.45	90.79
9473.968		0.43	89.83	3.41	90.15	5.62	90.25	0.06	89.66	6.68	90.28	0.36	89.81	1.13	89.97	6.09	90.26	9.45	90.37
9379.995		0.43	89.14	3.41	89.46	5.62	89.58	0.06	88.97	6.68	89.63	0.36	89.11	1.13	89.27	6.09	89.60	9.45	89.75
9320.319		0.43	87.19	3.41	87.61	5.62	87.77	0.06	87.04	6.68	87.84	0.36	87.17	1.13	87.37	6.09	87.80	9.45	87.99
9296.913		0.43	84.37	3.41	84.76	5.62	84.90	0.06	84.21	6.68	84.96	0.36	84.35	1.13	84.52	6.09	84.93	9.45	85.10
9269.78		0.69	83.30	3.89	83.55	6.17	83.67	0.17	83.16	7.18	83.72	0.61	83.29	1.50	83.39	6.74	83.70	10.14	83.84
9213.969		0.69	83.02	3.89	83.27	6.17	83.37	0.17	82.79	7.18	83.39	0.61	83.00	1.50	83.12	6.74	83.37	10.14	83.48
9087.692		0.69	82.23	3.89	82.55	6.17	82.66	0.17	82.08	7.18	82.75	0.61	82.21	1.50	82.34	6.74	82.74	10.14	82.82
9037.473		0.69	82.05	3.89	82.3	6.17	82.40	0.17	81.93	7.18	82.44	0.61	82.04	1.50	82.15	6.74	82.42	10.14	82.54
8955.241		0.69	81.73	3.89	81.95	6.17	82.08	0.17	81.53	7.18	82.13	0.61	81.71	1.50	81.81	6.74	82.11	10.14	82.24
8866.257		0.69	81.15	3.89	81.59	6.17	81.73	0.17	80.82	7.18	81.77	0.61	81.11	1.50	81.36	6.74	81.75	10.14	81.89
8793.795		0.69	81.00	3.89	81.42	6.17	81.58	0.17	80.66	7.18	81.62	0.61	80.97	1.50	81.21	6.74	81.60	10.14	81.72
8725.256		0.69	80.73	3.89	81.08	6.17	81.12	0.17	80.54	7.18	81.18	0.61	80.71	1.50	80.84	6.74	81.16	10.14	81.41
8590.857		0.69	80.02	3.89	80.63	6.17	80.89	0.17	79.80	7.18	81.03	0.61	80.00	1.50	80.26	6.74	80.97	10.14	81.35
8546.309		0.69	79.93	3.89	80.54	6.17	80.84	0.17	79.68	7.18	81.01	0.61	79.90	1.50	80.17	6.74	80.93	10.14	81.34
8481.811		0.69	79.60	3.89	80.27	6.17	80.73	0.17	79.43	7.18	80.94	0.61	79.58	1.50	79.78	6.74	80.85	10.14	81.32
8478.137		0.69	79.44	3.89	80.13	6.17	80.55	0.17	79.21	7.18	80.75	0.61	79.41	1.50	79.65	6.74	80.66	10.14	81.32
8464.13	Culvert																		
8451.362		0.69	79.39	3.89	79.76	6.17	79.83	0.17	79.15	7.18	79.84	0.61	79.37	1.50	79.54	6.74	79.84	10.14	79.93
8443.007		0.69	79.36	3.89	79.65	6.17	79.79	0.17	79.14	7.18	79.84	0.61	79.33	1.50	79.44	6.74	79.82	10.14	79.97
8393.492		0.69	79.00	3.89	79.5	6.17	79.66	0.17	78.83	7.18	79.72	0.61	78.98	1.50	79.22	6.74	79.69	10.14	79.82
8196.676		0.69	78.45	3.89	78.86	6.17	79.05	0.17	78.19	7.18	79.18	0.61	78.39	1.50	78.54	6.74	79.16	10.14	79.62
8190.341		0.69	78.45	3.89	78.85	6.17	79.00	0.17	78.19	7.18	79.11	0.61	78.39	1.50	78.55	6.74	79.10	10.14	79.47
8168.672	Culvert																		
8147.386		1.47	78.44	3.96	78.78	6.25	78.84	0.57	78.19	7.21	78.91	1.19	78.38	1.93	78.52	7.17	78.91	10.68	78.96
8134.654		1.47	78.40	3.96	78.76	6.25	78.79	0.57	78.16	7.21	78.99	1.19	78.35	1.93	78.49	7.17	78.98	10.68	79.14
7984.847		1.47	77.66	3.96	78.04	6.25	78.58	0.57	77.33	7.21	78.94	1.19	77.58	1.93	77.76	7.17	78.93	10.68	79.09
7921.126		1.47	77.48	3.96	77.83	6.25	78.55	0.57	77.20	7.21	78.93	1.19	77.40	1.93	77.57	7.17	78.92	10.68	79.08
7867.032		1.47	77.09	3.96	77.58	6.25	78.54	0.57	76.93	7.21	78.93	1.19	77.05	1.93	77.15	7.17	78.92	10.68	79.08
7863.271		1.47	76.89	3.96	77.45	6.25	78.40	0.57	76.62	7.21	78.93	1.19	76.81	1.93	77.00	7.17	78.92	10.68	79.08

Shirley's Brook **Hydraulic Model Results - Existing Conditions with Updated Rail Line Culvert**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
7840.144	Culvert																		
7818.661		1.47	76.67	3.96	76.92	6.25	77.19	0.57	76.52	7.21	77.30	1.19	76.63	1.93	76.71	7.17	77.29	10.68	77.64
7809.326		1.47	76.65	3.96	76.97	6.25	77.18	0.57	76.47	7.21	77.25	1.19	76.60	1.93	76.73	7.17	77.25	10.68	77.46
7750.895		1.47	76.49	3.96	76.81	6.25	77.02	0.57	76.29	7.21	77.09	1.19	76.44	1.93	76.56	7.17	77.09	10.68	77.29
7692.484		1.47	76.37	3.96	76.69	6.25	76.89	0.57	76.17	7.21	76.96	1.19	76.32	1.93	76.44	7.17	76.96	10.68	77.16
7591.312		1.47	76.02	3.96	76.36	6.25	76.54	0.57	75.78	7.21	76.60	1.19	75.96	1.93	76.10	7.17	76.60	10.68	76.79
7501.981		1.47	75.70	3.96	76	6.25	76.17	0.57	75.50	7.21	76.23	1.19	75.65	1.93	75.78	7.17	76.22	10.68	76.41
7465.594		1.47	75.54	3.96	75.74	6.25	75.82	0.57	75.40	7.21	75.93	1.19	75.51	1.93	75.59	7.17	75.90	10.68	76.08
7451.432		1.47	75.35	3.96	75.48	6.25	75.71	0.57	75.27	7.21	75.90	1.19	75.33	1.93	75.38	7.17	75.86	10.68	76.06
7333.883		1.47	75.09	3.96	75.4	6.25	75.72	0.57	74.95	7.21	75.91	1.19	75.05	1.93	75.15	7.17	75.87	10.68	76.07
7207.136		1.47	75.01	3.96	75.35	6.25	75.69	0.57	74.83	7.21	75.89	1.19	74.96	1.93	75.08	7.17	75.84	10.68	76.03
7140.229		1.47	74.92	3.96	75.3	6.25	75.67	0.57	74.70	7.21	75.87	1.19	74.86	1.93	75.00	7.17	75.82	10.68	76.01
7047.343		1.47	74.87	3.96	75.26	6.25	75.64	0.57	74.65	7.21	75.86	1.19	74.81	1.93	74.95	7.17	75.80	10.68	76.02
6893.653		1.47	74.77	3.96	75.15	6.25	75.57	0.57	74.56	7.21	75.81	1.19	74.71	1.93	74.84	7.17	75.75	10.68	75.98
6812.767		1.47	74.63	3.96	75.11	6.25	75.58	0.57	74.39	7.21	75.81	1.19	74.54	1.93	74.69	7.17	75.75	10.68	75.98
6747.781		1.47	74.64	3.96	75.11	6.25	75.57	0.57	74.40	7.21	75.81	1.19	74.55	1.93	74.70	7.17	75.75	10.68	75.98
6683.657		1.47	74.63	3.96	75.11	6.25	75.57	0.57	74.40	7.21	75.81	1.19	74.55	1.93	74.69	7.17	75.75	10.68	75.98
6678.357		1.47	74.62	3.96	75.06	6.25	75.51	0.57	74.40	7.21	75.81	1.19	74.54	1.93	74.67	7.17	75.74	10.68	75.97
6662.563	Culvert																		
6646.137		2.01	74.59	5.07	74.85	7.32	74.92	0.78	74.39	8.37	74.95	1.55	74.52	2.48	74.62	7.94	74.89	11.28	74.87
6631.114		2.01	74.60	5.07	74.9	7.32	75.03	0.78	74.39	8.37	75.09	1.55	74.53	2.48	74.64	7.94	75.03	11.28	75.16
6596.294		2.01	74.60	5.07	74.9	7.32	75.03	0.78	74.39	8.37	75.08	1.55	74.53	2.48	74.64	7.94	75.03	11.28	75.15
6565.697		2.01	74.60	5.07	74.9	7.32	75.03	0.78	74.39	8.37	75.08	1.55	74.53	2.48	74.64	7.94	75.02	11.28	75.15
6547.102		2.01	74.60	5.07	74.9	7.32	75.02	0.78	74.39	8.37	75.08	1.55	74.53	2.48	74.64	7.94	75.02	11.28	75.14
6518.839		2.55	74.60	6.19	74.9	8.40	75.02	0.99	74.39	9.52	75.07	1.92	74.53	3.03	74.64	8.71	75.02	11.87	75.13
6483.158		2.55	74.60	6.19	74.89	8.40	75.01	0.99	74.39	9.52	75.06	1.92	74.52	3.03	74.64	8.71	75.00	11.87	75.12
6410.477		2.55	74.58	6.19	74.87	8.40	74.99	0.99	74.38	9.52	75.04	1.92	74.51	3.03	74.62	8.71	74.99	11.87	75.10
6337.265		3.10	74.54	7.3	74.84	9.48	74.96	1.20	74.35	10.68	75.01	2.28	74.47	3.59	74.58	9.47	74.95	12.47	75.06
6258.598		3.10	74.46	7.3	74.77	9.48	74.90	1.20	74.29	10.68	74.95	2.28	74.40	3.59	74.50	9.47	74.88	12.47	75.00
6190.743		3.10	74.10	7.3	74.64	9.48	74.79	1.20	73.94	10.68	74.83	2.28	74.05	3.59	74.13	9.47	74.76	12.47	74.86
6178.128		3.64	73.88	8.42	74.64	10.55	74.79	1.41	73.59	11.83	74.83	2.65	73.77	4.14	73.94	10.24	74.77	13.06	74.87
6155.664	Culvert																		
6136.349		3.64	73.81	8.42	74.14	10.55	74.32	1.41	73.56	11.83	74.41	2.65	73.73	4.14	73.85	10.24	74.27	13.06	74.47
6095.834		4.18	73.83	9.53	74.16	11.63	74.34	1.63	73.57	12.99	74.43	3.01	73.74	4.69	73.87	11.01	74.28	13.66	74.49
5983.689		4.18	73.82	9.53	74.14	11.63	74.32	1.63	73.56	12.99	74.41	3.01	73.73	4.69	73.86	11.01	74.27	13.66	74.47
5931.329		4.18	73.81	9.53	74.12	11.63	74.30	1.63	73.56	12.99	74.39	3.01	73.72	4.69	73.84	11.01	74.25	13.66	74.46
5887.91		4.18	73.80	9.53	74.11	11.63	74.29	1.63	73.55	12.99	74.38	3.01	73.72	4.69	73.84	11.01	74.24	13.66	74.45
5854.557		4.18	73.79	9.53	74.09	11.63	74.27	1.63	73.55	12.99	74.36	3.01	73.71	4.69	73.83	11.01	74.22	13.66	74.43
5829.428		4.18	73.72	9.53	73.92	11.63	74.20	1.63	73.52	12.99	74.31	3.01	73.66	4.69	73.74	11.01	74.12	13.66	74.39
5760.031		4.22	73.57	9.76	73.9	12.36	74.21	1.87	73.39	13.94	74.32	3.40	73.53	4.75	73.60	11.60	74.13	14.93	74.39
5688.408		4.22	73.22	9.76	73.85	12.36	74.19	1.87	73.12	13.94	74.30	3.40	73.19	4.75	73.24	11.60	74.11	14.93	74.38
5629.195		4.26	72.90	9.98	73.85	13.09	74.18	2.11	72.63	14.89	74.29	3.78	72.89	4.81	72.98	12.19	74.10	16.21	74.37
5539.58		4.26	72.84	9.98	73.84	13.09	74.18	2.11	72.56	14.89	74.29	3.78	72.84	4.81	72.93	12.19	74.10	16.21	74.37
5536.916		4.29	72.79	10.21	73.83	13.82	74.18	2.35	72.54	15.84	74.29	4.17	72.79	4.87	72.87	12.78	74.09	17.49	74.37
5531.699	Culvert																		
5527.413		4.29	72.75	10.21	73.56	13.82	74.07	2.35	72.52	15.84	74.24	4.17	72.75	4.87	72.82	12.78	73.92	17.49	74.34
5522.147		4.29	72.78	10.21	73.56	13.82	74.06	2.35	72.53	15.84	74.24	4.17	72.78	4.87	72.86	12.78	73.92	17.49	74.34
5435.197		4.31	72.74	10.29	73.54	14.08	74.06	2.44	72.46	16.17	74.23	4.30	72.74	4.89	72.82	12.99	73.91	17.94	74.33
5382.4		4.31	72.72	10.29	73.53	14.08	74.05	2.44	72.44	16.17	74.23	4.30	72.72	4.89	72.80	12.99	73.90	17.94	74.33
5373.434		4.31	72.62	10.29	73.33	14.08	73.81	2.44	72.38	16.17	74.23	4.30	72.62	4.89	72.69	12.99	73.67	17.94	74.32
5361.118	Culvert																		
5349.394		4.27	72.35	10.18	72.82	13.78	73.05	2.42	72.27	15.78	73.17	4.27	72.35	4.86	72.40	12.69	72.98	17.03	73.24
5342.432		4.27	72.50	10.18	72.76	13.78	72.89	2.42	72.32	15.78	72.95	4.27	72.50	4.86	72.53	12.69	72.85	17.03	72.99
5201.062		4.27	71.71	10.18	72.08	13.78	72.25	2.42	71.64	15.78	72.33	4.27	71.71	4.86	71.76	12.69	72.20	17.03	72.38
5126.834		4.27	71.36	10.18	71.74	13.78	71.92	2.42	71.19	15.78	72.00	4.27	71.36	4.86	71.41	12.69	71.87	17.03	72.05
5062.261		4.27	71.20	10.18	71.59	13.78	71.76	2.42	71.03	15.78	71.86	4.27	71.20	4.86	71.25	12.69	71.72	17.03	71.90
4998.115		4.27	70.97	10.18	71.42	13.78	71.59	2.42	70.73	15.78	71.69	4.27	70.95	4.86	71.04	12.69	71.54	17.03	71.73
4901.173		6.21	70.66	15.18	71.05	19.85	71.18	3.26	70.44	22.99	71.25	5.74	70.63	7.18	70.72	18.48	71.14	24.31	71.25
4838.144		6.21	70.62	15.18	71.02	19.85	71.14	3.26	70.36	22.99	71.21	5.74	70.58	7.18	70.68	18.48	71.11	24.31	71.21
4751.767		6.21	70.46	15.18	70.87	19.85	70.99	3.26	70.17	22.99	71.07	5.74	70.42	7.18	70.52	18.48	70.96	24.31	71.11
4690.586		6.21	69.98	15.18	70.23	19.85	70.36	3.26	69.80	22.99	70.50	5.74	69.97	7.18	70.00	18.48	70.32	24.31	70.57
4635.215		6.21	69.23	15.18	69.75	19.85	70.03	3.26	69.05	22.99	70.26	5.74	69.19	7.18	69.31	18.48	69.94	24.31	70.39

Shirley's Brook **Hydraulic Model Results - Existing Conditions with Updated Rail Line Culvert**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
4564.609		6.21	69.02	15.18	69.55	19.85	69.88	3.26	68.69	22.99	70.15	5.74	68.98	7.18	69.09	18.48	69.78	24.31	70.31
4535.882		6.21	68.98	15.18	69.54	19.85	69.87	3.26	68.64	22.99	70.15	5.74	68.94	7.18	69.06	18.48	69.77	24.31	70.31
4525.185		6.21	68.99	15.18	69.52	19.85	69.83	3.26	68.65	22.99	70.11	5.74	68.94	7.18	69.06	18.48	69.73	24.31	70.26
4507.086	Culvert																		
4486.599		6.21	68.98	15.18	69.46	19.85	69.75	3.26	68.65	22.99	69.99	5.74	68.93	7.18	69.04	18.48	69.66	24.31	70.12
4462.663		6.21	68.94	15.18	69.39	19.85	69.71	3.26	68.62	22.99	70.00	5.74	68.90	7.18	69.00	18.48	69.59	24.31	70.14
4432.086		6.21	68.89	15.18	69.37	19.85	69.71	3.26	68.60	22.99	70.00	5.74	68.85	7.18	68.95	18.48	69.60	24.31	70.14
4334.765		6.21	68.76	15.18	69.28	19.85	69.67	3.26	68.52	22.99	69.97	5.74	68.73	7.18	68.82	18.48	69.54	24.31	70.12
4236.688		6.21	68.69	15.18	69.23	19.85	69.64	3.26	68.46	22.99	69.96	5.74	68.66	7.18	68.75	18.48	69.51	24.31	70.11
4167.088		6.21	68.59	15.18	69.2	19.85	69.63	3.26	68.38	22.99	69.95	5.74	68.56	7.18	68.66	18.48	69.49	24.31	70.10
4112.813		6.21	68.41	15.18	69.14	19.85	69.61	3.26	68.02	22.99	69.94	5.74	68.36	7.18	68.50	18.48	69.46	24.31	70.09
4110.796		6.21	68.37	15.18	68.97	19.85	69.42	3.26	68.05	22.99	69.76	5.74	68.33	7.18	68.44	18.48	69.27	24.31	69.91
4090.206	Culvert																		
4079.661		6.30	68.30	15.25	68.64	20.50	68.68	3.18	67.98	23.51	68.67	5.83	68.27	7.38	68.37	18.87	68.67	25.16	68.64
4045.686		6.30	68.28	15.25	68.68	20.50	68.79	3.18	67.94	23.51	68.83	5.83	68.24	7.38	68.35	18.87	68.76	25.16	68.86
3964.183		6.30	68.04	15.25	68.32	20.50	68.39	3.18	67.78	23.51	68.43	5.83	68.01	7.38	68.10	18.87	68.38	25.16	68.44
3910.996		6.30	67.89	15.25	68.13	20.50	68.20	3.18	67.68	23.51	68.23	5.83	67.86	7.38	67.94	18.87	68.18	25.16	68.24
3852.352		6.30	67.68	15.25	67.85	20.50	67.92	3.18	67.56	23.51	67.95	5.83	67.67	7.38	67.71	18.87	67.90	25.16	67.97
3787.461		6.30	67.55	15.25	67.73	20.50	67.80	3.18	67.41	23.51	67.84	5.83	67.53	7.38	67.58	18.87	67.78	25.16	67.86
3713.495		6.30	67.31	15.25	67.58	20.50	67.67	3.18	67.20	23.51	67.71	5.83	67.30	7.38	67.35	18.87	67.64	25.16	67.73
3653.05		6.30	67.26	15.25	67.55	20.50	67.63	3.18	67.13	23.51	67.67	5.83	67.25	7.38	67.31	18.87	67.60	25.16	67.69
3615.362		6.30	67.24	15.25	67.54	20.50	67.62	3.18	67.10	23.51	67.66	5.83	67.23	7.38	67.30	18.87	67.59	25.16	67.68
3539.195		6.30	67.21	15.25	67.52	20.50	67.59	3.18	67.02	23.51	67.64	5.83	67.19	7.38	67.27	18.87	67.57	25.16	67.65
3459.393		6.30	67.14	15.25	67.49	20.50	67.57	3.18	66.91	23.51	67.61	5.83	67.12	7.38	67.23	18.87	67.54	25.16	67.62
3361.237		6.30	66.90	15.25	67.44	20.50	67.50	3.18	66.47	23.51	67.54	5.83	66.83	7.38	67.11	18.87	67.48	25.16	67.55
3330.8		6.30	66.91	15.25	67.45	20.50	67.51	3.18	66.46	23.51	67.54	5.83	66.84	7.38	67.11	18.87	67.49	25.16	67.55
3320.636		6.30	66.62	15.25	67.44	20.50	67.50	3.18	66.18	23.51	67.53	5.83	66.55	7.38	66.87	18.87	67.48	25.16	67.55
3308.937	Culvert																		
3301.163		5.98	66.65	14.35	66.98	19.12	66.96	3.01	66.21	21.73	66.99	5.64	66.62	7.14	66.77	17.91	66.94	23.85	67.02
3292.083		5.98	66.66	14.35	67.03	19.12	67.05	3.01	66.26	21.73	67.10	5.64	66.63	7.14	66.79	17.91	67.03	23.85	67.13
3262.229		5.98	66.63	14.35	67.01	19.12	67.03	3.01	66.22	21.73	67.07	5.64	66.59	7.14	66.75	17.91	67.00	23.85	67.11
3211.613		5.98	66.55	14.35	66.99	19.12	66.99	3.01	66.14	21.73	67.03	5.64	66.52	7.14	66.68	17.91	66.96	23.85	67.07
3182.32		5.98	66.52	14.35	66.96	19.12	66.90	3.01	66.11	21.73	66.95	5.64	66.48	7.14	66.65	17.91	66.88	23.85	67.00
3157.212		5.98	66.51	14.35	66.95	19.12	66.87	3.01	66.09	21.73	66.92	5.64	66.47	7.14	66.64	17.91	66.84	23.85	66.97
3112.739		5.98	66.49	14.35	66.94	19.12	66.84	3.01	66.07	21.73	66.90	5.64	66.45	7.14	66.62	17.91	66.81	23.85	66.95
3106.096		5.98	66.39	14.35	66.17	19.12	66.83	3.01	66.03	21.73	66.89	5.64	66.36	7.14	66.50	17.91	66.80	23.85	66.95
3100.236	Culvert																		
3094.45		5.98	66.33	14.35	66.7	19.12	66.83	3.01	66.01	21.73	66.90	5.64	66.30	7.14	66.40	17.91	66.80	23.85	66.95
3086.02		5.98	66.35	14.35	66.63	19.12	66.74	3.01	66.01	21.73	66.80	5.64	66.32	7.14	66.43	17.91	66.71	23.85	66.85
3065.567		5.98	66.32	14.35	66.54	19.12	66.58	3.01	65.99	21.73	66.58	5.64	66.29	7.14	66.40	17.91	66.57	23.85	66.60
2993.621		5.98	66.20	14.35	66.51	19.12	66.59	3.01	65.91	21.73	66.57	5.64	66.17	7.14	66.27	17.91	66.56	23.85	66.61
2926.23		5.98	66.09	14.35	66.42	19.12	66.46	3.01	65.84	21.73	66.52	5.64	66.07	7.14	66.16	17.91	66.52	23.85	66.55
2838.9		5.98	65.91	14.35	66.1	19.12	66.15	3.01	65.72	21.73	66.19	5.64	65.90	7.14	65.95	17.91	66.14	23.85	66.22
2716.764		5.98	65.69	14.35	65.86	19.12	65.91	3.01	65.55	21.73	65.94	5.64	65.68	7.14	65.73	17.91	65.90	23.85	65.96
2517.733		5.98	65.46	14.35	65.6	19.12	65.66	3.01	65.36	21.73	65.69	5.64	65.45	7.14	65.49	17.91	65.64	23.85	65.72
2400.535		5.98	65.30	14.35	65.47	19.12	65.55	3.01	65.19	21.73	65.58	5.64	65.29	7.14	65.33	17.91	65.53	23.85	65.62
2199.535		5.98	64.99	14.35	65.22	19.12	65.31	3.01	64.86	21.73	65.35	5.64	64.97	7.14	65.03	17.91	65.28	23.85	65.39
2073.74		5.98	64.74	14.35	64.98	19.12	65.07	3.01	64.61	21.73	65.10	5.64	64.72	7.14	64.78	17.91	65.05	23.85	65.13
2011.088		5.98	64.62	14.35	64.88	19.12	64.96	3.01	64.47	21.73	65.01	5.64	64.60	7.14	64.66	17.91	64.94	23.85	65.04
1869.72		5.98	64.50	14.35	64.75	19.12	64.81	3.01	64.37	21.73	64.86	5.64	64.49	7.14	64.55	17.91	64.80	23.85	64.90
1754.4		6.09	64.37	14.77	64.64	19.63	64.64	2.98	64.21	22.10	64.68	5.77	64.35	7.55	64.42	18.68	64.62	25.10	64.71
1600.626		6.09	63.95	14.77	64.18	19.63	64.33	2.98	63.82	22.10	64.40	5.77	63.94	7.55	64.00	18.68	64.31	25.10	64.52
1476.175		6.09	63.81	14.77	64.11	19.63	64.25	2.98	63.66	22.10	64.34	5.77	63.79	7.55	63.87	18.68	64.22	25.10	64.47
1299.13		6.09	63.49	14.77	63.9	19.63	64.07	2.98	63.22	22.10	64.18	5.77	63.47	7.55	63.58	18.68	64.04	25.10	64.36
1287.573		6.09	63.48	14.77	63.79	19.63	63.90	2.98	63.21	22.10	64.00	5.77	63.46	7.55	63.56	18.68	63.88	25.10	64.18
1276.827	Bridge																		
1263.755		6.09	63.44	14.77	63.69	19.63	63.75	2.98	63.18	22.10	63.77	5.77	63.42	7.55	63.51	18.68	63.74	25.10	63.78
1247.371		6.09	63.36	14.77	63.68	19.63	63.78	2.98	63.08	22.10	63.82	5.77	63.34	7.55	63.45	18.68	63.76	25.10	63.87
1133.542		6.09	62.80	14.77	63.16	19.63	63.28	2.98	62.58	22.10	63.33	5.77	62.78	7.55	62.89	18.68	63.26	25.10	63.39
954.9156		6.09	62.45	14.77	62.73	19.63	62.83	2.98	62.15	22.10	62.86	5.77	62.43	7.55	62.54	18.68	62.81	25.10	62.91
846.8483		6.09	62.18	14.77	62.55	19.63	62.67	2.98	61.86	22.10	62.66	5.77	62.15	7.55	62.27	18.68	62.65	25.10	62.70
747.0098		6.09	61.83	14.77	62.2	19.63	62.34	2.98	61.59	22.10	62.39	5.77	61.81	7.55	61.91	18.68	62.32	25.10	62.46

Shirley's Brook **Hydraulic Model Results - Existing Conditions with Updated Rail Line Culvert**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
632.3096		6.09	61.50	14.77	61.86	19.63	61.99	2.98	61.16	22.10	62.05	5.77	61.47	7.55	61.58	18.68	61.97	25.10	62.11
492.7144		6.09	61.07	14.77	61.4	19.63	61.51	2.98	60.81	22.10	61.57	5.77	61.06	7.55	61.14	18.68	61.49	25.10	61.63
414.3949		6.09	60.91	14.77	61.17	19.63	61.26	2.98	60.71	22.10	61.30	5.77	60.89	7.55	60.94	18.68	61.24	25.10	61.36
334.7006		6.09	60.79	14.77	60.95	19.63	60.95	2.98	60.61	22.10	60.98	5.77	60.77	7.55	60.71	18.68	60.94	25.10	61.01
246.4345		6.09	60.36	14.77	60.43	19.63	60.48	2.98	60.17	22.10	60.51	5.77	60.35	7.55	60.41	18.68	60.47	25.10	60.54
185.9653		6.09	60.08	14.77	60.26	19.63	60.31	2.98	59.89	22.10	60.34	5.77	60.06	7.55	60.09	18.68	60.30	25.10	60.37
78.72429		6.09	59.86	14.77	59.96	19.63	60.03	2.98	59.64	22.10	60.06	5.77	59.85	7.55	59.92	18.68	60.01	25.10	60.08
29.9602		6.09	59.53	14.77	59.78	19.63	59.78	2.98	59.51	22.10	59.80	5.77	59.52	7.55	59.58	18.68	59.78	25.10	59.82

Shirley's Brook **Hydraulic Model Results - Interim Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
12556.39	Realigned Shirley's Brook	0.45	100.72	3.34	101.33	5.48	101.52	0.00	100.40	6.62	101.61	0.29	100.64	1.05	100.91	5.79	101.55	8.94	101.76
12393.71	Realigned Shirley's Brook	0.45	100.46	3.34	101.02	5.48	101.27	0.00	100.15	6.62	101.38	0.29	100.39	1.05	100.63	5.79	101.30	8.94	101.58
12343.71	Realigned Shirley's Brook	0.45	100.32	3.34	100.81	5.48	101.02	0.00	100.08	6.62	101.12	0.29	100.26	1.05	100.47	5.79	101.05	8.94	101.29
12334.39	Realigned Shirley's Brook	0.45	100.29	3.34	100.79	5.48	101.00	0.00	100.07	6.62	101.10	0.29	100.24	1.05	100.44	5.79	101.03	8.94	101.27
12286.39	Realigned Shirley's Brook	0.45	100.22	3.34	100.71	5.48	100.92	0.00	99.99	6.62	101.02	0.29	100.17	1.05	100.37	5.79	100.95	8.94	101.18
12193.71	Realigned Shirley's Brook	0.45	100.07	3.34	100.55	5.48	100.75	0.00	99.85	6.62	100.83	0.29	100.02	1.05	100.24	5.79	100.77	8.94	100.98
12093.71	Realigned Shirley's Brook	0.45	99.97	3.34	100.44	5.48	100.63	0.00	99.70	6.62	100.72	0.29	99.91	1.05	100.16	5.79	100.66	8.94	100.88
12031.71	Realigned Shirley's Brook	0.45	99.92	3.34	100.39	5.48	100.59	0.00	99.61	6.62	100.69	0.29	99.85	1.05	100.11	5.79	100.62	8.94	100.85
11943.71	Realigned Shirley's Brook	0.45	99.74	3.34	100.27	5.48	100.48	0.00	99.48	6.62	100.58	0.29	99.67	1.05	99.93	5.79	100.51	8.94	100.75
11931.4	Realigned Shirley's Brook	0.45	99.73	3.34	100.26	5.48	100.47	0.00	99.46	6.62	100.56	0.29	99.66	1.05	99.93	5.79	100.50	8.94	100.73
11871.4	Realigned Shirley's Brook	0.45	99.67	3.34	100.19	5.48	100.40	0.00	99.37	6.62	100.49	0.29	99.60	1.05	99.87	5.79	100.42	8.94	100.65
11843.71	Realigned Shirley's Brook	0.45	99.63	3.34	100.16	5.48	100.37	0.00	99.26	6.62	100.46	0.29	99.56	1.05	99.83	5.79	100.39	8.94	100.62
11743.71	Realigned Shirley's Brook	0.45	99.49	3.34	99.98	5.48	100.16	0.00	99.18	6.62	100.24	0.29	99.42	1.05	99.70	5.79	100.18	8.94	100.39
11708.4	Realigned Shirley's Brook	0.45	99.43	3.34	99.89	5.48	100.06	0.00	99.12	6.62	100.13	0.29	99.36	1.05	99.65	5.79	100.08	8.94	100.28
11593.71	Realigned Shirley's Brook	0.45	99.22	3.34	99.69	5.48	99.87	0.00	98.90	6.62	99.95	0.29	99.16	1.05	99.43	5.79	99.89	8.94	100.11
11533.7	Realigned Shirley's Brook	0.45	99.13	3.34	99.6	5.48	99.79	0.00	98.87	6.62	99.88	0.29	99.07	1.05	99.32	5.79	99.81	8.94	100.04
11433.4	Realigned Shirley's Brook	0.45	98.99	3.34	99.46	5.48	99.66	0.00	98.72	6.62	99.76	0.29	98.93	1.05	99.16	5.79	99.69	8.94	99.93
11383.71	Realigned Shirley's Brook	0.45	98.90	3.34	99.38	5.48	99.60	0.00	98.63	6.62	99.70	0.29	98.84	1.05	99.05	5.79	99.63	8.94	99.87
11293.71	Realigned Shirley's Brook	0.45	98.72	3.34	99.22	5.48	99.43	0.00	98.50	6.62	99.52	0.29	98.67	1.05	98.87	5.79	99.45	8.94	99.68
11178.72	Realigned Shirley's Brook	0.45	98.56	3.34	99.1	5.48	99.30	0.00	98.33	6.62	99.39	0.29	98.50	1.05	98.73	5.79	99.33	8.94	99.55
11093.71	Realigned Shirley's Brook	0.45	98.48	3.34	99.04	5.48	99.24	0.00	98.20	6.62	99.32	0.29	98.41	1.05	98.67	5.79	99.26	8.94	99.48
11043.71	Realigned Shirley's Brook	0.45	98.44	3.34	99	5.48	99.19	0.00	98.13	6.62	99.28	0.29	98.37	1.05	98.64	5.79	99.22	8.94	99.43
10993.71	Realigned Shirley's Brook	0.45	98.37	3.34	98.97	5.48	99.17	0.00	98.05	6.62	99.26	0.29	98.30	1.05	98.58	5.79	99.20	8.94	99.42
10947.39	Realigned Shirley's Brook	0.45	98.30	3.34	98.91	5.48	99.11	0.00	97.98	6.62	99.21	0.29	98.23	1.05	98.51	5.79	99.14	8.94	99.37
10823.93		0.45	97.73	3.34	98.19	5.48	98.38	0.00	97.51	6.62	98.45	0.29	97.68	1.05	97.88	5.79	98.40	8.94	98.60
10784.32		0.45	97.38	3.34	98.25	5.48	98.34	0.00	96.80	6.62	98.37	0.29	97.26	1.05	97.72	5.79	98.35	8.94	98.43
10781.03		0.45	97.35	3.34	98.24	5.48	98.34	0.00	96.80	6.62	98.37	0.29	97.24	1.05	97.66	5.79	98.35	8.94	98.43
10770.63	Culvert																		
10758.25		0.63	96.61	3.57	97.06	5.81	97.18	0.34	96.56	6.96	97.23	0.42	96.58	1.20	96.75	6.19	97.20	9.49	97.32
10753.84		0.63	96.61	3.57	96.85	5.81	96.93	0.34	96.53	6.96	96.97	0.42	96.54	1.20	96.70	6.19	96.95	9.49	97.04
10709.87		0.63	96.43	3.57	96.63	5.81	96.69	0.34	96.37	6.96	96.72	0.42	96.39	1.20	96.49	6.19	96.70	9.49	96.77
10633.91		0.63	96.08	3.57	96.24	5.81	96.33	0.34	96.03	6.96	96.37	0.42	96.05	1.20	96.14	6.19	96.34	9.49	96.47
10574.15		0.63	95.82	3.57	96.05	5.81	96.16	0.34	95.76	6.96	96.21	0.42	95.78	1.20	95.88	6.19	96.18	9.49	96.37
10515.42		0.63	95.49	3.57	95.64	5.81	95.72	0.34	95.45	6.96	95.76	0.42	95.47	1.20	95.56	6.19	95.73	9.49	96.20
10473.51		0.63	94.77	3.57	95.23	5.81	95.56	0.34	94.72	6.96	95.72	0.42	94.74	1.20	94.83	6.19	95.61	9.49	96.18
10470.06		0.63	94.66	3.57	95.22	5.81	95.52	0.34	94.56	6.96	95.67	0.42	94.60	1.20	94.81	6.19	95.57	9.49	96.12
10463.11	Bridge																		
10453.9		0.44	94.49	3.4	94.73	5.59	94.82	0.12	94.36	6.65	94.86	0.37	94.47	1.15	94.59	6.09	94.84	9.44	94.92
10441.99		0.44	94.44	3.4	94.7	5.59	94.81	0.12	94.31	6.65	94.86	0.37	94.43	1.15	94.53	6.09	94.84	9.44	94.96
10343.18		0.44	93.74	3.4	93.93	5.59	94.00	0.12	93.62	6.65	94.02	0.37	93.74	1.15	93.83	6.09	94.01	9.44	94.09
10149.12		0.44	93.01	3.4	93.23	5.59	93.34	0.12	92.87	6.65	93.39	0.37	92.97	1.15	93.07	6.09	93.36	9.44	93.50
10028.23		0.44	92.46	3.4	92.81	5.59	92.94	0.12	92.30	6.65	92.99	0.37	92.44	1.15	92.60	6.09	92.97	9.44	93.12
9916.492		0.44	91.94	3.4	92.06	5.59	92.11	0.12	91.92	6.65	92.13	0.37	91.94	1.15	91.98	6.09	92.12	9.44	92.18
9837.811		0.44	91.54	3.4	91.7	5.59	91.76	0.12	91.45	6.65	91.79	0.37	91.54	1.15	91.60	6.09	91.78	9.44	91.85
9740.979		0.44	91.04	3.4	91.21	5.59	91.27	0.12	91.01	6.65	91.30	0.37	91.03	1.15	91.10	6.09	91.29	9.44	91.37
9623.555		0.44	90.35	3.4	90.62	5.59	90.70	0.12	90.23	6.65	90.73	0.37	90.33	1.15	90.46	6.09	90.71	9.44	90.79
9473.968		0.44	89.83	3.4	90.15	5.59	90.24	0.12	89.72	6.65	90.28	0.37	89.82	1.15	89.97	6.09	90.26	9.44	90.37
9379.995		0.44	89.14	3.4	89.46	5.59	89.58	0.12	89.01	6.65	89.63	0.37	89.11	1.15	89.27	6.09	89.60	9.44	89.75
9320.319		0.44	87.20	3.4	87.61	5.59	87.77	0.12	87.08	6.65	87.84	0.37	87.18	1.15	87.37	6.09	87.80	9.44	87.99
9296.913		0.44	84.37	3.4	84.76	5.59	84.90	0.12	84.25	6.65	84.96	0.37	84.35	1.15	84.53	6.09	84.93	9.44	85.10
9269.78		0.70	83.30	3.88	83.55	6.15	83.67	0.21	83.18	7.16	83.71	0.62	83.29	1.52	83.39	6.75	83.70	10.14	83.84
9213.969		0.70	83.02	3.88	83.27	6.15	83.37	0.21	82.82	7.16	83.39	0.62	83.00	1.52	83.12	6.75	83.37	10.14	83.48
9087.692		0.70	82.24	3.88	82.55	6.15	82.66	0.21	82.10	7.16	82.75	0.62	82.22	1.52	82.34	6.75	82.74	10.14	82.82
9037.473		0.70	82.05	3.88	82.3	6.15	82.40	0.21	81.95	7.16	82.44	0.62	82.04	1.52	82.15	6.75	82.42	10.14	82.54
8955.241		0.70	81.73	3.88	81.95	6.15	82.08	0.21	81.55	7.16	82.12	0.62	81.71	1.52	81.81	6.75	82.11	10.14	82.24
8866.257		0.70	81.15	3.88	81.59	6.15	81.73	0.21	80.84	7.16	81.77	0.62	81.11	1.52	81.36	6.75	81.75	10.14	81.89
8793.795		0.70	81.01	3.88	81.42	6.15	81.58	0.21	80.70	7.16	81.62	0.62	80.97	1.52	81.21	6.75	81.60	10.14	81.72
8725.256		0.70	80.73	3.88	81.08	6.15	81.12	0.21	80.56	7.16	81.18	0.62	80.71	1.52	80.84	6.75	81.16	10.14	81.41
8590.857		0.70	80.03	3.88	80.63	6.15	80.89	0.21	79.82	7.16	81.03	0.62	80.00	1.52	80.26	6.75	80.97	10.14	81.35
8546.309		0.70	79.93	3.88	80.54	6.15	80.84	0.21	79.71	7.16	81.00	0.62	79.90	1.52	80.18	6.75	80.93	10.14	81.34
8481.811		0.70	79.60	3.88	80.27	6.15	80.73	0.21	79.45	7.16	80.94	0.62	79.58	1.52	79.79	6.75	80.85	10.14	81.32
8478.137		0.70	79.44	3.88	80.13	6.15	80.55	0.21	79.23	7.16	80.75	0.62	79.41	1.52	79.65	6.75	80.66	10.14	81.32
8464.13	Culvert																		
8451.362		0.70	79.40	3.88	79.76	6.15	79.83	0.21	79.18	7.16	79.84	0.62	79.37	1.52	79.54	6.75	79.84	10.14	79.93
8443.007		0.70	79.36	3.88	79.65	6.15	79.79	0.21	79.16	7.16	79.84	0.62	79.33	1.52	79.45	6.75	79.82	10.14	79.97
8393.492		0.70	79.00	3.88	79.49	6.15	79.66	0.21	78.85	7.16	79.71	0.62	78.98	1.52	79.22	6.75	79.69	10.14	79.82
8196.676		0.70	78.46	3.88	78.86	6.15	79.04	0.21	78.20	7.16	79.17	0.62	78.40	1.52	78.56	6.75	79.16	10.14	79.62
8190.341		0.70	78.46	3.88	78.85	6.15	78.99	0.21	78.20	7.16	79.10	0.62	78.40	1.52	78.56	6.75	79.10	10.14	79.48
8168.672	Culvert																		
8147.386		1.52	78.44	3.95	78.78	6.23	78.83	0.58	78.19	7.19	78.91	1.23	78.39	2.01	78.53	7.18	78.91	10.67	78.97
8134.654		1.52	78.41	3.95	78.75	6.23	78.79	0.58	78.17	7.19	78.98	1.23	78.36	2.01	78.50	7.18	78.98	10.67	79.15
7984.847		1.52	77.68	3.95	78.04	6.23	78.57	0.58	77.33	7.19	78.93	1.23	77.59	2.01	77.78	7.18	78.93	10.67	79.10
7921.126		1.52	77.49	3.95	77.83	6.23	78.54	0.58	77.20	7.19	78.92	1.23	77.41	2.01	77.58	7.18	78.92	10.67	79.09
7867.032		1.52	77.10	3.95	77.57	6.23	78.52	0.58	76.93	7.19	78.92	1.23	77.06	2.01	77.16	7.18	78.92	10.67	79.09
7863.271		1.52	76.90	3.95	77.44	6.23	78.39	0.58	76.63	7.19	78.92	1.23	76.82	2.01	77.02	7.18	78.92	10.67	79.09
7840.144	Culvert																		

Shirley's Brook **Hydraulic Model Results - Interim Conditions**

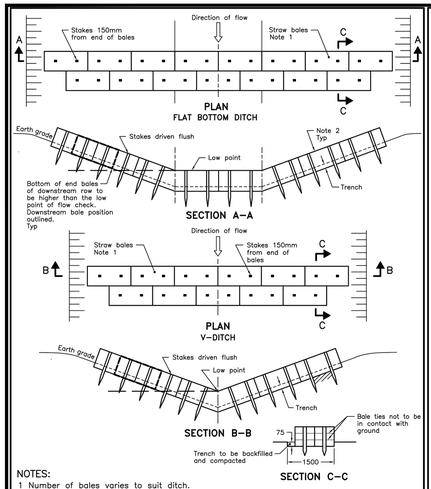
		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
7818.661		1.52	76.67	3.95	76.92	6.23	77.19	0.58	76.52	7.19	77.29	1.23	76.64	2.01	76.71	7.18	77.30	10.67	77.63
7809.326		1.52	76.66	3.95	76.97	6.23	77.18	0.58	76.47	7.19	77.25	1.23	76.61	2.01	76.74	7.18	77.25	10.67	77.46
7750.895		1.52	76.50	3.95	76.81	6.23	77.02	0.58	76.30	7.19	77.09	1.23	76.45	2.01	76.57	7.18	77.09	10.67	77.29
7692.484		1.52	76.38	3.95	76.69	6.23	76.89	0.58	76.17	7.19	76.96	1.23	76.33	2.01	76.46	7.18	76.96	10.67	77.16
7591.312		1.52	76.03	3.95	76.35	6.23	76.54	0.58	75.78	7.19	76.60	1.23	75.97	2.01	76.11	7.18	76.60	10.67	76.79
7501.981		1.52	75.71	3.95	76	6.23	76.17	0.58	75.51	7.19	76.22	1.23	75.66	2.01	75.79	7.18	76.22	10.67	76.41
7465.594		1.52	75.55	3.95	75.74	6.23	75.82	0.58	75.40	7.19	75.93	1.23	75.51	2.01	75.60	7.18	75.91	10.67	76.08
7451.432		1.52	75.35	3.95	75.48	6.23	75.71	0.58	75.27	7.19	75.90	1.23	75.33	2.01	75.38	7.18	75.86	10.67	76.06
7333.883		1.52	75.10	3.95	75.4	6.23	75.72	0.58	74.95	7.19	75.91	1.23	75.05	2.01	75.16	7.18	75.87	10.67	76.07
7207.136		1.52	75.02	3.95	75.35	6.23	75.69	0.58	74.84	7.19	75.88	1.23	74.96	2.01	75.09	7.18	75.84	10.67	76.03
7140.229		1.52	74.93	3.95	75.3	6.23	75.66	0.58	74.71	7.19	75.87	1.23	74.87	2.01	75.01	7.18	75.83	10.67	76.01
7047.343		1.52	74.88	3.95	75.26	6.23	75.64	0.58	74.65	7.19	75.85	1.23	74.82	2.01	74.96	7.18	75.81	10.67	76.02
6893.653		1.52	74.78	3.95	75.15	6.23	75.57	0.58	74.57	7.19	75.80	1.23	74.72	2.01	74.85	7.18	75.75	10.67	75.98
6812.767		1.52	74.63	3.95	75.11	6.23	75.58	0.58	74.39	7.19	75.81	1.23	74.55	2.01	74.70	7.18	75.76	10.67	75.98
6747.781		1.52	74.64	3.95	75.11	6.23	75.57	0.58	74.40	7.19	75.81	1.23	74.56	2.01	74.71	7.18	75.75	10.67	75.98
6683.657		1.52	74.64	3.95	75.11	6.23	75.57	0.58	74.40	7.19	75.80	1.23	74.55	2.01	74.70	7.18	75.75	10.67	75.98
6678.357		1.52	74.62	3.95	75.06	6.23	75.51	0.58	74.40	7.19	75.80	1.23	74.54	2.01	74.68	7.18	75.74	10.67	75.97
6662.563	Culvert																		
6646.137		2.05	74.59	5.07	74.85	7.32	74.92	0.79	74.39	8.40	74.95	1.59	74.52	2.55	74.63	7.98	74.90	11.33	74.88
6631.114		2.05	74.61	5.07	74.91	7.32	75.03	0.79	74.39	8.40	75.09	1.59	74.53	2.55	74.65	7.98	75.03	11.33	75.16
6596.294		2.05	74.60	5.07	74.9	7.32	75.03	0.79	74.39	8.40	75.09	1.59	74.53	2.55	74.65	7.98	75.03	11.33	75.16
6565.697		2.05	74.60	5.07	74.9	7.32	75.03	0.79	74.39	8.40	75.09	1.59	74.53	2.55	74.65	7.98	75.03	11.33	75.16
6547.102		2.05	74.60	5.07	74.9	7.32	75.02	0.79	74.39	8.40	75.08	1.59	74.53	2.55	74.65	7.98	75.02	11.33	75.14
6518.839		2.59	74.60	6.19	74.9	8.41	75.02	1.00	74.39	9.60	75.08	1.95	74.53	3.10	74.65	8.78	75.02	11.99	75.14
6483.158		2.59	74.60	6.19	74.89	8.41	75.01	1.00	74.39	9.60	75.06	1.95	74.53	3.10	74.64	8.78	75.01	11.99	75.13
6410.477		2.59	74.58	6.19	74.87	8.41	74.99	1.00	74.38	9.60	75.05	1.95	74.51	3.10	74.63	8.78	74.99	11.99	75.11
6337.265		3.12	74.54	7.31	74.84	9.50	74.96	1.21	74.35	10.80	75.01	2.31	74.47	3.64	74.58	9.58	74.95	12.65	75.07
6258.598		3.12	74.47	7.31	74.77	9.50	74.90	1.21	74.29	10.80	74.95	2.31	74.40	3.64	74.50	9.58	74.89	12.65	75.00
6190.743		3.12	74.10	7.31	74.64	9.50	74.79	1.21	73.94	10.80	74.83	2.31	74.05	3.64	74.14	9.58	74.77	12.65	74.87
6178.128		3.65	73.89	8.43	74.64	10.58	74.79	1.42	73.59	12.00	74.84	2.68	73.77	4.19	73.95	10.38	74.77	13.31	74.87
6155.664	Culvert																		
6136.349		3.65	73.81	8.43	74.15	10.58	74.32	1.42	73.56	12.00	74.42	2.68	73.73	4.19	73.85	10.38	74.27	13.31	74.47
6095.834		4.19	73.83	9.55	74.16	11.67	74.34	1.63	73.57	13.21	74.43	3.04	73.74	4.73	73.87	11.18	74.29	13.97	74.49
5983.689		4.19	73.82	9.55	74.14	11.67	74.32	1.63	73.56	13.21	74.42	3.04	73.74	4.73	73.86	11.18	74.27	13.97	74.47
5931.329		4.19	73.81	9.55	74.12	11.67	74.30	1.63	73.56	13.21	74.40	3.04	73.73	4.73	73.85	11.18	74.25	13.97	74.45
5887.91		4.19	73.80	9.55	74.11	11.67	74.30	1.63	73.55	13.21	74.39	3.04	73.72	4.73	73.84	11.18	74.24	13.97	74.44
5854.557		4.19	73.79	9.55	74.09	11.67	74.28	1.63	73.55	13.21	74.37	3.04	73.71	4.73	73.83	11.18	74.22	13.97	74.42
5829.428		4.19	73.72	9.55	73.93	11.67	74.20	1.63	73.52	13.21	74.31	3.04	73.66	4.73	73.75	11.18	74.12	13.97	74.38
5760.031		4.23	73.57	9.79	73.91	12.40	74.21	1.87	73.39	14.11	74.32	3.42	73.53	4.79	73.60	11.73	74.13	15.07	74.39
5688.408		4.23	73.22	9.79	73.86	12.40	74.19	1.87	73.12	14.11	74.31	3.42	73.19	4.79	73.24	11.73	74.11	15.07	74.38
5629.195		4.26	72.90	10.03	73.85	13.14	74.19	2.12	72.63	15.01	74.30	3.81	72.89	4.86	72.98	12.27	74.11	16.16	74.37
5539.58		4.26	72.85	10.03	73.85	13.14	74.18	2.12	72.56	15.01	74.29	3.81	72.84	4.86	72.94	12.27	74.10	16.16	74.36
5536.916		4.30	72.80	10.27	73.84	13.87	74.18	2.36	72.54	15.91	74.29	4.19	72.80	4.92	72.88	12.82	74.10	17.25	74.36
5531.699	Culvert																		
5527.413		4.30	72.75	10.27	73.57	13.87	74.07	2.36	72.52	15.91	74.25	4.19	72.76	4.92	72.83	12.82	73.92	17.25	74.33
5522.147		4.30	72.78	10.27	73.57	13.87	74.07	2.36	72.53	15.91	74.25	4.19	72.78	4.92	72.87	12.82	73.92	17.25	74.33
5435.197		4.32	72.74	10.36	73.55	14.12	74.06	2.45	72.47	16.22	74.24	4.33	72.74	4.94	72.83	13.01	73.91	17.64	74.32
5382.4		4.32	72.72	10.36	73.54	14.12	74.06	2.45	72.44	16.22	74.23	4.33	72.72	4.94	72.81	13.01	73.90	17.64	74.32
5373.434		4.32	72.62	10.36	73.34	14.12	73.82	2.45	72.38	16.22	74.23	4.33	72.62	4.94	72.70	13.01	73.67	17.64	74.32
5361.118	Culvert																		
5349.394		4.28	72.35	10.25	72.82	13.84	73.05	2.43	72.27	15.84	73.18	4.30	72.35	4.91	72.41	12.76	72.99	17.02	73.25
5342.432		4.28	72.50	10.25	72.76	13.84	72.89	2.43	72.32	15.84	72.95	4.30	72.50	4.91	72.54	12.76	72.85	17.02	72.99
5201.062		4.28	71.71	10.25	72.08	13.84	72.25	2.43	71.64	15.84	72.33	4.30	71.72	4.91	71.76	12.76	72.20	17.02	72.38
5126.834		4.28	71.36	10.25	71.75	13.84	71.92	2.43	71.19	15.84	72.01	4.30	71.37	4.91	71.41	12.76	71.87	17.02	72.05
5062.261		4.28	71.20	10.25	71.6	13.84	71.77	2.43	71.03	15.84	71.86	4.30	71.20	4.91	71.25	12.76	71.72	17.02	71.90
4998.115		4.28	70.98	10.25	71.42	13.84	71.59	2.43	70.73	15.84	71.69	4.30	70.96	4.91	71.04	12.76	71.55	17.02	71.73
4901.173		6.23	70.66	15.25	71.05	19.92	71.18	3.26	70.44	23.09	71.25	5.78	70.64	7.23	70.72	18.62	71.15	24.44	71.25
4838.144		6.23	70.62	15.25	71.02	19.92	71.15	3.26	70.36	23.09	71.22	5.78	70.59	7.23	70.68	18.62	71.11	24.44	71.22
4751.767		6.23	70.46	15.25	70.87	19.92	71.00	3.26	70.17	23.09	71.07	5.78	70.42	7.23	70.53	18.62	70.96	24.44	71.11
4690.586		6.23	69.98	15.25	70.23	19.92	70.36	3.26	69.80	23.09	70.51	5.78	69.97	7.23	70.00	18.62	70.32	24.44	70.58
4635.215		6.23	69.23	15.25	69.76	19.92	70.03	3.26	69.05	23.09	70.27	5.78	69.19	7.23	69.31	18.62	69.95	24.44	70.40
4564.609		6.23	69.02	15.25	69.56	19.92	69.88	3.26	68.69	23.09	70.17	5.78	68.98	7.23	69.09	18.62	69.79	24.44	70.32
4535.882		6.23	68.99	15.25	69.54	19.92	69.88	3.26	68.64	23.09	70.17	5.78	68.94	7.23	69.06	18.62	69.78	24.44	70.33
4525.185		6.23	68.99	15.25	69.52	19.92	69.84	3.26	68.65	23.09	70.12	5.78	68.95	7.23	69.06	18.62	69.74	24.44	70.27
4507.086	Culvert																		
4486.599		6.23	68.98	15.25	69.47	19.92	69.75	3.26	68.65	23.09	70.01	5.78	68.94	7.23	69.05	18.62	69.67	24.44	70.13
4462.663		6.23	68.95	15.25	69.39	19.92	69.71	3.26	68.62	23.09	70.01	5.78	68.90	7.23	69.01	18.62	69.61	24.44	70.15
4432.086		6.23	68.89	15.25	69.37	19.92	69.72	3.26	68.60	23.09	70.01	5.78	68.86	7.23	68.96	18.62	69.61	24.44	70.15
4334.765		6.23	68.76	15.25	69.28	19.92	69.67	3.26	68.52	23.09	69.98	5.78	68.73	7.23	68.82	18.62	69.55	24.44	70.13
4236.688		6.23	68.69	15.25	69.24	19.92	69.65	3.26	68.46	23.09	69.97	5.78	68.66	7.23	68.75	18.62	69.52	24.44	70.12
4167.088		6.23	68.59	15.25	69.2	19.92	69.63	3.26	68.38	23.09	69.96	5.78	68.56	7.23	68.66	18.62	69.50	24.44	70.12
4112.813		6.23	68.41	15.25	69.15	19.92	69.62	3.26	68.02	23.09	69.95	5.78	68.36	7.23	68.51	18.62	69.48	24.44	70.11
4110.796		6.23	68.37	15.25	68.97	19.92	69.43	3.26	68.05	23.09	69.77	5.78	68.33	7.23	68.45	18.62	69.29	24.44	69.93
4090.206	Culvert																		
4079.661		6.33	68.31	15.34	68.64	20.58	68.68	3.19	67.98	23.66	68.66	5.87	68.27	7.44	68.38	19.04	68.67	25.36	68.64
4045.686		6.33	68.28	15.34	68.68	20.58	68.79	3.19	67.94	23.66	68.84	5.87	68.25	7.44	68.36	19.04	68.76	25.36	68.86

Shirley's Brook **Hydraulic Model Results - Interim Conditions**

		C3H00510		100 Year Chicago		C3H12010		C4H25M10		HJU79		2 Year SCS		5 Year SCS		100 Year SCS		100 Year + 20% SCS	
River Sta	Location	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)	Q (cms)	Elev (m)
3964.183		6.33	68.04	15.34	68.32	20.58	68.40	3.19	67.78	23.66	68.43	5.87	68.01	7.44	68.10	19.04	68.38	25.36	68.45
3910.996		6.33	67.89	15.34	68.13	20.58	68.21	3.19	67.68	23.66	68.23	5.87	67.87	7.44	67.94	19.04	68.18	25.36	68.24
3852.352		6.33	67.68	15.34	67.85	20.58	67.92	3.19	67.56	23.66	67.95	5.87	67.67	7.44	67.71	19.04	67.90	25.36	67.97
3787.461		6.33	67.55	15.34	67.73	20.58	67.80	3.19	67.41	23.66	67.84	5.87	67.53	7.44	67.58	19.04	67.78	25.36	67.86
3713.495		6.33	67.31	15.34	67.58	20.58	67.67	3.19	67.20	23.66	67.72	5.87	67.30	7.44	67.36	19.04	67.65	25.36	67.74
3653.05		6.33	67.26	15.34	67.54	20.58	67.63	3.19	67.13	23.66	67.67	5.87	67.25	7.44	67.32	19.04	67.61	25.36	67.69
3615.362		6.33	67.25	15.34	67.53	20.58	67.62	3.19	67.10	23.66	67.66	5.87	67.23	7.44	67.30	19.04	67.60	25.36	67.68
3539.195		6.33	67.21	15.34	67.51	20.58	67.60	3.19	67.02	23.66	67.64	5.87	67.19	7.44	67.28	19.04	67.58	25.36	67.66
3459.393		6.33	67.14	15.34	67.49	20.58	67.57	3.19	66.91	23.66	67.61	5.87	67.12	7.44	67.24	19.04	67.55	25.36	67.63
3361.237		6.33	66.91	15.34	67.43	20.58	67.50	3.19	66.47	23.66	67.54	5.87	66.83	7.44	67.12	19.04	67.49	25.36	67.55
3330.8		6.33	66.92	15.34	67.43	20.58	67.51	3.19	66.47	23.66	67.55	5.87	66.85	7.44	67.12	19.04	67.49	25.36	67.56
3320.636		6.33	66.64	15.34	67.43	20.58	67.50	3.19	66.18	23.66	67.54	5.87	66.56	7.44	66.88	19.04	67.49	25.36	67.55
3308.937	Culvert																		
3301.163		6.03	66.66	14.45	66.91	19.29	66.96	3.02	66.21	21.91	66.99	5.67	66.62	7.21	66.78	18.11	66.94	24.16	67.02
3292.083		6.03	66.67	14.45	66.95	19.29	67.05	3.02	66.26	21.91	67.10	5.67	66.63	7.21	66.79	18.11	67.03	24.16	67.14
3262.229		6.03	66.63	14.45	66.93	19.29	67.03	3.02	66.22	21.91	67.08	5.67	66.59	7.21	66.76	18.11	67.01	24.16	67.12
3211.613		6.03	66.56	14.45	66.88	19.29	66.99	3.02	66.14	21.91	67.04	5.67	66.52	7.21	66.68	18.11	66.97	24.16	67.08
3182.32		6.03	66.53	14.45	66.8	19.29	66.90	3.02	66.11	21.91	66.96	5.67	66.49	7.21	66.65	18.11	66.88	24.16	67.00
3157.212		6.03	66.52	14.45	66.77	19.29	66.87	3.02	66.09	21.91	66.92	5.67	66.47	7.21	66.64	18.11	66.84	24.16	66.98
3112.739		6.03	66.50	14.45	66.73	19.29	66.85	3.02	66.07	21.91	66.90	5.67	66.45	7.21	66.63	18.11	66.82	24.16	66.96
3106.096		6.03	66.40	14.45	66.72	19.29	66.84	3.02	66.03	21.91	66.90	5.67	66.37	7.21	66.51	18.11	66.81	24.16	66.96
3100.236	Culvert																		
3094.45		6.03	66.33	14.45	66.7	19.29	66.83	3.02	66.01	21.91	66.90	5.67	66.30	7.21	66.41	18.11	66.80	24.16	66.96
3086.02		6.03	66.35	14.45	66.63	19.29	66.74	3.02	66.01	21.91	66.80	5.67	66.32	7.21	66.44	18.11	66.72	24.16	66.85
3065.567		6.03	66.32	14.45	66.54	19.29	66.58	3.02	65.99	21.91	66.58	5.67	66.29	7.21	66.40	18.11	66.57	24.16	66.60
2993.621		6.03	66.20	14.45	66.51	19.29	66.59	3.02	65.91	21.91	66.58	5.67	66.17	7.21	66.28	18.11	66.57	24.16	66.61
2926.23		6.03	66.09	14.45	66.42	19.29	66.47	3.02	65.84	21.91	66.52	5.67	66.07	7.21	66.16	18.11	66.53	24.16	66.56
2838.9		6.03	65.91	14.45	66.1	19.29	66.15	3.02	65.73	21.91	66.19	5.67	65.90	7.21	65.95	18.11	66.14	24.16	66.23
2716.764		6.03	65.70	14.45	65.86	19.29	65.91	3.02	65.55	21.91	65.94	5.67	65.68	7.21	65.73	18.11	65.90	24.16	65.97
2517.733		6.03	65.46	14.45	65.6	19.29	65.66	3.02	65.36	21.91	65.69	5.67	65.45	7.21	65.49	18.11	65.65	24.16	65.72
2400.535		6.03	65.30	14.45	65.47	19.29	65.55	3.02	65.19	21.91	65.59	5.67	65.29	7.21	65.33	18.11	65.53	24.16	65.62
2199.535		6.03	64.99	14.45	65.22	19.29	65.31	3.02	64.86	21.91	65.36	5.67	64.98	7.21	65.03	18.11	65.29	24.16	65.39
2073.74		6.03	64.74	14.45	64.98	19.29	65.07	3.02	64.61	21.91	65.10	5.67	64.73	7.21	64.78	18.11	65.05	24.16	65.13
2011.088		6.03	64.62	14.45	64.88	19.29	64.97	3.02	64.47	21.91	65.02	5.67	64.61	7.21	64.67	18.11	64.95	24.16	65.04
1869.72		6.03	64.50	14.45	64.76	19.29	64.82	3.02	64.37	21.91	64.86	5.67	64.49	7.21	64.55	18.11	64.80	24.16	64.90
1754.4		6.14	64.37	14.88	64.65	19.87	64.64	2.99	64.21	22.30	64.68	5.81	64.35	7.62	64.43	18.83	64.63	25.38	64.71
1600.626		6.14	63.95	14.88	64.18	19.87	64.34	2.99	63.82	22.30	64.41	5.81	63.94	7.62	64.00	18.83	64.31	25.38	64.51
1476.175		6.14	63.81	14.88	64.11	19.87	64.26	2.99	63.66	22.30	64.34	5.81	63.79	7.62	63.87	18.83	64.23	25.38	64.46
1299.13		6.14	63.50	14.88	63.9	19.87	64.08	2.99	63.22	22.30	64.19	5.81	63.47	7.62	63.58	18.83	64.04	25.38	64.39
1287.573		6.14	63.48	14.88	63.79	19.87	63.91	2.99	63.21	22.30	64.00	5.81	63.46	7.62	63.56	18.83	63.89	25.38	64.19
1276.827	Bridge																		
1263.755		6.14	63.44	14.88	63.69	19.87	63.75	2.99	63.18	22.30	63.77	5.81	63.42	7.62	63.52	18.83	63.74	25.38	63.78
1247.371		6.14	63.36	14.88	63.68	19.87	63.78	2.99	63.09	22.30	63.82	5.81	63.34	7.62	63.45	18.83	63.77	25.38	63.88
1133.542		6.14	62.80	14.88	63.16	19.87	63.28	2.99	62.58	22.30	63.34	5.81	62.78	7.62	62.90	18.83	63.26	25.38	63.40
954.9156		6.14	62.46	14.88	62.73	19.87	62.83	2.99	62.15	22.30	62.86	5.81	62.43	7.62	62.54	18.83	62.81	25.38	62.91
846.8483		6.14	62.18	14.88	62.55	19.87	62.68	2.99	61.86	22.30	62.66	5.81	62.16	7.62	62.27	18.83	62.65	25.38	62.71
747.0098		6.14	61.83	14.88	62.21	19.87	62.35	2.99	61.59	22.30	62.40	5.81	61.81	7.62	61.92	18.83	62.32	25.38	62.47
632.3096		6.14	61.50	14.88	61.87	19.87	62.00	2.99	61.16	22.30	62.05	5.81	61.48	7.62	61.58	18.83	61.97	25.38	62.12
492.7144		6.14	61.08	14.88	61.4	19.87	61.52	2.99	60.81	22.30	61.57	5.81	61.06	7.62	61.15	18.83	61.49	25.38	61.63
414.3949		6.14	60.91	14.88	61.17	19.87	61.26	2.99	60.71	22.30	61.31	5.81	60.90	7.62	60.95	18.83	61.24	25.38	61.36
334.7006		6.14	60.79	14.88	60.95	19.87	60.95	2.99	60.61	22.30	60.98	5.81	60.78	7.62	60.72	18.83	60.94	25.38	61.02
246.4345		6.14	60.36	14.88	60.43	19.87	60.48	2.99	60.18	22.30	60.51	5.81	60.35	7.62	60.41	18.83	60.47	25.38	60.54
185.9653		6.14	60.08	14.88	60.26	19.87	60.32	2.99	59.90	22.30	60.34	5.81	60.06	7.62	60.10	18.83	60.31	25.38	60.38
78.72429		6.14	59.87	14.88	59.96	19.87	60.03	2.99	59.64	22.30	60.06	5.81	59.85	7.62	59.92	18.83	60.02	25.38	60.09
29.9602		6.14	59.53	14.88	59.78	19.87	59.79	2.99	59.51	22.30	59.80	5.81	59.52	7.62	59.59	18.83	59.78	25.38	59.82

APPENDIX E

- Erosion and Sediment Control Plan Drawing No. 102101-900

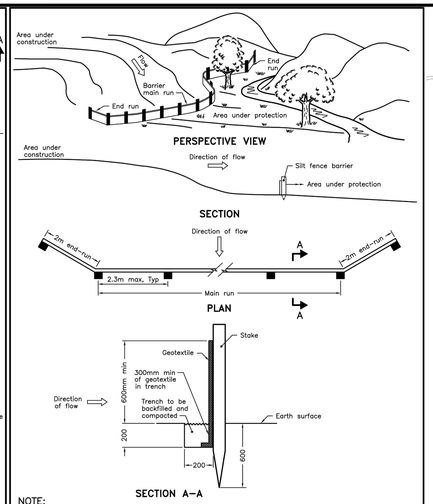


NOTES:

1 Number of bales varies to suit ditch.
2 Straw bales to be butted tightly against adjoining bales and shaped to conform to the sides of the ditch to prevent water flow through barrier.

A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2006	Rev	1
STRAW BALE FLOW CHECK DAM		OPSD 219.180	



NOTE:

A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2006	Rev	1
LIGHT–DUTY SILT FENCE BARRIER		OPSD 219.110	

NOTES:

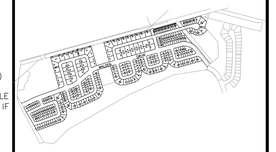
1. SILT FENCE TO BE ERECTED PRIOR TO EARTH WORKS BEING COMMENCED. SILT FENCE TO BE MAINTAINED UNTIL VEGETATION IS ESTABLISHED OR UNTIL START OF SUBSEQUENT PHASE.
2. STRAW BALE SEDIMENT TRAPS TO BE CONSTRUCTED IN EXISTING ROAD SIDE DITCHES. TRAPS TO REMAIN AND BE MAINTAINED UNTIL VEGETATION IS ESTABLISHED.
3. GEOTEXTILE FABRIC TO BE PLACED UNDER COVER OF ALL CATCHBASINS. GEOTEXTILE FABRIC IN STREET CB'S TO REMAIN UNTIL BASE COURSE ASPHALT IS LAID. GEOTEXTILE FABRIC IN RYCB'S TO REMAIN UNTIL VEGETATION IS ESTABLISHED. ALL CATCHBASINS TO BE REGULARLY INSPECTED AND CLEANED, AS NECESSARY, UNTIL SOD AND CURBS ARE CONSTRUCTED.
4. CONTRACTOR TO PROVIDE DETAILS ON LOCATION(S) AND DESIGN OF DEWATERING TRAP(S) PRIOR TO COMMENCING WORK. CONTRACTOR ALSO RESPONSIBLE FOR MAINTAINING TRAP(S) AND ADJUSTING SIZE(S) IF DEEMED REQUIRED BY THE ENGINEER DURING CONSTRUCTION.
5. CONTRACTOR TO PROTECT EXISTING CATCHBASINS WITH FILTER CLOTH UNDER THE COVERS TO TRAP SEDIMENTATION. REFER TO IDENTIFIED STRUCTURES.

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed _____

Date _____ 2018

Plan Number _____

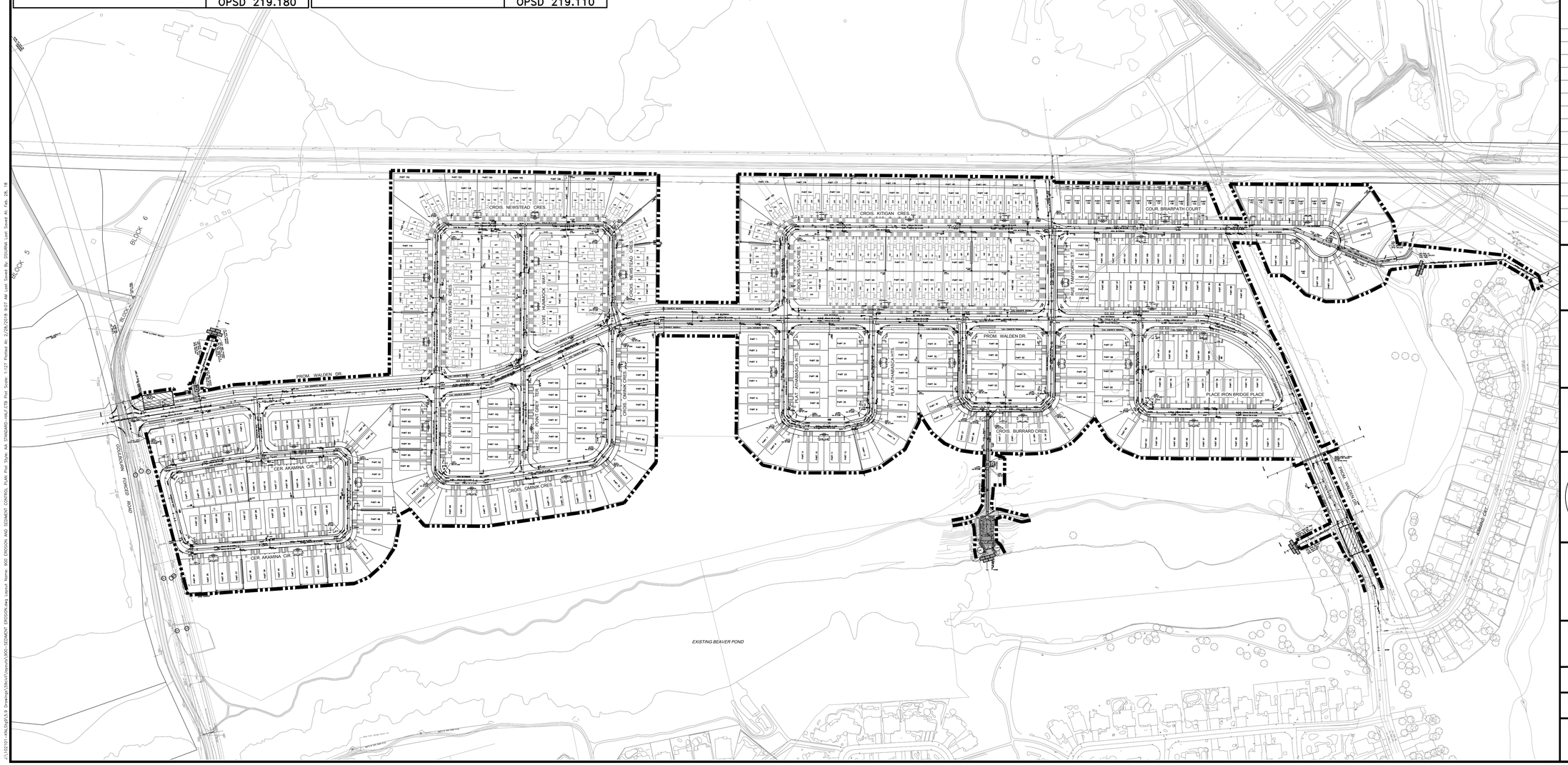


KEY PLAN
NTS

FOR LEGEND AND DETAILS SEE DRAWING 102101-010

LEGEND :

- LIGHT DUTY SILT FENCE AS PER OPSD-219.110
- SNOW FENCE
- STRAW BALE CHECK DAM AS PER OPSD-219.180
- SEDIMENT SAC PLACED UNDER EXISTING CB, CICB OR MH COVER
- TEMPORARY MUD MAT 0.15m THICK 50mm CLEAR STONE ON NON WOVEN FILTER CLOTH (2.5 x 75.0)



No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7			
6	REVISED AS PER CITY COMMENTS	LME	2018:02:23
5	ISSUED FOR 4TH SUBMISSION	LME	2018:01:24
4	REVISED AS PER CITY COMMENTS	LME	2017:10:27
3	ISSUED FOR 2ND SUBMISSION	LME	2017:08:30
2	REVISED AS PER CITY COMMENTS	LME	2017:08:18
1	ISSUED TO CITY FOR REVIEW	LME	2017:02:15

KANATA LAKES

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ibigroup.com

Project Title
KNL STAGE 9

PROFESSIONAL ENGINEER
L. M. ERION
13379508
2018/02/23
PROVINCE OF ONTARIO

N

Drawing Title
EROSION AND SEDIMENTATION CONTROL PLAN

Scale
N.T.S.

Design	Date
L.E.	FEB. 2017
Drawn	Checked
D.S./C.C./M.M.	T.R.B.
Project No.	Drawing No.
102101	900

D07-XX-XX-XXXX

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