UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

Upper Canada
Planning &
Engineering Ltd.
3-30 Hannover Drive
St. Catharines, ON
L2W 1A3
Phone 905-688-9400
Fax 905-688-5274

UCC File: 2159

FUNCTIONAL SERVICING REPORT

294 QUAKER ROAD

CITY OF WELLAND
December 2024

INTRODUCTION

The purpose of this Functional Servicing Report (FSR) is to address the municipal servicing requirements for the proposed subdivision and condominium development located at 294 Quaker Road in the north-eastern portion of the Northwest Welland Secondary Plan (NWWSP) Area in the City of Welland, north of Quaker Road, west of Niagara Street, east of First Avenue, and south of the municipal boundary with the City of Thorold.

The proposed Draft Plan of Subdivision for the 294 Quaker Road property consists of 5 Blocks of townhouse dwellings (Blocks 1 to 5) fronting on a future municipal roadway (Street 'A'), a watercourse Block (Block 7), and a Block for a future residential multiple family condominium development (Block 6) which will be subject to a future Site Plan application.

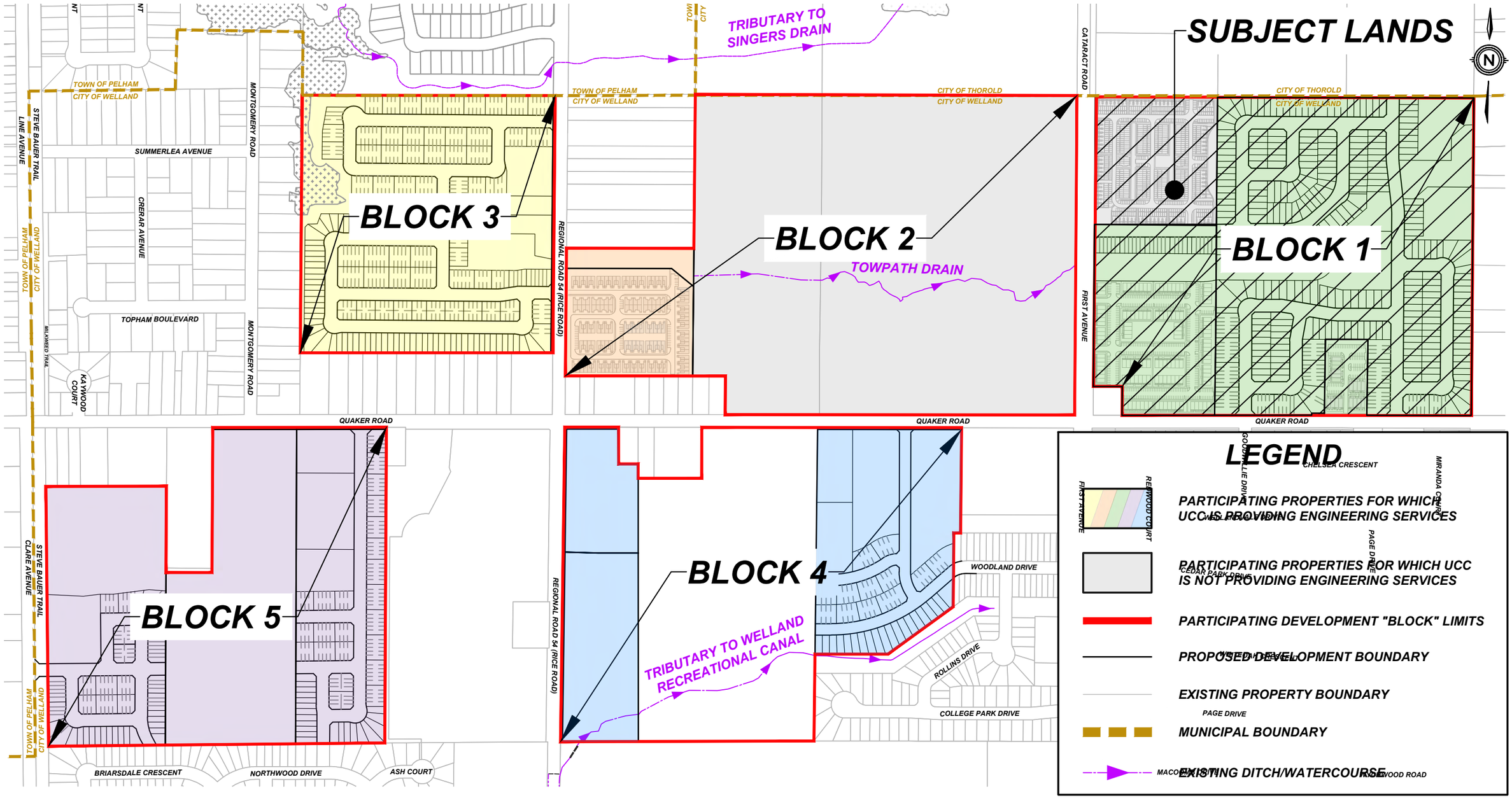
The following FSR will assess the available municipal servicing capacity for the entire 'Block' of development area bound by Quaker Road on the south, First Avenue on the west, to the eastern limit of 210 Quaker Road, and south of the municipal boundary with the City of Thorold as shown in Figure 1 as Block 3. Therefore, this Block (Block 3) will hereafter be referred to as 'subject lands' in this report.

The subject lands are approximately 28.99 hectares and will consist of a mix of subdivision and condominium developments, comprising of an overall mix of residential single detached, street townhouse, stacked townhouse, and apartment dwellings. The subject lands will be developed to include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

The objectives of this report are as follows:

1. Identify domestic and fire protection water servicing needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

As part of the Northwest Welland Secondary Plan (NWWSP), a Conceptual Municipal Servicing Design Report was prepared by Associated Engineering on behalf of the City of Welland This design report assessed the existing municipal infrastructure (water, sanitary, and storm) to service the Secondary Plan Area, and provided a conceptual framework to identify the locations where new or upgraded infrastructure will be required to support future development. The updated report (June 2024) has been included in Appendix A.



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NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

SITE LOCATION PLAN - BLOCK 1

DATE	2024-10-18
SCALE	1:6000 m
REF No.	-
DWG No.	FIGURE 1

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WATER SERVICING

There is an existing 300mm diameter municipal watermain located on Quaker Road, in front of the subject lands and no existing watermain on First Avenue.

The Conceptual Municipal Servicing Design Report assessed the City of Welland watermain model to determine the required watermain sizes to provide adequate domestic water supply and fire protection to a minimum fire flow of 133 L/s within the Secondary Plan Area.

It was determined in the Design Report that a new 300mm diameter trunk watermain would be required within the subject lands and on First Avenue, extending from the existing 300mm watermain on Quaker Road. Smaller diameter mains connecting the new 300mm diameter trunk watermains can provide domestic water supply and fire protection within the proposed local roads and a new 250mm diameter watermain connecting to the existing 200mm watermain on Niagara Street may be required following further modelling at the detailed engineering design stage.

A Watermain Distribution Plan has been prepared by Upper Canada Consultants which shows the watermain locations within the "Block 3" in accordance with Figure 3-4 in the Conceptual Municipal Design Report and is enclosed in Appendix B. As shown in this Plan:

- A 300mm diameter looped watermain will be provided on First Avenue, Street G and Street C extending from the existing 300 watermain on Quaker Road;
- A 200mm diameter watermain will be provided on Street E connecting to the new 300mm trunk on Street G;
- A 200mm diameter watermain will be provided on Street A connecting the new 300mm trunk on Street C and existing 300mm trunk on Quaker Road; and,
- The remaining streets will be serviced with local 150mm diameter watermains.

Blocks 1 to 5 will be provided individual water services for each dwelling unit from the proposed 300mm diameter watermain on Street A. Block 6 is proposed to be serviced from the 300mm diameter watermain on First Avenue. The size and location of the proposed service to Block 6 will be determined as part of detailed engineering design for the future Site Plan Application for Block 6.

The subject lands are expected to consist of a total population of 2,929 persons, divided as follows:

- 1,071 persons within 744 First Avenue;
- 874 persons within 294 Quaker Road;
- 159 persons within 232 – 238 Quaker Road; and,
- 825 persons within 210, 256 & 276 Quaker Road.

The estimated peak domestic water demands have been summarized in Table 1 below using an average residential flow rate of 270 L/capita/day. Peaking factors for the maximum daily demand and maximum hourly demand were taken from the Table 3-1 of the Ministry of Environment Design Guidelines for Drinking Water Systems for a population between 2,001 – 3,000. The peak demands will be confirmed as part of the detailed engineering design.

Table 1. Estimated Peak Domestic Water Demand	
Average Domestic Demand *270 L/cap/day; 2,929 persons*	**9.15 L/s**
Maximum Day Peaking Factor	2.25
Maximum Day Domestic Demand	**20.59 L/s**
Peak Hour Peaking Factor	3.38
Peak Hour Domestic Demand	**30.93 L/s**

The fire hydrants located within the development site will be prepared to provide fire protection for the proposed dwellings. The spacing and location of the proposed fire hydrants will be provided in accordance with the City of Welland design standards as part of the detailed engineering design.

Therefore, there is expected to be adequate capacity to provide domestic water supply and fire protection within the subject lands and adjacent development lands.

SANITARY SERVICING

There is presently a 750mm diameter Regional trunk sanitary sewer flowing easterly on Quaker Road, in front of the subject site which ultimately outlets to Towpath Road Sanitary Pumping Station.

A Sanitary Drainage Area Plan for the subject lands, enclosed in Appendix C, shows a total sanitary drainage area (including the subject lands as Drainage Area A1 and A5) of approximately 24.84 ha and a population of 2,929.

Blocks 1 to 5 will be provided individual sanitary services for each dwelling unit from the proposed 200mm diameter watermain on Street A. Block 6 is proposed to be serviced from the proposed sanitary sewers constructed within the adjacent 210, 256 & 276 Quaker Road to the west.

It is proposed to provide a single sanitary connection for the subject lands to the existing 750mm diameter Regional sanitary sewer on Quaker Road. As shown in the Sanitary Drainage Area Plan, it is proposed to extend a new 300mm diameter sanitary sewer within the subject lands from Street 'C'.

The existing 750mm diameter Regional trunk sanitary sewer on Quaker Road in front of the subject lands has a capacity of 556.99 L/s. The future peak sanitary flow from the subject lands will is calculated to be 36.94 L/s, which will occupy 6.6% of the existing 750mm diameter sanitary sewer on Quaker Road. Therefore, the receiving sanitary sewer system is expected to have adequate capacity to receive future sanitary flows from the subject lands. The sanitary sewer design is attached in Appendix C for reference.

The Conceptual Municipal Servicing Design Report assessed the City of Welland InfoSWMM sanitary sewer model and the available capacities in the Towpath SPS and associated forcemain and the Welland WWTP.

Per the conclusions in the Design Report, there is expected to be adequate capacity in the existing Towpath SPS and associated forcemain following upgrades planned to this infrastructure by the Niagara Region, and Welland WWTP without upgrades for the entire NWWSP Area. The Design Report indicates that the capacity in the downstream sanitary sewer system will need to be re-evaluated as part of detailed engineering design, prior to build-out of the NWWSP Area.

Therefore, there is expected to be adequate capacity in the receiving sanitary network for the subject lands.

STORMWATER MANAGEMENT

A Storm Servicing Plan has been included in Appendix D showing a preliminary layout of the proposed internal storm sewers discharging to the proposed stormwater management facilities (P30 and P31).

A separate Stormwater Management Plan has been prepared by Upper Canada Consultants (UCC) which includes the future Storm Drainage Areas for the subject lands and detailed calculations for each proposed stormwater management facility. The 294 Quaker Road property was included with the future storm drainage areas for SWM facilities P30 and P31. The Stormwater Management Plan has been enclosed in Appendix E for reference.

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CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the servicing for this site:

1. The existing municipal watermain system is expected to have adequate capacity to provide both domestic and fire protection water supply for the subject lands.

2. The receiving 750mm diameter Regional sanitary sewer on Quaker Road, the Towpath SPS and associated forcemain, and Welland WWTP are expected to have adequate capacity for the subject lands upon full build-out of the NWWSP Area.

3. Detailed calculations, conclusions, and recommendations regarding Stormwater Management can be found in the Stormwater Management Plan found in Appendix E.

Based on the above and the accompanying calculations, there exists adequate municipal infrastructure for this development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Respectfully Submitted,

Reviewed By:

B. Kapteyn

Brendan Kapteyn, P.Eng.

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APPENDICES

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APPENDIX A

NW Welland Secondary Plan Municipal Servicing Conceptual Design Report
(Associated Engineering, June 2024)

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

REPORT

City of Welland

Northwest Welland Secondary Plan
Municipal Servicing
Conceptual Design Report

JUNE 2024

REVISIONS PAGE

Northwest Welland Secondary Plan Municipal Servicing Conceptual Design Report	
Client:	Engineer:
Upper Canada Consultants	Associated Engineering (Ont.) Ltd.

Revision/ Issue	Date	Description	Prepared by/ Reviewed by	Client Review
1	2023-11-22	Municipal Servicing Report_v1	AL & BB/ RC & MG	
3	2024-03-26	Municipal Servicing Report_v3	AL & BB/ RC & MG	
5	2024-06-24	Municipal Servicing Report_v5	AL & BB/ RC & MG	
	Click or tap to enter a date.			
	Click or tap to enter a date.			

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1 INTRODUCTION

The City of Welland identified the development of the Northwest Secondary Plan as a priority to provide for detailed land use planning policies for a mix of uses, including policies that address infrastructure requirements, and natural and cultural heritage considerations. The Northwest Welland Secondary Plan (NWSP) will guide future growth and development within the study area. This report (previously issued May 2021) reviews background information and provides capacity analysis for existing water, sanitary, and storm sewer servicing in the study area. In addition, an initial assessment was completed for proposed conceptual water, sanitary, and storm servicing. These analyses were used to develop general recommendations for municipal water, sanitary, and storm servicing requirements in the Secondary Area.

1.1 Study Area

The study area (Figure 1-1) includes the land within the urban area boundary of Welland that is bounded by Clare Avenue to the west, Niagara Street to the east, land on the south side of Quaker Road to a depth of approximately 500m to the south and 500m to the north and comprises approximately 190ha. Quaker Road bisects through the Study Area and is identified as an arterial road and all other streets are considered local roads.

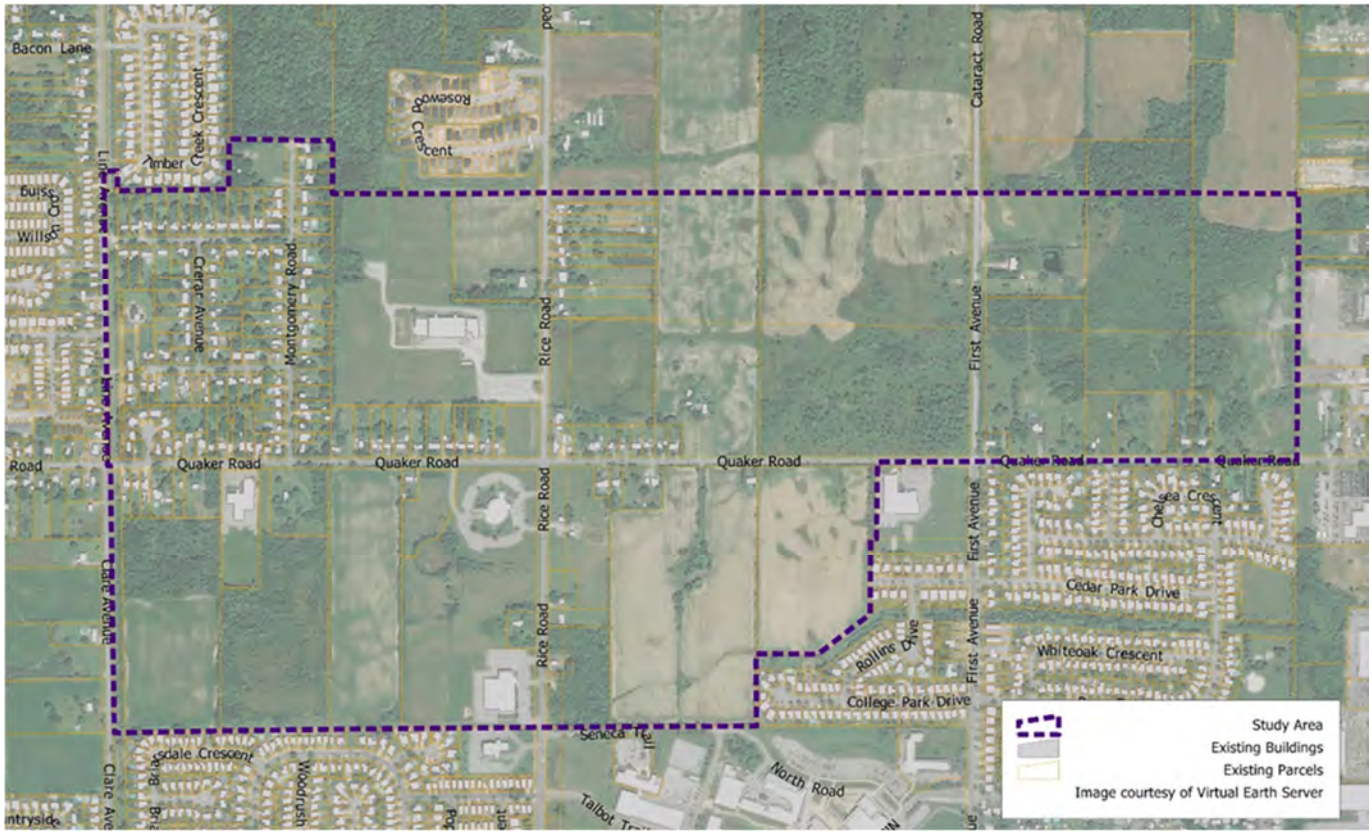


Figure 1-1: Northwest Welland Secondary Plan Study Area

Existing land uses are primarily residential, institutional, agricultural, and open space. Currently, municipal services for water, sanitary and storm exist in parts of the NWSP area, which will be leveraged to accommodate the NWSP area.

1.2 Proposed Secondary Plan

Figure 1-2 shows the proposed NWSP layout provided by Upper Canada Consultants (September 2023). Based on the proposed layout, population and unit numbers for each development block were also provided by Upper Canada Consultants. Projected units and populations are summarized in Table 1-1.

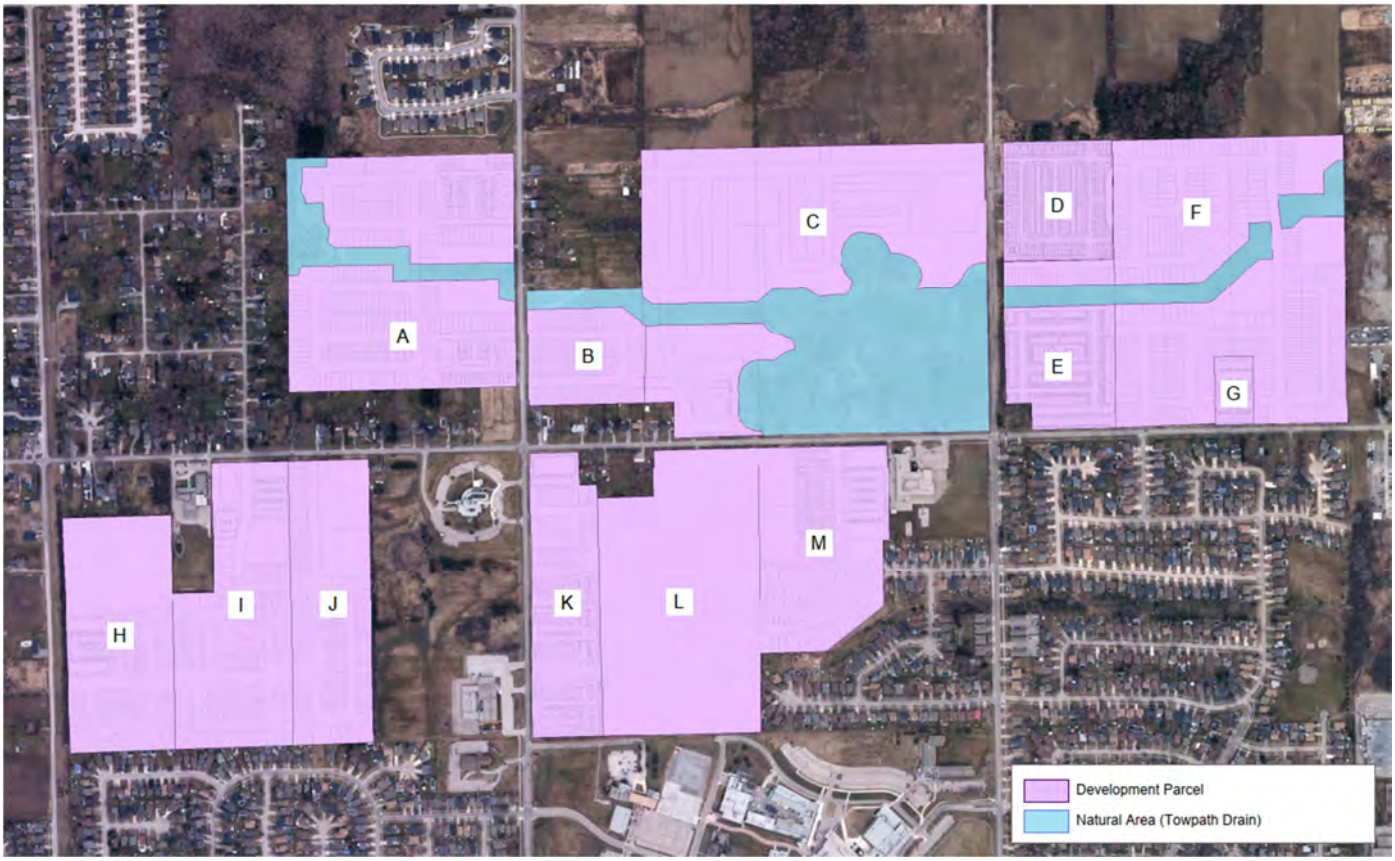


Figure 1-2: NWSP Proposed Population and Unit Plan

Table 1-1: NWSP Population and Unit Numbers

Block Number	Area (ha)	Units	Population (+/-)
A	13.25	386	1,081
B	3.36	114	319
C	18.15	800	2,240
D	4.05	360	1,008
E	4.77	401	1,123
F	17.71		1,128
G	0.80	96	269

Block Number	Area (ha)	Units	Population (+/-)
H	8.40	226	633
I	8.79	227	636
J	7.04		454
K	5.73	439	1,229
L	13.02	500	1,400
M	7.05	236	661

2 BACKGROUND INFORMATION

2.1 Sources

Table 2-1 provides a list of sources used to aid in completing the analysis of water, wastewater, and stormwater servicing for the NWSP area.

Table 2-1: Water, Sanitary and Storm Data Sources

System	Description	File Type(s)	Author(s)
All	City of Welland Northwest Area Planning and Servicing Study Municipal Class EA	PDF	Earth Tech
All	1m Elevation Contours	SHP	City of Welland
All	City of Welland GIS Data	GIS	City of Welland
All	City of Welland Official Plan	PDF	Dillon Consulting
All	Key Directions Report for the Northwest Welland Secondary Plan Area	PDF	SGL
All	City of Welland Municipal Standards, 2013	PDF	City of Welland
Water/Wastewater	2016 Water and Wastewater Master Servicing Plan Update Hydraulic Model for City of Welland, May 2017	PDF	GM Blue Plan
Water	Welland Water Model (part of the Niagara Region Water Model for the 2017 Niagara Region Master Servicing Plan), 2017	InfoWater	Niagara Region
*Water	City of Welland All Pipe Water Model	InfoWater	City of Welland
Water	Design Guidelines for Drinking-Water Systems, 2008	PDF	MECP
Water	City of Welland Fire Flow Requirements – By Building Zone	PDF	AE

System	Description	File Type(s)	Author(s)
*Wastewater	Welland All Pipe Wastewater Model	InfoSWMM	City of Welland/ Niagara Region
*Wastewater	City of Welland Pollution Prevention Control Plan Update & Wastewater Master Servicing Plan, 2020	PDF	GM Blue Plan
*Storm	Northwest Welland Stormwater Management Implementation Plan, 2022	PDF	Upper Canada Consultants

*additional/updated data sources since May 2021 Report

2.2 Data Gaps

Data gaps are presented in Table 2-2, which summarizes missing, relevant information that would provide a clearer picture of the existing and future needs of the systems in future steps of this process (i.e. confirmation of criteria to be used in future design of systems).

Table 2-2: Data Gaps

System	Data Gaps	Justification
All	Detailed topographic survey	To confirm elevations for servicing

3 WATER

Water servicing in the Niagara Region is a two-tiered approach; Niagara Region has jurisdiction over the drinking water supply for homes and businesses throughout the Region and is responsible for treatment, storage, pumping, and trunk watermains. The City of Welland is responsible for the local distribution system.

Currently, the area surrounding the proposed development is pipe fed from the Welland Water Treatment Plant (WTP) to the Shoalt's Drive Reservoir and surrounding area. During periods where the WTP is offline, the area is predominately supplied by gravity from the Shoalt's Reservoir. The Welland system also has an elevated storage tank (Bemis) located in the southern portion of the distribution system.

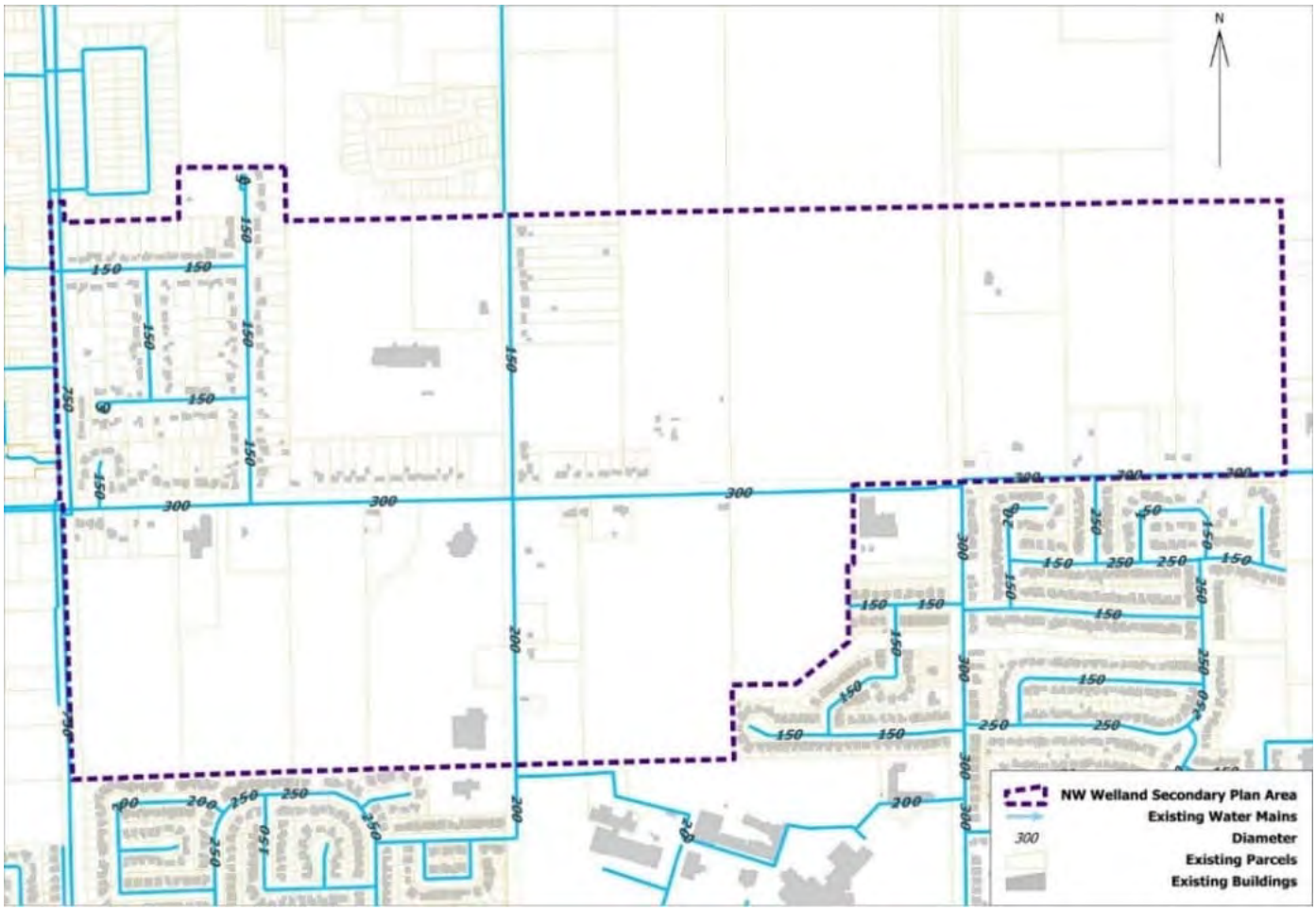


Figure 3-1: Existing Watermains Configuration in Study Area

The existing system configuration within the study area, including existing pipe diameters, is shown in

Figure 3-1. Within this area there is a small existing development east of Line Avenue and north of Quaker Road. This area, which was built in 2002, consists of 150mm PVC watermain connecting to both the 750mm CPP on Line Avenue to the west and the 300mm CI on Quaker Road to the south. In addition, there is a 150mm existing main on Rice Road (north of Quaker Road) which appears to serve few properties. There are also existing properties along Quaker Road, which are serviced off the 300mm main.

3.1 Design Criteria

The design criteria used for the analysis of the water distribution system includes the following:

- Target normal operating pressures:
  - Preferred system pressure between 350 kPa to 550 kPa (50 to 80 psi)
  - Minimum system pressure to be greater than 275 kPa (40 psi)
  - Maximum system pressure to be less than 700 kPa (100 psi)
- Fire flow requirements during MDD with 140 kPa (20 psi) residual system pressure:

  - Parks: 67 L/s
  - Low Density Residential (Single Family Residential): 67 L/s
  - Medium Density Residential (Townhomes): 133 L/s
  - Multi-Use: 133 L/s
- Per capita demand: 240 L/cap-day (Based on City design criteria)
- Peaking factors as per the City of Welland Model, as follows:
  - Maximum Day Demand peaking factor: 1.5
  - Peak Hour Demand peaking factor: 1.87 (2.81 x Average Day Demand)
- ADD and MDD demand patterns as per City of Welland Model
- C-Factor for new pipes: 135 (Based on the City design standard)

3.1.1 Water Demands

Table 3-1 summarizes the new demands assigned within the model for the NWSP area. These demands were calculated based on the newly proposed populations/units previously identified in Table 1-1 and design criteria noted in Section 3.1.

Table 3-1: New NWSP Demands

Junction ID	ADD (L/s)	MDD (L/s)	PHD (L/s)
814	0.89	1.33	2.49
951	3.89	5.83	10.93
1700	0.75	1.12	2.10
3952	1.76		4.94
8338	1.50	2.25	4.22
8622	3.41	5.12	9.59
8623	2.07	3.11	5.83
J-FUT-47	2.80	4.20	7.87
J_NWSP_4	1.26	1.89	3.55
J_NWSP_6	1.50	2.25	4.22
J_NWSP_8	2.07	3.11	5.83
J_NWSP_9	2.07	3.11	5.83
J_NWSP_10	3.12	4.68	8.77
J_NWSP_15	1.84	2.76	5.16
J_NWSP_20	3.13	4.70	8.81
J-FUT-49	1.77	2.65	4.97

Junction ID	ADD (L/s)	MDD (L/s)	PHD (L/s)
Total Demand	33.84	50.77	95.11

3.2 Model Updates and Existing System Conditions

An InfoWater Model (WELLAND_WATER_2023, dated October 23, 2023) provided by the City was used for the analysis. The City's model includes both existing and future Average Day Demand (ADD) and Maximum Day Demand (MDD) extended period simulation scenarios. Model data sets suggest that the existing demand scenarios in the model were last reviewed and updated in 2022. The earlier study completed for this development reviewed and commented on the Niagara Region & City of Welland InfoWater models for their future development growth, providing an insight into the future development areas of the region. It has been assumed that this information still applies despite the time passed since that report.

During the development of this study, City noted that there were two errors in the existing model scenarios that should be rectified and therefore, the analysis was updated with the following changes/corrections.

- The size of the watermain, dead end on Montogomery Road where hydrant was connected, was changed from 50mm to 150mm pipe.
- The connection to the intersection of the Regional trunk main at Line Avenue and Summerlea Avenue was opened in the model.
- Recent discussions with the City indicated that the watermain along Quaker Road from Clare Avenue to Rice Road is currently being replaced with a new 300mm watermain and therefore, this portion of pipe was upsized and a C-factor of 135 was assigned in the model to reflect the upgrade.
- The connection (IW pipe ID – 2377) between the 750mm Region trunk main on Clare Avenue N and the 300mm watermain on Quaker Road was opened in the model.

Other than the above noted model updates, no quality control checks were conducted on the City's model; it was assumed that the model is sufficiently calibrated for the purpose of this analysis and is indicative of the current system.

Figures for this section can be found in Appendix A. Table 3-2 shows the existing and current future pumping schemes from the City's model (on/off settings) at the WTP for both ADD and MDD scenarios. No changes were made to these settings for the development analysis.

Table 3-2: Existing and Future WTP Pump Settings – City's InfoWater Model

Pump	Existing ADD	Existing MDD	Future ADD	Future MDD
Low Flow Pump #1	On at 0:00 Off at 6:00	Off at 0:00	Off at 0:00 On at 11:00	Off at 0:00 On at 20:00 Off at 22:00
Low Flow Pump #2	Off at 0:00	Off at 0:00	Off at 0:00 On at 20:00	Off at 0:00

Pump	Existing ADD	Existing MDD	Future ADD	Future MDD
High Flow Pump #1	Off at 0:00 On at 13:00	On at 0:00 Off at 7:00	On at 0:00	On at 0:00 Off at 2:00 On at 5:00
High Flow Pump #2	Off at 0:00	Off at 0:00 On at 12:00	On at 0:00 Off at 3:00 On at 6:00 Off at 20:00	On at 0:00 Off at 2:00 On at 5:00

3.2.1 Current Hydraulic Conditions

A hydraulic analysis of the existing system was completed to provide a baseline level of service to compare to the future development scenarios.

Figures A-1 and A-2 show the minimum pressure during existing ADD and MDD in the study limits and surrounding area. At certain locations within the study area, pressures are lower than the required minimum pressure of 275 kPa (40 psi). These low-pressure nodes are in proximity to the Shoalt's reservoir and occur during peak periods; simulation time 11am to 12 noon for ADD and 10am to 11am for MDD. The observed minimum pressures in this portion of the study area for ADD and MDD are 239 kPa and 234 kPa respectively and are thought to be due to high ground elevations (maximum of 193m) and fluctuations of the Shoalt's Drive Reservoir head (between 217.5m and 219.0m). As to be expected during higher demands, more low-pressure nodes were observed in the surrounding study area during MDD scenario than ADD. There were also few low-pressure nodes observed in the other future growth areas of the system.

Figure A-3 shows the available fire flow during MDD at a residual pressure of 140 kPa (20 psi). Certain portions of the study area, specifically watermains along the Rice Road and Topham Boulevard have available fire flows less than 67 L/s (the City standard for single family residential). However, the new 300mm watermain upgrade along Quaker Road (from Clare Avenue to Rice Road) improves fire flows along Quaker Road, Montgomery Road and in Summerlea Avenue. The dead ends of the watermains in this portion of the area still indicated low fire flows (< 67 L/s).

The low availability of fire flows is due to both the high ground elevation and the size of the watermains supplying these hydrants.

3.2.2 Future Conditions without NWSP Development

In the existing model from the City, it was observed that the future model scenario included NWSP infrastructure and demands based on the previous study. A total of 48.7 L/s for future ADD and 73.1 L/s for future MDD was allocated in the NWSP region at the model junctions summarized below in Table 3-3.

Table 3-3: Identified Previous NWSP Demands from the City's Model

Junction ID	Future ADD (L/s)	Future MDD (L/s)
3952	1.00	1.07
567	3.15	4.72
812	2.52	3.77
815	3.86	5.79
818	4.01	6.02
8622	1.18	1.77
8623	5.35	8.03
J-FUT-47	10.10	15.16
J-FUT-48	2.14	3.21
J-FUT-49	5.58	8.37
J-FUT-50	6.08	9.12
J-FUT-51	4.03	6.05
Total Demand	49.00	73.08

To prevent "doubling up" on NWSP demands, the previously proposed infrastructure for NWSP has been removed from the future analysis.

Figures A-4 and A-5 show the minimum pressure during future ADD and MDD, without the NWSP development. As these figures show, a significant improvement in pressures was noted in the surrounding study area when compared to the existing scenarios, with only a small number of low-pressure nodes noted. This is due to the change in the pumping procedure at the WTP for the future scenario.

Figures 3-2 and 3-3 below show the hydraulic grade (HG) for Shoalt's and Bemis tanks for the existing and future MDD Scenarios. The pumping operating procedure at the WTP for the existing scenario shuts down the pumps mid-morning, coinciding with periods of higher system demand. During this mid-morning WTP shutdown, both the Shoalt's Drive Reservoir and the Bemis Elevated Tank levels are drawn down; this draw down is sharp and reaches its lowest hydraulic grade level (HG) around noon. However, with the current future pumping scheme at WTP, the HG at Shoalt's and Bemis shows a sustained hydraulic head after 6 am showing improved pressures in the surrounding study area.

The future pumping schemes in the model for ADD and MDD scenarios showed improved pressures surrounding the study area which appeared to resolve most of the low-pressure nodes that were highlighted in existing scenarios. A few low-pressure nodes (250 kPa to 261kPa) still persisted surrounding the study area particularly nodes close to the Shoalt's reservoir.

An attempt was made to assess the future system by changing the current future pumping scheme for MDD scenario by altering the pumping hours at pump H-1 (On at 0:00 and Off at 2:00) which showed improved pressures in the reservoir area but not completely eliminated. As modification of pumping schemes is outside of the scope of this analysis, this would need to be confirmed by the City when adjusting the overall system configuration and settings.

Figure A-6 shows the available fire flow during future MDD prior to the proposed development. Parts of the surrounding study area on the south and east sides showed sufficient fire flows as required for multi-family residential housing (133 L/s) however, the nodes on the Rice Road watermain have less than the design standard of 133 L/s. Most of the Shoalt's reservoir area showed adequate fire flows with the new 300mm watermain upgrade in Quaker Road and by opening the 750mm Region trunk main interconnection in Clare Avenue N with the exception of the dead-end locations.

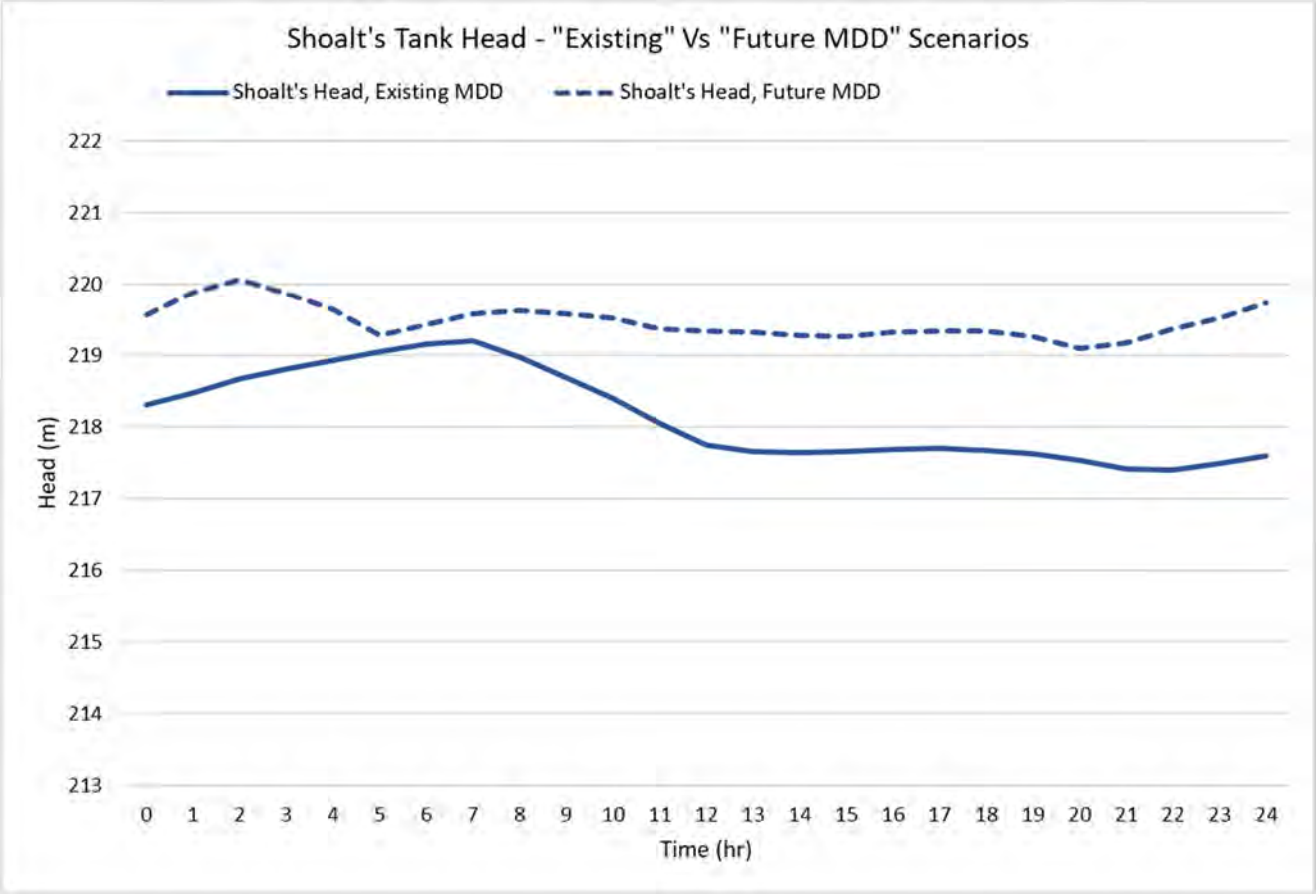


Figure 3-2: Shoalt's Tank Head – Existing and Future MDD Scenarios (without NWSP)

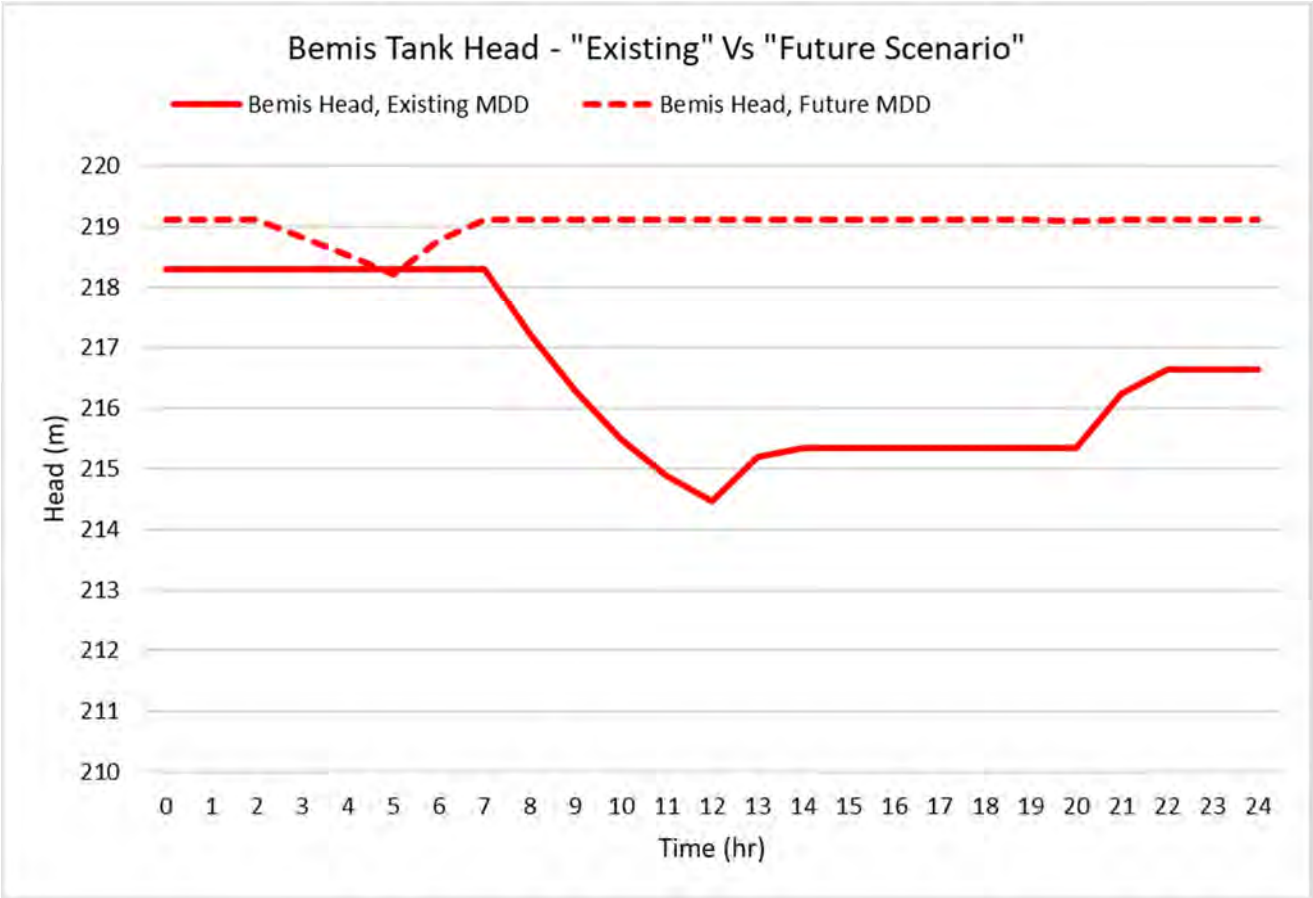


Figure 3-3: Bemis Tank Head – Existing and Future MDD Scenarios (without NWSP)

3.3 Proposed System Requirements

Several pipes and junctions were added to the City of Welland InfoWater model to represent future servicing of the NWSP area. The proposed pipe routing is laid based on the new NWSP site layout as shown in Figure 1-2 in Section 1.0 of this report. As the existing 300mm main on Quaker Road acts as a main supply line for this study area, the proposed mains for NWSP were mainly branched and looped out from this main to service the proposed development. Note that only significant pipes that will connect the NWSP site were included in the model. There will be additional future piping required along local roads upon finalization of the site layout.

Junction elevations for the newly added nodes in the study area were assigned based on the City of Welland 1 m contours. Pipe sizing for the major loops shown in Figure 3-4 was established as part of the hydraulic analysis to achieve the required fire flow of 133 L/s as needed for the medium density residential. New piping is shown in bold red; existing piping in blue.

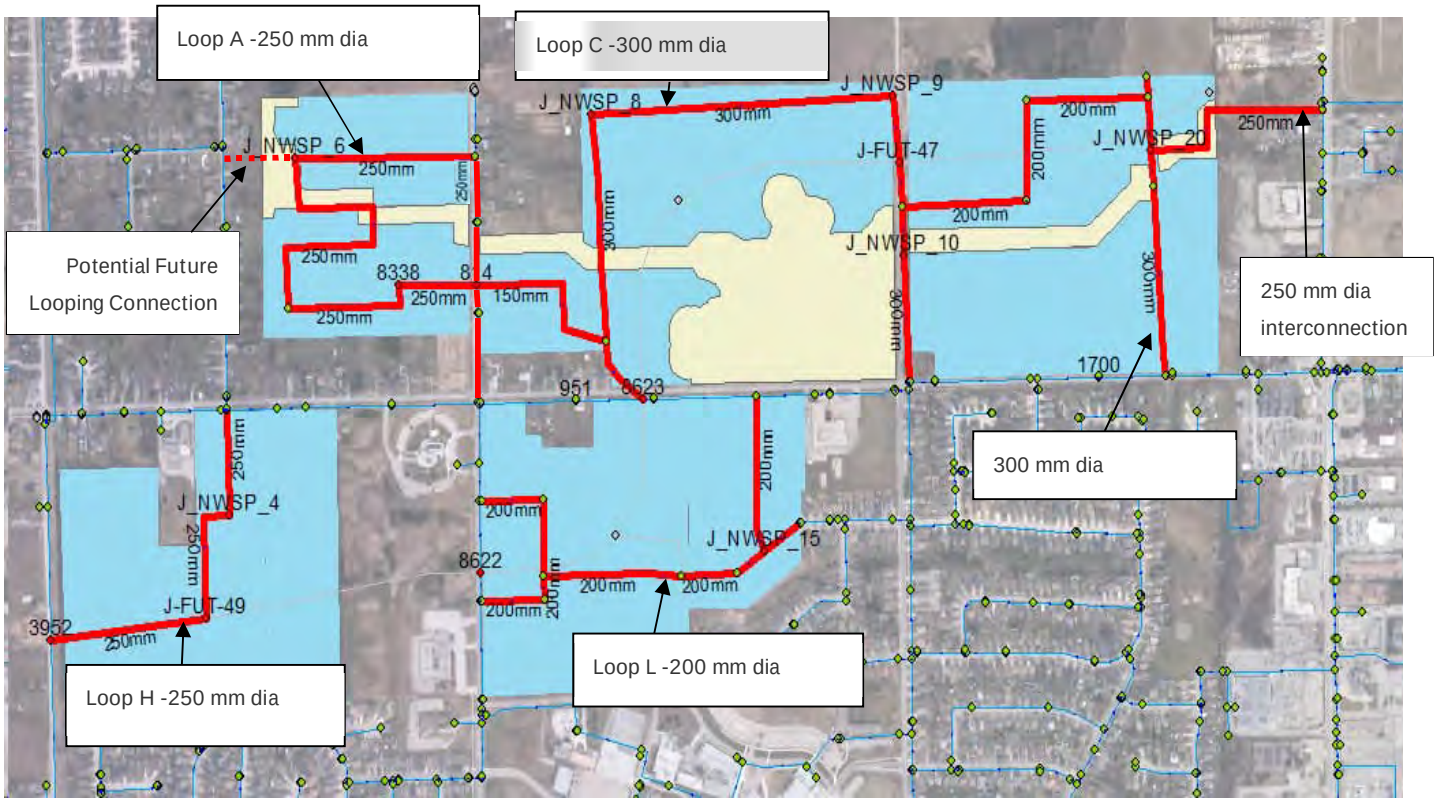


Figure 3-4: Proposed Infrastructure for NWSP Development

3.3.1 Hydraulic Analysis

The development demands for the proposed NWSP development were added to the Futures ADD and MDD scenarios in the model. The hydraulic analysis then was carried out with NWSP future demands to identify the impact of this proposed development on the future system and to confirm the pipe sizing and servicing requirements to support the future NWSP development.

Figures A-7 and A-8 show the minimum available pressures during ADD and MDD EPS, and Figure A-9 shows the available fire flows, with the NWSP area serviced with the proposed watermain sizes identified.

As these figures show, the addition of NWSP area to the future system does not significantly impact the surrounding system pressures, instead the proposed servicing has shown improved pressures over Future ADD and MDD when no NWSP development was added. As with the other modelled scenarios, there are existing low-pressure nodes near Shoalt's Drive Reservoir area, however no exacerbation of low pressures was noted when the NWSP development was added.

Figure A-9 shows most of the NWSP study area meets fire flow requirements of 133 L/s that is required for medium density housing with the following pipe servicing requirements.

The major watermain loops (Loop A, C, H and L) that are proposed to service the future NWSP development are shown in Figure 3-4 above. The pipe routing and sizing was identified based on the current site layout provided by the

developers and to achieve the design fire flow of 133 L/s throughout the study area. Should a change in the NWSP site layout occur in the future, a review of the analysis may be required to re-confirm the pipe sizes and servicing options. Furthermore, additional modelling may be required in the future to assess the extent of the overall system that is required to be constructed to facilitate each development block on a project-by-project basis.

To supply the required fire flow (133 L/s) to the northwest portion of the NWSP, specifically, the development that is planned west of Rice Road, an upgrade of Rice Road watermain and as well as the new water mains installed in this area should be a minimum of 250mm as shown as Loop A. With this upgrade, the fire flows in the area were improved and vary from 138 L/s to 213 L/s. It is also noted that a potential future looping connection between the northwest portion of the NWSP and the existing watermain on Montgomery Road can be considered based on final development details and servicing requirements within the area.

A new 300mm watermain loop, Loop C will be required to supply the C-block of the NWSP planned development. In addition, a new interconnection with 250mm watermain connecting the NWSP development to the watermain in Niagara Street on the eastern side is also made to improve the fire flows in the area.

Two major watermain loops with 200mm and 250mm, Loop L and Loop H respectively will be required for the southern portion of the NWSP, to provide the required fire flow of 133 L/s in this area. Without the Loop L, the development blocks K and M were not able to achieve the design fire flows of 133 L/s.

Overall, the proposed NWSP development shows improved operating pressures except in the low-pressure areas previously identified. Improved fire flows were also noted around the NWSP study area with the proposed pipe servicing, both within and outside the development boundaries.

3.3.2 Storage Requirements Review

A review of the City of Welland's overall storage capacity and existing and future storage requirements was conducted to determine the impact of the NWSP area on future storage needs. As per the MECP Design Guidelines for Drinking Water Systems, storage requirements for a water distribution system are as follows:

- Equalization Storage (A) = 25% of Maximum Day Demand
- Fire Storage (B) = 378 L/s for 6 hours (Based on MECP Equivalent Population Fire Flow Requirement)
- Emergency Storage (C) = 25% of A +B

Table 3-4 summarizes the total available storage identified in the Region Master Plan (as used in the previous report) and the calculated existing and future storage needs for the system based on the City of Welland model demands. As shown, there is sufficient storage in the Welland system to allow for the addition of the NWSP area. The total additional storage required for the addition of the NWSP area is 1.4 ML.

Table 3-4: Available and Required Water Storage

Description	Storage (ML)
Total Available Storage	37.0
Existing Required Storage	19.7
Future Required Storage without NWSP (a)	26.5

Description	Storage (ML)
Future Required Storage with NWSP (b)	27.9
Required Additional Storage for NWSP (b-a)	1.4

4 SANITARY

Sanitary servicing in Niagara Region is based on a two-tiered approach. The Region is responsible for the wastewater treatment plants, trunk sewers, pumping stations and forcemains. The City of Welland is responsible for the local gravity sewer system.

The sanitary sewage from the NWSP area will ultimately be treated at the Welland Wastewater Treatment Plant (WWTP). This WWTP services the City of Welland, Town of Pelham, and the Port Robinson area of the City of Thorold.

The existing sanitary services in the NWSP area includes a regional main down Rice Road, local main in the Montgomery subdivision, and local and regional (trunk) sanitary sewer along Quaker Road. Primary sanitary sewage flows south down Rice Road, and then east down Quaker Road to Towpath Road. Sanitary sewage then flows northeast along Towpath Road to Towpath Sewage Pumping Station (SPS). Towpath SPS receives gravity flow from the regional trunk sanitary sewer along Quaker Road and flows from Hurricane Road SPS (Rice Road). Sewage from Towpath SPS is pumped through a forcemain across the Welland River to a gravity system, which ultimately flows to the Welland WWTP. A schematic of the existing sanitary servicing within the NWSP study area is provided in Figure 4-1.

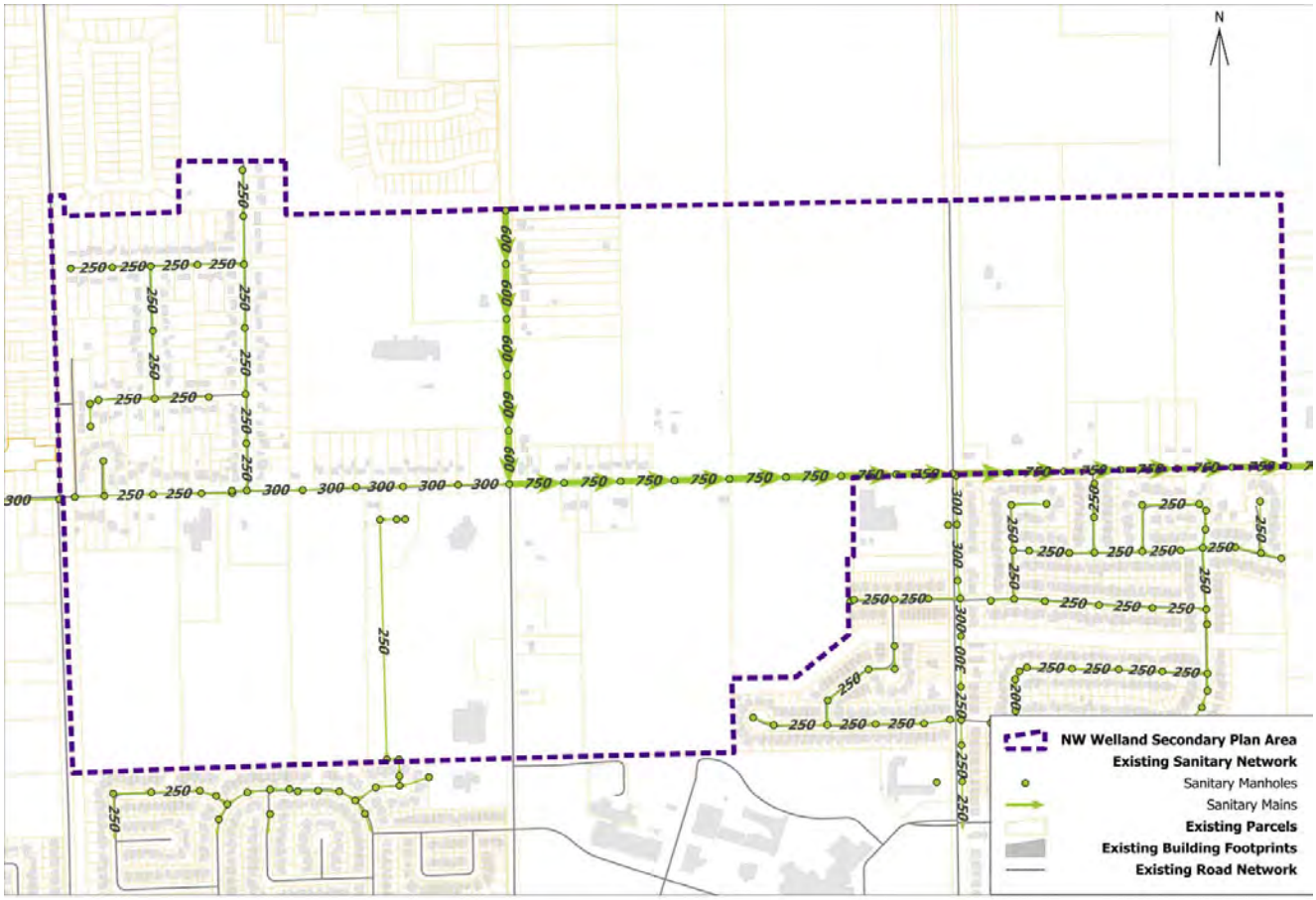


Figure 4-1: Schematic of Existing Sanitary System in NWSP Study Area

4.1 Design Criteria

Existing and future peak flows conveyed by the trunk sewer on Quaker Road to the Towpath SPS were assumed to be equivalent to the flows represented in the City's all-pipe InfoSWMM model.

Additional flows contributed to the Quaker Road trunk sewer, and ultimately the Towpath SPS, by the NWSP area were calculated using the following design criteria:

- Extraneous flows = 0.286 L/s/ha
- Roughness coefficient = 0.013
- Residential per capita flow rate (for sewage generation) = 275 L/cap/day
- Peaking factor = Calculated based on Harmon formula with values between 2.0 and 4.0

4.2 Existing System Capacity

4.2.1 Trunk Sewer

The available capacity of the existing trunk sewer along Quaker Road from Rice Road to the Towpath SPS was reviewed using the City's all pipe InfoSWMM model.

Currently Line Avenue is the break point in the collection system, with areas west of Line Avenue flowing west and then south, contributing to the Welland WWTP drainage area. However, the Region Master Servicing Plan Update (MSPU) identified a new 600mm diameter connection (WW-SS-002) along Quaker Road from Line Avenue to Rice Road, which would redirect approximately 130L/s of flows from Pelham (north-west of Line Avenue) to the Quaker Road trunk sewer, and ultimately the Towpath SPS. Given this change in flows through the Quaker Road trunk sewer, the available capacity of this sewer was reviewed with this new connection. This completed available capacity assessment, based on the InfoSWMM model outputs, is attached in Appendix B. In general, the Quaker Road trunk sewer has significant available capacity – with future available capacity ranging from 100L/s to 3,194L/s with the new Line Avenue connection.

4.2.2 Towpath SPS and Forcemain

The Region MSPU identified that Towpath SPS has existing and future deficiencies based on existing and design peak wet weather flows. As such, the Region MSPU identified a capital project to upgrade the Towpath SPS during the timeframe of 2022 – 2026 from 118L/s to 600L/s (WW-SPS-037).

The Region MSPU also indicates that the existing Towpath SPS forcemain has current capacity; however, will have a projected capacity deficit for 2051 growth. There is already a constructed 600mm diameter forcemain that can be commissioned in line with Towpath upgrades, as identified in the Region MSPU capital projects during the timeframe of 2032-2036 (WW-FM-022).

4.2.3 Welland WWTP

The Region MSPU identified that the existing Welland WWTP has surplus capacity available to treat existing and future flows at the plant, with the plant reaching 80% capacity around the 2041 time horizon.

4.3 Proposed System Requirements

4.3.1 NWSP Sanitary Drainage Areas and Proposed Collection System

As requested, two sanitary servicing options were prepared and reviewed for feasibility for the NWSP area, including: 1) development blocks on the east and west side of First Avenue are connected to a new city trunk located on First Avenue and 2) development blocks on the east and west side of First Avenue are connected through the development blocks to a new city trunk located on Quaker Road.

Figure 4-2 and Figure 4-3 (also provided in Appendix B as Figure B-1 and B-2, respectively) show the approximate location of future city trunk sanitary gravity sewers within the NWSP area and the location where the city trunks will connect to the existing Region trunk sewer on Quaker Road for each servicing option. Figure 4-2 and Figure 4-3 also show identifying numbers for the individual NWSP drainage areas, which are referenced in the sewer design sheets provided in Appendix B.

The design sheets for the proposed sanitary sewers have been prepared with the new Line Avenue connection included. Note that the inverts and pipe lengths assigned to the existing trunk sewer in the proposed design sheets are from the City's InfoSWMM model. Existing peak flows into the trunk sewer, input at existing manhole locations in the design sheets, are also as per the City's InfoSWMM model. All inverts and pipe lengths of the proposed city trunk sewers have been assigned based on preliminary modeling and the existing ground contours of the area. Note that, it is assumed that any other sanitary sewer required on future local roads servicing the NWSP area, will be 200 mm diameter.

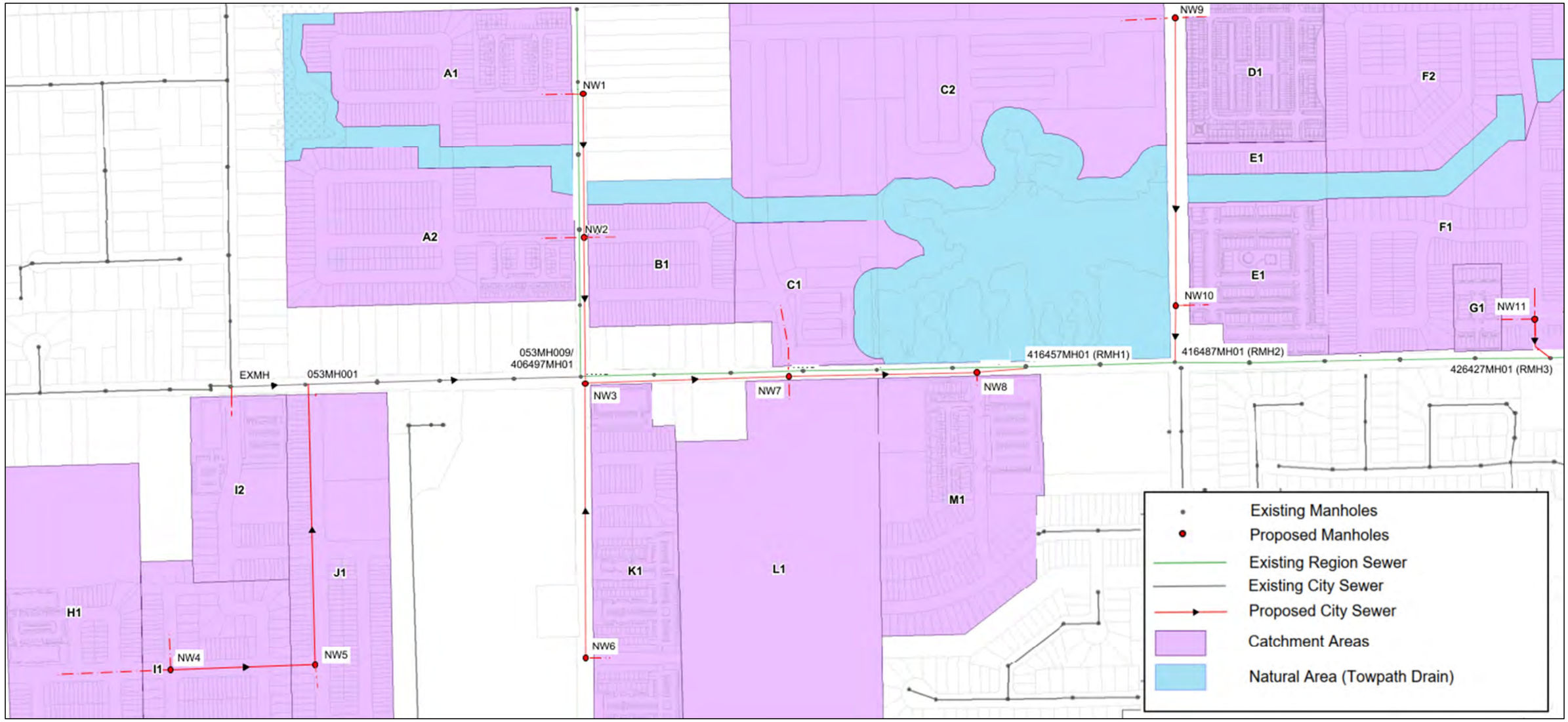


Figure 4-2: Proposed Sanitary System and Drainage Areas – Option 1

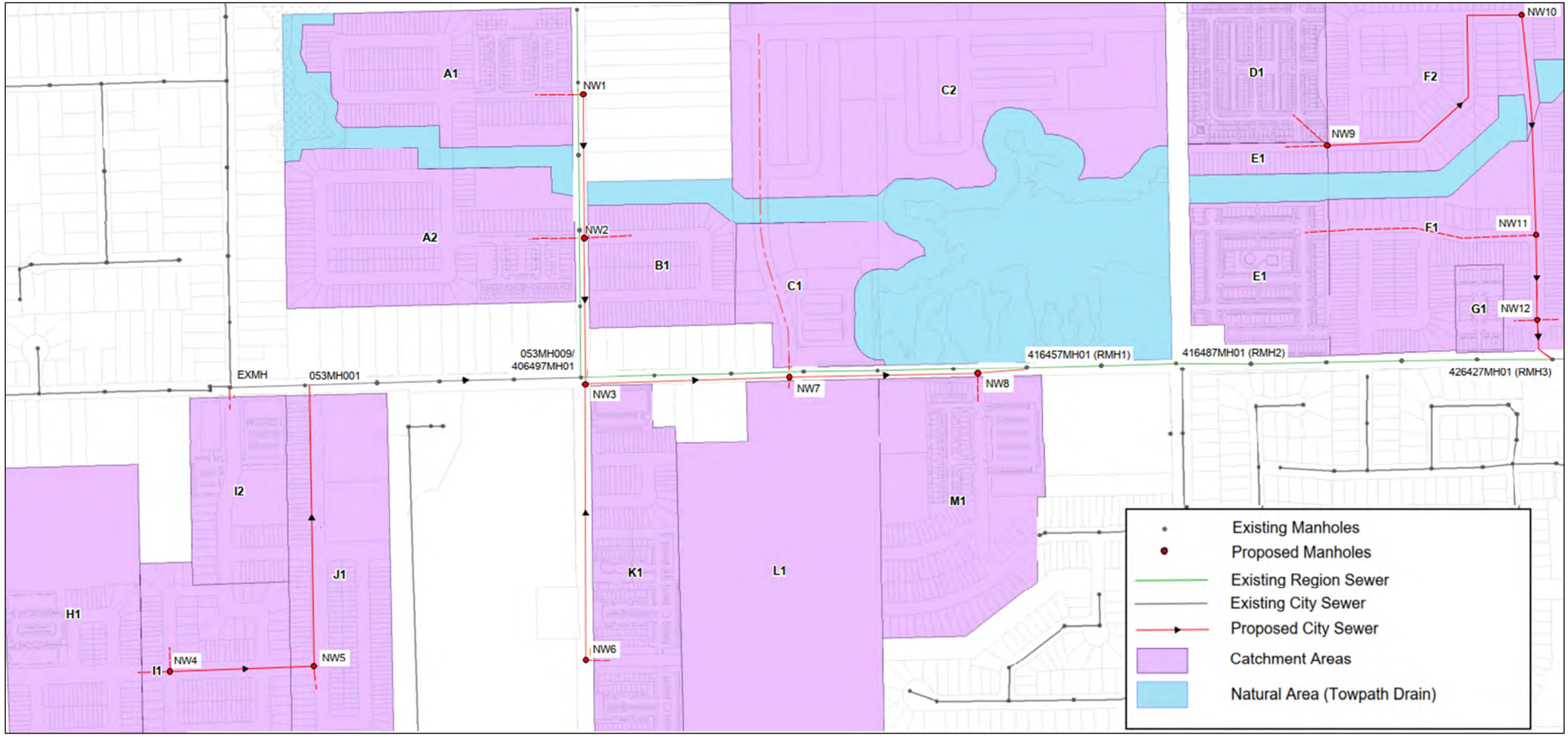


Figure 4-3: Proposed Sanitary System and Drainage Areas – Option 2

For servicing Option 2, the proposed trunk sewer within the quadrant east of First Avenue and north of Quaker Road (from NW10 to NW11) must cross the proposed Towpath Drain. For this preliminary assessment, using the existing ground contours and referencing the Towpath Drain Re-Alignment drawing package (Upper Canada Consultants, 2022) it appears that the proposed trunk sewer will be in direct conflict with the proposed box culvert and new creek bottom, making this servicing option not achievable. Further review and confirmation, based on proposed development details, will be required to determine viability of this servicing option moving forward.

As shown in the appended design sheets, the NWSP drainage area contributes overall an additional 143.3L/s of peak flow to the Quaker Road trunk sewer. Based on the capacity review of the existing trunk sewer on Quaker Road (provided in Appendix B), there are two (2) pipe segments that have an available capacity below 143L/s. The first pipe segment (19001376) is located between Rice Road and RMH1 (as shown on Figures 4-2 and 4-3 above). Since this segment will only receive an additional 27L/s sanitary flow from the NWSP area, this segment is not a concern. The second pipe segment (19001405) is located further downstream on Towpath Road between Grisdale Road and the Towpath Road SPS. Model analysis indicates this segment has 100L/s of available capacity with the Line Avenue trunk sewer connection. Further review and confirmation of available capacity within this segment should be completed prior to full build out of the NWSP area.

Although the phasing of future development within the NWSP area is not currently known, the proposed layout of this area and the associated sanitary design is such that the individual quadrants (defined as: areas west of Rice Road and north of Quaker Road (catchment area A); areas west of Rice Road and south of Quaker Road (catchment areas H, I, J); areas east of Rice Road and south of Quaker Road (catchment areas K, L, M); areas east of Rice Road and north of Quaker Road (catchment areas B, C1); areas east of First Avenue and north of Quaker Road (catchment areas D, E, F, G); and areas west of First Avenue (catchment area C2)) can mostly be developed independently of each other. Several exceptions to this include:

- the proposed city trunk sewer on Quaker Road (from NW3 to RMH1) must be constructed prior to development of catchment area A, catchment area B and catchment area K occurring;
- a portion of the proposed city trunk sewer on Quaker Road (from NW7 to RMH1) must be constructed prior to any development occurring within catchment areas C1 (and C2 for servicing Option 2), L, and M.
- for servicing Option 1, the proposed city trunk sewer on First Avenue (from NW9 to RMH2) must be constructed prior to development within catchment areas C2, D, and E.

The remainder of the city trunk sewers within each development quadrant should be constructed as development occurs in that quadrant starting from the downstream end.

Alternatively, to eliminate duplication of trunk infrastructure along Quaker Road and Rice Road, additional connections can be considered directly to the regional trunk main in order to eliminate the need for a ‘local’ trunk system. This approach would also eliminate most of the phasing exceptions noted above, as the local trunk would not need to be constructed.

4.3.2 Towpath SPS and Forcemain

The Welland NWSP area will contribute an additional 143.3L/s of peak flow to the Towpath SPS. As previously noted, the Region MSPU identified a planned upgrade to this SPS. The SPS upgrades will be required to address existing and future capacity and will be required to be completed before significant development can occur within the NWSP area.

The Towpath SPS forcemain has sufficient existing and future capacity to accommodate flows from the Welland NWSP area, provided the constructed 600mm diameter forcemain is commissioned prior to 2051 flows and build-out.

4.3.3 Welland WWTP and Downstream System

As previously noted, the Welland WWTP currently has a capacity surplus, and the NWSP area can be added. The Region MSPU did indicate the plant will reach 80% capacity around 2041. The post-2051 flows are expected to exceed the plant capacity; however, the plant can accommodate flows to 2051.

Additionally, the trunk sewer that the Towpath SPS forcemain discharges to has available capacity between the discharge point and the WWTP to accept an increase in flow. The design of the future Towpath SPS upgrade should confirm the capacity of the downstream trunk sewer when determining SPS outflow rates.

5 STORM

The existing NWSP area topography is quite flat and drains in a west to east direction. The land use is mainly pasture/ agricultural land interspersed with country residential homes. The plan area is significantly developed all around the boundary as well as within the plan area itself. The west side of the study area is already developed with country residential homes. There are two (2) major drainage channels that flow through the site – Towpath Drain within the northern portion of the development area and a tributary to Welland Recreational Canal within the southern portion of the development area. These two (2) channels are identified by the Niagara Peninsula Conservation Authority (NPCA) as requiring approval for any development draining to the channels. The existing stormwater drainage paths are shown in Figure 5-1.

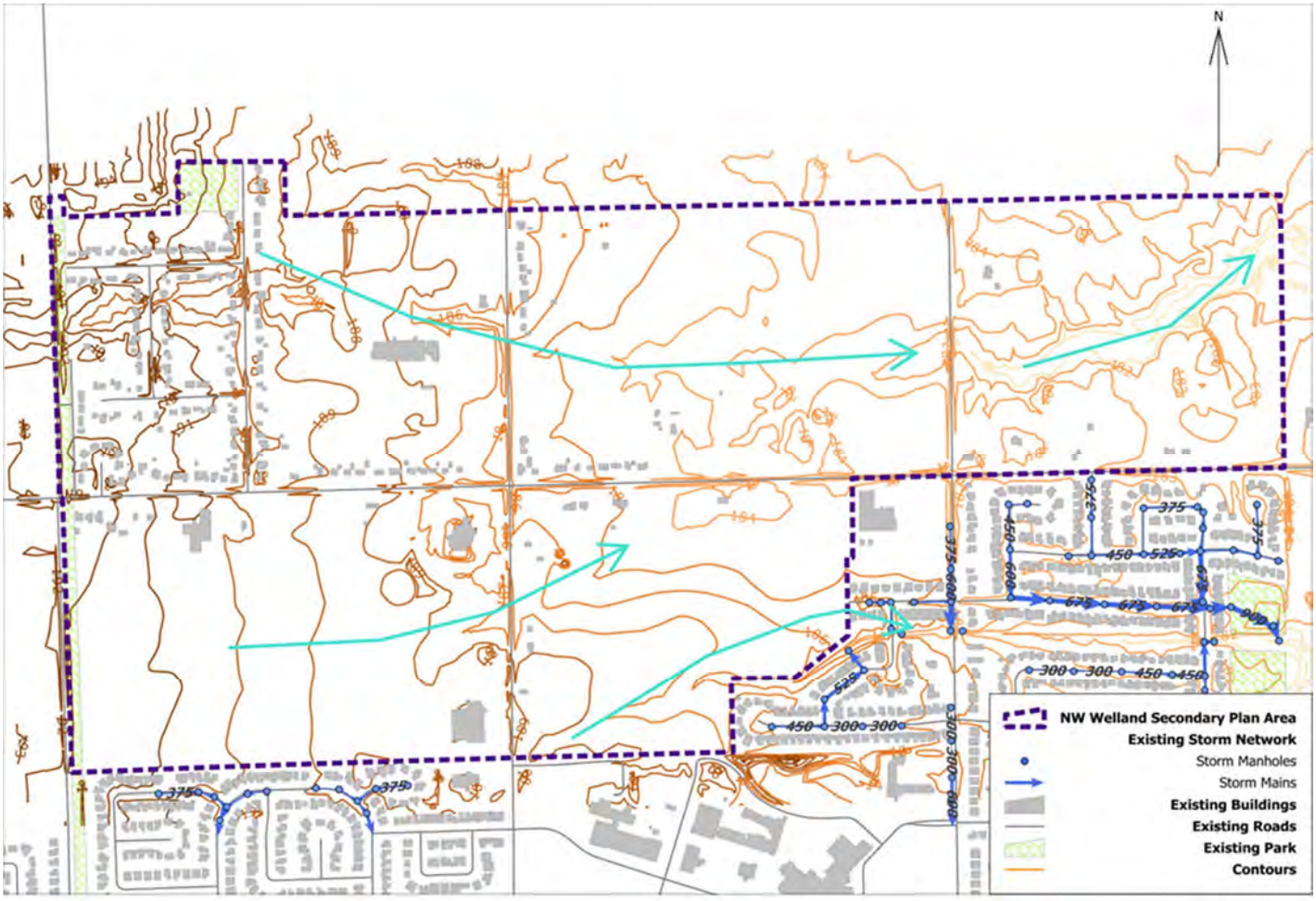


Figure 5-1: Schematic of Existing Stormwater Drainage Path

5.1 Design Criteria

The overall stormwater management plan for the NWSP area was initially developed by Aquafor Beech (2020) and updated and refined by Upper Canada Consultants (2022). The focus of this report is the identification of gravity sewer servicing requirements. The following design criteria were used in identifying these servicing requirements:

- Pipes were sized using the rational method with the City of Welland's 5-Year IDF curve values (a = 830, b =0.777, c = 7.3)
- Friction factor = 0.013
- Run-off coefficients (as per City of Welland's Design Standards) of:
    - Low Density Residential (i.e.: Single Family) = 0.40
    - Medium Density Residential (i.e.: Semi-Detached) = 0.50
    - High Density Residential (i.e.: Townhouses) = 0.60

5.2 Existing System Capacity

Since the proposed servicing, which is the focus of this report, will not leverage any existing gravity storm sewers in the area, no review of existing system capacity was conducted.

5.3 Proposed System Requirements

5.3.1 Proposed Stormwater Management Pond Locations

The stormwater management plan developed by Upper Canada Consultants identified approximate locations for eight (8) storm ponds, which will outlet to the Towpath Drain (channel north of Quaker Road), while one (1) storm pond will outlet to the tributary to Welland Recreational Canal (channel south of Quaker Road). The intent of the stormwater management plan is that all runoff from the proposed NWSP area will be directed to these storm pond locations through new gravity sewers installed on existing and future roads.

The approximate location of these proposed storm ponds is shown on the Ultimate Stormwater Management Plan figure from the Upper Canada Consultants Stormwater Management Implementation Plan (October 2022), which is included in Appendix C for reference. These pond locations were used to identify approximate outlet locations for the gravity sewers that will be required to service the NWSP area.

5.3.2 Proposed Gravity Sewers

Figure 5-2 (also provided in Appendix C as Figure C-2) shows the approximate location of future trunk storm gravity sewer outlets to the proposed storm ponds within the NWSP area. Figure 5-2 also shows identifying numbers for the individual NWSP drainage areas, which are referenced in the sewer design sheet found in Appendix C. Note, the design sheet was used primarily to identify outlet pipe sizing. Pipe sizes/lengths for the remainder of the future system were also approximated for preliminary costing (see Section 6), with a conservative assumption of a minimum pipe size of 450mm.

Based on the results of the completed sewer design sheet found in Appendix C, Table 5-1 shows the identified required outlet sizes for each approximate pond location.

Figure 5-2: Proposed Storm System and Drainage Areas

Table 5-1: Required Outlet Size

Outlet #	Size (mm)
SWM1	900
SWM3	1050
SWM5	1350
SWM7	1350
SWM9	1200

Note that pipe slopes identified in the design sheet were assigned based on the existing ground contours for the area and the required outlet elevations, with the intent of ensuring suitable cover over all proposed pipes.

6 PRELIMINARY COSTING

Preliminary costing for the conceptual water, sanitary, and stormwater servicing is provided in Table 6-1. Note – neither road works, utilities (including hydro, gas and communications servicing), nor restoration cost (asphalt) for works proposed on existing roads (Rice Road, Quaker Road, and First Avenue) are included in this estimate. A more detailed breakdown of these preliminary cost estimates can be found in Appendix D.

Table 6-1: Preliminary Cost Estimate for Municipal Servicing

Item	Scope of Work	Cost
Water Distribution System	Watermain (150mm to 300mm) including services, valves, and hydrants	$26,366,775
Sanitary Collection Servicing		$36,657,195
Storm Collection Servicing	Storm Sewer (450mm to 1350mm), including structures	$19,136,475
Sub-total	Water/Sanitary/Storm	$82,160,445
Engineering	10% of Capital	$8,216,200
Contingency	15% of Capital	$12,324,200
TOTAL		$102,700,845

7 CONCLUSIONS

The conclusions from the water, sanitary, and storm servicing capacity assessments are as follows:

Water:

- Proposed pipe servicing for the NWSP development is sized based on the design fire flow criteria of 133 L/s which are provided in Section 3. These include:
    - To supply fire flows for the northwest portion of NWSP development, the existing Rice Road watermain and the new infrastructure west of Rice Road (Loop A), should be a minimum of 250mm in diameter.
    - To supply water and adequate fire flows to the south-west portion of the development, a new 250mm diameter interconnection (Loop-H) is required to connect the existing 750mm regional trunk main on Clare Avenue to the new 300mm main on Quaker Road.
    - Loop C (300mm dia) for block C of NWSP and Loop L (200mm dia) for blocks K, L and M are required to provide the adequate fire flows.
    - A new 250mm watermain interconnection connecting the NWSP development to the Niagara Street Watermain on the east side will also be required to support the required fire flows.
- The addition of the NWSP development to the City's system does not negatively impact the surrounding system, and instead should improve pressures and fire flows in the area.
- The existing system has sufficient storage to support the future NWSP development.
- The proposed development does not negatively impact the existing low-pressure areas identified near Shoalt's Reservoir.

Sanitary:

- The existing trunk along Quaker Road, which conveys flows to the Towpath SPS, has sufficient capacity to accept the additional 143.3 L/s peak flow generated by the NWSP area, with the exception of pipe segment 19001405 on Towpath Road between Grisdale Road and the Towpath Road SPS. Model results indicate this segment has only 100L/s of available capacity.
- The Towpath SPS was identified in the Region MSPU as requiring an upgrade due to both growth north of the study area and the redirection of a portion of the flows from Pelham (north-west of Line Avenue) to the Towpath SPS through the Quaker Road trunk sewer. The timing of the Towpath SPS upgrade is 2022-2026 and will be required to be completed before significant development can occur within the NWSP area.
- The Towpath SPS forcemain has sufficient existing capacity; however, will have a projected capacity deficit for 2051 growth. There is already a constructed 600mm diameter forcemain that will require commissioning in line with Towpath SPS upgrades during the timeframe of 2032-2036 (WW-FM-022).
- The trunk sewer that the Towpath SPS forcemain discharges to has available capacity between the discharge point and the WWTP to accept an increase in flow.
- The WWTP has sufficient capacity to allow for the addition of the NWSP area.
- Future sanitary sewer sizing will range from 200 mm diameter to 450 mm diameter. Sizing to be confirmed during design.
- The phasing of future development within the NWSP area is not currently known; however, the proposed layout of this area is such that the individual quadrants (defined as: areas west of Rice Road and north of Quaker Road; areas west of Rice Road and south of Quaker Road; areas east of Rice Road and south of Quaker Road; areas east of Rice Road and north of Quaker Road; areas east of First Avenue and north of

Quaker Road; and areas west of First Avenue) can mostly be developed independently of each other, with exceptions noted below.

- The proposed city trunk sewer on Quaker Road (from NW3 to RMH1) must be constructed prior to development west of Rice Road, north of Quaker Road, and lands fronting the east side of Rice Road both north and south of Quaker Road.
- A portion of the proposed city trunk sewer on Quaker Road (from NW7 to RMH1) must be constructed prior to any development occurring east of Rice Road and west of First Avenue.
- For servicing Option 1, the proposed city trunk sewer on First Avenue (from NW9 to RMH2) must be constructed prior to development occurring immediately east and west of First Avenue.

- Alternatively, to eliminate duplication of trunk infrastructure along Quaker Road and Rice Road, additional connections can be considered directly to the regional trunk main in order to eliminate the need for a 'local' trunk system and most of the phasing exceptions noted above.

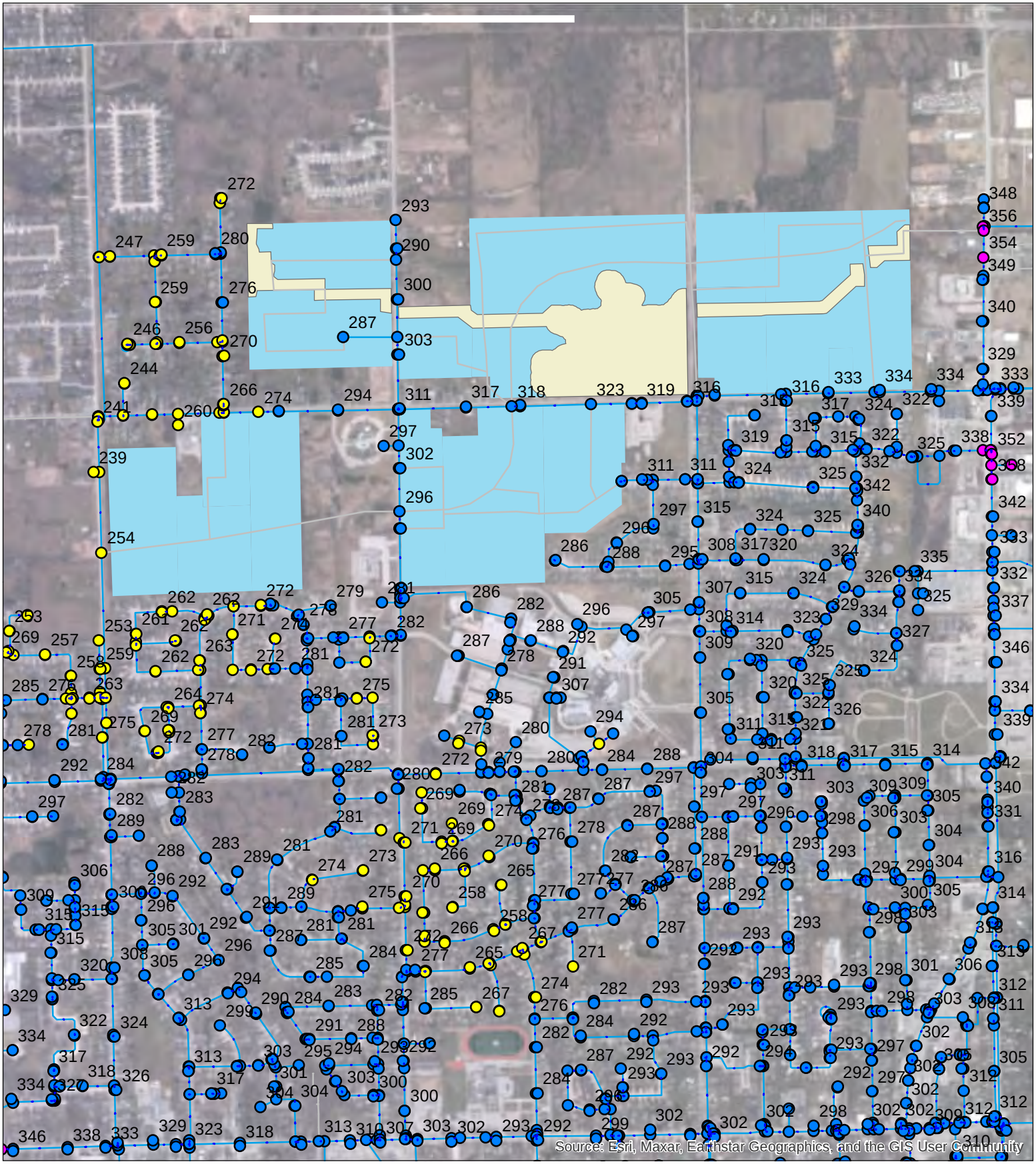
Storm:

- The stormwater management plan developed by Upper Canada Consultants identified approximate locations for nine (9) new storm water ponds to service the NWSP area. Gravity sewers along the existing and future roads will direct runoff to these pond locations. Outlet sizing for the ponds will range from approximately 750 mm diameter to 1350 mm diameter. Sizing to be confirmed during design.

Respectfully Submitted by,

Andrea LaPlante, P.Eng.
Project Manager

APPENDIX A - WATER



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Associated Engineering

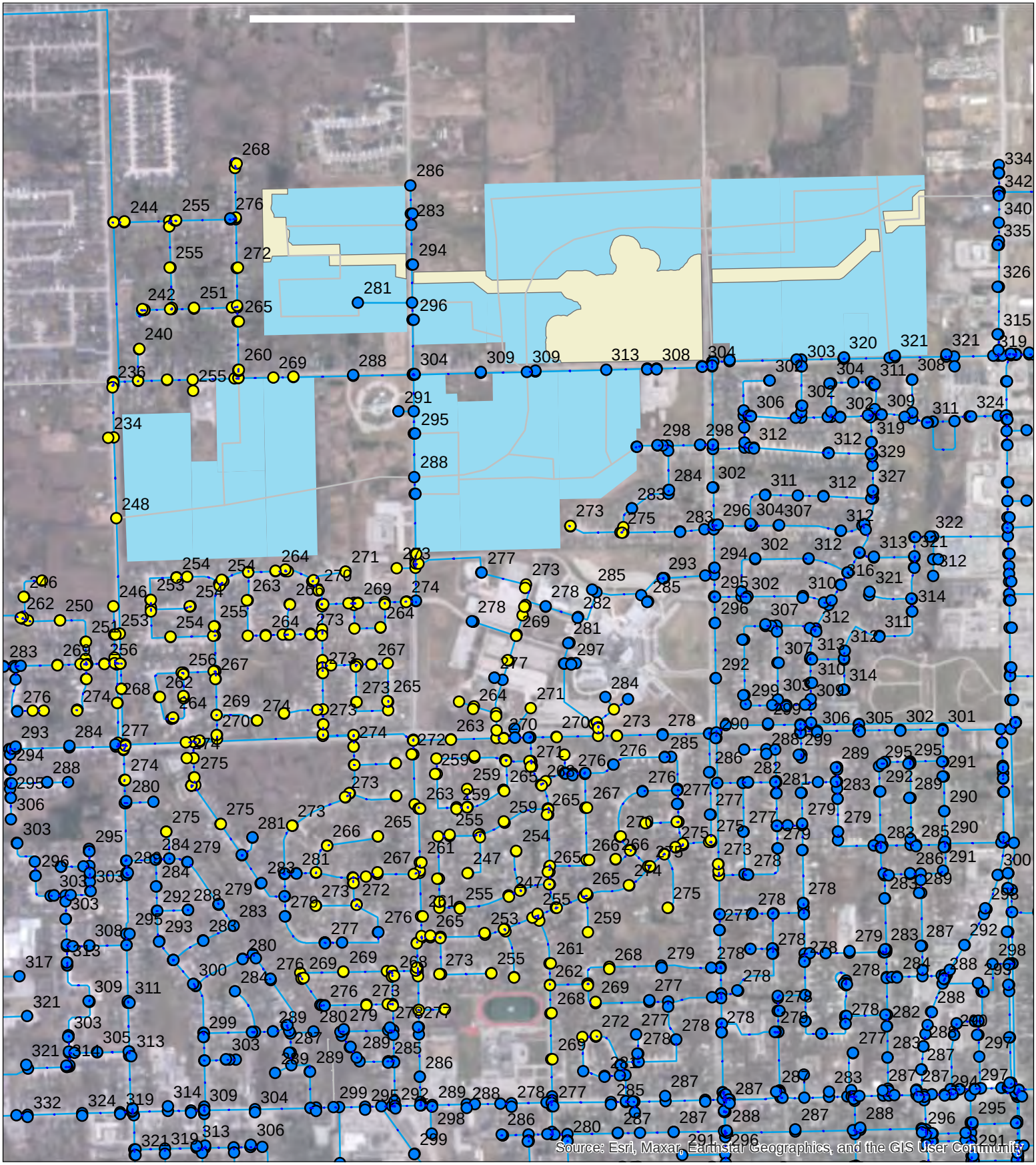
BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Existing ADD: Minimum Pressures

Project No: 2023-5773
Date: March 2024

Figure A-1



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Associated Engineering

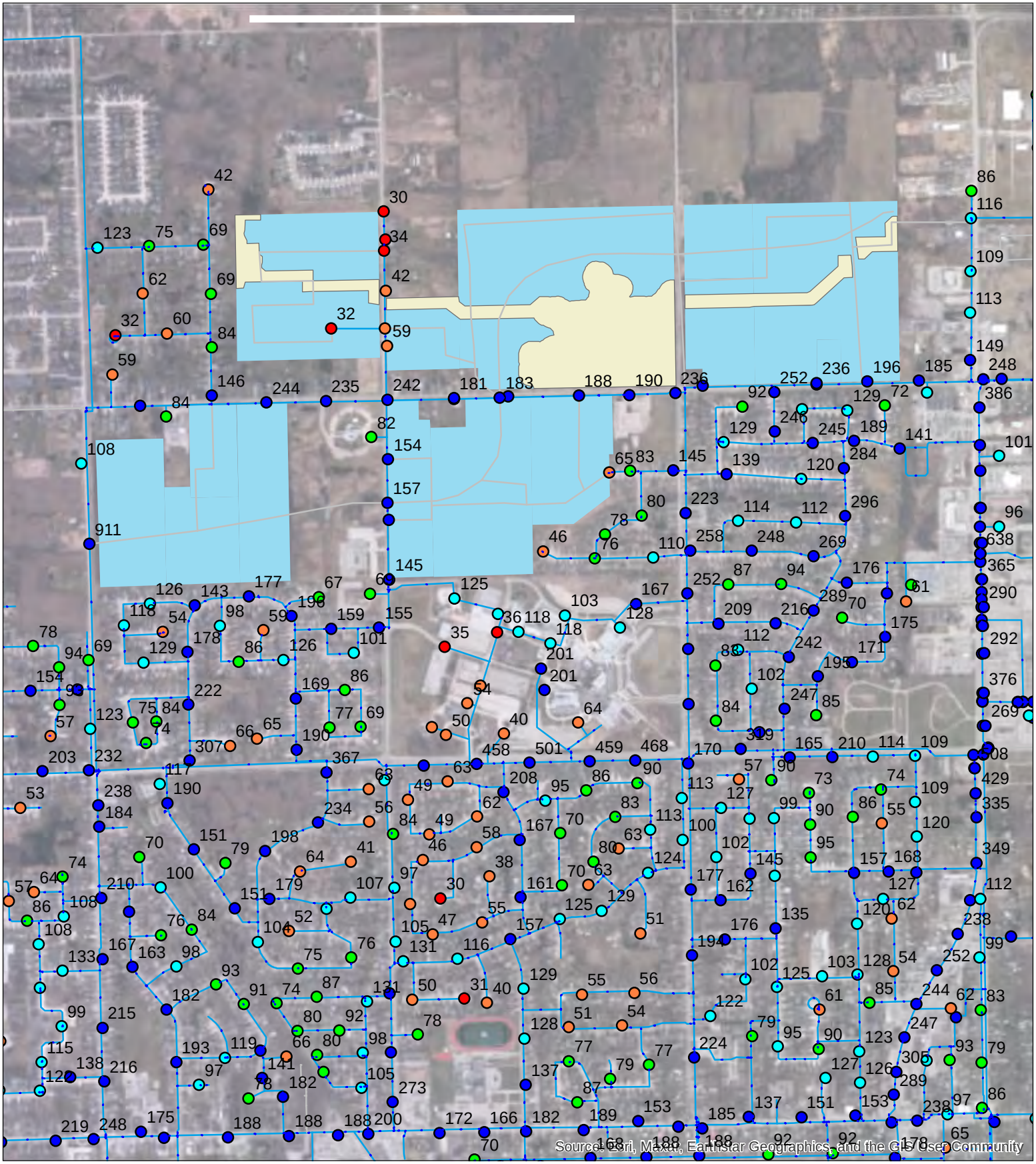
BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Existing MDD: Minimum Pressures

Project No: 2023-5773
Date: March 2024

Figure A-2



Available Fire Flows (L/s)

- < 37 L/s
- 37 - 67 L/s
- 67 - 95 L/s
- 95 - 133 L/s
- > 133 l/s

Existing Watermain

Proposed Development

Associated Engineering

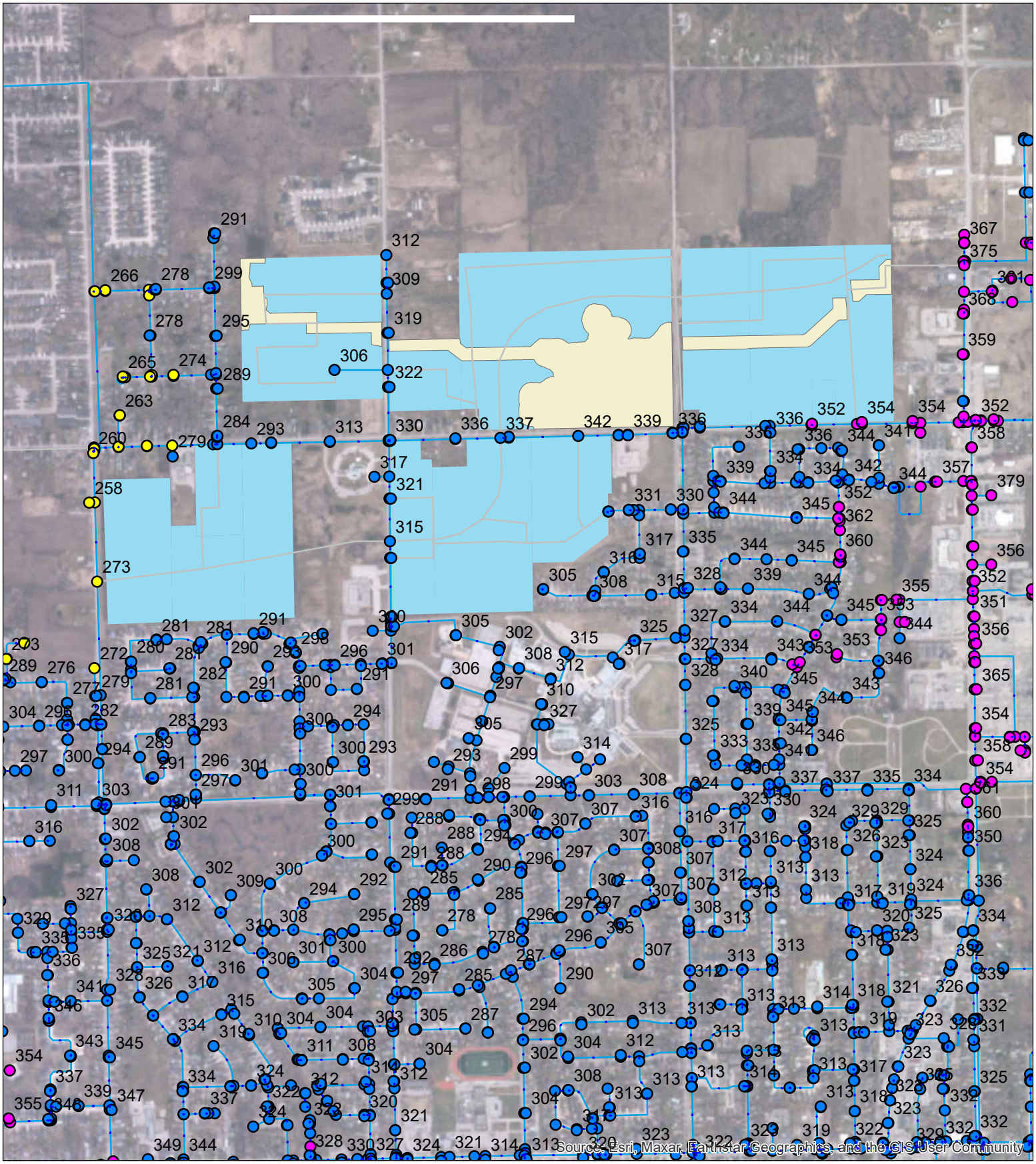
BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Existing MDD+FF: Available Fire Flows (L/s)

Project No: 2023-5773
Date: March 2024

Figure A-3



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

N

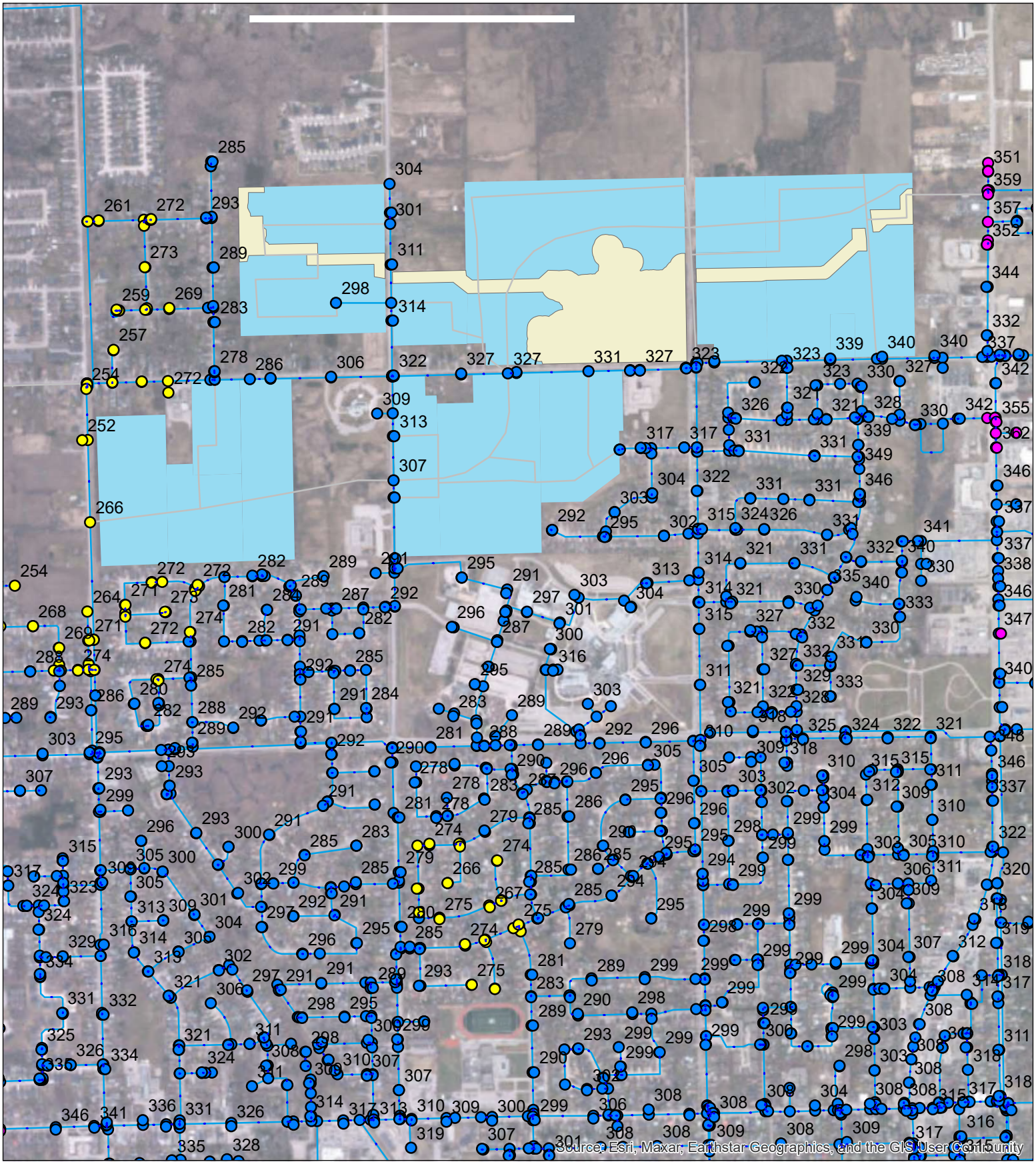
Associated Engineering

BEST MANAGED COMPANIES

Northwest Secondary Paln Municipal Servicing

Future ADD without NWSP: Minimum Pressures

Project No: 2023-5773	Figure A-4
Date: March 2024	



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

N

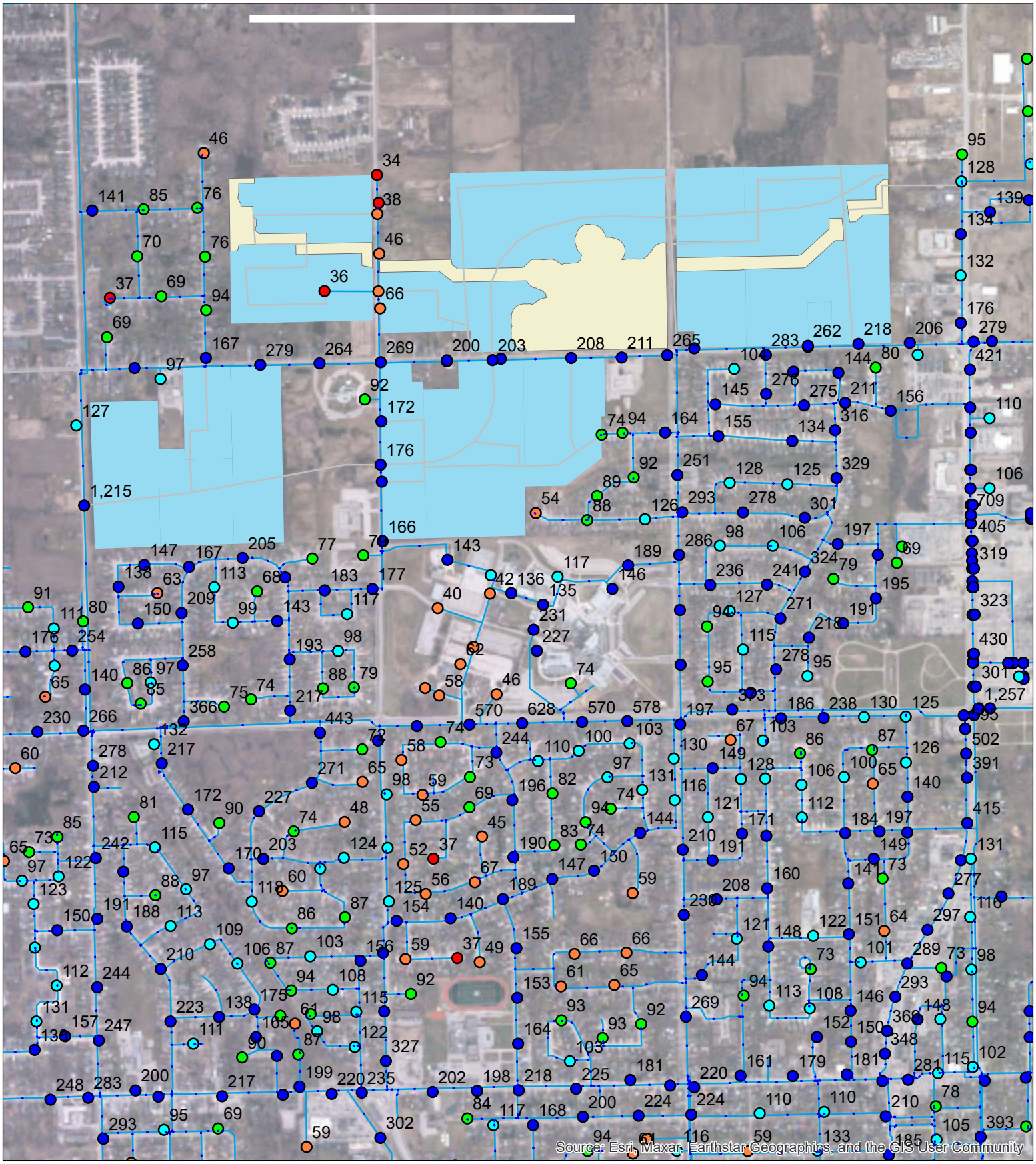
Associated Engineering

BEST MANAGED COMPANIES

Northwest Secondary Paln Municipal Servicing

Future MDD without NWSP: Minimum Pressures

Project No: 2023-5773	Figure A-5
Date: March 2024	



Available Fire Flows (L/s)

- < 37 L/s
- 37 - 67 L/s
- 67 - 95 L/s
- 95 - 133 L/s
- > 133 l/s

Existing Watermain

Proposed Development

N

Associated Engineering

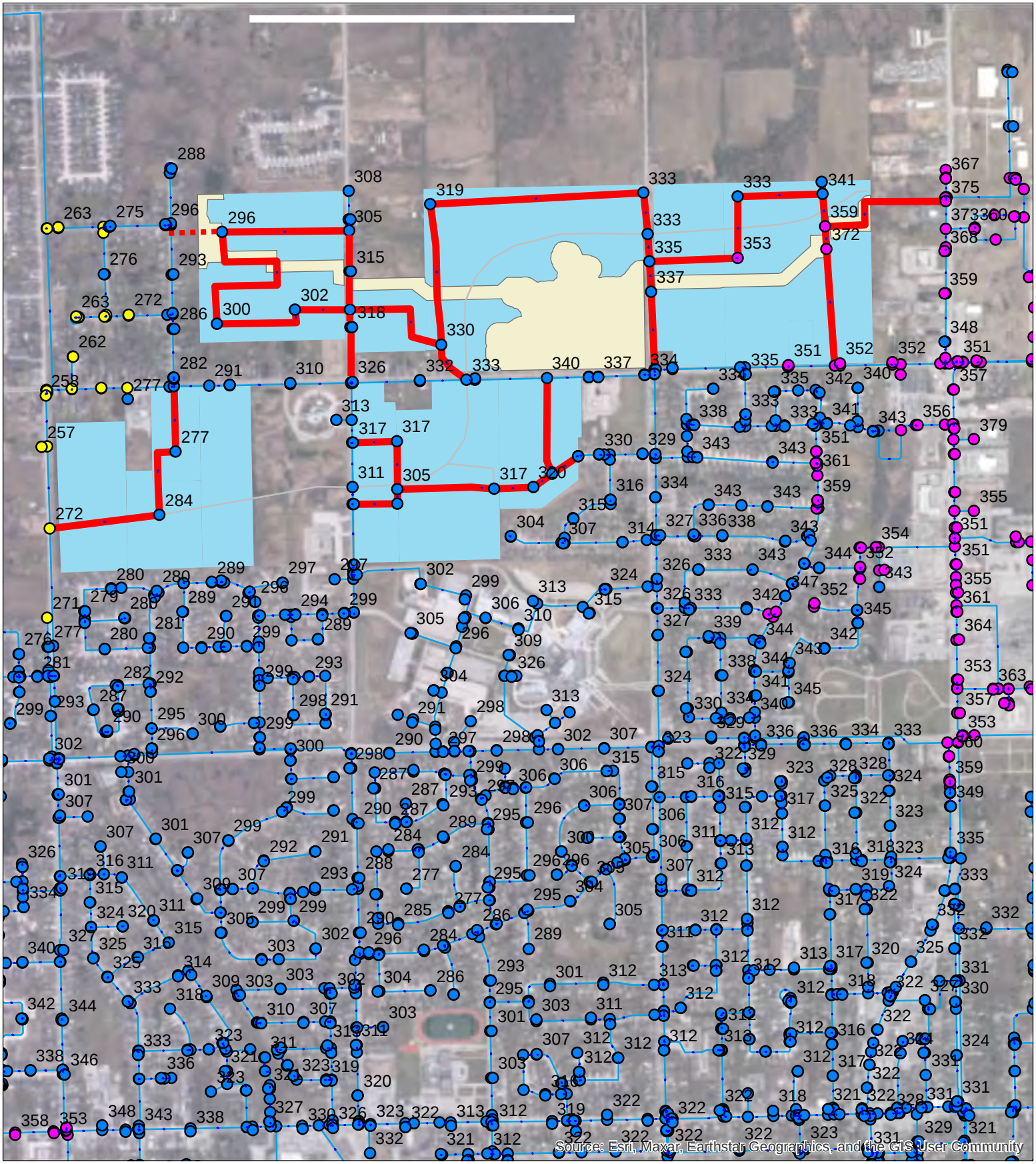
BEST MANAGED COMPANIES

Northwest Secondary Paln Municipal Servicing

Future MDD+FF without NWSP : Available Fire Flows

Project No: 2023-5773
Date: March 2024

Figure A-6



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Proposed Pipes for NWSP Development

Potential Future Looping

Associated Engineering

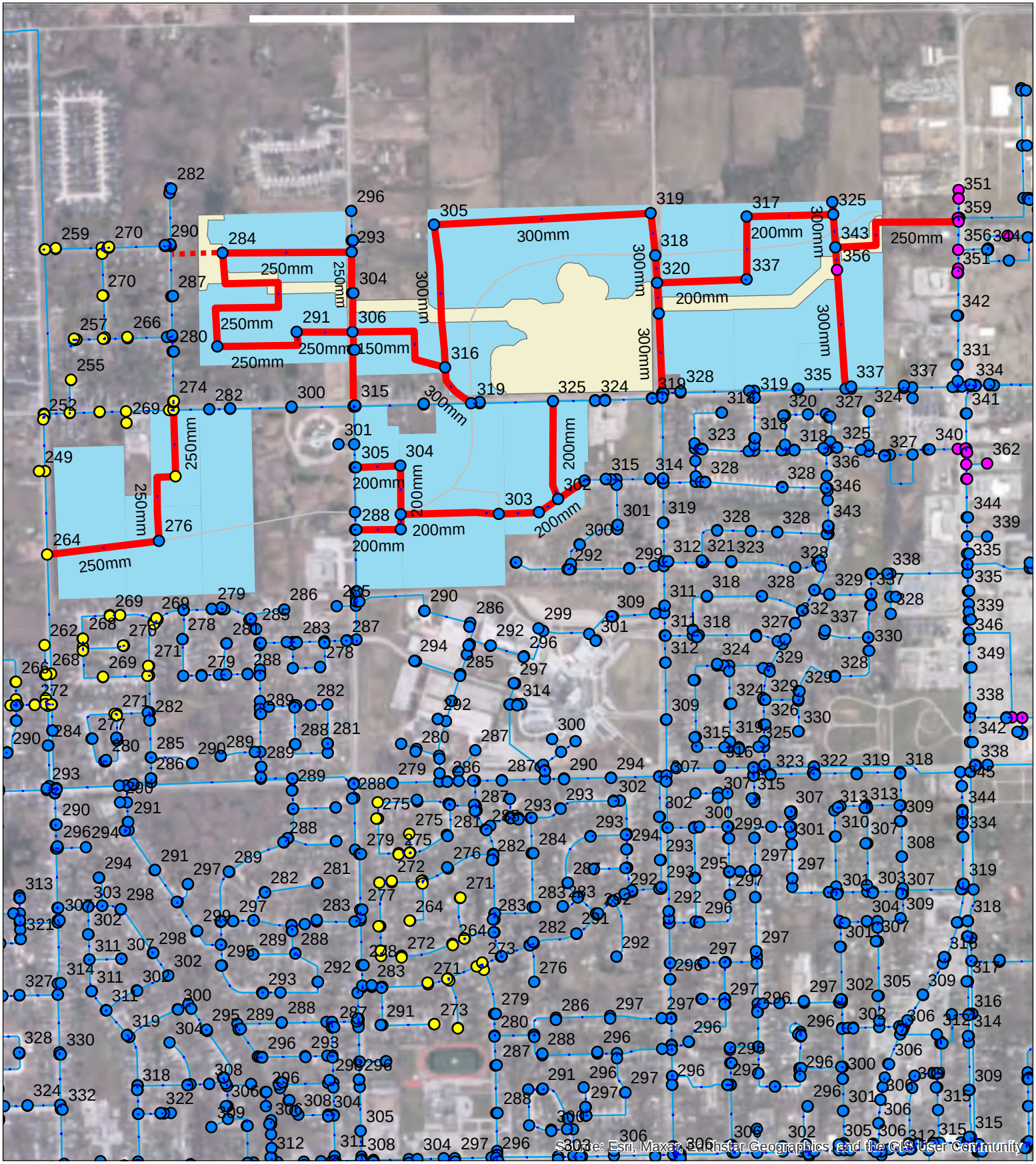
BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Future ADD with NWSP: Minimum Pressures

Project No: 2023-5773
Date: March 2024

Figure A-7



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Proposed Pipes for NWSP Development

Potential Future Looping

Associated Engineering

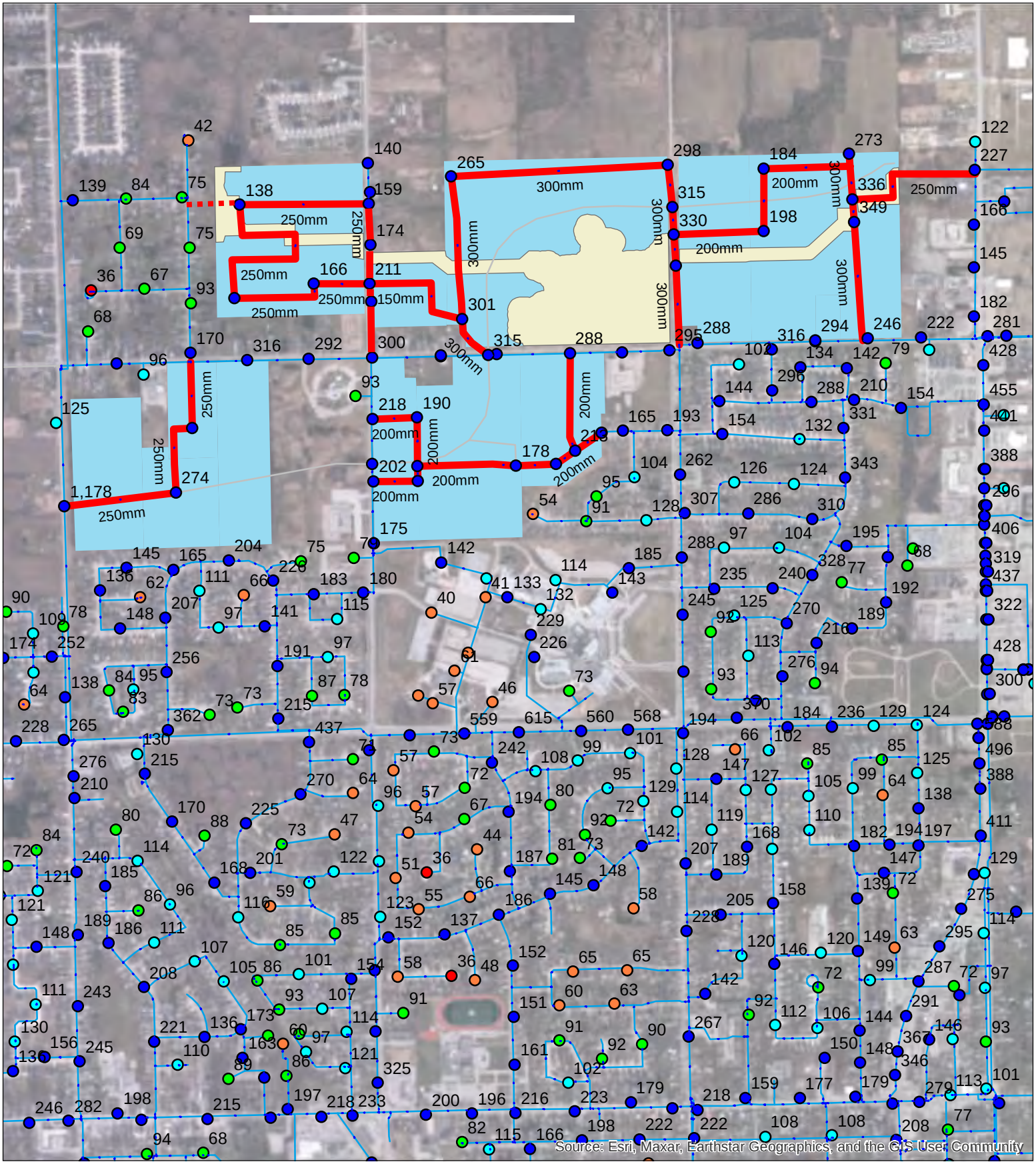
BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Future MDD with NWSP: Minimum Pressures

Project No: 2023-5773
Date: March 2024

Figure A-8



Available Fire Flows (L/s)

- < 37 L/s
- 37 - 67 L/s
- 67 - 95 L/s
- 95 - 133 L/s
- > 133 l/s

Existing Watermain

Proposed Development

Proposed Pipes for NWSP Development

Potential Future Looping

Associated Engineering

BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Future MDD with NWSP: Available Fire Flows (L/s)

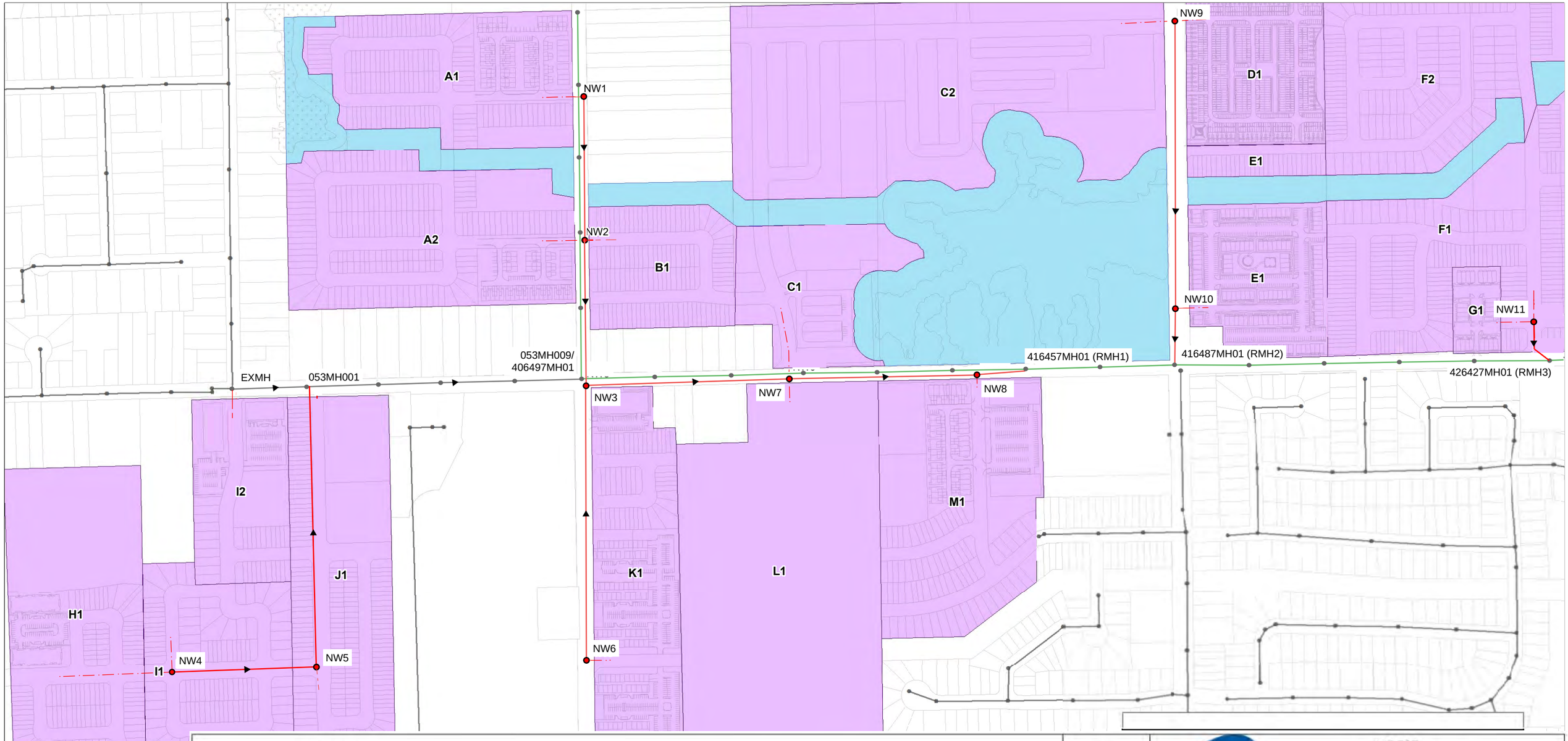
Project No: 2023-5773
Date: March 2024

Figure A-9

APPENDIX B - SANITARY

Northwest Secondary Plan
Municipal Servicing
2041 Quaker Road to Towpath SPS Trunk Sewer Available Capacity

Pipe Segment ID	Full Flow Capacity (L/s)	2041 without Line Avenue Connection		2041 with Line Avenue Connection	
		Peak Flow 2041 (L/s)	Available Capacity (L/s)	Peak Flow 2041 (L/s)	Available Capacity (L/s)
19001374	608	146	462	276	332
19001375	547	146	401	276	271
19001376	383	147	236	277	106
19001377	495	147	348	277	218
19001378	446	147	299	277	169
19001366	282	125	157	124	158
19001367	327	126	201	125	202
19001365	313	124	189	124	189
19001364	370	124	246	123	247
19001363	353	123	230	122	231
19001379	639	147	492	277	362
19001380	623	147	476	277	346
19001381	540	148	392	278	262
19001382	729	148	581	278	451
19001383	452	148	304	278	174
19001384	720	149	571	279	441
19001385	747	149	598	279	468
19001386	638	149	489	279	359
19001387	588	149	439	279	309
19001388	638	150	488	280	358
19001389	816	150	666	280	536
19001390	671	170	501	300	371
19001391	731	170	561	300	431
19001392	718	170	548	300	418
19001393	731	170	561	300	431
19001394	717	170	547	300	417
19001395	714	170	544	300	414
19001396	733	170	563	300	433
19001397	844	170	674	300	544
19001398	708	170	538	300	408
19001399	740	170	570	300	440
19001400	718	170	548	300	418
19001401	718	170	548	300	418
19001402	918	170	748	300	618
19001403	917	170	747	300	617
19001404	907	170	737	300	607
19001405	401	171	230	301	100
19001406	923	171	752	301	622
19001407	1143	177	966	307	836
19001408	914	177	737	307	607
19001409	914	177	737	307	607
19001410	912	177	735	307	605
19001411	914	177	737	307	607
19001412	1125	220	905	350	775
19001413	889	220	669	350	539
19001519	3470	220	3250	350	3120
19001520	3544	220	3324	350	3194



Legend:

- Existing Manholes
- Proposed Manholes
- Existing Region Sewer
- Existing City Sewer
- Proposed City Sewer
- Catchment Areas
- Natural Area (Towpath Drain)

–

Associated Engineering

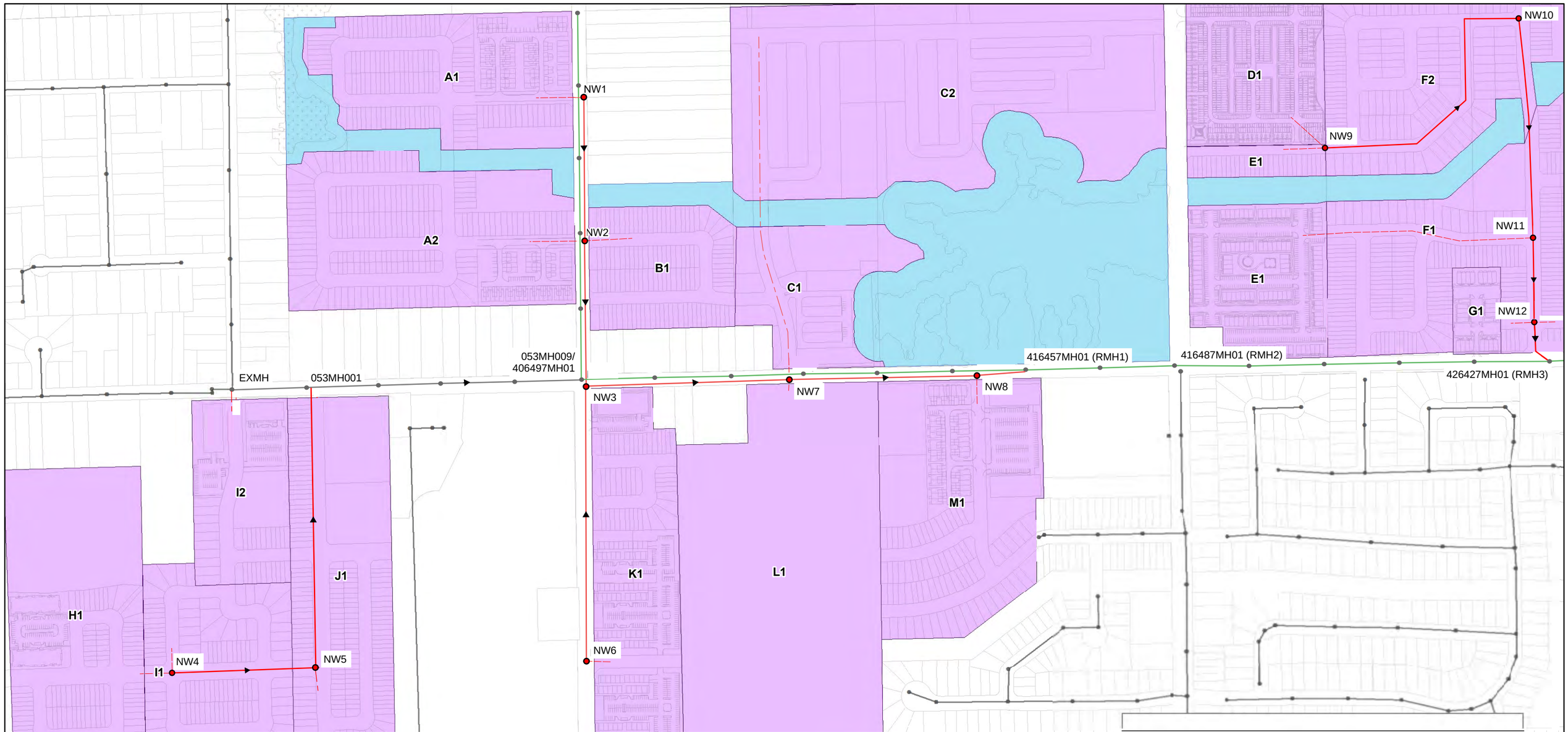
BEST MANAGED COMPANIES CANADA Platinum member

Northwest Secondary Plan
Municipal Servicing

Sanitary Sewer Design - Option 1

Project No: 2023-5773
Date: March 2024

Figure B-1



Legend:

- Existing Manholes
- Proposed Manholes
- Existing Region Sewer
- Existing City Sewer
- Proposed City Sewer
- Catchment Areas
- Natural Area (Towpath Drain)

—

Associated Engineering

BEST MANAGED COMPANIES Platinum member

Northwest Secondary Plan
Municipal Servicing

Sanitary Sewer Design - Option 2

Project No: 2023-5773
Date: March 2024

Figure B-2

SANITARY SEWER DESIGN SHEET

Design Option - 1

Project: Welland Northwest Secondary Plan
Location:

Roughness Coefficient (n) = 0.013
Residential Per Capita Flow Rate = 0.00318287 L/cap/s (275 L/cap/day)
Infiltration Rate= 0.286 L/s/ha

Associated Engineering

LOCATION							NWSP POPULATION AND FLOW DATA										EX TRUNK FLOW		TOTAL (NWSP + EX)	SEWER DESIGN									
DESCRIPTION	DRAINAGE AREA	MANHOLE		INVERTS		LENGTH	AREA	POP	CUMULATIVE		AVG. DAILY FLOW	PEAKING FACTOR (PF = 1+14/(4+P^1/2))	PEAK FLOW (NO INFIL.)	INFILT. FLOW	PEAK FLOW (W/ INFIL.)	ADDITIONAL PEAK FLOW (FROM MODEL)	CUMULATIVE PEAK FLOW (FROM MODEL)	TOTAL PEAK FLOW	PIPE SIZE	ACTUAL SLOPE	APPROX. CRITICAL SLOPE	DESIGN SLOPE	Act. Dia.	PIPE AREA	HYD. RAD.	FULL FLOW VELOCITY	FULL FLOW CAPACITY	PERCENT FULL	CAPACITY CHECK	ACTUAL VELOCITY
									AREA	POP. Served																				
STREET	ID	FROM	TO	U/S	D/S	m	(ha)	(ppl)	(ha)	(ppl)	(l/s)	(dmnl)	(L/s)	(L/s)	(L/s)	(L/s)		(L/s)	(mm)	(%)	(%)	(%)	(mm)	(m^2)	(m)	(m/s)	(L/s)	(%)		(m/s)
Rice Road (N of Quaker)	A1	NW1	NW2	182.30	181.02	200	6.0	532	6.0	532	1.69	3.96	6.71	1.72	8.43	0.0	0.0	**8.4**	200	0.64	1.54	0.64	203.2	0.032	0.051	0.84	**27.4**	30.8	OK	0.65
Rice Road (N of Quaker)	A2, B1	NW2	NW3	181.02	180.10	197	10.6	868	16.6	1400	4.46	3.70	16.49	4.76	21.25	0.0	0.0	**21.2**	250	0.47	1.43	0.47	254.0	0.051	0.064	0.84	**42.5**	50.0	OK	0.74
Kaywood Crt.				188.89	188.47	65	0.5	15	0.5	15	0.05	4.00	0.19	0.14	0.33	0.0	0.0	**0.3**	200	0.65	1.54	0.65	203.2	0.032	0.051	0.85	**27.6**	1.2	OK	0.20
Quaker Road (School/Daycare)							1.6	500	1.6	500	0.36	3.97	1.41	0.47	1.88	0.0	0.0	**1.9**											
Montgomery (end to Summerlea)				186.53	186.10	179	3.0	25	3.0	25	0.08	4.00	0.32	0.86	1.18	0.0	0.0	**1.2**	250	0.24	1.43	0.24	254.0	0.051	0.064	0.60	**30.4**	3.9	OK	0.24
Topham/Crerar/Summerlea				188.66	186.12	420	10.9	148	10.9	148	0.47	4.00	1.88	3.12	5.00	0.0	0.0	**5.0**	250	0.60	1.43	0.60	254.0	0.051	0.064	0.95	**48.1**	10.4	OK	0.53
Montgomery (Summerlea to Quaker)			EXMH	186.08	185.03	423	5.7	78	19.6	250	0.80	4.00	3.18	5.61	8.79	0.0	0.0	**8.8**	250	0.25	1.43	0.25	254.0	0.051	0.064	0.61	**31.0**	28.3	OK	0.46
Quaker Road (Line to Kaywood)				188.89	188.42	53	0.7	13	0.7	13	0.04	4.00	0.16	0.20	0.36	0.0	0.0	**0.4**	200	0.89	1.54	0.89	203.2	0.032	0.051	1.00	**32.3**	1.1	OK	0.21
Quaker Road (Kaywood to Montgomery)			EXMH	188.41	184.55	270	3.4	38	4.6	565	2.15	3.95	8.50	1.32	9.82	0.0	0.0	**9.8**	250	1.43	1.43	1.43	254.0	0.051	0.064	1.46	**74.2**	13.2	OK	0.88
Quaker Road (W of Rice)	I2	EXMH	053MH001	184.52	183.93	104	3.4	330	27.6	1145	4.00	3.76	15.05	7.90	22.95	0.0	0.0	**22.9**	300	0.57	1.34	0.57	304.8	0.073	0.076	1.04	**76.2**	30.1	OK	0.80
NWSP (W of Rice, S of Quaker)	H1, I1	NW4	NW5	186.40	185.40	210	13.8	938	13.8	938	2.99	3.82	11.40	3.94	15.34	0.0	0.0	**15.3**	200	0.48	1.54	0.48	203.2	0.032	0.051	0.73	**23.7**	64.7	OK	0.69
NWSP (W of Rice, S of Quaker)	J1	NW5	053MH001	185.40	183.90	389	7.0	454	20.8	1392	4.43	3.70	16.41	5.96	22.36	0.0	0.0	**22.4**	250	0.39	1.43	0.39	254.0	0.051	0.064	0.76	**38.7**	57.7	OK	0.70
Quaker Road (W of Rice)	-	053MH001	053MH009 / 406497MH01	183.88	181.64	385	3.5	33	51.9	2570	8.54	3.50	29.87	14.86	44.72	0.0	0.0	**44.7**	300	0.58	1.34	0.58	304.8	0.073	0.076	1.05	**76.8**	58.2	OK	0.97
Rice Road (S of Quaker)	K1	NW6	NW3	184.50	180.10	387	5.7	1229	5.7	1229	3.91	3.74	14.63	1.64	16.27	0.0	0.0	**16.3**	200	1.14	1.54	1.14	203.2	0.032	0.051	1.13	**36.5**	44.5	OK	0.96
Quaker Road (Rice to W of First)	-	NW3	NW7	180.10	179.24	287	-	-	22.4	2629	8.37	3.49	29.21	6.40	35.60	0.0	0.0	**35.6**	300	0.30	1.34	0.30	304.8	0.073	0.076	0.76	**55.3**	64.4	OK	0.71
Quaker Road (Rice to W of First)	C1, L1	NW7	NW8	179.24	178.72	261	16.6	1842	39.0	4471	14.23	3.29	46.81	11.15	57.96	0.0	0.0	**58.0**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	70.9	OK	0.69
Quaker Road (Rice to W of First)	M1	NW8	416457MH01 (RMH1)	178.72	178.58	69	7.1	661	46.0	5132	16.33	3.23	52.83	13.17	66.00	0.0	0.0	**66.0**	450	0.20	1.17	0.20	457.2	0.164	0.114	0.81	**133.0**	49.6	OK	0.71
Flows from Hurricane SPS/Rice Road (North)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	97.7	97.7	**97.7**	-	-	-		-	-	-	-	**-**	**-**	**-**	
Flows from West of Quaker and Rice (from Line Ave)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	79.1	79.1	**79.1**	-	-	-		-	-	-	-	**-**	-	-	-
Quaker Road (Region Trunk E of Rice)	-	053MH009 / 406497MH01	416457MH01 (RMH1)	179.94	178.58	618	-	-	51.9	2570	8.54	3.50	29.87	14.86	44.72	0.0	176.8	**221.5**	750	0.22	0.99	0.22	762.0	0.456	0.191	1.19	**544.8**	40.7	OK	1.00
Quaker Road (W of First to First)	-	416457MH01 (RMH1)	416487MH01 (RMH2)	178.58	178.25	207	-	-	98.0	7702	24.87	3.07	76.26	28.02	104.29	0.0	176.8	**281.1**	750	0.16	0.99	0.16	762.0	0.456	0.191	1.02	**464.6**	60.5	OK	0.95
First Ave (N of Quaker)	C2, D1, F2	NW9	NW10	179.40	178.41	393	26.1	3223	26.1	3223	10.26	3.42	35.04	7.47	42.51	0.0	0.0	**42.5**	375	0.25	1.25	0.25	381.0	0.114	0.095	0.80	**91.5**	46.5	OK	0.69
First Ave (N of Quaker)	E1	NW10	416487MH01 (RMH2)	178.41	178.25	80	4.8	1123	30.9	4346	13.83	3.30	45.66	8.83	54.49	0.0	0.0	**54.5**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	66.6	OK	0.68
Quaker Road (First to W of Niagara)	-	416487MH01 (RMH2)	426427MH01 (RMH3)	178.25	177.07	521	-	-	128.9	12048	38.70	2.87	111.23	36.86	148.09	3.0	179.8	**327.9**	750	0.23	0.99	0.23	762.0	0.456	0.191	1.22	**557.0**	58.9	OK	1.13
NWSP (N of Quaker, E of First)	F1, G1	NW11	426427MH01 (RMH3)	177.29	177.07	50	10.9	980	10.9	980	3.12	3.81	11.87	3.13	15.00	0.0	0.0	**15.0**	200	0.44	1.54	0.44	203.2	0.032	0.051	0.70	**22.7**	66.1	OK	0.67
Quaker Road (W of Niagara to Towpath)	-	426427MH01 (RMH3)	436437MH03	177.07	171.78	1320	-	-	139.8	13028	41.82	2.84	118.77	39.99	158.76	28.8	208.6	**367.4**	750	0.40	0.99	0.40	762.0	0.456	0.191	1.61	**734.5**	50.0	OK	1.42
Towpath (to SPS)	-	436540MH01	446525MH01	171.05	169.40	1002	-	-	139.8	13028	41.82	2.84	118.77	39.99	158.76	98.1	306.7	**465.5**	900	0.16	0.93	0.16	914.4	0.657	0.229	1.15	**755.4**	61.6	OK	1.07

Notes:
1. Residential design flows as per UCC
2. Slopes approximate; calculated based on length
3. Infiltration rate is 0.286 as per Region Master Plan Update 2021
4. Peak Factors for NWSP Flows as per Harmon's Formula
5. Population for NWSP as per UCC
6. All other peak flows as per All Pipe Model
7. Assume population density for existing residential single family home is 2.5p/household
8. School and daycare flows as per Building Code Table 8.2.1.3.B

SANITARY SEWER DESIGN SHEET

Design Option - 2

Project: Welland Northwest Secondary Plan
Location:

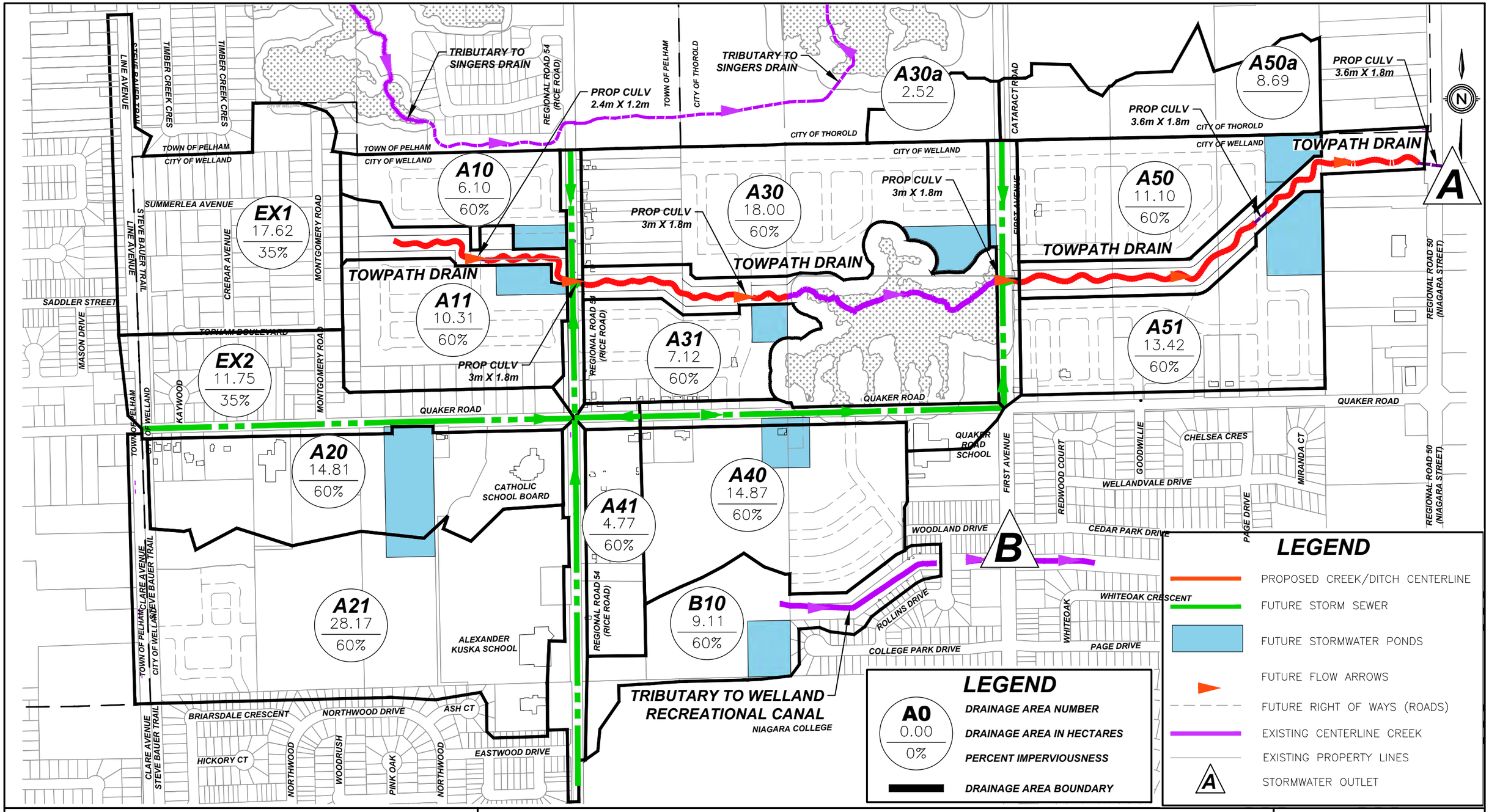
Roughness Coefficient (n) = 0.013
Residential Per Capita Flow Rate = 0.00318287 L/cap/s (275 L/cap/day)
Infiltration Rate= 0.286 L/s/ha

Associated Engineering

LOCATION							NWSP POPULATION AND FLOW DATA										EX TRUNK FLOW		TOTAL (NWSP + EX)	SEWER DESIGN									
DESCRIPTION	DRAINAGE AREA	MANHOLE		INVERTS		LENGTH	AREA	POP	CUMULATIVE		AVG. DAILY FLOW	PEAKING FACTOR (PF = 1+14/(4+P^1/2))	PEAK FLOW (NO INFIL.)	INFILT. FLOW	PEAK FLOW (W/ INFIL.)	ADDITIONAL PEAK FLOW (FROM MODEL)	CUMULATIVE PEAK FLOW (FROM MODEL)	TOTAL PEAK FLOW	PIPE SIZE	ACTUAL SLOPE	APPROX. CRITICAL SLOPE	DESIGN SLOPE	Act. Dia.	PIPE AREA	HYD. RAD.	FULL FLOW VELOCITY	FULL FLOW CAPACITY	PERCENT FULL	CAPACITY CHECK	ACTUAL VELOCITY
									AREA	POP. Served																				
STREET	ID	FROM	TO	U/S	D/S	m	(ha)	(ppl)	(ha)	(ppl)	(l/s)	(dmnl)	(L/s)	(L/s)	(L/s)	(L/s)			(mm)	(%)	(%)	(%)	(mm)	(m^2)	(m)	(m/s)	(L/s)	(%)		(m/s)
Rice Road (N of Quaker)	A1	NW1	NW2	182.30	181.02	200	6.0	532	6.0	532	1.69	3.96	6.71	1.72	8.43	0.0	0.0	**8.4**	200	0.64	1.54	0.64	203.2	0.032	0.051	0.84	**27.4**	30.8	OK	0.65
Rice Road (N of Quaker)	A2, B1	NW2	NW3	181.02	180.10	197	10.6	868	16.6	1400	4.46	3.70	16.49	4.76	21.24	0.0	0.0	**21.2**	250	0.47	1.43	0.47	254.0	0.051	0.064	0.84	**42.5**	50.0	OK	0.74
Kaywood Crt.				188.89	188.47	65	0.5	15	0.5	15	0.05	4.00	0.19	0.14	0.33	0.0	0.0	**0.3**	200	0.65	1.54	0.65	203.2	0.032	0.051	0.85	**27.6**	1.2	OK	0.20
Quaker Road (School/Daycare)							1.6	500	1.6	500	0.36	3.97	1.41	0.47	1.88	0.0	0.0	**1.9**											
Montgomery (end to Summerlea)				186.53	186.10	179	3.0	25	3.0	25	0.08	4.00	0.32	0.86	1.18	0.0	0.0	**1.2**	250	0.24	1.43	0.24	254.0	0.051	0.064	0.60	**30.4**	3.9	OK	0.24
Topham/Crerar/Summerlea				188.66	186.12	420	10.9	148	10.9	148	0.47	4.00	1.88	3.12	5.00	0.0	0.0	**5.0**	250	0.60	1.43	0.60	254.0	0.051	0.064	0.95	**48.1**	10.4	OK	0.53
Montgomery (Summerlea to Quaker)			EXMH	186.08	185.03	423	5.7	78	19.6	250	0.80	4.00	3.18	5.61	8.79	0.0	0.0	**8.8**	250	0.25	1.43	0.25	254.0	0.051	0.064	0.61	**31.0**	28.3	OK	0.46
Quaker Road (Line to Kaywood)				188.89	188.42	53	0.7	13	0.7	13	0.04	4.00	0.16	0.20	0.36	0.0	0.0	**0.4**	200	0.89	1.54	0.89	203.2	0.032	0.051	1.00	**32.3**	1.1	OK	0.21
Quaker Road (Kaywood to Montgomery)			EXMH	188.41	184.55	270	3.4	38	4.6	565	2.15	3.95	8.50	1.32	9.82	0.0	0.0	**9.8**	250	1.43	1.43	1.43	254.0	0.051	0.064	1.46	**74.2**	13.2	OK	0.88
Quaker Road (W of Rice)	I2	EXMH	053MH001	184.52	183.93	104	3.4	330	27.6	1145	4.00	3.76	15.05	7.90	22.95	0.0	0.0	**22.9**	300	0.57	1.34	0.57	304.8	0.073	0.076	1.04	**76.2**	30.1	OK	0.80
NWSP (W of Rice, S of Quaker)	H1, I1	NW4	NW5	186.40	185.40	210	13.8	938	13.8	938	2.99	3.82	11.40	3.95	15.35	0.0	0.0	**15.3**	200	0.48	1.54	0.48	203.2	0.032	0.051	0.73	**23.7**	64.7	OK	0.69
NWSP (W of Rice, S of Quaker)	J1	NW5	053MH001	185.40	183.90	389	7.0	454	20.8	1392	4.43	3.70	16.41	5.96	22.37	0.0	0.0	**22.4**	250	0.39	1.43	0.39	254.0	0.051	0.064	0.76	**38.7**	57.7	OK	0.70
Quaker Road (W of Rice)	-	053MH001	053MH009 / 406497MH01	183.88	181.64	385	3.5	33	52.0	2571	8.54	3.50	29.87	14.86	44.73	0.0	0.0	**44.7**	300	0.58	1.34	0.58	304.8	0.073	0.076	1.05	**76.8**	58.2	OK	0.97
Rice Road (S of Quaker)	K1	NW6	NW3	184.50	180.10	387	5.7	1229	5.7	1229	3.91	3.74	14.63	1.64	16.27	0.0	0.0	**16.3**	200	1.14	1.54	1.14	203.2	0.032	0.051	1.13	**36.5**	44.5	OK	0.96
Quaker Road (Rice to W of First)	-	NW3	NW7	180.10	179.24	287	-	-	22.4	2629	8.37	3.49	29.21	6.39	35.60	0.0	0.0	**35.6**	300	0.30	1.34	0.30	304.8	0.073	0.076	0.76	**55.3**	64.4	OK	0.71
Quaker Road (Rice to W of First)	C1, C2, L1	NW7	NW8	179.24	178.72	261	31.2	3640	53.5	6269	19.95	3.15	62.90	15.31	78.21	0.0	0.0	**78.2**	450	0.20	1.17	0.20	457.2	0.164	0.114	0.81	**133.0**	58.8	OK	0.75
Quaker Road (Rice to W of First)	M1	NW8	416457MH01 (RMH1)	178.72	178.58	69	7.1	661	60.6	6930	22.06	3.11	68.61	17.32	85.94	0.0	0.0	**85.9**	450	0.20	1.17	0.20	457.2	0.164	0.114	0.81	**133.0**	64.6	OK	0.77
Flows from Hurricane SPS/Rice Road (North)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	97.7	97.7	**97.7**	-	-	-		-	-	-	-	**-**	**-**	-	
Flows from West of Quaker and Rice (from Line Ave)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	79.1	79.1	**79.1**	-	-	-		-	-	-	-	**-**	-	-	-
Quaker Road (Region Trunk E of Rice)	-	053MH009 / 406497MH01	416457MH01 (RMH1)	179.94	178.58	618	-	-	52.0	2571	8.54	3.50	29.87	14.86	44.73	0.0	176.8	**221.5**	750	0.22	0.99	0.22	762.0	0.456	0.191	1.19	**544.8**	40.7	OK	1.00
Quaker Road (W of First to W of Niagara)	-	416457MH01 (RMH1)	426427MH01 (RMH3)	178.58	177.07	728	-	-	112.5	9500	30.59	2.98	91.07	32.18	123.26	3.0	179.8	**303.1**	750	0.21	0.99	0.21	762.0	0.456	0.191	1.17	**532.2**	56.9	OK	1.07
NWSP (N of Quaker, E of First)	D1, E1	NW9	NW10	179.99	178.32	408	4.9	1089	4.9	1089	3.47	3.78	13.09	1.40	14.49	0.0	0.0	**14.5**	200	0.41	1.54	0.41	203.2	0.032	0.051	0.68	**21.9**	66.1	OK	0.64
NWSP (N of Quaker, E of First)	F2	NW10	NW11	178.32	177.40	306	7.4	417	12.3	1506	4.79	3.68	17.64	3.53	21.17	0.0	0.0	**21.2**	250	0.30	1.43	0.30	254.0	0.051	0.064	0.67	**34.0**	62.3	OK	0.63
NWSP (N of Quaker, E of First)	E2, F1	NW11	NW12	177.40	177.17	117	14.2	1753	26.5	3259	10.37	3.41	35.39	7.58	42.97	0.0	0.0	**43.0**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	52.5	OK	0.64
NWSP (N of Quaker, E of First)	G1	NW12	426427MH01 (RMH3)	177.17	177.07	50	0.8	269	27.3	3528	11.23	3.38	37.97	7.81	45.78	0.0	0.0	**45.8**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	56.0	OK	0.65
Quaker Road (W of Niagara to Towpath)	-	426427MH01 (RMH3)	436437MH03	177.07	171.78	1320	-	-	139.8	13029	41.82	2.84	118.77	39.99	158.77	28.8	208.6	**367.4**	750	0.40	0.99	0.40	762.0	0.456	0.191	1.61	**734.5**	50.0	OK	1.42
Towpath (to SPS)	-	436540MH01	446525MH01	171.05	169.40	1002	-	-	139.8	13029	41.82	2.84	118.77	39.99	158.77	98.1	306.7	**465.5**	900	0.16	0.93	0.16	914.4	0.657	0.229	1.15	**755.4**	61.6	OK	1.07

Notes:
1. Residential design flows as per UCC
2. Slopes approximate; calculated based on length
3. Infiltration rate is 0.286 as per Region Master Plan Update 2021
4. Peak Factors for NWSP Flows as per Harmon's Formula
5. Population for NWSP as per UCC
6. All other peak flows as per All Pipe Model
7. Assume population density for existing residential single family home is 2.5p/household
8. School and daycare flows as per Building Code Table 8.2.1.3.B

APPENDIX C - STORM



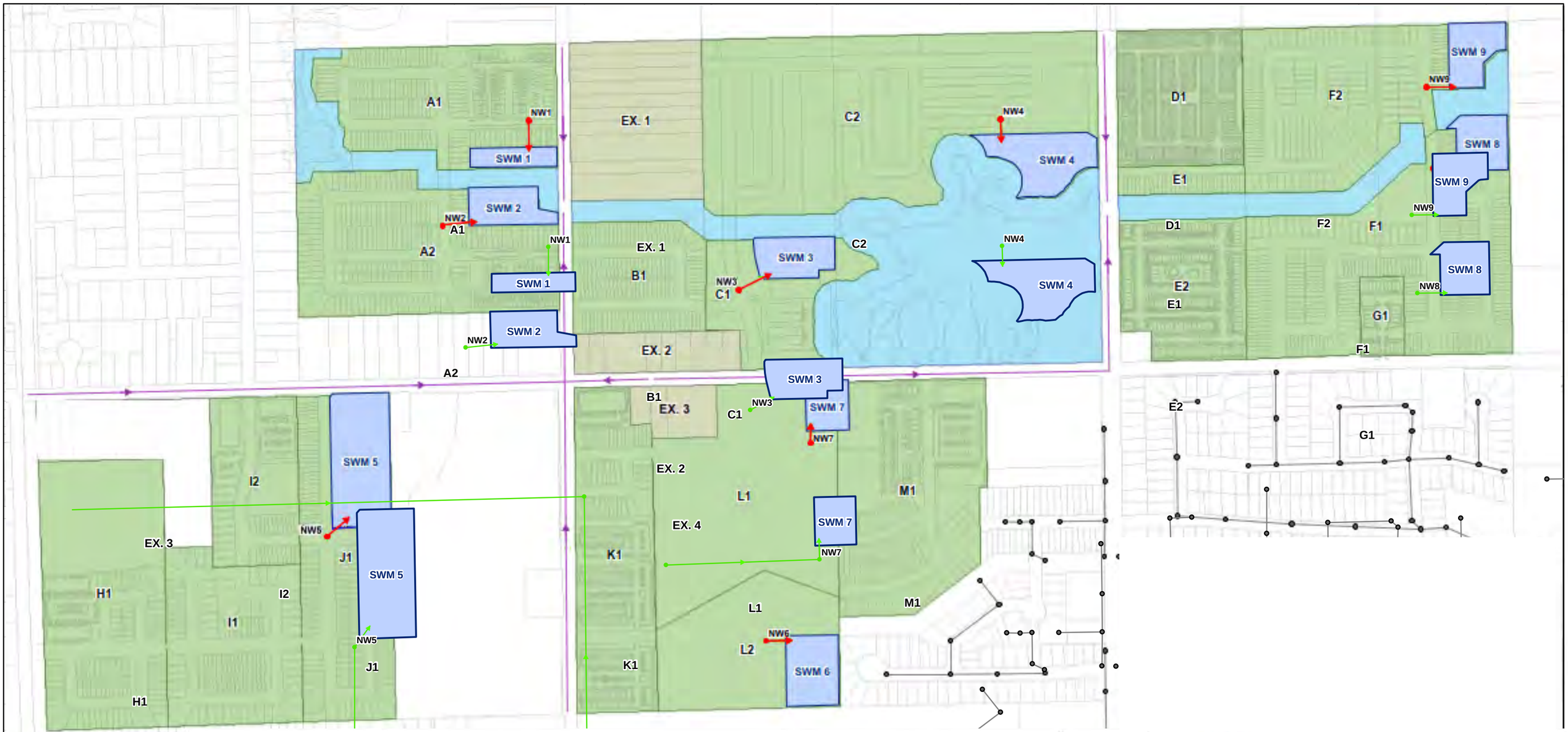
UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND STORMWATER MANAGEMENT IMPLEMENTATION PLAN

CITY OF WELLAND

ULTIMATE STORMWATER MANAGEMENT PLAN

DATE	2022-10-12
SCALE	1:7000
REF No.	21243
DWG No.	FIGURE 10



Legend:

- Proposed Manholes
- Proposed Storm Outlet
- Future Trunk Storm
- Existing Manholes
- Existing Storm Sewer
- Proposed SWM Ponds
- Proposed SWM Catchment
- Existing SWM Catchment

Associated Engineering

BEST MANAGED COMPANIES — Platinum member

Northwest Secondary Plan
Municipal Servicing

Storm Sewer Design

Project No: 2023-5773

Date: November 2023

Figure C-2

STORM SEWER DESIGN SHEET

Associated Engineering — GLOBAL PERSPECTIVE. LOCAL FOCUS.

Q=2.78AiR Storm Event = 5.00 Years

A = Area (ha) a = 830 b = 0.777 c = 7.3

R = Runoff Coefficient

T_c = Time of Concentration n = 0.013

i = Avg Rainfall Intensity (mm/hr) = $a / (T_c+c)^b$

Northwest Secondary Plan
Municipal Servicing

JOB No.: 2023-5773

DEVELOPMENT DATA				DESIGN DATA						PIPE DATA								
AREA NO	FROM	TO	AREA (ha)	RUNOFF COEFF. R	A * R	ACCUM A * R	TIME OF CONC. (min)	INTENSITY i (mm/hr)	PEAK FLOW (l/s)	PIPE DIA (mm)	SLOPE (%)	CRITICAL SLOPE (%)	DESIGN SLOPE (%)	LENGTH (m)	FLOW FULL (l/s)	VEL FULL (m/s)	TRAVEL TIME (min)	% FULL
Pond 1																		
A1	NW1	SWM 1	5.70	0.53	3.006	3.006	12.00	83.21	**695.399**	900	0.20	0.93	0.20	40	**809.60**	1.27	0.52	85.89
Pond 2																		
A2	NW2	SWM2	7.33	0.52	3.775	3.775	12.00	83.21	**873.297**	900	0.30	0.93	0.30	40	**991.55**	1.56	0.43	88.07
Pond 3																		
B1, Ex.2, C1	NW3	SWM3	8.50	0.49	4.193	4.193	12.00	83.21	**969.880**	1050	0.30	0.89	0.30	40	**1495.68**	1.73	0.39	64.85
Pond 4																		
Ex. 1, C2	NW4	SWM4	18.00	0.50	9.034	9.034	15.00	74.38	**1867.971**	1200	0.30	0.85	0.30	40	**2135.42**	1.89	0.35	87.48
Pond 5																		
H1, I1, I2, J1	NW5	SWM5	21.77	0.51	11.131	11.131	15.00	74.38	**2301.570**	1350	0.30	0.81	0.30	40	**2923.42**	2.04	0.33	78.73
Pond 6																		
L2	NW6	SWM6	3.88	0.50	1.940	1.940	12.00	83.21	**448.794**	750	0.30	0.99	0.30	40	**609.77**	1.38	0.48	73.60
Pond 7																		
K1, Ex.3, L1, M1	NW7	SWM7	22.90	0.53	12.041	12.041	15.00	74.38	**2489.732**	1350	0.30	0.81	0.30	40	**2923.42**	2.04	0.33	85.17
Pond 8																		
E2, F1, G1	NW8	SWM8	14.31	0.53	7.634	7.634	15.00	74.38	**1578.491**	1200	0.30	0.85	0.30	116	**2135.42**	1.89	1.02	73.92
Pond 9																		
D1, E1, F2	NW9	SWM9	13.14	0.53	6.975	6.975	15.00	74.38	**1442.229**	1200	0.30	0.85	0.30	116	**2135.42**	1.89	1.02	67.54

APPENDIX D - COST ESTIMATE DETAIL

Northwest Welland Secondary Plan
Municipal Servicing

Preliminary Cost Estimate

Watermain				
Item	Quantity	Unit	Unit Price	Cost
150mm PVC DR18 Watermain	8420	m	$455	$3,831,100
150mm Gate Valve & Box	92	each	$3,250	$299,000
200 mm PVC DR18 Watermain	1645	m	$520	$855,400
200mm Gate Valve & Box	20	each	$4,225	$84,500
250 mm PVC DR18 Watermain	2480	m	$620	$1,537,600
250mm Gate Valve & Box	24	each	$5,200	$124,800
300mm PVC DR18 Watermain	1985	m	$845	$1,677,325
300mm Gate Valve & Box	22	each	$7,150	$157,300
Water Services	4350	each	$2,600	$11,310,000
Hydrants	97	each	$9,750	$945,750
Connect to Existing	13	each	$6,500	$84,500
Granular A	87500	t	$35	$3,062,500
Other General Construction	1	LS	$2,397,000	$2,397,000
Subtotal				$26,366,775
Contingency (15% of subtotal)				$3,955,100
Engineering (10% of subtotal)				$2,636,700
Total				$32,958,575
Rounded Total				$33,000,000

Sanitary Sewer				
Item	Quantity	Unit	Unit Price	Cost
200mm PVC DR35	13,620	m	$490	$6,673,800
250mm PVC DR35	586	m	$585	$342,810
375mm PVC DR35	734	m	$975	$715,650
450mm PVC DR35	69	m	$1,175	$81,075
Maintenance Hole Structure	134	each	$13,000	$1,742,000
Sanitary Laterals	4,350	each	$3,900	$16,965,000
Connect to Existing Trunk	3	each	$6,500	$19,500
Granular A	176,700	t	$35	$6,184,500
Flush & CCTV (end of construction)	15,009	m	$20	$300,180
Flush & CCTV (end of maintenance)	15,009	m	$20	$300,180
Other General Construction	1	LS	$3,332,500	$3,332,500
Subtotal				$36,657,195
Contingency (15% of subtotal)				$5,498,600
Engineering (10% of subtotal)				$3,665,800
Total				$45,821,595
Rounded Total				$45,900,000

Northwest Welland Secondary Plan
Municipal Servicing

Preliminary Cost Estimate

Storm Sewer				
450mm PVC DR35 Ultra Rib	2204	m	$455	$1,002,820
525mm PVC DR35 Ultra Rib	2515	m	$520	$1,307,800
600mm CONC	2661	m	$585	$1,556,685
675mm CONC	81	m	$815	$66,015
750mm CONC	902	m	$1,025	$924,550
825mm CONC	554	m	$1,175	$650,950
900mm CONC	1015	m	$1,380	$1,400,700
1050mm CONC	941	m	$1,775	$1,670,275
1200mm CONC	332	m	$2,190	$727,080
1350mm CONC	80	m	$2,795	$223,600
1200mm Diameter MH	68	each	$13,000	$884,000
1500mm Diameter CBMH	13	each	$18,200	$236,600
1800mm Diameter CBMH	18	each	$20,800	$374,400
2400mm Diameter CBMH	2	each	$24,700	$49,400
Catchbasin	380	each	$4,175	$1,586,500
Catchbasin leads	1900	m	$490	$931,000
Granular A	95800	t	$35	$3,353,000
Flush & CCTV (end of construction)	11285	m	$20	$225,700
Flush & CCTV (end of maintenance)	11285	m	$20	$225,700
Other General Construction	1	LS	$1,739,700	$1,739,700
Subtotal				$19,136,475
Contingency (15% of subtotal)				$2,870,500
Engineering (10% of subtotal)				$1,913,700
Total				$23,920,675
Rounded Total				$24,000,000

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX B

Water Distribution Plan (DWG#: 1601-WD-FSR)

FIRST AVENUE

744 FIRST AVENUE
(AMBRIA (FIRST WELLAND) LIMITED)

STREET 'E'

STREET 'F'

STREET 'G'

STREET 'C'

BLOCK 291
(SWM POND)

BLOCK 290
(CHANNEL)

BLOCK 292
(SWM POND)

STREET 'D'

REGIONAL ROAD 50 (NIAGARA STREET)

EX 200Ø PVC

200Ø

150Ø

300Ø

BLOCK 289
(CHANNEL)

BLOCK 279
PARK

BLOCK 288
SERVICING CORRIDOR/
PEDESTRIAN WALKWAY

STREET 'A'

STREET 'B'

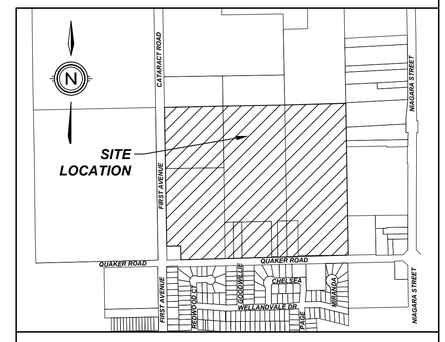
294 QUAKER ROAD
(CENTENNIAL HOMES (NIAGARA) INC)

BLOCK 287
SERVICING CORRIDOR/
PEDESTRIAN WALKWAY

232-238
QUAKER ROAD
(MD DEVELOPMENTS
INC)

EX 300Ø PVC

QUAKER ROAD



KEY PLAN
N.T.S.

LEGEND
- PROPOSED WATERMAIN
- EXISTING WATERMAIN

CONSULTANT FILE No.	1601
DATE	2024–10–18
PRINTED	2024–10–18
SCALE	1:1000 m
REF No.	
DWG No.	1601-WD-FSR
REV	0

210, 256 & 276 QUAKER ROAD
CITY OF WELLAND

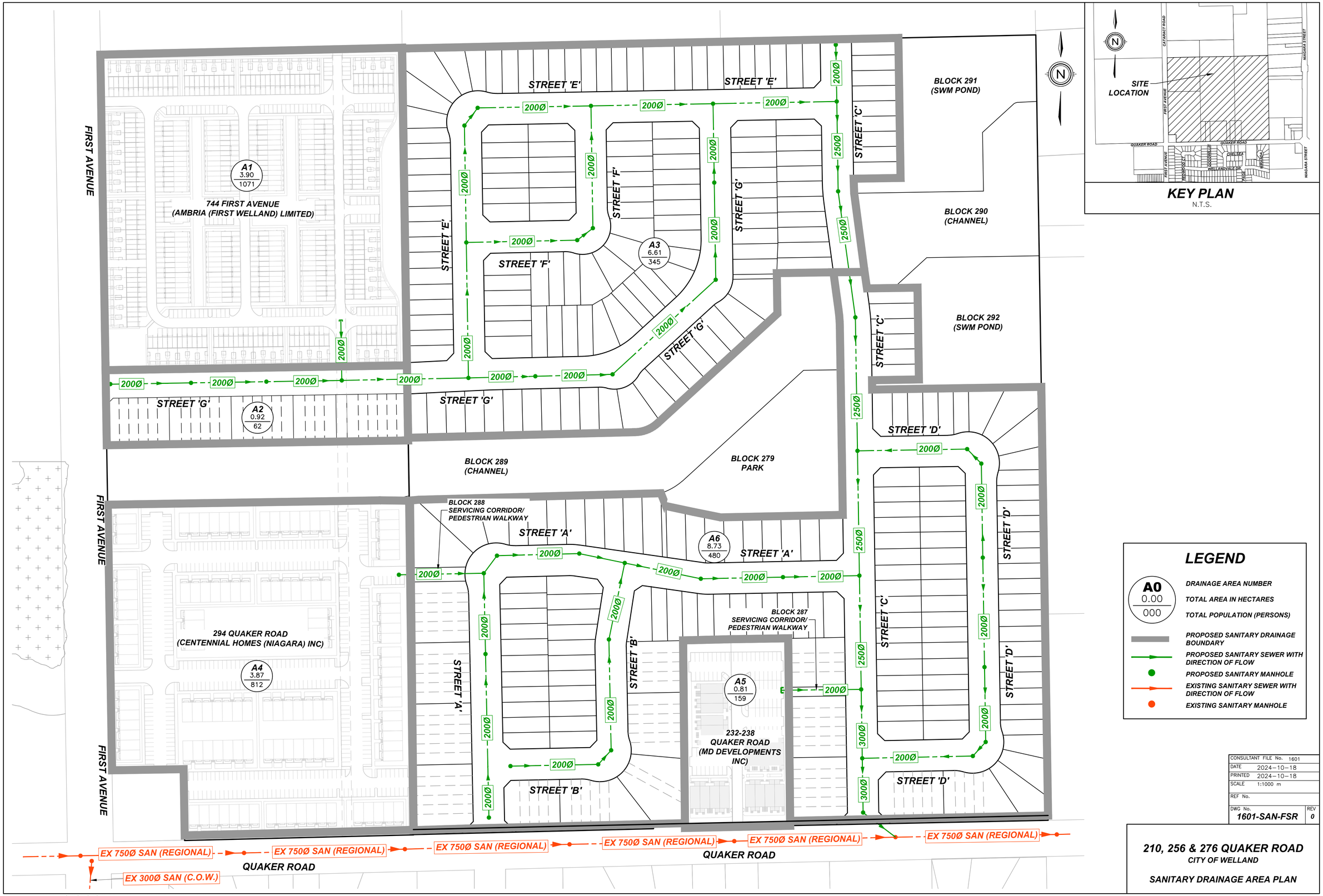
WATER DISTRIBUTION PLAN

DRAWING FILE: F:\1601\SWM\FSR\FSR BASE BLOCK 1.dwg PLOTTED: Oct 18, 2024 – 11:27am PLOTTED BY: brendon

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX C

Sanitary Drainage Area Plan (DWG#: 1601-SAN-FSR)
Sanitary Sewer Calculation Sheet



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DATE	2024–10–18
PRINTED	2024–10–18
SCALE	1:1000 m
REF No.	
DWG No.	1601-SAN-FSR
REV	0

210, 256 & 276 QUAKER ROAD

CITY OF WELLAND

SANITARY DRAINAGE AREA PLAN

DRAWING FILE: F:\1601\SWM\FSR\FSR BASE BLOCK 1.dwg PLOTTED: Oct 18, 2024 – 11:26am PLOTTED BY: brendan

UPPER CANADA CONSULTANTS
30 HANNOVER DRIVE, UNIT 3
ST.CATHARINES, ON, L2W 1A3

DESIGN FLOWS

RESIDENTIAL:	255	LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE:	0.286	LITRES/HECTARE
POPULATION DENSITY:	2.5	PERSONS / UNIT (SINGLE FAMILY DWELLING
	2.2	PERSONS / UNIT (TOWNHOUSE DWELLING)

SEWER DESIGN

PIPE ROUGHNESS:	0.013	FOR MANNING'S EQUATION
PIPE SIZES:	1.016	IMPERIAL EQUIVALENT FACTOR
PERCENT FULL:		TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF WELLAND
PROJECT : 210, 256 & 276 QUAKER ROAD
PROJECT NO: 1601

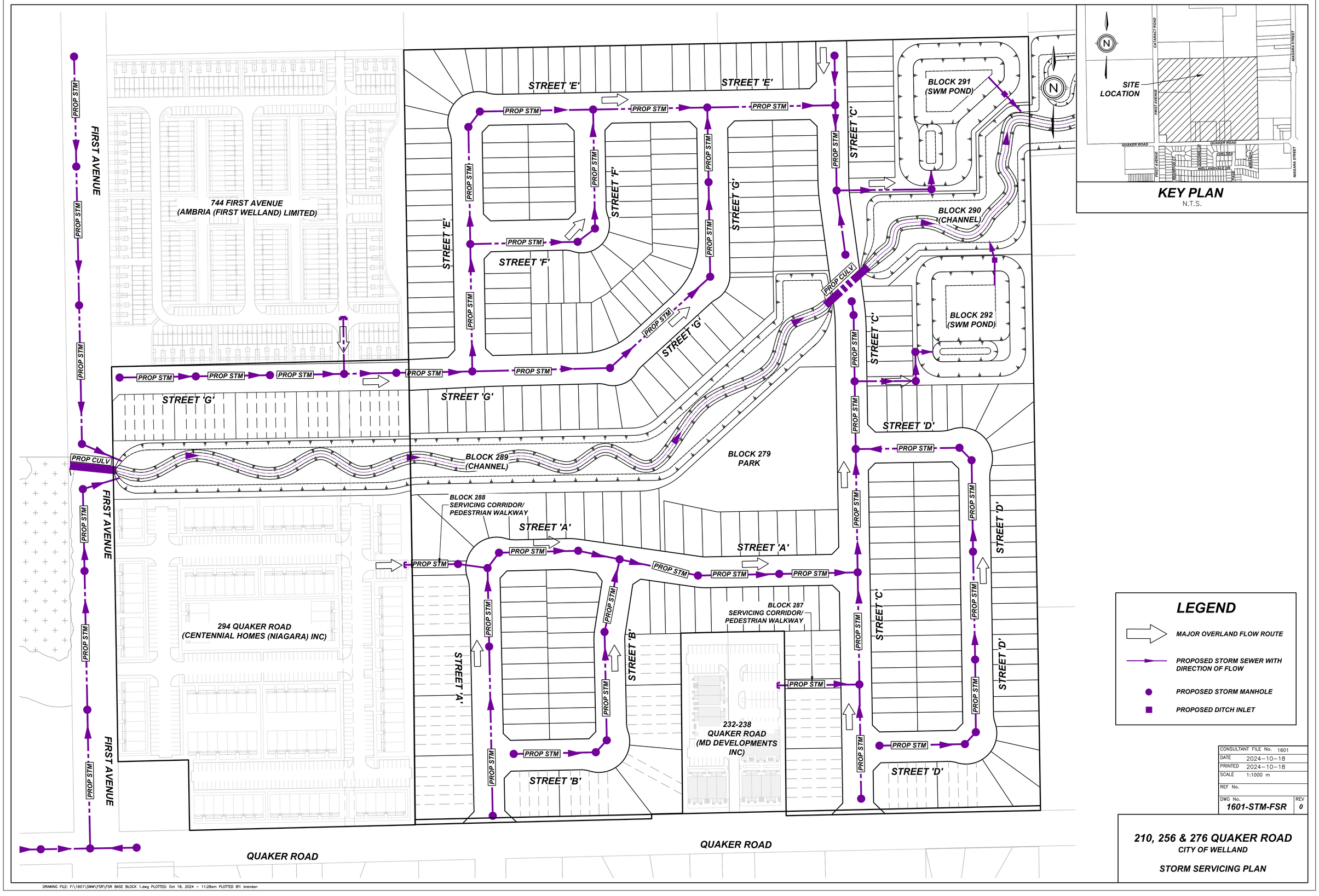
S A N I T A R Y S E W E R D E S I G N S H E E T

LOCATION	AREA				ACCUMULATED PEAK FLOW				DESIGN FLOW				
Description	Increment (hectares)	Accumulated (hectares)	Population Increment	Total Population Served (P)	Peaking Factor (PF)	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Percent Full
Area A1 Population per 744 First Avenue Functional Servicing Report (1,071 persons)													
A1 - 744 First Avenue	3.90	3.90	1071	1071	3.78	11.95	1.12	13.07	200	0.40	0.7	21.64	60.4%
A2 - 294 Quaker Road	0.92	0.92	62	62	4.29	0.79	0.26	1.05	200	0.40	0.7	21.64	4.8%
A3 - 210, 256 & 276 Quaker Road	6.61	11.43	345	1478	3.68	16.07	3.27	19.34	250	0.28	0.6	32.83	58.9%
A4 - 294 Quaker Road	3.87	3.87	812	812	3.86	9.24	1.11	10.35	200	0.40	0.7	21.64	47.8%
A5 - 232 - 238 Quaker Road	0.81	0.81	159	159	4.18	1.96	0.23	2.19	200	0.40	0.7	21.64	10.1%
A6 - 210, 256 & 276 Quaker Road	8.73	24.84	480	2929	3.45	29.83	7.10	36.94	300	0.22	0.6	47.32	78.1%
Quaker Road (Ex. 750mm dia.)		24.84		2929	3.45	29.83	7.10	36.94	750	0.23	1.2	556.99	6.6%

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX D

Storm Servicing Plan (DWG#: 1601-STM-FSR)



CONSULTANT FILE No.	1601
DATE	2024-10-18
PRINTED	2024-10-18
SCALE	1:1000 m
REF No.	
DWG No.	1601-STM-FSR
REV	0

210, 256 & 276 QUAKER ROAD

CITY OF WELLAND

STORM SERVICING PLAN

DRAWING FILE: F:\1601\SWM\FSR\FSR BASE BLOCK 1.dwg PLOTTED: Oct 18, 2024 - 11:28am PLOTTED BY: brendon

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX E

210, 256 & 276 Quaker Road Stormwater Management Plan (UCC, October 2024)

STORMWATER MANAGEMENT PLAN

210, 256 & 276 QUAKER ROAD

CITY OF WELLAND

Prepared For:

Ashton Homes (Western) Limited
17 Rancine Road
Etobicoke, ON
M9W 2Z4

Prepared by:

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, Ontario
L2W 1A3

October 2024

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Appendix A Existing Conditions MIDUSS Output File

Appendix B Stormwater Management Facility Calculations (P30)

Appendix C Stormwater Management Facility Calculations (P31)

Appendix D Future Conditions MIDUSS Output File

REFERENCES

1. Stormwater Management Planning and Design Manual
   Ontario Ministry of Environment (March 2003)

2. Soils of the Regional Municipality of Niagara Soil Survey Report No. 60 of the Ontario Institute of Pedology. (1989)

3. Northwest Welland Stormwater Management Implementation Plan
   Upper Canada Consultants (October 2022)

STORMWATER MANAGEMENT PLAN

210, 256 & 276 Quaker Road

CITY OF WELLAND

1.0 INTRODUCTION

1.1 Study Area

Upper Canada Consultants (UCC) has been retained by landowner of the 210, 256, & 276 Quaker Road properties to prepare a stormwater management plan to address the stormwater management needs for the proposed subdivision development located within the aforementioned properties.

The proposed subdivision is located in the north-eastern portion of the Northwest Welland Secondary Plan (NWWSP) area in the City of Welland, north of Quaker Road, west of Niagara Street, east of First Avenue, and south of the municipal boundary with the City of Thorold.

UCC has previously prepared a Stormwater Management Implementation Plan for the entirety of the NWWSP Area. This Plan identified the preferred locations of future stormwater management (SWM) Facilities within the developable areas in the Secondary Plan in support of the realignment of the Towpath Drain, which flows through the proposed subdivision lands, and identified the existing stormwater flows through each segment of the existing watercourse.

It was identified in the Implementation Plan that two SWM Facilities are to be constructed in the eastern limit of the proposed subdivision lands to provide stormwater management quality and quantity controls the entire 'Block' of development area, bound by Quaker Road on the south, First Avenue on the west, to the eastern limit of 210 Quaker Road, and south of the municipal boundary with the City of Thorold as shown in Figure 1 as Block 1. Therefore, this Block (Block 1) will hereafter be referred to as 'subject lands' in this report.

The subject lands are approximately 28.99 hectares and will consist of a mix of subdivision and condominium developments, comprising of an overall mix of residential single detached, street townhouse, stacked townhouse, and apartment dwellings. The subject lands will be developed to include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

1.2 Objectives

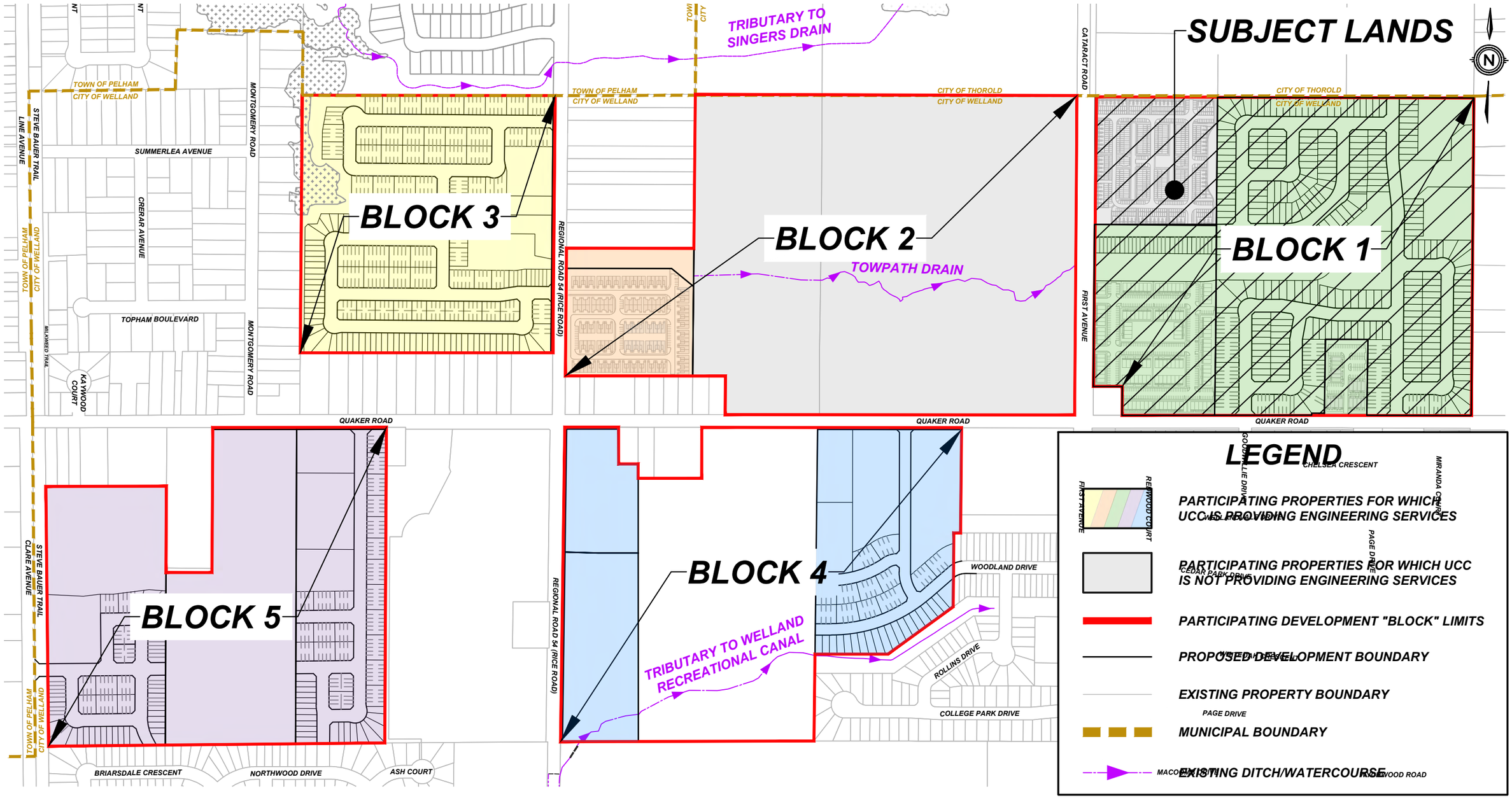
The objectives of this study are as follows:

1. Establish specific criteria for the management of stormwater from this site.

2. Determine the impact of development on the stormwater peak flow & volume of stormwater from the drainage area.

3. Investigate alternatives for controlling the quality of stormwater discharging from the site.

4. Establish the property requirements to construct stormwater management facilities for the Draft Plan of Subdivision.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

SITE LOCATION PLAN - BLOCK 1

DATE	2024-07-16
SCALE	1:6000 m
REF No.	-
DWG No.	FIGURE 1

1.3 Existing & Proposed Conditions

a) Existing Conditions

The topography of the subject lands is relatively flat with a general slope towards the Towpath Drain, which flows through the middle of the site from west to east direction. The Towpath Drain conveys stormwater flows through the City of Welland and the City of Thorold, prior to ultimately outletting into the Welland Canal, with multiple crossings at Municipal and Regional roads, and Highway 406.

Existing stormwater flows and the delineation of existing stormwater drainage areas for the Towpath Drain were assessed as part of the Implementation Plan to the culvert crossing at Regional Road 50 (Niagara Street) and will be the basis for future peak flow targets for all stormwater management facilities constructed within the Secondary Plan Area.

As part of the realignment of the Towpath Drain, twin 2.4 x 1.8m concrete box culverts will be constructed crossing Regional Road 50 (Niagara Street), a 1.8 x 1.2m concrete box culvert will be constructed crossing Regional Road 54 (Rice Road), and the existing 1800mm diameter culvert crossing First Avenue will remain. Upgrades to the First Avenue Culvert will be subject to a future NPCA Work Permit.

b) Proposed Conditions

The subject lands are approximately 28.99 hectares and will consist of a mix of subdivision and condominium developments, comprising of an overall mix of residential single detached, street townhouse, stacked townhouse, and apartment dwellings.

The subject lands will include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

It is proposed to convey all future Stormwater flows from the subject lands to the Towpath Drain as identified in the Implementation Plan.

UCC has been retained as the engineering consultant for the majority of the developing landowners in the NWWSP, as shown in Figure 1. For the purpose of maintaining consistency between the various Draft Plan of Subdivision submissions within the Secondary Plan Area, the “Proposed Conditions” stormwater modelling will include the future SWM Facilities designed for each respective Block in the NWWSP.

For lands where Planning Act Applications are not expected to be submitted in the near future as of the writing of this stormwater management plan, where UCC has not been retained as the engineering consultant, or a stormwater management alternative has not yet been selected, future stormwater flows have been allocated to the Towpath Drain at the existing levels identified in the Implementation Plan.

The existing conditions MIDUSS modelling output file provided in the Implementation Plan has been included in Appendix A for reference.

2.0 STORMWATER MANAGEMENT CRITERIA

New developments are required to provide stormwater management in accordance with provincial and municipal policies including:

- Stormwater Quality Guidelines for New Development (MECP/MNRF, May 1991)
- Stormwater Management Planning and Design Manual (MECP, March 2003)

Based on the comments and outstanding policies from the City of Welland, Regional Municipality of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of the Environment, Conservation and Parks (MECP), the following site-specific considerations were identified:

- Per City of Welland requirements, stormwater **quality** improvements must be provided to a minimum of Enhanced Protection (80% TSS Removal).
- Per the Northwest Welland Stormwater Management Implementation Plan prepared by Upper Canada Consultants, future stormwater management facilities within the Secondary Plan Area will be required to provide **quantity** controls up to and including the 100 year design storm event before outletting to the Towapth Drain.
- **Erosion control** to be provided in accordance with MECP guidelines. The guidelines require an extended detention volume to be detained for 24 hours.

Based on above policies and site specific considerations, the following stormwater management criteria have been established for this site:

- Stormwater **quality** controls are to be provided for the more frequent storm events to provide Enhanced Protection (80% TSS Removal), prior to discharging to the receiving watercourse (Towpath Drain).
- To maintain existing water surface elevations in the Towpath Drain, stormwater **quantity controls** will be provided up to and including the 100 year design storm event.
- **Erosion protection** will be provided in accordance with MECP guidelines. The quidelines require an extended detention volume to be detained for 24 hours.

3.0 STORMWATER ANALYSIS

Stormwater for the existing and proposed conditions was estimated using the MIDUSS computer modelling program. This program was selected because it is applicable to both urban and rural drainage areas like the study area. It is relatively easy to use and modify for the future drainage conditions and control facilities. It readily allows for design storm hyetographs for the various return periods being investigated.

3.1 Design Storms

Design storm hyetographs for the storm system design uses a Chicago distribution based on the City of Welland Intensity-Duration-Frequency (IDF) curves. Hyetographs for the 25mm, 2, 5, 10, 25 and 100 year events were developed using a 4 hour Chicago distribution. The 25mm design storm event parameters were derived using the IDF curve and a 4-hour Chicago distribution. Table 1 summarizes the rainfall data applied in the stormwater modelling.

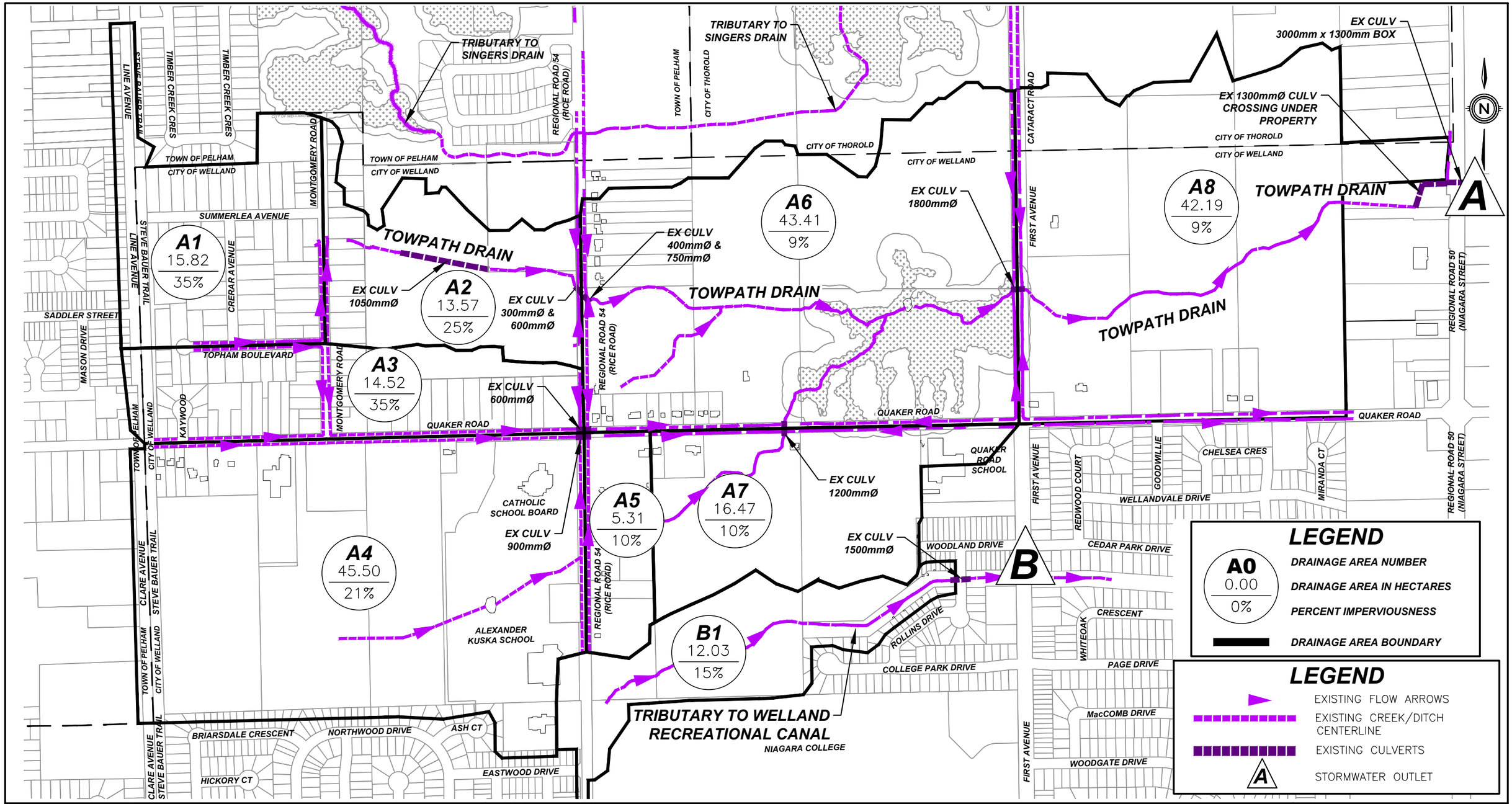
Table 1. Rainfall Data

Design Storm (Return Period)	Chicago Distribution Parameters $i = \frac{a}{(t+b)^c}$			Duration (minutes)
	a	b	c	
25mm	512	6.0	0.800	240
2 Year	755	8.0	0.789	240
5 Year	830	7.3	0.777	240
10 Year	860	6.5	0.763	240
25 Year	900	5.2	0.745	240
100 Year	1020	4.7	0.731	240

3.2 Existing Conditions

Existing conditions within the Towpath Drain were assessed as part of the Implementation Plan to determine the existing the peak flows within the watercourse at existing and future roadway crossings. The existing catchment areas as provided in Figure 2 of the Implementation Plan have been included as Figure 2 in this stormwater management plan for reference.

For consistency between the stormwater management plans submitted by UCC in the NWWSP, Outlets A through D have been identified at specific locations along the Towpath Drain to demonstrate that the existing flows identified in the Implementation Plan are maintained at all locations within the watercourse under future conditions. The locations of Outlets A through D can be found on Figure 3 and the summary of the existing flows at each Outlet have been summarized in Table 2 below.



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NORTHWEST WELLAND STORMWATER MANAGEMENT IMPLEMENTATION PLAN

CITY OF WELLAND

EXISTING STORM DRAINAGE AREA PLAN

DATE	2022-10-12
SCALE	1:7000
REF No.	21243
DWG No.	FIGURE 2

Table 2. Existing Peak Stormwater Flows – Towpath Drain					
Location	**Peak Flow (m^3/s)**				
	2 Year	**5 Year**	**10 Year**	**25 Year**	**100 Year**
Outlet A1	1.317	1.589	1.800	2.099	2.558
Outlet A2	3.301	4.194	4.777	5.619	6.987
Outlet B (*)	3.425	4.367	4.977	5.863	7.305
Outlet C	4.035	5.176	5.914	7.005	8.781
Outlet D	4.509	5.835	6.678	7.938	9.995

Note (*) : Outlet B was not specified as a location where peak flows were evaluated within the Implementation Plan.

Therefore, the change in existing peak flow across the 803m width of Drainage Area A6 (between Rice Road and First Avenue) was prorated to the location of Outlet B (at 205m east of Rice Road) for the peak flow at Outlet B for each design storm event.

3.3 Proposed Conditions

For the purpose of maintaining consistency between the various Draft Plan of Subdivision submissions within the NWWSP Area, the "Proposed Conditions" stormwater modelling will include the future SWM Facilities designed for each respective Block in the NWWSP.

For lands where Planning Act Applications are not expected to be submitted in the near future, as of the writing of this stormwater management plan, or where UCC has not been retained as the engineering consultant, future stormwater flows have been allocated to the Towpath Drain at the existing levels identified in the Implementation Plan.

The future stormwater drainage areas for the NWWSP Area are shown in Figure 3, and a schematic of the future hydrologic modelling is provided as Figure 4.

As shown in Figure 3, there is an existing drainage area (A30) which is entirely within the City of Thorold and conveys existing stormwater flows through the subject lands to the Towpath Drain. For the purposes of this SWM Plan, this area will be included within the proposed SWM Facility at existing conditions. Should a Planning Act Application be submitted within this area, a separate SWM Facility on the adjacent property is to be constructed with a new outlet to the Towpath Drain.

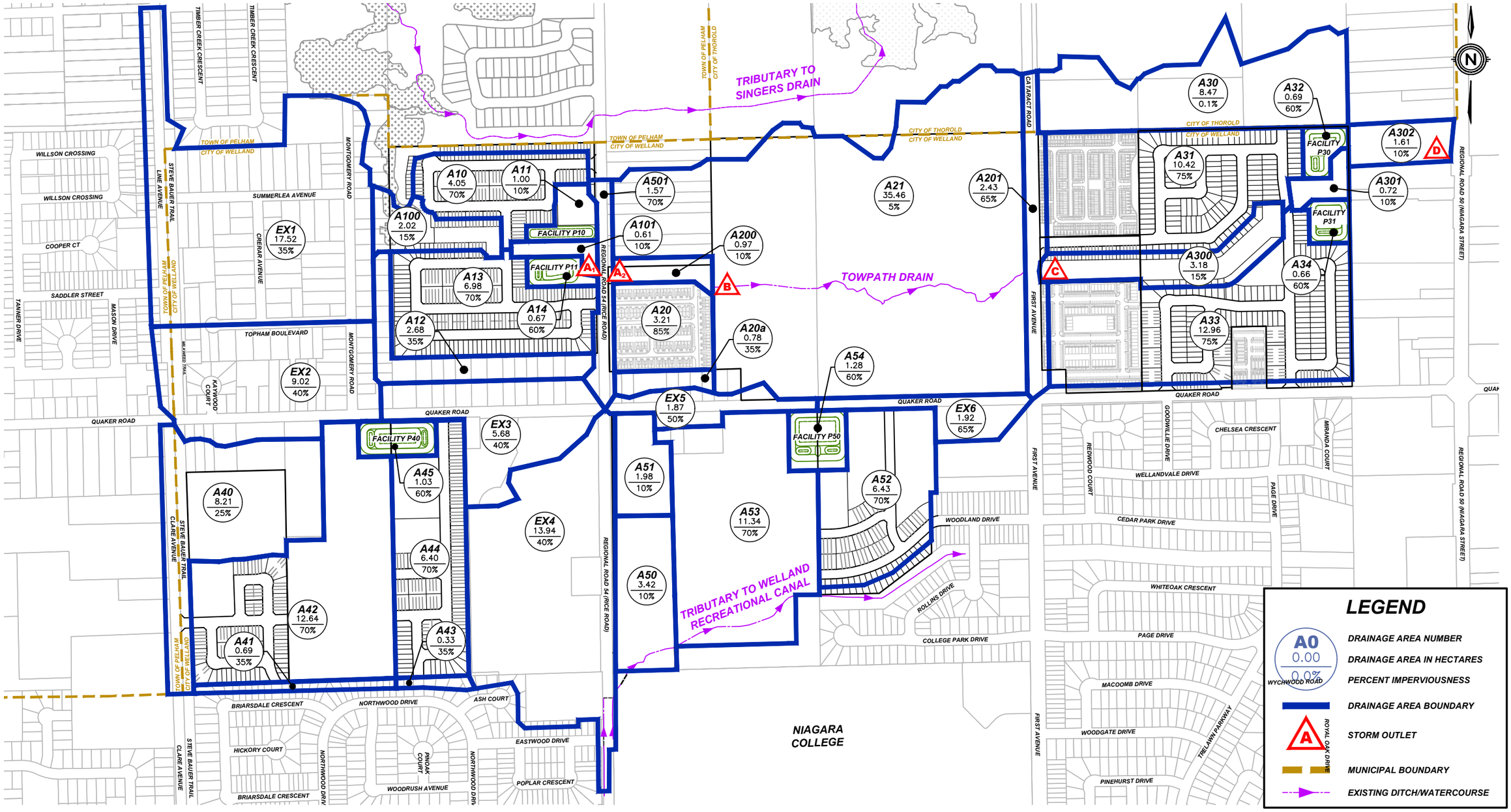
Table 3 below provides a summary of the catchment areas shown in Figure 3 and associated hydrological parameters used for the MIDUSS software model.

The future conditions MIDUSS modelling output file has been enclosed in Appendix D for reference.

Table 3. Hydrologic Parameters for Future Conditions

Area No.	Area (ha)	Length (m)	Slope (%)	Manning – "n"		Soil Type	SCS CN	Percent Impervious
				Perv.	Imperv.			
EX1	17.52	343	1.0	0.25	0.015	CD	74	35%
A100	2.02	116	0.4	0.25	0.015	CD	74	15%
A10	4.05	164	1.0	0.25	0.015	CD	74	70%
A11	1.00	82	1.0	0.25	0.015	CD	74	10%
A101	0.61	64	1.0	0.25	0.015	CD	74	10%
A12	2.68	134	1.0	0.25	0.015	CD	74	35%
A13	6.98	216	1.0	0.25	0.015	CD	74	70%
A14	0.67	67	1.0	0.25	0.015	CD	74	60%
A40	8.21	234	1.0	0.25	0.015	CD	74	25%
A41	0.69	68	1.0	0.25	0.015	CD	74	35%
A42	12.64	290	1.0	0.25	0.015	CD	74	70%
A43	0.33	47	1.0	0.25	0.015	CD	74	35%
A44	6.40	207	1.0	0.25	0.015	CD	74	70%
A45	1.03	83	1.0	0.25	0.015	CD	74	60%
EX2	9.02	245	1.0	0.25	0.015	CD	74	40%
EX3	5.68	195	1.0	0.25	0.015	CD	74	40%
EX4	13.94	305	1.0	0.25	0.015	CD	74	40%
A50	3.42	151	1.0	0.25	0.015	CD	74	10%
A51	1.98	115	1.0	0.25	0.015	CD	74	10%
A501	1.57	102	1.0	0.25	0.015	CD	74	70%
A20a	0.78	72	1.0	0.25	0.015	CD	74	35%
A20	3.21	146	1.0	0.25	0.015	CD	74	85%
A200	0.97	80	1.0	0.25	0.015	CD	74	10%
A21	35.46	487	0.2	0.25	0.015	CD	74	5%
A52	6.43	207	1.0	0.25	0.015	CD	74	70%
A53	11.34	275	1.0	0.25	0.015	CD	74	70%
A54	1.28	92	1.0	0.25	0.015	CD	74	60%
EX5	1.87	112	1.0	0.25	0.015	CD	74	50%
EX6	1.92	113	0.2	0.25	0.015	CD	74	65%

A201	2.43	127	1.0	0.25	0.015	CD	74	65%
A300	3.18	146	0.2	0.25	0.015	CD	74	15%
A301	0.72	69	0.2	0.25	0.015	CD	74	10%
A30	8.47	238	0.2	0.25	0.015	CD	74	0.1%
A31	10.42	264	1.0	0.25	0.015	CD	74	75%
A32	0.69	68	1.0	0.25	0.015	CD	74	60%
A33	12.99	294	1.0	0.25	0.015	CD	74	75%
A34	0.66	66	1.0	0.25	0.015	CD	74	60%
A302	1.61	104	0.2	0.25	0.015	CD	74	10%
	204.87	**Total Area (ha)**						



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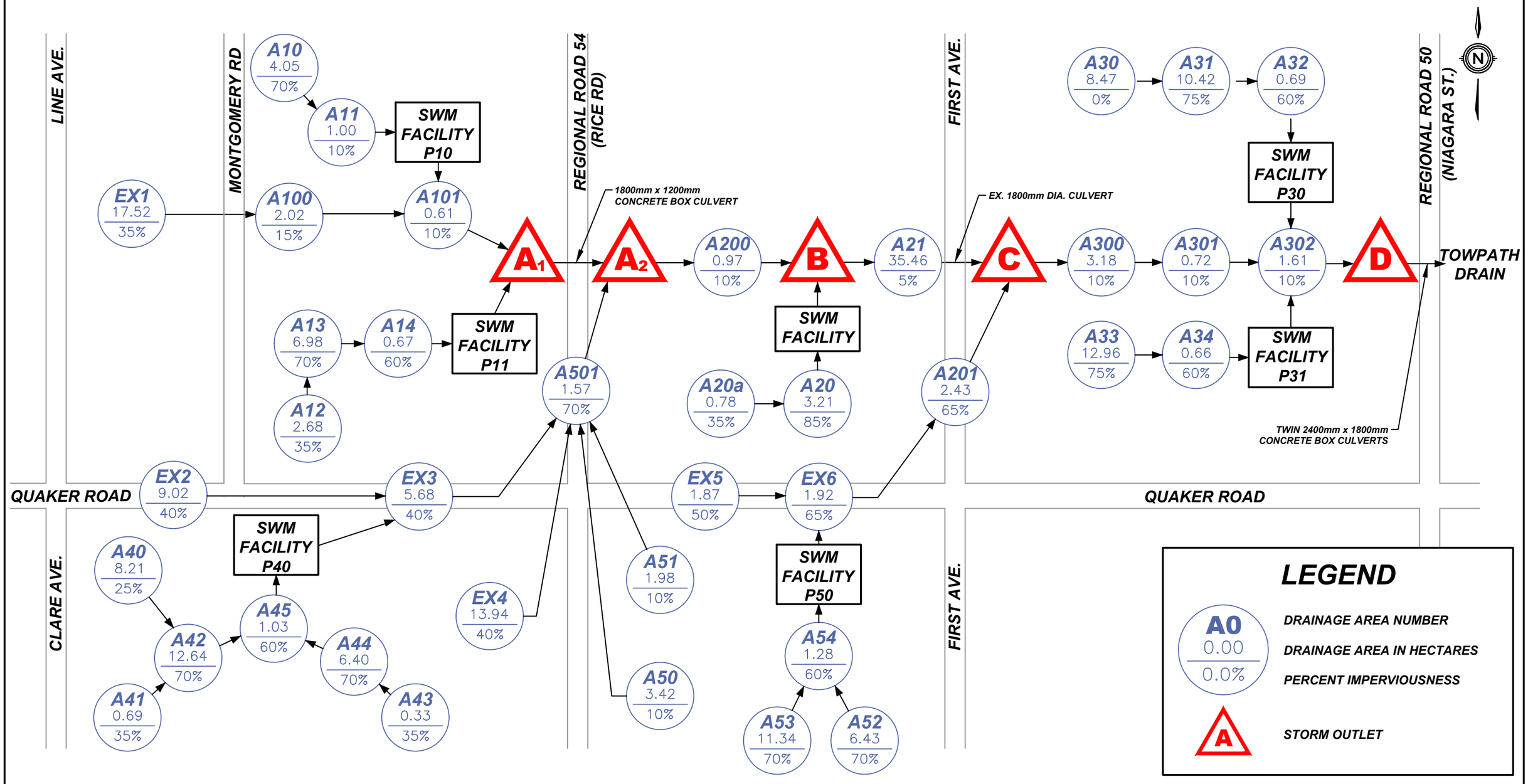
NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

FUTURE STORM DRAINAGE AREAS

DATE	2024-10-17
SCALE	1:7500 m
REF No.	-
DWG No.	FIGURE 3



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NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

FUTURE HYDROLOGICAL MODELLING SCHEMATIC

DATE	2024-07-16
SCALE	N.T.S.
REF No.	-
DWG No.	FIGURE 4

4.0 STORMWATER MANAGEMENT ALTERNATIVES

4.1 Screening of Stormwater Management Alternatives

A variety of stormwater management alternatives are available to control the quantity and quality of stormwater, most of which are described in the Stormwater Management Planning and Design Manual (MECP, March 2003). Alternatives for the proposed and ultimate developments were considered in the following broad categories: lot level, vegetative, infiltration, and end-of-pipe controls. General comments on each category are provided below. Individual alternatives for the proposed development are listed in Table 4 with comments on their effectiveness and applicability to the proposed outlet.

a) Lot Level Controls

Lot level controls are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

b) Vegetative Alternatives

Vegetative stormwater management practices are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

c) Infiltration Alternatives

Where soils are suitable, infiltration techniques can be very effective in providing quantity and quality control. However, the very small amount of surface area on this site dedicated to permeable surfaces such as greenspace and landscaping make this an impractical option. Therefore, infiltration techniques will not be considered for this development.

d) End-of-Pipe Alternatives

Surface storage techniques can be very effective in providing quality and quantity control. Wet facilities are effective practices for stormwater erosion, quality and quantity control for large drainage areas (>5 ha).

Table 4. Evaluation of Stormwater Management Practices

210, 256 & 276 Quaker Road	Criteria for Implementation of Stormwater Management Practices (SWMP)					Technical Effectiveness (10 high)	Recommend Implementation Yes / No	Comments
	Topography	**Soils**	**Bedrock**	**Groundwater**	**Area**			
Site Conditions	***Flat ±1%***	***Variable ±15 mm/hr***	***Shallow***	***At Considerable Depth***	***± 28.99ha***			
Lot Level Controls								
Lot Grading	<5%	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Leaders to Surface	nlc	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Ldrs.to Soakaway Pits	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	6	Yes	Quality/quantity benefits
Sump Pump Fdtn. Drains	nlc	nlc	nlc	nlc	nlc	2	No	Unsuitable site conditions
Vegetative								
Grassed Swales	< 5 %	nlc	nlc	nlc	nlc	7	Yes	Quality/quantity benefits
Filter Strips(Veg. Buffer)	< 10 %	nlc	nlc	>.5m Below Bottom	< 2 ha	5	No	Unsuitable site conditions
Infiltration								
Infiltration Basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 5 ha	2	No	Unsuitable site conditions
Infiltration Trench	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 2 ha	4	No	Unsuitable site conditions
Rear Yard Infiltration	< 2.0 %	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	7	No	Unsuitable site conditions
Perforated Pipes	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	4	No	Unsuitable site conditions
Pervious Catch basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	3	No	Unsuitable site conditions
Sand Filters	nlc	nlc	nlc	>.5m Below Bottom	< 5 ha	5	No	High maintenance/poor aesthetics
Surface Storage								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	7	No	No quality control
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	9	Yes	Very effective quality/quantity control
Wetlands	nlc	nlc	nlc	nlc	> 5 ha	6	No	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	<2 ha	3	No	Limited benefit/area too large

Reference: Stormwater Management Practices Planning and Design Manual - 2003
nlc - No Limiting Criteria

4.2 Selection of Stormwater Management Alternatives

Stormwater management alternatives were screened based on technical effectiveness, physical suitability for this site, and their ability to meet the stormwater management criteria established for proposed and future development areas. The following stormwater management alternatives are recommended for implementation on the proposed development:

- **Lot grading** to be kept as flat as practical in order to slow down stormwater and encourage infiltration.
- **Roof leaders to be discharged to the ground surface** in order to slow down stormwater and encourage infiltration.
- **Grassed swales** to be used to collect rear lot drainage. Grassed swales tend to filter sediments and slow down the rate of stormwater.
- Two **wet pond facilities** on either side of the Towpath Drain are to be constructed to provide stormwater quality and quantity controls.

5.0 STORMWATER MANAGEMENT PLAN

A MIDUSS model was created to assess existing and future flows generated by the proposed subdivision. The stormwater management facility was sized according to MECP Guidelines (MECP, March 2003) as follows:

5.1 Northern Stormwater Management Facility 'P30'

5.1.1 Stormwater Quality Control

The stormwater drainage outlet for the proposed Wet Pond 'P30' is the Towpath Drain, where *Enhanced* protection will be provided. Based on Table 3.2 of SWMP & Design Manual, the Enhanced water quality storage requirement for wet pond facilities in a development with 75% impervious area is approximately 233 m^3/ha. The wet pond facility will provide stormwater quality controls for a drainage area of approximately 10.42 hectares (Area 31) as shown in Table 5.

Table 5. SWM Facility 'P30' - Stormwater Quality Volume Calculations

Total Water Quality Volume = 10.42 ha x 233 m^3/ha = 2,428 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 10.42 ha x 193 m^3/ha = 2,011 m^3	**Extended Detention Volume** = 10.42 ha x 40 m^3/ha = 417 m^3

5.1.2 Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for the overall 19.58 hectare drainage area (Areas A30. A31, and A32) to the proposed facility is 1,924 m^3.

The following table shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

Table 6. SWM Facility 'P30' – Stormwater Quality Volume Requirements	
A. Permanent Pool Volume	2,011 m^3
B. Extended Detention Volume	417 m^3
C. Stormwater Volume from 25mm – 4-hour rainfall event	1,924 m^3
D. Minimum Extended Detention Volume (greater of B & C)	1,924 m^3
Total Quality and Extended Detention Volume (A + D)	**3,935 m^3**

5.1.3 Stormwater Management Facility 'P30' Configuration

As shown in Figure 5, it is proposed to construct a three-stage control outlet for the proposed stormwater management facility. The first stage of control consists of a reverse slope pipe acting as a tubular control orifice to detain the extended detention volume and release it slowly over an extended period of time. The second stage of control consists of a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The third stage consists of an emergency spillway to provide an outlet for greater storm events.

The proposed bottom elevation of the facility is 177.20 m, and the permanent pool water level is proposed at 178.80 m, for a permanent water depth of 1.6 metre. The configuration of the facility provides 2,221 m^3 of permanent pool volume, which is more than the required 2,011 m^3. The proposed top of pond is at an elevation of 180.80 m which provides a total active volume of 8,137 m^3 with 5:1 side slopes.

Based on the configuration of the proposed facility, it was determined that a 135 mm diameter (5 inch) quality orifice at an invert of 178.80 m can provide 29 hours of extended detention for the 25mm design storm event, which has a corresponding water surface elevation of 179.28m within the proposed facility.

The proposed ditch inlet catchbasin will be constructed with the rim at an elevation of 180.10 m which will provide an extended detention volume of 4,649 m^3, which is greater than the minimum volume of 1,924 m^3 specified in Table 6.

The outflow pipe from the stormwater management facility is to be 450mm in diameter and will convey the stormwater flows from the ditch inlet to the proposed headwall structure outletting to Towpath Drain. A stage-storage-discharge relationship was determined for the facility and is included in Appendix B for reference purposes.

Major overland flows within the northern portion of the subject lands directed to the proposed wetpond facility, and then to the Towpath Drain.

A sediment forebay has been sized for this facility to minimize the transport of heavy sediment throughout the facility and to localize maintenance activities. Calculations for the forebay sizing follow MECP Guidelines and is shown in Table 7.

Table 7. Stormwater Management Facility 'P30' Forebay Sizing

a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)

$$Settling\ Length = \sqrt{\left(\frac{r \times Q}{V_s}\right)}$$

r =	3.5	:1	(Length:Width Ratio)
Q_p =	0.025	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **17.08** **m**

b) Dispersion Length (MOE SWMP&D, Equation 4.6)

$$Dispersion\ Length = \frac{8 \times Q}{D \times V_f}$$

Q =	1.401	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.50	m	(Depth of Perm. Pool in the Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **14.94** **m**

c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP&D), Equation 4.7)

$$Width = \frac{Min.Forebay\ Length}{8}$$

17.08 m (minimum required length)

Width = **2.13** **m** (minimum required width)

d) Average Velocity of Flow

$$Average\ Velocity = \frac{Q}{A}$$

Q =	0.760	m^3/s	(25mm Storm Design Inflow)
A =	15.75	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	6.00	m	(Proposed Bottom Width)
SS =	3	:1	(Side Slopes - Minimum)

Average Velocity = **0.05** **m/s**

Is this Acceptable? **Yes** (Maximum velocity of flow = 0.15 m/s)

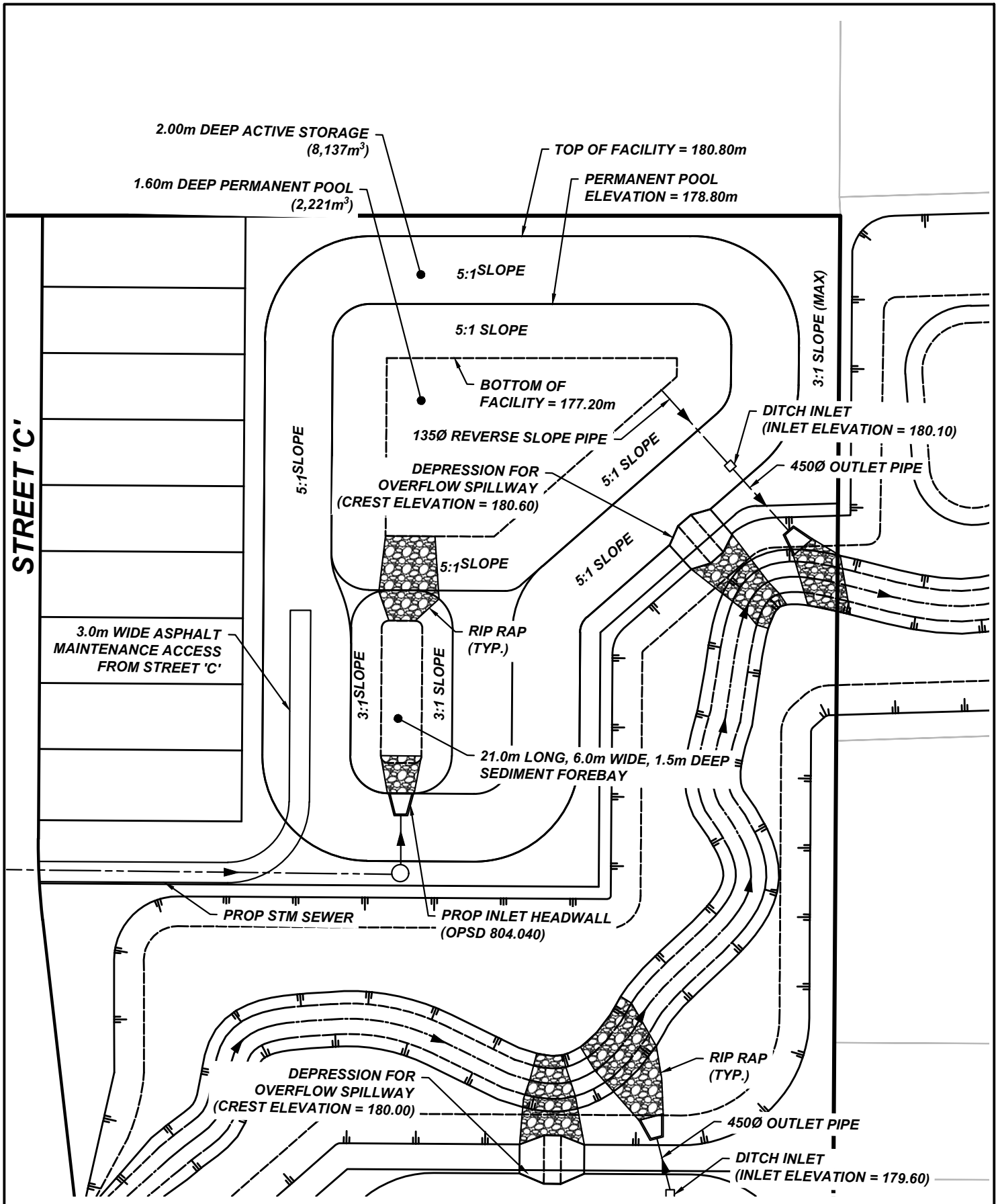
e) Cleanout Frequency

Is this Acceptable? **Yes**

L =	21.0	m	(Proposed Bottom Length)
ASL =	3.13	m^3/ha	(Annual Sediment Loading)
A =	10.42	ha	(Drainage Area)
FRC =	80	%	(Facility Removal Efficiency)
FV =	432.0	m^3	(Forebay Volume)

Cleanout Frequency = **10.6** **Years**

Is this Acceptable? **Yes** (10 Year Minimum Cleanout Frequency)



UPPER CANADA CONSULTANTS
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210, 256 & 276 QUAKER ROAD
CITY OF WELLAND
STORMWATER MANAGEMENT POND P30

DATE	2024–07–18
SCALE	1:750 m
REF No.	1601
DWG No.	FIGURE 5

Table 8 summarizes the peak inflows and outflows for the stormwater management facility along with corresponding pond elevations. Based on the MIDUSS model, the maximum wet pond elevation is 180.38 m, and an active storage volume is 5,999 m^3 for the 100-year design storm event.

Table 8. Stormwater Management Wet Pond Facility 'P30' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Inflow	Outflow		
25mm	760	25	179.28	1,460
2 Year	1,210	34	179.64	2,856
5 Year	1,401	38	179.85	3,675
10 Year	1,576	42	180.03	4,365
25 Year	1,840	114	180.19	5,104
100 Year	2,246	250	180.38	5,999

Table 9. SWM Facility 'P30' – MECP Quality Requirements Comparison

SWM Facility Characteristic	MECP Requirement	Provided by SWM Facility
Permanent Pool Volume (m^3) - *minimum*	2,011 (min)	2,221
Extended Detention Volume (m^3) – *minimum*	1,924 (min)	4,649
Total Quality + Detention Storage (m^3) – *minimum*	3,935 min)	6,870
Drawdown Time (hr) – *minimum*	24 (min)	29
Forebay Length (m) – *minimum*	17.08 (min)	21.00
Forebay Width (m) – *minimum*	2.13 (min)	6.00
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.05
Cleanout Frequency (years) - *minimum*	10 (min)	11

As shown in Table 9, the proposed stormwater management facility configuration satisfies the quality control requirements for the associated drainage area.

5.2 Southern Stormwater Management Facility 'P31'

5.2.1 Stormwater Quality Control

The stormwater drainage outlet for the proposed Wet Pond 'P31' is the Towpath Drain, where *Enhanced* protection will be provided. Based on Table 3.2 of SWMP & Design Manual, the Enhanced water quality storage requirement for wet pond facilities in a development with 75% impervious area is approximately 233 m^3/ha. The wet pond facility will provide stormwater quality controls for a drainage area of approximately 12.96 hectares (Area A33) as shown in Table 10.

Table 10. SWM Facility 'P31' - Stormwater Quality Volume Calculations

Total Water Quality Volume = 12.96 ha x 233 m^3/ha = 3,020 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 12.96 ha x 193 m^3/ha = 2,501 m^3	**Extended Detention Volume** = 12.96 ha x 40 m^3/ha = 518m^3

5.1.2 Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for the overall 13.62 hectare area (Areas A33 and A34) is 2,114 m^3.

The following table shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

Table 11. SWM Facility 'P31' – Stormwater Quality Volume Requirements

A. Permanent Pool Volume (m^3)	2,501 m^3
B. Extended Detention Volume (m^3)	518 m^3
C. Stormwater Volume from 25mm – 4-hour rainfall event	2,114 m^3
D. Minimum Extended Detention Volume (greater of B & C)	2,114 m^3
Total Quality and Extended Detention Volume (A + D)	**4,615 m^3**

5.1.3 Stormwater Management Facility 'P31' Configuration

As shown in Figure 6, it is proposed to construct a three-stage control outlet for the proposed stormwater management facility. The first stage of control consists of a reverse slope pipe acting as a tubular control orifice to detain the extended detention volume and release it slowly over an extended period of time. The second stage of control consists of a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The third stage will consist of an emergency spillway to provide an outlet for greater storm events.

The proposed bottom elevation of the facility is 176.50 m, and the permanent pool water level is proposed at 178.30 m, for a permanent water depth of 1.80 metres. The configuration of the facility provides 2,733 m^3 of permanent pool volume, which is more than the required 2,501 m^3. The proposed top of pond is at an elevation of 180.30 m which provides a total active volume of 8,059 m^3 with 5:1 side slopes.

Based on the configuration of the proposed facility, it was determined that a 150 mm diameter quality orifice at an invert of 178.30 m can provide 26 hours of extended detention for the 25mm design storm event, which has a corresponding water surface elevation of 178.84m within the proposed facility.

The proposed ditch inlet catchbasin will be constructed with the rim at an elevation of 179.60 m which will provide an extended detention volume of 4,692 m^3, which is greater than the minimum volume of 2,114 m^3 specified in Table 11.

The outflow pipe from the stormwater management facility is to be 450mm in diameter and will convey the stormwater flows from the ditch inlet to the proposed headwall structure outletting to Towpath Drain. A stage-storage-discharge relationship was determined for the facility and is included in Appendix C for reference purposes.

Major overland flows within the southern portion of the subject lands directed to the proposed wetpond facility, and then to the Towpath Drain.

A sediment forebay was included in this stormwater management facility to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility and to localize maintenance activities. Calculations for the forebay sizing follow MECP Guidelines and is shown in Table 12.

Table 12. Stormwater Management Facility 'P31' Forebay Sizing

a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)

$$Settling\ Length = \sqrt{\left(\frac{r \times Q}{V_s}\right)}$$

r =	8.0	:1	(Length:Width Ratio)
Q_p =	0.032	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **29.30** **m**

b) Dispersion Length (MOE SWMP&D, Equation 4.6)

$$Dispersion\ Length = \frac{8 \times Q}{D \times V_f}$$

Q =	1.765	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.50	m	(Depth of Perm. Pool in the Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **18.83** **m**

c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP&D), Equation 4.7)

$$Width = \frac{Min.Forebay\ Length}{8}$$

29.30 m (minimum required length)

Width = **3.66** **m** (minimum required width)

d) Average Velocity of Flow

$$Average\ Velocity = \frac{Q}{A}$$

Q =	0.922	m^3/s	(25mm Storm Design Inflow)
A =	12.90	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	4.10	m	(Proposed Bottom Width)
SS =	3	:1	(Side Slopes - Minimum)

Average Velocity = **0.07** **m/s**

Is this Acceptable? **Yes** (Maximum velocity of flow = 0.15 m/s)

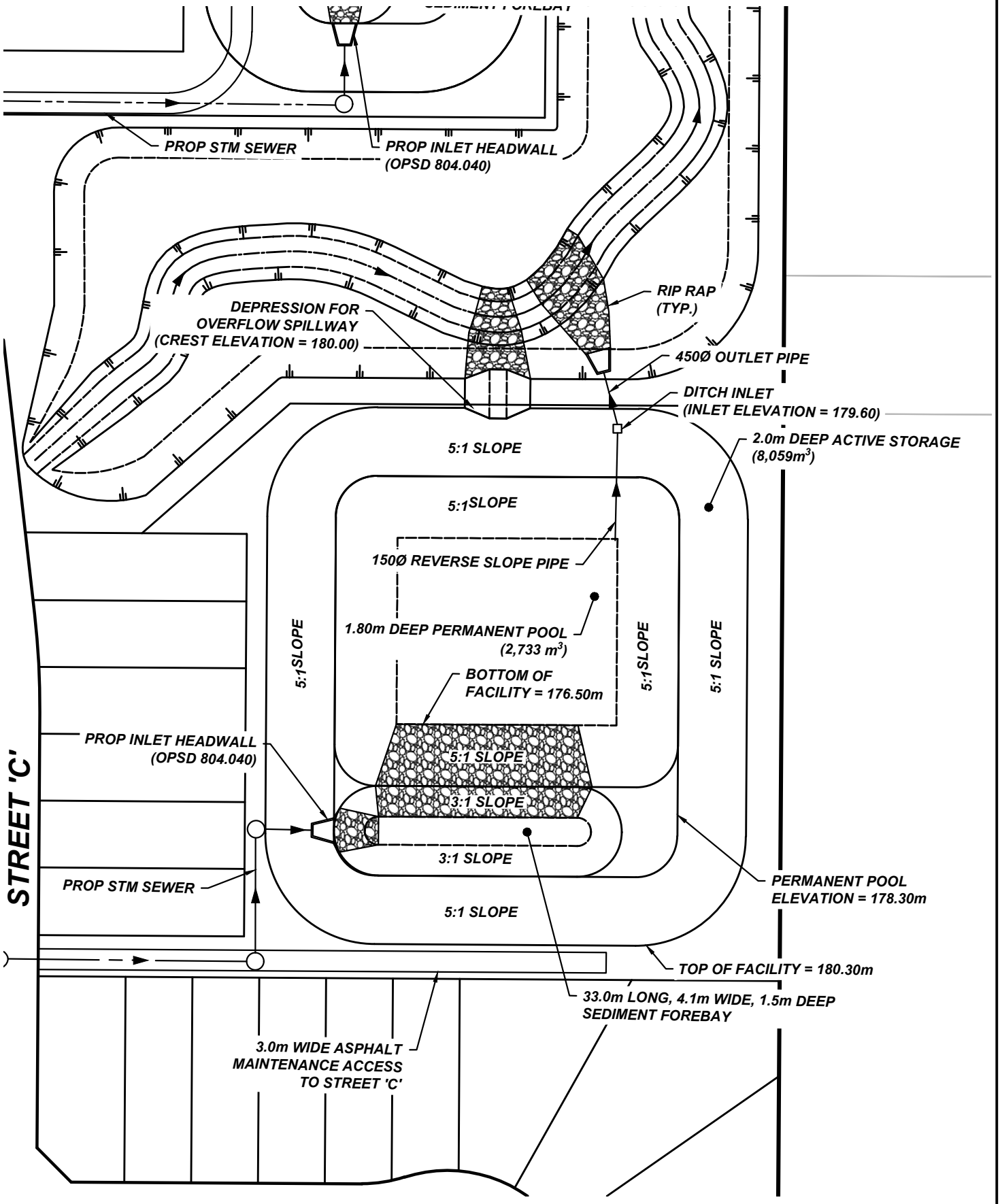
e) Cleanout Frequency

L =	33.0	m	(Proposed Bottom Length)
ASL =	3.13	m^3/ha	(Annual Sediment Loading)
A =	12.96	ha	(Drainage Area)
FRC =	80	%	(Facility Removal Efficiency)
FV =	514.1	m^3	(Forebay Volume)

Is this Acceptable? **Yes**

Cleanout Frequency = **10.1** **Years**

Is this Acceptable? **Yes** (10 Year Minimum Cleanout Frequency)



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

210, 256 & 276 QUAKER ROAD
CITY OF WELLAND
STORMWATER MANAGEMENT POND P31

DATE	2024–07–18
SCALE	1:750 m
REF No.	1601
DWG No.	FIGURE 6

Table 13 summarizes the peak inflows and outflows for the stormwater management facility along with corresponding pond elevations. Based on the MIDUSS model, Table 13 shows the maximum wet pond elevation of 179.88 m, and an active storage volume of 5,982 m^3 for the 100-year design storm event.

Table 13. Stormwater Management Wet Pond Facility 'P31' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Future Inflow	Future Outflow		
25mm	922	32	178.84	1,746
2 Year	1,478	43	179.20	3,116
5 Year	1,765	48	179.39	3,856
10 Year	1,983	52	179.54	4,465
25 Year	2,245	107	179.71	5,183
100 Year	2,731	221	179.88	5,982

Table 14. SWM Facility 'P31' – MECP Quality Requirements Comparison

SWM Facility Characteristic	MECP Requirement	Provided by SWM Facility
Permanent Pool Volume (m^3) - *minimum*	2,497 (min)	2,733
Extended Detention Volume (m^3) – *minimum*	2,114 (min)	4,692
Total Quality + Detention Storage (m^3) – *minimum*	4,615 (min)	7,425
Drawdown Time (hr) – *minimum*	24 (min)	26
Forebay Length (m) – *minimum*	29.30 (min)	33
Forebay Width (m) – *minimum*	3.66 (min)	4.10
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.07
Cleanout Frequency (years) - *minimum*	10 (min)	10

As shown in Table 14, the proposed stormwater management facility configuration satisfies the quality control requirements for the associated drainage area.

5.3 Overall Stormwater Management Plan

As previously discussed, UCC has prepared a comprehensive Future conditions MIDUSS model to include all of the proposed stormwater management facilities to be constructed within the properties for which UCC is providing engineering services. The facilities included in the model are SWM Facilities P10 through P50, as shown in Figures 3 and 4.

Within properties where there are no Planning Act Applications forthcoming at the time of writing this report, that UCC is not providing engineering services, or a stormwater management alternative has not been selected, existing conditions were assumed in accordance with the Implementation Plan (see Figure 2).

As part of the Planning Act Applications on the properties where UCC is providing engineering services, separate Stormwater Management Reports will be submitted to outline the detailed calculations for each proposed facility. For the purposes of this Stormwater Management Plan, Tables 15 through 21 have been including providing the summary of the characteristics of each SWMF designed by UCC in the NWWSP Area.

5.3.1 Block 2

As shown in Figure 1, Block 2 consists of a property where UCC is providing the engineering services (450 Rice Road) and the remaining property where UCC is not providing engineering services.

The 450 Rice Road will provide only stormwater management quality controls (Facility P20) which will be via an Oil/Grit Separator as the tributary drainage area (Areas A20 and A20a) is below 5.0 hectares. A separate SWM Plan will be submitted outlining the detailed calculations for this Block.

The adjacent lands where UCC is not providing engineering services have been assumed at existing conditions for the purposes of identifying future stormwater flows within the realigned watercourse. A separate SWM Plan will be submitted by the owner's engineering consultant addressing the future stormwater management within this property.

5.3.2 Block 3

As shown in Figure 1, Block 3 consists of lands owned by a single owner for which UCC is providing engineering services and will include two stormwater management facilities (P10 and P11). Facility P10 will be comprised of a dry pond and Oil/Grit Separator as the tributary drainage area to the Oil/Grit Separator (Areas A10) is below 5.0 hectares, and Facility P11 will be comprised of a single wet pond providing quality and quantity controls for areas A12, A13, and A14. A separate SWM Plan will be submitted outlining the detailed calculations for this Block.

Table 15, 16, and 17 below summarize the design characteristics for Facilites P10 and P11.

Table 15. Stormwater Management Dry Pond Facility 'P10' Characteristics				
Design Storm	**Peak Flows (L/s)**		**Maximum Elevation (m)**	**Maximum Storage (m3)**
	Future Inflow	**Future Outflow**		
25mm	273	23	185.94	390
2 Year	422	25	186.13	803
5 Year	497	26	186.26	1,035
10 Year	1,229	26	186.30	1,229
25 Year	0.644	27	186.41	1,531
100 Year	0.783	105	186.51	1,804

Table 16. Stormwater Management Wet Pond Facility 'P11' Characteristics				
Design Storm	**Peak Flows (L/s)**		**Maximum Elevation (m)**	**Maximum Storage (m3)**
	Future Inflow	**Future Outflow**		
25mm	584	14	185.31	1,163
2 Year	889	18	185.63	2,132
5 Year	1,052	20	185.81	2,641
10 Year	1,177	22	185.95	3,066
25 Year	1,367	48	186.14	3,650
100 Year	1,659	143	186.28	4,180

Table 17. SWM Facility 'P11' – MECP Quality Requirements Comparison		
SWM Facility Characteristic	**MECP Requirement**	**Provided by SWM Facility**
Permanent Pool Volume (m^3) - *minimum*	1,565 (min)	1,616
Extended Detention Volume (m^3) – *minimum*	1,350 (min)	3,519
Total Quality + Detention Storage (m^3) – *minimum*	2,915 (min)	5,135
Drawdown Time (hr) – *minimum*	24 (min)	40
Forebay Length (m) – *minimum*	19.80 (min)	21.00
Forebay Width (m) – *minimum*	2.41 (min)	2.50
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.06
Cleanout Frequency (years) - *minimum*	10 (min)	11

As shown in the above tables, Facilities P10 and P11 have adequate capacity to provide stormwater management quantity and quality controls in accordance with MECP requirements and the requirements of the Implementation Plan.

5.3.3 Block 4

As shown in Figure 1, Block 4 consists of multiple properties owned by a single owner for which UCC is providing engineering services separated by a property for which there is not expected to be a future Planning Act Application submitted in the near future.

The area fronting on Rice Road will be consolidated into multiple properties that will be subject to separate applications for Site Plan Approval. The stormwater management facility characteristics for quantity control (storage) within these areas are not presently known and have therefore been included at existing conditions. Stormwater management quality controls will also be provided in accordance with the Implementation Plan.

For the area fronting onto Quaker Road, it is proposed to constuct a single communal wet pond SWM Facility (P50) to provide quality and quantity controls for Areas A52, A53, and A54 prior to discharging to the Towpath Drain.

Additionally, there is an existing catchment area within these lands that drain to the existing unnamed tributary to the Welland Recreational Canal that was constructed as part of the College Park Subdivision.

For the purposes of this Stormwater Management Plan, it was assumed that the majority of this area will convey future stormwater flows to the Towpath Drain. However, a separate SWM Plan will be submitted outlining the detailed calculations for this Block to ensure that future stormwater flows to each watercourse are controlled to existing levels.

Table 20 and 21 below summarize the design characteristics for Facility P50.

Table 18. Stormwater Management Wet Pond Facility 'P50' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Future Inflow	Future Outflow		
25mm	1,227	9	182.40	2,607
2 Year	1,923	17	182.70	4,589
5 Year	2,285	20	182.85	5,617
10 Year	2,514	21	182.96	6,474
25 Year	2,924	23	183.13	7,762
100 Year	3,539	132	183.33	9,342

Table 19. SWM Facility 'P50' – MECP Quality Requirements Comparison		
SWM Facility Characteristic	**MECP Requirement**	**Provided by SWM Facility**
Permanent Pool Volume (m^3) - *minimum*	3,287 (min)	5,743
Extended Detention Volume (m^3) – *minimum*	2,782 (min)	7,895
Total Quality + Detention Storage (m^3) – *minimum*	6,072 (min)	13,638
Drawdown Time (hr) – *minimum*	24 (min)	99
West Forebay		
Forebay Length (m) – *minimum*	12.42 (min)	18.50
Forebay Width (m) – *minimum*	1.55 (min)	3.80
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.04
Cleanout Frequency (years) - *minimum*	10 (min)	11
East Forebay		
Forebay Length (m) – *minimum*	6.98 (min)	18.50
Forebay Width (m) – *minimum*	0.87 (min)	3.80
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.03
Cleanout Frequency (years) - *minimum*	10 (min)	20

As shown in the above tables, Facility P50 has adequate capacity to provide stormwater management quantity and quality controls in accordance with MECP requirements and the requirements of the Implementation Plan.

5.3.4 Block 5

As shown in Figure 1, Block 5 consists of lands owned by multiple owners for which UCC is providing engineering services and will include a single communal wet pond SWM Facility (P40) providing quality and quantity controls for the Areas A40 to A45. A separate SWM Plan will be submitted outlining the detailed calculations for this Block.

Table 18 and 19 below summarize the design characteristics for Facility P40.

Table 20. Stormwater Management Wet Pond Facility 'P40' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Future Inflow	Future Outflow		
25mm	1,513	41	186.59	3,005
2 Year	2,374	64	187.04	5,502
5 Year	2,832	72	187.27	6,887
10 Year	3,124	129	187.42	7,854
25 Year	3,648	198	187.60	9,121
100 Year	4,453	430	187.86	10,981

Table 21. SWM Facility 'P40' – MECP Quality Requirements Comparison		
SWM Facility Characteristic	**MECP Requirement**	**Provided by SWM Facility**
Permanent Pool Volume (m^3) - *minimum*	4,297 (min)	4,612
Extended Detention Volume (m^3) – *minimum*	3,593 (min)	7,091
Total Quality + Detention Storage (m^3) – *minimum*	7,890 (min)	11,703
Drawdown Time (hr) – *minimum*	24 (min)	30
West Forebay		
Forebay Length (m) – *minimum*	23.34 (min)	25.00
Forebay Width (m) – *minimum*	2.92 (min)	5.20
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.07
Cleanout Frequency (years) - *minimum*	10 (min)	10
East Forebay		
Forebay Length (m) – *minimum*	14.14 (min)	25.00
Forebay Width (m) – *minimum*	1.77 (min)	5.00
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.05
Cleanout Frequency (years) - *minimum*	10 (min)	10

As shown in the above tables, Facility P40 has adequate capacity to provide stormwater management quantity and quality controls in accordance with MECP requirements and the requirements of the Implementation Plan.

5.3.5 Existing and Future Peak Flow Comparison

As summarized in Table 22 below, the proposed SWM Facilities (P10 through P50) can provide adequate stormwater quantity controls to control future flows to the existing levels identified in the Implementation Plan at each identified outlet along the Towpath Drain during each storm event.

Table 22. Impacts of SWM Facilities on Peak Flows at Outlets A through D			
Design Storm	**Peak Flow (m^3/s)**		
	Existing	**Future with SWM**	**Change**
Upstream of Rice Road Culvert Crossing – Outlet A1			
2 Year	1.317	0.983	-25.4%
5 Year	1.589	1.185	-25.4%
10 Year	1.800	1.344	-25.3%
25 Year	2.099	1.583	-24.6%
100 Year	2.558	1.908	-25.4%
Downstream of Rice Road Culvert Crossing – Outlet A2			
2 Year	3.301	2.916	-11.7%
5 Year	4.194	3.502	-16.5%
10 Year	4.777	3.959	-17.1%
25 Year	5.619	4.621	-17.8%
100 Year	6.987	5.662	-19.0%
Towpath Drain Upstream of Existing PSW – Outlet B			
2 Year	3.425	3.353	-2.1%
5 Year	4.367	4.015	-8.1%
10 Year	4.977	4.532	-8.9%
25 Year	5.863	5.284	-9.9%
100 Year	7.305	6.464	-11.5%
Downstream of First Avenue Culvert Crossing – Outlet C			
2 Year	4.035	4.031	-0.1%
5 Year	5.176	4.834	-6.6%
10 Year	5.914	5.467	-7.6%
25 Year	7.005	6.402	-8.6%
100 Year	8.781	7.881	-10.2%
Upstream of Niagara Street Culvert Crossing – Outlet D			
2 Year	4.509	4.177	-7.4%
5 Year	5.835	5.016	-14.0%
10 Year	6.678	5.677	-15.0%
25 Year	7.938	6.649	-16.2%
100 Year	9.995	8.188	-18.1%

6.0 SEDIMENT AND EROSION CONTROL

Sediment controls are required during construction. The proposed extended detention facility can be used for this purpose. Therefore, the proposed constructed wet pond facility should be constructed prior to the facility for sediment control during construction.

The following additional erosion and sediment controls will also be implemented during construction:

- Install silt control fencing along the limits of construction where overland flows will flow beyond the limits of the development or into downstream watercourse.

- Re-vegetate disturbed areas as soon as possible after grading works have been completed.

- Lot grading and siltation controls plans will be provided with sediment and erosion control measures to the appropriate agencies for approval during the final design stage.

- The Stormwater management facility be cleaned after construction prior to assumption by municipality.

7.0 STORMWATER MANAGEMENT FACILITY MAINTENANCE

Maintenance is a necessary and important aspect of urban stormwater quality and quantity measures such as constructed wetlands. Many pollutants (i.e. nutrients, metals, bacteria, etc.) bind to sediment and therefore removal of sediment on a scheduled basis is required.

The wet pond for this development is subject to frequent wetting and deposition of sediments as a result of frequent low intensity storm event. The purpose of the wet pond is to improve post development sediment and contaminant loadings by detaining the 'first flush' flow for a 24 hour period. For the initial operation period of the stormwater management facility, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the home construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the effectiveness of sediment and erosion control techniques employed.

Inspections of the wet pond will indicate whether or not maintenance is required. Inspections should be made after every significant storm during the first two years of operation or until all development is completed to ensure the wet pond is functioning properly. This may translate into an average of six inspections per year. Once all building activity is finalized, inspections shall be performed annually. The following points should be addressed during inspections of the facility.

a) Standing water above the inlet storm sewer invert a day or more after a storm may indicate a blockage in the reverse slope pipe or orifice. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.

b) The vegetation around the wet pond should be inspected to ensure its function and aesthetics. Visual inspections will indicate whether replacement of plantings are required. A decline in vegetation habitat may indicate that other aspects of the constructed wet pond are operating improperly, such as the detention times may be inadequate or excessive.

c) The accumulation of sediment and debris at the wet pond inlet sediment forebay or around the high water line of the wet pond should be inspected. This will indicate the need for sediment removal or debris clean up.

d) The wet pond has been created by excavating a detention area. The integrity of the embankments should be periodically checked to ensure that it remains watertight and the side slopes have not sloughed.

Grass cutting is a maintenance activity that is done solely for aesthetic purposes. It is recommended that grass cutting be eliminated. It should be noted that municipal by-laws may require regular grass maintenance for weed control.

Trash removal is an integral part of maintenance and an annual clean-up, usually in the spring, is a minimum requirement. After this, trash removal is performed as required basis on observation of trash build-up during inspections.

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically to ensure that sediment in not deposited throughout the facility. For sediment removal operations, typical grading/excavating equipment should be used to remove sediment from the inlet forebay and detention areas. Care should be taken to ensure that limited damage occurs to existing vegetation and habitat.

Generally, the sediment which is removed from the detention pond will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, the following conclusions are offered:

- Infiltration techniques are not suitable for this site as the primary control facility due to the low soil infiltration rates.

- Two proposed stormwater management wet pond facilities will provide stormwater quality, quantity and erosion controls to the proposed development.

- Multiple stormwater management facilities external to the subject lands will provide stormwater quality, quantity and erosion controls for the respective catchment areas, to be addressed in separate SWM Reports as part of forthcoming Planning Act Applications.

- Various lot level vegetative stormwater management practices can be implemented to enhance stormwater quality.

- This report was prepared in accordance with the provincial guidelines contained in "Stormwater Management Planning and Design Manual, March 2003".

The above conclusions lead to the following recommendations:

- That the stormwater management criteria established in this report be accepted.

- That two stormwater management wet pond facilities be constructed to provide stormwater quality protection to MECP *Enhanced* Protection levels and quantity controls as outlined in this report.

- That the external SWM Facilities be constructed to the criteria established in the separately submitted SWM Reports.

- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.

- That sediment and erosion controls during construction as described in this report be implemented.

Respectfully Submitted,

Brendan Kapteyn, P.Eng.

APPENDICES

APPENDIX A

Existing Conditions MIDUSS Output File

```
      Output File (4.7) EX.OUT       opened 2024-04-03  15:59
      Units used are defined by G =    9.810
          24   144    10.000        are MAXDT MAXHYD & DTMIN values
      Licensee: UPPER CANADA CONSULTANTS
35    COMMENT
     4     line(s) of comment
      STORMWATER MANAGEMENT PLAN
      QUAKER ROAD
      CITY OF WELLAND
      EXISTING CONDITIONS
35    COMMENT
     3     line(s) of comment
      ***********
      25mm STORM EVENT
      ***********
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    512.000     Coefficient  a
      6.000     Constant  b    (min)
       .800     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration    240 min
               25.035 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3     line(s) of comment
      ***********
      AREA NORTH OF QUAKER
      ***********
 4    CATCHMENT
      1.000     ID No.  99999
     15.820     Area in hectares
    325.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    325.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .499       .000       .000       .000 c.m/s
              .098       .805       .346     C perv/imperv/total
15    ADD RUNOFF
              .499       .499       .000       .000 c.m/s
 4    CATCHMENT
      2.000     ID No.  99999
     13.570     Area in hectares
    301.000     Length (PERV) metres
      1.000     Gradient (%)
     25.000     Per cent Impervious
    301.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .309       .499       .000       .000 c.m/s
              .098       .802       .274     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ************************
      FLOW AT RICE ROAD
      ************************
15    ADD RUNOFF
              .309       .808       .000       .000 c.m/s
 4    CATCHMENT
      3.000     ID No.  99999
     14.520     Area in hectares
    311.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    311.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .461       .808       .000       .000 c.m/s
              .098       .803       .345     C perv/imperv/total
15    ADD RUNOFF
              .461      1.269       .000       .000 c.m/s
 4    CATCHMENT
      4.000     ID No.  99999
     45.500     Area in hectares
    551.000     Length (PERV) metres
      1.000     Gradient (%)
     21.000     Per cent Impervious
    551.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .611      1.269       .000       .000 c.m/s
              .098       .804       .247     C perv/imperv/total
15    ADD RUNOFF
              .611      1.879       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      ***********
      AREA SOUTH OF QUAKER
      ***********
 4    CATCHMENT
      5.000     ID No.  99999
      5.310     Area in hectares
    188.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    188.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .051      1.879       .000       .000 c.m/s
              .098       .806       .169     C perv/imperv/total
15    ADD RUNOFF
              .051      1.930       .000       .000 c.m/s
 4    CATCHMENT
      6.000     ID No.  99999
     43.410     Area in hectares
    538.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    538.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .255      1.930       .000       .000 c.m/s
              .098       .803       .162     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ************************
      TOTAL FLOW AT FIRST AVENUE
      ************************
15    ADD RUNOFF
              .255      2.185       .000       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
              .255      2.185      2.185       .000 c.m/s
17    COMBINE
      1     Junction Node No.
              .255      2.185      2.185      2.185 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********
      AREA SOUTH OF QUAKER
      ***********
 4    CATCHMENT
      7.000     ID No.  99999
     16.470     Area in hectares
    331.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    331.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .149       .000      2.185      2.185 c.m/s
              .098       .805       .169     C perv/imperv/total
15    ADD RUNOFF
              .149       .149      2.185      2.185 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
              .149       .149       .149      2.185 c.m/s
17    COMBINE
      1     Junction Node No.
              .149       .149       .149      2.334 c.m/s
18    CONFLUENCE
      1     Junction Node No.
              .149      2.334       .149       .000 c.m/s
 4    CATCHMENT
      8.000     ID No.  99999
     42.190     Area in hectares
    530.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .250      2.334       .149       .000 c.m/s
              .098       .803       .162     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ****************************
      TOTAL FLOW AT NIAGARA STREET
      ****************************
15    ADD RUNOFF
              .250      2.584       .149       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1074966E+05 c.m
14    START
      1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ***********
       2-YEAR STORM EVENT
        ***********
 2     STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     755.000     Coefficient  a
       8.000     Constant  b    (min)
        .789     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration    240 min
              38.971 mm     Total depth
 3     IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ***********
       AREA NORTH OF QUAKER
        ***********
 4     CATCHMENT
       1.000     ID No.  99999
      15.820     Area in hectares
     325.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     325.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .813       .000       .149       .000 c.m/s
             .194       .859       .427     C perv/imperv/total
15     ADD RUNOFF
             .813       .813       .149       .000 c.m/s
 4     CATCHMENT
       2.000     ID No.  99999
      13.570     Area in hectares
     301.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     301.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .504       .813       .149       .000 c.m/s
             .194       .862       .361     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
       FLOW AT RICE ROAD
        ************************
15     ADD RUNOFF
             .504      1.317       .149       .000 c.m/s
 4     CATCHMENT
       3.000     ID No.  99999
      14.520     Area in hectares
     311.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     311.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .749      1.317       .149       .000 c.m/s
             .194       .861       .428     C perv/imperv/total
15     ADD RUNOFF
             .749      2.066       .149       .000 c.m/s
 4     CATCHMENT
       4.000     ID No.  99999
      45.500     Area in hectares
     551.000     Length (PERV) metres
       1.000     Gradient (%)
      21.000     Per cent Impervious
     551.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.153      2.066       .149       .000 c.m/s
             .194       .868       .336     C perv/imperv/total
15     ADD RUNOFF
            1.153      3.219       .149       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ***********
       AREA SOUTH OF QUAKER
        ***********
 4     CATCHMENT
       5.000     ID No.  99999
       5.310     Area in hectares
     188.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     188.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .082      3.219       .149       .000 c.m/s
             .194       .863       .261     C perv/imperv/total
15     ADD RUNOFF
             .082      3.301       .149       .000 c.m/s
 4     CATCHMENT
       6.000     ID No.  99999
      43.410     Area in hectares
     538.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     538.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .485      3.301       .149       .000 c.m/s
             .194       .868       .255     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
       TOTAL FLOW AT FIRST AVENUE
        ************************
15     ADD RUNOFF
             .485      3.786       .149       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .485      3.786      3.786       .000 c.m/s
17     COMBINE
       1     Junction Node No.
             .485      3.786      3.786      3.786 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
       AREA SOUTH OF QUAKER
        ***********
 4     CATCHMENT
       7.000     ID No.  99999
      16.470     Area in hectares
     331.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     331.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .249       .000      3.786      3.786 c.m/s
             .194       .858       .261     C perv/imperv/total
15     ADD RUNOFF
             .249       .249      3.786      3.786 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .249       .249       .249      3.786 c.m/s
17     COMBINE
       1     Junction Node No.
             .249       .249       .249      4.035 c.m/s
18     CONFLUENCE
       1     Junction Node No.
             .249      4.035       .249       .000 c.m/s
 4     CATCHMENT
       8.000     ID No.  99999
      42.190     Area in hectares
     530.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     530.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .474      4.035       .249       .000 c.m/s
             .194       .867       .255     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ****************************
       TOTAL FLOW AT NIAGARA STREET
        ****************************
15     ADD RUNOFF
             .474      4.509       .249       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .2362202E+05 c.m
14     START
       1     1=Zero; 2=Define
```

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35    COMMENT
      3     line(s) of comment
       ***********
       5-YEAR STORM EVENT
       ***********
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    830.000     Coefficient  a
      7.300     Constant  b    (min)
       .777     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration    240 min
             45.874 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
      3     line(s) of comment
       ***********
       AREA NORTH OF QUAKER
       ***********
 4    CATCHMENT
      1.000     ID No.  99999
     15.820     Area in hectares
    325.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    325.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .980       .000       .249       .000 c.m/s
             .236       .880       .461     C perv/imperv/total
15    ADD RUNOFF
             .980       .980       .249       .000 c.m/s
 4    CATCHMENT
      2.000     ID No.  99999
     13.570     Area in hectares
    301.000     Length (PERV) metres
      1.000     Gradient (%)
     25.000     Per cent Impervious
    301.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .608       .980       .249       .000 c.m/s
             .236       .883       .398     C perv/imperv/total
35    COMMENT
      3     line(s) of comment
       ************************
       FLOW AT RICE ROAD
       ************************
15    ADD RUNOFF
             .608      1.589       .249       .000 c.m/s
 4    CATCHMENT
      3.000     ID No.  99999
     14.520     Area in hectares
    311.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    311.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .902      1.589       .249       .000 c.m/s
             .236       .882       .462     C perv/imperv/total
15    ADD RUNOFF
             .902      2.491       .249       .000 c.m/s
 4    CATCHMENT
      4.000     ID No.  99999
     45.500     Area in hectares
    551.000     Length (PERV) metres
      1.000     Gradient (%)
     21.000     Per cent Impervious
    551.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.602      2.491       .249       .000 c.m/s
             .236       .885       .372     C perv/imperv/total
15    ADD RUNOFF
            1.602      4.093       .249       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4    CATCHMENT
      5.000     ID No.  99999
      5.310     Area in hectares
    188.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    188.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .101      4.093       .249       .000 c.m/s
             .236       .875       .300     C perv/imperv/total
15    ADD RUNOFF
             .101      4.194       .249       .000 c.m/s
 4    CATCHMENT
      6.000     ID No.  99999
     43.410     Area in hectares
    538.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    538.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .676      4.194       .249       .000 c.m/s
             .236       .885       .294     C perv/imperv/total
35    COMMENT
      3     line(s) of comment
       ************************
       TOTAL FLOW AT FIRST AVENUE
       ************************
15    ADD RUNOFF
             .676      4.870       .249       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .676      4.870      4.870       .000 c.m/s
17    COMBINE
      1     Junction Node No.
             .676      4.870      4.870      4.870 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4    CATCHMENT
      7.000     ID No.  99999
     16.470     Area in hectares
    331.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    331.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .306       .000      4.870      4.870 c.m/s
             .236       .880       .300     C perv/imperv/total
15    ADD RUNOFF
             .306       .306      4.870      4.870 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .306       .306       .306      4.870 c.m/s
17    COMBINE
      1     Junction Node No.
             .306       .306       .306      5.176 c.m/s
18    CONFLUENCE
      1     Junction Node No.
             .306      5.176       .306       .000 c.m/s
 4    CATCHMENT
      8.000     ID No.  99999
     42.190     Area in hectares
    530.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .659      5.176       .306       .000 c.m/s
             .236       .885       .294     C perv/imperv/total
35    COMMENT
      3     line(s) of comment
       ****************************
       TOTAL FLOW AT NIAGARA STREET
       ****************************
15    ADD RUNOFF
             .659      5.835       .306       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3122033E+05 c.m
14    START
      1     1=Zero; 2=Define
```

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35    COMMENT
      3     line(s) of comment
       **********
       10-YEAR STORM EVENT
       **********
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    860.000     Coefficient  a
      6.500     Constant  b    (min)
       .763     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration    240 min
             51.471 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
      3     line(s) of comment
       **********
       AREA NORTH OF QUAKER
       **********
 4    CATCHMENT
      1.000     ID No.  99999
     15.820     Area in hectares
    325.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    325.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        1.110       .000       .306       .000 c.m/s
         .267       .894       .486     C perv/imperv/total
15    ADD RUNOFF
        1.110      1.110       .306       .000 c.m/s
 4    CATCHMENT
      2.000     ID No.  99999
     13.570     Area in hectares
    301.000     Length (PERV) metres
      1.000     Gradient (%)
     25.000     Per cent Impervious
    301.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         .690      1.110       .306       .000 c.m/s
         .267       .896       .424     C perv/imperv/total
35    COMMENT
      3     line(s) of comment
       ************************
       FLOW AT RICE ROAD
       ************************
15    ADD RUNOFF
         .690      1.800       .306       .000 c.m/s
 4    CATCHMENT
      3.000     ID No.  99999
     14.520     Area in hectares
    311.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    311.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        1.020      1.800       .306       .000 c.m/s
         .267       .896       .487     C perv/imperv/total
15    ADD RUNOFF
        1.020      2.820       .306       .000 c.m/s
 4    CATCHMENT
      4.000     ID No.  99999
     45.500     Area in hectares
    551.000     Length (PERV) metres
      1.000     Gradient (%)
     21.000     Per cent Impervious
    551.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        1.840      2.820       .306       .000 c.m/s
         .267       .896       .399     C perv/imperv/total
15    ADD RUNOFF
        1.840      4.660       .306       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       **********
       AREA SOUTH OF QUAKER
       **********
 4    CATCHMENT
      5.000     ID No.  99999
      5.310     Area in hectares
    188.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    188.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .117      4.660       .306       .000 c.m/s
        .267       .883       .328     C perv/imperv/total
15    ADD RUNOFF
        .117      4.777       .306       .000 c.m/s
 4    CATCHMENT
      6.000     ID No.  99999
     43.410     Area in hectares
    538.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    538.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .784      4.777       .306       .000 c.m/s
        .267       .896       .323     C perv/imperv/total
35    COMMENT
      3     line(s) of comment
       ************************
       TOTAL FLOW AT FIRST AVENUE
       ************************
15    ADD RUNOFF
        .784      5.561       .306       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
        .784      5.561      5.561       .000 c.m/s
17    COMBINE
      1     Junction Node No.
        .784      5.561      5.561      5.561 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       **********
       AREA SOUTH OF QUAKER
       **********
 4    CATCHMENT
      7.000     ID No.  99999
     16.470     Area in hectares
    331.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    331.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .353       .000      5.561      5.561 c.m/s
        .267       .894       .329     C perv/imperv/total
15    ADD RUNOFF
        .353       .353      5.561      5.561 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
        .353       .353       .353      5.561 c.m/s
17    COMBINE
      1     Junction Node No.
        .353       .353       .353      5.914 c.m/s
18    CONFLUENCE
      1     Junction Node No.
        .353      5.914       .353       .000 c.m/s
 4    CATCHMENT
      8.000     ID No.  99999
     42.190     Area in hectares
    530.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .764      5.914       .353       .000 c.m/s
        .267       .896       .323     C perv/imperv/total
35    COMMENT
      3     line(s) of comment
       ****************************
       TOTAL FLOW AT NIAGARA STREET
       ****************************
15    ADD RUNOFF
        .764      6.678       .353       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3783245E+05 c.m
14    START
      1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ***********
        25-YEAR STORM EVENT
        ***********
 2     STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     900.000     Coefficient  a
       5.200     Constant  b    (min)
        .745     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration    240 min
              59.713 mm     Total depth
 3     IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ***********
        AREA NORTH OF QUAKER
        ***********
 4     CATCHMENT
       1.000     ID No.  99999
      15.820     Area in hectares
     325.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     325.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
       1.306        .000       .353       .000 c.m/s
        .308        .910       .519     C perv/imperv/total
15     ADD RUNOFF
       1.306      1.306       .353       .000 c.m/s
 4     CATCHMENT
       2.000     ID No.  99999
      13.570     Area in hectares
     301.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     301.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .793      1.306       .353       .000 c.m/s
        .308       .910       .459     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
        FLOW AT RICE ROAD
        ************************
15     ADD RUNOFF
        .793      2.099       .353       .000 c.m/s
 4     CATCHMENT
       3.000     ID No.  99999
      14.520     Area in hectares
     311.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     311.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
       1.164      2.099       .353       .000 c.m/s
        .308       .910       .519     C perv/imperv/total
15     ADD RUNOFF
       1.164      3.263       .353       .000 c.m/s
 4     CATCHMENT
       4.000     ID No.  99999
      45.500     Area in hectares
     551.000     Length (PERV) metres
       1.000     Gradient (%)
      21.000     Per cent Impervious
     551.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
       2.211      3.263       .353       .000 c.m/s
        .308       .907       .434     C perv/imperv/total
15     ADD RUNOFF
       2.211      5.473       .353       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ***********
        AREA SOUTH OF QUAKER
        ***********
 4     CATCHMENT
       5.000     ID No.  99999
       5.310     Area in hectares
     188.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     188.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .146      5.473       .353       .000 c.m/s
        .308       .892       .367     C perv/imperv/total
15     ADD RUNOFF
        .146      5.619       .353       .000 c.m/s
 4     CATCHMENT
       6.000     ID No.  99999
      43.410     Area in hectares
     538.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     538.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .957      5.619       .353       .000 c.m/s
        .308       .906       .362     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
        TOTAL FLOW AT FIRST AVENUE
        ************************
15     ADD RUNOFF
        .957      6.576       .353       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
        .957      6.576      6.576       .000 c.m/s
17     COMBINE
       1     Junction Node No.
        .957      6.576      6.576      6.576 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        AREA SOUTH OF QUAKER
        ***********
 4     CATCHMENT
       7.000     ID No.  99999
      16.470     Area in hectares
     331.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     331.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .429       .000      6.576      6.576 c.m/s
        .308       .909       .369     C perv/imperv/total
15     ADD RUNOFF
        .429       .429      6.576      6.576 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
        .429       .429       .429      6.576 c.m/s
17     COMBINE
       1     Junction Node No.
        .429       .429       .429      7.005 c.m/s
18     CONFLUENCE
       1     Junction Node No.
        .429      7.005       .429       .000 c.m/s
 4     CATCHMENT
       8.000     ID No.  99999
      42.190     Area in hectares
     530.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     530.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        .933      7.005       .429       .000 c.m/s
        .308       .906       .362     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ****************************
        TOTAL FLOW AT NIAGARA STREET
        ****************************
15     ADD RUNOFF
        .933      7.938       .429       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4820893E+05 c.m
14     START
       1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ************
        100-YEAR STORM EVENT
        *************
 2     STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1020.000     Coefficient  a
       4.700     Constant  b    (min)
        .731     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration    240 min
               73.203 mm     Total depth
 3     IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ***********
        AREA NORTH OF QUAKER
        ***********
 4     CATCHMENT
       1.000     ID No.  99999
      15.820     Area in hectares
     325.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     325.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.566       .000       .429       .000 c.m/s
          .368       .924       .562     C perv/imperv/total
15     ADD RUNOFF
         1.566      1.566       .429       .000 c.m/s
 4     CATCHMENT
       2.000     ID No.  99999
      13.570     Area in hectares
     301.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     301.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .992      1.566       .429       .000 c.m/s
          .367       .923       .506     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
        FLOW AT RICE ROAD
        ************************
15     ADD RUNOFF
          .992      2.558       .429       .000 c.m/s
 4     CATCHMENT
       3.000     ID No.  99999
      14.520     Area in hectares
     311.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     311.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.440      2.558       .429       .000 c.m/s
          .367       .923       .562     C perv/imperv/total
15     ADD RUNOFF
         1.440      3.998       .429       .000 c.m/s
 4     CATCHMENT
       4.000     ID No.  99999
      45.500     Area in hectares
     551.000     Length (PERV) metres
       1.000     Gradient (%)
      21.000     Per cent Impervious
     551.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         2.790      3.998       .429       .000 c.m/s
          .368       .916       .483     C perv/imperv/total
15     ADD RUNOFF
         2.790      6.789       .429       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ***********
        AREA SOUTH OF QUAKER
        ***********
 4     CATCHMENT
       5.000     ID No.  99999
       5.310     Area in hectares
     188.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     188.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .199      6.789       .429       .000 c.m/s
          .367       .904       .421     C perv/imperv/total
15     ADD RUNOFF
          .199      6.987       .429       .000 c.m/s
 4     CATCHMENT
       6.000     ID No.  99999
      43.410     Area in hectares
     538.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     538.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.246      6.987       .429       .000 c.m/s
          .368       .915       .417     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
        TOTAL FLOW AT FIRST AVENUE
        ************************
15     ADD RUNOFF
         1.246      8.233       .429       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
         1.246      8.233      8.233       .000 c.m/s
17     COMBINE
       1     Junction Node No.
         1.246      8.233      8.233      8.233 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        AREA SOUTH OF QUAKER
        ***********
 4     CATCHMENT
       7.000     ID No.  99999
      16.470     Area in hectares
     331.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     331.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .548       .000      8.233      8.233 c.m/s
          .368       .925       .423     C perv/imperv/total
15     ADD RUNOFF
          .548       .548      8.233      8.233 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
          .548       .548       .548      8.233 c.m/s
17     COMBINE
       1     Junction Node No.
          .548       .548       .548      8.781 c.m/s
18     CONFLUENCE
       1     Junction Node No.
          .548      8.781       .548       .000 c.m/s
 4     CATCHMENT
       8.000     ID No.  99999
      42.190     Area in hectares
     530.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     530.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.214      8.781       .548       .000 c.m/s
          .368       .916       .417     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ****************************
        TOTAL FLOW AT NIAGARA STREET
        ****************************
15     ADD RUNOFF
         1.214      9.995       .548       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .6645652E+05 c.m
14     START
       1     1=Zero; 2=Define
```

APPENDIX B

Stormwater Management Facility Calculations (P30)

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, ON, L2W 1A3
PROJECT NAME: **210, 256 & 276 QUAKER ROAD, CITY OF WELLAND**
PROJECT NO.: **1601**

PROPOSED NORTH WET POND CALCULATIONS (POND P30)

Quality Requirements
Drainage Area (ha) = 10.42
Enhanced (m3/ha) = 233
Perm Pool (m3/ha) = 193
Perm Pool Vol (m3) = 2,011
Active Vol (m3) 417
25mm MOE Volume = 1,924
Water Level Elev. = 178.80 m

Quality Orifice
Diameter (m) = 0.135
Cd = 0.63
Invert (m) = 178.80

Outlet Weir
Perimeter Length (m) = 0.60
Inlet Elevation (m) = 180.10

Overflow Spillway
Length (m) = 2.50
Slopes (X:1) = 10.00
Invert (m) = 180.60

Outflow Pipe Orifice
Diameter (m) = 0.450
Cd = 0.65
Invert (m) = 178.80
Obvert (m) = 179.25
Top of Pipe (m) = 179.35

Pond Drawdown Time Calculation (MOE, 2003)
Water Surface Elevation during 25mm Design Storm Event = 179.28
MOE Equation 4.11 Drawdown Coefficient 'C2' = 1,351
MOE Equation 4.11 Drawdown Coefficient 'C3' = 2,711
MOE Equation 4.11 Drawdown Time (h) = **29**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m2)	Average Surface Area (m2)	Increment Volume (m3)	Permanent Volume (m3)	Active Volume (m3)	Quality Orifice (m3/s)	Ditch Inlet (m3/s)	Max Pipe Orifice (m3/s)	Overflow Spillway (m3/s)	Total Outflow (m3/s)	Average Discharge (m3/s)
177.20		-1.60	812			0							
5:1 SLOPE	0.60			1,015	609								
177.80		-1.00	1,218			609							
5:1 SLOPE	0.50			1,410	705								
178.30		-0.50	1,602			1,314							
5:1 SLOPE	0.50			1,814	907								
178.80		**0.00**	**2,026**			**2,221**							
5:1 SLOPE													
178.80		**0.00**	**2,741**				**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
5:1 SLOPE	0.50			3,039	1,520								0.023
179.30		0.50	3,338				1,520	0.026	0.000	0.205	0.000	0.026	
5:1 SLOPE	0.80			3,912	3,130								0.161
180.10		1.30	4,486				4,649	0.044	0.000	0.458	0.000	0.044	
5:1 SLOPE	0.50			4,840	2,420								0.554
180.60		1.80	5,194				7,069	0.052	0.362	0.561	0.000	0.414	
5:1 SLOPE	0.20			5,341	1,068								0.809
180.80		2.00	5,488				8,137	0.055	0.599	0.597	0.607	1.204	

Notes

1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
3. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
4. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

APPENDIX C

Stormwater Management Facility Calculations (P31)

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, ON, L2W 1A3
PROJECT NAME: **210, 256 & 276 QUAKER ROAD, CITY OF WELLAND**
PROJECT NO.: **1601**

PROPOSED SOUTH WET POND CALCULATIONS (POND P31)

Quality Requirements
Drainage Area (ha) = 12.96
Enhanced (m3/ha) = 233
Perm Pool (m3/ha) = 193
Perm Pool Vol (m3) = 2,501
Active Vol (m3) 518
25mm MOE Volume = 2,114
Water Level Elev. = 178.30 m

Quality Orifice
Diameter (m) = 0.150
Cd = 0.63
Invert (m) = 178.30

Outlet Weir
Perimeter Length (m) = 0.60
Inlet Elevation (m) = 179.60

Overflow Spillway
Length (m) = 2.50
Slopes (X:1) = 10.00
Invert (m) = 180.00

Outflow Pipe Orifice
Diameter (m) = 0.450
Cd = 0.65
Invert (m) = 178.30
Obvert (m) = 178.75
Top of Pipe (m) = 178.85

Pond Drawdown Time Calculation (MOE, 2003)
Water Surface Elevation during 25mm Design Storm Event = 178.84
MOE Equation 4.11 Drawdown Coefficient 'C2' = 1,193
MOE Equation 4.11 Drawdown Coefficient 'C3' = 2,819
MOE Equation 4.11 Drawdown Time (h) = **26**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m2)	Average Surface Area (m2)	Increment Volume (m3)	Permanent Volume (m3)	Active Volume (m3)	Quality Orifice (m3/s)	Ditch Inlet (m3/s)	Max Pipe Orifice (m3/s)	Overflow Spillway (m3/s)	Total Outflow (m3/s)	Average Discharge (m3/s)
176.50		-1.80	872			0							
5:1 SLOPE	0.80			1,141	913								
177.30		-1.00	1,409			913							
5:1 SLOPE	1.00			1,821	1,821								
178.30		**0.00**	**2,232**			**2,733**							
178.30		**0.00**	**2,888**				**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
5:1 SLOPE	0.60			3,212	1,927								0.060
178.90		0.60	3,536				1,927	0.035	0.000	0.251	0.000	0.035	
5:1 SLOPE	0.70			3,950	2,765								0.080
179.60		1.30	4,363				4,692	0.054	0.000	0.458	0.000	0.054	
5:1 SLOPE	0.20			4,488	898								0.175
179.80		1.50	4,614				5,590	0.058	0.092	0.502	0.000	0.150	
5:1 SLOPE	0.20			4,742	948								0.798
180.00		1.70	4,870				6,538	0.062	0.259	0.542	0.000	0.321	
5:1 SLOPE	0.30			5,069	1,521								1.121
180.30		2.00	5,267				8,059	0.068	0.599	0.597	1.324	1.922	

Notes

1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
3. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
4. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

APPENDIX D

Future Conditions MIDUSS Output File

Development Conditions with SWM

```
        Output File (4.7) 25MM.OUT     opened 2024-10-16  18:02
        Units used are defined by G =    9.810
           24   144    10.000        are MAXDT MAXHYD & DTMIN values
        Licensee: UPPER CANADA CONSULTANTS
35      COMMENT
       4     line(s) of comment
        STORMWATER MANAGEMENT PLAN
        QUAKER ROAD
        CITY OF WELLAND
        FUTURE CONDITIONS
35      COMMENT
       3     line(s) of comment
        ************************************************************
        25mm STORM EVENT
        ************************************************************
 2      STORM
            1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      512.000     Coefficient  a
        6.000     Constant  b    (min)
         .800     Exponent  c
         .450     Fraction to peak  r
      240.000     Duration ó  240 min
                 25.035 mm     Total depth
 3      IMPERVIOUS
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
35      COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
        *****************
 4      CATCHMENT
       10.000     ID No.ó 99999
        4.050     Area in hectares
      164.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      164.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .264       .000       .000       .000 c.m/s
               .098       .806       .594     C perv/imperv/total
15      ADD RUNOFF
               .264       .264       .000       .000 c.m/s
 4      CATCHMENT
       11.000     ID No.ó 99999
        1.000     Area in hectares
       82.000     Length (PERV) metres
        1.000     Gradient (%)
       10.000     Per cent Impervious
       82.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .009       .264       .000       .000 c.m/s
               .098       .791       .168     C perv/imperv/total
15      ADD RUNOFF
               .009       .273       .000       .000 c.m/s
10      POND
       6 Depth - Discharge - Volume sets
        184.800        .000          .0
        185.750       .0210         1.0
        186.000       .0230       503.0
        186.250       .0260      1091.0
        186.500       .0280      1765.0
        186.700      1.244       2370.0
        Peak Outflow    =      .023 c.m/s
        Maximum Depth   =   185.944 metres
        Maximum Storage =      390. c.m
               .009       .273       .023       .000 c.m/s
14      START
       1     1=Zero; 2=Define
35      COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
        *****************
 4      CATCHMENT
       12.000     ID No.ó 99999
        2.680     Area in hectares
      134.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
      134.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .088       .000       .023       .000 c.m/s
               .098       .801       .344     C perv/imperv/total
15      ADD RUNOFF
               .088       .088       .023       .000 c.m/s
 4      CATCHMENT
       13.000     ID No.ó 99999
        6.980     Area in hectares
      216.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      216.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .461       .088       .023       .000 c.m/s
               .098       .804       .592     C perv/imperv/total
15      ADD RUNOFF
               .461       .549       .023       .000 c.m/s
 4      CATCHMENT
       14.000     ID No.ó 99999
         .670     Area in hectares
       67.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       67.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .036       .549       .023       .000 c.m/s
               .098       .798       .518     C perv/imperv/total
15      ADD RUNOFF
               .036       .584       .023       .000 c.m/s
27      HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1350286E+04 c.m
10      POND
       5 Depth - Discharge - Volume sets
        184.800        .000          .0
        185.300       .0140      1142.0
        186.100       .0240      3519.0
        186.500        .287      4978.0
        186.800       1.922      6222.0
        Peak Outflow    =      .014 c.m/s
        Maximum Depth   =   185.307 metres
        Maximum Storage =     1163. c.m
               .036       .584       .014       .000 c.m/s
14      START
       1     1=Zero; 2=Define
35      COMMENT
       3     line(s) of comment
        **********************
        PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
        **********************
 4      CATCHMENT
       40.000     ID No.ó 99999
        8.210     Area in hectares
      234.000     Length (PERV) metres
        1.000     Gradient (%)
       25.000     Per cent Impervious
      234.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .193       .000       .014       .000 c.m/s
               .098       .800       .274     C perv/imperv/total
15      ADD RUNOFF
               .193       .193       .014       .000 c.m/s
 9      ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .193       .193       .193       .000 c.m/s
17      COMBINE
       2     Junction Node No.
               .193       .193       .193       .193 c.m/s
14      START
       1     1=Zero; 2=Define
 4      CATCHMENT
       41.000     ID No.ó 99999
         .690     Area in hectares
       68.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
       68.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .022       .000       .193       .193 c.m/s
               .098       .798       .343     C perv/imperv/total
15      ADD RUNOFF
               .022       .022       .193       .193 c.m/s
 4      CATCHMENT
       42.000     ID No.ó 99999
```

```
 12.640     Area in hectares
290.000     Length (PERV) metres
  1.000     Gradient (%)
 70.000     Per cent Impervious
290.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .809       .022       .193       .193 c.m/s
          .098       .800       .590     C perv/imperv/total
15   ADD RUNOFF
          .809       .831       .193       .193 c.m/s
 9   ROUTE
   .000     Conduit Length
   .000     No Conduit defined
   .000     Zero lag
   .000     Beta weighting factor
   .000     Routing timestep
      0     No. of sub-reaches
          .809       .831       .831       .193 c.m/s
17   COMBINE
 2     Junction Node No.
          .809       .831       .831      1.024 c.m/s
14   START
 1     1=Zero; 2=Define
 4   CATCHMENT
 43.000     ID No.ó 99999
   .330     Area in hectares
 47.000     Length (PERV) metres
  1.000     Gradient (%)
 35.000     Per cent Impervious
 47.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .011       .000       .831      1.024 c.m/s
          .098       .798       .343     C perv/imperv/total
15   ADD RUNOFF
          .011       .011       .831      1.024 c.m/s
 4   CATCHMENT
 44.000     ID No.ó 99999
  6.400     Area in hectares
207.000     Length (PERV) metres
  1.000     Gradient (%)
 70.000     Per cent Impervious
207.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .424       .011       .831      1.024 c.m/s
          .098       .805       .593     C perv/imperv/total
15   ADD RUNOFF
          .424       .433       .831      1.024 c.m/s
 9   ROUTE
   .000     Conduit Length
   .000     No Conduit defined
   .000     Zero lag
   .000     Beta weighting factor
   .000     Routing timestep
      0     No. of sub-reaches
          .424       .433       .433      1.024 c.m/s
17   COMBINE
 2     Junction Node No.
          .424       .433       .433      1.457 c.m/s
14   START
 1     1=Zero; 2=Define
18   CONFLUENCE
 2     Junction Node No.
          .424      1.457       .433       .000 c.m/s
 4   CATCHMENT
 45.000     ID No.ó 99999
  1.030     Area in hectares
 83.000     Length (PERV) metres
  1.000     Gradient (%)
 60.000     Per cent Impervious
 83.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .056      1.457       .433       .000 c.m/s
          .098       .791       .514     C perv/imperv/total
15   ADD RUNOFF
          .056      1.513       .433       .000 c.m/s
27   HYDROGRAPH DISPLAY
 5     is # of Hyeto/Hydrograph chosen
  Volume  =  .3593299E+04 c.m
10   POND
 6 Depth - Discharge - Volume sets
  186.000        .000          .0
  186.800       .0550      4048.0
  187.300       .0730      7091.0
  187.500        .170      8424.0
  187.800        .257     10552.0
  188.000        .880     12094.0
  Peak Outflow    =      .041 c.m/s
  Maximum Depth   =   186.594 metres
  Maximum Storage =     3005. c.m
          .056      1.513       .041       .000 c.m/s
14   START
 1     1=Zero; 2=Define
35   COMMENT
 3     line(s) of comment
  **********
  PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
  **********
 4   CATCHMENT
 52.000     ID No.ó 99999
  6.430     Area in hectares
207.000     Length (PERV) metres
  1.000     Gradient (%)
 70.000     Per cent Impervious
207.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .426       .000       .041       .000 c.m/s
          .098       .805       .593     C perv/imperv/total
15   ADD RUNOFF
          .426       .426       .041       .000 c.m/s
 9   ROUTE
   .000     Conduit Length
   .000     No Conduit defined
   .000     Zero lag
   .000     Beta weighting factor
   .000     Routing timestep
      0     No. of sub-reaches
          .426       .426       .426       .000 c.m/s
17   COMBINE
 2     Junction Node No.
          .426       .426       .426       .426 c.m/s
14   START
 1     1=Zero; 2=Define
 4   CATCHMENT
 53.000     ID No.ó 99999
 11.340     Area in hectares
275.000     Length (PERV) metres
  1.000     Gradient (%)
 70.000     Per cent Impervious
275.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .731       .000       .426       .426 c.m/s
          .098       .798       .588     C perv/imperv/total
15   ADD RUNOFF
          .731       .731       .426       .426 c.m/s
 9   ROUTE
   .000     Conduit Length
   .000     No Conduit defined
   .000     Zero lag
   .000     Beta weighting factor
   .000     Routing timestep
      0     No. of sub-reaches
          .731       .731       .731       .426 c.m/s
17   COMBINE
 2     Junction Node No.
          .731       .731       .731      1.157 c.m/s
18   CONFLUENCE
 2     Junction Node No.
          .731      1.157       .731       .000 c.m/s
 4   CATCHMENT
 54.000     ID No.ó 99999
  1.280     Area in hectares
 92.000     Length (PERV) metres
  1.000     Gradient (%)
 60.000     Per cent Impervious
 92.000     Length (IMPERV)
   .000     %Imp. with Zero Dpth
      1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
   .250     Manning "n"
 74.000     SCS Curve No or C
   .100     Ia/S Coefficient
  8.924     Initial Abstraction
      1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .070      1.157       .731       .000 c.m/s
          .098       .786       .511     C perv/imperv/total
15   ADD RUNOFF
          .070      1.227       .731       .000 c.m/s
27   HYDROGRAPH DISPLAY
 5     is # of Hyeto/Hydrograph chosen
  Volume  =  .2781534E+04 c.m
10   POND
 6 Depth - Discharge - Volume sets
  182.000        .000          .0
  182.800       .0190      5251.0
  183.150       .0230      7895.0
  183.500        .238     10751.0
  183.800        .396     13425.0
  184.000       1.028     15337.0
  Peak Outflow    =      .009 c.m/s
  Maximum Depth   =   182.397 metres
  Maximum Storage =     2607. c.m
          .070      1.227       .009       .000 c.m/s
14   START
```

```
      1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
        ***********
 4     CATCHMENT
       30.000     ID No.ó 99999
        8.470     Area in hectares
      238.000     Length (PERV) metres
         .200     Gradient (%)
         .100     Per cent Impervious
      238.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .007       .000       .009       .000 c.m/s
                .098       .803       .099     C perv/imperv/total
15     ADD RUNOFF
                .007       .007       .009       .000 c.m/s
 4     CATCHMENT
       31.000     ID No.ó 99999
       10.420     Area in hectares
      264.000     Length (PERV) metres
         .000     Gradient (%)
       75.000     Per cent Impervious
      264.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .723       .007       .009       .000 c.m/s
                .098       .798       .623     C perv/imperv/total
15     ADD RUNOFF
                .723       .724       .009       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1834827E+04 c.m
 4     CATCHMENT
       32.000     ID No.ó 99999
         .690     Area in hectares
       68.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       68.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .037       .724       .009       .000 c.m/s
                .098       .798       .518     C perv/imperv/total
15     ADD RUNOFF
                .037       .760       .009       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1924289E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
        178.800        .000          .0
        179.300       .0260      1520.0
        180.100       .0440      4649.0
        180.600        .414      7069.0
        180.800       1.204      8137.0
        Peak Outflow    =      .025 c.m/s
        Maximum Depth   =   179.280 metres
        Maximum Storage =     1460. c.m
                .037       .760       .025       .000 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
        ***********
 4     CATCHMENT
       33.000     ID No.ó 99999
       12.960     Area in hectares
      294.000     Length (PERV) metres
        1.000     Gradient (%)
       75.000     Per cent Impervious
      294.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .887       .000       .025       .000 c.m/s
                .098       .801       .625     C perv/imperv/total
15     ADD RUNOFF
                .887       .887       .025       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .2028780E+04 c.m
 4     CATCHMENT
       34.000     ID No.ó 99999
         .660     Area in hectares
       66.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       66.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .036       .887       .025       .000 c.m/s
                .098       .798       .518     C perv/imperv/total
15     ADD RUNOFF
                .036       .922       .025       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .2114417E+04 c.m
10     POND
       6 Depth - Discharge - Volume sets
        178.300        .000          .0
        178.900       .0350      1927.0
        179.600       .0540      4692.0
        179.800        .150      5590.0
        180.000        .321      6538.0
        180.300       1.922      8059.0
        Peak Outflow    =      .032 c.m/s
        Maximum Depth   =   178.844 metres
        Maximum Storage =     1746. c.m
                .036       .922       .032       .000 c.m/s
14     START
       1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ************************************************************
        2-YEAR STORM EVENT
        ************************************************************
 2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      755.000     Coefficient  a
        8.000     Constant  b    (min)
         .789     Exponent  c
         .450     Fraction to peak  r
      240.000     Duration ó  240 min
                38.971 mm     Total depth
 3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015     Manning "n"
       98.000     SCS Curve No or C
         .100     Ia/S Coefficient
         .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ******************
        EXISTING RES. WEST OF SEGMENT 1
        ******************
 4     CATCHMENT
        1.000     ID No.ó 99999
       17.520     Area in hectares
      343.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
      343.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .896       .000       .000       .000 c.m/s
               .194       .857       .426     C perv/imperv/total
15     ADD RUNOFF
               .896       .896       .000       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
      100.000     ID No.ó 99999
        2.020     Area in hectares
      116.000     Length (PERV) metres
         .400     Gradient (%)
       15.000     Per cent Impervious
      116.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .046       .896       .000       .000 c.m/s
               .194       .862       .294     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        *****************
        FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
        *****************
15     ADD RUNOFF
               .046       .941       .000       .000 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
           0     No. of sub-reaches
               .046       .941       .941       .000 c.m/s
17     COMBINE
       1     Junction Node No.
               .046       .941       .941       .941 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
        *****************
 4     CATCHMENT
       10.000     ID No.ó 99999
        4.050     Area in hectares
      164.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      164.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .406       .000       .941       .941 c.m/s
               .194       .857       .658     C perv/imperv/total
15     ADD RUNOFF
               .406       .406       .941       .941 c.m/s
 4     CATCHMENT
       11.000     ID No.ó 99999
        1.000     Area in hectares
       82.000     Length (PERV) metres
        1.000     Gradient (%)
       10.000     Per cent Impervious
       82.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .015       .406       .941       .941 c.m/s
               .194       .858       .261     C perv/imperv/total
15     ADD RUNOFF
               .015       .422       .941       .941 c.m/s
10     POND
       6 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.750       .0210         1.0
       186.000       .0230       503.0
       186.250       .0260      1091.0
       186.500       .0280      1765.0
       186.700      1.244       2370.0
       Peak Outflow    =      .025 c.m/s
       Maximum Depth   =   186.128 metres
       Maximum Storage =      803. c.m
               .015       .422       .025       .941 c.m/s
17     COMBINE
       1     Junction Node No.
               .015       .422       .025       .963 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
               .015       .963       .025       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
      101.000     ID No.ó 99999
         .610     Area in hectares
       64.000     Length (PERV) metres
        1.000     Gradient (%)
       10.000     Per cent Impervious
       64.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .010       .963       .025       .000 c.m/s
               .194       .855       .260     C perv/imperv/total
15     ADD RUNOFF
               .010       .972       .025       .000 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
           0     No. of sub-reaches
               .010       .972       .972       .000 c.m/s
17     COMBINE
       1     Junction Node No.
               .010       .972       .972       .972 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
        *****************
 4     CATCHMENT
       12.000     ID No.ó 99999
        2.680     Area in hectares
      134.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
      134.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .134       .000       .972       .972 c.m/s
               .194       .850       .424     C perv/imperv/total
15     ADD RUNOFF
               .134       .134       .972       .972 c.m/s
 4     CATCHMENT
       13.000     ID No.ó 99999
        6.980     Area in hectares
      216.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      216.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .704       .134       .972       .972 c.m/s
```

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            .194       .867       .665     C perv/imperv/total
15    ADD RUNOFF
            .704       .838       .972       .972 c.m/s
 4    CATCHMENT
      14.000     ID No.ó 99999
        .670     Area in hectares
      67.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      67.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .060       .838       .972       .972 c.m/s
            .194       .856       .592     C perv/imperv/total
15    ADD RUNOFF
            .060       .889       .972       .972 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2406793E+04 c.m
10    POND
      5 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.300       .0140      1142.0
       186.100       .0240      3519.0
       186.500        .287      4978.0
       186.800       1.922      6222.0
       Peak Outflow    =      .018 c.m/s
       Maximum Depth   =   185.633 metres
       Maximum Storage =     2132. c.m
            .060       .889       .018       .972 c.m/s
35    COMMENT
      3     line(s) of comment
       *****************
       FLOW U/S OF RICE RD CULVERT - OUTLET A1
       *****************
17    COMBINE
      1     Junction Node No.
            .060       .889       .018       .983 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
       ***********************
 4    CATCHMENT
      40.000     ID No.ó 99999
       8.210     Area in hectares
     234.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     234.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .300       .000       .018       .983 c.m/s
            .194       .868       .363     C perv/imperv/total
15    ADD RUNOFF
            .300       .300       .018       .983 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .300       .300       .300       .983 c.m/s
17    COMBINE
      2     Junction Node No.
            .300       .300       .300       .300 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      41.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .036       .000       .300       .300 c.m/s
            .194       .857       .426     C perv/imperv/total
15    ADD RUNOFF
            .036       .036       .300       .300 c.m/s
 4    CATCHMENT
      42.000     ID No.ó 99999
      12.640     Area in hectares
     290.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     290.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.302       .036       .300       .300 c.m/s
            .194       .863       .662     C perv/imperv/total
15    ADD RUNOFF
         1.302      1.333       .300       .300 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
         1.302      1.333      1.333       .300 c.m/s
17    COMBINE
      2     Junction Node No.
         1.302      1.333      1.333      1.633 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      43.000     ID No.ó 99999
        .330     Area in hectares
      47.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      47.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .018       .000      1.333      1.633 c.m/s
            .194       .858       .426     C perv/imperv/total
15    ADD RUNOFF
            .018       .018      1.333      1.633 c.m/s
 4    CATCHMENT
      44.000     ID No.ó 99999
       6.400     Area in hectares
     207.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     207.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .646       .018      1.333      1.633 c.m/s
            .194       .866       .665     C perv/imperv/total
15    ADD RUNOFF
            .646       .660      1.333      1.633 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .646       .660       .660      1.633 c.m/s
17    COMBINE
      2     Junction Node No.
            .646       .660       .660      2.293 c.m/s
14    START
      1     1=Zero; 2=Define
18    CONFLUENCE
      2     Junction Node No.
            .646      2.293       .660       .000 c.m/s
 4    CATCHMENT
      45.000     ID No.ó 99999
       1.030     Area in hectares
      83.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      83.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .088      2.293       .660       .000 c.m/s
            .194       .857       .592     C perv/imperv/total
15    ADD RUNOFF
            .088      2.374       .660       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .6483683E+04 c.m
10    POND
      6 Depth - Discharge - Volume sets
       186.000        .000          .0
       186.800       .0550      4048.0
       187.300       .0730      7091.0
       187.500        .170      8424.0
       187.800        .257     10552.0
       188.000        .880     12094.0
       Peak Outflow    =      .064 c.m/s
       Maximum Depth   =   187.039 metres
       Maximum Storage =     5502. c.m
            .088      2.374       .064       .000 c.m/s
17    COMBINE
      2     Junction Node No.
            .088      2.374       .064       .064 c.m/s
```

```
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       2.000     ID No.ó 99999
       9.020     Area in hectares
     245.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     245.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .520       .000       .064       .064 c.m/s
              .194       .868       .464     C perv/imperv/total
15     ADD RUNOFF
              .520       .520       .064       .064 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .520       .520       .520       .064 c.m/s
17     COMBINE
       2     Junction Node No.
              .520       .520       .520       .548 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
              .520       .548       .520       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       3.000     ID No.ó 99999
       5.680     Area in hectares
     195.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     195.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .330       .548       .520       .000 c.m/s
              .194       .865       .462     C perv/imperv/total
15     ADD RUNOFF
              .330       .878       .520       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .330       .878       .878       .000 c.m/s
17     COMBINE
       2     Junction Node No.
              .330       .878       .878       .878 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
        **********************
 4     CATCHMENT
      50.000     ID No.ó 99999
       3.420     Area in hectares
     151.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     151.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .053       .000       .878       .878 c.m/s
              .194       .854       .260     C perv/imperv/total
15     ADD RUNOFF
              .053       .053       .878       .878 c.m/s
 4     CATCHMENT
      51.000     ID No.ó 99999
       1.980     Area in hectares
     115.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     115.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .031       .053       .878       .878 c.m/s
              .194       .850       .260     C perv/imperv/total
15     ADD RUNOFF
              .031       .084       .878       .878 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .031       .084       .084       .878 c.m/s
17     COMBINE
       2     Junction Node No.
              .031       .084       .084       .962 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
        **********************
 4     CATCHMENT
       4.000     ID No.ó 99999
      13.940     Area in hectares
     305.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     305.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .822       .000       .084       .962 c.m/s
              .194       .862       .461     C perv/imperv/total
15     ADD RUNOFF
              .822       .822       .084       .962 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .822       .822       .822       .962 c.m/s
17     COMBINE
       2     Junction Node No.
              .822       .822       .822      1.784 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
              .822      1.784       .822       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
        *****************
 4     CATCHMENT
     501.000     ID No.ó 99999
       1.570     Area in hectares
     102.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     102.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .149      1.784       .822       .000 c.m/s
              .194       .854       .656     C perv/imperv/total
15     ADD RUNOFF
              .149      1.933       .822       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .149      1.933      1.933       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW D/S OF RICE RD CULVERT - OUTLET A2
        *****************
17     COMBINE
       1     Junction Node No.
              .149      1.933      1.933      2.916 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
        *****************
 4     CATCHMENT
      20.100     ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .040       .000      1.933      2.916 c.m/s
            .194       .857       .426     C perv/imperv/total
15   ADD RUNOFF
            .040       .040      1.933      2.916 c.m/s
 4   CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .386       .040      1.933      2.916 c.m/s
            .194       .854       .755     C perv/imperv/total
15   ADD RUNOFF
            .386       .422      1.933      2.916 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .386       .422       .422      2.916 c.m/s
17   COMBINE
    1     Junction Node No.
            .386       .422       .422      3.338 c.m/s
14   START
    1     1=Zero; 2=Define
18   CONFLUENCE
    1     Junction Node No.
            .386      3.338       .422       .000 c.m/s
35   COMMENT
    3     line(s) of comment
     *****************
     REALIGNED CHANNEL - SEGMENT 2
     *****************
 4   CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .015      3.338       .422       .000 c.m/s
            .194       .858       .261     C perv/imperv/total
35   COMMENT
    3     line(s) of comment
     *****************
     FLOW D/S OF AREA A20 - OUTLET B
     *****************
15   ADD RUNOFF
            .015      3.353       .422       .000 c.m/s
35   COMMENT
    3     line(s) of comment
     ***********************
     EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
     ***********************
 4   CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .181      3.353       .422       .000 c.m/s
            .194       .867       .228     C perv/imperv/total
15   ADD RUNOFF
            .181      3.489       .422       .000 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .181      3.489      3.489       .000 c.m/s
35   COMMENT
    3     line(s) of comment
     ***********************
     FLOW U/S OF FIRST AVE CULVERT
     ***********************
17   COMBINE
    1     Junction Node No.
            .181      3.489      3.489      3.489 c.m/s
14   START
    1     1=Zero; 2=Define
35   COMMENT
    3     line(s) of comment
     ***********
     PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
     ***********
 4   CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .649       .000      3.489      3.489 c.m/s
            .194       .866       .665     C perv/imperv/total
15   ADD RUNOFF
            .649       .649      3.489      3.489 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .649       .649       .649      3.489 c.m/s
17   COMBINE
    2     Junction Node No.
            .649       .649       .649       .649 c.m/s
14   START
    1     1=Zero; 2=Define
 4   CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.171       .000       .649       .649 c.m/s
            .194       .865       .664     C perv/imperv/total
15   ADD RUNOFF
          1.171      1.171       .649       .649 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          1.171      1.171      1.171       .649 c.m/s
17   COMBINE
    2     Junction Node No.
          1.171      1.171      1.171      1.820 c.m/s
18   CONFLUENCE
    2     Junction Node No.
          1.171      1.820      1.171       .000 c.m/s
 4   CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .107      1.820      1.171       .000 c.m/s
            .194       .857       .592     C perv/imperv/total
15   ADD RUNOFF
            .107      1.923      1.171       .000 c.m/s
27   HYDROGRAPH DISPLAY
    5     is # of Hyeto/Hydrograph chosen
     Volume  =  .4892284E+04 c.m
10   POND
    6 Depth - Discharge - Volume sets
     182.000        .000          .0
     182.800       .0190      5251.0
     183.150       .0230      7895.0
     183.500        .238     10751.0
     183.800        .396     13425.0
     184.000       1.028     15337.0
     Peak Outflow    =      .017 c.m/s
     Maximum Depth   =   182.699 metres
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       Maximum Storage =     4589. c.m
             .107      1.923       .017       .000 c.m/s
17     COMBINE
       2     Junction Node No.
             .107      1.923       .017       .017 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ************************
       EXISTING AREA ON QUAKER RD, EAST OF RICE RD
        ************************
 4     CATCHMENT
       5.000     ID No.ó 99999
       1.870     Area in hectares
     112.000     Length (PERV) metres
       1.000     Gradient (%)
      50.000     Per cent Impervious
     112.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .130       .000       .017       .017 c.m/s
          .194       .851       .522     C perv/imperv/total
15     ADD RUNOFF
          .130       .130       .017       .017 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .130       .130       .130       .017 c.m/s
17     COMBINE
       2     Junction Node No.
             .130       .130       .130       .136 c.m/s
18     CONFLUENCE
       2     Junction Node No.
             .130       .136       .130       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ************************
       EXISTING AREA ON QUAKER RD, EAST OF RICE RD
        ************************
 4     CATCHMENT
       6.000     ID No.ó 99999
       1.920     Area in hectares
     113.000     Length (PERV) metres
        .200     Gradient (%)
      65.000     Per cent Impervious
     113.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .185       .136       .130       .000 c.m/s
          .194       .867       .631     C perv/imperv/total
15     ADD RUNOFF
          .185       .321       .130       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ***********
       FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
        ***********
 4     CATCHMENT
     201.000     ID No.ó 99999
       2.430     Area in hectares
     127.000     Length (PERV) metres
       1.000     Gradient (%)
      65.000     Per cent Impervious
     127.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .221       .321       .130       .000 c.m/s
          .194       .848       .619     C perv/imperv/total
15     ADD RUNOFF
          .221       .542       .130       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .221       .542       .542       .000 c.m/s
17     COMBINE
       1     Junction Node No.
             .221       .542       .542      4.031 c.m/s
35     COMMENT
       3     line(s) of comment
        ************************
       FLOW D/S OF FIRST AVE CULVERT - OUTLET C
        ************************
18     CONFLUENCE
       1     Junction Node No.
             .221      4.031       .542       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ***********
       REALIGNED CHANNEL - SEGMENT 3
        ***********
 4     CATCHMENT
     300.000     ID No.ó 99999
       3.180     Area in hectares
     146.000     Length (PERV) metres
        .200     Gradient (%)
      15.000     Per cent Impervious
     146.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .071      4.031       .542       .000 c.m/s
          .194       .859       .294     C perv/imperv/total
15     ADD RUNOFF
          .071      4.102       .542       .000 c.m/s
 4     CATCHMENT
     301.000     ID No.ó 99999
        .720     Area in hectares
      69.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
      69.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .011      4.102       .542       .000 c.m/s
          .194       .855       .260     C perv/imperv/total
15     ADD RUNOFF
          .011      4.113       .542       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .011      4.113      4.113       .000 c.m/s
17     COMBINE
       1     Junction Node No.
             .011      4.113      4.113      4.113 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
       PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
        ***********
 4     CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .035       .000      4.113      4.113 c.m/s
          .194       .867       .195     C perv/imperv/total
15     ADD RUNOFF
          .035       .035      4.113      4.113 c.m/s
 4     CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.154       .035      4.113      4.113 c.m/s
          .194       .866       .698     C perv/imperv/total
15     ADD RUNOFF
         1.154      1.158      4.113      4.113 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .3477034E+04 c.m
 4     CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

```
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .061      1.158      4.113      4.113 c.m/s
          .194       .857       .592     C perv/imperv/total
15   ADD RUNOFF
          .061      1.210      4.113      4.113 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .3636135E+04 c.m
10   POND
     5 Depth - Discharge - Volume sets
      178.800        .000          .0
      179.300       .0260      1520.0
      180.100       .0440      4649.0
      180.600        .414      7069.0
      180.800       1.204      8137.0
      Peak Outflow    =      .034 c.m/s
      Maximum Depth   =   179.642 metres
      Maximum Storage =     2856. c.m
          .061      1.210       .034      4.113 c.m/s
17   COMBINE
     1     Junction Node No.
          .061      1.210       .034      4.131 c.m/s
14   START
     1     1=Zero; 2=Define
35   COMMENT
     3     line(s) of comment
      ***********
      PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
      ***********
 4   CATCHMENT
     33.000     ID No.ó 99999
     12.960     Area in hectares
    294.000     Length (PERV) metres
      1.000     Gradient (%)
     75.000     Per cent Impervious
    294.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        1.428       .000       .034      4.131 c.m/s
         .194       .863       .696     C perv/imperv/total
15   ADD RUNOFF
        1.428      1.428       .034      4.131 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .3513004E+04 c.m
 4   CATCHMENT
     34.000     ID No.ó 99999
      .660     Area in hectares
     66.000     Length (PERV) metres
      1.000     Gradient (%)
     60.000     Per cent Impervious
     66.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .059      1.428       .034      4.131 c.m/s
          .194       .856       .591     C perv/imperv/total
15   ADD RUNOFF
          .059      1.478       .034      4.131 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .3665095E+04 c.m
10   POND
     6 Depth - Discharge - Volume sets
      178.300        .000          .0
      178.900       .0350      1927.0
      179.600       .0540      4692.0
      179.800        .150      5590.0
      180.000        .321      6538.0
      180.300       1.922      8059.0
      Peak Outflow    =      .043 c.m/s
      Maximum Depth   =   179.201 metres
      Maximum Storage =     3116. c.m
          .059      1.478       .043      4.131 c.m/s
17   COMBINE
     1     Junction Node No.
          .059      1.478       .043      4.153 c.m/s
14   START
     1     1=Zero; 2=Define
18   CONFLUENCE
     1     Junction Node No.
          .059      4.153       .043       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ************************
      REALIGNED CHANNEL - SEGMENT 3
      ************************
 4   CATCHMENT
    302.000     ID No.ó 99999
      1.610     Area in hectares
    104.000     Length (PERV) metres
       .200     Gradient (%)
     10.000     Per cent Impervious
    104.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .024      4.153       .043       .000 c.m/s
          .194       .868       .262     C perv/imperv/total
35   COMMENT
     3     line(s) of comment
      ************************
      FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
      ************************
15   ADD RUNOFF
          .024      4.177       .043       .000 c.m/s
14   START
     1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ************************************************************
       5-YEAR STORM EVENT
        ************************************************************
 2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     830.000     Coefficient  a
       7.300     Constant  b    (min)
        .777     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration ó  240 min
               45.874 mm     Total depth
 3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ******************
       EXISTING RES. WEST OF SEGMENT 1
        ******************
 4     CATCHMENT
       1.000     ID No.ó 99999
      17.520     Area in hectares
     343.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     343.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.082       .000       .000       .000 c.m/s
          .236       .879       .461     C perv/imperv/total
15     ADD RUNOFF
         1.082     1.082       .000       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     100.000     ID No.ó 99999
       2.020     Area in hectares
     116.000     Length (PERV) metres
        .400     Gradient (%)
      15.000     Per cent Impervious
     116.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .055     1.082       .000       .000 c.m/s
          .236       .874       .332     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
        *****************
15     ADD RUNOFF
          .055     1.137       .000       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .055     1.137     1.137       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .055     1.137     1.137     1.137 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
        *****************
 4     CATCHMENT
      10.000     ID No.ó 99999
       4.050     Area in hectares
     164.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     164.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .477       .000     1.137     1.137 c.m/s
          .236       .871       .681     C perv/imperv/total
15     ADD RUNOFF
          .477       .477     1.137     1.137 c.m/s
 4     CATCHMENT
      11.000     ID No.ó 99999
       1.000     Area in hectares
      82.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      82.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .020       .477     1.137     1.137 c.m/s
          .235       .875       .299     C perv/imperv/total
15     ADD RUNOFF
          .020       .497     1.137     1.137 c.m/s
10     POND
       6 Depth - Discharge - Volume sets
       184.800       .000         .0
       185.750      .0210        1.0
       186.000      .0230      503.0
       186.250      .0260     1091.0
       186.500      .0280     1765.0
       186.700     1.244     2370.0
       Peak Outflow    =      .026 c.m/s
       Maximum Depth   =   186.226 metres
       Maximum Storage =     1035. c.m
          .020       .497       .026     1.137 c.m/s
17     COMBINE
       1     Junction Node No.
          .020       .497       .026     1.160 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
          .020     1.160       .026       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     101.000     ID No.ó 99999
        .610     Area in hectares
      64.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      64.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .012     1.160       .026       .000 c.m/s
          .235       .873       .299     C perv/imperv/total
15     ADD RUNOFF
          .012     1.172       .026       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .012     1.172     1.172       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .012     1.172     1.172     1.172 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
        *****************
 4     CATCHMENT
      12.000     ID No.ó 99999
       2.680     Area in hectares
     134.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     134.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .159       .000     1.172     1.172 c.m/s
          .236       .866       .456     C perv/imperv/total
15     ADD RUNOFF
          .159       .159     1.172     1.172 c.m/s
 4     CATCHMENT
      13.000     ID No.ó 99999
       6.980     Area in hectares
     216.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     216.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .835       .159     1.172     1.172 c.m/s
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            .236       .882       .688     C perv/imperv/total
15    ADD RUNOFF
            .835       .994      1.172      1.172 c.m/s
 4    CATCHMENT
      14.000     ID No.ó 99999
        .670     Area in hectares
      67.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      67.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .072       .994      1.172      1.172 c.m/s
           .235       .873       .618     C perv/imperv/total
15    ADD RUNOFF
            .072      1.052      1.172      1.172 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2954374E+04 c.m
10    POND
      5 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.300       .0140      1142.0
       186.100       .0240      3519.0
       186.500        .287      4978.0
       186.800       1.922      6222.0
       Peak Outflow    =      .020 c.m/s
       Maximum Depth   =   185.805 metres
       Maximum Storage =     2641. c.m
            .072      1.052       .020      1.172 c.m/s
35    COMMENT
      3     line(s) of comment
       *****************
       FLOW U/S OF RICE RD CULVERT - OUTLET A1
       *****************
17    COMBINE
      1     Junction Node No.
            .072      1.052       .020      1.185 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
       ***********************
 4    CATCHMENT
      40.000     ID No.ó 99999
       8.210     Area in hectares
     234.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     234.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .361       .000       .020      1.185 c.m/s
           .236       .884       .398     C perv/imperv/total
15    ADD RUNOFF
            .361       .361       .020      1.185 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .361       .361       .361      1.185 c.m/s
17    COMBINE
      2     Junction Node No.
            .361       .361       .361       .361 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      41.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .044       .000       .361       .361 c.m/s
           .236       .873       .459     C perv/imperv/total
15    ADD RUNOFF
            .044       .044       .361       .361 c.m/s
 4    CATCHMENT
      42.000     ID No.ó 99999
      12.640     Area in hectares
     290.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     290.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             1.556       .044       .361       .361 c.m/s
              .236       .884       .690     C perv/imperv/total
15    ADD RUNOFF
            1.556      1.594       .361       .361 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            1.556      1.594      1.594       .361 c.m/s
17    COMBINE
      2     Junction Node No.
            1.556      1.594      1.594      1.955 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      43.000     ID No.ó 99999
        .330     Area in hectares
      47.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      47.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .022       .000      1.594      1.955 c.m/s
              .236       .875       .460     C perv/imperv/total
15    ADD RUNOFF
              .022       .022      1.594      1.955 c.m/s
 4    CATCHMENT
      44.000     ID No.ó 99999
       6.400     Area in hectares
     207.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     207.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .765       .022      1.594      1.955 c.m/s
              .236       .880       .687     C perv/imperv/total
15    ADD RUNOFF
              .765       .782      1.594      1.955 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .765       .782       .782      1.955 c.m/s
17    COMBINE
      2     Junction Node No.
              .765       .782       .782      2.737 c.m/s
14    START
      1     1=Zero; 2=Define
18    CONFLUENCE
      2     Junction Node No.
              .765      2.737       .782       .000 c.m/s
 4    CATCHMENT
      45.000     ID No.ó 99999
       1.030     Area in hectares
      83.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      83.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .107      2.737       .782       .000 c.m/s
              .236       .876       .620     C perv/imperv/total
15    ADD RUNOFF
              .107      2.832       .782       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .8023741E+04 c.m
10    POND
      6 Depth - Discharge - Volume sets
       186.000        .000          .0
       186.800       .0550      4048.0
       187.300       .0730      7091.0
       187.500        .170      8424.0
       187.800        .257     10552.0
       188.000        .880     12094.0
       Peak Outflow    =      .072 c.m/s
       Maximum Depth   =   187.266 metres
       Maximum Storage =     6887. c.m
              .107      2.832       .072       .000 c.m/s
17    COMBINE
      2     Junction Node No.
              .107      2.832       .072       .072 c.m/s
```

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14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
        2.000     ID No.ó 99999
        9.020     Area in hectares
      245.000     Length (PERV) metres
        1.000     Gradient (%)
       40.000     Per cent Impervious
      245.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .624       .000       .072       .072 c.m/s
               .236       .885       .496     C perv/imperv/total
15     ADD RUNOFF
               .624       .624       .072       .072 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .624       .624       .624       .072 c.m/s
17     COMBINE
       2     Junction Node No.
               .624       .624       .624       .660 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
               .624       .660       .624       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
        3.000     ID No.ó 99999
        5.680     Area in hectares
      195.000     Length (PERV) metres
        1.000     Gradient (%)
       40.000     Per cent Impervious
      195.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .392       .660       .624       .000 c.m/s
               .236       .877       .492     C perv/imperv/total
15     ADD RUNOFF
               .392      1.052       .624       .000 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .392      1.052      1.052       .000 c.m/s
17     COMBINE
       2     Junction Node No.
               .392      1.052      1.052      1.052 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
        **********************
 4     CATCHMENT
       50.000     ID No.ó 99999
        3.420     Area in hectares
      151.000     Length (PERV) metres
        1.000     Gradient (%)
       10.000     Per cent Impervious
      151.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .066       .000      1.052      1.052 c.m/s
               .236       .868       .299     C perv/imperv/total
15     ADD RUNOFF
               .066       .066      1.052      1.052 c.m/s
 4     CATCHMENT
       51.000     ID No.ó 99999
        1.980     Area in hectares
      115.000     Length (PERV) metres
        1.000     Gradient (%)
       10.000     Per cent Impervious
      115.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .039       .066      1.052      1.052 c.m/s
               .236       .872       .299     C perv/imperv/total
15     ADD RUNOFF
               .039       .104      1.052      1.052 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .039       .104       .104      1.052 c.m/s
17     COMBINE
       2     Junction Node No.
               .039       .104       .104      1.156 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
        **********************
 4     CATCHMENT
        4.000     ID No.ó 99999
       13.940     Area in hectares
      305.000     Length (PERV) metres
        1.000     Gradient (%)
       40.000     Per cent Impervious
      305.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .988       .000       .104      1.156 c.m/s
               .236       .883       .495     C perv/imperv/total
15     ADD RUNOFF
               .988       .988       .104      1.156 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .988       .988       .988      1.156 c.m/s
17     COMBINE
       2     Junction Node No.
               .988       .988       .988      2.144 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
               .988      2.144       .988       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
        *****************
 4     CATCHMENT
      501.000     ID No.ó 99999
        1.570     Area in hectares
      102.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      102.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .182      2.144       .988       .000 c.m/s
               .236       .874       .683     C perv/imperv/total
15     ADD RUNOFF
               .182      2.317       .988       .000 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .182      2.317      2.317       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW D/S OF RICE RD CULVERT - OUTLET A2
        *****************
17     COMBINE
       1     Junction Node No.
               .182      2.317      2.317      3.502 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
        *****************
 4     CATCHMENT
       20.100     ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .049       .000      2.317      3.502 c.m/s
            .236       .873       .459     C perv/imperv/total
15   ADD RUNOFF
            .049       .049      2.317      3.502 c.m/s
 4   CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .452       .049      2.317      3.502 c.m/s
            .236       .866       .772     C perv/imperv/total
15   ADD RUNOFF
            .452       .494      2.317      3.502 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .452       .494       .494      3.502 c.m/s
17   COMBINE
     1     Junction Node No.
            .452       .494       .494      3.996 c.m/s
14   START
     1     1=Zero; 2=Define
18   CONFLUENCE
     1     Junction Node No.
            .452      3.996       .494       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 2
      *****************
 4   CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .019      3.996       .494       .000 c.m/s
            .236       .875       .299     C perv/imperv/total
35   COMMENT
     3     line(s) of comment
      *****************
      FLOW D/S OF AREA A20 - OUTLET B
      *****************
15   ADD RUNOFF
            .019      4.015       .494       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ***********************
      EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
      ***********************
 4   CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .229      4.015       .494       .000 c.m/s
            .236       .884       .268     C perv/imperv/total
15   ADD RUNOFF
            .229      4.202       .494       .000 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .229      4.202      4.202       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ***********************
      FLOW U/S OF FIRST AVE CULVERT
      ***********************
17   COMBINE
     1     Junction Node No.
            .229      4.202      4.202      4.202 c.m/s
14   START
     1     1=Zero; 2=Define
35   COMMENT
     3     line(s) of comment
      ***********
      PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
      ***********
 4   CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .768       .000      4.202      4.202 c.m/s
            .236       .880       .687     C perv/imperv/total
15   ADD RUNOFF
            .768       .768      4.202      4.202 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .768       .768       .768      4.202 c.m/s
17   COMBINE
     2     Junction Node No.
            .768       .768       .768       .768 c.m/s
14   START
     1     1=Zero; 2=Define
 4   CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.397       .000       .768       .768 c.m/s
            .236       .886       .691     C perv/imperv/total
15   ADD RUNOFF
           1.397      1.397       .768       .768 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           1.397      1.397      1.397       .768 c.m/s
17   COMBINE
     2     Junction Node No.
           1.397      1.397      1.397      2.165 c.m/s
18   CONFLUENCE
     2     Junction Node No.
           1.397      2.165      1.397       .000 c.m/s
 4   CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .131      2.165      1.397       .000 c.m/s
            .236       .876       .620     C perv/imperv/total
15   ADD RUNOFF
            .131      2.285      1.397       .000 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .5982220E+04 c.m
10   POND
     6 Depth - Discharge - Volume sets
      182.000        .000          .0
      182.800       .0190      5251.0
      183.150       .0230      7895.0
      183.500        .238     10751.0
      183.800        .396     13425.0
      184.000       1.028     15337.0
      Peak Outflow    =      .020 c.m/s
      Maximum Depth   =   182.848 metres
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      Maximum Storage =     5617. c.m
            .131      2.285       .020       .000 c.m/s
17    COMBINE
      2     Junction Node No.
            .131      2.285       .020       .020 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       5.000     ID No.ó 99999
       1.870     Area in hectares
     112.000     Length (PERV) metres
       1.000     Gradient (%)
      50.000     Per cent Impervious
     112.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .153       .000       .020       .020 c.m/s
             .236       .873       .554     C perv/imperv/total
15    ADD RUNOFF
             .153       .153       .020       .020 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .153       .153       .153       .020 c.m/s
17    COMBINE
      2     Junction Node No.
             .153       .153       .153       .160 c.m/s
18    CONFLUENCE
      2     Junction Node No.
             .153       .160       .153       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       6.000     ID No.ó 99999
       1.920     Area in hectares
     113.000     Length (PERV) metres
        .200     Gradient (%)
      65.000     Per cent Impervious
     113.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .214       .160       .153       .000 c.m/s
             .236       .886       .658     C perv/imperv/total
15    ADD RUNOFF
             .214       .374       .153       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
       ***********
 4    CATCHMENT
     201.000     ID No.ó 99999
       2.430     Area in hectares
     127.000     Length (PERV) metres
       1.000     Gradient (%)
      65.000     Per cent Impervious
     127.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .259       .374       .153       .000 c.m/s
             .236       .868       .647     C perv/imperv/total
15    ADD RUNOFF
             .259       .632       .153       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .259       .632       .632       .000 c.m/s
17    COMBINE
      1     Junction Node No.
             .259       .632       .632      4.834 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
       ************************
18    CONFLUENCE
      1     Junction Node No.
             .259      4.834       .632       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      REALIGNED CHANNEL - SEGMENT 3
       ***********
 4    CATCHMENT
     300.000     ID No.ó 99999
       3.180     Area in hectares
     146.000     Length (PERV) metres
        .200     Gradient (%)
      15.000     Per cent Impervious
     146.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .087      4.834       .632       .000 c.m/s
             .236       .880       .332     C perv/imperv/total
15    ADD RUNOFF
             .087      4.921       .632       .000 c.m/s
 4    CATCHMENT
     301.000     ID No.ó 99999
        .720     Area in hectares
      69.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
      69.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .014      4.921       .632       .000 c.m/s
             .236       .869       .299     C perv/imperv/total
15    ADD RUNOFF
             .014      4.935       .632       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .014      4.935      4.935       .000 c.m/s
17    COMBINE
      1     Junction Node No.
             .014      4.935      4.935      4.935 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
       ***********
 4    CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .057       .000      4.935      4.935 c.m/s
             .236       .885       .236     C perv/imperv/total
15    ADD RUNOFF
             .057       .057      4.935      4.935 c.m/s
 4    CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.333       .057      4.935      4.935 c.m/s
             .236       .886       .723     C perv/imperv/total
15    ADD RUNOFF
            1.333      1.341      4.935      4.935 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .4376407E+04 c.m
 4    CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .074      1.341      4.935      4.935 c.m/s
             .236       .873       .618     C perv/imperv/total
15     ADD RUNOFF
             .074      1.401      4.935      4.935 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4571937E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
        178.800        .000          .0
        179.300       .0260      1520.0
        180.100       .0440      4649.0
        180.600        .414      7069.0
        180.800       1.204      8137.0
        Peak Outflow    =      .038 c.m/s
        Maximum Depth   =   179.851 metres
        Maximum Storage =     3675. c.m
             .074      1.401       .038      4.935 c.m/s
17     COMBINE
       1     Junction Node No.
             .074      1.401       .038      4.958 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
        ***********
 4     CATCHMENT
       33.000     ID No.ó 99999
       12.960     Area in hectares
      294.000     Length (PERV) metres
        1.000     Gradient (%)
       75.000     Per cent Impervious
      294.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.708       .000       .038      4.958 c.m/s
           .236       .884       .722     C perv/imperv/total
15     ADD RUNOFF
          1.708      1.708       .038      4.958 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4291300E+04 c.m
 4     CATCHMENT
       34.000     ID No.ó 99999
         .660     Area in hectares
       66.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       66.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .072      1.708       .038      4.958 c.m/s
             .235       .873       .618     C perv/imperv/total
15     ADD RUNOFF
             .072      1.765       .038      4.958 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4478340E+04 c.m
10     POND
       6 Depth - Discharge - Volume sets
        178.300        .000          .0
        178.900       .0350      1927.0
        179.600       .0540      4692.0
        179.800        .150      5590.0
        180.000        .321      6538.0
        180.300       1.922      8059.0
        Peak Outflow    =      .048 c.m/s
        Maximum Depth   =   179.388 metres
        Maximum Storage =     3856. c.m
             .072      1.765       .048      4.958 c.m/s
17     COMBINE
       1     Junction Node No.
             .072      1.765       .048      4.986 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
             .072      4.986       .048       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ************************
        REALIGNED CHANNEL - SEGMENT 3
        ************************
 4     CATCHMENT
      302.000     ID No.ó 99999
        1.610     Area in hectares
      104.000     Length (PERV) metres
         .200     Gradient (%)
       10.000     Per cent Impervious
      104.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .030      4.986       .048       .000 c.m/s
             .236       .884       .301     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
        FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
        ************************
15     ADD RUNOFF
             .030      5.016       .048       .000 c.m/s
14     START
       1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ************************************************************
       10-YEAR STORM EVENT
        ************************************************************
 2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     860.000     Coefficient  a
       6.500     Constant  b    (min)
        .763     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration ó  240 min
              51.471 mm     Total depth
 3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ******************
       EXISTING RES. WEST OF SEGMENT 1
        ******************
 4     CATCHMENT
       1.000     ID No.ó 99999
      17.520     Area in hectares
     343.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     343.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.227       .000       .000       .000 c.m/s
          .267       .892       .486     C perv/imperv/total
15     ADD RUNOFF
         1.227     1.227       .000       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     100.000     ID No.ó 99999
       2.020     Area in hectares
     116.000     Length (PERV) metres
        .400     Gradient (%)
      15.000     Per cent Impervious
     116.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .063     1.227       .000       .000 c.m/s
          .267       .883       .359     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
        *****************
15     ADD RUNOFF
          .063     1.290       .000       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .063     1.290     1.290       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .063     1.290     1.290     1.290 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
        *****************
 4     CATCHMENT
      10.000     ID No.ó 99999
       4.050     Area in hectares
     164.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     164.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .531       .000     1.290     1.290 c.m/s
          .267       .879       .695     C perv/imperv/total
15     ADD RUNOFF
          .531       .531     1.290     1.290 c.m/s
 4     CATCHMENT
      11.000     ID No.ó 99999
       1.000     Area in hectares
      82.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      82.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .024       .531     1.290     1.290 c.m/s
          .267       .886       .329     C perv/imperv/total
15     ADD RUNOFF
          .024       .555     1.290     1.290 c.m/s
10     POND
       6 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.750       .0210         1.0
       186.000       .0230       503.0
       186.250       .0260      1091.0
       186.500       .0280      1765.0
       186.700      1.244      2370.0
       Peak Outflow    =      .026 c.m/s
       Maximum Depth   =   186.301 metres
       Maximum Storage =     1229. c.m
          .024       .555       .026     1.290 c.m/s
17     COMBINE
       1     Junction Node No.
          .024       .555       .026     1.313 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
          .024     1.313       .026       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     101.000     ID No.ó 99999
        .610     Area in hectares
      64.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      64.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .016     1.313       .026       .000 c.m/s
          .266       .884       .328     C perv/imperv/total
15     ADD RUNOFF
          .016     1.329       .026       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .016     1.329     1.329       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .016     1.329     1.329     1.329 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
        *****************
 4     CATCHMENT
      12.000     ID No.ó 99999
       2.680     Area in hectares
     134.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     134.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .178       .000     1.329     1.329 c.m/s
          .267       .880       .481     C perv/imperv/total
15     ADD RUNOFF
          .178       .178     1.329     1.329 c.m/s
 4     CATCHMENT
      13.000     ID No.ó 99999
       6.980     Area in hectares
     216.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     216.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .933       .178     1.329     1.329 c.m/s
```

```
            .267       .890       .703     C perv/imperv/total
15     ADD RUNOFF
            .933      1.112      1.329      1.329 c.m/s
 4     CATCHMENT
      14.000     ID No.ó 99999
        .670     Area in hectares
      67.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      67.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .083      1.112      1.329      1.329 c.m/s
            .267       .884       .637     C perv/imperv/total
15     ADD RUNOFF
            .083      1.177      1.329      1.329 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3408792E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.300       .0140      1142.0
       186.100       .0240      3519.0
       186.500        .287      4978.0
       186.800       1.922      6222.0
       Peak Outflow    =      .022 c.m/s
       Maximum Depth   =   185.947 metres
       Maximum Storage =     3066. c.m
            .083      1.177       .022      1.329 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        FLOW U/S OF RICE RD CULVERT - OUTLET A1
        *****************
17     COMBINE
       1     Junction Node No.
            .083      1.177       .022      1.344 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********************
        PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
        ***********************
 4     CATCHMENT
      40.000     ID No.ó 99999
       8.210     Area in hectares
     234.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     234.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .408       .000       .022      1.344 c.m/s
            .267       .894       .423     C perv/imperv/total
15     ADD RUNOFF
            .408       .408       .022      1.344 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .408       .408       .408      1.344 c.m/s
17     COMBINE
       2     Junction Node No.
            .408       .408       .408       .408 c.m/s
14     START
       1     1=Zero; 2=Define
 4     CATCHMENT
      41.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .051       .000       .408       .408 c.m/s
            .267       .884       .483     C perv/imperv/total
15     ADD RUNOFF
            .051       .051       .408       .408 c.m/s
 4     CATCHMENT
      42.000     ID No.ó 99999
      12.640     Area in hectares
     290.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     290.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.695       .051       .408       .408 c.m/s
           .267       .897       .708     C perv/imperv/total
15     ADD RUNOFF
          1.695      1.737       .408       .408 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          1.695      1.737      1.737       .408 c.m/s
17     COMBINE
       2     Junction Node No.
          1.695      1.737      1.737      2.145 c.m/s
14     START
       1     1=Zero; 2=Define
 4     CATCHMENT
      43.000     ID No.ó 99999
        .330     Area in hectares
      47.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      47.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .026       .000      1.737      2.145 c.m/s
            .266       .885       .483     C perv/imperv/total
15     ADD RUNOFF
            .026       .026      1.737      2.145 c.m/s
 4     CATCHMENT
      44.000     ID No.ó 99999
       6.400     Area in hectares
     207.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     207.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .854       .026      1.737      2.145 c.m/s
            .267       .887       .701     C perv/imperv/total
15     ADD RUNOFF
            .854       .874      1.737      2.145 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .854       .874       .874      2.145 c.m/s
17     COMBINE
       2     Junction Node No.
            .854       .874       .874      3.019 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
            .854      3.019       .874       .000 c.m/s
 4     CATCHMENT
      45.000     ID No.ó 99999
       1.030     Area in hectares
      83.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      83.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .122      3.019       .874       .000 c.m/s
            .267       .886       .638     C perv/imperv/total
15     ADD RUNOFF
            .122      3.124       .874       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
       Volume  =  .9292279E+04 c.m
10     POND
       6 Depth - Discharge - Volume sets
       186.000        .000          .0
       186.800       .0550      4048.0
       187.300       .0730      7091.0
       187.500        .170      8424.0
       187.800        .257     10552.0
       188.000        .880     12094.0
       Peak Outflow    =      .129 c.m/s
       Maximum Depth   =   187.415 metres
       Maximum Storage =     7854. c.m
            .122      3.124       .129       .000 c.m/s
17     COMBINE
       2     Junction Node No.
            .122      3.124       .129       .129 c.m/s
```

```
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       2.000     ID No.ó 99999
       9.020     Area in hectares
     245.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     245.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .702       .000       .129       .129 c.m/s
              .267       .895       .518     C perv/imperv/total
15     ADD RUNOFF
              .702       .702       .129       .129 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .702       .702       .702       .129 c.m/s
17     COMBINE
       2     Junction Node No.
              .702       .702       .702       .745 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
              .702       .745       .702       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       3.000     ID No.ó 99999
       5.680     Area in hectares
     195.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     195.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .440       .745       .702       .000 c.m/s
              .267       .885       .514     C perv/imperv/total
15     ADD RUNOFF
              .440      1.185       .702       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .440      1.185      1.185       .000 c.m/s
17     COMBINE
       2     Junction Node No.
              .440      1.185      1.185      1.185 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
        **********************
 4     CATCHMENT
      50.000     ID No.ó 99999
       3.420     Area in hectares
     151.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     151.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .077       .000      1.185      1.185 c.m/s
              .267       .875       .328     C perv/imperv/total
15     ADD RUNOFF
              .077       .077      1.185      1.185 c.m/s
 4     CATCHMENT
      51.000     ID No.ó 99999
       1.980     Area in hectares
     115.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     115.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .046       .077      1.185      1.185 c.m/s
              .267       .885       .328     C perv/imperv/total
15     ADD RUNOFF
              .046       .123      1.185      1.185 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .046       .123       .123      1.185 c.m/s
17     COMBINE
       2     Junction Node No.
              .046       .123       .123      1.308 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
        **********************
 4     CATCHMENT
       4.000     ID No.ó 99999
      13.940     Area in hectares
     305.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     305.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             1.115       .000       .123      1.308 c.m/s
              .267       .896       .518     C perv/imperv/total
15     ADD RUNOFF
             1.115      1.115       .123      1.308 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
             1.115      1.115      1.115      1.308 c.m/s
17     COMBINE
       2     Junction Node No.
             1.115      1.115      1.115      2.423 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
             1.115      2.423      1.115       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
        *****************
 4     CATCHMENT
     501.000     ID No.ó 99999
       1.570     Area in hectares
     102.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     102.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .209      2.423      1.115       .000 c.m/s
              .267       .886       .700     C perv/imperv/total
15     ADD RUNOFF
              .209      2.615      1.115       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .209      2.615      2.615       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW D/S OF RICE RD CULVERT - OUTLET A2
        *****************
17     COMBINE
       1     Junction Node No.
              .209      2.615      2.615      3.959 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
        *****************
 4     CATCHMENT
      20.100     ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .057       .000      2.615      3.959 c.m/s
          .267       .884       .483     C perv/imperv/total
15   ADD RUNOFF
          .057       .057      2.615      3.959 c.m/s
 4   CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .500       .057      2.615      3.959 c.m/s
          .267       .877       .785     C perv/imperv/total
15   ADD RUNOFF
          .500       .549      2.615      3.959 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          .500       .549       .549      3.959 c.m/s
17   COMBINE
     1     Junction Node No.
          .500       .549       .549      4.508 c.m/s
14   START
     1     1=Zero; 2=Define
18   CONFLUENCE
     1     Junction Node No.
          .500      4.508       .549       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 2
      *****************
 4   CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .024      4.508       .549       .000 c.m/s
          .267       .886       .328     C perv/imperv/total
35   COMMENT
     3     line(s) of comment
      *****************
      FLOW D/S OF AREA A20 - OUTLET B
      *****************
15   ADD RUNOFF
          .024      4.532       .549       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ***********************
      EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
      ***********************
 4   CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .269      4.532       .549       .000 c.m/s
          .267       .897       .298     C perv/imperv/total
15   ADD RUNOFF
          .269      4.762       .549       .000 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          .269      4.762      4.762       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ***********************
      FLOW U/S OF FIRST AVE CULVERT
      ***********************
17   COMBINE
     1     Junction Node No.
          .269      4.762      4.762      4.762 c.m/s
14   START
     1     1=Zero; 2=Define
35   COMMENT
     3     line(s) of comment
      ***********
      PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
      ***********
 4   CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .858       .000      4.762      4.762 c.m/s
          .267       .887       .701     C perv/imperv/total
15   ADD RUNOFF
          .858       .858      4.762      4.762 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          .858       .858       .858      4.762 c.m/s
17   COMBINE
     2     Junction Node No.
          .858       .858       .858       .858 c.m/s
14   START
     1     1=Zero; 2=Define
 4   CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.523       .000       .858       .858 c.m/s
          .267       .897       .708     C perv/imperv/total
15   ADD RUNOFF
          1.523      1.523       .858       .858 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          1.523      1.523      1.523       .858 c.m/s
17   COMBINE
     2     Junction Node No.
          1.523      1.523      1.523      2.381 c.m/s
18   CONFLUENCE
     2     Junction Node No.
          1.523      2.381      1.523       .000 c.m/s
 4   CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .149      2.381      1.523       .000 c.m/s
          .267       .887       .639     C perv/imperv/total
15   ADD RUNOFF
          .149      2.514      1.523       .000 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .6870401E+04 c.m
10   POND
     6 Depth - Discharge - Volume sets
      182.000        .000          .0
      182.800       .0190      5251.0
      183.150       .0230      7895.0
      183.500        .238     10751.0
      183.800        .396     13425.0
      184.000       1.028     15337.0
      Peak Outflow    =      .021 c.m/s
      Maximum Depth   =   182.962 metres
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      Maximum Storage =     6474. c.m
            .149      2.514       .021       .000 c.m/s
17    COMBINE
      2     Junction Node No.
            .149      2.514       .021       .021 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       5.000     ID No.ó 99999
       1.870     Area in hectares
     112.000     Length (PERV) metres
       1.000     Gradient (%)
      50.000     Per cent Impervious
     112.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .175       .000       .021       .021 c.m/s
            .267       .885       .576     C perv/imperv/total
15    ADD RUNOFF
            .175       .175       .021       .021 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .175       .175       .175       .021 c.m/s
17    COMBINE
      2     Junction Node No.
            .175       .175       .175       .180 c.m/s
18    CONFLUENCE
      2     Junction Node No.
            .175       .180       .175       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       6.000     ID No.ó 99999
       1.920     Area in hectares
     113.000     Length (PERV) metres
        .200     Gradient (%)
      65.000     Per cent Impervious
     113.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .240       .180       .175       .000 c.m/s
            .267       .896       .676     C perv/imperv/total
15    ADD RUNOFF
            .240       .418       .175       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
       ***********
 4    CATCHMENT
     201.000     ID No.ó 99999
       2.430     Area in hectares
     127.000     Length (PERV) metres
       1.000     Gradient (%)
      65.000     Per cent Impervious
     127.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .287       .418       .175       .000 c.m/s
            .267       .882       .667     C perv/imperv/total
15    ADD RUNOFF
            .287       .705       .175       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .287       .705       .705       .000 c.m/s
17    COMBINE
      1     Junction Node No.
            .287       .705       .705      5.467 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
       ************************
18    CONFLUENCE
      1     Junction Node No.
            .287      5.467       .705       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      REALIGNED CHANNEL - SEGMENT 3
       ***********
 4    CATCHMENT
     300.000     ID No.ó 99999
       3.180     Area in hectares
     146.000     Length (PERV) metres
        .200     Gradient (%)
      15.000     Per cent Impervious
     146.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .099      5.467       .705       .000 c.m/s
            .267       .894       .361     C perv/imperv/total
15    ADD RUNOFF
            .099      5.566       .705       .000 c.m/s
 4    CATCHMENT
     301.000     ID No.ó 99999
        .720     Area in hectares
      69.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
      69.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .016      5.566       .705       .000 c.m/s
            .267       .876       .328     C perv/imperv/total
15    ADD RUNOFF
            .016      5.582       .705       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .016      5.582      5.582       .000 c.m/s
17    COMBINE
      1     Junction Node No.
            .016      5.582      5.582      5.582 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
       ***********
 4    CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .077       .000      5.582      5.582 c.m/s
            .267       .896       .267     C perv/imperv/total
15    ADD RUNOFF
            .077       .077      5.582      5.582 c.m/s
 4    CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.498       .077      5.582      5.582 c.m/s
            .267       .897       .739     C perv/imperv/total
15    ADD RUNOFF
          1.498      1.509      5.582      5.582 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .5129908E+04 c.m
 4    CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .085      1.509      5.582      5.582 c.m/s
             .267       .884       .637     C perv/imperv/total
15     ADD RUNOFF
             .085      1.576      5.582      5.582 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5356146E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
        178.800        .000          .0
        179.300       .0260      1520.0
        180.100       .0440      4649.0
        180.600        .414      7069.0
        180.800       1.204      8137.0
        Peak Outflow    =      .042 c.m/s
        Maximum Depth   =   180.027 metres
        Maximum Storage =     4365. c.m
             .085      1.576       .042      5.582 c.m/s
17     COMBINE
       1     Junction Node No.
             .085      1.576       .042      5.608 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
        ***********
 4     CATCHMENT
       33.000     ID No.ó 99999
       12.960     Area in hectares
      294.000     Length (PERV) metres
        1.000     Gradient (%)
       75.000     Per cent Impervious
      294.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.919       .000       .042      5.608 c.m/s
           .267       .897       .739     C perv/imperv/total
15     ADD RUNOFF
          1.919      1.919       .042      5.608 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4931688E+04 c.m
 4     CATCHMENT
       34.000     ID No.ó 99999
         .660     Area in hectares
       66.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       66.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .082      1.919       .042      5.608 c.m/s
             .267       .884       .637     C perv/imperv/total
15     ADD RUNOFF
             .082      1.983       .042      5.608 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5148061E+04 c.m
10     POND
       6 Depth - Discharge - Volume sets
        178.300        .000          .0
        178.900       .0350      1927.0
        179.600       .0540      4692.0
        179.800        .150      5590.0
        180.000        .321      6538.0
        180.300       1.922      8059.0
        Peak Outflow    =      .052 c.m/s
        Maximum Depth   =   179.543 metres
        Maximum Storage =     4465. c.m
             .082      1.983       .052      5.608 c.m/s
17     COMBINE
       1     Junction Node No.
             .082      1.983       .052      5.642 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
             .082      5.642       .052       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ************************
        REALIGNED CHANNEL - SEGMENT 3
        ************************
 4     CATCHMENT
      302.000     ID No.ó 99999
        1.610     Area in hectares
      104.000     Length (PERV) metres
         .200     Gradient (%)
       10.000     Per cent Impervious
      104.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .035      5.642       .052       .000 c.m/s
             .267       .893       .329     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ************************
        FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
        ************************
15     ADD RUNOFF
             .035      5.677       .052       .000 c.m/s
14     START
       1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ************************************************************
        25-YEAR STORM EVENT
        ************************************************************
 2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     900.000     Coefficient  a
       5.200     Constant  b    (min)
        .745     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration ó  240 min
               59.713 mm     Total depth
 3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ******************
        EXISTING RES. WEST OF SEGMENT 1
        ******************
 4     CATCHMENT
       1.000     ID No.ó 99999
      17.520     Area in hectares
     343.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     343.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.445       .000       .000       .000 c.m/s
          .308       .909       .518     C perv/imperv/total
15     ADD RUNOFF
         1.445     1.445       .000       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     100.000     ID No.ó 99999
       2.020     Area in hectares
     116.000     Length (PERV) metres
        .400     Gradient (%)
      15.000     Per cent Impervious
     116.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .077     1.445       .000       .000 c.m/s
          .308       .891       .396     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        *****************
        FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
        *****************
15     ADD RUNOFF
          .077     1.522       .000       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .077     1.522     1.522       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .077     1.522     1.522     1.522 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
        *****************
 4     CATCHMENT
      10.000     ID No.ó 99999
       4.050     Area in hectares
     164.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     164.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .612       .000     1.522     1.522 c.m/s
          .308       .889       .715     C perv/imperv/total
15     ADD RUNOFF
          .612       .612     1.522     1.522 c.m/s
 4     CATCHMENT
      11.000     ID No.ó 99999
       1.000     Area in hectares
      82.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      82.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .033       .612     1.522     1.522 c.m/s
          .308       .898       .367     C perv/imperv/total
15     ADD RUNOFF
          .033       .644     1.522     1.522 c.m/s
10     POND
       6 Depth - Discharge - Volume sets
       184.800       .000        .0
       185.750      .0210       1.0
       186.000      .0230     503.0
       186.250      .0260    1091.0
       186.500      .0280    1765.0
       186.700     1.244     2370.0
       Peak Outflow    =      .027 c.m/s
       Maximum Depth   =   186.413 metres
       Maximum Storage =     1531. c.m
          .033       .644       .027     1.522 c.m/s
17     COMBINE
       1     Junction Node No.
          .033       .644       .027     1.546 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
          .033     1.546       .027       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     101.000     ID No.ó 99999
        .610     Area in hectares
      64.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      64.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .023     1.546       .027       .000 c.m/s
          .308       .899       .367     C perv/imperv/total
15     ADD RUNOFF
          .023     1.567       .027       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .023     1.567     1.567       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .023     1.567     1.567     1.567 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
        *****************
 4     CATCHMENT
      12.000     ID No.ó 99999
       2.680     Area in hectares
     134.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     134.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .209       .000     1.567     1.567 c.m/s
          .308       .897       .514     C perv/imperv/total
15     ADD RUNOFF
          .209       .209     1.567     1.567 c.m/s
 4     CATCHMENT
      13.000     ID No.ó 99999
       6.980     Area in hectares
     216.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     216.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.083       .209     1.567     1.567 c.m/s
```

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            .308       .897       .721     C perv/imperv/total
15     ADD RUNOFF
            1.083      1.292      1.567      1.567 c.m/s
 4     CATCHMENT
       14.000     ID No.ó 99999
         .670     Area in hectares
       67.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       67.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .099      1.292      1.567      1.567 c.m/s
            .308       .898       .662     C perv/imperv/total
15     ADD RUNOFF
            .099      1.367      1.567      1.567 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4091430E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
        184.800        .000          .0
        185.300       .0140      1142.0
        186.100       .0240      3519.0
        186.500        .287      4978.0
        186.800       1.922      6222.0
        Peak Outflow    =      .048 c.m/s
        Maximum Depth   =   186.136 metres
        Maximum Storage =     3650. c.m
            .099      1.367       .048      1.567 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        FLOW U/S OF RICE RD CULVERT - OUTLET A1
        *****************
17     COMBINE
       1     Junction Node No.
            .099      1.367       .048      1.583 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********************
        PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
        ***********************
 4     CATCHMENT
       40.000     ID No.ó 99999
        8.210     Area in hectares
      234.000     Length (PERV) metres
        1.000     Gradient (%)
       25.000     Per cent Impervious
      234.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .484       .000       .048      1.583 c.m/s
            .308       .902       .457     C perv/imperv/total
15     ADD RUNOFF
            .484       .484       .048      1.583 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
            .484       .484       .484      1.583 c.m/s
17     COMBINE
       2     Junction Node No.
            .484       .484       .484       .484 c.m/s
14     START
       1     1=Zero; 2=Define
 4     CATCHMENT
       41.000     ID No.ó 99999
         .690     Area in hectares
       68.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
       68.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .061       .000       .484       .484 c.m/s
            .308       .898       .515     C perv/imperv/total
15     ADD RUNOFF
            .061       .061       .484       .484 c.m/s
 4     CATCHMENT
       42.000     ID No.ó 99999
       12.640     Area in hectares
      290.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      290.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.980       .061       .484       .484 c.m/s
            .308       .910       .729     C perv/imperv/total
15     ADD RUNOFF
            1.980      2.030       .484       .484 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
            1.980      2.030      2.030       .484 c.m/s
17     COMBINE
       2     Junction Node No.
            1.980      2.030      2.030      2.514 c.m/s
14     START
       1     1=Zero; 2=Define
 4     CATCHMENT
       43.000     ID No.ó 99999
         .330     Area in hectares
       47.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
       47.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .031       .000      2.030      2.514 c.m/s
            .308       .898       .515     C perv/imperv/total
15     ADD RUNOFF
            .031       .031      2.030      2.514 c.m/s
 4     CATCHMENT
       44.000     ID No.ó 99999
        6.400     Area in hectares
      207.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      207.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .990       .031      2.030      2.514 c.m/s
            .308       .896       .719     C perv/imperv/total
15     ADD RUNOFF
            .990      1.014      2.030      2.514 c.m/s
 9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
            .990      1.014      1.014      2.514 c.m/s
17     COMBINE
       2     Junction Node No.
            .990      1.014      1.014      3.528 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
            .990      3.528      1.014       .000 c.m/s
 4     CATCHMENT
       45.000     ID No.ó 99999
        1.030     Area in hectares
       83.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       83.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .147      3.528      1.014       .000 c.m/s
            .308       .899       .662     C perv/imperv/total
15     ADD RUNOFF
            .147      3.648      1.014       .000 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1120983E+05 c.m
10     POND
       6 Depth - Discharge - Volume sets
        186.000        .000          .0
        186.800       .0550      4048.0
        187.300       .0730      7091.0
        187.500        .170      8424.0
        187.800        .257     10552.0
        188.000        .880     12094.0
        Peak Outflow    =      .198 c.m/s
        Maximum Depth   =   187.598 metres
        Maximum Storage =     9121. c.m
            .147      3.648       .198       .000 c.m/s
17     COMBINE
       2     Junction Node No.
            .147      3.648       .198       .198 c.m/s
```

```
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       2.000     ID No.ó 99999
       9.020     Area in hectares
     245.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     245.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .824       .000       .198       .198 c.m/s
              .308       .904       .547     C perv/imperv/total
15     ADD RUNOFF
              .824       .824       .198       .198 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .824       .824       .824       .198 c.m/s
17     COMBINE
       2     Junction Node No.
              .824       .824       .824       .877 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
              .824       .877       .824       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       3.000     ID No.ó 99999
       5.680     Area in hectares
     195.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     195.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .515       .877       .824       .000 c.m/s
              .308       .894       .543     C perv/imperv/total
15     ADD RUNOFF
              .515      1.392       .824       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .515      1.392      1.392       .000 c.m/s
17     COMBINE
       2     Junction Node No.
              .515      1.392      1.392      1.392 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
        **********************
 4     CATCHMENT
      50.000     ID No.ó 99999
       3.420     Area in hectares
     151.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     151.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .097       .000      1.392      1.392 c.m/s
              .308       .892       .367     C perv/imperv/total
15     ADD RUNOFF
              .097       .097      1.392      1.392 c.m/s
 4     CATCHMENT
      51.000     ID No.ó 99999
       1.980     Area in hectares
     115.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     115.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .059       .097      1.392      1.392 c.m/s
              .308       .899       .367     C perv/imperv/total
15     ADD RUNOFF
              .059       .156      1.392      1.392 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .059       .156       .156      1.392 c.m/s
17     COMBINE
       2     Junction Node No.
              .059       .156       .156      1.548 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
        **********************
 4     CATCHMENT
       4.000     ID No.ó 99999
      13.940     Area in hectares
     305.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     305.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.270       .000       .156      1.548 c.m/s
              .308       .910       .549     C perv/imperv/total
15     ADD RUNOFF
            1.270      1.270       .156      1.548 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            1.270      1.270      1.270      1.548 c.m/s
17     COMBINE
       2     Junction Node No.
            1.270      1.270      1.270      2.818 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
            1.270      2.818      1.270       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
        *****************
 4     CATCHMENT
     501.000     ID No.ó 99999
       1.570     Area in hectares
     102.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     102.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .250      2.818      1.270       .000 c.m/s
              .308       .901       .723     C perv/imperv/total
15     ADD RUNOFF
              .250      3.038      1.270       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .250      3.038      3.038       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW D/S OF RICE RD CULVERT - OUTLET A2
        *****************
17     COMBINE
       1     Junction Node No.
              .250      3.038      3.038      4.621 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
        *****************
 4     CATCHMENT
      20.100     ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .068       .000      3.038      4.621 c.m/s
          .308       .897       .514     C perv/imperv/total
15   ADD RUNOFF
          .068       .068      3.038      4.621 c.m/s
 4   CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .575       .068      3.038      4.621 c.m/s
          .308       .893       .806     C perv/imperv/total
15   ADD RUNOFF
          .575       .639      3.038      4.621 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          .575       .639       .639      4.621 c.m/s
17   COMBINE
     1     Junction Node No.
          .575       .639       .639      5.253 c.m/s
14   START
     1     1=Zero; 2=Define
18   CONFLUENCE
     1     Junction Node No.
          .575      5.253       .639       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 2
      *****************
 4   CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .032      5.253       .639       .000 c.m/s
          .308       .898       .367     C perv/imperv/total
35   COMMENT
     3     line(s) of comment
      *****************
      FLOW D/S OF AREA A20 - OUTLET B
      *****************
15   ADD RUNOFF
          .032      5.284       .639       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ***********************
      EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
      ***********************
 4   CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .338      5.284       .639       .000 c.m/s
          .308       .911       .339     C perv/imperv/total
15   ADD RUNOFF
          .338      5.586       .639       .000 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          .338      5.586      5.586       .000 c.m/s
35   COMMENT
     3     line(s) of comment
      ***********************
      FLOW U/S OF FIRST AVE CULVERT
      ***********************
17   COMBINE
     1     Junction Node No.
          .338      5.586      5.586      5.586 c.m/s
14   START
     1     1=Zero; 2=Define
35   COMMENT
     3     line(s) of comment
      ***********
      PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
      ***********
 4   CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .995       .000      5.586      5.586 c.m/s
          .308       .896       .719     C perv/imperv/total
15   ADD RUNOFF
          .995       .995      5.586      5.586 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          .995       .995       .995      5.586 c.m/s
17   COMBINE
     2     Junction Node No.
          .995       .995       .995       .995 c.m/s
14   START
     1     1=Zero; 2=Define
 4   CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
        1.776       .000       .995       .995 c.m/s
          .308       .908       .728     C perv/imperv/total
15   ADD RUNOFF
        1.776      1.776       .995       .995 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
        1.776      1.776      1.776       .995 c.m/s
17   COMBINE
     2     Junction Node No.
        1.776      1.776      1.776      2.771 c.m/s
18   CONFLUENCE
     2     Junction Node No.
        1.776      2.771      1.776       .000 c.m/s
 4   CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .179      2.771      1.776       .000 c.m/s
          .308       .900       .663     C perv/imperv/total
15   ADD RUNOFF
          .179      2.924      1.776       .000 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
     Volume  =  .8196629E+04 c.m
10   POND
     6 Depth - Discharge - Volume sets
     182.000        .000          .0
     182.800       .0190      5251.0
     183.150       .0230      7895.0
     183.500        .238     10751.0
     183.800        .396     13425.0
     184.000       1.028     15337.0
     Peak Outflow    =      .023 c.m/s
     Maximum Depth   =   183.132 metres
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      Maximum Storage =     7762. c.m
            .179      2.924       .023       .000 c.m/s
17    COMBINE
      2     Junction Node No.
            .179      2.924       .023       .023 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       5.000     ID No.ó 99999
       1.870     Area in hectares
     112.000     Length (PERV) metres
       1.000     Gradient (%)
      50.000     Per cent Impervious
     112.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .211       .000       .023       .023 c.m/s
          .308       .900       .604     C perv/imperv/total
15    ADD RUNOFF
          .211       .211       .023       .023 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .211       .211       .211       .023 c.m/s
17    COMBINE
      2     Junction Node No.
            .211       .211       .211       .217 c.m/s
18    CONFLUENCE
      2     Junction Node No.
            .211       .217       .211       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       6.000     ID No.ó 99999
       1.920     Area in hectares
     113.000     Length (PERV) metres
        .200     Gradient (%)
      65.000     Per cent Impervious
     113.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .279       .217       .211       .000 c.m/s
          .308       .906       .697     C perv/imperv/total
15    ADD RUNOFF
          .279       .486       .211       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
       ***********
 4    CATCHMENT
     201.000     ID No.ó 99999
       2.430     Area in hectares
     127.000     Length (PERV) metres
       1.000     Gradient (%)
      65.000     Per cent Impervious
     127.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .344       .486       .211       .000 c.m/s
          .308       .898       .692     C perv/imperv/total
15    ADD RUNOFF
          .344       .816       .211       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .344       .816       .816       .000 c.m/s
17    COMBINE
      1     Junction Node No.
            .344       .816       .816      6.402 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
       ************************
18    CONFLUENCE
      1     Junction Node No.
            .344      6.402       .816       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      REALIGNED CHANNEL - SEGMENT 3
       ***********
 4    CATCHMENT
     300.000     ID No.ó 99999
       3.180     Area in hectares
     146.000     Length (PERV) metres
        .200     Gradient (%)
      15.000     Per cent Impervious
     146.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .119      6.402       .816       .000 c.m/s
          .308       .910       .399     C perv/imperv/total
15    ADD RUNOFF
          .119      6.521       .816       .000 c.m/s
 4    CATCHMENT
     301.000     ID No.ó 99999
        .720     Area in hectares
      69.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
      69.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .020      6.521       .816       .000 c.m/s
          .308       .892       .367     C perv/imperv/total
15    ADD RUNOFF
          .020      6.541       .816       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .020      6.541      6.541       .000 c.m/s
17    COMBINE
      1     Junction Node No.
            .020      6.541      6.541      6.541 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
       ***********
 4    CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .113       .000      6.541      6.541 c.m/s
          .308       .906       .309     C perv/imperv/total
15    ADD RUNOFF
          .113       .113      6.541      6.541 c.m/s
 4    CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.743       .113      6.541      6.541 c.m/s
          .308       .907       .758     C perv/imperv/total
15    ADD RUNOFF
         1.743      1.763      6.541      6.541 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .6276292E+04 c.m
 4    CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
        8.924    Initial Abstraction
            1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .102      1.763      6.541      6.541 c.m/s
              .308       .898       .662     C perv/imperv/total
15      ADD RUNOFF
              .102      1.840      6.541      6.541 c.m/s
27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .6549078E+04 c.m
10      POND
        5 Depth - Discharge - Volume sets
        178.800        .000          .0
        179.300       .0260      1520.0
        180.100       .0440      4649.0
        180.600        .414      7069.0
        180.800       1.204      8137.0
        Peak Outflow    =      .114 c.m/s
        Maximum Depth   =   180.194 metres
        Maximum Storage =     5104. c.m
              .102      1.840       .114      6.541 c.m/s
17      COMBINE
        1     Junction Node No.
              .102      1.840       .114      6.569 c.m/s
14      START
        1     1=Zero; 2=Define
35      COMMENT
        3     line(s) of comment
        ***********
        PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
        ***********
 4      CATCHMENT
        33.000     ID No.ó 99999
        12.960     Area in hectares
       294.000     Length (PERV) metres
         1.000     Gradient (%)
        75.000     Per cent Impervious
       294.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            2.171       .000       .114      6.569 c.m/s
             .308       .910       .759     C perv/imperv/total
15      ADD RUNOFF
            2.171      2.171       .114      6.569 c.m/s
27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5876996E+04 c.m
 4      CATCHMENT
        34.000     ID No.ó 99999
          .660     Area in hectares
        66.000     Length (PERV) metres
         1.000     Gradient (%)
        60.000     Per cent Impervious
        66.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
          .100     Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .098      2.171       .114      6.569 c.m/s
              .308       .898       .662     C perv/imperv/total
15      ADD RUNOFF
              .098      2.245       .114      6.569 c.m/s
27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .6138025E+04 c.m
10      POND
        6 Depth - Discharge - Volume sets
        178.300        .000          .0
        178.900       .0350      1927.0
        179.600       .0540      4692.0
        179.800        .150      5590.0
        180.000        .321      6538.0
        180.300       1.922      8059.0
        Peak Outflow    =      .107 c.m/s
        Maximum Depth   =   179.709 metres
        Maximum Storage =     5183. c.m
              .098      2.245       .107      6.569 c.m/s
17      COMBINE
        1     Junction Node No.
              .098      2.245       .107      6.606 c.m/s
14      START
        1     1=Zero; 2=Define
18      CONFLUENCE
        1     Junction Node No.
              .098      6.606       .107       .000 c.m/s
35      COMMENT
        3     line(s) of comment
        ************************
        REALIGNED CHANNEL - SEGMENT 3
        ************************
 4      CATCHMENT
       302.000     ID No.ó 99999
         1.610     Area in hectares
       104.000     Length (PERV) metres
          .200     Gradient (%)
        10.000     Per cent Impervious
       104.000     Length (IMPERV)
          .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
          .250     Manning "n"
        74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
        8.924    Initial Abstraction
            1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .043      6.606       .107       .000 c.m/s
              .308       .901       .368     C perv/imperv/total
35      COMMENT
        3     line(s) of comment
        ************************
        FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
        ************************
15      ADD RUNOFF
              .043      6.649       .107       .000 c.m/s
14      START
        1     1=Zero; 2=Define
```

```
35     COMMENT
       3     line(s) of comment
        ************************************************************
        100-YEAR STORM EVENT
        ************************************************************
 2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1020.000     Coefficient  a
       4.700     Constant  b    (min)
        .731     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration ó  240 min
              73.203 mm     Total depth
 3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
       3     line(s) of comment
        ******************
        EXISTING RES. WEST OF SEGMENT 1
        ******************
 4     CATCHMENT
       1.000     ID No.ó 99999
      17.520     Area in hectares
     343.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     343.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.731       .000       .000       .000 c.m/s
          .368       .925       .563     C perv/imperv/total
15     ADD RUNOFF
         1.731     1.731       .000       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     100.000     ID No.ó 99999
       2.020     Area in hectares
     116.000     Length (PERV) metres
        .400     Gradient (%)
      15.000     Per cent Impervious
     116.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .101     1.731       .000       .000 c.m/s
          .368       .905       .448     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        *****************
        FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
        *****************
15     ADD RUNOFF
          .101     1.832       .000       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .101     1.832     1.832       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .101     1.832     1.832     1.832 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
        *****************
 4     CATCHMENT
      10.000     ID No.ó 99999
       4.050     Area in hectares
     164.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     164.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .735       .000     1.832     1.832 c.m/s
          .367       .909       .747     C perv/imperv/total
15     ADD RUNOFF
          .735       .735     1.832     1.832 c.m/s
 4     CATCHMENT
      11.000     ID No.ó 99999
       1.000     Area in hectares
      82.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      82.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .054       .735     1.832     1.832 c.m/s
          .367       .912       .422     C perv/imperv/total
15     ADD RUNOFF
          .054       .783     1.832     1.832 c.m/s
10     POND
       6 Depth - Discharge - Volume sets
       184.800       .000         .0
       185.750      .0210        1.0
       186.000      .0230      503.0
       186.250      .0260     1091.0
       186.500      .0280     1765.0
       186.700     1.244     2370.0
       Peak Outflow    =      .105 c.m/s
       Maximum Depth   =   186.513 metres
       Maximum Storage =     1804. c.m
          .054       .783       .105     1.832 c.m/s
17     COMBINE
       1     Junction Node No.
          .054       .783       .105     1.857 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
          .054     1.857       .105       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 1
        *****************
 4     CATCHMENT
     101.000     ID No.ó 99999
        .610     Area in hectares
      64.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      64.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .038     1.857       .105       .000 c.m/s
          .367       .914       .422     C perv/imperv/total
15     ADD RUNOFF
          .038     1.890       .105       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          .038     1.890     1.890       .000 c.m/s
17     COMBINE
       1     Junction Node No.
          .038     1.890     1.890     1.890 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
        PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
        *****************
 4     CATCHMENT
      12.000     ID No.ó 99999
       2.680     Area in hectares
     134.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     134.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .262       .000     1.890     1.890 c.m/s
          .367       .914       .559     C perv/imperv/total
15     ADD RUNOFF
          .262       .262     1.890     1.890 c.m/s
 4     CATCHMENT
      13.000     ID No.ó 99999
       6.980     Area in hectares
     216.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     216.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.307       .262     1.890     1.890 c.m/s
```

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            .368       .908       .746     C perv/imperv/total
15    ADD RUNOFF
           1.307      1.567      1.890      1.890 c.m/s
 4    CATCHMENT
      14.000     ID No.ó 99999
        .670     Area in hectares
      67.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      67.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .124      1.567      1.890      1.890 c.m/s
            .367       .914       .695     C perv/imperv/total
15    ADD RUNOFF
            .124      1.659      1.890      1.890 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .5247869E+04 c.m
10    POND
      5 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.300       .0140      1142.0
       186.100       .0240      3519.0
       186.500        .287      4978.0
       186.800       1.922      6222.0
       Peak Outflow    =      .143 c.m/s
       Maximum Depth   =   186.281 metres
       Maximum Storage =     4180. c.m
            .124      1.659       .143      1.890 c.m/s
35    COMMENT
      3     line(s) of comment
       *****************
       FLOW U/S OF RICE RD CULVERT - OUTLET A1
       *****************
17    COMBINE
      1     Junction Node No.
            .124      1.659       .143      1.908 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
       ***********************
 4    CATCHMENT
      40.000     ID No.ó 99999
       8.210     Area in hectares
     234.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     234.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .607       .000       .143      1.908 c.m/s
            .367       .911       .503     C perv/imperv/total
15    ADD RUNOFF
            .607       .607       .143      1.908 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
            .607       .607       .607      1.908 c.m/s
17    COMBINE
      2     Junction Node No.
            .607       .607       .607       .607 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      41.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .078       .000       .607       .607 c.m/s
            .367       .914       .559     C perv/imperv/total
15    ADD RUNOFF
            .078       .078       .607       .607 c.m/s
 4    CATCHMENT
      42.000     ID No.ó 99999
      12.640     Area in hectares
     290.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     290.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          2.409       .078       .607       .607 c.m/s
           .368       .921       .755     C perv/imperv/total
15    ADD RUNOFF
          2.409      2.475       .607       .607 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          2.409      2.475      2.475       .607 c.m/s
17    COMBINE
      2     Junction Node No.
           2.409      2.475      2.475      3.082 c.m/s
14    START
      1     1=Zero; 2=Define
 4    CATCHMENT
      43.000     ID No.ó 99999
        .330     Area in hectares
      47.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
      47.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .039       .000      2.475      3.082 c.m/s
            .367       .911       .557     C perv/imperv/total
15    ADD RUNOFF
            .039       .039      2.475      3.082 c.m/s
 4    CATCHMENT
      44.000     ID No.ó 99999
       6.400     Area in hectares
     207.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     207.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.193       .039      2.475      3.082 c.m/s
           .368       .906       .744     C perv/imperv/total
15    ADD RUNOFF
          1.193      1.226      2.475      3.082 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
          1.193      1.226      1.226      3.082 c.m/s
17    COMBINE
      2     Junction Node No.
           1.193      1.226      1.226      4.308 c.m/s
14    START
      1     1=Zero; 2=Define
18    CONFLUENCE
      2     Junction Node No.
           1.193      4.308      1.226       .000 c.m/s
 4    CATCHMENT
      45.000     ID No.ó 99999
       1.030     Area in hectares
      83.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      83.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .184      4.308      1.226       .000 c.m/s
            .367       .912       .694     C perv/imperv/total
15    ADD RUNOFF
            .184      4.453      1.226       .000 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .1443723E+05 c.m
10    POND
      6 Depth - Discharge - Volume sets
       186.000        .000          .0
       186.800       .0550      4048.0
       187.300       .0730      7091.0
       187.500        .170      8424.0
       187.800        .257     10552.0
       188.000        .880     12094.0
       Peak Outflow    =      .430 c.m/s
       Maximum Depth   =   187.856 metres
       Maximum Storage =    10981. c.m
            .184      4.453       .430       .000 c.m/s
17    COMBINE
      2     Junction Node No.
            .184      4.453       .430       .430 c.m/s
```

```
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       2.000     ID No.ó 99999
       9.020     Area in hectares
     245.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     245.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              1.013       .000       .430       .430 c.m/s
                .368       .912       .586     C perv/imperv/total
15     ADD RUNOFF
              1.013      1.013       .430       .430 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              1.013      1.013      1.013       .430 c.m/s
17     COMBINE
       2     Junction Node No.
              1.013      1.013      1.013      1.074 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
              1.013      1.074      1.013       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
        **********************
 4     CATCHMENT
       3.000     ID No.ó 99999
       5.680     Area in hectares
     195.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     195.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .632       .903       .582     C perv/imperv/total
15     ADD RUNOFF
               .632      1.706      1.013       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
               .632      1.706      1.706       .000 c.m/s
17     COMBINE
       2     Junction Node No.
               .632      1.706      1.706      1.706 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
        **********************
 4     CATCHMENT
      50.000     ID No.ó 99999
       3.420     Area in hectares
     151.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     151.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .148       .000      1.706      1.706 c.m/s
                .367       .912       .422     C perv/imperv/total
15     ADD RUNOFF
               .148       .148      1.706      1.706 c.m/s
 4     CATCHMENT
      51.000     ID No.ó 99999
       1.980     Area in hectares
     115.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     115.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .092       .148      1.706      1.706 c.m/s
                .368       .916       .422     C perv/imperv/total
15     ADD RUNOFF
                .092       .240      1.706      1.706 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
                .092       .240       .240      1.706 c.m/s
17     COMBINE
       2     Junction Node No.
                .092       .240       .240      1.925 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        **********************
       EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
        **********************
 4     CATCHMENT
       4.000     ID No.ó 99999
      13.940     Area in hectares
     305.000     Length (PERV) metres
       1.000     Gradient (%)
      40.000     Per cent Impervious
     305.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              1.566       .000       .240      1.925 c.m/s
                .367       .923       .590     C perv/imperv/total
15     ADD RUNOFF
              1.566      1.566       .240      1.925 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              1.566      1.566      1.566      1.925 c.m/s
17     COMBINE
       2     Junction Node No.
              1.566      1.566      1.566      3.491 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       2     Junction Node No.
              1.566      3.491      1.566       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
        *****************
 4     CATCHMENT
     501.000     ID No.ó 99999
       1.570     Area in hectares
     102.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     102.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .314      3.491      1.566       .000 c.m/s
                .367       .915       .751     C perv/imperv/total
15     ADD RUNOFF
               .314      3.754      1.566       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
               .314      3.754      3.754       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        *****************
       FLOW D/S OF RICE RD CULVERT - OUTLET A2
        *****************
17     COMBINE
       1     Junction Node No.
               .314      3.754      3.754      5.662 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        *****************
       PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
        *****************
 4     CATCHMENT
      20.100     ID No.ó 99999
```

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      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .087       .000      3.754      5.662 c.m/s
            .366       .914       .558     C perv/imperv/total
15   ADD RUNOFF
            .087       .087      3.754      5.662 c.m/s
 4   CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .720       .087      3.754      5.662 c.m/s
            .368       .913       .831     C perv/imperv/total
15   ADD RUNOFF
            .720       .807      3.754      5.662 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .720       .807       .807      5.662 c.m/s
17   COMBINE
    1     Junction Node No.
            .720       .807       .807      6.417 c.m/s
14   START
    1     1=Zero; 2=Define
18   CONFLUENCE
    1     Junction Node No.
            .720      6.417       .807       .000 c.m/s
35   COMMENT
    3     line(s) of comment
     *****************
     REALIGNED CHANNEL - SEGMENT 2
     *****************
 4   CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .053      6.417       .807       .000 c.m/s
            .367       .912       .422     C perv/imperv/total
35   COMMENT
    3     line(s) of comment
     *****************
     FLOW D/S OF AREA A20 - OUTLET B
     *****************
15   ADD RUNOFF
            .053      6.464       .807       .000 c.m/s
35   COMMENT
    3     line(s) of comment
     ***********************
     EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
     ***********************
 4   CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .559      6.464       .807       .000 c.m/s
            .368       .922       .395     C perv/imperv/total
15   ADD RUNOFF
            .559      6.890       .807       .000 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .559      6.890      6.890       .000 c.m/s
35   COMMENT
    3     line(s) of comment
     ***********************
     FLOW U/S OF FIRST AVE CULVERT
     ***********************
17   COMBINE
    1     Junction Node No.
            .559      6.890      6.890      6.890 c.m/s
14   START
    1     1=Zero; 2=Define
35   COMMENT
    3     line(s) of comment
     ***********
     PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
     ***********
 4   CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.198       .000      6.890      6.890 c.m/s
            .368       .906       .744     C perv/imperv/total
15   ADD RUNOFF
           1.198      1.198      6.890      6.890 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           1.198      1.198      1.198      6.890 c.m/s
17   COMBINE
    2     Junction Node No.
           1.198      1.198      1.198      1.198 c.m/s
14   START
    1     1=Zero; 2=Define
 4   CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           2.157       .000      1.198      1.198 c.m/s
            .368       .919       .753     C perv/imperv/total
15   ADD RUNOFF
           2.157      2.157      1.198      1.198 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           2.157      2.157      2.157      1.198 c.m/s
17   COMBINE
    2     Junction Node No.
           2.157      2.157      2.157      3.355 c.m/s
18   CONFLUENCE
    2     Junction Node No.
           2.157      3.355      2.157       .000 c.m/s
 4   CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .225      3.355      2.157       .000 c.m/s
            .367       .913       .695     C perv/imperv/total
15   ADD RUNOFF
            .225      3.539      2.157       .000 c.m/s
27   HYDROGRAPH DISPLAY
    5     is # of Hyeto/Hydrograph chosen
     Volume  =  .1040810E+05 c.m
10   POND
    6 Depth - Discharge - Volume sets
     182.000        .000          .0
     182.800       .0190      5251.0
     183.150       .0230      7895.0
     183.500        .238     10751.0
     183.800        .396     13425.0
     184.000       1.028     15337.0
     Peak Outflow    =      .132 c.m/s
     Maximum Depth   =   183.327 metres
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      Maximum Storage =     9342. c.m
            .225      3.539       .132       .000 c.m/s
17    COMBINE
      2     Junction Node No.
            .225      3.539       .132       .132 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       5.000     ID No.ó 99999
       1.870     Area in hectares
     112.000     Length (PERV) metres
       1.000     Gradient (%)
      50.000     Per cent Impervious
     112.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .266       .000       .132       .132 c.m/s
            .367       .916       .642     C perv/imperv/total
15    ADD RUNOFF
            .266       .266       .132       .132 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
            .266       .266       .266       .132 c.m/s
17    COMBINE
      2     Junction Node No.
            .266       .266       .266       .274 c.m/s
18    CONFLUENCE
      2     Junction Node No.
            .266       .274       .266       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ************************
 4    CATCHMENT
       6.000     ID No.ó 99999
       1.920     Area in hectares
     113.000     Length (PERV) metres
        .200     Gradient (%)
      65.000     Per cent Impervious
     113.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .339       .274       .266       .000 c.m/s
            .368       .914       .723     C perv/imperv/total
15    ADD RUNOFF
            .339       .594       .266       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
       ***********
 4    CATCHMENT
     201.000     ID No.ó 99999
       2.430     Area in hectares
     127.000     Length (PERV) metres
       1.000     Gradient (%)
      65.000     Per cent Impervious
     127.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .433       .594       .266       .000 c.m/s
            .367       .915       .723     C perv/imperv/total
15    ADD RUNOFF
            .433       .991       .266       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
            .433       .991       .991       .000 c.m/s
17    COMBINE
      1     Junction Node No.
            .433       .991       .991      7.881 c.m/s
35    COMMENT
      3     line(s) of comment
       ************************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
       ************************
18    CONFLUENCE
      1     Junction Node No.
            .433      7.881       .991       .000 c.m/s
35    COMMENT
      3     line(s) of comment
       ***********
      REALIGNED CHANNEL - SEGMENT 3
       ***********
 4    CATCHMENT
     300.000     ID No.ó 99999
       3.180     Area in hectares
     146.000     Length (PERV) metres
        .200     Gradient (%)
      15.000     Per cent Impervious
     146.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .148      7.881       .991       .000 c.m/s
            .368       .924       .451     C perv/imperv/total
15    ADD RUNOFF
            .148      8.029       .991       .000 c.m/s
 4    CATCHMENT
     301.000     ID No.ó 99999
        .720     Area in hectares
      69.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
      69.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .030      8.029       .991       .000 c.m/s
            .367       .911       .422     C perv/imperv/total
15    ADD RUNOFF
            .030      8.057       .991       .000 c.m/s
 9    ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
            .030      8.057      8.057       .000 c.m/s
17    COMBINE
      1     Junction Node No.
            .030      8.057      8.057      8.057 c.m/s
14    START
      1     1=Zero; 2=Define
35    COMMENT
      3     line(s) of comment
       ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
       ***********
 4    CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .188       .000      8.057      8.057 c.m/s
            .368       .916       .368     C perv/imperv/total
15    ADD RUNOFF
            .188       .188      8.057      8.057 c.m/s
 4    CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          2.113       .188      8.057      8.057 c.m/s
            .367       .917       .779     C perv/imperv/total
15    ADD RUNOFF
          2.113      2.151      8.057      8.057 c.m/s
27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .8226000E+04 c.m
 4    CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

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        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .127      2.151      8.057      8.057 c.m/s
             .367       .914       .695     C perv/imperv/total
15     ADD RUNOFF
             .127      2.246      8.057      8.057 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .8577177E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
        178.800        .000          .0
        179.300       .0260      1520.0
        180.100       .0440      4649.0
        180.600        .414      7069.0
        180.800       1.204      8137.0
        Peak Outflow    =      .250 c.m/s
        Maximum Depth   =   180.379 metres
        Maximum Storage =     5999. c.m
             .127      2.246       .250      8.057 c.m/s
17     COMBINE
       1     Junction Node No.
             .127      2.246       .250      8.089 c.m/s
14     START
       1     1=Zero; 2=Define
35     COMMENT
       3     line(s) of comment
        ***********
        PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
        ***********
 4     CATCHMENT
       33.000     ID No.ó 99999
       12.960     Area in hectares
      294.000     Length (PERV) metres
        1.000     Gradient (%)
       75.000     Per cent Impervious
      294.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          2.640       .000       .250      8.089 c.m/s
           .368       .922       .783     C perv/imperv/total
15     ADD RUNOFF
          2.640      2.640       .250      8.089 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .7430276E+04 c.m
 4     CATCHMENT
       34.000     ID No.ó 99999
         .660     Area in hectares
       66.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       66.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .122      2.640       .250      8.089 c.m/s
             .367       .914       .695     C perv/imperv/total
15     ADD RUNOFF
             .122      2.731       .250      8.089 c.m/s
27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .7766209E+04 c.m
10     POND
       6 Depth - Discharge - Volume sets
        178.300        .000          .0
        178.900       .0350      1927.0
        179.600       .0540      4692.0
        179.800        .150      5590.0
        180.000        .321      6538.0
        180.300       1.922      8059.0
        Peak Outflow    =      .221 c.m/s
        Maximum Depth   =   179.883 metres
        Maximum Storage =     5982. c.m
             .122      2.731       .221      8.089 c.m/s
17     COMBINE
       1     Junction Node No.
             .122      2.731       .221      8.131 c.m/s
14     START
       1     1=Zero; 2=Define
18     CONFLUENCE
       1     Junction Node No.
             .122      8.131       .221       .000 c.m/s
35     COMMENT
       3     line(s) of comment
        ************************
        REALIGNED CHANNEL - SEGMENT 3
        ************************
 4     CATCHMENT
      302.000     ID No.ó 99999
        1.610     Area in hectares
      104.000     Length (PERV) metres
         .200     Gradient (%)
       10.000     Per cent Impervious
      104.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
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        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .057      8.131       .221       .000 c.m/s
               .367       .910       .422     C perv/imperv/total
35     COMMENT
       3     line(s) of comment
        ***************************
        FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
        ***************************
15     ADD RUNOFF
               .057      8.188       .221       .000 c.m/s
14     START
       1     1=Zero; 2=Define
```