PRELIMINARY SERVICING AND STORMWATER MANAGEMENT REPORT
PERTHMORE SUBDIVISION - PHASE 6

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TABLE OF CONTENTS

1.0 PROJECT DESCRIPTION 1
1.1 Purpose 1
1.2 Site Description 1
2.0 BACKGROUND INFORMATION 2
3.0 EXISTING SERVICES 2
4.0 SERVICING PLAN 3
4.1 Proposed Servicing Overview 3
4.2 Watermain Design 3
4.3 Sanitary Sewer Design 4
4.4 Storm Sewer Design 4
4.5 Site Utilities 6
4.6 Service Locations/Cover 6
5.0 PROPOSED STORMWATER MANAGEMENT 6
5.1 Design Criteria and Methodology 6
5.2 Runoff Calculations 7
5.3 Pre-Development Parameters 7
5.3.1 General 7
5.3.2 Time of Concentration/Time to Peak 8
5.3.3 SCS Curve Number 8
5.3.4 Rainfall 9
5.4 Pre-Development Results 9
5.5 Post-Development Drainage 10
5.5.1 Post-Development Parameters 10
5.6 Quantity Control 11
5.6.1 Major Drainage Route 12
5.7 Quality Control 13
5.7.1 Best Management Practices 13
6.0 SEDIMENT EROSION CONTROL 14

6.1 Temporary Measures 14
6.2 Permanent Measures 14
7.0 SUMMARY 15
8.0 RECOMMENDATIONS 16
9.0 STATEMENT OF LIMITATIONS 17

LIST OF TABLES

Table 1 – Time to Peak 8
Table 2 – Curve Number 8
Table 3 – Pre-Development Calculated Flows 9
Table 4 – Post-Development Hydrologic Model Parameters 11
Table 5 – Post-Development Calculated Flows 12
Table 6 - Post-Development Calculated Flows 12

LIST OF FIGURES

Figure 1 - Pre-Development Drainage Areas 7
Figure 2 – Additional Post-Development Sub-Catchments 10

APPENDICES

APPENDIX A: Location Plan
APPENDIX B: Watermain Design
APPENDIX C: Sanitary Sewer Design
APPENDIX D: Storm Sewer Design
APPENDIX E: Existing Conditions Memo

1.0 PROJECT DESCRIPTION

1.1 Purpose

McIntosh Perry (MP) has been retained by Perthmore Developments Co. to prepare this Preliminary Servicing and Stormwater Management Report in support of the Draft Plan of Subdivision Application for Phase 6 of the Perthmore Subdivision in Perth, Ontario.

The main purpose of this report is to present preliminary servicing options for the development in accordance with the recommendations and guidelines provided by the Ministry of the Environment, Conservation and Parks (MECP), Rideau Valley Conservation Authority (RVCA) and the Town of Perth (Town). This report will address the servicing for the entire development so that an overall servicing scheme can be presented, ensuring that existing and available services will adequately service the proposed development.

1.2 Site Description

The subject property is generally located within the northeastern quadrant of the Town of Perth and south of provincial Highway 7. The property is legally described as Part of the northeast and southwest halves of Lot 3 and the southwest half of Lot 4, Concession 2, within the geographic Township of Drummond now in the Town of Perth and part of Block 15 registered plan 27M-21. This phase of development encompasses approximately 11.10 hectares and is bound by vacant land to the north and east, and by the existing phases of the subdivision immediately to the south and west. Refer to the Draft Plan of Subdivision in Appendix 'A' for more details.

The topography of the site varies with a ridge generally bisecting the property near the western limit and splitting the drainage in easterly and westerly directions. The elevation generally slopes off near the eastern limit at the propose tie-in point of Street B and the future roadway. The land is generally overgrown with a variety of grass, shrubs and bush along with some trees located at the northeast portion of the site. At the time of writing of this report, portions of the property have been cleared or are in the process of being cleared.

Phase 6 is made up of 65 lots with 42 single family homes and 23 semi-detached units. There is also approximately 885 meters of associated municipal roadway and municipal services. The Town and the RVCA will be reviewing and approving this report as part of the Draft Plan of Subdivision Application.

2.0 BACKGROUND INFORMATION

Background studies that have been completed for the site include review of as-built drawings, a topographical survey of the site, along with servicing and stormwater reports from previous phases of the development.

Various as-built drawings, design drawings, and design calculations for the existing subdivision services were reviewed in order to determine proper servicing schemes for the site.

A topographic survey of the site was completed by MPSI dated August, 2020 and can be found under separate cover.

The following reports have previously been completed and are available under separate cover:

- Drainage Design Report – Perthmore Subdivision Phase 3 prepared by McIntosh Hill dated March 1998.
- Sanitary Sewer Report – Perthmore Subdivision Phase 3 prepared by McIntosh Hill dated February 1998.
- Stormwater Management Report – Perthmore Subdivision Phase 4 prepared by McIntosh Perry dated September 12, 2002
- Preliminary Stormwater Management Report – Perthmore Subdivision Phase 5 prepared by McIntosh Perry dated February 17, 2004

3.0 EXISTING SERVICES

Phase 6 of the Perthmore Subdivision will be serviced partially via existing services and infrastructure within the existing phases of the development. Newly proposed storm sewers and an associated stormwater management facility will provide storm service for the project.

Existing services within Senators Gate Drive include a 200mm sanitary sewer, a 200mm watermain and a 450mm storm sewer. Existing Services within Perthmore Street include a 200mm sanitary sewer, a 300mm watermain and a 525mm storm sewer. Stubs have been left at the intersection of Senators Gate Drive and Perthmore Street. There are stubs extending in both the northeast and northwest directions. Stubs have also been left at the intersection of Senators Gate Drive and Street B. The storm sewer at this intersection is a 300mm, the sanitary and water are both 200mm in diameter.

The above-described storm sewers are currently served by a previously constructed stormwater management facility located south of Phase 6 that is proposed to be combined and upgraded as part of the Phase 6 design process.

Gas, hydro, cable and telephone utilities are available nearby and locations will be confirmed from respective utility companies during detailed design process.

4.0 SERVICING PLAN

4.1 Proposed Servicing Overview

The overall servicing of Phase 6 of the subdivision will be accomplished through multiple connections to the existing stubs as detailed below. See below for more details pertaining to each specific service.

4.2 Watermain Design

Water servicing for the proposed development will be accomplished through connections at three locations: to the existing 200mm stub at the intersection of Senators Gate Drive and Street B, and to the existing 300mm and 200mm stubs at the intersection of Senators Gate Drive and Perthmore Street. The watermain will be 200mm or 300mm in diameter throughout Phase 6. Flow control valves will be installed as required. See *Drawing 100 – General Plan of Services* for details pertaining to the layout of the watermain.

Fire hydrants will be located on-site as required. The fire hydrants will be spaced 90m to 180m apart in order to meet municipal firefighting requirements. The fire hydrants will be owned and operated by the Town. Individual water services will be installed and will be Pex conforming to AWWA C904. Curb stops will be installed on all water services on the property line, away from driveways and any aboveground utilities. All watermains and associated structures will be designed and constructed per the design criteria detailed in the Design Guidelines for Drinking-Water Systems 2008 by the MECP and constructed per the Ontario Provincial Standard Details (OPSD's).

The watermain is designed to have a minimum of 2.4m cover and when crossing over or under utilities the watermain will have a minimum 0.3m clearance. A minimum horizontal separation of 2.5m (from pipe wall to pipe wall) will be maintained between the proposed watermain and storm/sanitary mains.

Water demands have been calculated per MECP Design Guidelines for Drinking-Water Systems 2008. The population for Phase 6 is calculated as 204.9 people creating the following demands:

- Average Day Flow = 39.84 L/min
- Max. Day Flow = 99.60 L/min
- Peak Hourly Flow = 149.41 L/min

See *Water Demands Sheet* in Appendix 'B' of this report for more details.

Prior to connecting to the municipal water distribution system, it is essential to determine whether the system has adequate capacity and that the overall impact to the existing system is minimal. A WaterCAD model will be generated at the detailed design stage to confirm the capacity, pressure and size of pipes required to service the proposed site.

4.3 Sanitary Sewer Design

The sanitary sewers for the Subdivision will flow by gravity to the existing sanitary sewers. Sanitary connections will be made to the stubs at the intersection of Senators Gate Drive and Perthmore Street. A new sanitary sewer will also be extended from Street B through an easement and the existing pond block and to the existing sanitary main within Perthmore Street at Decaria Boulevard. See *Drawing 100 – General Plan of Services* for details pertaining to the layout of the sanitary sewers.

The sanitary sewers within the new phase of development are 200mm diameter will be installed throughout with a minimum full flow target velocity (cleansing velocity) of 0.6 m/s and a full flow velocity of not more than 3.0 m/s. A target velocity of 0.6 m/s in the pipe may not be feasible on every length of pipe, as the capture area for the uppermost mains in the system is relatively small. This issue is dealt with by increasing the slopes of the sanitary sewers on the uppermost mains. All sewers and associated structures will be designed and constructed per the design criteria detailed in the Design Guidelines for Sewage Works 2008 by the MECP and constructed per the Ontario Provincial Standard Details (OPSD's).

Design parameters for Phase 6 include an extraneous infiltration rate of 0.33 L/s/ha. Daily per capita flow rates of 280 L/p/d and residential densities of 3.4 persons per single unit, 2.7 persons per semi-detached units, and 60 persons per net hectare of futured development blocks were used in the design of this development. The residential peaking factor used is based on the Harmon Equation, with a maximum of 4.0 and a minimum of 2.0.

Phase 6 of the subdivision has been accounted for in the design of sanitary sewers of previous phases. As noted above the new phase of the subdivision will have multiple sanitary outlets. Ultimately the flows will be directed towards the Treelawn Boulevard and to Garden Avenue sewer outlets. Within the *Perthmore Development Phase III – Sanitary Sewer Report*, dated February 1998 by McIntosh Hill, the Treelawn Boulevard and Garden Avenue Sewers have been sized to accommodate the full buildout of the Perthmore Subdivision.

It was assumed the total number of lots being serviced by the Treelawn Boulevard sewer would be 258 lots with a total flow of 17.6L/s for the full buildout of the development. According to the previous report the existing 200mm sanitary sewer within Treelawn Boulevard is sloped at 0.40%, therefore the total capacity of the pipe is approximately 21.64 L/s. Phase 6 of the development will generate a total flow of 8.72 L/s to be captured by the Treelawn Boulevard sanitary sewer. This also includes Blocks 67-69 which have been accounted for as high-density residential developments.

See *Sanitary Sewer Design Sheet* and *PP-13-9668-01 – Sanitary Drainage Areas - SAN* in Appendix 'C' of this report for more details.

4.4 Storm Sewer Design

Stormwater runoff will be conveyed through curb and gutter and rear-yard swale networks towards catch basins, where it will be captured and conveyed into the new storm sewer network. The storm sewers are designed with a minimum of 1.5m cover. The storm sewer network within the subdivision is designed to accommodate a storm event with a 5-year return period. Storms in excess of this event will result in surcharging at catch basin and road sag locations. Stormwater runoff during these major events will be conveyed via overland flow routes within rear-yard swales and along the roadway, as is typical in subdivisions of this nature. A detailed lot grading and drainage plan will prepared during the detailed design stage outlining the proposed drainage pattern within the subdivision.

The storm sewers within Phase 6 will flow by gravity to a newly proposed stormwater management facility generally located where the current facility is constructed. A new storm sewer will also be extended from Street B through an easement and to a new facility. As previously noted, the pond will be upgraded in this phase of the development as detailed in Section 6.0. See *Drawing 100 – General Plan of Services* for details pertaining to the layout of the storm sewers.

Due to topographical constraints, Block 66 will be designed independently from a stormwater management perspective. It is not feasible to capture runoff from this block within the drainage area of the proposed pond. Further analysis will be carried out during the detailed design stage.

The storm sewers within this phase of development range in diameter from 250mm to 900mm and are designed with a minimum full flow target velocity (cleansing velocity) of 0.8 m/s (cleansing velocity) and a full flow velocity of not more than 3.0 m/s. No storm sewer will have a slope less than 0.1%. Appropriately sized maintenance holes will be installed at every change in pipe size or direction and will be spaced no more than 120m apart in order to facilitate cleaning and maintenance. All sewers and associated structures will be designed and constructed per the design criteria detailed in the Design Guidelines for Sewage Works 2008 by the MECP and constructed per the Ontario Provincial Standard Details (OPSD's).

A preliminary storm sewer design sheet was created using the rational method, which allows for the proper sizing of the storm pipes within the development. Drainage area information, along with respective pipe slopes and other necessary information was utilized to evaluate the performance of the storm sewer network. The time of concentration calculated for the storm sewer system is based on a 20-minute inlet time. Rainfall intensities were obtained from Intensity-Duration-Frequency (IDF) curves for the Town of Perth from the Ministry of Transportation (MTO).

The preliminary storm sewer design sheet identifies the 5-year flow that is conveyed through each pipe section of the storm sewer network. The peak flow and peak velocity are the maximum results based on gravity flow. Included in the sheet is the full flow capacity of the pipe and the associated full flow velocity, when the pipe is under gravity flow condition. The peak flow was checked against the full flow capacity to ensure that each storm sewer pipe can convey the 5-year flow unrestricted.

The proposed storm sewer layout and approach is further detailed in Section 5.0 *Proposed Stormwater Management.*

See *Storm Sewer Design Sheet* and *PP-13-9668-01 - Storm Drainage Areas - STM* in Appendix 'D' of this report for more details regarding pie sizing.

4.5 Site Utilities

All relevant utility companies will be contacted prior to construction in order to confirm adequate utility servicing for the site. Existing utilities are present in prior phases of the development and will be extended to provide service for this phase.

4.6 Service Locations/Cover

The minimum cover for the sanitary, storm and water mains will be as follows:

Service	Minimum Cover
Sanitary Sewer	1.8m
Storm Sewer	1.5m
Watermain	2.4m

All minimum cover requirements are as per municipal standards. Separation distances between the storm, water and sanitary will be maintained as per the MECP requirements.

5.0 PROPOSED STORMWATER MANAGEMENT

5.1 Design Criteria and Methodology

In the absence of a subwatershed plan for this area, the MECP *Stormwater Management Planning and Design Manual* (March 2003) is used to govern the management of stormwater. This methodology promotes stormwater management from an environmentally sustainable perspective. The intent of the stormwater management plan is to provide adequate stormwater treatment for both quantity and quality control.

Stormwater Best Management Practices (BMPs) will be implemented at the “lot level” and “conveyance” locations. These concepts are explained further in Section 5.7.1. To summarize, roof water will be directed to grass surfaces that in turn will be collected in grassed swales or in rear yard/roadway catchbasins prior to entering into the proposed storm sewer network.

An existing stormwater management (SWM) pond is located on the northeast side of Perthmore Street as shown on Figure 1, below. As part of development of this subsequent phase, this SWM facility will be reconstructed and expanded to address the water quality and quantity control requirements for the tributary drainage area.

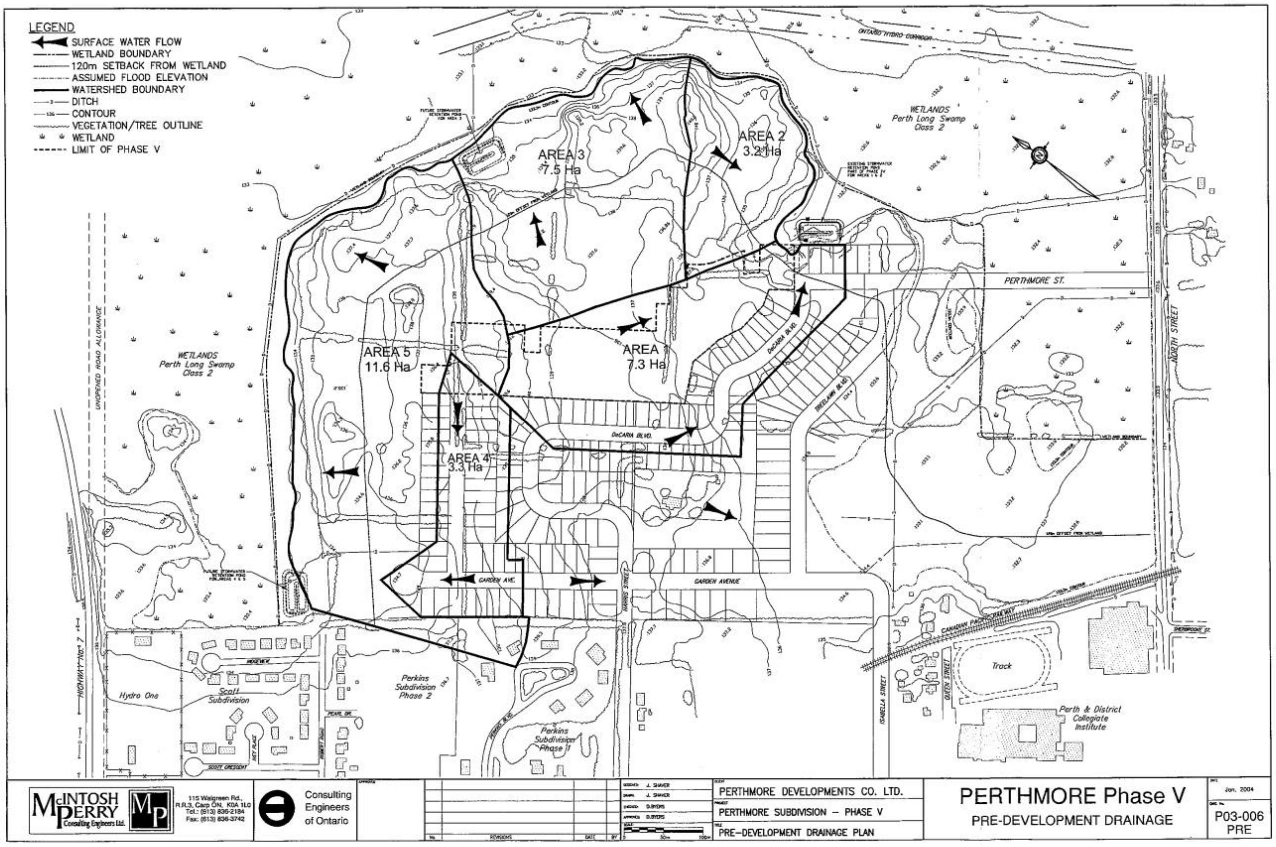


Figure 1 - Pre-Development Drainage Areas

5.2 Runoff Calculations

As stated previously, as part of the development of this subsequent development phase, the existing SWM facility will be reconstructed and expanded. Therefore, for the SWM design, the pre-development flows, to be used as the target flows for the quantity control, were also reassessed.

A Visual OTTHMO Version 5 (VO5) model was assembled for the analysis. As shown in the figure above, the pre-development tributary area to the SWM facility consists of Areas 1 and 2 and the total tributary pre-development drainage area is 10.5 ha. The VO5 hydrologic model requires various measured and calculated input parameters. The calculations of these input parameters area detailed below.

5.3 Pre-Development Parameters

5.3.1 General

Since the pre-development land use was rural, the NASHYD command was employed in the VO5 model to calculate the runoff flows. NASHYD is used to simulate runoff flows with NASH instantaneous unit hydrograph. This hydrograph is made of a cascade of “n” linear reservoirs. The n (number of linear reservoirs) parameter was set at 3, in the model, and the rainfall losses were computed by the SCS CN procedure.

5.3.2 Time of Concentration/Time to Peak

The Time of Concentration (Tc), for the pre-development drainage basins, was calculated using the Airport Formula.

$T_c = 3.26 * (1.1 - C) * L^{0.5} * S_W^{-0.33}$

Where:

- Tc = time of concentration in minutes
- C = runoff coefficient
- L = watershed length in metres
- S_W = watershed slope in percentage

From the Tc value, the Time to Peak (Tp) value was calculated as 0.67 times Tc. The parameters employed in the calculation of Tc and Tp for the two drainage basins are show in Table 1.

Table 1 – Time to Peak

Sub-Catchment	Area	Flow Length	Fall	Slope	Tc[1]	Tp[2]
	ha	m	m	%	min	hrs
Area 1	7.3	435	7	1.61	58.1	0.65
Area 2	3.2	165	7	4.24	26.0	0.29

Notes: 1 – Airport Formula
2 – 0.67*Tc

5.3.3 SCS Curve Number

The Curve Number (CN) is the most important parameter in determining surface runoff when the SCS equation is used. Table 2 shows the parameters and the resulting CN value for Areas 1 and 2.

Table 2 – Curve Number

Sub-Catchment	Soil Type	Hydrologic	Land Use	Runoff	CN[3]	Ia
		Soil Group[1]	(0-5% Slope)	Coefficient[2]	(AMC II)	mm
Area 1	Sandy Loam	AB	Pasture	0.10	59	5
Area 2	Sandy Loam	AB	Pasture	0.10	59	5

Notes: 1 – MTO Drainage Management Manual – Design Chart 1.08
2 - MTO Drainage Management Manual – Design Chart 1.07
3 - MTO Drainage Management Manual – Design Chart 1.09 (Pasture, fair condition – average of A and B Hydrologic Soil Groups)

5.3.4 Rainfall

For the rainfall input to the VO5 model, the 12 hour SCS rainfall distribution, representing a high volume lower intensity storm, and a 4 hour Chicago rainfall distribution, representing a high intensity "thunder storm" type of rainfall event were used ion the analysis. The Intensity-Duration-Frequency (IDF) curve was obtained from the Ministry of Transportation (MTO) IDF Curve Lookup tool with the location centred over the property.

5.4 Pre-Development Results

Employing the above noted parameters and the VO5 hydrologic model, Table 3 shows the calculated pre-development flow values for the 12-hour SCS and 4-hour Chicago rainfall hyetographs. These flow values will be used for the water quantity control assessment of the reconstructed SWM facility. The redesign of the end of pipe facility will also include water quality control for the post-development tributary drainage area.

Table 3 – Pre-Development Calculated Flows

	12 hour SCS			4 hour Chicago		
Return Period	Area 1	Area 2	Total	Area 1	Area 2	Total
Yrs	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
2	0.06	0.05	0.09	0.03	0.02	0.05
5	0.11	0.09	0.17	0.06	0.04	0.09
10	0.14	0.11	0.22	0.08	0.06	0.12
25	0.20	0.15	0.30	0.11	0.08	0.17
50	0.24	0.18	0.37	0.14	0.10	0.21
100	0.29	0.22	0.44	0.17	0.12	0.25

5.5 Post-Development Drainage

In addition to the previous subdivision phases tributary to the existing SWM facility (Area 1 shown in Figure 1), the sub-catchments shown in Figure 2, below, will drain to the reconstructed and expanded SWM facility. As noted above, Block 66 will be designed and captured independently due to topographical constraints.

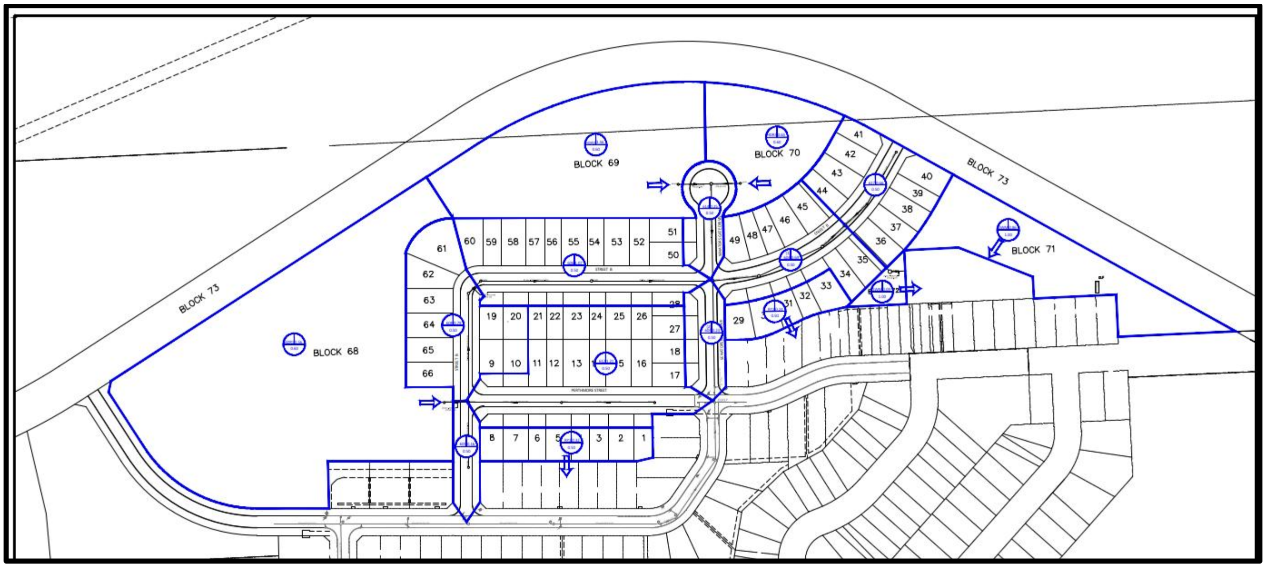


Figure 2 – Additional Post-Development Sub-Catchments

5.5.1 Post-Development Parameters

For the post-development hydrologic analysis, since the proposed development is fully urban with full municipal services, the STANHYD command was used in the VO5 model. Table 4 shows the post-development input parameters for the VO5 model. Blocks 68, 69 and 70 are slated for high density residential development and therefore the total imperviousness and directly connected parameters were set accordingly. The previous phases and the remaining sub-catchments, in the proposed additional phase, are slated or have been constructed as single-family residential development. The total imperviousness and directly connected parameters were calculated based on a typical lot in the existing development area. The flow lengths for the pervious area were assumed to be 10 m and the flow lengths for the impervious area were calculated by the standard equation in the VO5 model as shown in the notes below the table. Lastly, the slopes used in the model for pervious and impervious areas were assumed to be 2.0% and 1.0% respectively.

Table 4 – Post-Development Hydrologic Model Parameters

					Pervious Area				Impervious Area			
Sub-Catchment	Area	Total Imp.	Directly Connected	CN	Slope	Flow Length	Manning n	Ia	Slope	Flow Length[3]	Manning n	Depression Storage
	ha	%	%		%	m		mm	%			mm
Block 67	1.56	70.0	60.0	59.0	2.0	10.0	0.25	5.0	1.0	102.0	0.13	1.0
Block 68	1.56	70.0	60.0	59.0	2.0	10.0	0.25	5.0	1.0	102.0	0.13	1.0
Block 69	0.65	70.0	60.0	59.0	2.0	10.0	0.25	5.0	1.0	65.8	0.13	1.0
SWM Block[4]	0.95	90.0	85.0	59.0	2.0	10.0	0.25	5.0	1.0	79.6	0.13	1.0
Previous Phases	7.3	50.0	35.0	59.0	2.0	10.0	0.25	5.0	1.0	220.6	0.13	1.0
Remainder[5]	5.62	50.0	35.0	59.0	2.0	10.0	0.25	5.0	1.0	193.6	0.13	1.0

Notes

1 -0 Airport Formula

2 - 0.67* Tc

3 - Flow Length = SquareRoot (Area/1.5) - (Area in square metres)

4 - Blocks 70 and 71

5 - 604(1), 604(2), 606, 608, 609, 612, 614, 617, RY1 and RY2

5.6 Quantity Control

The quantity control for the site will mainly be provided by the reconstructed end of pipe facility. For Blocks 67, 68 and 69 the hydrologic modelling assumes that the peak flows, up to and including the 100-year storm event, from the blocks are controlled to the 5-year level through the use of on-site detention storage. The preliminary calculation of the required on-site detention storage is 350 m^3 for Blocks 67 and 68 and 180 m^3 for Block 69. The imperviousness value for the SWM block was assumed to be high, since and rainfall on the block would be converted to direct runoff.

Tables 5 and 6 show the calculated post-development and controlled flow values outletting from the proposed reconstructed SWM facility. To provide the quantity control as shown in the tables would require a total of 9000 m^3 of detention storage. Further details of the SWM facility will be developed during detailed design.

Table 5 – Post-Development Calculated Flows

12 hour SCS								
Return Period	Block 68[1]	Block 69[1]	Block 70[1]	SWM Block[2]	Previous Phases	Remainder[3]	Total[4]	Controlled Flow[5]
Yrs	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
2	0.09	0.09	0.03	0.13	0.53	0.41	1.26	0.06
5	0.12	0.12	0.05	0.18	0.78	0.60	1.81	0.09
10	0.14	0.14	0.06	0.21	0.93	0.72	2.16	0.12
25	0.17	0.17	0.07	0.25	1.17	0.90	2.70	0.17
50	0.19	0.19	0.08	0.28	1.34	1.03	3.08	0.22
100	0.22	0.22	0.09	0.31	1.55	1.19	3.53	0.29

Notes: 1 - Controlled flows with on-site storage

2 - Blocks 70 and 71

3 - 604(1), 604(2), 606, 608, 609, 612, 614, 617, RY1 and RY2

4- Inflow to reconstructed SWM Pond

5- Includes 100-year flows controlled to post-development 5-year flows for Blocks 67, 68 and 69

Table 6 - Post-Development Calculated Flows

4 hour Chicago								
Return Period	Block 68[1]	Block 69[1]	Block 70[1]	SWM Block[2]	Previous Phases	Remainder[3]	Total[4]	Controlled Flow[5]
Yrs	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
2	0.07	0.07	0.03	0.16	0.51	0.40	1.21	0.05
5	0.10	0.10	0.04	0.22	0.74	0.57	1.71	0.07
10	0.12	0.12	0.05	0.26	0.89	0.69	2.07	0.09
25	0.14	0.14	0.05	0.30	1.10	0.85	2.52	0.11
50	0.16	0.16	0.06	0.34	1.27	0.97	2.88	0.14
100	0.18	0.18	0.07	0.37	1.43	1.10	3.25	0.17

Notes: 1 - Controlled flows with on-site storage

2 - Blocks 70 and 71

3 - 604(1), 604(2), 606, 608, 609, 612, 614, 617, RY1 and RY2

4- Inflow to reconstructed SWM Pond

5- Includes 100-year flows controlled to post-development 5-year flows for Blocks 67, 68 and 69

5.6.1 Major Drainage Route

The pipe network within the subdivision will be designed to accommodate the 5-year storm. Storm events greater that 5-year will make use the roadway as the major drainage route and this will be incorporated into the grading plan design. The roadway will direct these flows to the proposed SWM pond. Rear yard drainage swales and easements will be incorporated to provide additional overflow capacity.

5.7 Quality Control

Water quality control will be provided by the reconstructed SWM facility. The facility will be designed as a wet pond to provide an enhanced level of water quality control (80% T.S.S. removal). Table 3.2 in the *Stormwater Management Planning and Design Manual* was used to calculate the required storage volume. The weighted impervious level for the total tributary drainage area is 55.5%. Therefore, interpreting between the specific storage volumes shown in Table 3.2, a total 200 m^3/ha or 3550 m^3 of storage volume is required to provided an enhanced level of treatment. For the wet pond the permanent pool volume would be 2850 m^3 and the extended detention volume (700 m^3) can be combined with the water quantity volume detailed in Section 6.6.

Therefore, the total storage volume required for the reconstructed SWM facility would be 11,850 m^3. The design of the SWM facility will be advanced during detailed design.

5.7.1 Best Management Practices

The entire subdivision will employ Best Management Practices (BMPs) wherever possible. The intent of implementing stormwater BMPs throughout the entire development is to ensure that water quality and quantity concerns are addressed at all stages of the development. Stormwater BMPs will be implemented at lot, conveyance and end of pipe levels.

Lot level BMPs include the directing of roof leaders onto grassed areas, minimizing ground slopes and maintaining as much of the lot as possible in a natural state. Roof leaders will flow to grass areas, which will provide an opportunity for initial filtration of any sediment, and provide an opportunity for absorption and ground water recharge. Recent recommendations by a number of Conservation Authorities and the MOECP suggest that yard grading as flat as 0.5% be implemented to promote infiltration. The target range for finished ground slopes will be 1% - 5% where possible. This range of slope will still provide an opportunity for the absorption and filtration process.

The conveyance system to be employed within the subdivision is a combination of side/rear swales and road catchbasins. All swales will be constructed at minimal gradient where possible, thus promoting absorption and infiltration, as well as providing some opportunity for particle filtration. The gradient of the system will be enough to ensure the continuous flow of stormwater, limiting any standing water. Rip rap will be placed at erosion-prone areas and all disturbed areas shall be landscaped as soon as possible.

6.0 SEDIMENT EROSION CONTROL

6.1 Temporary Measures

Before construction begins, temporary silt fence, straw bales or rock flow check dams will need to be installed at all-natural runoff outlets from the property. It is crucial that these controls be maintained throughout construction and inspection of sediment and erosion control will be facilitated by the Contractor or Contract Administration staff throughout the construction period.

The Contractor, at their discretion or at the instruction of the Town of Perth, RVCA or the Contract Administrator shall increase the quantity of sediment and erosion controls on-site to ensure that the site is operating as intended and no additional sediment finds its way into the storm sewer network on site. The straw bales and silt fences shall be inspected weekly and after rainfall events. Care shall be taken to properly remove sediment from the fences and check dams as required.

Work through winter months shall be closely monitored for erosion along sloped areas. Should erosion be noted, the Contractor shall be alerted and shall take all necessary steps to rectify the situation. Should the Contractor's efforts fail at remediating the eroded areas, the Contractor shall contact the Conservation Authority to review the site conditions and determine the appropriate course of action.

As each lot is developed, proper sediment and erosion controls will need to be installed and maintained. Sediment controls shall consist of, at minimum, straw bales at the down gradient property line. Grass shall be established as soon as possible and excess fill shall be removed or leveled promptly. All manholes, catch basins and other drainage structures shall be covered in geosock when installed.

6.2 Permanent Measures

Rip-rap will be placed at all locations that have the potential for concentrated flow. It is crucial that the Contractor ensure that the geotextile is keyed in properly to ensure runoff does not undermine the rip rapped area. Additional rip rap is to be placed at erosion prone locations as identified by the Contractor / Contract Administrator / Town of Perth or RVCA.

It is expected that the Contractor will promptly ensure that all disturbed areas receive topsoil and seed/sod and that grass be established as soon as possible. Any areas of excess fill shall be removed or levelled as soon as possible and must be located a sufficient distance from any watercourse to ensure that no sediment is washed out into the watercourse. As the vegetation growth within the site provides a key component to the control of sediment for the site, it must be properly maintained once established. Once the construction is complete, it will be up to the landowner to maintain the vegetation and ensure that the vegetation is not overgrown or impeded by foreign objects.

7.0 SUMMARY

- A new subdivision with 42 single family homes, 23 semi-detached homes will be constructed in Phase 6 of the Perthmore Subdivision.
- Proposed watermains ranging in diameter from 200mm to 300mm will be installed throughout the subdivision and will have multiple connection points to existing infrastructure.
- The proposed sanitary sewer will be 200 mm in diameter, will be installed throughout the subdivision and will gravity drain through the existing subdivision infrastructure though multiple connections.
- The proposed storm sewer, ranging in diameter from 250 mm to 900 mm, will be installed throughout the subdivision and will drain to a newly proposed stormwater management facility that will replace the existing facility.
- Stormwater quantity and quality control will be provided by the reconstructed SWM facility. The facility will be designed as a wet pond to provide an enhanced level of water quality control (80% T.S.S. removal).
- Sediment and erosion protection measures will be installed as soon as ground conditions warrant and permit and shall remain in place until construction is complete and vegetation is re-established.

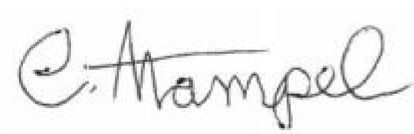
8.0 RECOMMENDATIONS

Based on the information presented in this report, we recommend that the Town approve this Preliminary Servicing and Stormwater Management Report in support of the Draft Plan of Subdivision Application for Phase 6 of the Perthmore Subdivision.

This report is respectfully being submitted for Draft Plan of Subdivision Application.

Regards,

McIntosh Perry Consulting Engineers Ltd.



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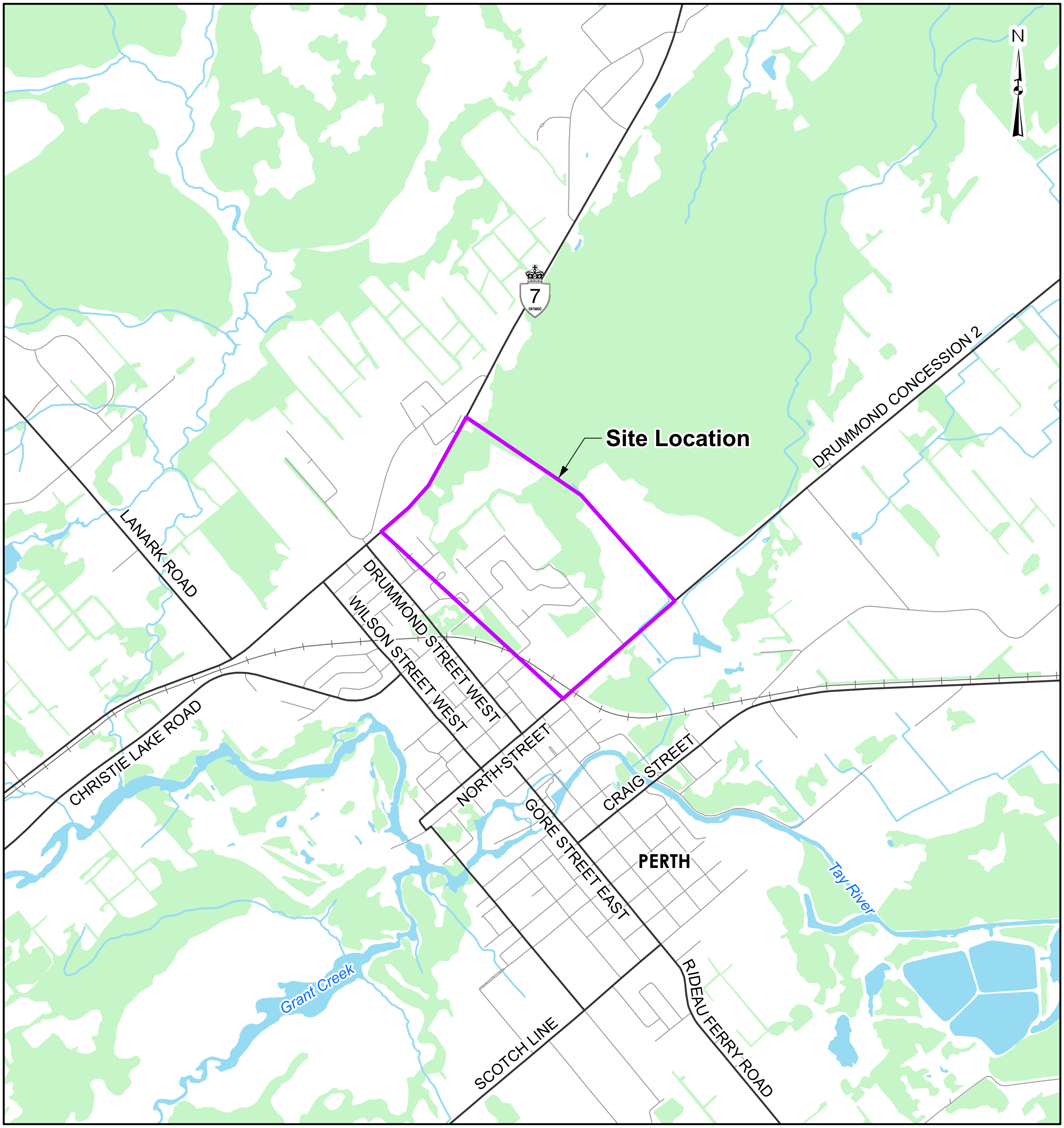
9.0 STATEMENT OF LIMITATIONS

This report was produced for the exclusive use of Perthmore Developments Co. The purpose of the report is to assess the existing servicing infrastructure and to provide recommendations and designs for the post-construction scenario that are in compliance with the guidelines and standards from the Ministry of the Environment, Conservation and Parks, Town of Perth and local approval agencies. McIntosh Perry reviewed the site information and background documents listed in Section 2.0 of this report. While the previous data was reviewed by McIntosh Perry and site visits were performed, no field verification/measures of any information were conducted.

Any use of this review by a third party, or any reliance on decisions made based on it, without a reliance report is the responsibility of such third parties. McIntosh Perry accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this review.

The findings, conclusions and/or recommendations of this report are only valid as of the date of this report. No assurance is made regarding any changes in conditions subsequent to this date. If additional information is discovered or becomes available at a future date, McIntosh Perry should be requested to re-evaluate the conclusions presented in this report, and provide amendments, if required.

APPENDIX A
LOCATION PLAN



1,000 500 0 1,000

Scale 1:30,000 Metres

LEGEND

- Approximate Site Boundary
- Local Road
- Major Road
- Railroad
- Watercourse
- Waterbody
- Wooded Area

REFERENCE

GIS data provided by the Ontario Ministry of Natural Resources and Forestry, 2020.

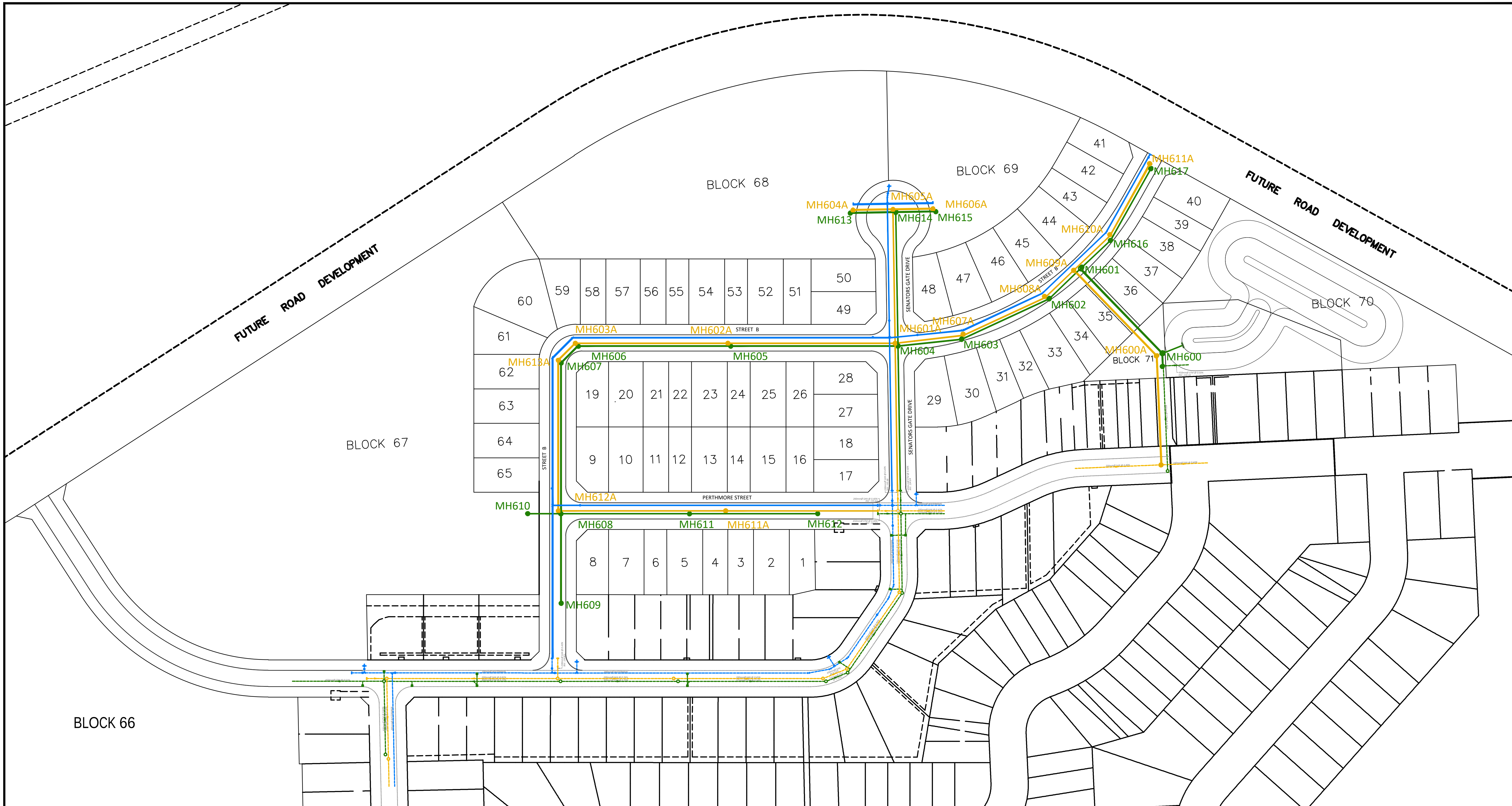
CLIENT:
PERTHMORE DEVELOPMENT CO.

PROJECT:
PERTHMORE SUBDIVISION PHASE 6

TITLE:
LOCATION PLAN

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

PROJECT NO:PP-13-9668-01		FIGURE:
Date	Dec., 21, 2020	1
GIS	EU	
Checked By	CH	



LEGEND

- - - -	EXISTING WATERMAIN
———	PROPOSED WATERMAIN
- - - -	EXISTING SANITARY SEWER
———	PROPOSED SANITARY SEWER
- - - -	EXISTING STORM SEWER
———	PROPOSED STORM SEWER

N

McINTOSH PERRY

115 Walgreen Road, RR3, Carp, ON K0A 1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

Drawn by: P.G.K.	Checked By: R.P.K.
Scale: 1:2000	Project Number: PP-13-9668-01

Client: PERTHMORE DEVELOPMENT CO.
80 DUFFERIN STREET PERTH, ON K7H 3M6

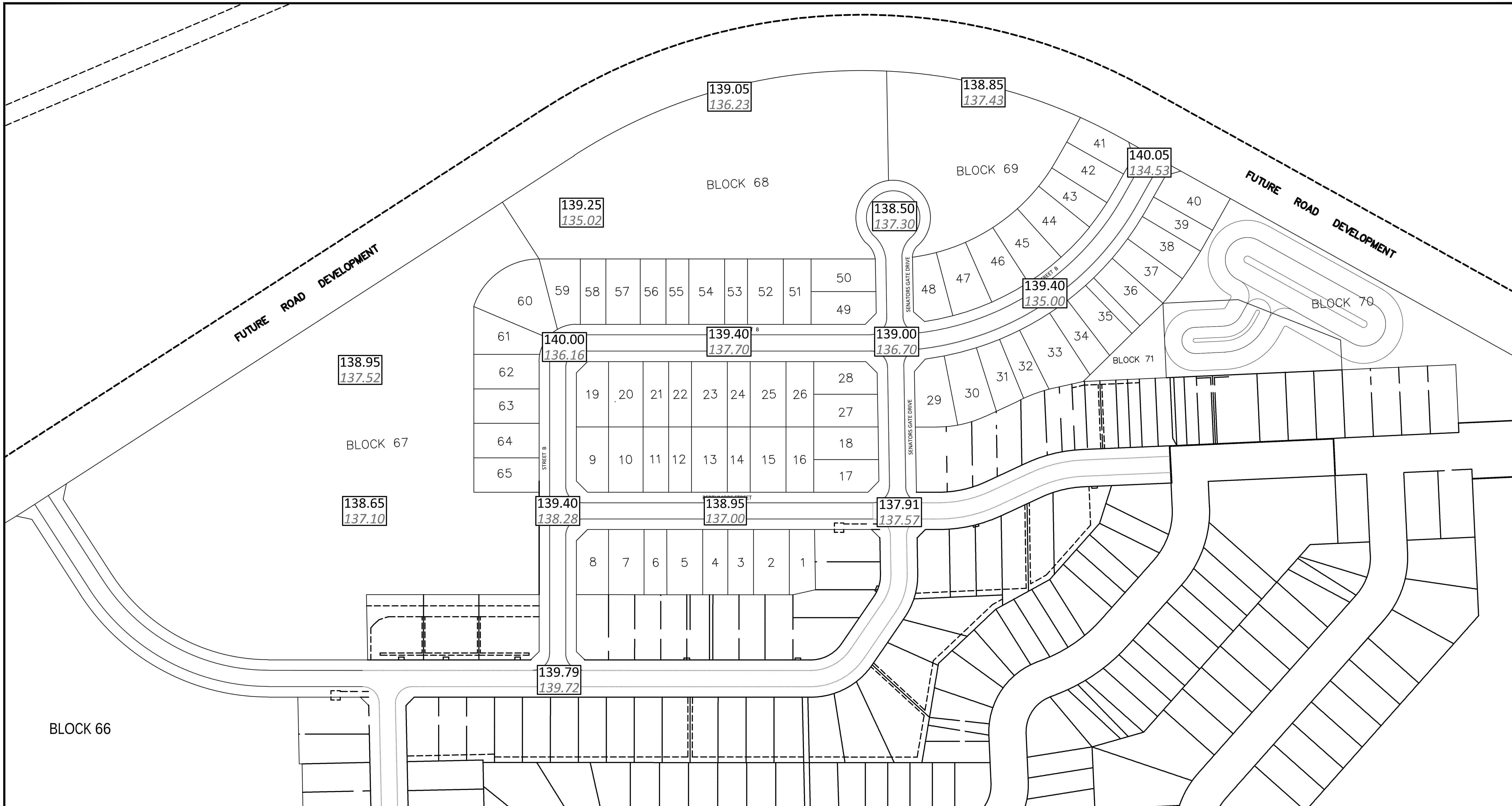
Project: PERTHMORE SUBDIVISION PHASE 6

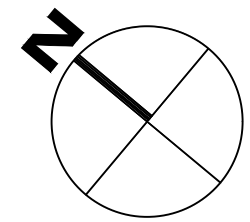
Drawing Title: GENERAL PLAN OF SERVICES

No.	Revisions	Date
1	ISSUED FOR DRAFT PLAN APPLICATION	DEC. 18, 2020

Drawing Number: 100

FILENAME: U:\Ottawa\01 Project - Proposals\2013 Jobs\0PP-13-9668-01 Perthmore Development Co_Perthmore Subdivision\03-Drawings\Production\PP-13-9668-01_Drawings.dwg
LAST SAVED: Monday, December 21, 2020 LAST SAVED BY: c.hampel
LAST PLOTTED: Monday, December 21, 2020 CTB FILE USED: ----





SCALE 1 : 2000

0 50 100 150 200 Metres

LEGEND

139.40	FINISHED ELEVATION
138.28	EXISTING ELEVATION

McINTOSH PERRY

115 Walgreen Road, RR3, Carp, ON K0A 1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

Client: PERTHMORE DEVELOPMENT CO.
80 DUFFERIN STREET PERTH, ON K7H 3M6

Project: PERTHMORE SUBDIVISION PHASE 6

Drawing Title: LOT GRADING & DRAINAGE PLAN

Drawn by:	Checked By:
P.G.K.	R.P.K.
Scale: 1:2000	Project Number: PP-13-9668-01

No.	Revisions	Date
1	ISSUED FOR DRAFT PLAN APPLICATION	DEC. 18, 2020

Drawing Number: 200

FILENAME: U:\Ottawa\01 Project - Proposals\2013 Jobs\0PP-13-9668-01 Perthmore Development Co_Perthmore Subdivision\03-Drawings\Production\PP-13-9668-01_Drawings.dwg
LAST SAVED: Monday, December 21, 2020 LAST SAVED BY: c.hampel
LAST PLOTTED: Monday, December 21, 2020 CTB FILE USED: ----

DRAFT PLAN OF SUBDIVISION OF PART OF THE NORTHEAST AND SOUTHWEST HALVES LOT 3, PART OF THE SOUTHWEST HALF LOT 4 CONCESSION 2 GEOGRAPHIC TOWNSHIP OF DRUMMOND NOW IN THE TOWN OF PERTH AND PART OF BLOCK 15 REGISTERED PLAN 27M-21 TOWN OF PERTH COUNTY OF LANARK

McINTOSH PERRY SURVEYING INC.

TO BE SUBDIVIDED INTO:

LOTS 1,3,4,6,8,9,11,12,14,16,17,18,19,21,22,24,26,27,28,29,31,32,34,36,37,38,39,40, 41,42,43,48,49,50,51,53,55,56,58,59,60 AND 61 FOR SINGLE DETACHED RESIDENTIAL DWELLINGS
LOTS 2,5,7,10,13,15,20,23,25,30,33,35,44,45,46,47,52,54,57, 62,63,64 AND 65 FOR SEMI-DETACHED RESIDENTIAL DWELLINGS
BLOCKS 66-69 FOR MEDIUM/HIGH DENSITY RESIDENTIAL
BLOCKS 70 AND 71 - STORMWATER MANAGEMENT FACILITY
STREETS A, B, PERTHMORE STREEET & SENATORS GATE DRIVE -20 METRES WIDE

APPLICANT AND PROPERTY OWNER

PERTHMORE ENTERPRISES INC.

DRAFT

LEGEND AND NOTES

□	DENOTES	MONUMENT PLANTED
■	DENOTES	MONUMENT FOUND
IB	DENOTES	IRON BAR
SIB	DENOTES	STANDARD IRON BAR
SSIB	DENOTES	SHORT STANDARD IRON BAR
RPL	DENOTES	ROCK PLUG
RIB	DENOTES	ROUND IRON BAR
(1352)	DENOTES	B.W. KERR, OLS
(MPS)	DENOTES	McINTOSH PERRY SURVEYING INC.
(OU)	DENOTES	ORIGIN UNKNOWN
(S/T)	DENOTES	SUBJECT TO
BF	DENOTES	BOARD FENCE
CLF	DENOTES	CHAIN LINK FENCE
RF	DENOTES	RAIL FENCE
N,S,E,W	DENOTES	NORTH, SOUTH, EAST, WEST
R.P.	DENOTES	REGISTERED PLAN

BEARINGS AND ELEVATIONS

BEARINGS ARE GRID BEARINGS DERIVED FROM REAL TIME NETWORK OBSERVATIONS AND ARE REFERRED TO THE CENTRAL MERIDIAN OF MTM ZONE 9 (76° 30 WEST LONGITUDE) NAD 83 (CSRS) (1997.0)

ELEVATIONS AND TOPOGRAPHIC CONTOUR FEATURES SHOWN ON THIS PLAN HAVE BEEN DERIVED FROM DIGITAL IMAGERY DATA FILES RECEIVED FROM THE ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY (M.R.N.F.), DATED 2019.

SCALE 1 : 1000

0 25 50 75 100 Metres

METRIC :

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 (17) OF THE PLANNING ACT

A. AS SHOWN ON THE DRAFT PLAN
B. AS SHOWN ON THE DRAFT PLAN
C. AS SHOWN ON THE DRAFT PLAN
D. AS DESCRIBED ON THE TITLE BLOCK
E. AS SHOWN ON THE DRAFT PLAN
F. AS SHOWN ON THE DRAFT PLAN
G. AS SHOWN ON THE DRAFT PLAN
H. PIPED MUNICIPAL WATER IS AVAILABLE TO SERVICE THE PROPERTY
I. SOIL TYPE IS GENERALLY SANDY AND SILTY, WITH GRAVEL AND SHALLOW BEDROCK
J. AS SHOWN ON THE DRAFT PLAN
K. PIPED MUNICIPAL WATER AND WASTEWATER SERVICES TO BE MADE AVAILABLE TO SERVE THE SUBJECT PROPERTY
L. NO RESTRICTIONS APPLY

SCHEDULE OF AREAS

LOT/BLOCK	AREA(sq.m.)	TYPE
1	467	SINGLE DETACHED
2	673	SEMI-DETACHED
3	481	SINGLE DETACHED
4	472	SINGLE DETACHED
5	673	SEMI-DETACHED
6	428	SINGLE DETACHED
7	665	SEMI-DETACHED
8	587	SINGLE DETACHED
9	589	SINGLE DETACHED
10	648	SEMI-DETACHED
11	482	SINGLE DETACHED
12	429	SINGLE DETACHED
13	675	SEMI-DETACHED
14	429	SINGLE DETACHED
15	675	SEMI-DETACHED
16	522	SINGLE DETACHED
17	594	SINGLE DETACHED
18	607	SINGLE DETACHED
19	588	SINGLE DETACHED
20	648	SEMI-DETACHED
21	482	SINGLE DETACHED
22	429	SINGLE DETACHED
23	675	SEMI-DETACHED
24	429	SINGLE DETACHED
25	675	SEMI-DETACHED
26	522	SINGLE DETACHED
27	602	SINGLE DETACHED
28	579	SINGLE DETACHED
29	703	SINGLE DETACHED
30	739	SEMI-DETACHED
31	513	SINGLE DETACHED
32	451	SINGLE DETACHED
33	797	SEMI-DETACHED
34	506	SINGLE DETACHED
35	749	SEMI-DETACHED
36	568	SINGLE DETACHED
37	548	SINGLE DETACHED
38	582	SINGLE DETACHED
39	456	SINGLE DETACHED
40	685	SINGLE DETACHED
41	541	SINGLE DETACHED
42	592	SINGLE DETACHED
43	495	SINGLE DETACHED
44	681	SEMI-DETACHED
45	681	SEMI-DETACHED
46	681	SEMI-DETACHED
47	681	SEMI-DETACHED
48	585	SINGLE DETACHED
49	594	SINGLE DETACHED
50	607	SINGLE DETACHED
51	522	SINGLE DETACHED
52	675	SEMI-DETACHED
53	429	SINGLE DETACHED
54	675	SEMI-DETACHED
55	429	SINGLE DETACHED
56	482	SINGLE DETACHED
57	648	SEMI-DETACHED
58	482	SINGLE DETACHED
59	624	SINGLE DETACHED
60	1129	SINGLE DETACHED
61	661	SINGLE DETACHED
62	649	SEMI-DETACHED
63	648	SEMI-DETACHED
64	648	SEMI-DETACHED
65	648	SEMI-DETACHED
BLOCK 66	31875	Medium/High Density
BLOCK 67	34265	Medium/high Density
BLOCK 68	15556	Medium/High Density
BLOCK 69	6483	Medium/High Density
BLOCK 70	8571	Stormwater
BLOCK 71	894	Stormwater
TOTAL LOT/BLOCK AREA(sq.m.)		**136,153**

STREET	AREA(sq.m.)	LENGTH
STREET A	4388	217
STREET B	10299	507
PERTHMORE ST	3310	162
SENATORS GATE DR	3824	147
TOTAL SUBDIVISION AREA(sq.m.)		**157,974**

TABLE OF P.I.N.'S

NUMBER	BLOCK 05165-
P1	0575(LT)
P2	0574(LT)
P3	0634(LT)
P4	0633(LT)
P5	0632(LT)
P6	0631(LT)
P7	0630(LT)
P8	0629(LT)
P9	0628(LT)
P10	0696(LT)
P11	0695(LT)
P12	0758(LT)
P13	0759(LT)
P14	0760(LT)
P15	0694(LT)
P16	0693(LT)
P17	0692(LT)
P18	0691(LT)
P19	0690(LT)
P20	0689(LT)
P21	0688(LT)
P22	0687(LT)
P23	0685(LT)

TABLE OF P.I.N.'S

NUMBER	BLOCK 05165-
P24	0684(LT)
P25	0683(LT)
P26	0682(LT)
P27	0681(LT)
P28	0680(LT)
P29	0679(LT)
P30	0678(LT)
P31	0743(LT)
P32	0744(LT)
P33	0745(LT)
P34	0746(LT)
P35	0741(LT)
P36	0740(LT)
P37	0739(LT)
P38	0738(LT)
P39	0729(LT)
P40	0737(LT)
P41	0589(LT)
P42	0298(LT)
P43	0299(LT)
P44	0300(LT)
P45	0301(LT)

REVISIONS

No.	DESCRIPTION	DATE	BY

McINTOSH PERRY
SURVEYING INC.
3240 Drummond Con. 5A, R.R. #7, Perth, ON K7H 3C9
Tel: 613-267-6524 Fax: 613-267-7992
www.mcintoshperry.com

PROJECT				DRAWN:
PERTHMORE DEVELOPMENT				DL, RF
				CHECHED: XX
DATE	PAPER SIZE	SCALE	PROJECT No.	DWG No.
DECEMBER 10, 2020	36"x54"	1:1000	19-4081	Rev-1

U:\PERTH\MPSI CORRESPONDENCE\2019 JOBS\19-4081 MPCE (MONICA SHADE)_PERTHMORE_BOUNDARY PLAN\DRAFT PLAN\CAD\DRAWINGS\UPDATED (RF)\D19-4081 DRAFT PLAN (DL)_UPDATED REV-1.DWG
December 21, 2020 12:27:07 PM

APPENDIX B
WATERMAIN DESIGN

MCINTOSH PERRY

PP-13-9668-01 - Perthmore Subdivision Phase 6 - Water Demands

Peaking Factors:

Table 3-1: Peaking Factors

POPULATION	MINIMUM RATE FACTOR (MINIMUM HOUR)	MAXIMUM DAY FACTOR	PEAK RATE FACTOR (PEAK HOUR)
500 - 1,000	0.40	2.75	4.13
1,001 - 2,000	0.45	2.50	3.75
2,001 -3,000	0.45	2.25	3.38
3,001 - 10,000	0.50	2.00	3.00
10,001 - 25,000	0.60	1.90	2.85
25,001 - 50,000	0.65	1.80	2.70
50,001 - 75,000	0.65	1.75	2.62
75,001 - 150,000	0.70	1.65	2.48
greater than 150,000	0.80	1.50	2.25

Note: Domestic water demand peaking factors are per Section 3.4.2 of the Design Guidelines for Drinking-Water Systems 2008.

Population Density:

Unit Type	Persons Per Unit (ppu)
Single Family	3.4
Semi-detached	2.7
Townhouse	2.7
unknown	60/ha

Calculations:

Phase 5 - consists of 42 single family and 23 Semi-detached units

population = 204.9 people

*Average Day Flow		Max. Day Flow		Peak Hourly Flow		
(L/s)	(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	
0.66	39.84	1.66	99.60	2.49	149.41	
0.66	39.84	1.66	99.60	2.49	149.41	Total

*Domestic flow was assumed to be 280L/(cap-day)

APPENDIX C

SANITARY SEWER DESIGN

McINTOSH PERRY

SANITARY SEWER DESIGN SHEET

McINTOSH PERRY

PROJECT: PERTHMORE SUBDIVISION PHASE 6
LOCATION: PERTH, ON
CLIENT: PERTHMORE DEVELOPMENT CO.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			FLOW	SEWER DATA								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	30	31
STREET	AREA ID	FROM MH	TO MH	UNIT TYPES SF	SD	TH	APT	AREA (ha)	POPULATION IND	CUM	PEAK FACTOR	PEAK FLOW (L/s)	AREA (ha) INSTITUTIONAL IND	CUM	COMMERCIAL IND	CUM	INDUSTRIAL IND	CUM	PEAK FLOW (L/s)	AREA (ha) IND	CUM	FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	DIA (mm)	SLOPE (%)	VELOCITY (full) (m/s)	FLOW DEPTH (mm)	VELOCITY (actual) (m/s)	AVAILABLE CAPACITY L/s	(%)
STREET B	603A(1)	603A	602A	6	4			0.71	31.2	31.2	4.00	0.40		0.00		0.00		0.00	0.00	0.71	0.71	0.23	0.64	27.59	82.10	200	0.65	0.851	22.6	0.356	26.95	97.68
	602A	602A	601A	4	2			0.49	19.0	50.2	4.00	0.65		0.00		0.00		0.00	0.00	0.49	1.20	0.40	1.05	21.64	90.00	200	0.40	0.667	31.8	0.348	20.59	95.16
SENATORS GATE DRIVE	HD1	604A	605A					1.56	93.6	93.6	4.00	1.21		0.00		0.00		0.00	0.00	1.56	1.56	0.51	1.73	21.64	21.50	200	0.40	0.667	40.3	0.405	19.91	92.01
	HD2	606A	605A					0.65	39.0	39.0	4.00	0.51		0.00		0.00		0.00	0.00	0.65	0.65	0.21	0.72	21.64	21.50	200	0.40	0.667	26.7	0.311	20.92	96.67
	605A	605A	601A	2				0.33	6.8	139.4	4.00	1.81		0.00		0.00		0.00	0.00	0.33	2.54	0.84	2.65	21.64	72.00	200	0.40	0.667	49.2	0.458	19.00	87.78
SENATORS GATE DRIVE	601A(1)	601A	*CAP*	4				0.41	13.6	212.7	4.00	2.76		0.00		0.00		0.00	0.00	0.41	4.43	1.46	4.22	21.64	79.13	200	0.40	0.667	61.6	0.523	17.42	80.50
		CAP	*S106*					0.00	0.0	212.7	4.00	2.76		0.00		0.00		0.00	0.00	0.00	4.43	1.46	4.22	21.64	*11.00*	*200*	*0.40*	0.667	61.6	0.523	17.42	80.50
STREET B	601A(2)	601A	607A	2	1			0.28	9.5	9.5	4.00	0.12		0.00		0.00		0.00	0.00	0.28	0.28	0.09	0.22	27.59	37.00	200	0.65	0.851	13.5	0.255	27.37	99.22
	607A	607A	608A	2	3			0.40	14.9	24.4	4.00	0.32		0.00		0.00		0.00	0.00	0.40	0.68	0.22	0.54	27.59	48.25	200	0.65	0.851	20.9	0.338	27.05	98.04
	608A	608A	609A	2	1			0.22	9.5	33.9	4.00	0.44		0.00		0.00		0.00	0.00	0.22	0.90	0.30	0.74	21.64	21.41	200	0.40	0.667	27.0	0.313	20.90	96.60
STREET B	611A	611A	610A	6				0.44	20.4	20.4	4.00	0.26		0.00		0.00		0.00	0.00	0.44	0.44	0.15	0.41	27.59	43.90	200	0.65	0.851	18.3	0.311	27.18	98.52
	610A	610A	609A	1	2			0.25	8.8	29.2	4.00	0.38		0.00		0.00		0.00	0.00	0.25	0.69	0.23	0.61	27.59	26.84	200	0.65	0.851	22.0	0.350	26.98	97.80
EASEMENT		609A	600A					0.00	0.0	63.1	4.00	0.82		0.00		0.00		0.00	0.00	0.00	1.59	0.52	1.34	21.64	64.06	200	0.40	0.667	35.8	0.375	20.30	93.80
	INFIL(1)	600A	*EX 200mm*					0.00	0.0	63.1	4.00	0.82		0.00		0.00		0.00	0.00	1.26	2.85	0.94	1.76	21.64	58.67	200	0.40	0.667	40.6	0.407	19.88	91.87
STREET B	603A(2)	603A	614A	3				0.28	10.2	10.2	4.00	0.13		0.00		0.00		0.00	0.00	0.28	0.28	0.09	0.22	27.59	12.90	200	0.65	0.851	13.8	0.258	27.36	99.19
	614A	614A	613A		4			0.41	10.8	21.0	4.00	0.27		0.00		0.00		0.00	0.00	0.41	0.69	0.23	0.50	27.59	81.00	200	0.65	0.851	20.1	0.330	27.09	98.19
PERTHMORE STREET	HD3, INFIL(2), 613A	613A	612A	6	4			4.18	31.2	52.2	4.00	0.68		0.00		0.00		0.00	0.00	4.34	5.03	1.66	2.34	21.64	90.00	200	0.40	0.667	46.4	0.442	19.30	89.20
	612A	612A	*CAP*	4	2			0.49	19.0	71.2	4.00	0.92		0.00		0.00		0.00	0.00	0.49	5.52	1.82	2.74	21.64	81.68	200	0.40	0.667	50.1	0.463	18.90	87.32
		CAP	*S106*					0.00	0.0	71.2	4.00	0.92		0.00		0.00		0.00	0.00	0.00	5.52	1.82	2.74	21.64	*11.00*	*200*	*0.40*	0.667	50.1	0.463	18.90	87.32

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.4	p/p/u	INST	28,000	L/Ha/day	1.5
SD	2.7	p/p/u	COM	28,000	L/Ha/day	1.5
TH	2.7	p/p/u	IND	35,000	L/Ha/day	MOE Chart
APT	1.8	p/p/u				
Other	60	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 280 L/day
3. Infiltration allowance: 0.33 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

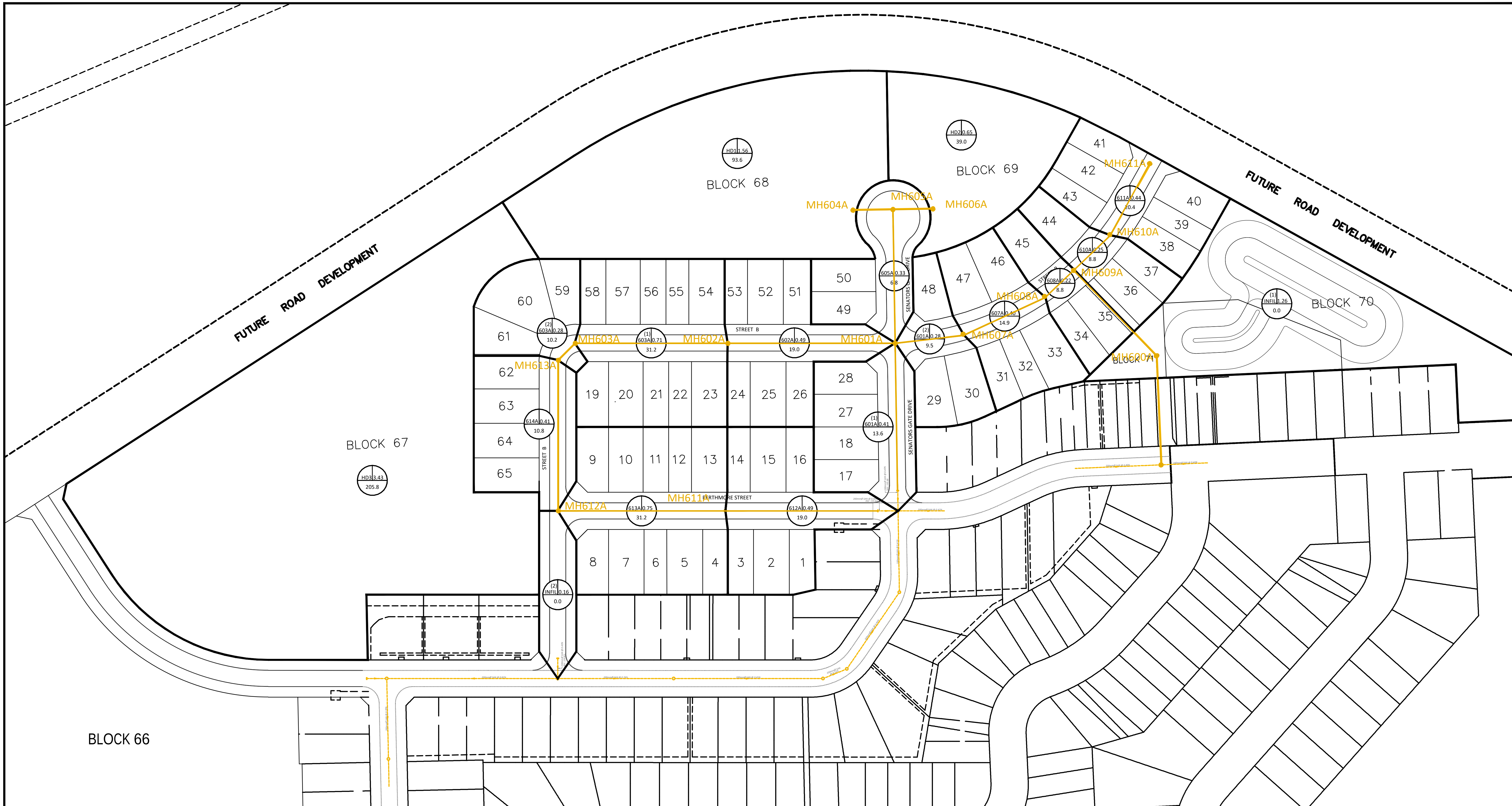
Designed: P.G.K.

Checked: R.P.K.

Project No.: PP-13-9668-01

No.	Revision	Date
1.	ISSUED FOR DRAFT PLAN APPLICATION	DEC. 18, 2020

Sheet No: 1 of 1



LEGEND

LOCATION I.D. — AREA (ha)

123 | 0.25

6.8

POPULATION

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A 1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

Client: PERTHMORE DEVELOPMENT CO.
80 DUFFERIN STREET PERTH, ON K7H 3M6

Project: PERTHMORE SUBDIVISION PHASE 6

Drawing Title: SANITARY DRAINAGE AREA PLAN

Drawn by:	Checked By:
P.G.K.	R.P.K.
Scale: 1:2000	Project Number: PP-13-9668-01

No.	Revisions	Date
1	ISSUED FOR DRAFT PLAN APPLICATION	DEC. 18, 2020

Drawing Number: 500

APPENDIX D
STORM SEWER DESIGN

McINTOSH PERRY

STORM SEWER DESIGN SHEET

McINTOSH PERRY

PROJECT: PERTHMORE SUBDIVISION PHASE 6
LOCATION: PERTH, ON
CLIENT: PERTHMORE DEVELOPMENT CO.

LOCATION				CONTRIBUTING AREA (ha)								RATIONAL DESIGN FLOW											SEWER DATA								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
STREET	AREA ID	FROM MH	TO MH	C-VALUE						INDIV AC	CUMUL AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm)			SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr)	
				0.20	0.40	0.50	0.60	0.80	1.00																DIA	W	H			(L/s)	(%)
BLOCK 68	HDR1	610	608				1.56			0.94	0.94	20.00	0.33	20.33	58.41	67.89	97.42	151.98				151.98	200.65	18.00	525			0.20	0.898	48.66	24.25
STREET B	609	609	608			0.16				0.08	0.08	20.00	0.97	20.97	58.41	67.89	97.42	12.99				12.99	41.62	48.00	250			0.45	0.821	28.63	68.79
PERTHMORE STREET	612	612	611			1.21				0.61	0.61	20.00	1.42	21.42	58.41	67.89	97.42	98.24				98.24	133.02	69.00	450			0.20	0.810	34.78	26.15
		611	608							0.00	0.61	21.42	1.42	22.84	55.68	64.71	92.86	93.64				93.64	133.02	69.00	450			0.20	0.810	39.38	29.60
STREET B	608	608	607			0.79				0.40	2.02	22.84	1.47	24.31	53.23	61.88	88.79	298.35				298.35	339.63	81.00	675			0.15	0.919	41.29	12.16
		607	606							0.00	2.02	24.31	0.23	24.54	50.96	59.24	85.00	285.63				285.63	339.63	12.90	675			0.15	0.919	54.00	15.90
	606	606	605			1.07				0.54	2.55	24.54	1.39	25.93	50.62	58.84	84.44	359.02				359.02	449.81	82.10	750			0.15	0.986	90.79	20.18
		605	604							0.00	2.55	25.93	1.52	27.45	48.72	56.63	81.25	345.48				345.48	449.81	90.00	750			0.15	0.986	104.33	23.19
BLOCK 69	HDR2	613	614				1.56			0.94	0.94	20.00	0.45	20.45	58.41	67.89	97.42	151.98				151.98	200.65	24.50	525			0.20	0.898	48.66	24.25
BLOCK 70	HDR3	615	614				0.65			0.39	0.39	20.00	0.45	20.45	58.41	67.89	97.42	63.33				63.33	91.46	21.50	375			0.25	0.802	28.13	30.76
SENATORS GATE DRIVE	614	614	604			0.25				0.13	1.45	20.45	1.31	21.76	57.50	66.83	95.90	231.93				231.93	339.63	72.00	675			0.15	0.919	107.70	31.71
STREET B	604(1)	604	603			0.69				0.35	4.35	27.45	0.51	27.96	46.81	54.41	78.08	565.72				565.72	731.45	34.38	900			0.15	1.114	165.73	22.66
		603	602							0.00	4.35	27.96	0.78	28.74	46.21	53.71	77.07	558.42				558.42	731.45	51.90	900			0.15	1.114	173.02	23.65
		602	601							0.00	4.35	28.74	0.35	29.09	45.33	52.69	75.61	547.83				547.83	731.45	23.20	900			0.15	1.114	183.61	25.10
STREET B	617	617	616			0.66				0.33	0.33	20.00	0.90	20.90	58.41	67.89	97.42	53.58				53.58	59.68	44.30	300			0.35	0.818	6.10	10.22
		616	601							0.00	0.33	20.90	0.46	21.36	56.63	65.83	94.46	51.96				51.96	59.68	22.42	300			0.35	0.818	7.73	12.95
POND EASEMENT		601	600							0.00	4.68	29.09	0.72	29.81	44.95	52.25	74.98	584.50				584.50	731.45	48.00	900			0.15	1.114	146.95	20.09
		EX 450	600									20.00	0.09	20.09	58.41	67.89	97.42	0.00				0.00	210.32	6.83	450			0.50	1.281	210.32	100.00
		600	POND							0.00	4.68	29.81	0.18	29.99	44.19	51.37	73.71	574.61				574.61	731.45	12.00	900			0.15	1.114	156.83	21.44
		POND	OUTLET						1.26	1.26	5.94	29.99	#DIV/0!	#DIV/0!	44.01	51.15	73.40	726.36				726.36	0.00						0.000	-726.36	#DIV/0!
SENATORS GATE DRIVE	604(2)	604	*BULKHEAD*			0.23				0.12	0.12	20.00	1.13	21.13	58.41	67.89	97.42	18.67				18.67	188.11	77.63	450			0.40	1.146	169.44	90.07
		BULKHEAD	*D207*							0.00	0.12	21.13	0.18	21.31	56.21	65.33	93.75	17.97				17.97	188.11	*12.50*	*450*			*0.40*	1.146	170.14	90.45
PERTHMORE STREET		*BULKHEAD*	*D207*							0.00	0.00	20.00	0.18	20.18	58.41	67.89	97.42	0.00				0.00	188.11	*12.50*	*450*			*0.40*	1.146	188.11	100.00

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 27.1 * Tc^-0.699] 5 YEAR
[i = 31.5 * Tc^-0.699] 10 YEAR
[i = 45.2 * Tc^-0.699] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

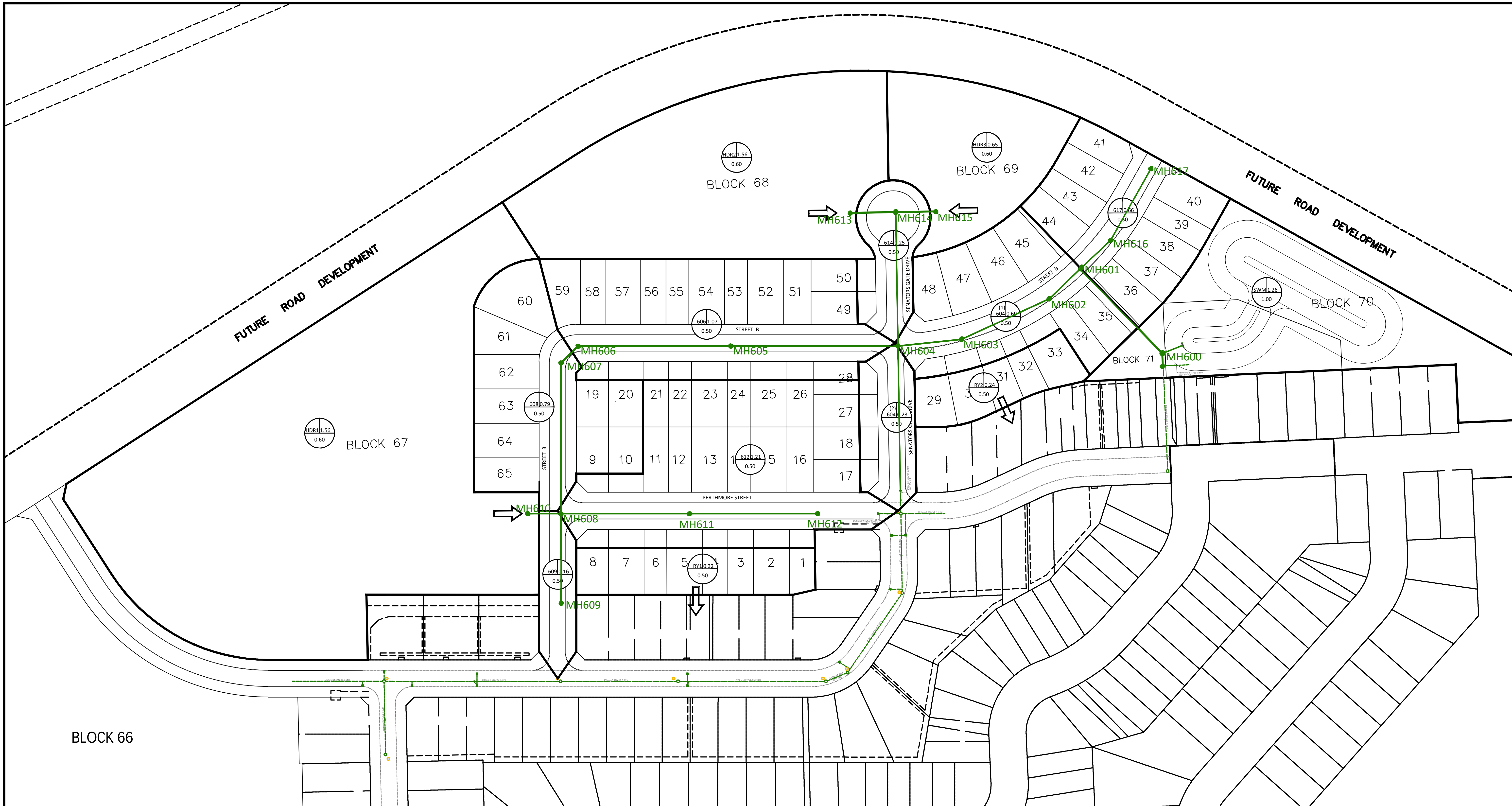
Designed: P.G.K.

Checked: R.P.K.

Project No.: PP-13-9668-01

No.	Revision	Date
1.	ISSUED FOR DRAFT PLAN APPLICATION	DEC. 18, 2020

Sheet No:
1 of 1



LEGEND

LOCATION I.D.
AREA (ha)
123F 0.25
0.60
0.75
AVERAGE COEFFICIENT
5-year
100-year

SCALE 1 : 2000

0 50 100 150 200 Metres

McINTOSH PERRY
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Client: PERTHMORE DEVELOPMENT CO.
80 DUFFERIN STREET PERTH, ON K7H 3M6

Project: PERTHMORE SUBDIVISION PHASE 6

Drawing Title: STORM DRAINAGE AREA PLAN

Drawn by:	Checked By:
P.G.K.	R.P.K.
Scale: 1:2000	Project Number: PP-13-9668-01

No.	Revisions	Date
1	ISSUED FOR DRAFT PLAN APPLICATION	DEC. 18, 2020

Drawing Number: 501

APPENDIX E

EXISTING CONDITIONS MEMO

McINTOSH PERRY

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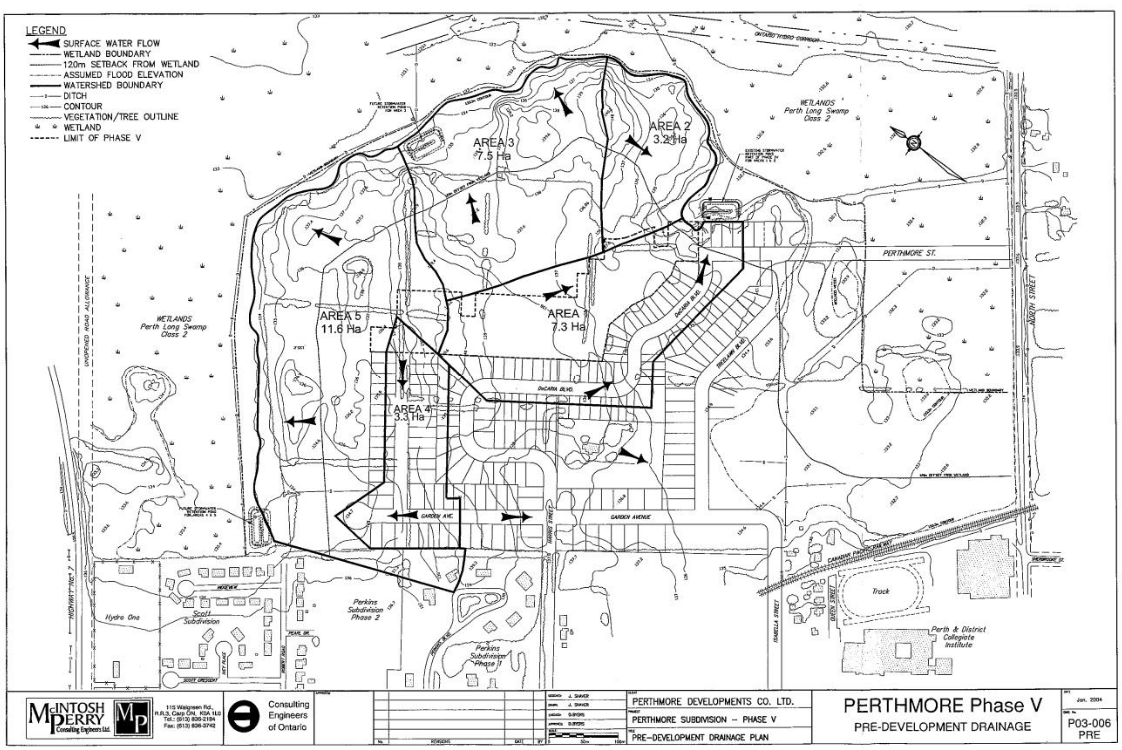
MEMORANDUM

To:	Ryan Kennedy, P. Eng., Practice Lead, Land Development
	Adam O'Connor, P.Eng., Assistant Vice President, Land Development
From:	John Price, P. Eng., Senior Water Resource Engineer
Cc:	Jason Sharp, P. Eng. Manager, Water Resources
Date:	December 2, 2020
Re:	Perthmore Subdivision

1.0 BACKGROUND

The Perthmore subdivision is located northwest of North Street in the Town of Perth. Various phases of the subdivision have been under development since the 1990s and the draft plan for a subsequent phase is now under consideration. The drainage and stormwater management infrastructure has also been constructed in phases over many years. The original pre-development flow values were first calculated in 1990s using the Rational Equation.

An existing stormwater management (SWM) pond is located on the northeast side of Perthmore Street as shown on the figure below. As part of development of this subsequent phase, this SWM facility will be reconstructed and expanded to address the water quality and quantity control requirements for the tributary drainage area. For the SWM design the pre-development flows, to be used as the target flows for the quantity control, were reassessed.



2.0 ANALYSIS

A Visual OTTHMO Version 5 (VO5) model was assembled for the analysis. As shown in the figure above, the pre-development tributary area to the SWM facility consists of Areas 1 and 2 and the total tributary pre-development drainage area is 10.5 ha. The VO5 hydrologic model requires various measured and calculated input parameters. The calculations of these input parameters area detailed below.

2.1 Parameters

2.1.1 General

Since the pre-development land use was rural the NASHYD command was employed in the VO5 model to calculate the runoff flows. NASHYD is used to simulate runoff flows with NASH instantaneous unit hydrograph. This hydrograph is made of a cascade of "n" linear reservoirs. The n (number of linear reservoirs) parameter was set at 3, in the model, and the rainfall losses were computed by the SCS CN procedure.

2.1.2 Time of Concentration/Time to Peak

The Time of Concentration (Tc), for the pre-development drainage basins, was calculated using the Airport Formula.

$$T_c = 3.26 * (1.1 - C) * L^{0.5} * S_W^{-0.33}$$

Where:

Tc = time of concentration in minutes
C = runoff coefficient
L = watershed length in metres
S_W = watershed slope in percentage

From the Tc value, the Time to Peak (Tp) value was calculated as 0.67 times Tc. The parameters employed in the calculation of Tc and Tp for the two drainage basins are show in Table 1.

Table 1 – Time to Peak

Catchment	Area	Flow Length	Fall	Slope	Tc[1]	Tp[2]
	ha	m	m	%	min	hrs
Area 1	7.3	435	7	1.61	58.1	0.65
Area 2	3.2	165	7	4.24	26.0	0.29

Notes: 1 – Airport Formula
2 – 0.67*Tc

2.1.3 SCS Curve Number

The Curve Number (CN) is the most important parameter in determining surface runoff when the SCS equation is used. Table 2 shows the parameters and the resulting CN value for Areas 1 and 2.

Table 2 – Curve Number

Catchment	Soil Type	Hydrologic	Land Use	Runoff	CN[3]	Ia
		Soil Group[1]	(0-5% Slope)	Coefficient[2]	(AMC II)	mm
Area 1	Sandy Loam	AB	Pasture	0.10	59	5
Area 2	Sandy Loam	AB	Pasture	0.10	59	5

Notes: 1 – MTO Drainage Management Manual – Design Chart 1.08
2 - MTO Drainage Management Manual – Design Chart 1.07
3 - MTO Drainage Management Manual – Design Chart 1.09 (Pasture, fair condition – average of A and B Hydrologic Soil Groups)

2.1.4 Rainfall

For the rainfall input to the VO5 model, the 12 hour SCS rainfall distribution, representing a high volume lower intensity storm, and a 4 hour Chicago rainfall distribution, representing a high intensity "thunder storm" type of rainfall event were used ion the analysis. The Intensity-Duration-Frequency (IDF) curve was obtained from the Ministry of Transportation (MTO) IDF Curve Lookup tool with the location centred over the property.

3.0 RESULTS

Employing the above noted parameters and the VO5 hydrologic model, Table 3 shows the calculated pre-development flow values for the 12 hour SCS and 4 hour Chicago rainfall hyetographs. It is recommended that these flow values be used for the water quantity control assessment of the reconstructed SWM facility. The redesign of the end of pipe facility will also include water quality control for the post-development tributary drainage area.

Table 3 – Calculated Flows

	12 hour SCS			4 hour Chicago		
Return Period	Area 1	Area 2	Total	Area 1	Area 2	Total
Yrs	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s
2	0.061	0.047	0.093	0.030	0.022	0.045
5	0.110	0.085	0.168	0.057	0.041	0.085
10	0.143	0.111	0.220	0.080	0.058	0.119
25	0.197	0.152	0.303	0.111	0.083	0.166
50	0.238	0.184	0.367	0.137	0.101	0.206
100	0.288	0.223	0.444	0.165	0.122	0.248

This memorandum is respectfully submitted by,
McIntosh Perry Consulting Engineers Ltd.

John Price, P. Eng.
Senior Water Resource Engineer
PH No. 613 714 5906
Email. J.Price@McIntoshPerry.com

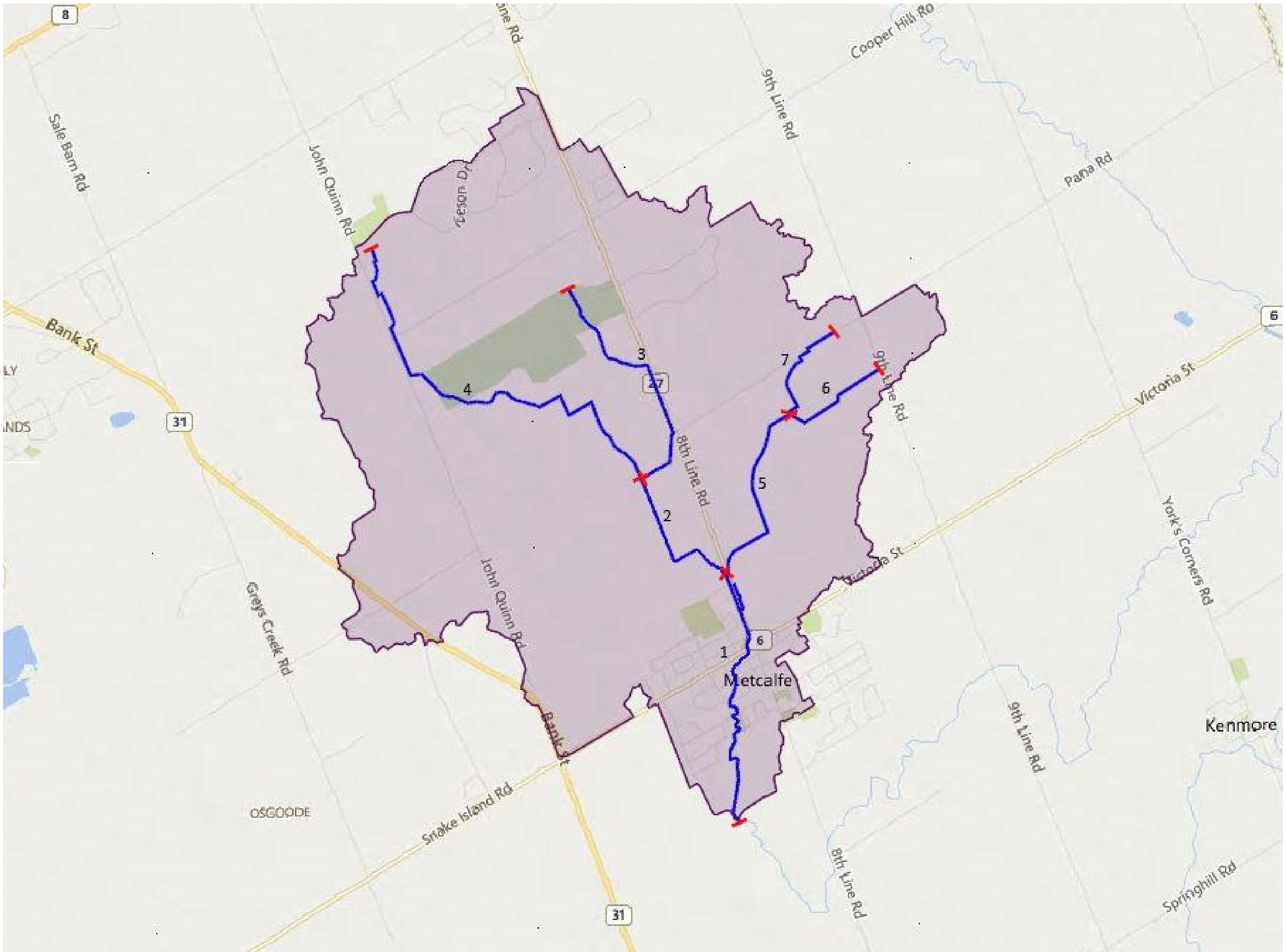


Figure 1 – Drain Reaches

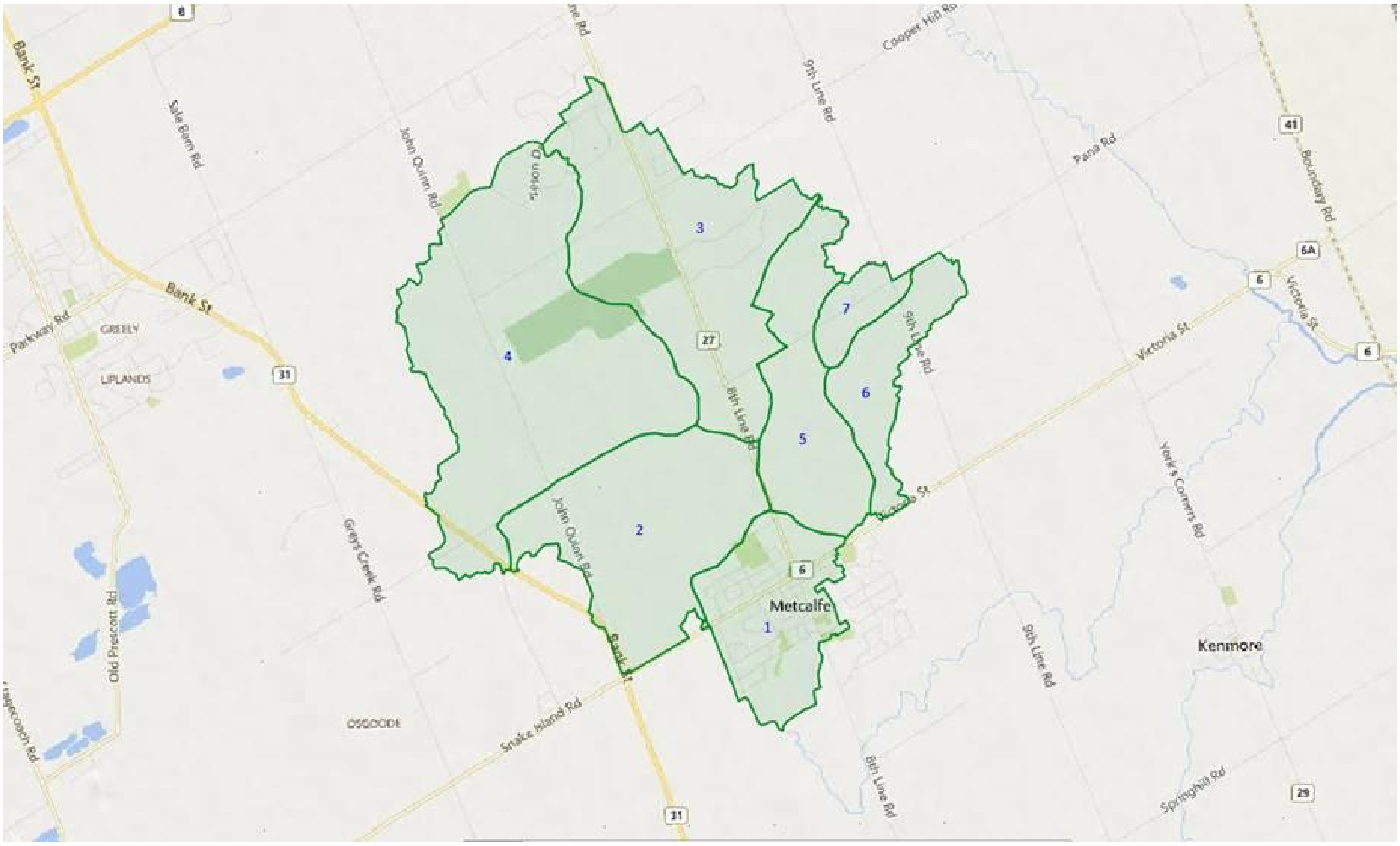


Figure 2 – Sub-catchments

Table 1 - Hydrologic Parameters					
Sub-Catchment ID	Area (ha)	CN Value (AMC II)	Runoff Coefficient (C)	Time to Peak (Tp) (hrs)	Initial Abstraction (Ia) (mm)
1	216.0	81.9	0.4	-	-
2	367.0	70.8	0.3	2.87	5
3	469.0	73.8	0.3	2.90	5
4	686.0	65.6	0.2	3.98	5
5	232.0	75.0	0.3	2.23	5
6	131.0	69.0	0.2	1.72	5
7	53.0	77.3	0.3	1.54	5

Note: Sub-catchment 1 was modelled using the Standhyd command with a total impervious value of 75% and directly connected value of 37.5%

Table 2 - Calculated Flows - Downstream End of Reach 7 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	0.15	0.38	0.50	0.50	0.66	0.66
5	0.27	0.64	0.83	0.83	1.03	1.03
10	0.37	0.85	1.07	1.07	1.31	1.31
25	0.50	1.10	1.37	1.37	1.67	1.67
50	0.61	1.29	1.60	1.60	1.92	1.92
100	0.72	1.52	1.85	1.85	2.18	2.18

* With Storage Reduction Factor

Table 3 - Calculated Flows - Downstream End of Reach 6 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	0.22	0.63	0.84	0.47	1.12	0.63
5	0.43	1.09	1.42	0.80	1.79	1.01
10	0.58	1.45	1.87	1.05	2.33	1.31
25	0.81	1.91	2.42	1.37	3.02	1.71
50	1.00	2.27	2.86	1.62	3.51	1.98
100	1.20	2.69	3.34	1.88	4.02	2.27

* With Storage Reduction Factor

Table 4 - Calculated Flows - Downstream End of Reach 5 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	0.68	2.04	2.71	1.58	3.59	2.09
5	1.30	3.51	4.57	2.66	5.71	3.33
10	1.79	4.66	5.97	3.48	7.39	4.31
25	2.49	6.10	7.70	4.49	9.39	5.47
50	3.07	7.23	8.98	5.23	10.75	6.27
100	3.68	8.49	10.31	6.01	12.11	7.06

* With Storage Reduction Factor

Table 5 - Calculated Flows - Downstream End of Reach 3 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	0.59	1.81	2.39	1.33	3.14	1.75
5	1.10	3.07	3.99	2.22	4.95	2.76
10	1.50	4.05	5.18	2.89	6.38	3.55
25	2.07	5.28	6.62	3.69	8.20	4.57
50	2.53	6.58	7.80	4.35	9.47	5.27
100	3.02	7.33	9.03	5.03	10.77	6.00

* With Storage Reduction Factor

Table 6 - Calculated Flows - Downstream End of Reach 4 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	0.44	1.49	2.06	1.13	2.73	1.50
5	0.85	2.58	3.50	1.93	4.40	2.42
10	1.17	3.46	4.61	2.53	5.74	3.16
25	1.63	4.57	5.96	3.28	7.49	4.12
50	2.01	5.44	7.09	3.90	8.73	4.80
100	2.42	6.46	8.27	4.55	10.02	5.51

* With Storage Reduction Factor

Table 7 - Calculated Flows - Downstream End of Reach 2 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	1.33	4.38	5.89	3.24	7.78	4.28
5	2.55	7.53	9.63	5.30	11.62	6.39
10	3.52	9.67	12.08	6.65	14.40	7.92
25	4.90	12.08	14.89	8.19	18.78	10.33
50	6.02	13.84	17.80	9.79	21.80	11.99
100	7.24	16.11	20.75	11.41	24.88	13.69

* With Storage Reduction Factor

Table 8 - Calculated Flows - Downstream End of Reach 1 (m3/s)						
	VO5 Flows					
Return Period (Yrs)	1 Hour AES	6 Hour SCS	12 Hour SCS	12 Hour SCS	24 Hour SCS	24 Hour SCS
2	5.63	8.33	9.49	5.29	11.71	6.52
5	9.19	12.76	16.03	8.93	17.70	9.86
10	11.32	16.51	18.76	10.45	21.97	12.24
25	14.98	20.30	22.94	12.78	28.14	15.67
50	17.32	23.95	27.06	15.07	31.91	17.77
100	20.57	27.27	30.62	17.05	35.64	19.85

* With Storage Reduction Factor

Table 9 - Cassidy Municipal Drain Channel Assessment								
Hydraulic Reach	5 year Design Flow (m^3/s)	Average Channel Parameters					Maximum Flow (m^3/s)	Conveys Design Flow?
		Bottom width (m)	Depth (m)	Side Slope (H:V)	Profile Slope (%)	Manning's n Value		
1	9.86	1.95	1.35	2.40	0.109%	0.035	5.61	NO
2	6.39	1.55	1.50	2.25	0.118%	0.035	6.39	YES
3	2.76	1.65	1.10	2.30	0.120%	0.035	3.38	YES
4	2.42	1.25	0.90	2.85	0.173%	0.035	2.62	YES
5	3.33	0.95	1.20	2.10	0.158%	0.035	3.50	YES
6	1.01	0.80	1.20	2.20	0.430%	0.035	5.66	YES
7	1.03	0.70	1.10	2.10	0.236%	0.035	3.16	YES

Table 10 - Cassidy Municipal Drain Crossing Assessment

Hydraulic Reach	5 year Design Flow (m^3/s)	Culvert No.	Reference Alignment	Start Station	End Station	Length (m)	Upstream invert (m)	Downstream Invert (m)	Culvert Type	Culvert Span/ Diameter (mm)	Culvert Height (m)	Minimum Top of Road (m)	Maximum Flow at Road Elevation (m^3/s)	Conveys Design Flow Prior to Road Overtopping?	Comment
1	9.86	C1	Cassidy Drain	0+185.3	0+180.2	5.1	79.18	79.1	CP	850	-	80.03	1.0	NO	
1	9.86	Byron Street	Cassidy Drain	1+550					Bridge						Bridge assume it can convey the 5 Year flow
1	9.86	Derby Street	Cassidy Drain	1+720					Bridge						Bridge assume it can convey the 5 Year flow
1	9.86	Bowen Street	Cassidy Drain	1+830					Bridge						Bridge assume it can convey the 5 Year flow
1	9.86	Victoria Street	Cassidy Drain	1+1910					Bridge						Bridge assume it can convey the 5 Year flow
1	9.86	C13/ Bruce Street	Cassidy Drain	2+034.6	2+013.3	21.3	81.49	81.42	SPCSPA	4900	2400	84.2	16.7	YES	Modelled as 4302 mm by 2672 mm
1	9.86	C16	Cassidy Drain	2+192.8	2+160.7	32.2	81.41	81.46	CP	2000		83.8	13.0	YES	Twin culvert under entrance
1		C17	Cassidy Drain	2+192.9	2+160.8	32.1	81.31	81.50	CP	2000		83.8			Twin culvert under entrance
1	9.86	C19	Cassidy Drain	2+418.7	2+369.2	49.5	82.06	81.96	CP	1700		84.0	7.0	NO	Twin culvert under entrance
1		C20	Cassidy Drain	2+418.7	2+369.2	49.5	82.09	82.01	CP	1700		84.0			Twin culvert under entrance
1	9.86	C22/ Andrew Simpson Drive	Cassidy Drain	2+533.4	2+518.6	14.8	78.54	78.34	RFB	4300	4300	83.7	11.0	YES	Assessed as embedded 3.53 m
2	6.39	C24	Cassidy Drain	2+955.3	2+949.1	6.2	81.70	81.78	CSP	500		82.4	0.5	NO	Twin culvert under crossing
2		C25	Cassidy Drain	2+955.4	2+949.3	6.1	81.57	81.77	CSP	500		82.4			Twin culvert under crossing
2	6.39	C26	Cassidy Drain	3+243.9	3+239.0	4.9	82.40	82.13	Boiler Drum	2000		84.4	6.8	YES	
2	6.39	C28	Cassidy Drain	3+649.7	3+640.8	8.9	81.27	81.20	CSP	3200		84.5	9.0	YES	
3	2.76	C30	Cassidy Drain	4+332.5	4+324.7	7.7	83.70	83.24	Boiler Drum	1700		85.4	4.5	YES	
3	2.76	C33	Cassidy Drain	4+739.2	4+729.3	9.9	84.00	83.95	CSP	1220		85.6	2.5	NO	
3	2.76	C34	Cassidy Drain	4+859.7	4+849.7	10.1	84.43	84.00	CSP	1100		85.8	2.0	NO	
3	2.76	C35	Cassidy Drain	4+959.8	4+954.9	4.9	84.48	84.48	CSP	1500		86.0	3.0	YES	
3	2.76	C37	Cassidy Drain	5+056.2	5+048.3	7.9	84.27	84.30	CSP	2000		86.4	4.0	YES	Mostly silted in effective in vert 85.0 m Assessed as embedded 0.7 m
3	2.76	C38	Cassidy Drain	5+077.6	5+068.4	9.2	85.04	84.88	CSP	1000		86.3	1.5	NO	
3	2.76	C39	Cassidy Drain	5+107.4	5+096.9	10.5	85.11	85.00	CSP	1200		86.8	2.7	NO	

Table 10 - Cassidy Municipal Drain Crossing Assessment

Hydraulic Reach	5 year Design Flow (m^3/s)	Culvert No.	Reference Alignment	Start Station	End Station	Length (m)	Upstream invert (m)	Downstream Invert (m)	Culvert Type	Culvert Span/ Diameter (mm)	Culvert Height (m)	Minimum Top of Road (m)	Maximum Flow at Road Elevation (m^3/s)	Conveys Design Flow Prior to Road Overtopping?	Comment
3	2.76	C40	Cassidy Drain	5+128.6	5+119.5	9.2	84.78	84.97	CSP	1200		86.8	3.0	YES	
3	2.76	C41	Cassidy Drain	5+159.4	5+149.5	9.9	85.14	84.94	CSP	1200		87.0	2.8	NO	
3	2.76	C42	Cassidy Drain	5+204.4	5+193.9	10.5	84.26	85.48	CSP	1100		87.1	3.2	YES	Sever reverse slope on pipe
3	2.76	C43	Cassidy Drain	5+214.4	5+240.4	26.0	85.46	85.45	Boiler Drum	1200		87.0	2.0	NO	
3	2.76	C44	Cassidy Drain	5+420.2	5+414.3	5.9	85.81	85.71	CSP	1150		87.0	1.6	NO	
3	2.76	C45	Cassidy Drain	5+749.9	5+746.3	3.6	85.64	85.70	CSP	800		86.5	0.7	NO	
3	2.76	C46	Cassidy Drain	5+906.5	5+902.9	3.6	86.05	85.90	CSP	1000		87.1	1.0	NO	
3	2.76	C47	Cassidy Drain	5+995.7	5+989.0	6.6	85.70	85.58	Smooth Wall	900		87.1	1.6	NO	
3	2.76	C48	Cassidy Drain	6+086.5	6+080.7	5.8	85.73	85.74	CSP	850		86.8	1.0	NO	
3	2.76	C49	Cassidy Drain	6+149.0	6+143.8	5.2	85.47	85.30	CSP	1660		87.0	3.5	YES	Effective invert immediately d/s 86.5 m
3	2.76	C50	Cassidy Drain	6+241.5	6+234.9	6.5	85.64	85.41	CSP	1000		87.1	1.7	NO	
3	2.76	C51	Cassidy Drain	6+301.3	6+262.9	38.3	85.99	85.48	CSP	1000		87.0	1.2	NO	
3	2.76	C52	Cassidy Drain	6+346.9	6+341.1	5.9	85.85	85.85	CSP	1000		87.0	1.0	NO	
4	2.42	C29	McCooeye Branch	4+042.2	4+040.2	7.2	83.58	83.08	CSP	900		84.7	1.1	NO	At confluence with Cassidy Drain
4	2.42	C53	McCooeye Branch	7+492.1	7+485.8	6.3	84.21	84.30	CSP	1200		85.6	2.0	NO	
4	2.42	C54	McCooeye Branch	7+782.8	7+778.0	4.8	84.28	84.62	CSP	1200		85.9	2.4	NO	No cover
4	2.42	C55	McCooeye Branch	8+205.1	8+199.3	5.8	84.56	84.61	CSP	1000		85.8	3.8	YES	No cover - Twin culvert under crossing
4		C56	McCooeye Branch	8+205.1	8+199.3	5.8	84.66	84.56	CSP	1000		85.8			No cover - Twin culvert under crossing
4	2.42	C57	McCooeye Branch	8+851.8	8+845.6	6.2	85.70	85.68	HDPE	600		86.3	0.8	NO	No cover - Twin culvert ub=nder crossing
4		C58	McCooeye Branch	8+851.8	8+845.6	6.2	85.70	85.67	HDPE	600		86.3			No cover - Twin culvert ub=nder crossing
4	2.42	C59	McCooeye Branch	9+385.9	9+380.1	5.8	87.46	87.48	CSP	900		88.4	0.8	NO	No cover

Table 10 - Cassidy Municipal Drain Crossing Assessment

Hydraulic Reach	5 year Design Flow (m^3/s)	Culvert No.	Reference Alignment	Start Station	End Station	Length (m)	Upstream invert (m)	Downstream Invert (m)	Culvert Type	Culvert Span/ Diameter (mm)	Culvert Height (m)	Minimum Top of Road (m)	Maximum Flow at Road Elevation (m^3/s)	Conveys Design Flow Prior to Road Overtopping?	Comment
4	2.42	C60	McCooeye Branch	9+440.3	9+434.8	5.5	87.38	87.55	CSP	900		88.5	1.0	NO	No cover
4	2.42	C61	McCooeye Branch	9+563.7	9+558.4	5.3	87.96	87.98	CSP	750		89.2	0.9	NO	
4	2.42	C63/Cooper Hil Road	McCooeye Branch	10+241.0	10+229.7	11.3	88.70	88.65	CSP	800		89.9	1.0	NO	
4	2.42	C64	McCooeye Branch	10+561.1	10+557.0	4.1	89.00	88.92	HDPE	450		89.5	0.3	NO	No cover
4	2.42	C65	McCooeye Branch	10+844.9	10+840.7	4.1	89.57	89.65	CSP	400		90.1	0.2	NO	No cover
5	3.33	C23	Graham Branch	2+642.4	2+642.0	19.9	81.38	81.38	CSP	2100		84.0	9.0	YES	At confluence with Cassidy Drain
5	3.33	C66	Graham Branch	12+091.2	12+082.4	8.8	81.74	81.79	CSP	1600		83.9	5.0	YES	
5	3.33	C67	Graham Branch	12+980.6	12+971.0	9.5	83.07	82.99	CP	900		84.0	0.8	NO	No cover
5	3.33	C68	Graham Branch	13+309.0	13+303.1	5.9	83.43	83.46	CSP	1200		84.8	2.0	NO	
6	1.01	C69/Ninth Line Road	Graham Branch	14+804.3	14+790.4	13.9	88.57	88.59	CSP	750		90.0	1.0	NO	
7	1.03	C70	Walker Branch	15+307.6	15+301.7	5.9	85.08	85.36	CSP	700		86.0	0.6	NO	
7	1.03	C71/Pana Road	Walker Branch	15+763.5	15+750.4	13.1	86.29	86.36	CSP	800		89.2	1.8	YES	
	0.06	C18	Fitzsimmons Branch	2+277.0	2+284.1	19.8	82.10	81.94	CSP	1100		83.9	2.4	YES	At confluence with Cassidy Drain
	0.06	C72	Fitzsimmons Branch	17+106.1	17+100.5	5.6	81.49	81.81	CSP	600		83.3	0.8	YES	