SERVICING BRIEF &
STORMWATER MANAGEMENT REPORT

3865 Old Richmond Road
Bells Corners, Ottawa, Ontario

Report No. 19022-1

April 28, 2020
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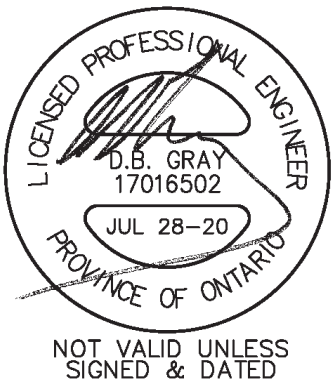

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D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

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3865 Old Richmond Road
Bells Corners, Ottawa, Ontario

Cahdco is working with the Anglican Diocese and Christ Church Bells Corners (CCBC) on an affordable housing development on 2,657 sq.m. of land (to be severed from the church property) at 3865 Old Richmond Road. Specifically, the proposed development is a four-level 35-unit affordable housing apartment building with a foodbank, and office and program space for a community resource centre on the ground floor. The site is currently occupied by the former rectory of CCBC, to be demolished, and is adjacent to the church (at 3861 Old Richmond Road). The two properties will share a private approach. This report describes the servicing of the proposed development and addresses the stormwater management requirements of the property. The parking lot at the adjacent church property is proposed to be expanded and this report also addresses the stormwater management requirements of the parking lot at 3861 Old Richmond Road

This report forms part of the stormwater management design for the proposed development. Refer to drawing C-1 to C-7 also prepared by D. B. Gray Engineering Inc.

WATER SUPPLY FOR FIREFIGHTING:

There is an existing fire hydrant in the municipal road right-of-way located adjacent to the southeast corner of the property; approximately 34 m unobstructed distance to the main entrance of the proposed building. A private on-site private fire hydrant is proposed to be located immediately north of the shared private approach; approximately 35 m unobstructed distance to the main entrance of the proposed building. There are also three other municipal hydrants: about 100 m south and 105 m north of the subject property on Old Richmond Road and about 105 m north on Kimberley Road.

The building is proposed to be wood-framed construction; a sprinkler system is not proposed. Based on this construction a fire flow of 333.3 L/s (20,000 L/min) is required, as calculated as per the Fire Underwriter Survey "Water Supply For Fire Protection". The calculations were submitted to the City and boundary conditions were requested.

The boundary conditions for the 333.3 L/s fire flow (based on the city's computer model of the municipal water distribution system) were received from the City. The boundary conditions include a HGL (hydraulic grade line) of 119.0 m during the above flow rate in the 400mm municipal watermain at the subject location which calculates to be 239 kPa (35 psi). Since the pressure is above 138 kPa (20 psi) there is an adequate water supply for firefighting from the existing municipal water distribution system.

(In the event the 333.3 L/s fire flow was not available a second set of calculations were submitted to the City assuming the same construction as above except with a sprinkler

system. Based on this construction a fire flow of 216.7 L/s (13,000 L/min) would be required. With a boundary condition HGL of 124.0m the pressure calculates to be 288 kPa (42 psi). However, since there is an adequate water supply for firefighting with the above scenario (i.e. with no sprinkler system) these calculations are redundant.)

As per City of Ottawa Tech Bulletin ISTB-2018-02, the aggregate fire flow of all contributing fire hydrants within 150 m of the building can used to supply the required fire flow. The closest municipal fire hydrant is a Class AA and the private on-site hydrant will be a Class AA, each can contribute 5,700 L/min (95 L/s) (as per Table 1 of ISTB-2018-02). The three other existing municipal fire hydrants are also Class AA hydrants; and, since they are between 75 m and 150 m from the building, they can contribute up to 3,800 L/min (63.3 L/s) (as per Table 1). Therefore, the aggregate flow from all five hydrants is 22,800 L/min (380.0 L/s), which is greater than the required fire flow.

WATER SERVICE:

The 35 apartment units are comprised of 16 bachelor/one-bedroom, 16 two-bedroom and 3 three-bedroom units. Based on the City of Ottawa Water Distribution Design Guidelines for residential properties (1.4 person per bachelor/one-bedroom unit; 2.1 persons per two-bedroom unit and 3.1 persons per three-bedroom unit; and 350 L/person/day) and Ministry of the Environment Design Guidelines for peaking factors the daily average flow is 0.3 L/s with a maximum daily and maximum hourly demand of 2.2 and 3.2 L/s, respectively. It is assumed that the water demand for the ground floor uses is small in comparison to the residential uses and would peak at different times and therefore is excluded.

To determine water pressure under the above demands, boundary conditions, based on the City of Ottawa computer simulation of the water distribution system, at the subject location, are required. In summary, we requested the boundary conditions for the subject area based on the following:

Average Daily Demand: 0.3 L/s.
Maximum Daily Demand: 2.2 L/s.
Maximum Hourly Demand: 3.3 L/s
Fire Flow Demand: 333.3 L/s
Maximum Daily + Fire Flow Demand 335.5 L/s

Based on the boundary conditions received from the City, the minimum HGL (hydraulic grade line) is 126.0 m and the maximum is 131.5 m. With these HGLs the water pressure at the water meter is calculated to vary from 323 kPa to 376 kPa (47 to 55 psi). This is an acceptable range of pressures for the proposed development, although they are at the low end of the acceptable range. (As per Ministry of the Environment guidelines a normal operating pressure of 50 to 80 psi is acceptable and not less than 40 psi under maximum hourly demand conditions.)

Based on the AWWA water flow demand curve, and an estimated water pressure at the meter of 338 kPa (49 psi), the peak demand for the building is expected to be 3.0 L/s (182 L/min / 48 USgpm). The AWWA method calculates the instantaneous demand

and is used to size the water service. Based on this peak demand a 50 mm water service connection is proposed. The water service will connect to an existing 406mm ductile iron municipal watermain in Old Richmond Road.

SANITARY SERVICE:

The first pipe segment of the municipal sanitary sewer downstream of the proposed development is 250mm in diameter, having a pipe slope of 0.5%, which calculates to having a capacity of capacity of 43.9 L/s.

There is only one property upstream of the subject property: Our Lady Peace Elementary School, on 2.87 ha of land, with 460 student and staff; and having no showers and no cafeteria. Based on Appendix 4A of the City of Ottawa Sewer Design Guidelines the daily sewage flow of a school (without showers or cafeteria) is 30 litres per person. Using a daily flow of 13,800 litres (= 460 people x 30 L / person) and a 4.5 peaking factor (1.5 peaking factor x 24 / 8 hours); and a 0.33 l/s/ha infiltration flow (also based on the Sewer Guidelines); and including the flow from the existing rectory (assumed to be a single family house); and including the 0.27 hectare subject lands; the pre-development flow in the first downstream pipe segment is calculated to be 1.79 l/s (which calculates to be 4% of the capacity of the municipal sewer).

Based on the City of Ottawa Sewer Design Guidelines for residential properties (1.4 person per bachelor/one-bedroom unit; 2.1 persons per two-bedroom unit and 3.1 persons per three-bedroom unit; – 280 l/person/day – 3.2 peaking factor); and including the ground floor uses (assumed to be 14 people at 75 l per person – 4.5 peaking factor (1.5 peaking factor x 24 / 8 hours); and a 0.33 l/s/ha infiltration flow) the post development flow from the subject property is calculated to be 0.80 l/s. Including the upstream properties (i.e. the school), the total post development flow in the first downstream pipe segment of the municipal sewer is calculated to be 2.46 l/s. Therefore post development flow is expected to have an acceptable impact given the post development flows are only 6% of the capacity of the municipal sewer.

The proposed sanitary sewer connection is 150mm in diameter with a 1% slope, which calculates to having a capacity of 15.9 l/s. This sanitary sewer service connection would adequately handle the 0.80 l/s post development flow from the subject property (being at only 5% capacity).

STORMWATER MANAGEMENT:

Water Quality:

The Rideau Valley Conservation Authority (RVCA) has reviewed the proposed development and has commented: *“Given that the downstream outlet for the storm sewers is less than 1 km with no treatment facility, the appropriate water quality objective of 80%TSS removal. Opportunities for the implementation of LID’s should also be explored.”*

The Low Impact Development (LID) technique of volume detention and release with hydro-dynamic sediment separation is proposed (see also under “Water Quantity below). Specifically, oil/grit separator (OGS) manholes are proposed to be located downstream of the inlet control devices (ICDs) in both the site storm sewer system for the subject property and for the Church parking lot to the north. In both storm sewer system (other than drainage from the roof of the proposed building which is considered "clean“) these pipe sections convey 100% of the catchment area draining into municipal storm sewer system. Two AquaShield Aqua-Swirl Concentrator model AS-2 were selected to achieve a minimum 80% TSS removal. Based on software supplied by the manufacturer, the Aqua-Swirl AS-2 will remove approximately 94% of TSS from the runoff produced by the drainage area. Output from the manufacturer’s software is attached to the report. The Aqua-Swirl model AS-2 has a sediment capacity of 0.28 cubic metres and an oil/debris capacity of 140 litres.

Other Low Impact Development (LID) techniques, such as Retention (infiltration evapotranspiration, re-use) are not proposed. The underlying native soil is silty clay is not suitable for infiltration.

An erosion and sediment control plan has been developed to be implemented during construction, (see drawing C-4 notes 2.1 to 2.6 on drawing C-5). In summary: to filter out construction sediment; sediment capture filter sock inserts will be installed in all existing catch basins adjacent to the site; a silt fence barrier will be installed adjacent to a portion of the north and east property lines; and any material deposited on public road will be removed by sweeping and shoveling or vacuuming and disposing sediment in a controlled area.

Water Quantity:

As identified in the “Arbeatha Park Dual Drainage Assessment” (APDDA), prepared by Parsons, there are areas in Bells Corners where municipal “*storm sewers may surcharge during smaller, more frequent storm events* [that what is considered normal]*. This in turn can result in basement flooding and surface flooding vulnerabilities.”* However this study identifies that in the area of the subject property:

The minor system (i.e. storm sewers):

- The hydraulic grade line (HGL) of the 1500 mm municipal storm sewer to the south and west of the subject property was at an acceptable (low risk) 2.4m below the road during 2002 and 2004 storm events. Reference APDDA Figures 3-4 and 3-7 (attached to end of this report).
  (The 1350 mm municipal storm sewer in Old Richmond Road at the subject property is identified as shallow in APDDA Figures 3-4 and 3-7, however, the top of this sewer is over 3 m deep and it has a 100-year pipe capacity level of services – see below.)
- The pipe capacities of both the 1500 mm and 1350 mm storm sewers have a 1:100 year level of service (except a segment of a 1500mm storm sewer located in an easement adjacent to the rear lot line of the subject property which has a 5-year level of service – as per the City Design Guidelines in areas with that has a dual system (i.e. both minor and major) a minor system 5-year level of service is acceptable). Reference APDDA Figure 4-1 (attached to end of this report).

The major system (i.e. overland flow):

- The flow depth in the road is less than 150mm (which is considered acceptable) during 2002 and 2004 storm events. Reference APDDA Figures 3-3 and 3-6 (attached to end of this report).
- The surface flow level is at a 100-year of service. Reference APDDA Figures 4-5 (attached to end of this report).
  The basement flood risk has a 100-year level of service. Reference APDDA Figures 4-2 (attached to end of this report). (The 1350 mm municipal storm sewer in Old Richmond Road at the subject property is identified as shallow in the APDDA Figure 4-2, however, the top of this sewer is over 3 m deep and it has a 100-year pipe capacity level of services – see above.)

Since, as per the Parsons Dual Drainage study, the subject property is in an area that not considered at an abnormally high risk and since the local storm sewers have at least a 5-year level of service, it is expected that the City will require only the normal urban stormwater management criteria for quantity control. Specifically, the stormwater management criteria for quantity control are to control the post development peak flows for the 5-year and 100-year storm events to peak flows during the 5-year storm event using a pre-development runoff coefficient or runoff coefficient of 0.50, whichever is less; and a calculated time of concentration (but not less than 10 minutes). It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.67 and a time of concentration of 7.5 minutes. Therefore, based on runoff coefficient of 0.50, a 10 minute time of concentration; and using the Rational Method; the maximum allowable release rate is 38.48 L/s for all storm events. The runoff coefficients for the 100 year event are increased by 25% to maximum 1.00.

Stormwater will be stored within the development on the roof of the proposed building and in the parking area above a catch basin.

Drainage Area I
(Uncontrolled Flow Off Site – 147 sq.m.):
The runoff from front of the site will be allowed to flow uncontrolled off the site. The flow from is calculated at 10 minutes concentration.

	100-year	5-year
Maximum flow rate:	4.17 L/s	2.13 L/s

Drainage Area II (Roof 1 – 894 sq.m.):
Each of the two roof drains will be flow control types which will restrict the flow and cause the storm water to pond on the roof. The flow control type roof drain shall be installed with a parabolic shaped slotted weir (1 slot per weir drain at 0.0124 l/s per mm per slot - 5 USgpm per inch per slot); the opening at top of flow control weir shall be a minimum 50 mm in diameter: Watts roof drain with a Watts Accutrol Weir RD-100-A1 or equal. The roof drain will be installed at the low point of the roof which will be 150mm lower than the perimeter of the roof. Four scuppers, each 650 mm wide and installed 150 mm above the roof drains, are required (refer to architectural for exact locations and details). The roof shall be designed to carry the load of water having a 50mm depth at scupper and 200mm depth at roof drain (refer to structural).

	100-year	5-year
The maximum release rate:	3.55 L/s	2.74 L/s
The maximum ponding depth:	143 mm	111 mm

The maximum stored volume:	37.22 cu.m.	17.13 cu.m.

Drainage Area III (1,616 sq.m.):
An inlet control device (ICD) located at the outlet pipe of catch basin / manhole CB/MH-6 will control the release of stormwater from Drainage Area III The ICD will restrict the flow and force the stormwater to back up onto the asphalt surface above the catch basin. The ICD shall be a plug style with a round orifice design (with the orifice located at the bottom of the plug) manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 30.76 L/s at 2.45 m head. It is calculated that an orifice area of 7,268 sq.mm. (±96 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 30.76 L/s at a head of 2.45 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 30.29 l/s at 2.38 m.

	100-year	5-year
Maximum release rate:	30.76 L/s	30.29 L/s
Maximum water elevation:	93.36 m	93.29 m
Maximum stored volume:	23.38 cu.m.	5.71 cu.m.

The Entire Site:

	100-year	5-year
Maximum permitted release rate:	38.48 L/s	38.48 L/s
Maximum release rate:	38.48 L/s	35.17L/s
Maximum stored volume:	60.59 cu.m.	22.85 cu.m.

Therefore, the maximum post-development release rate for the 100-year storm event is calculated to be equal to the maximum allowable of 38.48 L/s and to achieve this release rate the total maximum required capacity is 60.59 cu.m. For the 5-year event the maximum post-development release is calculated to be less than the maximum allowable at 35.17 L/s and to achieve this release rate the total stored volume is 22.85 cu.m.

Storm Sewer System:

The unrestricted flowrate in the site storm sewer system, resulting from one in five-year storm event, will produce a peak flow of 34.01 L/s which will be adequately served by the proposed storm sewers with the last pipe segment (300 mm at 1.03% - 102.4 L/s capacity) being only at 33% of its capacity. (With the restricted flow (i.e. through the ICD) last pipe segment will be only 30% full.)

The unrestricted flowrate from the roof, resulting from 5-year event will produce a peak flow of 23.31 L/s which will be adequately served by the proposed storm sewer connection (200 mm at 1.0% - 34.2 L/s capacity) being at 68% of its capacity. (With the restricted flow (i.e. through the flow control roof drains) the storm sewer connection will be only be 8% full.)

The 38.48 L/s in stormwater flows contributing to the municipal storm sewer system is expected to have a positive impact given the post-development flows from the site are being reduced by 32% (from 51.34 to 35.17 L/s) during the 5-year event and by 61% (from 98.98 to 38.48 L/s) during the 100-year event.

Water Quantity (Church Parking Lot):

The City has stated that stormwater management is not required for the Church Parking Lot to the north of the subject property (although grading and layout modifications are proposed) provided *"it can be demonstrated that the existing drainage patterns are not changing and net-runoff can be demonstrated to be equal to, or less than pre-development net-runoff."* However, without stormwater management the post development runoff will be greater than pre-development, therefore, stormwater management is proposed for both quality (see above under Water Quality) and quantity control. Specifically, the stormwater management criteria for quantity control are to control the post development peak flows pre-development peak flows using a pre-development runoff coefficient; and a calculated time of concentration (but not less than 10 minutes). It is calculated that the pre-development conditions reflect a 5-year runoff coefficient of 0.79 and a time of concentration of 4.5 minutes. Therefore, based on a 10 minute time of concentration; and using the Rational Method; the maximum allowable release rate is 31.32 L/s for the 5-year event and 59.94 L/s for the 100-year. The runoff coefficients for the 100 year event are increased by 25% to maximum 1.00.

Stormwater will be stored in the parking lot above a catch basin.

Drainage Area A (The Church Parking Lot to the north - 1,371 sq.m.):
During five-year event an inlet control device (ICD) located in located at the outlet pipe of catch basin CB-8 will control the release of stormwater from Drainage Area A. During the one hundred-year event, in addition to the ICD, a depressed curb, 4.2 m wide, will act as a broad-crested weir and will control the release of stormwater. The ICD and weir will restrict the flow and force the stormwater to back up into the detention area. The top of the depressed section of curb will be at the 100-year elevation and will release 25.62 L/s. The ICD shall be a plug style with a round orifice design (with the orifice located at the bottom of the plug) manufactured by Pedro Plastics (or approved equal) and shall be sized by the manufacturer for a discharge rate of 31.63 L/s at 2.35 m head. It is calculated that an orifice area of 7,634 sq.mm. (±99 mm diameter) and a discharge coefficient of 0.61 will restrict the outflow rate to 31.63 L/s at a head of 2.35 m. Based on this orifice the maximum outflow rate for the 1:5 year storm event is calculated to be 31.32 l/s at 2.31 m.

	100-year	5-year
The maximum ICD release rate:	31.63 L/s	31.32 L/s
The maximum weir release rate:	25.62 L/s	0.00 L/s
The maximum release rate:	57.25 L/s	31.32 L/s
The maximum permitted release rate:	59.94 L/s	31.32 L/s
The maximum ponding elevation:	92.75 m	92.70 m
The maximum ponding depth:	0.15 m	0.10 m
The maximum stored volume:	4.25 cu.m.	1.44 cu.m.

Therefore, the maximum post-development release rate for the 100-year storm event is calculated to be approximately 5% less than the maximum allowable of 57.25 L/s and to achieve this release rate the maximum required storage capacity is 4.25 cu.m. For the 5-year event the maximum post-development release is calculated to be equal to the

maximum allowable at 31.32 L/s and to achieve this release rate the maximum required storage capacity is 1.44 cu.m.

Storm Sewer System (Church Parking Lot):

The unrestricted flowrate in the Church parking lot storm sewer system, resulting from one in five-year storm event, will produce a peak flow of 33.22 L/s which will be adequately served by the proposed storm sewers with the last pipe segment (300 mm at 1.15% - 108.2 L/s capacity) being only at 31% of its capacity. (With the restricted flow (i.e. through the ICD) last pipe segment will be only 29% full.)

The 31.32 L/s in stormwater flows contributing to the municipal storm sewer system is expected to have a negligible impact given the post-development flows from the parking area do not increase during the 5-year event and decreases slightly during the 100-year event.

MINISTRY OF ENVIRONMENT, CONSERVATION AND PARKS (MECP)
ENVIRONMENTAL COMPLIANCE APPROVAL (ECA):

The subject development is a residential rental project and will be located on one property (severed from the church property). It is expected that a MECP ECA will not be required.

CONCLUSIONS:

1. A private on-site private fire hydrant is proposed to be located immediately north of the shared private approach.

2. There is an adequate water supply for firefighting from the existing municipal water distribution system.

3. The aggregate flow from the proposed private fire hydrant plus the four municipal hydrants within 150 m of the subject property is 22,800 L/min (380.0 L/s), which is greater than the required fire flow of 20,000 L/min (333.3 L/s).

4. There is an acceptable range of pressures for the proposed development, although they are at the low end of the acceptable range.

5. The proposed 50mm water service connection will be adequate to serve the development.

6. The pre-development flow calculates to be only 4% of the capacity of the municipal sanitary sewer and post development flows it only increases to 6% and, therefore, the proposed development is expected to have an acceptable impact on the municipal sanitary sewers.

7. The proposed 150mm sanitary sewer connection with a slope of 1% will adequately serve the proposed development.

8. The RVCA require a minimum of 80% TSS removal and to achieve this criterion two oil/grit separator (OGS) manholes (both Aqua-Swirl AS-2) will remove approximately 94% of TSS from the runoff produced by the drainage area.

9. An erosion and sediment control plan has been developed to be implemented during construction.

10. As per the Parsons Dual Drainage study, the subject property is in an area that not considered at an abnormally high risk of flooding.

11. The stormwater management criteria for quantity control are to control the post development peak flows for the 5-year and 100-year storm events to peak flows during the 5-year storm event using runoff and a 10 minute time of concentration. Using the Rational Method the maximum allowable release rate is 38.48 L/s for all storm events.

12. The maximum post-development release rate for the 100-year storm event is calculated to be equal to the maximum allowable of 38.48 L/s and to achieve this release rate the total maximum required capacity is 60.59 cu.m. For the 5-year event the maximum post-development release is calculated to be less than the maximum allowable at 35.17 L/s and to achieve this release rate the total stored volume is 22.85 cu.m.

13. The unrestricted flowrate in the site storm sewer system, resulting from one in five-year storm event will be adequately served by the proposed storm sewers.

14. The unrestricted flowrate from the roof, resulting from 5-year event will be adequately served by the proposed storm sewer connection.

15. The 38.48 L/s in stormwater flows contributing to the municipal storm sewer system is expected to have a positive impact given the post-development flows from the site are being reduced by 32% during the 5-year event and by 61% during the 100-year event

16. In the Church parking lot the stormwater management criteria for quantity control are to control the post development peak flows are to control the post development peak flows pre-development peak flows using a pre-development runoff coefficient, whichever is less; and a calculated time of concentration (but not less than 10 minutes). Using the Rational Method; the maximum allowable release rate is 31.32 L/s for the 5-year event and 59.94 L/s for the 100-year.

17. In the Church parking lot the maximum post-development release rate for the 100-year storm event is calculated to be approximately 5% less than the maximum allowable of 57.25 L/s and to achieve this release rate the maximum required storage capacity is 4.25 cu.m. For the 5-year event the maximum post-development

release is calculated to be equal to the maximum allowable at 31.32 L/s and to achieve this release rate the maximum required storage capacity is 1.44 cu.m.

18. In the Church parking lot the unrestricted flowrate in the site storm sewer system, resulting from one in five-year storm event will be adequately served by the proposed storm sewers.

19. In the church parking lot the 31.32 L/s in stormwater flows contributing to the municipal storm sewer system is expected to have a negligible impact given the post-development flows from the parking area do not increase during the 5-year event and decreases slightly during the 100-year event.

20. It is expected that a MECP ECA will not be required.

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24-Mar-20
REVISED 31-Mar-20

3865 Old Richmond Rd

4-Level Mixed Use Apartment Building
Ottawa, Ontario

Fire Flow Requirements

Fire flow requirement as calculated as per Fire Undewriter Survey "Water Supply For Fire Protection".

F = 220 C $A^{0.5}$ = the required fire flow in litres per minute

C = coefficient related to the type of construction
= 1.5 Wood Frame Construction

A = total floor area (all storeys excluding basements at least 50% below grade)

Proposed 4 storey mixed building:

Ground Floor	892	sq.m. APPROX.
1st Floor	859	sq.m. APPROX.
2nd Floor	859	sq.m. APPROX.
3rd Floor	859	sq.m. APPROX.
TOTAL FIRE AREA:	3469	sq.m. APPROX.

F = 19,436 L/min
= 19,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Change for limited-combustible Ocuppancy

= 16,150 L/min

0% Reduction for No Sprinkler System

= - L/min

Increase for Separation Exposed Buildings / Adjacent Building

			Constuction	Length m	Storeys	Length-Height Factor
8%	North	20.1 to 30m	W-F	26	2	52
5%	East	30.1 to 45m	W-F	16	2	32
10%	South	10.1 to 20m	Ordinary	21	1	21
0%	West	>45				0

23% Total Increase for Exposure (maximum 75%)
= 3,715 L/min Increase

= 19,865 L/min
F = 20,000 L/min (rounded off to the nearest 1,000 L/min)
= 333.3 l/s

Elevation at Fire Hydrant	94.67	m ASL	Static Pressure at Fire Hydrant			
333 l/s FIRE FLOW:	119.0	m ASL	35	psi	239	kPa

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24-Mar-20
REVISED 31-Mar-20

3865 Old Richmond Rd

4-Level Mixed Use Apartment Building
Ottawa, Ontario

Fire Flow Requirements

Fire flow requirement as calculated as per Fire Undewriter Survey "Water Supply For Fire Protection".

F = 220 C $A^{0.5}$ = the required fire flow in litres per minute

C = coefficient related to the type of construction
= 1.5 Wood Frame Construction

A = total floor area (all storeys excluding basements at least 50% below grade)

Proposed 4 storey mixed building:

Ground Floor	892	sq.m. APPROX.
1st Floor	859	sq.m. APPROX.
2nd Floor	859	sq.m. APPROX.
3rd Floor	859	sq.m. APPROX.
TOTAL FIRE AREA:	3469	sq.m. APPROX.

F = 19,436 L/min
= 19,000 L/min (rounded off to the nearest 1,000 L/min)

-15% Change for limited-combustible Ocuppancy

= 16,150 L/min

40% Reduction for Sprinkler System

= 6,460 L/min

Increase for Separation Exposed Buildings / Adjacent Building

			Constuction	Length m	Storeys	Length-Height Factor
8%	North	20.1 to 30m	W-F	26	2	52
5%	East	30.1 to 45m	W-F	16	2	32
10%	South	10.1 to 20m	Ordinary	21	1	21
0%	West	>45				0
23%	Total Increase for Exposure (maximum 75%)					

= 3,715 L/min Increase

= 13,405 L/min
F = 13,000 L/min (rounded off to the nearest 1,000 L/min)
= 216.7 l/s

Elevation at Fire Hydrant	94.67	m ASL	Static Pressure at Fire Hydrant			
217 l/s FIRE FLOW:	124.0	m ASL	42	psi	288	kPa

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24-Mar-20
REVISED 31-Mar-20

3865 Old Richmond Rd
4-Level Mixed Use Apartment Building
Ottawa, Ontario

Water Demand

	Number of Units	Persons Per Unit	Population
APARTMENTS:			
1 Bedroom:	16	1.4	22
2 Bedroom:	16	2.1	34
3 Bedroom:	3	3.1	9
Average Aptarment:	0	1.8	0
		TOTAL:	65

DAILY AVERAGE

350 litres / person / day

15.9	L/min	0.3	L/s	4 USgpm

MAXIMUM DAILY DEMAND 8.1 (Peaking Factor for a population of 31: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)

129.3	L/min	2.2	L/s	34 USgpm

MAXIMUM HOURLY DEMAND 12.3 (Peaking Factor for a population of 31: Table 3-3 MOE Design Guidelines for Drinking-Water Systems)

194.7	L/min	3.2	L/s	51 USgpm

Elevation of Water Meter: 93.10 m ASL
Basement Floor Elevation: 92.20 m ASL

			Static Pressure at Water Meter	
MINIMUM HGL:	126.0	m ASL	47 psi	323 kPa
MAXIMUM HGL:	131.5	m ASL	55 psi	376 kPa

D.B. Gray Engineering Inc.

Douglas Gray <d.gray@dbgrayengineering.com>

Fw: Christ Church Bells Corners, 3865 Old Richmond Rd - Boundary Condition Request

1 message

Surprenant, Eric <Eric.Surprenant@ottawa.ca> Tue, Mar 31, 2020 at 8:00 AM
To: Douglas Gray <d.gray@dbgrayengineering.com>
Cc: Caoimhin Kennedy <c.kennedy@dbgrayengineering.com>

Hello Doug,

Please find attached the boundary conditions as requested for the above noted site.

Thanks
Eric Surprenant

The following are boundary conditions, HGL, for hydraulic analysis at 3865 Old Richmond (zone 2W) assumed to be connected to the 406mm on Old Richmond (see attached PDF for location).

Minimum HGL = 126.0m

Maximum HGL = 131.5m

MaxDay + FireFlow (183L/s) = 125.0m

MaxDay + FireFlow (217L/s) = 124.0m

MaxDay + FireFlow (333L/s) = 119.0m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

From: Douglas Gray <d.gray@dbgrayengineering.com>
Sent: Tuesday, March 24, 2020 3:26 PM
To: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Cc: Caoimhin Kennedy <c.kennedy@dbgrayengineering.com>
Subject: Christ Church Bells Corners, 3865 Old Richmond Rd - Boundary Condition Request

Hi Eric

Please provide the boundary conditions at 3865 Old Richmond Rd. We have calculated the following expected demands for the based on a 35-unit four-storey apartment building:

Average daily demand: 0.3 l/s.
Maximum daily demand: 2.1 l/s.
Maximum hourly daily demand: 3.2 l/s
Fire Flow demand: 333.3 l/s
Fire Flow + Max Day: 335.4 l/s

We are looking at an alternative design with the building having sprinklers so please also provide the boundary conditions for a fire flow demand of 183.3 l/s.

Average daily demand: 0.3 l/s.
Maximum daily demand: 2.1 l/s.
Maximum hourly daily demand: 3.2 l/s
Fire Flow demand: 216.7 l/s
Fire Flow + Max Day: 218.8 l/s

Our calculations are attached. Also attached are preliminary drawings.

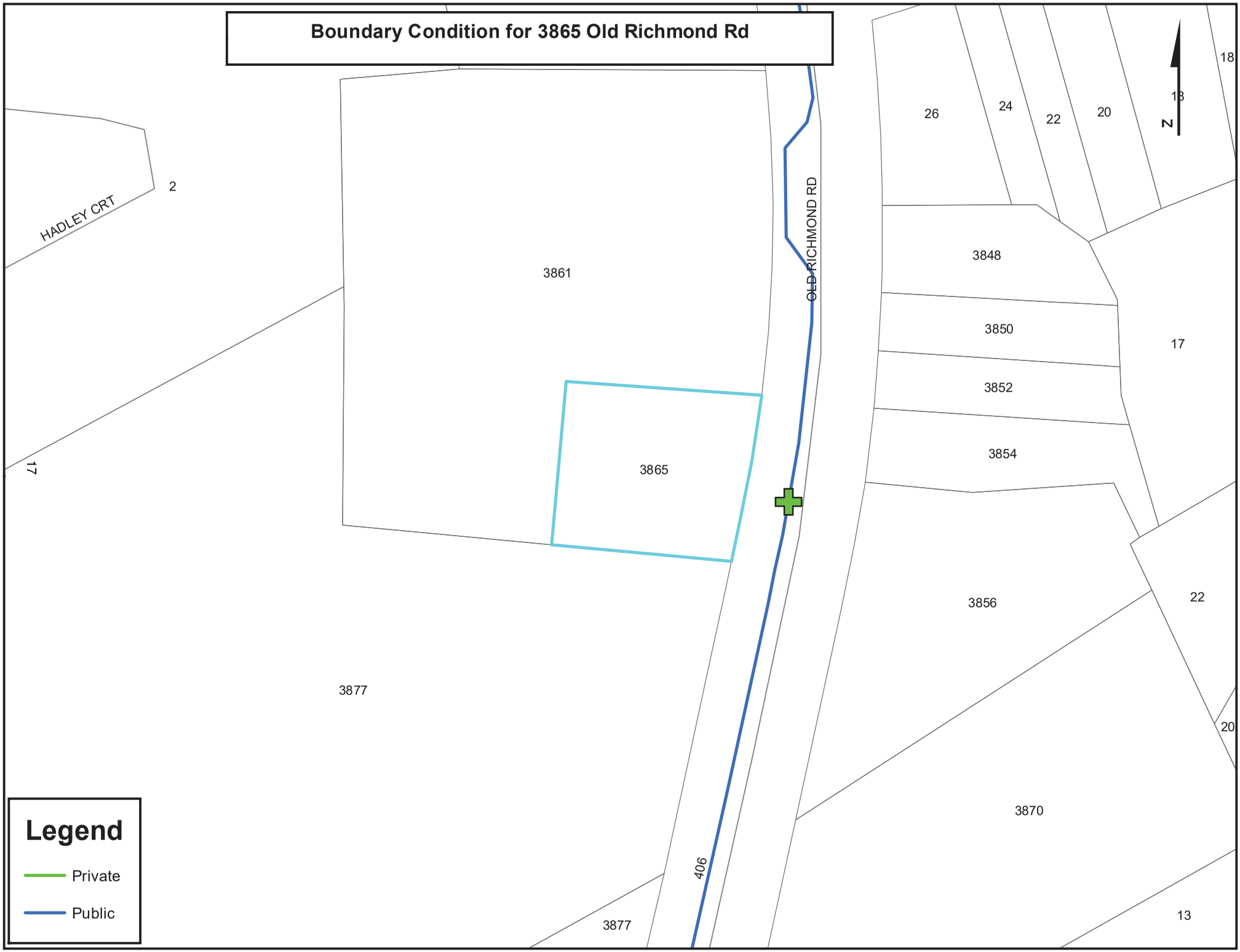
Regards, Doug

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle Tel: 613-425-8044
Ottawa, Ontario K1T 4E9 d.gray@dbgrayengineering.com

3865 Old Richmond Rd March 2020.pdf
77K


Boundary Condition for 3865 Old Richmond Rd
HADLEY CRT
2
17
3861
3865
3877
OLD RICHMOND RD
406
26
24
22
20
18
13
N
3848
3850
3852
3854
17
3856
22
20
3870
13
3877
Legend
Private
Public

27-Apr-20

3865 Richmond Road
Ottawa, Ontario

Peak Water Demand

WATER FIXTURE VALUE
(AWWA Manual M22 - Sizing Water Service Lines and Meters)

	No.	F.V.	Total
Bathtub	32	8	256
Tiolet - tank	40	6	240
Tiolet - flush valve	0	24	0
Lavs.	40	1.5	60
Bidet	0	2	0
Urinal - wall flush valve	0	10	0
Shower	3	2.5	7.5
K. Sink	35	1.8	63
Dishwasher	0	1.3	0
Clothes Washer	0	6	0
Commercial Sink	3	4	12
J. Sink	1	4	4
Commercial Dishwasher	2	4	8
Commercial Washer	2	4	8
Hose 1/2 in	0	5	0
Hose 3/4 in	0	12	0
			658.5

Peak Demand (fig 4-2 or 4-3 AWWA M22)			54	USgpm		
Pressure @ Meter	338	kPa	49	psi		
Pressure Factor (table 4-1 AWWA M22)			0.89			
Peak Demand			48	USgpm		
Irrigation - hose 1/2 in	0		0	USgpm (includes pressure factor)		
TOTAL PEAK DEMAND	182	l/min	48	USgpm	3.0	l/s
		Nominal Size	2.0	in	50	mm
			5.1	ft/s	1.5	m/s

D.B. GRAY ENGINEERING INC.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle
Ottawa, Ontario K1T 4E9
613-425-8044
d.gray@dbgrayengineering.co

SANITARY SEWER DESIGN FORM

Average Daily Flows:
- Residential: 280 l / capita / day
- Commercial: 28,000 l / ha / day
- Instituational: 28,000 l / ha / day
- Light Industrial: 35,000 l / ha / day
- Heavy Industrial: 55,000 l / ha / day

Infiltration Allowance: 0.33 l / s / ha

Peaking Factor:
- Residential (Harmon Equation): $P.F. = 1 + \frac{14}{4 + P^{0.5}}$ (P = Population / 1000)
- Harmon Correction Factor 0.8
- Commercial & Institutional: 1.5 If contrinbution > 20%
- Commercial & Institutional: 1.0 If contrinbution < 20%
- Industrial: As per Ottawa Guidelines Appendix 4-B

PROJECT: 3865 Old Richmond Road

Designed By: DBG

20-Apr-27

LOCATION			Section								Cumulative		Section			Cumulative					SEWER DATA								COMMENTS
											Residential		Non-Residential															n = 0.013		
STREET	FROM	TO	Single Family ppu = 3.4	Semi/Townhouse ppu = 2.7	Duplex / Triplex ppu = 2.3	Apartments (average) ppu = 1.8	Apartments (1 Bed.) ppu = 1.4	Apartments (2 Bed.) ppu = 2.1	Apartments (3 Bed.) ppu = 3.1	Resid-ential Area	Pop.	Peaking Factor	Area	Flow	Peaking Factor	Flow	Area	Sewage Flow	Infil-tration Flow	Total Flow	Type of Pipe	Dia. Actual (mm)	Dia. Nom. (mm)	Slope (%)	Length (m)	Capacity (l/s)	Velocity (m/s)	Ratio Q/Qfull	
			No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	No. of Units	ha			ha	l/ha/day		l/s	ha	l/s	l/s	l/s									
PRE-DEVELOPMENT CONDITIONS																													
	1st pipe segment downstream of proposed development										Our Lady Peace Elementary School: 460 students/staff x 30 L per person (as per Ottawa Sewer Guideline Appendix 4A) / 2.87 ha Peaking Factor = 4.5 (= 1.5 / 8 hrs x 24hrs)												1st pipe segment downstream of proposed development							
			Rectory																										
Old Richmond Rd	SAN MH 14557	SAN MH 14558	1							0.27	3	3.2	2.87	4808	4.5	0.72	3.14	0.75	1.03	1.79		254.0	250	0.50		43.9	0.87	0.04	
POST DEVELOPMENT CONDITIONS																													
	1st pipe segment downstream of proposed development										Our Lady Peace Elementary School: 460 students/staff x 30 L per person (as per Ottawa Sewer Guideline Appendix 4A) PLUS 14 people x 75 L per person in ground floor of the proposed building / 3.14 ha Peaking Factor = 4.5 (= 1.5 / 8 hrs x 24hrs)												1st pipe segment downstream of proposed development							
Old Richmond Rd	SAN MH 14557	SAN MH 14558					19	13	3		63	3.2	3.14	4736	4.5	0.77	3.14	1.43	1.03	2.46		254.0	250	0.50		43.9	0.87	0.06	
Proposed Sanitary Sewer Connection																													
											14 people x 75 L per person in ground floor of the proposed building / 0.27 ha Peaking Factor = 4.5 (= 1.5 / 8 hrs x 24hrs)												Proposed Sanitary Sewer Connection							
							19	13	3		63	3.2	0.27	3952	4.5	0.05	0.27	0.71	0.09	0.80		152.4	150	1.00	12.3	15.9	0.87	0.05	

D.B. Gray Engineering Inc.

Douglas Gray <d.gray@dbgrayengineering.com>

RE: RVCA Stormwater Management Comments - 3865 Old Richmond Road

1 message

Jamie Batchelor <jamie.batchelor@rvca.ca> Wed, Apr 22, 2020 at 2:21 PM
To: Ryan Faith <r.faith@dbgrayengineering.com>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>, Eric Lalande <eric.lalande@rvca.ca>

Good Afternoon Ryan,

Given that the downstream outlet for the storm sewers is less than 1 km with no treatment facility, the appropriate water quality objective of 80%TSS removal. Opportunities for the implementation of LID's should also be explored.

Jamie Batchelor, MCIP, RPP

Planner, ext. 1191

Jamie.batchelor@rvca.ca

Rideau Valley Conservation Authority

3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504 F 613-692-0831 | www.rvca.ca

From: Ryan Faith <r.faith@dbgrayengineering.com>
Sent: Wednesday, April 22, 2020 10:41 AM
To: Jamie Batchelor <jamie.batchelor@rvca.ca>
Cc: Douglas Gray <d.gray@dbgrayengineering.com>
Subject: RVCA Stormwater Management Comments - 3865 Old Richmond Road

Hi Jamie,

We are working on a proposed 3 storey mixed use building on 2657 sq.m of land at 3865 Old Richmond Road in Ottawa.

Please comment on the stormwater management for the site.

I have attached a site plan for your reference.

Thanks,

Ryan Faith

D.B. Gray Engineering Inc.

Stormwater Management - Grading & Drainage - Storm & Sanitary Sewers - Watermains

700 Long Point Circle 613-425-8044
Ottawa, Ontario r.faith@dbgrayengineering.com

AquaShield™ STORMWATER TREATMENT SOLUTIONS

Sizing Report

2733 Kanasita Drive • Suite 111 • Chattanooga, TN 37343 • Phone: (423) 870-8888 • Fax: (423) 826-2112 • www.aquashieldinc.com

Site Information

Project Name: **3865 Old Richmond Road**

Site Area (hectacres): **0.1616**

Unit Label: **OGS**

Runoff Coeff. : **0.78**

Unit Location:

Target Removal Efficiency(%): **80% based on NJDEP**

Product Recommendation

Aqua-Swirl™ Model	Net Annual TSS Removal Efficiency	Chamber Diameter	Maximum Inside Diameter (mm)		Oil/Debris Storage Capacity	Sediment Storage Capacity
			Offline	BYP[5]		
AS-2	**93.74 %**	763 mm.	205 mm.	381 mm.	140 L	0.28 m^3

Rainfall Information

NCDC Station[1]: **OTTAWA MACDONALD-CARTIER INT'L A**

Data Range[4]: **261,759 readings taken hourly between 1967 to 2007 (~40 years)**

Rainfall Event Range (mm/hre)	Rainfall Interval Point (mm/hre)	Operating Rate (Lps/m^2)	Total Rainfall (%)	Removal Efficiency (%)[2]	Relative Efficiency(%)
02.00 - 03.00	02.50	01.92	44.18	96.34	42.56
03.00 - 04.00	03.50	02.69	21.52	95.43	20.54
04.00 - 05.00	04.50	03.46	11.68	94.43	11.03
05.00 - 06.00	05.50	04.22	06.68	93.32	06.23
06.00 - 07.00	06.50	04.99	04.03	92.12	03.71
07.00 - 08.00	07.50	05.76	01.99	90.81	01.81
08.00 - 09.00	08.50	06.53	01.84	89.40	01.65
09.00 - 10.00	09.50	07.30	01.81	87.90	01.59
10.00 - 15.00	12.50	09.60	04.12	82.78	03.41
15.00 - 20.00	17.50	13.44	01.02	72.25	00.74
20.00 - 25.00	22.50	17.28	00.54	59.22	00.32
25.00 - 30.00	27.50	21.12	00.24	43.70	00.10
30.00 - 40.00	35.00	26.89	00.33	15.72	00.05
		Total Cumulative Rainfall %:	**99.98[3]**	**Net Annual %:**	**93.74**

Sales Agent Information

Agent Name: **Emmanuel Dion**

Phone:

Company Name: **Soleno**

Fax:

Address:

E-mail: **edion@soleno.com**

City, State Zip: **, ON**

Footnotes

1. Recorded as hourly precipitation rainfall data (inches), National Climatic Data Center (NCDC)
2. Based on Tennessee Tech University laboratory testing of the AquaSwirl™ Model AS-3 for OK-110 silica particles 50-125 microns(Neary, 2002)
3. 90% Rainfall Event, calculated as a cumulative percentile of individual events, www.stormwatercenter.net, sizing criteria (Center for Watershed Protection)
4. NCDC data may not be consecutive, skipping days, months and/or years in the range of dates.
5. The Aqua-Swirl™ Internal Bypass (BYP) provides full treatment of the "first flush," while the peak design storm is diverted and channeled through the main conveyance pipe. Please refer to your local representative for more information.

6. When applicable, the performance curve was adjusted via Peclet Scaling to provide estimated sizing per NJDEP PSD (d50 = 67 microns).

STORMWATER MANAGEMENT CALCULATIONS

The orifice calculations are based on the following formula:

$$Q = C_d \times A_o \sqrt{2gh} \times 1000$$

where:

- Q = flowrate in litres per second
- C_d = coefficient of discharge
- A_o = orifice area in sq.m.
- g = 9.81 m/s2
- h = head above orifice in meters

Flow control roof drain calculations are based on the following formula:

$$Q = N \times S \times d \times F$$

where:

- Q = flowrate in litres per second
- N = number of roof drains
- S = slots per weir
- d = pond depth at roof drain in mm
- F = flowrate through each slot
  0.0124 litres per second per mm pond depth (5 USgpm per inch)

Storage calculations on the roof and parking area are based on the following formula for volume of a cone:

$$V = (A \times d)/3$$

where:

- V = volume in cu.m.
- A = ponding area in sq.m.
- d = ponding depth in meters

Summary Tables

ONE HUNDRED YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	4.17	-	-
AREA II (Roof)	-	3.55	37.22	37.22
AREA III	-	30.76	23.38	23.38
TOTAL	38.48	38.48	60.59	60.59

FIVE YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA I (Uncontrolled Flow Off Site)	-	2.13	-	-
AREA II (Roof)	-	2.74	17.13	17.13
AREA III	-	30.19	3.73	3.73
TOTAL	38.48	35.07	20.86	20.86

April 27, 2020
REVISED July 28, 2020

3865 Old Richmond Road

4-Level Mixed Use Apartment Building

Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS

Rational Method

PRE-DEVELOPMENT CONDITIONS

100 Year Release Rate

			C
Roof Area:	176	sq.m	1.00
Asphalt/Concrete Area:	1597	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	884	sq.m	0.25
Total Catchment Area (A):	2657	sq.m	0.75

Bransby William Formula (Used when C > 0.40)

$$Tc = \frac{0.057 \cdot L}{Sw^{0.2} \cdot A^{0.1}} \text{ min}$$

Sheet Flow Distance (L):	30	m
Slope of Land (Sw):	1.0	%
Area (A):	0.2657	ha
Time of Concentration (Tc):	2.0	min
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.75	
100-Year Pre-Development Release Rate (2.78AiC):	98.98	L/s

5 Year Release Rate

			C
Roof Area:	176	sq.m	0.90
Asphalt/Concrete Area:	1597	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	884	sq.m	0.20
Total Catchment Area (A):	2657	sq.m	0.67
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.67		
5-Year Pre-Development Release Rate (2.78AiC):	51.34	L/s	

Maximum Allowable Release Rate

			C
Roof Area:	176	sq.m	0.90
Asphalt/Concrete Area:	1597	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	884	sq.m	0.20
Total Catchment Area:	2657	sq.m	0.67
Area (A):	2657	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	(5 year event)
Runoff Coeficient (C):	0.50		
Maximum Allowable Release Rate (2.78AiC):	38.18	L/s	

ONE HUNDRED YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	63	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	84	sq.m	0.25
Total Catchment Area:	147	sq.m	0.57
Area (A):	147	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	179	mm/hr	
Runoff Coeficient (C):	0.57		
Release Rate (2.78AiC):	4.17	L/s	

DRAINAGE AREA II (Roof)

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	894	sq.m	1.00
Asphalt/Concrete Area:	0	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	0	sq.m	0.25
Total Catchment Area:	894	sq.m	1.00

No. of Roof Drains: 2

Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 143 mm

Maximum Release Rate: 3.55 L/s

Pond Area: 779 sq.m

Achieved Volume: 37.22 cu.m

Maximum Volume Required: 37.22 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
10	179	44.38	3.55	40.82	24.49
15	143	35.51	3.55	31.96	28.76
20	120	29.81	3.55	26.26	31.51
25	104	25.81	3.55	22.26	33.38
30	92	22.83	3.55	19.28	34.70
35	83	20.52	3.55	16.97	35.64
40	75	18.68	3.55	15.12	36.29
45	69	17.16	3.55	13.61	36.74
50	64	15.89	3.55	12.34	37.02
55	60	14.82	3.55	11.26	37.17
60	56	13.89	3.55	10.34	37.22
65	53	13.08	3.55	9.53	37.17
70	50	12.37	3.55	8.82	37.05
75	47	11.74	3.55	8.19	36.86
80	45	11.18	3.55	7.63	36.62
85	43	10.68	3.55	7.12	36.32
90	41	10.22	3.55	6.66	35.99
95	39	9.80	3.55	6.25	35.61
100	38	9.42	3.55	5.87	35.20
105	36	9.07	3.55	5.52	34.76
110	35	8.75	3.55	5.20	34.29
115	34	8.45	3.55	4.90	33.80
120	33	8.18	3.55	4.62	33.28
125	32	7.92	3.55	4.37	32.74
130	31	7.68	3.55	4.13	32.18
135	30	7.46	3.55	3.90	31.60
140	29	7.25	3.55	3.69	31.01
145	28	7.05	3.55	3.49	30.40
150	28	6.86	3.55	3.31	29.78
180	24	5.94	3.55	2.39	25.78
210	21	5.26	3.55	1.70	21.44
240	19	4.72	3.55	1.17	16.85
270	17	4.30	3.55	0.74	12.07
300	16	3.95	3.55	0.40	7.13

DRAINAGE AREA III

(ONE HUNDRED YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	1334	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	282	sq.m	0.25
Total Catchment Area:	1616	sq.m	0.87

Water Elevation: 93.36 m

Invert of Outlet Pipe - CB/MH-6: 90.86 m

Centroid of ICD Orifice: 90.91 m
(ICD in Outlet Pipe of CB/MH-6)

Head: 2.45 m

Orifice Diameter: 96 mm

Orifice Area: 7268 sq.mm

Coefficient of Discharge: 0.61

Maximum Release Rate: 30.76 L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB/MH-2	22	0.05	0.38	cu.m
CB/MH-6	361	0.19	23.00	cu.m

Achieved Volume: 23.38 cu.m

Maximum Volume Required: 23.38 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
10	179	69.72	30.76	38.96	23.38
15	143	55.79	30.76	25.04	22.53
20	120	46.83	30.76	16.08	19.29
25	104	40.55	30.76	9.79	14.68
30	92	35.87	30.76	5.11	9.20
35	83	32.24	30.76	1.48	3.12
40	75	29.34	29.34	0.00	0.00
45	69	26.96	26.96	0.00	0.00
50	64	24.97	24.97	0.00	0.00
55	60	23.28	23.28	0.00	0.00
60	56	21.82	21.82	0.00	0.00
65	53	20.56	20.56	0.00	0.00
70	50	19.44	19.44	0.00	0.00
75	47	18.45	18.45	0.00	0.00
80	45	17.57	17.57	0.00	0.00
85	43	16.77	16.77	0.00	0.00
90	41	16.05	16.05	0.00	0.00
95	39	15.40	15.40	0.00	0.00
100	38	14.80	14.80	0.00	0.00
105	36	14.25	14.25	0.00	0.00
110	35	13.74	13.74	0.00	0.00
115	34	13.28	13.28	0.00	0.00
120	33	12.84	12.84	0.00	0.00
125	32	12.44	12.44	0.00	0.00
130	31	12.06	12.06	0.00	0.00
135	30	11.71	11.71	0.00	0.00
140	29	11.38	11.38	0.00	0.00
145	28	11.07	11.07	0.00	0.00
150	28	10.78	10.78	0.00	0.00
180	24	9.33	9.33	0.00	0.00
210	21	8.26	8.26	0.00	0.00
240	19	7.42	7.42	0.00	0.00
270	17	6.75	6.75	0.00	0.00
300	16	6.20	6.20	0.00	0.00

FIVE YEAR EVENT

DRAINAGE AREA I (Uncontrolled Flow Off Site)

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	63	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	84	sq.m	0.20
Total Catchment Area:	147	sq.m	0.50
Area (A):	147	sq.m	
Time of Concentration:	10	min	
Rainfall Intensity (i):	104	mm/hr	
Runoff Coeficient (C):	0.50		
Release Rate (2.78 • A • i • C):	2.13	L/s	

DRAINAGE AREA II (Roof)

(FIVE YEAR EVENT)

			C
Roof Area:	894	sq.m	0.90
Asphalt/Concrete Area:	0	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	0	sq.m	0.20
Total Catchment Area:	894	sq.m	0.90

No. of Roof Drains: 2

Slots per Wier: 1 0.0124 L/s/mm/slot (5 USGPM/in/slot)

Depth at Roof Drain: 111 mm

Maximum Release Rate: 2.74 L/s

Pond Area: 465 sq.m

Achieved Volume: 17.13 cu.m

Maximum Volume Required: 17.13 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
10	104	23.31	2.74	20.56	12.34
15	84	18.69	2.74	15.95	14.35
20	70	15.71	2.74	12.97	15.56
25	61	13.62	2.74	10.88	16.32
30	54	12.06	2.74	9.32	16.77
35	49	10.85	2.74	8.11	17.03
40	44	9.88	2.74	7.14	17.13
45	41	9.09	2.74	6.34	17.13
50	38	8.42	2.74	5.68	17.04
55	35	7.86	2.74	5.11	16.87
60	33	7.37	2.74	4.62	16.65
65	31	6.94	2.74	4.20	16.38
70	29	6.57	2.74	3.83	16.07
75	28	6.24	2.74	3.49	15.72
80	27	5.94	2.74	3.20	15.35
85	25	5.67	2.74	2.93	14.95
90	24	5.43	2.74	2.69	14.52
95	23	5.21	2.74	2.47	14.07
100	22	5.01	2.74	2.27	13.61
105	22	4.83	2.74	2.08	13.13
110	21	4.66	2.74	1.91	12.63
115	20	4.50	2.74	1.76	12.12
120	19	4.35	2.74	1.61	11.60
125	19	4.22	2.74	1.47	11.06
130	18	4.09	2.74	1.35	10.52
135	18	3.97	2.74	1.23	9.96
140	17	3.86	2.74	1.12	9.40
145	17	3.76	2.74	1.01	8.82
150	16	3.66	2.74	0.92	8.24
180	14	3.17	2.74	0.43	4.62
210	13	2.81	2.74	0.06	0.81
240	11	2.53	2.53	0.00	0.00
270	10	2.30	2.30	0.00	0.00
300	9	2.12	2.12	0.00	0.00

DRAINAGE AREA III

(FIVE YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	1334	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	282	sq.m	0.20
Total Catchment Area:	1616	sq.m	0.78

Water Elevation:	93.27	m
Invert of Outlet Pipe - CB/MH-6:	90.86	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-6)	90.91	m
Head:	2.36	m
Orifice Diameter:	96	mm
Orifice Area:	7268	sq.mm
Coefficient of Discharge:	0.61	
Maximum Release Rate:	30.19	L/s

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB/MH-6	110	0.10	3.73	cu.m

Achieved Volume: 3.73 cu.m

Maximum Volume Required: 3.73 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
10	104	36.41	30.19	6.22	3.73
15	84	29.20	29.20	0.00	0.00
20	70	24.55	24.55	0.00	0.00
25	61	21.28	21.28	0.00	0.00
30	54	18.84	18.84	0.00	0.00
35	49	16.95	16.95	0.00	0.00
40	44	15.44	15.44	0.00	0.00
45	41	14.20	14.20	0.00	0.00
50	38	13.16	13.16	0.00	0.00
55	35	12.27	12.27	0.00	0.00
60	33	11.51	11.51	0.00	0.00
65	31	10.85	10.85	0.00	0.00
70	29	10.26	10.26	0.00	0.00
75	28	9.75	9.75	0.00	0.00
80	27	9.28	9.28	0.00	0.00
85	25	8.86	8.86	0.00	0.00
90	24	8.49	8.49	0.00	0.00
95	23	8.14	8.14	0.00	0.00
100	22	7.83	7.83	0.00	0.00
105	22	7.54	7.54	0.00	0.00
110	21	7.28	7.28	0.00	0.00
115	20	7.03	7.03	0.00	0.00
120	19	6.80	6.80	0.00	0.00
125	19	6.59	6.59	0.00	0.00
130	18	6.39	6.39	0.00	0.00
135	18	6.21	6.21	0.00	0.00
140	17	6.03	6.03	0.00	0.00
145	17	5.87	5.87	0.00	0.00
150	16	5.72	5.72	0.00	0.00
180	14	4.96	4.96	0.00	0.00
210	13	4.39	4.39	0.00	0.00
240	11	3.95	3.95	0.00	0.00
270	10	3.59	3.59	0.00	0.00
300	9	3.30	3.30	0.00	0.00

Summary Tables
Church Parking Lot

ONE HUNDRED YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA A	-	57.25	4.25	4.25
TOTAL	59.94	57.25	4.25	4.25

FIVE YEAR EVENT				
Drainage Area	Maximum Allowable Release Rate (L/s)	Maximum Release Rate (L/s)	Maximum Volume Required (cu.m)	Maximum Volume Stored (cu.m)
AREA A	-	31.32	1.44	1.44
TOTAL	31.32	31.32	1.44	1.44

3865 Old Richmond Road
Church Parking Lot
Ottawa, Ontario

STORMWATER MANAGEMENT CALCULATIONS
Rational Method

PRE-DEVELOPMENT CONDITIONS

100-Year Release Rate

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	1153	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	218	sq.m	0.25
Total Catchment Area:	1371	sq.m	0.88

Bransby William Formula (Used when C > 0.40)

$$Tc = \frac{0.057 \cdot L}{Sw^{0.2} \cdot A^{0.1}} \text{ min}$$

Sheet Flow Distance (L):	64	m
Slope of Land (Sw):	0.9	%
Area (A):	0.1371	ha
Time of Concentration (Sheet Flow):	4.5	min
Time of Concentration:	10	min
Rainfall Intensity (i):	179	mm/hr
Runoff Coeficient (C):	0.88	
100-Year Pre-Development Release Rate (2.78AiC): (100-Year Maximum Allowable Release Rate)	59.94	L/s

5-Year Release Rate

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	1153	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	218	sq.m	0.20
Total Catchment Area:	1371	sq.m	0.79

Area (A):	1371	sq.m
Time of Concentration:	10	min
Rainfall Intensity (i):	104	mm/hr
Runoff Coeficient (C):	0.79	
5-Year Pre-Development Release Rate (2.78AiC): (5-Year Maximum Allowable Release Rate)	31.32	L/s

ONE HUNDRED-YEAR EVENT

DRAINAGE AREA A

(ONE HUNDRED-YEAR EVENT)

			C
Roof Area:	0	sq.m	1.00
Asphalt/Concrete Area:	1271	sq.m	1.00
Gravel Area:	0	sq.m	0.875
Landscaped Area:	100	sq.m	0.25
Total Catchment Area:	1371	sq.m	0.95

Water Elevation:	92.75	m
Invert of Outlet Pipe - CB-8:	90.35	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB-8)	90.40	m
Head:	2.35	m
Orifice Diameter:	99	mm
Orifice Area:	7634	sq.mm
Coefficient of Discharge:	0.61	

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-8	85	0.15	4.25	cu.m

Maximum ICD Release Rate:	31.63	L/s	Achieved Volume:	4.25 cu.m
Maximum Overflow Release Rate:	25.62	L/s		
Total Maximum Release Rate:	57.25	L/s	Maximum Volume Required:	4.25 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Overflow Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
10	179	64.33	31.63	25.62	7.08	4.25
15	143	51.48	31.63	15.14	4.72	4.25
20	120	43.22	31.63	8.05	3.54	4.25
25	104	37.41	31.63	2.96	2.83	4.25
30	92	33.10	31.63	0.00	1.47	2.65
35	83	29.75	29.75	0.00	0.00	0.00
40	75	27.07	27.07	0.00	0.00	0.00
45	69	24.88	24.88	0.00	0.00	0.00
50	64	23.04	23.04	0.00	0.00	0.00
55	60	21.48	21.48	0.00	0.00	0.00
60	56	20.14	20.14	0.00	0.00	0.00
65	53	18.97	18.97	0.00	0.00	0.00
70	50	17.94	17.94	0.00	0.00	0.00
75	47	17.03	17.03	0.00	0.00	0.00
80	45	16.21	16.21	0.00	0.00	0.00
85	43	15.48	15.48	0.00	0.00	0.00
90	41	14.81	14.81	0.00	0.00	0.00
95	39	14.21	14.21	0.00	0.00	0.00
100	38	13.66	13.66	0.00	0.00	0.00
105	36	13.15	13.15	0.00	0.00	0.00
110	35	12.68	12.68	0.00	0.00	0.00
115	34	12.25	12.25	0.00	0.00	0.00
120	33	11.85	11.85	0.00	0.00	0.00
125	32	11.48	11.48	0.00	0.00	0.00
130	31	11.13	11.13	0.00	0.00	0.00
135	30	10.81	10.81	0.00	0.00	0.00
140	29	10.50	10.50	0.00	0.00	0.00
145	28	10.22	10.22	0.00	0.00	0.00
150	28	9.95	9.95	0.00	0.00	0.00
180	24	8.61	8.61	0.00	0.00	0.00
210	21	7.62	7.62	0.00	0.00	0.00
240	19	6.85	6.85	0.00	0.00	0.00
270	17	6.23	6.23	0.00	0.00	0.00
300	16	5.73	5.73	0.00	0.00	0.00

FIVE-YEAR EVENT

DRAINAGE AREA A

(FIVE-YEAR EVENT)

			C
Roof Area:	0	sq.m	0.90
Asphalt/Concrete Area:	1271	sq.m	0.90
Gravel Area:	0	sq.m	0.70
Landscaped Area:	100	sq.m	0.20
Total Catchment Area:	1371	sq.m	0.85

Water Elevation:	92.70	m
Invert of Outlet Pipe - CB-8:	90.35	m
Centroid of ICD Orifice: (ICD in Outlet Pipe of CB/MH-6)	90.40	m
Head:	2.31	m
Orifice Diameter:	99	mm
Orifice Area:	7634	sq.mm
Coefficient of Discharge:	0.61	

CB/MH	Top Area (sq.m)	Depth (m)	Volume	
CB-8	41	0.10	1.44	cu.m

Maximum ICD Release Rate:	31.32	L/s	Achieved Volume:	1.44 cu.m
Maximum Overflow Release Rate:	0.00	L/s		
Total Maximum Release Rate:	31.32	L/s	Maximum Volume Required:	1.44 cu.m

Time (min)	i (mm/hr)	2.78AiC (L/s)	ICD Release Rate (L/s)	Overflow Release Rate (L/s)	Stored Rate (L/s)	Stored Volume (cu.m)
10	104	33.71	31.32	0.00	2.40	1.44
15	84	27.04	27.04	0.00	0.00	0.00
20	70	22.73	22.73	0.00	0.00	0.00
25	61	19.70	19.70	0.00	0.00	0.00
30	54	17.45	17.45	0.00	0.00	0.00
35	49	15.70	15.70	0.00	0.00	0.00
40	44	14.30	14.30	0.00	0.00	0.00
45	41	13.15	13.15	0.00	0.00	0.00
50	38	12.18	12.18	0.00	0.00	0.00
55	35	11.36	11.36	0.00	0.00	0.00
60	33	10.66	10.66	0.00	0.00	0.00
65	31	10.04	10.04	0.00	0.00	0.00
70	29	9.50	9.50	0.00	0.00	0.00
75	28	9.02	9.02	0.00	0.00	0.00
80	27	8.59	8.59	0.00	0.00	0.00
85	25	8.21	8.21	0.00	0.00	0.00
90	24	7.86	7.86	0.00	0.00	0.00
95	23	7.54	7.54	0.00	0.00	0.00
100	22	7.25	7.25	0.00	0.00	0.00
105	22	6.98	6.98	0.00	0.00	0.00
110	21	6.74	6.74	0.00	0.00	0.00
115	20	6.51	6.51	0.00	0.00	0.00
120	19	6.30	6.30	0.00	0.00	0.00
125	19	6.10	6.10	0.00	0.00	0.00
130	18	5.92	5.92	0.00	0.00	0.00
135	18	5.75	5.75	0.00	0.00	0.00
140	17	5.59	5.59	0.00	0.00	0.00
145	17	5.44	5.44	0.00	0.00	0.00
150	16	5.29	5.29	0.00	0.00	0.00
180	14	4.59	4.59	0.00	0.00	0.00
210	13	4.06	4.06	0.00	0.00	0.00
240	11	3.65	3.65	0.00	0.00	0.00
270	10	3.33	3.33	0.00	0.00	0.00
300	9	3.06	3.06	0.00	0.00	0.00

28-Jul-20

3865 Old Richmond Road
Church Parking Lot
Ottawa, Ontario

BROAD CRESTED WEIR CALCULATIONS

1:100 YEAR EVENT

DRAINAGE AREA A

Length of Weir based on an assumed coefficient of discharge (Cd):

if Q=	25.62	l/s (maximum permited flow)	assumes Cd= 0.577
=	0.02562	cu.m./s	
& H=	0.02	m (max. depth of water above top of weir)	(assumes P/H is large)
then L=	4.20	m (length of weir) L = (Q / ((1.705 x H^(3/2))	

Length of Weir based on a calculate coefficient of discharge (Cd):

if P=	0.15	m (depth of pond)
& Lp=	10.0	m (width of pond: perpendicular to direction of flow)
then Vp=	0.0148	m/s (velocity in pond: Vp = Q / (P+H) / Lp)
& E=	0.023411	m (energy: E = H + 2V^2/2g)
& Cd=	0.578	(Cd = 0.577 x (E/H)^(3/2))

if Q=	25.62	l/s (maximum permited flow)
=	0.02562	cu.m./s
& H=	0.02	m (depth of water above top of weir)
then L=	4.20	m (length of weir) L = (Q / ((Cd^(2/3) x (2x9.81)^(1/2) x H^(3/2))

3865 Old Richmond Road — STORM SEWER COMPUTATION FORM — FIVE YEAR EVENT — July 28, 2020

Ottawa, Ontario — Rational Method — Q = 2.78 A i C

n = 0.013

Location			Areas (ha)									Pipe Data									Notes
			Hard	Gravel	Landscape	Roof	Individual	Accum.	Time of Conc.	Rainfall Intensity i	Peak Flow Q		Actual Diameter	Nominal Diameter	Slope	Length	Capacity	Velocity	Time of Flow	Ratio	
Street	From	To	C = 0.9	C = 0.7	C = 0.2	C = 0.9	2.78AC	2.78AC	(min)	(mm/hr)	(L/s)	Material	(mm)	(mm)	(%)	(m)	(L/s)	(m/s)	(min)	Q/Qfull	
	Roof Drains	Existing 1350 ST				0.0894	0.2237	0.2237	10.00	104	23.31	PVC	203.2	200	1.00	14.4	34.2	1.06	0.23	0.68	
											2.74	PVC	203.2	200	1.00	14.4	34.2	1.06	0.23	0.08	Through flow control roof drains
													Existing 1350 ST in Old Richmond Road								
													1371.6	1350	0.39		3477.3	2.35			
	CB-1	CB/MH-2	0.0145		0.0009		0.0368	0.0368	10.00	104	3.83	PVC	254.0	250	0.43	25.9	40.7	0.80	0.54	0.09	
	CB/MH-2	CB/MH-6	0.0223		0.0020		0.0569	0.0937	10.54	101	9.50	PVC	254.0	250	0.43	24.7	40.7	0.80	0.51	0.23	
	CB-3	CB/MH-4	0.0024		0.0022		0.0072	0.0072	10.00	104	0.75	PVC	254.0	250	0.43	16.4	40.7	0.80	0.34	0.02	
	CB/MH-4	CB/MH-5	0.0019		0.0075		0.0089	0.0162	10.34	102	1.65	PVC	254.0	250	0.43	24.8	40.7	0.80	0.51	0.04	
	CB/MH-5	CB/MH-6			0.0023		0.0013	0.0174	10.86	100	1.74	PVC	254.0	250	0.43	21.3	40.7	0.80	0.44	0.04	
	CB/MH-6	MH-7	0.0923		0.0133		0.2383	0.3494	11.30	98	34.18	PVC	304.8	300	1.03	8.7	102.4	1.40	0.10	0.33	
											30.29	PVC	304.8	300	1.03	8.7	102.4	1.40	0.10	0.30	Flow through ICD
	MH-7	Exist. 1500 ST						0.3494	11.40	97	34.01	PVC	304.8	300	1.03	2.5	102.4	1.40	0.03	0.33	
											30.29	PVC	304.8	300	1.03	2.5	102.4	1.40	0.03	0.30	Restricted flow
													Existing 1500 ST								
													1524.0	1500	0.30		4039.2	2.21			
North (Church) Parking Lot																					
	CB-8	MH-9	0.1271		0.01		0.3236	0.3236	10.00	104	33.71	PVC	304.8	300	1.15	25.9	108.2	1.48	0.29	0.31	
											31.32	PVC	304.8	300	1.15	25.9	108.2	1.48	0.29	0.29	Flow through ICD
	MH-9	Exist. 1500 ST						0.3236	10.29	103	33.22	PVC	304.8	300	1.15	2.5	108.2	1.48	0.03	0.31	
											31.32	PVC	304.8	300	1.15	2.5	108.2	1.48	0.03	0.29	Restricted flow
													Existing 1500 ST								
													1524.0	1500	0.13		2658.9	1.46			

City of Ottawa Servicing Study Checklist

General Content

Executive Summary (for large reports only): not applicable

Date and revision number of the report: see page 1 of Servicing Brief and Stormwater Management Report

Location map and plan showing municipal address, boundary, and layout of proposed development: see drawings C-1 to C-6

Plan showing the site and location of all existing services: see drawings C-1 to C-6

Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere: not applicable

Summary of Pre-consultation Meetings with City and other approval agencies: not available

Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria: not applicable

Statement of objectives and servicing criteria: see page 1 of Servicing Brief and Stormwater Management Report

Identification of existing and proposed infrastructure available in the immediate area: see drawings C-1 to C-6

Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available). see drawings C-1 to C-6

Concept level master grading plan to confirm existing and proposed grades in the development and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths: not applicable

Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts: not applicable

Proposed phasing of the development, if applicable: not applicable

Reference to geotechnical studies and recommendations concerning servicing: see note 1.5 on drawing C-5

All preliminary and formal site plan submissions should have the following information:

- **Metric scale:** included
- **North arrow:** included
    - **(including construction North):** not included
- **Key Plan:** included

- **Name and contact information of applicant and property owner:** not available
- **Property limits**: included
    - **including bearings and dimensions:** not included
- **Existing and proposed structures and parking areas:** included
- **Easements, road widening and rights-of-way:** included
- **Adjacent street names:** included

Development Servicing Report: Water

Confirm consistency with Master Servicing Study, if available: not applicable

Availability of public infrastructure to service proposed development: see page 2 of Servicing Brief

Identification of system constraints: see page 2 of Servicing Brief

Confirmation of adequate domestic supply and pressure: see page 2 of Servicing Brief

Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow locations throughout the development: see page 2 & 5 to 8 of Servicing Brief

Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves: see page 2 of Servicing Brief

Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design: not applicable

Address reliability requirements such as appropriate location of shut-off valves: not applicable

Check on the necessity of a pressure zone boundary modification:. not applicable

Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range: not applicable

Description of the proposed water distribution network, including locations of proposed connections to the existing systems, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions: not applicable

Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation: not applicable

Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines: see page 2 of Servicing Brief

Provision of a model schematic showing the boundary conditions locations, streets , parcels, and building locations for reference: not applicable

Development Servicing Report: Wastewater

Summary of proposed design criteria: see page 3 of Servicing Brief

(Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure): not applicable

Confirm consistency with Master Servicing Study and /or justification for deviations: not applicable

Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and conditions of sewers: not applicable

Descriptions of existing sanitary sewer available for discharge of wastewater from proposed development: see page 3 of Servicing Brief

Verify available capacity in downstream sanitary sewer and / or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable): not applicable

Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix C) format. see page 12 of Servicing Brief

Description of proposed sewer network including sewers, pumping stations, and forcemains: see page 3 of Servicing Brief

Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality): not applicable

Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development: not applicable

Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity: not applicable

Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding: not applicable

Special considerations such as contamination, corrosive environment etc: not applicable

Development Servicing Report: Stormwater Checklist

Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property): see page 4 of Servicing Brief and Stormwater Management Report

Analysis of available capacity in existing public infrastructure. not applicable

A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern: see drawing C-1 & C-6

Water quality control objective (e/g/ controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects: see Stormwater Management Report Servicing Brief and Stormwater Management Report

Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements: Servicing Brief and Stormwater Management Report

Descriptions of the references and supporting information.
Set-back from private sewage disposal systems. not applicable

Watercourse and hazard lands setbacks: not applicable

Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed: the pre-application consultation record is not yet been issued

Confirm consistency with sub-waterched and Master Servicing Study, if applicable study exists: not applicable

Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period). see drawings C-1 to C-6 and Servicing Brief and Stormwater Management Report

Identification of watercourses within the proposed development and how watercourses will be protected, or , if necessary, altered by the proposed development with applicable approvals. see drawings C-1 to C-4 and Servicing Brief and Stormwater Management Report

Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions: see Servicing Brief and Stormwater Management Report

Any proposed diversion of drainage catchment areas from one outlet to another. : not applicable

Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities. : not applicable

If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event: not applicable

Identification of potential impacts to receiving watercourses: Servicing Brief and Stormwater Management Report

Identification of municipal drains and related approval requirements. : not applicable

Descriptions of how the conveyance and storage capacity will be achieved for the development: see page 3 of Servicing Brief and Stormwater Management Report

100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading:

Inclusion of hydraulic analysis including hydraulic grade line elevations. : not applicable

Description of approach to erosion and sediment control during construction for the protection of receiving watercourses of drainage corridors: see drawing C-2 & notes 2.1 to 2.7 on drawing C-4

Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplains elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current: not applicable

Identification of fill constraints related to floodplain and geotechnical investigation. : not applicable

Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act: see page 19 of Servicing Brief and Stormwater Management Report

Application for Certificate of Approval (CofA) under the Ontario Water Resources Act:

Changes to Municipal Drains. : not applicable

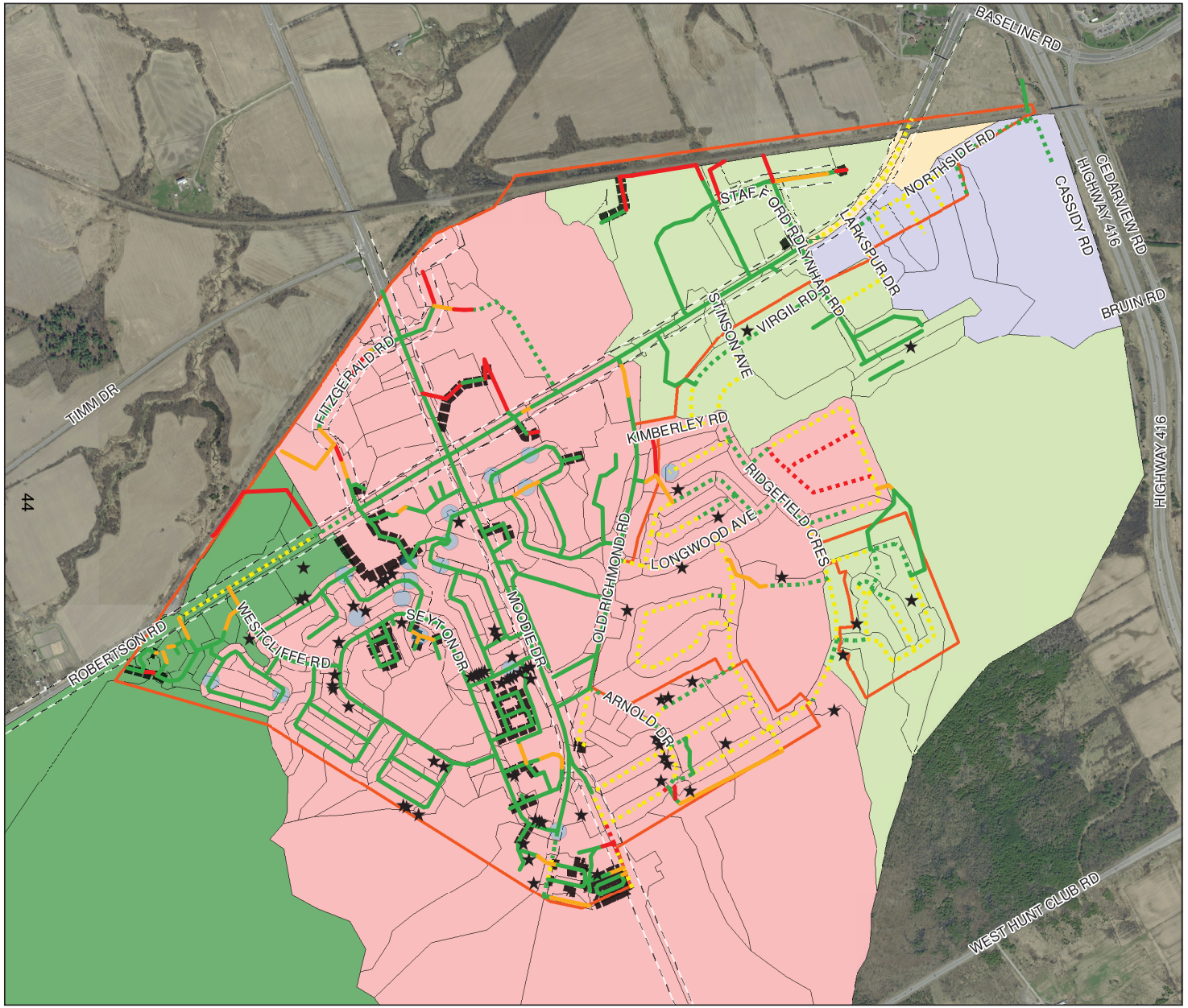
Other permits (National Capital commission, Parks Canada, public Works and Government Services Canada, Ministry of transportation etc.) : not applicable

Conclusion Checklist

Clearly stated conclusions and recommendations: see page 6 of Servicing Brief

Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario: included



Arbeatha

Dual Drainage Study

N

Legend

- Detailed Study Area
- June 2002 Flood Report to the City of Ottawa
- Private Sewer
- Low Probability of Basement Connections

Major System Flow Depth

- < 150 mm
- 150 - 300 mm
- > 300 mm
- < 150 mm (ditched section)
- 150 - 300 mm (ditched section)
- > 300 mm (ditched section)
- Ponding Locations

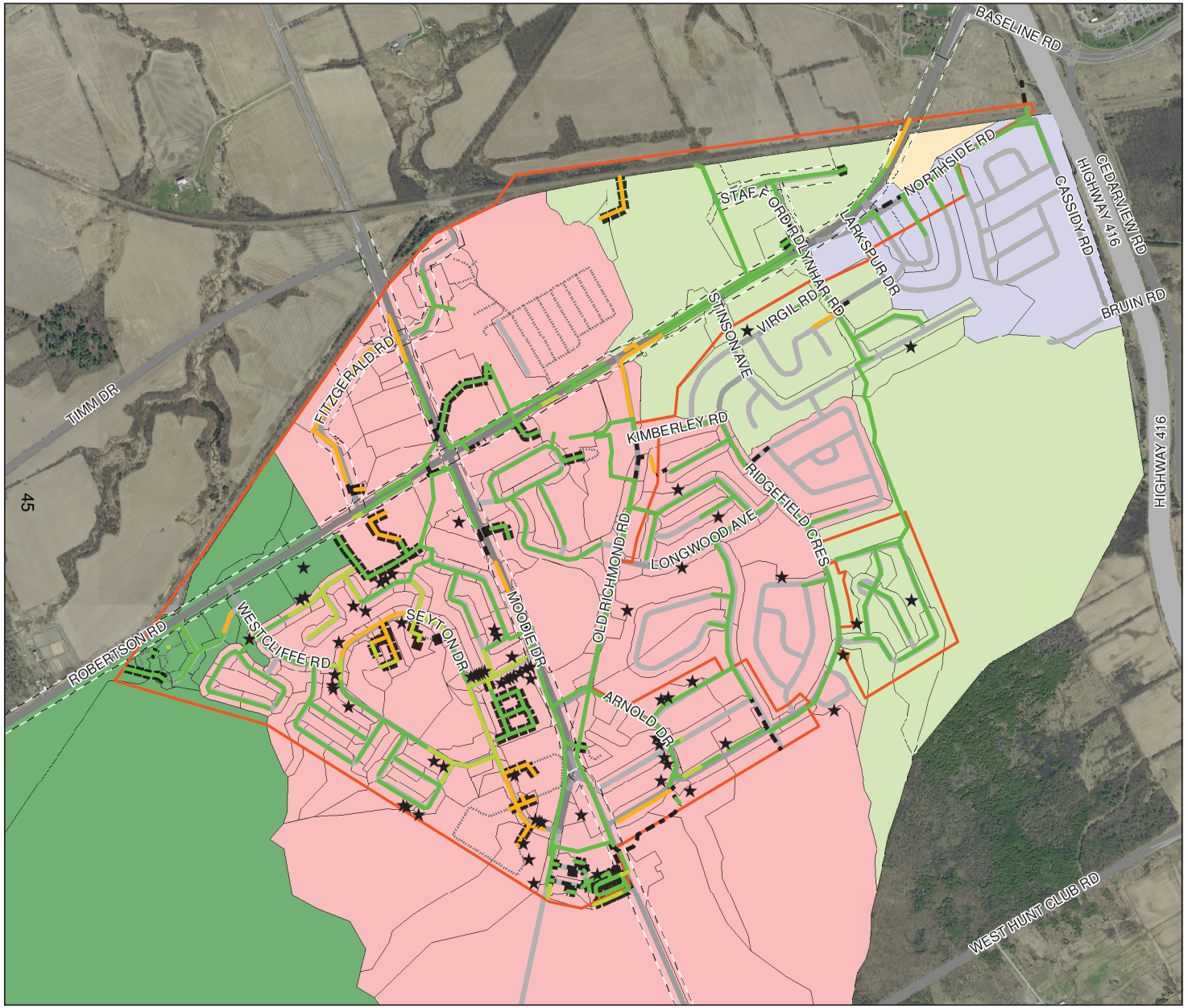
Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 3-3:
2002 Event Major System Flow Depth

PARSONS



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Dual Drainage Study

N

Legend

- Detailed Study Area
- June 2002 Flood Report to the City of Ottawa
- Private Sewer
- Low Probability of Basement Connections

2002 HGL

- Above catchbasin elevation
- 1.8m below road centreline
- 1.8 to 2.4m below road centreline
- Over 2.4m below road centreline
- Shallow Pipe

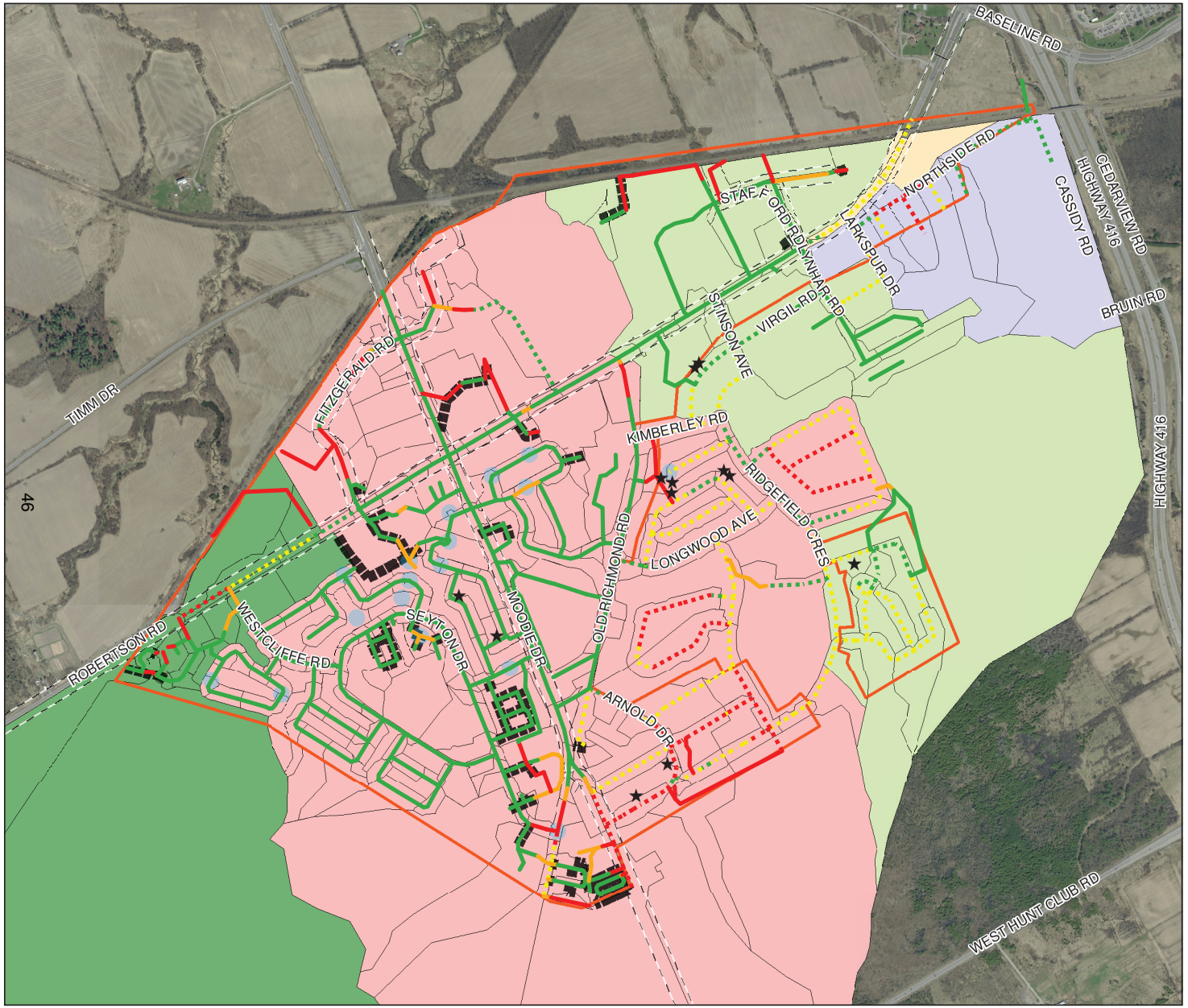
Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 3-4:
2002 Event Minor System HGL

PARSONS



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Dual Drainage Study

N

Legend

- Detailed Study Area
- ★ September 2004 Flood Report to the City of Ottawa
- Private Sewer
- Low Probability of Basement Connections

Major System Flow Depth

- < 150 mm
- 150 - 300 mm
- > 300 mm
- < 150 mm (ditched section)
- 150 - 300 mm (ditched section)
- > 300 mm (ditched section)
- Ponding Locations

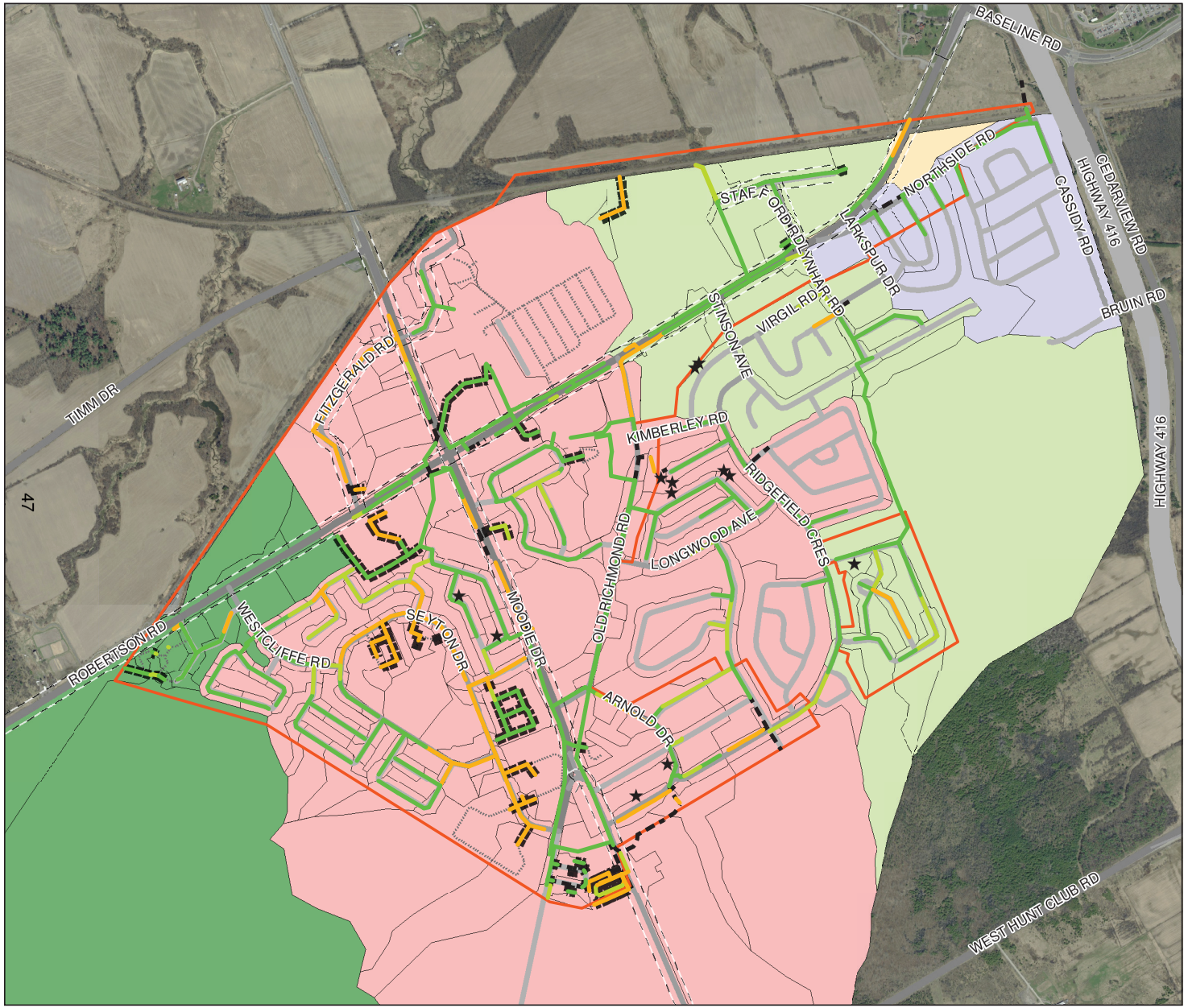
Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 3-6:
2004 Event Major System Flow Depth

PARSONS



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Dual Drainage Study

N

Legend

- Detailed Study Area
- ★ September 2004 Flood Report to the City of Ottawa
- Private Sewer
- Low Probability of Basement Connections

BASEF_Plot

- Above catchbasin elevation
- 1.8m below road centreline
- 1.8 to 2.4m below road centreline
- Over 2.4m below road centreline
- Shallow Pipe

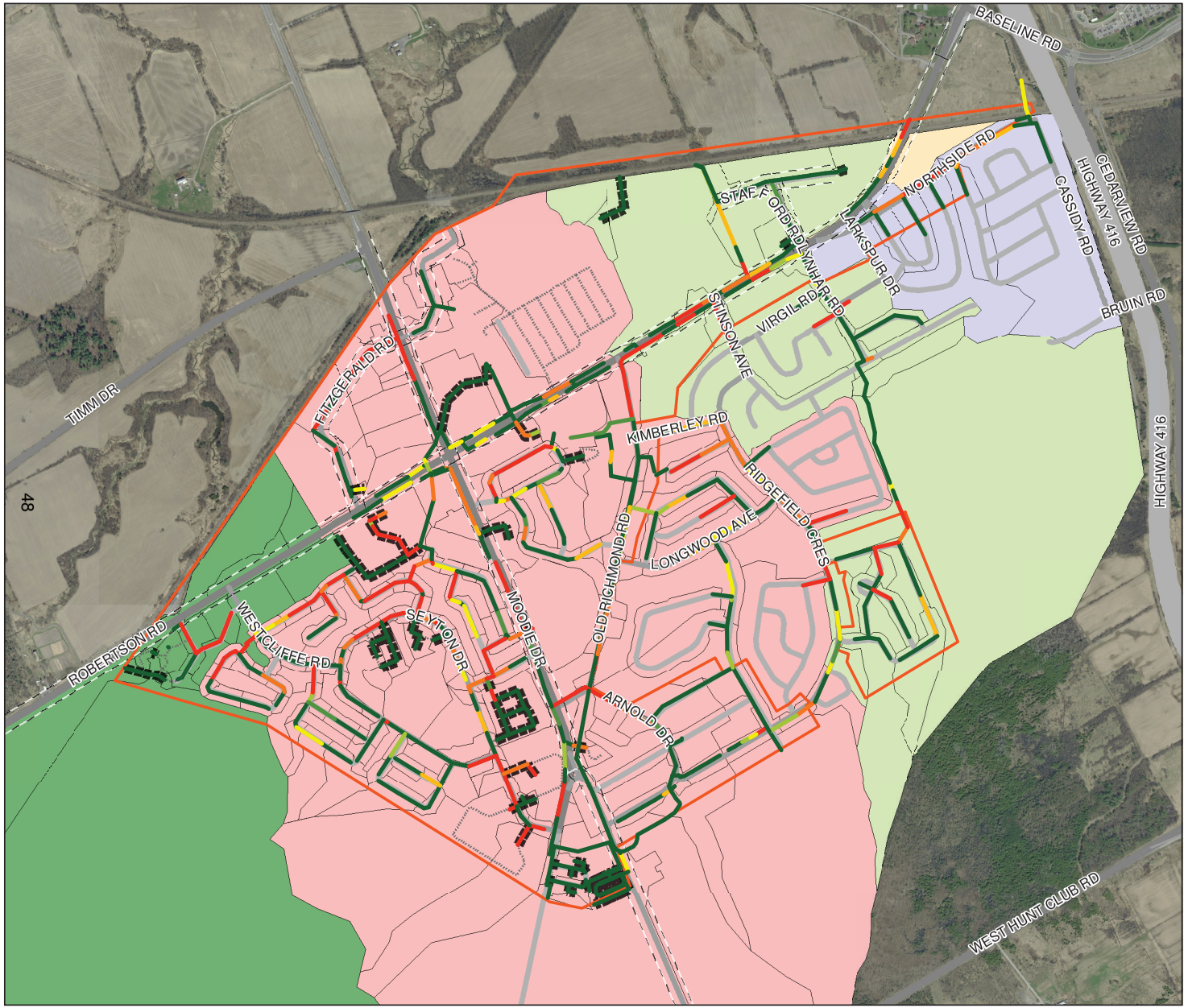
Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 3-7:
2004 Event Minor System HGL

PARSONS



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Dual Drainage Study

N

Legend

- Detailed Study Area
- Private Sewer
- Low Probability of Basement Connections

Q/Qcap Level of Service

- 100 year
- 50 year
- 25 year
- 10 year
- 5 year
- 2 year
- <2 year

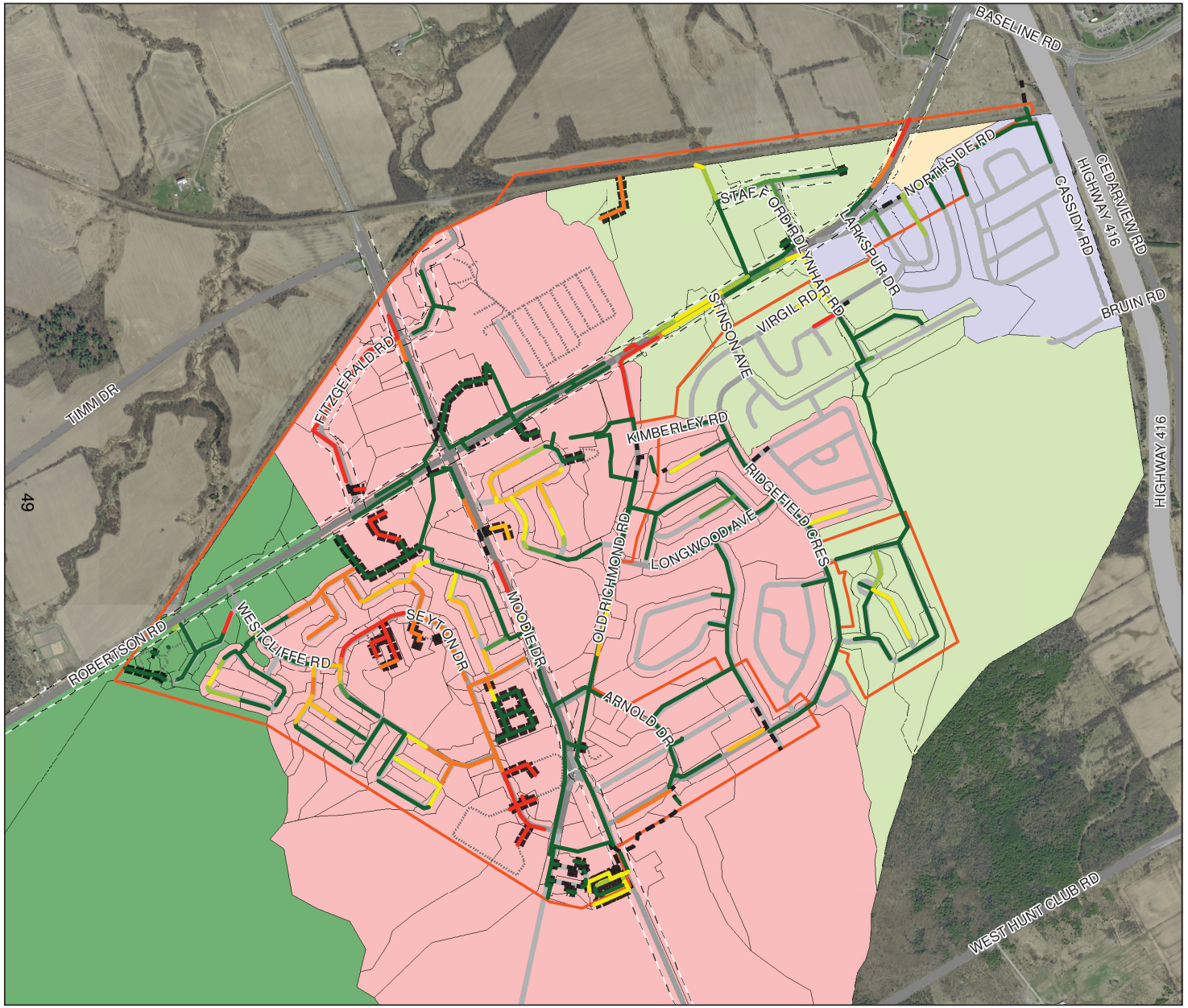
Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 4-1:
Existing Conditions
Pipe Capacity Level of Service

PARSONS



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Dual Drainage Study

N

Legend

- Detailed Study Area
- Private Sewer
- Low Probability of Basement Connections

Basement Flood Risk Level of Service

- 100 year
- 50 year
- 25 year
- 10 year
- 5 year
- 2 year
- <2 year
- Shallow Pipe

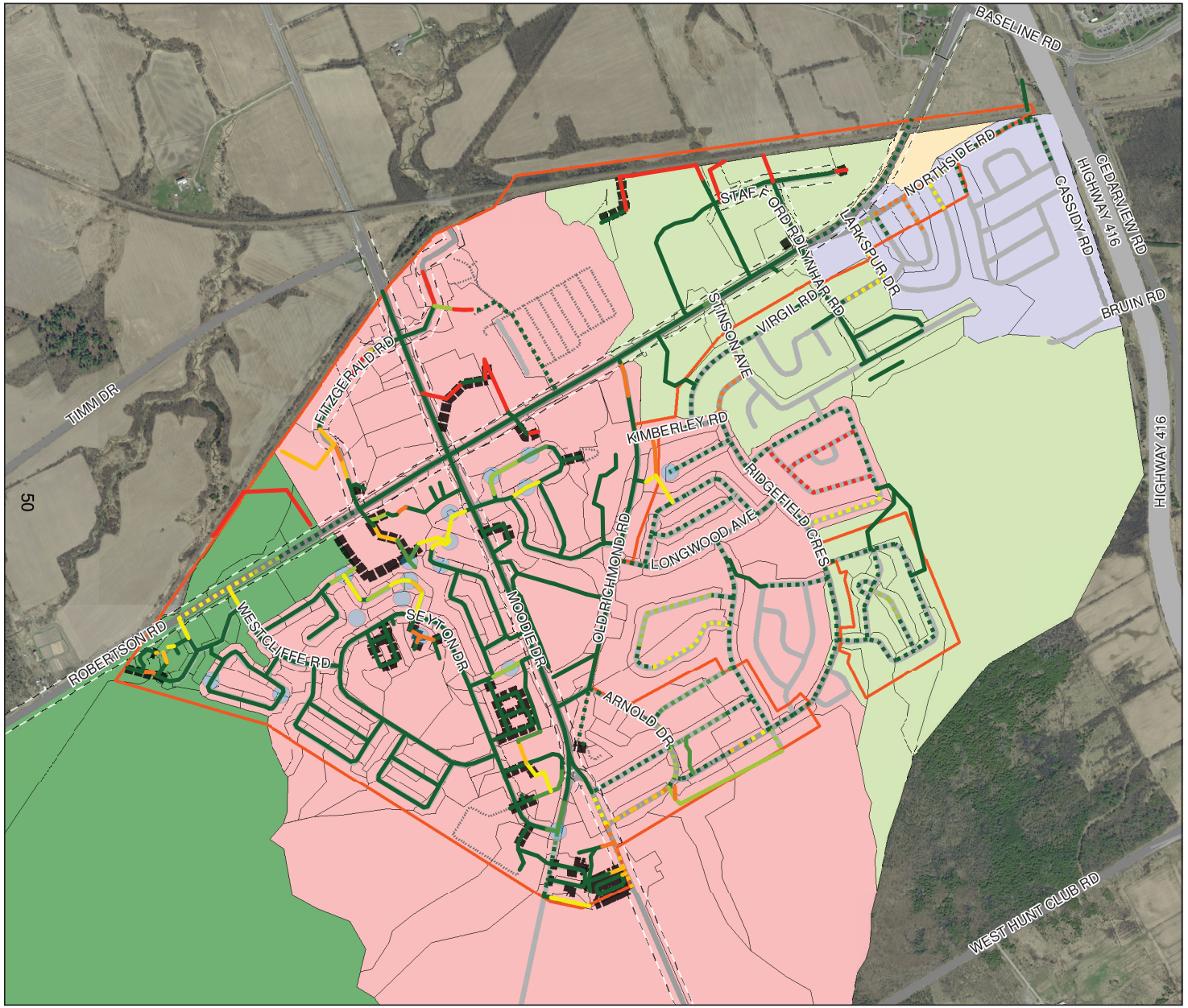
Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 4-2:
Existing Conditions
Basement Flood Risk Level of Service

PARSONS



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Dual Drainage Study

N

Legend

- Detailed Study Area
- Private Sewer
- Low Probability of Basement Connections

Surface Flow Depth Level of Service

100 year	100 year (ditched section)
50 year	50 year (ditched section)
25 year	25 year (ditched section)
10 year	10 year (ditched section)
5 year	5 year (ditched section)
2 year	2 year (ditched section)
<2 year	<2 year (ditched section)

- Areas of Ponding

Major Drainage Areas

- A
- B
- C
- D
- E

0 190 380 760 Meters

Figure 4-5:
Existing Conditions
Major System Depth Level of Service

PARSONS