

GASTON LEVAC MUNICIPAL DRAIN

S. 78(1) ENGINEER'S REPORT
THE NATION MUNICIPALITY

PREPARED BY

SHADE GROUP INC
4625 MARCH ROAD
ALMONTE, ONTARIO
K0A 1A0

PREPARED FOR

THE NATION MUNICIPALITY
958 ROUTE 500W
CASSELMAN, ON
K0A 1M0



REV 01 – OCTOBER 5, 2026

TABLE OF CONTENTS

1.0	OBJECTIVE	1
2.0	DRAIN HISTORY	1
3.0	DESCRIPTION OF THE WATERSHED + ALIGNMENT OF DRAIN	2
4.0	CROSSINGS	3
4.1	WATERSHED REVIEW	3
4.2	HISTORICAL PERFORMANCE	3
4.3	CROSSING SIZING	4
4.4	CROSSING LENGTH DESIGN CRITERIA	5
4.5	CULVERT INSTALLATION	5
4.6	REINSTATEMENT OF ASPHALT DRIVEWAYS	5
4.7	DRAIN CROSS-SECTION AND PROFILE	6
5.0	ASSESSMENTS	6
6.0	FUTURE MAINTENANCE	7
6.1	PRIVATE CROSSING REPLACEMENTS – TIMING	7
6.2	ROAD CROSSING REPLACEMENT	7
7.0	SPECIAL CONSIDERATIONS	8
	DRAIN CLASSIFICATION & PERMITTING	8
	EROSION AND SEDIMENT CONTROL	8
	UTILITIES	9
	ENCLOSURES E4 AND E7 – TEE WITH GRATE	9
8.0	ENGINEERING COSTS	9
9.0	CONSTRUCTION AND MAINTENANCE COSTS	9
10.0	DRAINAGE ACT, 1990, PROCESS	11
10.1	TO DATE	11
10.2	NEXT STEPS	12
10.3	RESOLUTION AND BY-LAW	12
10.4	LIMITATIONS	13
11.0	ADIP GRANT	13
12.0	CLOSING	13

APPENDICES

APPENDIX A: WATERSHED MAP
APPENDIX B: ASSESSMENT SCHEDULE
APPENDIX C: HYDROLOGIC & HYDRAULIC ANALYSIS - CROSSINGS
APPENDIX D: STANDARD DRAWING
APPENDIX E: CONSTRUCTION COST ESTIMATE
APPENDIX F: BY-LAWS

REVISIONS, SUBMISSIONS + KEY DATES

Revision #	Comments	Date
-	Adoption of By-law to Appoint Engineer	November 10, 2025
-	On-Site Meeting – Nation Fournier Satellite Office	January 7, 2026
00	Draft Submitted to Municipality	September 8, 2026
01	Formal Submission to Municipality	October 5, 2026
-	Meeting to Consider	November 23, 2026
-	Court of Revision	

1.0 OBJECTIVE

This Engineer's Report has been prepared under Section 78(1) of the *Drainage Act, R.S.O. 1990, c. D. 17*. The primary purpose of this report is to update the culvert specifications on the Gaston Levac Municipal Drain to meet current standards and by-laws. The culvert lengths adopted under the previous Engineer's Report are too short to meet the requirements for current farming practices, and the specified side slopes of the crossings do not meet current standards or by-laws for crossings along public roads. Many of the previous installed crossings have reached end-of-service-life and require replacement in the near future and like-for-like replacement is not possible.

2.0 DRAIN HISTORY

Prior to undertaking this report, consultation was undertaken with the Township's Drainage Superintendent to inquire about the governing report(s) for the Gaston Levac Municipal Drain. There are multiple governing reports for the municipal drain, including:

- Engineer's Report by Ghislain E. Seguin and Associates dated January 29, 1970 for the original construction. While we did not have a copy of this report, we did have access to the Profile Drawing (Mar 25, 1970). This 1970 report is referenced in the 1971 Engineer's Report.
- Engineer's Report by Ghislain E. Seguin and Associates dated October 7, 1971 which is an improvement and maintenance report. The 1971 Engineer's Report notes that "*flooding during the spring flood of 1971 and silting of the lower section has occurred since the construction*". Under the 1971 Engineer's Report the outlet of the Gaston Levac Municipal Drain was extended to the Boundary Road between Township of Caledonia and South Plantagenet.
- In 1972, the Omer Levac Municipal Drain was constructed under a new Engineer's Report (Ghislain E. Seguin and Associates), and the Omer Levac Municipal Drain deemed that the Gaston Levac Municipal Drain was "suitable outlet". The Omer Levac Municipal Drain continues to be governed under separate cover and is mentioned only as it directly contributes to the Gaston Levac Municipal Drain system.
- In 1978, Lascelles Seguin Tremblay Engineering Limited authored the Engineer's Report for the Glaude Municipal Drain & Improvements to the Gaston Levac Municipal Drain. The Glaude Municipal Drain continues to be governed under separate cover – changes are not being made to the Glaude Municipal Drain under this 2026 report. With respect to the Gaston Levac Municipal Drain, the 1978 Engineer's Report notes "*The Gaston Levac Municipal Drain was constructed in 1970, extended in 1971-72, and maintained and improved in 1974*". The 1978 described ongoing flooding concerns in the spring, with water cresting the road and eventually reaching the Glaude Municipal Drain. Improvements in 1978 to the Gaston Levac Municipal Drain included excavating a "new

outlet", which would connect to the Glaude Municipal Drain. The 1978 Engineer's Report does not include any specifications to abandon part of the previous alignment of the Gaston Levac Municipal Drain, so it has been assumed that both the old alignment (1970-1978) – and the "new outlet" – are all still considered part of the governing system.

For details pertaining to the profile and ditch cross-section, refer to the applicable governing Engineer's Report, available under separate cover. No changes are proposed to the profile or open-channel cross-section under this report and the applicable Engineer's Report shall continue to be the governing standards for maintenance of the open channel.

3.0 DESCRIPTION OF THE WATERSHED + ALIGNMENT OF DRAIN

The Gaston Levac Municipal Drain is described as serving Lots 19 to 24 in Concession 7 and 8 of the Township of Caledonia.

Per the description from the 1971 Engineer's Report:

"The Gaston Levac municipal drain starts at the dividing line between the E 1/3 and the W 2/3 of lot 19 in concession 8 of the Township of Caledonia, and runs in a westerly direction along the south side of the Concession Road between concessions 7 and 8, across lots 19, 20, 21, 22, and part of lot 23 until it reaches the dividing line between lot 22 and 23 in concession 7 where the drain turns and crosses the Concession Road between concession 7 and 8. From the Concession Road, the drain runs in a northerly direction along the dividing line between lot 22 and 23 in concession 7 until it reaches a point approximately 224 feet north of the Concession Road, where the drain turns and flows in a north-westerly direction across the S½ of lot 23 until it reaches a gully which was the outlet in the 1970 Engineer's report.

The drain will be extended from this outlet to the Boundary Road between the Township of Caledonia and the Township of South Plantagenet. From the previous outlet, the drain will flow in a north-westerly direction until it reaches a point near the intersection of the dividing line between the S½ and the N½ of lot 24, and the dividing line between the E½ and the W½ of lot 24 in concession 7; where the drain turns and flows in south-westerly direction until it reaches a corrugated steel pipe culvert across the Boundary Road between the Township of Caledonia and the Township of South Plantagenet, which is a suitable outlet.

The total length of the Gaston Levac Municipal Drain as improved will be 10,985 feet."

The 1978 "new outlet" included the following:

"We recommend that a new outlet be constructed for the upper section of this drain. This new outlet which will start at station 46+45 of the Gaston Levac Municipal Drain, will cross the Concession Road between concessions 7 and 8 and will run in a northerly direction along the dividing line between the E ½ and the W ½ of lot 22 in concession 7 until it reaches the proposed Glaude Municipal Drain which will provide a suitable outlet."

The contributing drainage area is estimated to be approximately 34ha (~842 acres).

The Gaston Levac Municipal Drain watershed is comprised almost entirely of active agricultural lands, some with residential houses and/or additional buildings, some without. There are also a handful of smaller, standalone residential properties, a number of which were already there in the previous governing report.

4.0 CROSSINGS

4.1 WATERSHED REVIEW

Shade Group conducted a high-level field review of the watershed on May 19, 2026 to assess the overall drainage area characteristics in comparison to available satellite imagery. Based on the review, it appears that the overall conditions observed in recent satellite imagery are accurately reflected on site. The majority of the watershed is comprised of active agricultural lands with a few residential properties scattered throughout.

The watershed boundary has been updated from the previous governing reports, referenced against publicly available topographic data (LiDAR). Additional revisions were made to the watershed boundary following the on-site meeting, with input from landowners. The 1971 Engineer's Report included an assessment to landowners on the west side of Caledonia Road (former Township of South Plantagenet), though there is no clear explanation as to why; given these properties are downstream of the specified end of the drain. It is possible that drainage patterns have been altered since 1971. Regardless, based on topographic mapping and observations made in the field, I do not feel that these properties should be assessed into the drain given its current end-point; and this has been reflected in my updated watershed boundary.

A copy of the Watershed Map prepared by Shade Group has been enclosed in **Appendix A**.

4.2 HISTORICAL PERFORMANCE

No concerns pertaining to historical flooding have been brought forth by landowners, municipal staff, or other applicable stakeholders for the Gaston Levac Municipal Drain. Shade Group staff conducted a hydrologic and hydraulic analysis of the various crossings based on current design standards and have prepared recommendations for the proposed replacement lengths and diameters in Section 4.3 of this report. Details pertaining to the hydrologic and hydraulic analysis are enclosed in **Appendix C**.

As there have not been any concerns with flooding brought forth, it is recommended that replacement only be completed as the existing infrastructure reaches end-of-life.

4.3 CROSSING SIZING

Table 1 provides a summary of culverts and enclosures on the Gaston Levac Municipal Drain.

Table 1: 2026 Crossing Summary

Culvert ID #	Crossing Use	Proposed Length (m)*	Min. Proposed Diameter (mm)
C1	Access Culvert – Agricultural	12	525
E2	Enclosure – Residential	24	600
C3	Access Culvert – Agricultural	15	750
E4	Enclosure – Residential + Agricultural	51	750
C5	Access Culvert – Agricultural	15	750
E6	Enclosure – Residential + Agricultural	30	900
E7	Enclosure – Residential + Agricultural	42	900
C8	Access Culvert – Residential	15	900
C9	Access Culvert – Agricultural	19.8	1050
R10	Local Road Crossing	21	1200
C11	Access Culvert – Residential	16.5	1050
R12	Local Road Crossing	21	1200
C13	Farm Crossing	12	1200
R14	Local Road Crossing	27	1800

*Lengths have been calculated in reference to typical standard available lengths for purchase. I.e. typical standard is 10ft (3.0m) 20ft (6.1m) or 30ft (9.1m) lengths. Per correspondence with the Drainage Superintendent, we understand that a local supplier sells 1050mm diameter pipe at 3.3m lengths. These referenced available standard lengths have been used to specify the install lengths. Should future replacement not fall into these breakdowns, the Drainage Superintendent shall round *up* to the nearest available length with the additional length not to exceed 2m beyond that specified herein.

Where a specified diameter is not readily available, or considerably more costly than installation of a slightly larger standard size diameter, the Drainage Superintendent may install the next immediate size *up*; as long as it is proven cost-effective to do so. The diameters mentioned herein are considered as *minimums*.

PROPOSED MATERIAL

The hydraulic analysis has been completed assuming that crossings C1 through C13 will be replaced with HDPE pipe. Chosen pipe shall be appropriate for traffic loading where applicable. For enclosures, the minimum specifications shall be 210 kPa across front lawns, while traffic loaded areas shall be minimum 320 kPa.

For the outlet road crossing at Caledonia Road, the analysis has been completed assuming replacement with CSP, which shall be minimum 2.0mm thickness. HDPE could be substituted for this larger road crossing if desired by the Township.

4.4 CROSSING LENGTH DESIGN CRITERIA

Proposed lengths for crossings have been calculated using the following minimum standards in reference to the Township's "General and Special Conditions" for Culvert Entrances – found on the municipality's website:

- Entrance top surface width:
 - o Single Driveway (residential access): Minimum of 6m
 - o Commercial (agricultural access): Minimum 9m
- Entrance end treatment shall be a minimum slope of 2:1 for crossings next to public roadways
- Headwalls are not permitted for entrances next to public roadways

4.5 CULVERT INSTALLATION

Whenever feasible, pipes are to be installed at a minimum slope of 0.5% with a minimum embedment of 150mm below the ditch grade at both the inlet and outlet sites of the crossing. It is acknowledged this slope is not practical for long enclosures and instead, the enclosures would be installed at the same gradient as the existing channel (per the governing design from the Engineer's Report). Rip-rap (or equivalent approved stone) is to be placed at the inlet and outlet sites of each crossing to assist in mitigating erosion and stabilization of the area. Rip-rap is to be underlain with geotextile, which shall be keyed in per the manufacturer's specifications. End treatment shall be installed as per Shade Group Standard Drawing 4, as enclosed in **Appendix D**. Crossings should be installed with a minimum cover of 12" (0.3m) and side slopes shall be no more than 2 (horizontal):1 (vertical).

Culverts shall be centred on the entrance and in the ditch line.

Enclosures longer than 30m in length are to be equipped with a maintenance tee near the approximate mid-point of the length. Exact placement is to be determined by the Township's Drainage Superintendent or the Engineer during construction. Details for the required tee are noted in Section 7.0 – Enclosures E4 and E7 – Tee with Grate.

4.6 REINSTATEMENT OF ASPHALT DRIVEWAYS

Reinstatement of asphalt driveways has *not* been included as part of the project costs. Given this is rural drainage area with predominantly gravel driveways, reinstatement to gravel will be considered the standard. Where a driveway is asphalt (now or in the future), it shall be at the landowner's expense to reinstate the asphalt following replacement of the crossing. Hauling off and disposing of the existing asphalt overtop of the culvert is to be considered part of the costs associated with the culvert replacement and assessed to the drain as part of the project costs as

this would be considered to be very minor in cost. Asphalt reinstatement however would not be assessed to the watershed.

4.7 DRAIN CROSS-SECTION AND PROFILE

All other specifications for the Gaston Levac Municipal Drain shall remain as outlined in the previously adopted governing reports. The associated profile and specified drain cross-section shall remain in accordance the applicable governing reports. No changes to the profile or drainage channel cross-section have been proposed.

5.0 ASSESSMENTS

Three assessment schedules have been prepared and included within this report. They are to be used as follows:

Schedule 'A' – Open Channel Maintenance – Main Drain

This assessment schedule has been calculated for the entire watershed and shall be used when assessing out future maintenance of the open channel. This assessment schedule has been prepared using an assumed maintenance cost of \$33,000+HST and assumes maintenance of the entire channel from start to finish. This does *not* include the “new outlet”.

Where only partial maintenance is performed, costs would only be assessed to those upstream of where the work was performed, which is in fitting with the specifications of the Drainage Act. Where partial maintenance is done – costs would be assessed in the same manner as outlined in the attached assessment schedule, but only to those upstream of the work.

Schedule 'B' – Improvements (Culvert Replacements) – Main Drain

A separate assessment schedule has been prepared for the culvert replacements as there are a number of downstream properties who do not drain into the residential/agricultural crossings and would therefore not be assessed for their replacement costs. This assessment schedule has been calculated based on crossing C13 being replaced as well as crossings upstream of C13. With that, certain properties are not assessed as their runoff would be expected to contribute to the Gaston Levac Municipal Drain downstream of this work. As the full extent of which exact crossings are intended for immediate replacement is not known at this time, a value of \$100,000 has been used for the preparation of this assessment schedule. The total replacement of all crossings across the drain is estimated to be around \$200,000, but not all crossings are expected to require immediate replacement. For a full breakdown of the estimated construction cost for all works, refer to **Appendix E**. Final assessed costs will be based on the replacement of crossings as needed, as they reach end-of-service-life.

Schedule 'C' – Maintenance – New Outlet

Schedule 'C' has been prepared in reference to the assessment schedule for the 'new outlet' from 1978. Values have been pro-rated accordingly to reflect updated estimated maintenance costs. Where there were severances or lot amalgamations, the assessment has been updated accordingly. Assessments were then updated based on 2026 estimated maintenance costs. This assessment schedule would be used when maintenance is undertaken on the 'new outlet' section of the Gaston Levac Municipal Drain.

Schedule 'D' – Engineering Costs

Schedule 'D' has been prepared using the breakdown from Schedule 'A' but assesses the estimated engineering costs associated with the preparation of this report.

It is anticipated that landowners will be assessed for works under Schedule 'A', 'B' and 'D' in the near future, reflective of works associated with bank stabilization and general maintenance of the open channel; culvert replacements; and the engineering costs for this report. Should work be completed on the "new outlet" – landowners would be assessed costs per Schedule 'C'.

The updated assessment schedules are enclosed in **Appendix B**.

6.0 FUTURE MAINTENANCE

All open channel maintenance works are to be performed in accordance with the governing specifications of the applicable Engineer's Report, with costs assessed per the assessment schedule enclosed in *this* report. For the crossing replacements this report shall be considered as governing.

6.1 PRIVATE CROSSING REPLACEMENTS – TIMING

Removal and replacement of the culverts and enclosures along the Gaston Levac Municipal Drain are to be carried out on an as-needed basis, only as infrastructure reaches end-of-service-life. As infrastructure becomes in need of replacement, the replacement should be done in conformance with the specifications outlined herein.

Replacement works will be determined by the Township's Drainage Superintendent as deemed necessary, and all required permitting, tendering, and oversight will be completed by the Township at the time of the scheduled works.

6.2 ROAD CROSSING REPLACEMENT

Replacement of road crossings shall only be completed on an as-needed basis – in consultation with Township Public Works staff. It should be noted that the crossing on Caledonia Road was already identified in the 1971 Engineer's Report as potentially being inadequate in size; and that is understood to have been prior to the adoption of the Omer Levac Municipal Drain. The 1971 Engineer's Report describes the crossing as being a 60-inch diameter corrugated steel pipe.

Per our hydraulic analysis, this crossing size does not appear to meet current standards and should be replaced with an 1800mm diameter corrugated steel pipe. We recommend that this culvert be monitored, particularly during the spring freshet and periods of high-water flow. This should be done by the Township Public Works department. Replacement should then be undertaken only if the existing crossing proves inadequate; or when the existing pipe reaches end-of-service-life.

7.0 SPECIAL CONSIDERATIONS

DRAIN CLASSIFICATION & PERMITTING

As part of the preparation of this report, the author conducted a review of AgMaps, the Geographic Information System managed by the Ministry of Agriculture, Food and Agribusiness (OMAFRA). AgMaps identifies the Gaston Levac Municipal Drain as a 'Class F' drain. Class F drains are defined as intermittent watercourses that are dry for at least 3 months of the year.

No fisheries studies were conducted as part of Shade Group's scope.

Per discussions with the Township's Drainage Superintendent, we understand that any permitting (as applicable) will be undertaken by the Township when works are scheduled to be completed. Works will only be completed as-needed – as the infrastructure reaches end-of-service-life. The Township's Drainage Superintendent will be responsible for adhering to applicable legislation at the time of the works being completed, including all applicable permits or notifications to applicable agencies.

EROSION AND SEDIMENT CONTROL

Permanent erosion and sediment control measures for the works outlined herein are anticipated to generally be limited to the proposed end treatment of the culverts/enclosures. End treatment installation shall be in accordance with Shade Group Standard Drawing 4 as enclosed in **Appendix D**.

Additional erosion and sediment control measures may be required at the direction of the engineer, municipality, Conservation Authority and Fisheries and Oceans Canada, as needed to address site conditions at the time that the works are performed. The review and implementation of erosion and sediment control measures is intended to be a living practice, where additional measures may be required depending on the conditions at the time of the work.

It is assumed the installation will be performed by an experienced, competent contractor, following standard industry practices for the protection of watercourses. This includes consideration of weather conditions when planning work and not performing works in or near watercourses when measurable rainfall is expected. It is expected that, with the exception of emergency replacement works, works would generally be completed in the dry.

UTILITIES

The contractor shall acquire applicable utility clearance prior to excavation as per the Ontario Underground Infrastructure Notification System Act. Should utility conflicts be identified, Shade Group shall be notified.

ENCLOSURES E4 AND E7 – TEE WITH GRATE

Given that enclosures E4 and E7 are greater than 30m in length, each enclosure is to be equipped with a tee and grate to facilitate maintenance and allow for surface water to enter the system. The tee with grate is to be field fitted to suit site conditions but should be located near the approximate mid-point of the enclosure. The maintenance access is intended to facilitate flushing of the enclosure if needed – it is not anticipated that access (e.g. manhole) would be required. Surface grading of the area shall then be completed to direct runoff towards either end of the enclosure or towards the surface grate. Minor regrading is to be undertaken by the contractor as part of the reinstatement works after the install; however major regrading would remain the responsibility of the landowner in fitting with typical undertakings for projects of this nature.

For enclosure E4, the tee is to be comprised of a 750mm diameter start/end – with a 450mm (18 inch) tee brought flush to grade and capped with an open grate.

For enclosure E7, the tee is to be comprised of a 900mm diameter start/end – with a 450mm (18 inch) tee brought flush to grade and capped with an open grate.

In each case, it shall be the respective landowner's responsibility to keep the grate opening clear of grass/leaves as well as snow and ice during the spring melt.

8.0 ENGINEERING COSTS

The engineering costs associated with the preparation of this report are estimated to be \$20,950 (exclusive of applicable taxes). This estimate does not account for any appeals to the Court of Revision, Tribunal, or the Referee. Fees associated with the updates to the assessment schedule were less than 25% of the total engineering fees.

All engineering costs are to be assessed to the landowners within the watershed in the same apportionments as the assessment schedules enclosed in **Appendix B – Schedule 'A'**. For clarity, Schedule 'D' has been prepared as a one-time use, using the estimated engineering costs; assessed in the same apportionments as Schedule 'A'.

9.0 CONSTRUCTION AND MAINTENANCE COSTS

The final scope of immediate maintenance required is at the discretion of the Township Drainage Superintendent. The construction cost estimate has been prepared as a "worst-case scenario" replacement of all crossings. This is unlikely to occur in a single year.

The actual anticipated scope will be at the discretion of the Township Drainage Superintendent. Only those crossings reaching end-of-service-life will be addressed, with the remainder replaced on an as-needed basis as their end-of-service-life approaches.

Estimated construction costs are based on consultation with suppliers and based on historical available data associated with labour and equipment costs. Discounts may be available for bulk purchasing of pipe, which has *not* been reflected in the current estimate. Similarly, final costs may be cheaper when multiple crossings are replaced at the same time. Costs reflect 2026 pricing.

The following tables provide a summary of the estimated costs associated with the Gaston Levac Municipal Drain:

Table 2: Summary Breakdown of Anticipated Construction Costs – Gaston Levac Municipal Drain Main Drain Open Channel Maintenance

Owner	Est. Costs (\$ - Excl. HST)
<u>Township of The Nation - Roads</u>	
○ Outlet	\$4,468
○ Benefit	\$294
<u>Real Property Owners – The Nation</u>	
- Outlet	\$20,282
- Benefit	\$7,956
<u>Project Subtotal</u>	\$33,000

Table 3: Summary Breakdown of Anticipated Construction Costs – Culvert Replacements (All)

Owner	Est. Costs (\$ - Excl. HST)
<u>Township of The Nation - Roads</u>	
○ Outlet	\$19,467
○ Benefit	\$1,174
<u>Real Property Owners – The Nation</u>	
- Outlet	\$55,533
- Benefit	\$23,826
<u>Project Subtotal</u>	\$100,000

Table 4: Summary Breakdown of Anticipated Construction Costs – Gaston Levac Municipal Drain 'New Outlet' Open Channel Maintenance

Owner	Est. Costs (\$ - Excl. HST)
<u>Township of The Nation - Roads</u>	
○ Outlet	\$383
○ Benefit	\$236
<u>Real Property Owners – The Nation</u>	
- Outlet	\$8,193
- Benefit	\$1,188
<u>Project Subtotal</u>	\$10,000

All estimates are exclusive of applicable taxes. A breakdown of construction costs for each crossing be found in **Appendix E**. Note that these are estimates only and actual construction costs may vary. This estimate is also based on full replacement of all crossings – while replacements will only be undertaken on an as-needed basis – as they reach end-of-service-life.

The project subtotals do not include the replacement of any road crossing culverts. Should the road crossing culverts require replacement, the full cost of replacement would be borne by the road authority as per Section 26 of the Drainage Act.

10.0 DRAINAGE ACT, 1990, PROCESS

10.1 TO DATE

Shade Group Inc. was appointed as the engineer under By-law No. 124-2025 on November 10, 2025, to undertake a Section 78 improvement to the Gaston Levac Municipal Drain.

Invitations to the on-site meeting were mailed to landowners within the watershed inviting them to attend a meeting on January 7, 2026 at the Nation Fournier Satellite Office. Shade Group outlined the project intentions and discussed the process moving forward. Landowners were asked to advise if there were any concerns with flooding or performance of the system, and were invited to provide input on their specific site needs. Three landowners attended the on-site meeting, including the Township's Drainage Superintendent.

No concerns were raised regarding flooding or erosion, nor were there any issues noted with the capacity or performance of the existing drainage channel as it exists today. One landowner requested a relocation of the existing farm crossing to a more convenient location on his property (C13), while another landowner requested that two of his laneways be connected by a single pipe rather to allow for safer access for large trucks entering his commercial farm (E7).

Following the on-site meeting, Shade Group staff also conducted a full inventory of the existing crossings using a GNSS receiver, collecting existing data of the installed infrastructure. A full survey of the entire drainage channel was not conducted as development of a new profile is

beyond the scope of work being undertaken. Instead, the previous governing profiles – including specifications for the channel cross-section – are to remain as the governing design.

10.2 NEXT STEPS

Following the submission of this report, the report will be brought to a Meeting to Consider (Drainage Act - Section 42).

The clerk of each affected municipality shall send a copy of the report and a notice stating the date on which the report was filed, the name or designation of the drainage works; and the date of the council meeting at which the report will be considered, to the prescribed people (Section 41). In this case, the watershed only impacts a single municipality.

The Meeting to Consider is hosted by council, and council may then adopt the report by provisional by-law by giving two readings (Section 45(1)).

Following the Meeting to Consider, and assuming a provisional by-law is adopted by two readings, a notice is sent, including a copy of the provisional by-law (exclusive of the Engineer's Report) of the time and place for the first sitting of the Court of Revision. This notice is sent to each body or person as entitled under Section 41 of the Drainage Act.

Following the completion of addressing all appeals; or the time for appealing has expired, the council may pass the provisional by-law by a third reading, thereby authorizing construction (or maintenance) of the drainage works. Work may then be commenced as early as ten days after the by-law is passed, if no notice of intention to make an application to quash the by-law has been filed with the clerk of the council (Section 58(1)).

Through discussions with The Nation staff, it is understood that the Township will oversee any permitting, tendering and oversight of maintenance/construction works, as required. Replacement of crossings is anticipated to be completed only on an "as-needed" basis, only replacing infrastructure as it is needed. Infrastructure that is still in acceptable condition as deemed so by the Drainage Superintendent – will be left until such a time as replacement is needed. As such, permitting is anticipated to be approached on an as-needed basis – only for those crossings in need of replacement, as the time comes, based on applicable legislative requirements at the time of the replacement works.

10.3 RESOLUTION AND BY-LAW

Appendix F has been included in this report as a place to attach the applicable by-laws associated with this Section 78 undertaking. The by-law from Shade Group's initial appointment is enclosed with this submission, and it is recommended that the Township attach a copy of the report adoption by-law following its third reading.

10.4 LIMITATIONS

The process overview described in Section 10.2 is provided as a general summary of the next steps to completion. Should the process described herein conflict with the specifications of the Drainage Act, the Drainage Act shall govern. The process described is provided as a summary only, the Township clerk shall be responsible for ensuring that the applicable administrative works are completed in accordance with the specifications of the Drainage Act.

11.0 ADIP GRANT

Properties that are registered with OMAFA for the Farm Property Class Tax Rate Program may be eligible for a 1/3 grant from the Province. As eligibility requires active status with OMAFA at the time of the works, the grant has not been reflected on the current assessment schedules. If you have questions on whether your property is eligible for grant, please contact the Township's Drainage Superintendent to discuss.

Where properties have more than one crossing, current ADIP policy states that:

"For every drain, every agricultural property is entitled to one drain crossing. Any additional crossing on this property will not be eligible for grant."

12.0 CLOSING

This final report is respectfully submitted to the Council of the Nation Municipality for consideration and adoption.

Should you have any questions or concerns, please do not hesitate to contact the undersigned.



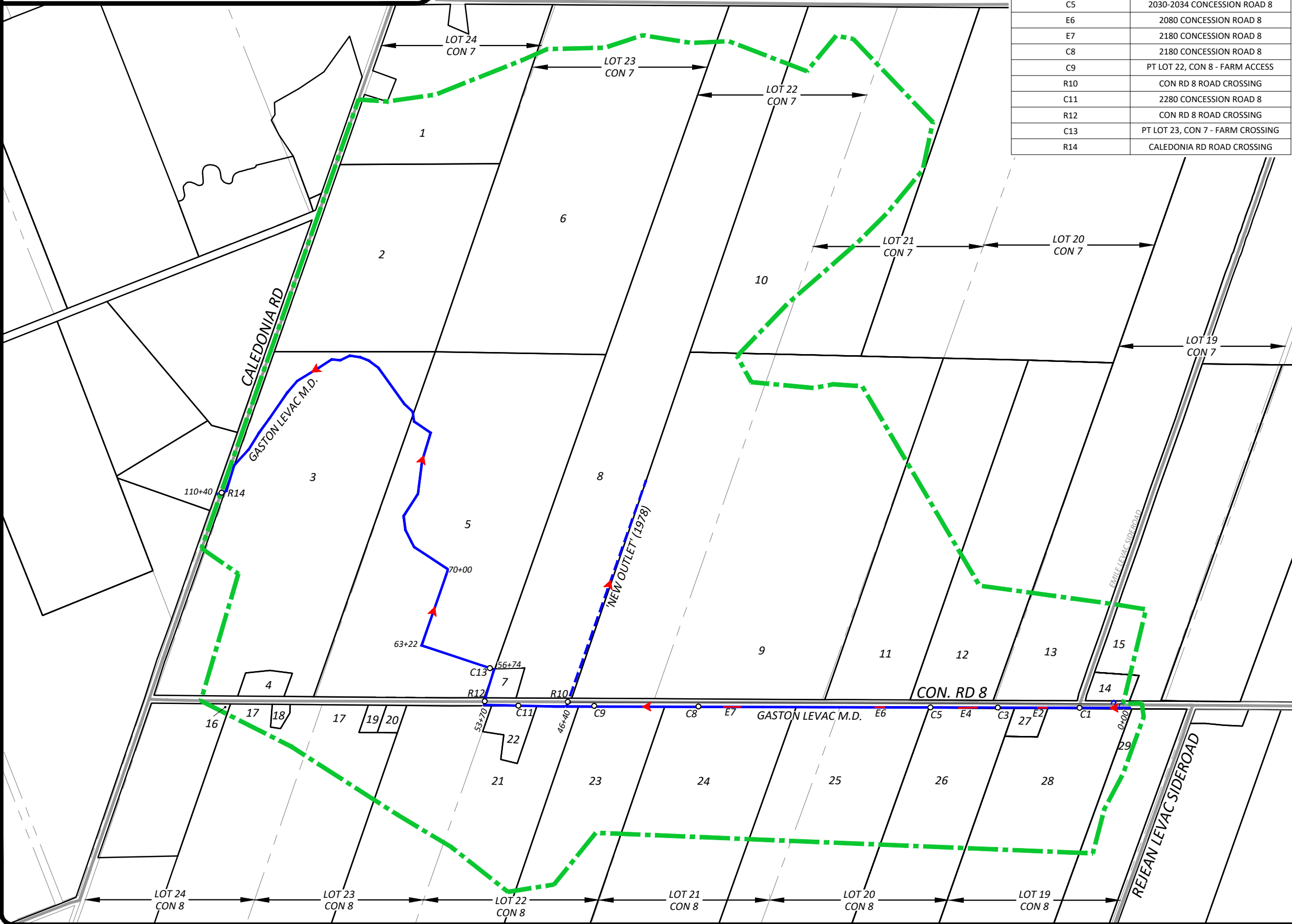
Monica Shade, P. Eng.
Drainage Engineer
Shade Group Inc.

APPENDIX A

WATERSHED MAP



GASTON LEVAC MUNICIPAL DRAIN



CROSSING LOCATIONS	
CROSSING I.D.	CIVIC ADDRESS/LOCATION
C1	PT LOT 19, CON 8 - FARM ACCESS
E2	1990 CONCESSION ROAD 8
C3	2030-2034 CONCESSION ROAD 8
E4	2030-2034 CONCESSION ROAD 8
C5	2030-2034 CONCESSION ROAD 8
E6	2080 CONCESSION ROAD 8
E7	2180 CONCESSION ROAD 8
C8	2180 CONCESSION ROAD 8
C9	PT LOT 22, CON 8 - FARM ACCESS
R10	CON RD 8 ROAD CROSSING
C11	2280 CONCESSION ROAD 8
R12	CON RD 8 ROAD CROSSING
C13	PT LOT 23, CON 7 - FARM CROSSING
R14	CALEDONIA RD ROAD CROSSING



SCALE BAR 0 100 250 500m
DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING

PAGE SIZE TABLOID SCALE 1:10,000

SHADE GROUP INC.
4625 MARCH ROAD
ALMONTE, ONTARIO
K0A 1A0



- LEGEND
- APPROX. PROPERTY LINES (GIS DATA)
 - ROAD
 - GASTON LEVAC MUNICIPAL DRAIN (1971)
 - GASTON LEVAC "NEW OUTLET" (1978)
 - GASTON LEVAC MUNICIPAL DRAIN WATERSHED
 - WATERCOURSES
 - LOT AND CONCESSION LINES
 - C1 PRIVATE CROSSING LOCATION & ID
 - R12 ROAD CROSSING LOCATION & ID
 - E7 ENCLOSURE LOCATION & ID
 - RED ARROW DIRECTION OF FLOW
 - #1 PROPERTY ID NUMBERS
 - 46+40 APPROX. PREVIOUS STATIONS (FT) PER 1971/1978 ENGINEER'S REPORT

00	ISSUED W. ENGINEER'S REPORT	OCT 5, 2026
REV.	DESCRIPTION	DATE



PROJECT TITLE	GASTON LEVAC MUNICIPAL DRAIN
DRAWING TITLE	WATERSHED MAP
DRAWING NO.	1 OF 1

APPENDIX B

ASSESSMENT SCHEDULES

Assessment Schedule - Updated 2026
Schedule 'A'
Gaston Levac Municipal Drain - Maintenance

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
1	0212012-007-06200	24	7	8.1	\$36.16	\$ -	\$ 36.16
2	0212012-007-06250	24	7	19.2	\$395.32	\$ -	\$ 395.32
3	0212012-007-06150	24	7	30.7	\$1,449.65	\$ 1,987.04	\$ 3,436.69
4	0212012-007-06100	24	7	0.7	\$36.05	\$ -	\$ 36.05
5	0212012-007-05900	23	7	37.7	\$3,960.65	\$ 2,862.39	\$ 6,823.03
6	0212012-007-06000	23	7	34.2	\$338.38	\$ -	\$ 338.38
7	0212012-007-05850	22	7	0.6	\$177.00	\$ 103.70	\$ 280.71
8	0212012-007-05800	22	7	33.9	\$583.67	\$ -	\$ 583.67
9	0212012-007-05700	21 & 22	7	50.3	\$1,270.93	\$ -	\$ 1,270.93
10	0212012-007-05600	21 & 22	7	23.6	\$171.75	\$ -	\$ 171.75
11	0212012-007-05400	20	7	10.4	\$380.31	\$ -	\$ 380.31
12	0212012-007-05300	20	7	6.3	\$323.76	\$ -	\$ 323.76
13	0212012-007-05200	19	7	5.4	\$298.10	\$ -	\$ 298.10
14	0212012-007-05100	19	7	0.7	\$95.19	\$ -	\$ 95.19
15	0212012-007-05005	19	7	1.4	\$69.90	\$ -	\$ 69.90
16	0212012-008-06200	24	8	0.1	\$2.40	\$ -	\$ 2.40
17	0212012-008-06100	23 & 24	8	4.8	\$206.94	\$ -	\$ 206.94
18	0212012-008-06160	24	8	0.2	\$11.48	\$ -	\$ 11.48
19	0212012-008-06145	23	8	0.3	\$52.64	\$ -	\$ 52.64
20	0212012-008-06150	23	8	0.4	\$66.63	\$ -	\$ 66.63
21	0212012-008-05810	22 & 23	8	14.2	\$1,402.43	\$ 349.99	\$ 1,752.42
22	0212012-008-05800	22	8	1.2	\$365.13	\$ 168.95	\$ 534.08

Assessment Schedule - Updated 2026
Schedule 'A'
Gaston Levac Municipal Drain - Maintenance

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
23	0212012-008-05700	22	8	8.6	\$1,025.30	\$ 377.84	\$ 1,403.14
24	0212012-008-05600	21	8	10.8	\$1,690.25	\$ 573.61	\$ 2,263.86
25	0212012-008-05500	20	8	11.4	\$1,979.29	\$ 581.52	\$ 2,560.82
26	0212012-008-05400	20	8	7.6	\$1,394.25	\$ 375.04	\$ 1,769.29
27	0212012-008-05310	19	8	0.6	\$333.45	\$ 105.82	\$ 439.27
28	0212012-008-05300	19	8	9.9	\$1,922.37	\$ 406.97	\$ 2,329.35
29	0212012-008-05000	19	8	1.2	\$243.03	\$ 63.09	\$ 306.12
Sub-Total				334.4	\$ 20,282.40	\$ 7,955.96	\$ 28,238.37

*Estimated Assessment does not include Farm Tax Credit (FTC). Farm Tax Credit eligibility to be confirmed at time of maintenance.

Roads

Road Name	Owner	Outlet	Benefit	Net Assessment
Concession Road 7-8	The Nation Municipality	\$4,222.21	\$ 294.04	\$ 4,516.24
Emile Levac Sideroad		\$235.45	\$ -	\$ 235.45
Caledonia Road		\$9.94	\$ -	\$ 9.94
Sub-Total		\$ 4,467.60	\$ 294.04	\$ 4,761.63

Summary

Real Properties	\$ 20,282.40	\$ 7,955.96	\$ 28,238.37
The Nation Municipality	\$ 4,467.60	\$ 294.04	\$ 4,761.63
Sub-Total (Pre-Tax/Grant)	\$ 24,750.00	\$ 8,250.00	\$ 33,000.00

Assessment Schedule - Updated 2026
Schedule 'B'
Gaston Levac Municipal Drain - Improvements

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
1	0212012-007-06200	24	7	8.1	\$ -	\$ -	\$ -
2	0212012-007-06250	24	7	19.2	\$ -	\$ -	\$ -
3	0212012-007-06150	24	7	30.7	\$ -	\$ -	\$ -
4	0212012-007-06100	24	7	0.7	\$ 166.20	\$ -	\$ 166.20
5	0212012-007-05900	23	7	37.7	\$ 4,565.22	\$ 11,425.84	\$ 15,991.06
6	0212012-007-06000	23	7	34.2	\$ -	\$ -	\$ -
7	0212012-007-05850	22	7	0.6	\$ 816.09	\$ 413.95	\$ 1,230.05
8	0212012-007-05800	22	7	33.9	\$ 672.77	\$ -	\$ 672.77
9	0212012-007-05700	21 & 22	7	50.3	\$ -	\$ -	\$ -
10	0212012-007-05600	21 & 22	7	23.6	\$ -	\$ -	\$ -
11	0212012-007-05400	20	7	10.4	\$ -	\$ -	\$ -
12	0212012-007-05300	20	7	6.3	\$ -	\$ -	\$ -
13	0212012-007-05200	19	7	5.4	\$ -	\$ -	\$ -
14	0212012-007-05100	19	7	0.7	\$ -	\$ -	\$ -
15	0212012-007-05005	19	7	1.4	\$ -	\$ -	\$ -
16	0212012-008-06200	24	8	0.1	\$ 11.06	\$ -	\$ 11.06
17	0212012-008-06100	23 & 24	8	4.8	\$ 954.12	\$ -	\$ 954.12
18	0212012-008-06160	24	8	0.2	\$ 52.92	\$ -	\$ 52.92
19	0212012-008-06145	23	8	0.3	\$ 242.68	\$ -	\$ 242.68
20	0212012-008-06150	23	8	0.4	\$ 307.22	\$ -	\$ 307.22
21	0212012-008-05810	22 & 23	8	14.2	\$ 6,466.02	\$ 1,397.06	\$ 7,863.08
22	0212012-008-05800	22	8	1.2	\$ 1,683.45	\$ 674.41	\$ 2,357.86

Assessment Schedule - Updated 2026
Schedule 'B'
Gaston Levac Municipal Drain - Improvements

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
23	0212012-008-05700	22	8	8.6	\$ 4,727.23	\$ 1,508.23	\$ 6,235.46
24	0212012-008-05600	21	8	10.8	\$ 7,793.03	\$ 2,289.70	\$ 10,082.73
25	0212012-008-05500	20	8	11.4	\$ 9,125.69	\$ 2,321.28	\$ 11,446.96
26	0212012-008-05400	20	8	7.6	\$ 6,428.30	\$ 1,497.04	\$ 7,925.34
27	0212012-008-05310	19	8	0.6	\$ 1,537.42	\$ 422.41	\$ 1,959.82
28	0212012-008-05300	19	8	9.9	\$ 8,863.26	\$ 1,624.53	\$ 10,487.79
29	0212012-008-05000	19	8	1.2	\$ 1,120.50	\$ 251.85	\$ 1,372.35
Sub-Total				334.4	\$ 55,533.18	\$ 23,826.29	\$ 79,359.47

*Estimated Assessment does not include Farm Tax Credit (FTC). Farm Tax Credit eligibility to be confirmed at time of maintenance.

Roads

Road Name	Owner	Outlet	Benefit	Net Assessment
Concession Road 7-8	The Nation Municipality	\$ 19,466.82	\$ 1,173.71	\$ 20,640.53
Emile Levac Sideroad		\$ -	\$ -	\$ -
Caledonia Road		\$ -	\$ -	\$ -
Sub-Total		\$ 19,466.82	\$ 1,173.71	\$ 20,640.53

Summary

Real Properties	\$ 55,533.18	\$ 23,826.29	\$ 79,359.47
The Nation Municipality	\$ 19,466.82	\$ 1,173.71	\$ 20,640.53
Sub-Total (Pre-Tax/Grant)	\$ 75,000.00	\$ 25,000.00	\$ 100,000.00

Assessment Schedule - Updated 2026

Schedule 'C'

Gaston Levac Municipal Drain "New Outlet" - Maintenance

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
1	0212012-007-06200	24	7	8.1	\$ -	\$ -	\$ -
2	0212012-007-06250	24	7	19.2	\$ -	\$ -	\$ -
3	0212012-007-06150	24	7	30.7	\$ -	\$ -	\$ -
4	0212012-007-06100	24	7	0.7	\$ -	\$ -	\$ -
5	0212012-007-05900	23	7	37.7	\$ -	\$ -	\$ -
6	0212012-007-06000	23	7	34.2	\$ -	\$ -	\$ -
7	0212012-007-05850	22	7	0.6	\$ -	\$ -	\$ -
8	0212012-007-05800	22	7	33.9	\$ 52.18	\$ 8.10	\$ 60.28
9	0212012-007-05700	21 & 22	7	50.3	\$ -	\$ -	\$ -
10	0212012-007-05600	21 & 22	7	23.6	\$ -	\$ -	\$ -
11	0212012-007-05400	20	7	10.4	\$ -	\$ -	\$ -
12	0212012-007-05300	20	7	6.3	\$ -	\$ -	\$ -
13	0212012-007-05200	19	7	5.4	\$ -	\$ -	\$ -
14	0212012-007-05100	19	7	0.7	\$ -	\$ -	\$ -
15	0212012-007-05005	19	7	1.4	\$ -	\$ -	\$ -
16	0212012-008-06200	24	8	0.1	\$ -	\$ -	\$ -
17	0212012-008-06100	23 & 24	8	4.8	\$ 116.87	\$ -	\$ 116.87
18	0212012-008-06160	24	8	0.2	\$ 5.81	\$ -	\$ 5.81
19	0212012-008-06145	23	8	0.3	\$ 7.82	\$ -	\$ 7.82
20	0212012-008-06150	23	8	0.4	\$ 8.65	\$ -	\$ 8.65
21	0212012-008-05810	22 & 23	8	14.2	\$ 417.46	\$ 99.73	\$ 517.20
22	0212012-008-05800	22	8	1.2	\$ 34.79	\$ 60.75	\$ 95.54

Assessment Schedule - Updated 2026

Schedule 'C'

Gaston Levac Municipal Drain "New Outlet" - Maintenance

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
23	0212012-008-05700	22	8	8.6	\$ 574.01	\$ 121.50	\$ 695.51
24	0212012-008-05600	21	8	10.8	\$ 1,374.16	\$ 193.39	\$ 1,567.54
25	0212012-008-05500	20	8	11.4	\$ 1,426.34	\$ 261.73	\$ 1,688.07
26	0212012-008-05400	20	8	7.6	\$ 1,513.31	\$ 176.17	\$ 1,689.48
27	0212012-008-05310	19	8	0.6	\$ 121.76	\$ 74.42	\$ 196.18
28	0212012-008-05300	19	8	9.9	\$ 2,226.48	\$ 165.54	\$ 2,392.02
29	0212012-008-05000	19	8	1.2	\$ 313.10	\$ 26.83	\$ 339.93
Sub-Total				334.4	\$ 8,192.75	\$ 1,188.16	\$ 9,380.91

*Estimated Assessment does not include Farm Tax Credit (FTC). Farm Tax Credit eligibility to be confirmed at time of maintenance.

Roads

Road Name	Owner	Outlet	Benefit	Net Assessment
Concession Road 7-8	The Nation Municipality	\$ 382.68	\$ 236.42	\$ 619.09
Emile Levac Sideroad		\$ -	\$ -	\$ -
Caledonia Road		\$ -	\$ -	\$ -
Sub-Total		\$ 382.68	\$ 236.42	\$ 619.09

Summary

Real Properties	\$ 8,192.75	\$ 1,188.16	\$ 9,380.91
The Nation Municipality	\$ 382.68	\$ 236.42	\$ 619.09
Sub-Total (Pre-Tax/Grant)	\$ 8,575.43	\$ 1,424.57	\$ 10,000.00

Assessment Schedule - Updated 2026

Schedule 'D'

Gaston Levac Municipal Drain - Engineering Costs S. 78 (One-Time Use)

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
1	0212012-007-06200	24	7	8.1	\$22.96	\$ -	\$ 22.96
2	0212012-007-06250	24	7	19.2	\$250.97	\$ -	\$ 250.97
3	0212012-007-06150	24	7	30.7	\$920.31	\$ 1,261.47	\$ 2,181.78
4	0212012-007-06100	24	7	0.7	\$22.88	\$ -	\$ 22.88
5	0212012-007-05900	23	7	37.7	\$2,514.41	\$ 1,817.18	\$ 4,331.59
6	0212012-007-06000	23	7	34.2	\$214.82	\$ -	\$ 214.82
7	0212012-007-05850	22	7	0.6	\$112.37	\$ 65.84	\$ 178.21
8	0212012-007-05800	22	7	33.9	\$370.54	\$ -	\$ 370.54
9	0212012-007-05700	21 & 22	7	50.3	\$806.85	\$ -	\$ 806.85
10	0212012-007-05600	21 & 22	7	23.6	\$109.03	\$ -	\$ 109.03
11	0212012-007-05400	20	7	10.4	\$241.44	\$ -	\$ 241.44
12	0212012-007-05300	20	7	6.3	\$205.54	\$ -	\$ 205.54
13	0212012-007-05200	19	7	5.4	\$189.25	\$ -	\$ 189.25
14	0212012-007-05100	19	7	0.7	\$60.43	\$ -	\$ 60.43
15	0212012-007-05005	19	7	1.4	\$44.37	\$ -	\$ 44.37
16	0212012-008-06200	24	8	0.1	\$1.52	\$ -	\$ 1.52
17	0212012-008-06100	23 & 24	8	4.8	\$131.38	\$ -	\$ 131.38
18	0212012-008-06160	24	8	0.2	\$7.29	\$ -	\$ 7.29
19	0212012-008-06145	23	8	0.3	\$33.42	\$ -	\$ 33.42
20	0212012-008-06150	23	8	0.4	\$42.30	\$ -	\$ 42.30
21	0212012-008-05810	22 & 23	8	14.2	\$890.33	\$ 222.19	\$ 1,112.52
22	0212012-008-05800	22	8	1.2	\$231.80	\$ 107.26	\$ 339.06

Assessment Schedule - Updated 2026

Schedule 'D'

Gaston Levac Municipal Drain - Engineering Costs S. 78 (One-Time Use)

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
23	0212012-008-05700	22	8	8.6	\$650.91	\$ 239.87	\$ 890.78
24	0212012-008-05600	21	8	10.8	\$1,073.05	\$ 364.16	\$ 1,437.21
25	0212012-008-05500	20	8	11.4	\$1,256.55	\$ 369.18	\$ 1,625.73
26	0212012-008-05400	20	8	7.6	\$885.14	\$ 238.09	\$ 1,123.23
27	0212012-008-05310	19	8	0.6	\$211.69	\$ 67.18	\$ 278.87
28	0212012-008-05300	19	8	9.9	\$1,220.42	\$ 258.37	\$ 1,478.78
29	0212012-008-05000	19	8	1.2	\$154.29	\$ 40.05	\$ 194.34
Sub-Total				334.4	\$12,876.25	\$ 5,050.83	\$ 17,927.08

*Estimated Assessment does not include Farm Tax Credit (FTC). Farm Tax Credit eligibility to be confirmed at time of maintenance.

Roads

Road Name	Owner			Net Assessment
Concession Road 7-8	The Nation Municipality	\$2,680.46	\$ 186.67	\$ 2,867.13
Emile Levac Sideroad		\$149.48	\$ -	\$ 149.48
Caledonia Road		\$6.31	\$ -	\$ 6.31
Sub-Total		\$ 2,836.25	\$ 186.67	\$ 3,022.92

Summary

Real Properties	\$ 12,876.25	\$ 5,050.83	\$ 17,927.08
The Nation Municipality	\$ 2,836.25	\$ 186.67	\$ 3,022.92
Sub-Total (Pre-Tax/Grant)	\$ 15,712.50	\$ 5,237.50	\$ 20,950.00

APPENDIX C

HYDROLOGIC & HYDRAULIC ANALYSIS

CROSSINGS

CROSSING DESIGN CONSIDERATIONS

SOIL CONDITIONS

As part of the preparation of this report, the author conducted a review of AgMaps, the Geographic Information System managed by OMAFA, for reference to the soil conditions of the watershed. AgMaps identifies the Hydrologic Soil Group within the Gaston Levac Municipal Drain watershed as Class 'B' and class 'C' soils.

HYDROLOGY & HYDRAULICS – CROSSINGS

Hydrologic design of all crossings and enclosures within the watershed was completed using Visual OTTHYMO 6.2 as well as the Rationale Method (where the contributing area was less than 1km²), while a hydraulic analysis was performed using HY-8. Calculations in Visual OTTHYMO were completed using a NASH unit hydrograph. Intensities were determined from the MTO IDF Curve Lookup. Peak flow rates were calculated for the 2, 5, 10, 25, 50 and 100-year storm events.

Peak flows were calculated using the Rationale Method (where the contributing area was less than 1km²) as well as against the 12-Hour SCS Type II and 24-Hour SCS Type II distributions using Visual OTTHYMO. The most conservative result was then used as the design flow.

The minimum design standard has been determined in reference to the Highway Drainage Design Standards from the Ministry of Transportation, in reference to Section WC-1, which notes that for culverts with a diameter of less than 6m, local roads are to be designed to a 10-year storm event. Although a driveway entrance would not be considered a local road, there is no lesser standard specified in WC-1 (Water Crossings). Private entrances are only referenced in the Highway Drainage Design Standards in reference to crossings *not* on a watercourse. This approach is – in my opinion – considered conservative, however despite being conservative, there was limited need for an increase in culvert sizes on the drain, with the exception of requiring a change in material from CSP to HDPE. Furthermore, I feel that this approach will allow for accommodation of changes in climate over the next 30-40 years.

One exception is enclosure E4 which has been sized to accommodate the 5-year, not the 10-year. Given the considerable length of this enclosure, it would have required an increase in diameter to accommodate the 10-year. I did not feel this was warranted given the rural nature of the surrounding area, and as there are other points of entrance to this property. Despite the reduced service level the pipe would not be expected to have any adverse impacts on the adjacent road nor the existing property, in comparison to existing conditions.

Elevations used in the calculation have been referenced back to the governing profile drawings for each drain. Shade Group staff conducted a field survey to collect elevations using a GNSS receiver – and these values were used to assess relative elevations between the various factors (e.g. depth of channel, top of driveway/access, etc.). The surveyed data was then referenced back to the profile elevations, which were generally *not* geodetic at the time of the governing report and appear to reference a generic

benchmark of 100ft. Where the design drawings were prepared in feet the values have been converted to meters.

Enclosed within the following pages is a breakdown of the hydrology for each culvert; and resulting hydraulic calculations. Full output results from Visual OTTHMO have not been enclosed given the sheer volume of the data. The results from VO have been summarized in the each of the aforementioned hydrologic analysis sheets. Similarly, visual output results from HY8 have not been enclosed.

Gaston Levac Municipal Drain

Methodology	VISUAL OTTHYMO	
Unit Hydrograph	NASHYD	
Description	C1	
Location	Lot 19, Con 8 - Prop ID 27	
Use	Agricultural	
Design Storm	10-Year	HW/D < 1.5
Check Storm	100-Year	

Watershed Area A= 5.28 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	5.203	82.24
Impervious	98.00	0.079	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	5.203	0.36
Impervious	0.90	0.079	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.86
Ia =	8.23

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
139	0.07	0.12	19

Total Tc (min)	Total Tp (hr)
121	1.35

Intensity

Return Period	Intensity (mm/hr)
2-Year	12.1
5-Year	16.1
10-Year	18.8
25-Year	22.1
50-Year	24.6
100-Year	27.0

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.06	0.05	0.06	0.06
5-Year	0.08	0.09	0.11	0.11
10-Year	0.10	0.11	0.14	0.14
25-Year	0.12	0.15	0.18	0.18
50-Year	0.13	0.18	0.21	0.21
100-Year	0.14	0.21	0.25	0.25

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description C1
Pipe Diameter 525mm Ø HDPE
Pipe Length 12m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.06	0.06	29.31	0.22	0.29	0.20	0.13	0.35	0.24	0.36	0.26
5 year	0.11	0.11	29.43	0.32	0.41	0.28	0.19	0.44	0.33	0.55	0.30
10 year	0.14	0.14	29.50	0.38	0.48	0.33	0.22	0.47	0.37	0.69	0.32
25 year	0.18	0.18	29.64	0.45	0.62	0.40	0.25	0.47	0.42	0.88	0.35
50 year	0.21	0.21	29.80	0.51	0.77	0.47	0.28	0.47	0.46	1.03	0.36
100 year	0.25	0.25	29.95	0.60	0.92	0.47	0.31	0.47	0.49	1.22	0.38

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 29.02

HW Elev= 29.50

HW = 0.48 m

D = 0.525 m

HW/D = 0.91 **Pass**

100-Year Check

HW Elev = 29.95 m

Dwy CL Elev = 30.41 m

Freeboard= 0.46 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description E2
Location Lot 19, Con 8 - Prop ID 26
Use Residential
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 9.76 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	9.629	82.21
Impervious	98.00	0.131	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	9.629	0.36
Impervious	0.90	0.131	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.95
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
241	0.07	0.12	33

Total Tc (min)	Total Tp (hr)
135	1.51

Intensity

Return Period	Intensity (mm/hr)
2-Year	11.2
5-Year	14.9
10-Year	17.4
25-Year	20.5
50-Year	22.8
100-Year	25.0

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.11	0.08	0.11	0.11
5-Year	0.14	0.15	0.18	0.18
10-Year	0.17	0.19	0.24	0.24
25-Year	0.20	0.26	0.31	0.31
50-Year	0.22	0.31	0.36	0.36
100-Year	0.24	0.35	0.42	0.42

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description E2
Pipe Diameter 600mm Ø; n=0.013
Pipe Length 24m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.11	0.11	29.37	0.30	0.41	0.32	0.18	0.44	0.33	0.47	0.30
5 year	0.18	0.18	29.52	0.41	0.56	0.45	0.24	0.54	0.42	0.68	0.35
10 year	0.24	0.24	29.82	0.50	0.86	0.54	0.28	0.54	0.49	0.90	0.37
25 year	0.31	0.31	30.09	0.62	1.13	0.54	0.33	0.54	0.55	1.16	0.40
50 year	0.36	0.36	30.30	0.71	1.34	0.54	0.36	0.54	0.59	1.35	0.41
100 year	0.42	0.36	30.36	0.72	1.40	0.54	0.36	0.54	0.63	1.36	0.43

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.96

HW Elev= 29.82

HW = 0.86 m

D = 0.6 m

HW/D = 1.43 **Pass**

100-Year Check

HW Elev = 30.36 m

Dwy CL Elev = 30.33 m

Overtopping = 0.03 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description C3
Location Lot 20, Con 8 - Prop ID 25
Use Agricultural
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 13.14 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	12.961	82.22
Impervious	98.00	0.179	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	12.961	0.36
Impervious	0.90	0.179	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.93
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
338	0.07	0.12	47

Total Tc (min)	Total Tp (hr)
149	1.66

Intensity

Return Period	Intensity (mm/hr)
2-Year	10.5
5-Year	14.0
10-Year	16.3
25-Year	19.2
50-Year	21.3
100-Year	23.4

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.14	0.10	0.13	0.14
5-Year	0.18	0.18	0.23	0.23
10-Year	0.21	0.24	0.30	0.30
25-Year	0.25	0.32	0.39	0.39
50-Year	0.28	0.38	0.45	0.45
100-Year	0.31	0.44	0.52	0.52

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description C3
Pipe Diameter 750mm Ø HDPE
Pipe Length 15m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.14	0.14	29.30	0.30	0.43	0.32	0.19	0.46	0.37	0.45	0.32
5 year	0.23	0.23	29.44	0.42	0.56	0.42	0.25	0.56	0.48	0.61	0.37
10 year	0.30	0.30	29.53	0.50	0.65	0.50	0.29	0.62	0.54	0.74	0.39
25 year	0.39	0.39	29.67	0.59	0.80	0.63	0.34	0.68	0.61	0.94	0.42
50 year	0.45	0.45	29.84	0.66	0.96	0.68	0.37	0.68	0.65	1.08	0.44
100 year	0.52	0.52	29.97	0.74	1.10	0.68	0.40	0.68	0.70	1.25	0.45

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.80

HW Elev= 29.53

HW = 0.73 m

D = 0.75 m

HW/D = 0.97 **Pass**

100-Year Check

HW Elev = 29.97 m

Dwy CL Elev = 30.40 m

Freeboard= 0.43 m

Gaston Levac Municipal Drain

Methodology	VISUAL OTTHYMO
Unit Hydrograph	NASHYD
Description	E4
Location	Lot 20, Con 8 - Prop ID 25
Use	Agricultural & Residential
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 16.34 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	16.121	82.21
Impervious	98.00	0.218	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	16.121	0.36
Impervious	0.90	0.218	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.95
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
418	0.07	0.12	58

Total Tc (min)	Total Tp (hr)
160	1.78

Intensity

Return Period	Intensity (mm/hr)
2-Year	10.0
5-Year	13.3
10-Year	15.5
25-Year	18.2
50-Year	20.3
100-Year	22.3

Peak Flow

Return Period	Results (m ³ /s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.16	0.12	0.16	0.16	Design Storm
5-Year	0.22	0.22	0.27	0.27	
10-Year	0.25	0.28	0.35	0.35	
25-Year	0.30	0.38	0.46	0.46	
50-Year	0.33	0.45	0.54	0.54	Check Storm
100-Year	0.36	0.52	0.62	0.62	

Methodology HY-8 RESULTS
Description E4
Pipe Diameter 750mm Ø; n=0.013
Pipe Length 51m
Design Storm 5-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.16	0.16	29.34	0.33	0.51	0.44	0.20	0.51	0.40	0.46	0.34
5 year	0.27	0.27	29.53	0.47	0.69	0.68	0.27	0.63	0.51	0.67	0.38
10 year	0.35	0.35	29.91	0.55	1.08	0.68	0.32	0.68	0.58	0.84	0.41
25 year	0.46	0.46	30.29	0.67	1.46	0.68	0.37	0.68	0.66	1.10	0.44
50 year	0.54	0.51	30.50	0.73	1.66	0.68	0.40	0.68	0.71	1.22	0.46
100 year	0.62	0.50	30.52	0.72	1.69	0.68	0.39	0.68	0.76	1.21	0.47

5-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.76

HW Elev= 29.53

HW = 0.77 m

D = 0.75 m

HW/D = 1.02 **Pass**

100-Year Check

HW Elev = 30.52 m

Dwy CL Elev = 30.48 m

Overtopping 0.04 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description C5
Location Lot 20, Con 8 - Prop ID 25
Use Agricultural
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 19.81 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	19.548	82.21
Impervious	98.00	0.264	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	19.548	0.36
Impervious	0.90	0.264	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.95
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
507	0.07	0.12	70

Total Tc (min)	Total Tp (hr)
172	1.92

Intensity

Return Period	Intensity (mm/hr)
2-Year	9.5
5-Year	12.6
10-Year	14.7
25-Year	17.3
50-Year	19.2
100-Year	21.2

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.19	0.14	0.18	0.19
5-Year	0.25	0.25	0.31	0.31
10-Year	0.29	0.32	0.40	0.40
25-Year	0.34	0.43	0.52	0.52
50-Year	0.38	0.51	0.61	0.61
100-Year	0.42	0.60	0.70	0.70

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description C5
Pipe Diameter 750mm Ø HDPE
Pipe Length 15m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.19	0.19	29.26	0.37	0.51	0.37	0.22	0.52	0.43	0.54	0.35
5 year	0.31	0.31	29.42	0.51	0.67	0.51	0.30	0.63	0.55	0.76	0.40
10 year	0.40	0.40	29.63	0.61	0.87	0.68	0.34	0.68	0.62	0.96	0.42
25 year	0.52	0.52	29.85	0.74	1.10	0.68	0.40	0.68	0.70	1.25	0.45
50 year	0.61	0.61	30.04	0.86	1.28	0.68	0.44	0.68	0.75	1.46	0.47
100 year	0.70	0.70	30.23	1.00	1.48	0.68	0.47	0.68	0.80	1.68	0.49

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.68

HW Elev= 29.63

HW = 0.95 m

D = 0.75 m

HW/D = 1.26 **Pass**

100-Year Check

HW Elev = 30.23 m

Dwy CL Elev = 30.54 m

Freeboard= 0.31 m

Gaston Levac Municipal Drain

Methodology	VISUAL OTTHYMO
Unit Hydrograph	NASHYD
Description	E6
Location	Lot 20 + 21, Con 8 - Prop ID 24
Use	Agricultural & Residential
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 24.23 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	23.901	82.22
Impervious	98.00	0.331	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	23.901	0.36
Impervious	0.90	0.331	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.93
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
640	0.07	0.12	88

Total Tc (min)	Total Tp (hr)
190	2.13

Intensity

Return Period	Intensity (mm/hr)
2-Year	8.8
5-Year	11.8
10-Year	13.7
25-Year	16.1
50-Year	17.9
100-Year	19.7

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.21	0.16	0.20	0.21
5-Year	0.28	0.28	0.35	0.35
10-Year	0.33	0.37	0.45	0.45
25-Year	0.39	0.49	0.59	0.59
50-Year	0.43	0.58	0.69	0.69
100-Year	0.47	0.67	0.79	0.79

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description E6
Pipe Diameter 900mm Ø; n=0.013
Pipe Length 30m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.21	0.21	29.20	0.35	0.53	0.44	0.22	0.54	0.46	0.48	0.36
5 year	0.35	0.35	29.36	0.49	0.69	0.60	0.29	0.66	0.58	0.66	0.41
10 year	0.45	0.45	29.47	0.58	0.80	0.76	0.34	0.73	0.65	0.78	0.44
25 year	0.59	0.59	29.77	0.69	1.10	0.81	0.40	0.81	0.74	0.98	0.47
50 year	0.69	0.69	29.94	0.78	1.27	0.81	0.43	0.81	0.79	1.15	0.49
100 year	0.79	0.79	30.11	0.87	1.44	0.81	0.47	0.81	0.84	1.32	0.50

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.58

HW Elev= 29.47

HW = 0.89 m

D = 0.9 m

HW/D = 0.98 **Pass**

100-Year Check

HW Elev = 30.11 m

Dwy CL Elev = 30.76 m

Freeboard= 0.65 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description E7
Location Lot 21, Con 8 - Prop ID 23
Use Agricultural
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 36.81 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	36.814	82.00
Impervious	98.00	0.000	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	36.814	0.35
Impervious	0.90	0.000	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	55.76
Ia =	8.36

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	103

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1022	0.07	0.12	141

Total Tc (min)	Total Tp (hr)
244	2.73

Intensity

Return Period	Intensity (mm/hr)
2-Year	7.4
5-Year	9.9
10-Year	11.5
25-Year	13.6
50-Year	15.1
100-Year	16.6

Peak Flow

Return Period	Results (m ³ /s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.27	0.20	0.26	0.27	Design Storm
5-Year	0.35	0.35	0.44	0.44	
10-Year	0.41	0.46	0.56	0.56	
25-Year	0.49	0.61	0.74	0.74	
50-Year	0.54	0.72	0.87	0.87	Check Storm
100-Year	0.59	0.84	1.00	1.00	

Gaston Levac Municipal Drain

Methodology HY-8 RESULTS
Description E7
Pipe Diameter 900mm Ø; n=0.013
Pipe Length 42m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.27	0.27	29.04	0.42	0.62	0.55	0.25	0.60	0.51	0.55	0.38
5 year	0.44	0.44	29.23	0.57	0.81	0.81	0.33	0.74	0.65	0.76	0.43
10 year	0.56	0.56	29.57	0.67	1.15	0.81	0.39	0.81	0.72	0.93	0.46
25 year	0.74	0.74	29.93	0.82	1.51	0.81	0.45	0.81	0.82	1.23	0.50
50 year	0.87	0.87	30.22	0.94	1.80	0.81	0.50	0.81	0.88	1.45	0.52
100 year	1.00	1.00	30.52	1.08	2.10	0.81	0.54	0.81	0.93	1.67	0.53

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.58

HW Elev= 29.57

HW = 0.99 m

D = 0.9 m

HW/D = 1.10 **Pass**

100-Year Check

HW Elev = 30.52 m

Dwy CL Elev = 30.76 m

Freeboard= 0.24 m

Gaston Levac Municipal Drain

Methodology	VISUAL OTTHYMO	
Unit Hydrograph	NASHYD	
Description	C8	
Location	Lot 21, Con 8 - Prop ID 23	
Use	Agricultural & Residential	
Design Storm	10-Year	HW/D < 1.5
Check Storm	100-Year	

Watershed Area A= 39.48 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	38.916	82.23
Impervious	98.00	0.560	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	38.916	0.36
Impervious	0.90	0.560	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.90
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1094	0.07	0.12	151

Total Tc (min)	Total Tp (hr)
253	2.82

Intensity

Return Period	Intensity (mm/hr)
2-Year	7.2
5-Year	9.7
10-Year	11.2
25-Year	13.2
50-Year	14.7
100-Year	16.2

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.28	0.21	0.27	0.28
5-Year	0.38	0.36	0.45	0.45
10-Year	0.44	0.48	0.59	0.59
25-Year	0.52	0.63	0.76	0.76
50-Year	0.58	0.75	0.90	0.90
100-Year	0.63	0.87	1.03	1.03

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description C8
Pipe Diameter 900mm Ø HDPE
Pipe Length 15m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.28	0.28	28.94	0.42	0.59	0.44	0.26	0.59	0.52	0.58	0.39
5 year	0.45	0.45	29.11	0.58	0.76	0.59	0.34	0.72	0.65	0.79	0.44
10 year	0.59	0.59	29.25	0.69	0.90	0.75	0.40	0.81	0.74	0.98	0.47
25 year	0.76	0.76	29.54	0.84	1.19	0.81	0.46	0.81	0.83	1.27	0.50
50 year	0.90	0.90	29.73	0.97	1.38	0.81	0.51	0.81	0.89	1.50	0.52
100 year	1.03	1.03	29.92	1.11	1.57	0.81	0.55	0.81	0.95	1.72	0.54

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.26

HW Elev= 29.25

HW = 0.99 m

D = 0.9 m

HW/D = 1.10 **Pass**

100-Year Check

HW Elev = 29.92 m

Dwy CL Elev = 30.47 m

Freeboard= 0.55 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description C9
Location Lot 22, Con 8 - Prop ID 22
Use Agricultural
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 50.23 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	49.543	82.22
Impervious	98.00	0.692	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	49.543	0.36
Impervious	0.90	0.692	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.93
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1360	0.07	0.12	187

Total Tc (min)	Total Tp (hr)
290	3.23

Intensity

Return Period	Intensity (mm/hr)
2-Year	6.6
5-Year	8.8
10-Year	10.2
25-Year	12.0
50-Year	13.4
100-Year	14.7

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.33	0.24	0.30	0.33
5-Year	0.44	0.42	0.52	0.52
10-Year	0.51	0.55	0.67	0.67
25-Year	0.60	0.72	0.87	0.87
50-Year	0.67	0.86	1.02	1.02
100-Year	0.73	1.00	1.18	1.18

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description C9
Pipe Diameter 1050mm Ø HDPE
Pipe Length 19.8m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.33	0.33	28.79	0.43	0.63	0.51	0.26	0.62	0.56	0.56	0.40
5 year	0.52	0.52	28.96	0.58	0.79	0.67	0.34	0.75	0.70	0.73	0.45
10 year	0.67	0.67	29.08	0.68	0.91	0.81	0.40	0.84	0.78	0.87	0.48
25 year	0.87	0.87	29.29	0.81	1.12	0.95	0.46	0.95	0.88	1.07	0.52
50 year	1.02	1.02	29.47	0.91	1.31	0.95	0.51	0.95	0.94	1.25	0.54
100 year	1.18	1.18	29.65	1.02	1.49	0.95	0.55	0.95	1.01	1.45	0.56

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 28.06

HW Elev= 29.08

HW = 1.02 m

D = 1.05 m

HW/D = 0.97 **Pass**

100-Year Check

HW Elev = 29.65 m

Dwy CL Elev = 30.24 m

Freeboard= 0.59 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description R10
Location Concession Road 8
Use Local Road
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 58.88 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	58.111	82.21
Impervious	98.00	0.773	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	58.111	0.36
Impervious	0.90	0.773	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.96
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1435	0.07	0.12	198

Total Tc (min)	Total Tp (hr)
300	3.35

Intensity

Return Period	Intensity (mm/hr)
2-Year	6.4
5-Year	8.6
10-Year	10.0
25-Year	11.8
50-Year	13.0
100-Year	14.3

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.38	0.27	0.35	0.38
5-Year	0.50	0.47	0.59	0.59
10-Year	0.58	0.62	0.76	0.76
25-Year	0.69	0.82	0.99	0.99
50-Year	0.76	0.98	1.17	1.17
100-Year	0.84	1.13	1.34	1.34

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description R10
Pipe Diameter 1200mm Ø HDPE
Pipe Length 21m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.38	0.38	28.77	0.43	0.66	0.46	0.27	0.69	0.60	0.50	0.42
5 year	0.59	0.59	28.93	0.58	0.82	0.60	0.35	0.83	0.74	0.66	0.47
10 year	0.76	0.76	29.05	0.68	0.94	0.69	0.40	0.92	0.83	0.78	0.50
25 year	0.99	0.99	29.19	0.81	1.08	0.83	0.47	1.02	0.93	0.95	0.53
50 year	1.17	1.17	29.34	0.90	1.23	0.95	0.52	1.08	1.00	1.10	0.56
100 year	1.34	1.34	29.53	0.99	1.42	1.08	0.56	1.08	1.06	1.26	0.57

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 27.99

HW Elev= 29.05

HW = 1.06 m

D = 0.9 m

HW/D = 1.17 **Pass**

100-Year Check

HW Elev = 29.53 m

Road CL Elev = 30.81 m

Freeboard= 1.28 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description C11
Location Lot 22, Con 8 - Prop ID 21
Use Residential
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 59.82 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	59.030	82.21
Impervious	98.00	0.789	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	59.030	0.36
Impervious	0.90	0.789	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	54.96
Ia =	8.24

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1539	0.07	0.12	212

Total Tc (min)	Total Tp (hr)
314	3.51

Intensity

Return Period	Intensity (mm/hr)
2-Year	6.2
5-Year	8.3
10-Year	9.6
25-Year	11.4
50-Year	12.6
100-Year	13.9

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.37	0.27	0.34	0.37
5-Year	0.49	0.47	0.58	0.58
10-Year	0.57	0.61	0.75	0.75
25-Year	0.68	0.81	0.97	0.97
50-Year	0.75	0.95	1.14	1.14
100-Year	0.83	1.11	1.31	1.31

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description C11
Pipe Diameter 1050mm Ø HDPE
Pipe Length 16.5m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.37	0.37	28.69	0.46	0.66	0.51	0.28	0.65	0.60	0.60	0.42
5 year	0.58	0.58	28.87	0.62	0.83	0.68	0.37	0.79	0.73	0.79	0.47
10 year	0.75	0.75	29.00	0.73	0.96	0.83	0.43	0.88	0.82	0.94	0.50
25 year	0.97	0.97	29.26	0.88	1.23	0.95	0.49	0.95	0.92	1.19	0.53
50 year	1.14	1.14	29.43	0.99	1.40	0.95	0.54	0.95	0.99	1.40	0.55
100 year	1.31	1.31	29.61	1.12	1.58	0.95	0.59	0.95	1.05	1.60	0.57

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 27.93

HW Elev= 29.00

HW = 1.07 m

D = 1.05 m

HW/D = 1.02 **Pass**

100-Year Check

HW Elev = 29.61 m

Dwy CL Elev = 30.30 m

Freeboard= 0.69 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description R12
Location Concession Road 8
Use Local Road
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 73.91 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	72.747	82.25
Impervious	98.00	1.163	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	72.747	0.36
Impervious	0.90	1.163	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	la = 0.15S
S =	54.81
la =	8.22

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	102

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1634	0.07	0.12	225

Total Tc (min)	Total Tp (hr)
327	3.65

Intensity

Return Period	Intensity (mm/hr)
2-Year	6.0
5-Year	8.1
10-Year	9.4
25-Year	11.1
50-Year	12.3
100-Year	13.5

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.45	0.32	0.41	0.45
5-Year	0.59	0.56	0.69	0.69
10-Year	0.69	0.73	0.89	0.89
25-Year	0.81	0.97	1.17	1.17
50-Year	0.91	1.15	1.37	1.37
100-Year	1.00	1.33	1.58	1.58

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description R12
Pipe Diameter 1200mm Ø HDPE
Pipe Length 21m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.45	0.45	28.68	0.48	0.72	0.65	0.30	0.69	0.65	0.60	0.44
5 year	0.69	0.69	28.86	0.64	0.90	0.85	0.38	0.83	0.79	0.77	0.49
10 year	0.89	0.89	28.98	0.75	1.02	1.08	0.44	0.93	0.89	0.90	0.52
25 year	1.17	1.17	29.17	0.90	1.21	1.08	0.52	1.04	1.00	1.11	0.56
50 year	1.37	1.37	29.41	1.01	1.45	1.08	0.57	1.08	1.07	1.28	0.58
100 year	1.58	1.58	29.58	1.13	1.62	1.08	0.62	1.08	1.14	1.48	0.60

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 27.84

HW Elev= 28.98

HW = 1.14 m

D = 1.2 m

HW/D = 0.95 **Pass**

100-Year Check

HW Elev = 29.58 m

Road CL Elev = 30.91 m

Freeboard= 1.33 m

Gaston Levac Municipal Drain

Methodology VISUAL OTTHYMO
Unit Hydrograph NASHYD
Description C13
Location Lot 23, Con 7 - Prop ID 5
Use Agricultural
Design Storm 10-Year HW/D < 1.5
Check Storm 100-Year

Watershed Area A= 77.17 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	74.585	82.54
Impervious	98.00	2.582	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	74.585	0.37
Impervious	0.90	2.582	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80 < 90	Ia = 0.15S
S =	53.75
Ia =	8.06

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	101

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1742	0.07	0.12	240

Total Tc (min)	Total Tp (hr)
341	3.81

Intensity

Return Period	Intensity (mm/hr)
2-Year	5.9
5-Year	7.8
10-Year	9.1
25-Year	10.7
50-Year	11.9
100-Year	13.1

Peak Flow

Return Period	Results (m ³ /s)			
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	0.46	0.33	0.42	0.46
5-Year	0.62	0.57	0.71	0.71
10-Year	0.72	0.75	0.91	0.91
25-Year	0.85	0.99	1.19	1.19
50-Year	0.94	1.17	1.40	1.40
100-Year	1.04	1.36	1.61	1.61

Design Storm

Check Storm

Gaston Levac Municipal Drain

Methodology HY-8 RESULTS
Description C13
Pipe Diameter 1200mm Ø HDPE
Pipe Length 12m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	0.46	0.46	28.61	0.49	0.72	0.56	0.30	0.70	0.66	0.61	0.44
5 year	0.71	0.71	28.78	0.65	0.89	0.72	0.39	0.84	0.80	0.78	0.49
10 year	0.91	0.91	28.91	0.76	1.02	0.85	0.45	0.94	0.90	0.92	0.52
25 year	1.19	1.19	29.07	0.91	1.18	1.08	0.52	1.05	1.01	1.12	0.56
50 year	1.40	1.40	29.27	1.03	1.38	1.08	0.58	1.08	1.08	1.31	0.58
100 year	1.61	1.61	29.42	1.15	1.53	1.08	0.62	1.08	1.15	1.51	0.60

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 27.77

HW Elev= 28.91

HW = 1.14 m

D = 1.2 m

HW/D = 0.95 **Pass**

100-Year Check

HW Elev = 29.42 m

Dwy CL Elev = 29.64 m

Freeboard= 0.22 m

Gaston Levac Municipal Drain

Methodology
Unit Hydrograph
Description
Location
Use
Design Storm
Check Storm

VISUAL OTTHYMO
NASHYD
R14
Caledonia Road
Local Road
10-Year HW/D < 1.5
100-Year

Watershed Area A= 340.46 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	82.00	337.273	82.15
Impervious	98.00	3.187	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.35	337.273	0.36
Impervious	0.90	3.187	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	55.19
Ia =	8.28

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
390	0.10	103

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
2134	0.07	0.12	294
404	0.34	0.27	25
206	0.25	0.23	15
587	0.17	0.19	52

Total Tc (min)	Total Tp (hr)
489	5.46

Peak Flow

Return Period	Results (m ³ /s)		
	12-Hour SCS Type II	24-Hour SCS Type II	Max
2-Year	1.11	1.36	1.36
5-Year	1.93	2.30	2.30
10-Year	2.52	2.97	2.97
25-Year	3.32	3.87	3.87
50-Year	3.93	4.54	4.54
100-Year	4.56	5.23	5.23

Design Storm

Check Storm

Methodology HY-8 RESULTS
Description R14
Pipe Diameter 1800mm Ø CSP
Pipe Length 27m
Design Storm 10-Year
Check Storm 100-Year

Storm Event	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth(m)	Outlet Control Depth(m)	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	1.36	1.36	27.95	0.77	1.17	1.62	0.47	1.09	1.07	0.77	0.58
5 year	2.30	2.30	28.30	1.09	1.52	1.62	0.64	1.36	1.34	1.06	0.66
10 year	2.97	2.97	28.54	1.28	1.76	1.62	0.74	1.51	1.49	1.27	0.70
25 year	3.87	3.87	28.96	1.55	2.18	1.62	0.87	1.62	1.67	1.61	0.75
50 year	4.54	4.54	29.26	1.76	2.48	1.62	0.95	1.62	1.78	1.89	0.78
100 year	5.23	5.23	29.58	1.99	2.80	1.62	1.03	1.62	1.89	2.18	0.81

10-Year Check

Design Criteria HW/D < 1.5

Culvert Invert= 26.60

HW Elev= 28.54

HW = 1.94 m

D = 1.80 m

HW/D = 1.08 **Pass**

100-Year Check

HW Elev = 29.58 m

Road CL Elev = 30.41 m

Freeboard= 0.83 m

Active coordinate

45° 25' 45" N, 74° 51' 44" W (45.429167,-74.862500)

Retrieved: Fri, 31 Jul 2026 14:06:44 GMT



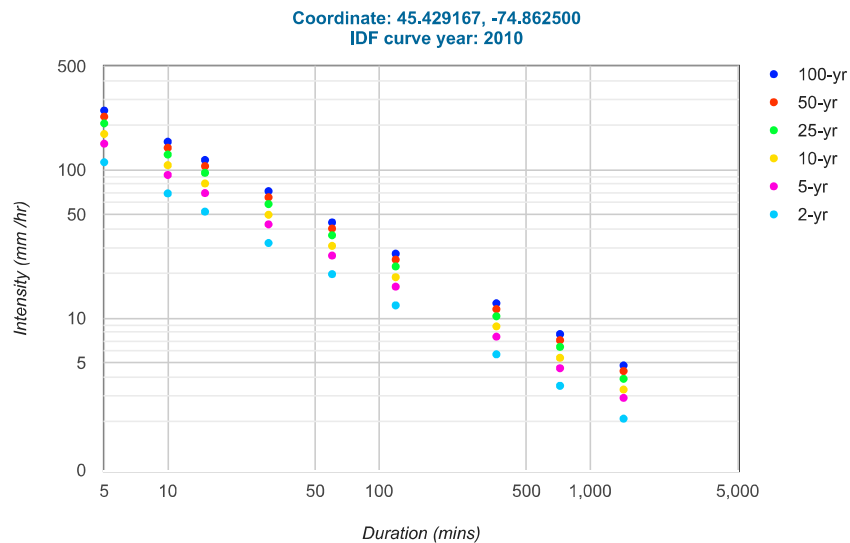
Location summary

These are the locations in the selection.

IDF Curve: 45° 25' 45" N, 74° 51' 44" W (45.429167,-74.862500)

Results

An IDF curve was found.



Coefficient summary

IDF Curve: 45° 25' 45" N, 74° 51' 44" W (45.429167,-74.862500)

Retrieved: Fri, 31 Jul 2026 14:06:44 GMT

Data year: 2010

IDF curve year: 2010

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	19.8	26.4	30.7	36.2	40.2	44.2
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Statistics

Rainfall intensity (mm hr⁻¹)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	112.5	69.3	52.2	32.1	19.8	12.2	5.7	3.5	2.1
5-yr	150.0	92.4	69.6	42.9	26.4	16.3	7.5	4.6	2.9
10-yr	174.4	107.4	80.9	49.8	30.7	18.9	8.8	5.4	3.3
25-yr	205.6	126.7	95.4	58.8	36.2	22.3	10.3	6.4	3.9
50-yr	228.3	140.7	105.9	65.3	40.2	24.8	11.5	7.1	4.4
100-yr	251.1	154.6	116.5	71.8	44.2	27.2	12.6	7.8	4.8

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	9.4	11.5	13.0	16.1	19.8	24.4	34.0	41.8	51.5
5-yr	12.5	15.4	17.4	21.4	26.4	32.5	45.3	55.8	68.7
10-yr	14.5	17.9	20.2	24.9	30.7	37.8	52.6	64.9	79.9
25-yr	17.1	21.1	23.9	29.4	36.2	44.6	62.1	76.5	94.2
50-yr	19.0	23.4	26.5	32.6	40.2	49.5	68.9	84.9	104.6
100-yr	20.9	25.8	29.1	35.9	44.2	54.5	75.8	93.4	115.0

Terms of Use

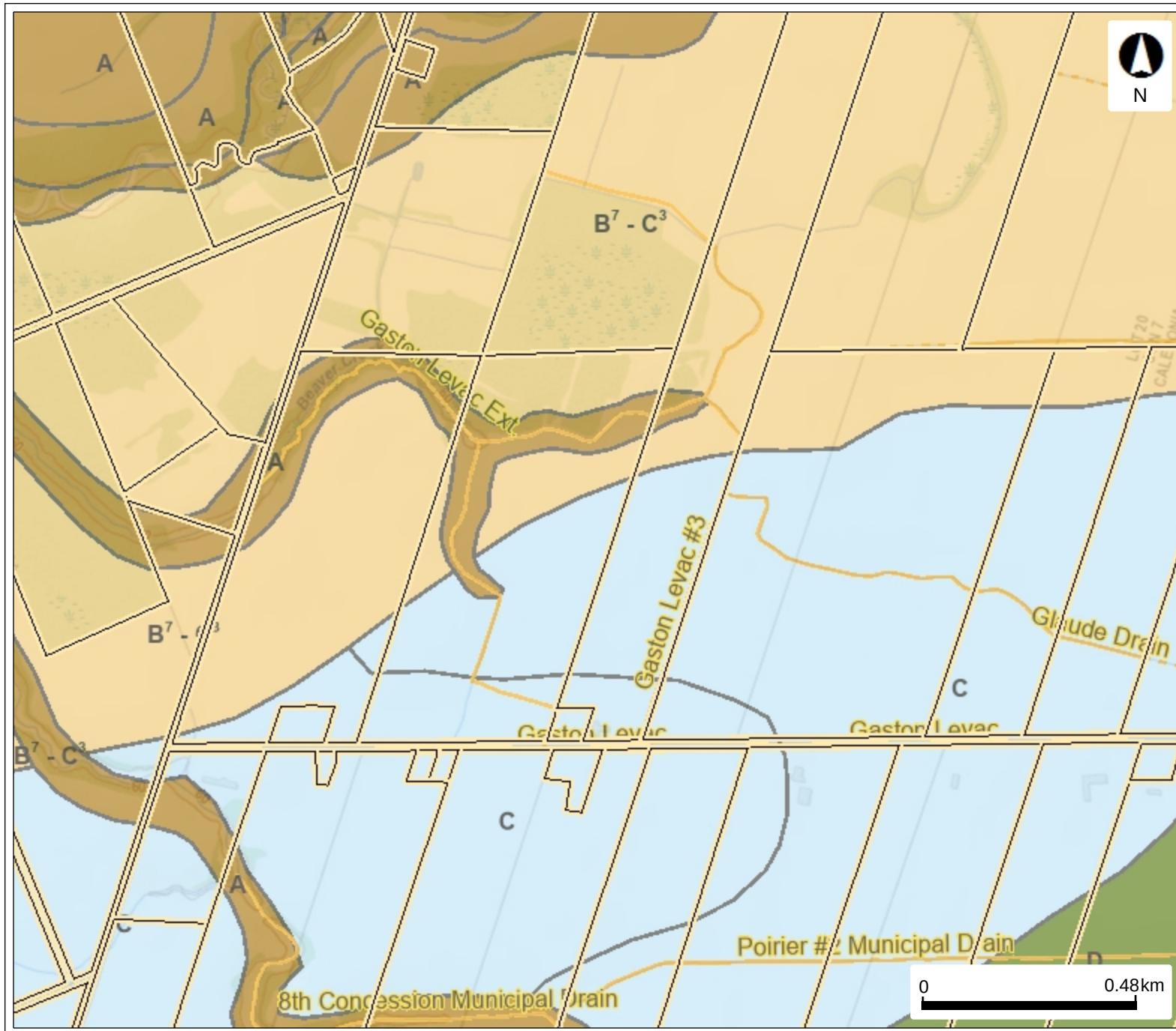
You agree to the [Terms of Use](#) of this site by reviewing, using, or interpreting these data.

[Ontario Ministry of Transportation](#) | [Terms and Conditions](#) | [Map About](#)

As outlined in the [OPS Accessible Customer Service Policy](#) , we are committed to providing accessible customer service. On request, we can arrange for accessible formats and communications supports. [Please contact us](#) .

[Results Exit](#) Last Modified: May 2026

Gaston Levac_Soils



Legend

Assessment Parcel

Constructed Drains

Open or Unknown

Closed/Tiled

Hydrologic Soil Group

A - High

B - Moderate

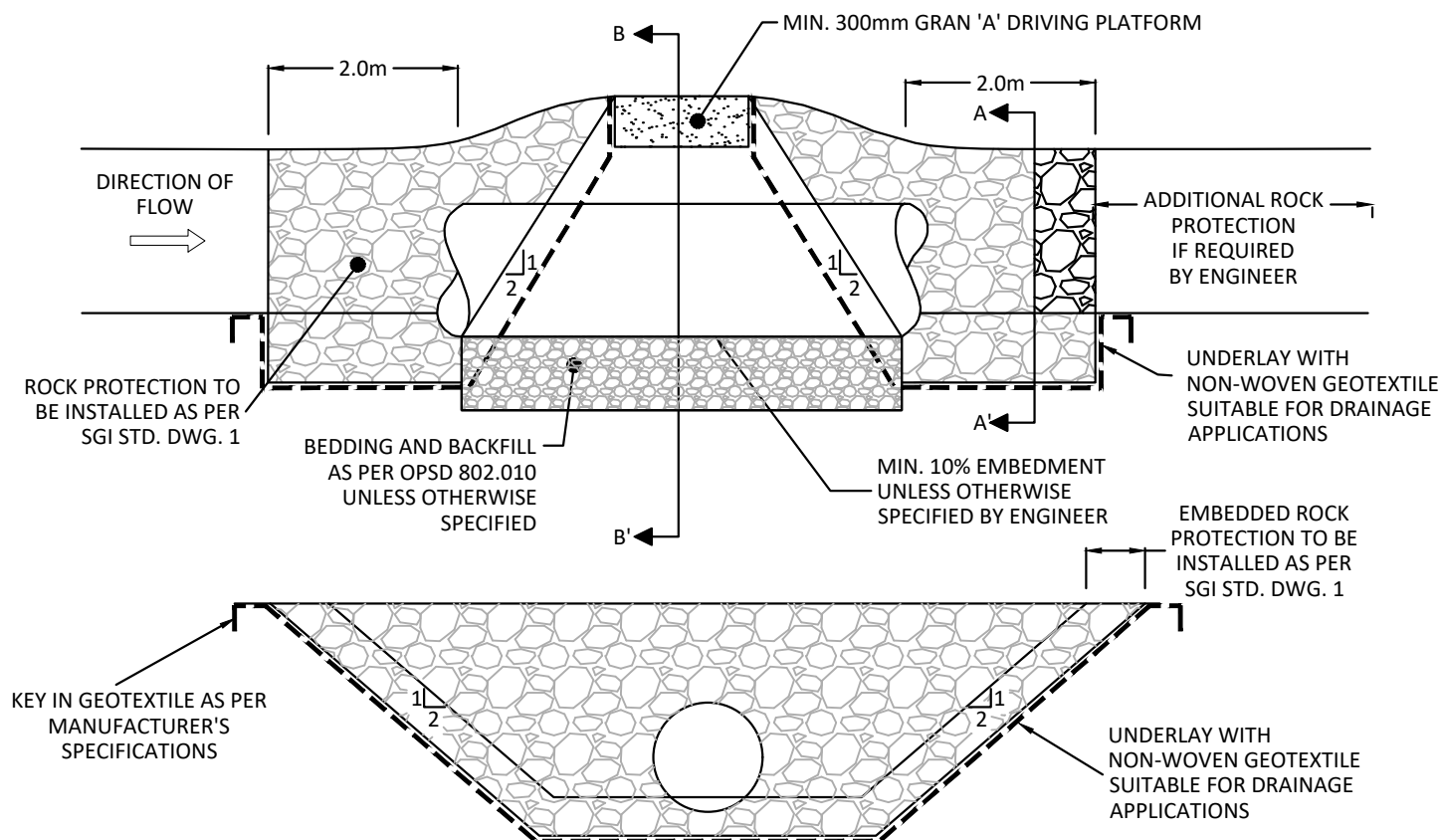
C - Slow

D - Very Slow

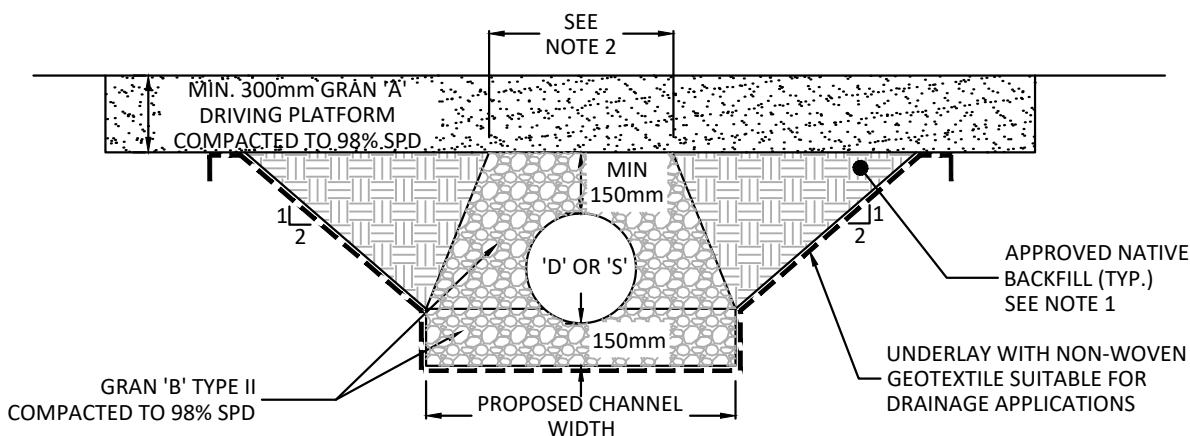
This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Agriculture, Food and Agribusiness (OMAFRA) shall not be liable in any way for the use or any information on this map, of, or reliance upon, this map.

APPENDIX D

STANDARD DRAWING



SECTION A-A'



SECTION B-B'

NOTES:

1. APPROVED NATIVE BACKFILL MATERIAL MAY CONSIST OF DRY CLAY, SAND OR GRANULAR MATERIAL WITH NO LARGE STONES, BOULDERS, DEBRIS OR ORGANIC MATERIAL. BACKFILL MUST BE PLACED IN LIFTS NOT EXCEEDING 300mm IN THICKNESS AND COMPACTED. ALL REQUIREMENTS FOR GRANULAR BEDDING, COVER AND SURFACE COURSE MUST BE MET PRIOR TO PLACING ANY BACKFILL.
2. FOR CIRCULAR CULVERTS, THE TOP-WIDTH OF COVER MATERIAL SHALL BE A MINIMUM OF THE DIAMETER OF THE PIPE ('D') PLUS 0.5 X 'D' EACH WAY FOR A TOTAL OF 2.0 X 'D'. FOR ARCH CULVERTS, THE TOP-WIDTH OF COVER MATERIAL SHALL BE A MINIMUM OF THE SPAN OF THE PIPE ('S') PLUS 0.75 X 'S' EACH WAY FOR A TOTAL OF 2.5 X 'S'. THE MINIMUM BOTTOM WIDTH SHALL CONFORM WITH THE PROPOSED CHANNEL WIDTH UPSTREAM/DOWNSTREAM OF THE CULVERT.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR ALL PIPES.

PETITION DRAIN STANDARD DRAWING

CULVERT INLET/END
PROTECTION

DETAIL DWG.NO.
SGI STD. DWG. 4

REVISION
00

DATE
FEB/24

**SHADE
GROUP**
INC.

SCALE
N.T.S

APPENDIX E

CONSTRUCTION COST ESTIMATE

Project Cost Estimate
Gaston Levac Municipal Drain - Estimated Construction Cost

Construction Estimate				
Item	Unit	Quantity	Cost/Unit	Total
Remove and Replace Crossing C1 Remove existing pipe + dispose, Install 525mm Ø HDPE x 12m, Install applicable end treatment, Reinstatement of gravel crossing	m	12.0	\$ 415.00	\$ 4,980.00
Remove and Replace Enclosure E2 Remove existing pipe + dispose, Install 600mm Ø smoothwall plastic pipe x 24m, Install applicable end treatment. Reinstatement of gravel entrance Reinstatement of front lawn (topsoil/seed)	m	24.0	\$ 500.00	\$ 12,000.00
Remove and Replace Crossing C3 Remove existing pipe + dispose, Install 750mm Ø HDPE x 15m, Install applicable end treatment, Reinstatement of gravel crossing	m	15.0	\$ 615.00	\$ 9,225.00
Remove and Replace Enclosure E4 Remove existing pipes + dispose, Install 750mm Ø smoothwall plastic pipe x 51m w. mid-point tee with open grate at surface (750mmx750mmx450mm), Install applicable end treatment, Reinstate of gravel entrances, backfill open ditch between previous two separate entrances; Reinstate front lawn (topsoil/seed)	m	51.0	\$ 700.00	\$ 35,700.00
Remove and Replace Crossing C5 Remove existing pipe + dispose, Install 750mm Ø HDPE x 15m, Install applicable end treatment, Reinstatement of gravel crossing	m	15.0	\$ 615.00	\$ 9,225.00
Remove and Replace Enclosure E6 Remove existing pipe + dispose, Install 900mm Ø smoothwall plastic pipe x 30m. Install applicable end treatment, Reinstate of gravel entrance; Reinstate front lawn (topsoil/seed)	m	30.0	\$ 740.00	\$ 22,200.00
Remove and Replace Enclosure E7 Remove existing pipes + dispose, Install 900mm Ø smoothwall plastic pipe x 42m w. mid-point tee with open grate at surface (900mmx900mmx450mm), Install applicable end treatment, Reinstate of gravel entrances, backfill open ditch between previous two separate entrances; Reinstate front lawn (topsoil/seed)	m	42.0	\$ 900.00	\$ 37,800.00

Project Cost Estimate
Gaston Levac Municipal Drain - Estimated Construction Cost

Remove and Replace Crossing C8 Remove existing pipe + dispose, Install 900mm Ø HDPE x 15m, Install applicable end treatment, Reinstatement of gravel crossing	m	15.0	\$ 800.00	\$ 12,000.00
Remove and Replace Crossing C9 Remove existing pipe + dispose, Install 1050mm Ø HDPE x 19.8m, Install applicable end treatment, Reinstatement of gravel crossing	m	19.8	\$ 780.00	\$ 15,444.00
Remove and Replace Crossing C11 Remove existing pipe + dispose, Install 1050mm Ø HDPE x 16.5m, Install applicable end treatment, Reinstatement of gravel crossing	m	16.5	\$ 780.00	\$ 12,870.00
Remove and Replace Crossing C13 Remove existing pipe (upstream) + dispose, Install 1200mm Ø HDPE x 12m at new location, Install applicable end treatment, New gravel crossing	m	12.0	\$ 1,000.00	\$ 12,000.00
Open Channel Maintenance - Main Drain	m	3,300	\$ 10.00	\$ 33,000.00
Open Channel Maintenance - New Outlet	LS	1	\$ 10,000.00	\$ 10,000.00

Sub-Total - Construction Costs			\$	226,444.00
Contingency Allowance - Construction	10%		\$	22,644.40
Sub-Total - Construction Costs (Pre-Tax)			\$	249,088.40

Engineering Estimate				
Item	Unit	Quantity	Cost/Unit	Total
Engineer's Report	Lump Sum	1	\$ 20,950.00	\$ 20,950.00
Sub-Total - Engineering Costs (Pre-Tax)				\$ 20,950.00

Summary	
Sub-Total - Construction Costs (Pre-Tax)	\$ 249,088.40
Sub-Total - Engineering Costs (Pre-Tax)	\$ 20,950.00
Estimated Project Total	\$ 270,038.40

APPENDIX F

BY-LAWS

CORPORATION OF THE NATION MUNICIPALITY

BY-LAW 124-2025

BEING A BY-LAW TO APPOINT SHADE GROUP INC. AS ENGINEER FOR THE GASTON LEVAC MUNICIPAL DRAIN, PURSUANT TO SECTION 78 OF THE DRAINAGE ACT, R.S.O. 1990, c. D.17.

REFERENCE: Section 78 of the *Drainage Act*, R.S.O. 1990, c. D. 17

WHEREAS the governing Engineer's Report for the Gaston Levac Municipal Drain was adopted in 1971, and a subsequent report to improve the eastern portion of the drain was adopted in 1978;

AND WHEREAS The Nation Municipality received a request for drain maintenance from a landowner within the watershed of the Gaston Levac Municipal Drain;

AND WHEREAS during maintenance work, the Drainage Superintendent attempted to restore the drain to its original profile and observed that several culverts were in poor condition;

AND WHEREAS the Drainage Superintendent recommends the appointment of an engineer under Section 78 of the *Drainage Act*, as the drain runs largely along a concession road where culvert replacements and improvements cannot be completed under the same design standards as the original report;

AND WHEREAS Council of The Nation Municipality deems it appropriate and beneficial to update the 1971, and 1978 Engineer's Reports to facilitate proper maintenance and improvements to the Gaston Levac Municipal Drain, pursuant to Section 78 of the *Drainage Act*;

AND WHEREAS the actual cost of preparing the updated Engineer's Report shall be assessed against the lands and roads liable for assessment under the revised report;

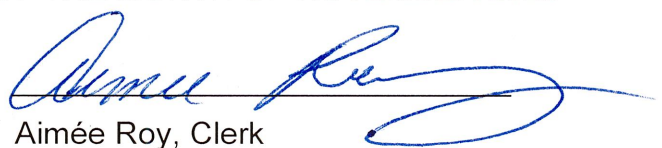
AND WHEREAS notice of the proposed appointment of an engineer was sent to the affected landowners in accordance with subsection 78(2) of the *Drainage Act*;

NOW THEREFORE the Council of The Corporation of The Nation Municipality, hereby enacts as follows:

1. That the engineering firm Shade Group Inc. is hereby appointed to prepare an updated Engineer's Report for the Gaston Levac Municipal Drain, in accordance with the proposal dated October 8, 2025 and pursuant to Section 78 of the *Drainage Act*.
2. That the cost of preparing the revised Engineer's Report shall be assessed against the lands and roads within the watershed of the Gaston Levac Municipal Drain in accordance with the *Drainage Act*.
3. That this by-law shall come into force and take effect upon the date of its passing.

READ A FIRST, SECOND AND DULY PASSED UPON THE THIRD READING IN OPEN COUNCIL THIS 10th DAY OF THE MONTH OF NOVEMBER 2025


Francis Brière, Mayor


Aimée Roy, Clerk