LIONEL LEVAC MUNICIPAL DRAIN
DESCHAMPS MUNICIPAL DRAIN

S. 78(1) ENGINEER'S REPORT

THE NATION MUNICIPALITY

PREPARED BY

SHADE GROUP INC
4625 MARCH ROAD
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PREPARED FOR

THE NATION MUNICIPALITY
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REV 01 – SEPTEMBER 5, 2025

EXECUTIVE SUMMARY

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 Lionel Levac Municipal Drain and the Deschamps 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 and by-laws for locations along a public road. Many of the previously installed crossings have reached end-of-service-life and require replacement in the near future, and like-for-like replacement is not possible.

The Lionel Levac Municipal Drain is comprised of two sections – the 'East Section' and the 'West Section'; while the Deschamps Municipal Drain also has a 'East Section' and 'West Section'. The 'East Section' of the Deschamps Municipal Drain has not been addressed in this report. The Lionel Levac Municipal Drain 'West Section' runs west and northerly – reaching sufficient outlet approximately 2,681m from its point of commencement; the Lionel Levac 'East Section' outlets to the Cadieux Drain; while the Deschamps Municipal Drain 'West Section' outlets to the Lionel Levac 'West Section'.

Shade Group Inc. was appointed as the engineer under By-law No. 83-2025 on June 30, 2025, to undertake a Section 78 improvement to the Lionel Levac Municipal Drain and the Deschamps Municipal Drain.

All maintenance works are to be performed in accordance with the governing specifications:

- Drain cross-section, alignment, profile, etc. – 1975 or 1982 Engineer's Report
- Crossing replacements – 2025 Engineer's Report

Enclosed within the Appendices of this report you will find: a location plan showing the location of the watershed and drain (**Appendix A**), a map of the watershed (**Appendix B**), updated assessment schedules for the distribution of costs associated with current and future maintenance of each respective section of drain (**Appendix C**), hydrologic/hydraulic analysis calculations supporting the design of the crossings/enclosures (**Appendix D**), Standard Drawing to be referenced for the construction works (**Appendix E**), construction cost estimates for each section (**Appendix F**), a brief letter reviewing Species at Risk impacts (**Appendix G**) and the applicable project by-laws (**Appendix H**).

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REVISIONS, SUBMISSIONS + KEY DATES

Revision #	Comments	Date
-	Adoption of By-law to Appoint Engineer	June 23, 2025
-	On-Site Meeting – Caledonia Community Centre	July 2, 2025
00	Draft Submitted to Municipality	August 26, 2025
01	Formal Submission to Township	September 5, 2025
-	Meeting to Consider	

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 Lionel Levac Municipal Drain and the Deschamps 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 and by-laws for locations along a public road. Many of the previously 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 Lionel Levac Municipal Drain and the Deschamps Municipal Drain. Multiple documents were provided, including:

- 1970 Engineer's Report – By-Law 7 – Lionel Levac
    - This report appears to be for the original construction of the Lionel Levac Municipal Drain – dated January 26, 1970, authored by Gaetan E. Seguin and Associates Ltd.
    - This report describes the Lionel Levac Drain as serving Lots 17-19 inclusively in Concession 7 and part of Lots 15-19, Concession 8, Geographic Township of Caledonia.
- 1975 Engineer's Report – By-Law 8 – Deschamps Municipal Drain and Lionel Levac Municipal Drain
    - This report refers to both the Lionel Levac Municipal Drain and the Deschamps Municipal Drain – which outlets to the Lionel Levac Municipal Drain.
    - The Lionel Levac Municipal Drain is described as draining in both a westerly and easterly direction ("west section" and "east section").
    - The Lionel Levac Municipal Drain is described as serving Lots 15 to 19 in Concession 7 and 8, Geographic Township of Caledonia.
    - The Deschamps Municipal Drain is described as serving Lots 14 to 18, Concession 7, Geographic Township of Caledonia. The Deschamps Municipal Drain is understood to have been newly proposed under this Engineer's Report.
    - This report was also authored by Gaetan E. Sequin and Associates Ltd.
- 1982 Engineer's Report – By-Law 15 – Lionel Levac Municipal Drain
    - The 1982 Engineer's Report was an improvement to the Lionel Levac Municipal Drain, deepening the entire system, undertaking improvements to the side slopes

– reducing the side slopes to 2:1 from their previous 1.5:1 and specifying permanent erosion control measures (rip-rap) as required.

- This report was authored by Andre E. Desjardins Engineering Limited.
- This report references only the "west" section of the Lionel Levac Municipal Drain and refers to the drain as having a total length of 2,681m.

For the purposes of this report, the 1982 Engineer's Report has been assumed to be the governing report for the "west" section of the municipal drain. The 1975 report is assumed to be the governing report for the "east" section of the Lionel Levac Municipal Drain and the "west" section of the Deschamps Municipal Drain. This report does not cover the "east" section of the Deschamps Municipal Drain.

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 DRAINAGE ACT, 1990, PROCESS

3.1 TO DATE

Shade Group Inc. was appointed as the engineer under By-law No. 83-2025 on June 30, 2025, to undertake a Section 78 improvement to the Lionel Levac Municipal Drain and the Deschamps Municipal Drain.

Invitations to the on-site meeting were mailed to landowners within the watershed inviting them to attend a roadside meeting on July 2, 2025. Shade Group and the Drainage Superintendent held the roadside meeting with those in attendance, outlining the project intentions and discussing 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 requirements. Following the formal meeting, Shade Group and the Township's Drainage Superintendent met with various landowners at their respective properties to review the site conditions and discuss concerns and construction considerations, including the requirement for the removal of a number of mature trees that were planted overtop of enclosures. Shade Group also observed site constraints, such as driveways located right on the edge of the top of slope, which would mean that shortening the enclosure length to accommodate the side slope/end treatment improvements would not be possible.

Prior to the on-site meeting the Township's Drainage Superintendent had already undertaken a pre-consultation meeting with the landowners to discuss the options for undertaking works associated with the project, and as such, the landowners were already aware of the project prior

to the invitation to the on-site meeting. Approximately 7 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. Concerns were raised regarding the proximity of the edge of some driveways to the drain – with requests made not to reduce the length of enclosures in these areas as it would impact the laneway. Similarly, concerns were raised with the proximity of the drain to the houses – and requests were made not to shorten enclosures in these areas as it would put the open channel closer to the house.

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. The drain was quite overgrown so not all inverts and/or obverts could be collected, but sufficient data was collected for the analysis. 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.

3.2 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 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.

3.3 RESOLUTION AND BY-LAW

Appendix H 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.

3.4 LIMITATIONS

The process overview described in Section 3.2 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.

4.0 DESCRIPTION OF THE WATERSHED + ALIGNMENT OF DRAIN

The following has been taken from the 1982 Engineer's Report for the Lionel Levac Municipal Drain and refers to the "west" section of the drain:

"The Lionel Levac Drain starts 42 meters east of the dividing line between Lots 15 and 16 in Concession 8, and runs in a westerly direction along the south side of the Concession Road between concessions 7 and 8, across part of Lot 15 and Lots, 16, 17 and 18, and part of Lot 19, where the drain turns and crosses the aforementioned Concession Road. From the Concession Road the drain runs in a northerly direction along the dividing line between lots 18 and 19, in Concession 7, for a distance of 1,204 meters, where sufficient outlet is obtained.

The Lionel Levac Drain is 2,681 metres in length and it drains approximately 156 hectares. "

The following summary has been taken from the 1975 Engineer's Report regarding the Lionel Levac Municipal Drain "east" section and Deschamps Municipal Drain:

"*The east section runs in an easterly direction along the south side of the Concession Road between concessions 7 and 8 across part of Lot 15 until it reaches the Cadieux Drain which is a suitable outlet"*

"The Deschamps municipal drain will serve part of Lots 14 to 18 in Concession 7 of the Township of Caledonia. The Deschamps Drain starts 324 feet east of the dividing line between lots 15 and 16 in Concession 7. The west section runs in a westerly direction along the north side of the

Concession Road between concessions 7 and 8 across part of lot 15, across lots 16, 17 and 18 until it reaches the Lionel Levac drain."

The Lionel Levac Municipal Drain and Deschamps Municipal Drain watershed is comprised almost entirely of active agricultural lands, some with residential houses and/or additional buildings, some without.

5.0 CROSSINGS

5.1 WATERSHED REVIEW

Shade Group conducted a high-level field review of the watershed on July 2, 2025 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 as outlined in the 1975/1982 governing reports, was determined to be generally accurate, as verified against available topographic information from the province (LiDAR) and further verified by the aforementioned site visit.

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

5.2 HISTORICAL PERFORMANCE

No concerns pertaining to historical flooding have been brought forth by landowners, municipal staff, or other applicable stakeholders for the Lionel Levac or Deschamps Municipal Drain. Shade Group staff conducted a hydrologic/hydraulic analysis of the culverts based on current design standards and have prepared recommendations for the proposed replacement diameters in Section 5.3 of this report. Details pertaining to the hydrologic/hydraulic analysis are enclosed in **Appendix D**.

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.

5.3 CROSSING SIZING

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

Table 1: 2025 Crossing Summary – Lionel Levac Municipal Drain

Culvert ID #	Crossing Use	Proposed Material	Proposed Length (m)*	Min. Proposed Diameter (mm)
West Section				
C1	Farm Crossing	HDPE	18.3	1200
C2	Local Road Crossing		18.3	1200
E3	Enclosure – Residential + Road Crossing		54.9	1200
E4	Enclosure - Residential		33.0	1050
E5	Enclosure – Residential + Agricultural		82.5	1050
C6	Access Culvert - Agricultural		19.8	1050
E7	Enclosure – Residential+ Agricultural		33.5	900
E8	Enclosure – Residential + Agricultural		39.6	750
C9	Access Culvert - Agricultural		18.3	750
C10	Access Culvert – Agricultural		15.2	600
East Section				
E11	Enclosure – Residential	HDPE	33.5	600
C12**	Access Culvert – Agricultural		15.2	600

*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.

**Along the east section of the Lionel Levac Municipal Drain there are currently two access culverts serving the east half of Lot 15, Concession 8, within relatively close proximity to one another. Through correspondence with the landowner, it was accepted that the westerly access culvert would not be replaced once it reaches end-of-life. As such, only the centrally located crossing has been included as part of the drain.

Note that no *new* crossings or enclosures are proposed; all are existing.

Table 2 provides a summary of crossings on the Deschamps Municipal Drain.

Table 2: 2025 Crossing Summary – Deschamps Municipal Drain

Culvert ID #	Crossing Use	Proposed Material	Proposed Length (m)*	Proposed Diameter (mm)
E13	Enclosure – Residential + Agricultural	HDPE	54.9	900
C14	Access Culvert - Agricultural		12.2	900
C15	Access Culvert – Agricultural		12.2	750
C16	Access Culvert – Agricultural		12.2	600
C17	Access Culvert – Agricultural		15.2	600

*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. 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.

Note that no *new* crossings or enclosures are proposed; all are existing.

Where a specified diameter is not readily available, or considerably more costly than installation of a slightly larger diameter standard size, 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*.

5.4 LENGTHS

Proposed lengths for *agricultural* crossings have been calculated using the following minimum standards: Driving platform width of 7m (23ft).

As all residential access points are enclosures, no special standard has been set for access to residential properties. Instead, the enclosures lengths have been verified on a case-by-case basis, taking into consideration proximity of the edge of laneway to the existing drainage channel and proximity to existing dwellings.

5.5 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 is not practical for long enclosures and instead, the enclosures would be installed at the same gradient as the existing channel. 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 E**. Crossings should be installed with a minimum cover of 12" (0.3m) and side slopes shall be no more than 2 (horizonal):1 (vertical).

All culverts shall be HDPE – with 320 kpa for entrances and 210 kpa for front yard ditch fill-ins. Culverts shall be centred on the entrance and in the ditch line.

5.6 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 an existing driveway is asphalt, it shall be at the landowner's expense to reinstate the asphalt. Hauling off and disposing of the existing asphalt overtop of the culvert are to be considered part of the costs associated with the culvert replacement.

5.7 DRAIN CROSS-SECTION AND PROFILE

All other specifications for the Lionel Levac Municipal Drain and the Deschamps 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.

6.0 ASSESSMENTS

Only minor changes were evident in the previously adopted assessment schedule. To ensure that future maintenance work can be assessed in a fair manner, Shade Group completed a minor update to the previously adopted governing reports. For the Lional Levac Municipal Drain – West Section – the 1982 Engineer's Report has been referenced. No separate assessment schedules were provided for the west vs. east. The Lionel Levac – West Section – assessment schedule therefore is simply an update from the 1982 assessment schedule, removing those who would drain only to the east. A separate 'new' assessment schedule has been created for the Lionel Levac – East Section. The split of benefit versus outlet was taken in reference to the splits used in the governing 1975 Engineer's Report (as the 1982 report did not make reference to any changes to the East Section). Finally, the Deschamps Municipal Drain has been updated in reference to the 1975 assessment schedule – including account for a S. 65 update that was completed in 1990. As part of the Deschamps Municipal Drain once again drains to the east (which was not part of the scope of this report) – and as a separate assessment schedule for the east vs. west sections of the Deschamps Municipal Drain were not available – adjustments have been made to assess only those who would be considered upstream of the Deschamps Municipal Drain addressed under this report (i.e. west only).

In general, the relative apportionment of assessed costs is quite similar to the 1975/1982 adopted reports.

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

7.0 FUTURE MAINTENANCE

All maintenance works are to be performed in accordance with the governing specifications of the applicable Engineer's Report. For the drain cross-section, alignment, profile, etc. it is understood that the governing report is the 1975 or 1982 Engineer's Reports as outlined in Section 2.0 of this report. For the crossing replacements on both the Lionel Levac Municipal Drain and the Deschamps Municipal Drain, this report shall be considered as governing.

Maintenance works associated with the cleanout of the existing drain shall be considered works as performed under Section 74 of the Drainage Act.

7.1 CROSSING REPLACEMENTS – TIMING

Removal and replacement of the culverts and enclosures along the Lionel Levac Municipal Drain and Deschamps Municipal Drain are to be carried out on an as-needed basis, only as infrastructure reaches its 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.

8.0 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 Rural Affairs. AgMaps identifies both the Lionel Levac Municipal Drain and Deschamps Municipal Drain as 'Class F' drains. 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 as works are anticipated 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.

SPECIES AT RISK

A desktop review of how the project could impact Species at Risk has been performed by Shade Group's biologist. A copy of the summary has been enclosed in **Appendix G**.

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 E**.

Additional erosion and sediment control measures may be required at the direction of the engineer, municipality, SNCA or DFO, 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.

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.

ENCLOSURE 5 – TEE W. GRATE

Given the considerable length of enclosure E5; and as the existing setup already includes a surface inlet source; it is proposed that E5 be equipped with a tee and grate to allow for maintenance near the midpoint 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.

The tee is to be comprised of a 1050mm start / end – with a 450mm (18 inch) tee to be brought flush to grade and capped with an open grate. It shall be the landowner's responsibility to keep the grate opening clear of grass/leaves.

9.0 ENGINEERING COSTS

The costs associated with the preparation of this report are estimated to be $21,000 (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 C** – Schedules 'A', 'B' and 'C'.

The breakdown of engineering fees to each respective drain section were as follows:

Lionel Levac Municipal Drain – East Section: $1,706.34

Lionel Levac Municipal Drain – West Section: $12,834.62

Deschamps Municipal Drain: $6,459.04

10.0 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 in reference to an Inspection Report as prepared by the Township's Drainage Superintendent for the Lionel Levac Municipal Drain dated 2025-04-15. At the time, many of the culverts were full of sediment and water so a full inspection wasn't possible. Given the majority of the crossings are described as what would be nearing end-of-life; my construction cost estimate has been calculated based on an eventual replacement of all of the crossings. 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 2025 pricing.

The estimated construction cost for Lionel Levac Municipal Drain – West Section is $219,210; the Lionel Levac Municipal Drain – East Section is $28,120, while the estimated construction cost for the Deschamps Municipal Drain is $94,510. All estimates are exclusive of applicable taxes. A breakdown of construction costs for each respective section/drain can be found in **Appendix F**. 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.

A breakdown of real properties, municipal roads and county road apportionment of costs for the Lionel Levac Municipal Drain and Deschamps Municipal Drain are summarized in Tables 3-5.

Table 3: Summary Breakdown of Anticipated Construction Costs – Lionel Levac Municipal Drain – West Section

Owner	Est. Costs ($ - Excl. HST)
Township of The Nation	
- Roads	
○ Outlet	$2,630
○ Benefit	$6,542
Real Property Owners – The Nation	
- Outlet	$60,959
- Benefit	$149,079
Project Subtotal	**$219,210**

Table 4: Summary Breakdown of Anticipated Construction Costs – Lionel Levac Municipal Drain – East Section

Owner	Est. Costs ($ - Excl. HST)
Township of The Nation	
- Roads	
○ Outlet	$1,411
○ Benefit	$5,547
Real Property Owners – The Nation	
- Outlet	$10,394
- Benefit	$10,768
Project Subtotal	**$28,120**

Table 5: Summary Breakdown of Anticipated Construction Costs – Deschamps Municipal Drain

Owner	Est. Costs ($ - Excl. HST)
Township of The Nation	
- Roads	
○ Outlet	$2,412
○ Benefit	$12,739
Real Property Owners – The Nation	
- Outlet	$13,080
- Benefit	$66,279
Project Subtotal	**$94,510**

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.

10.1 ASSESSMENT OF ENCLOSURE 3

Enclosure 3 is - and has historically been - an enclosure that extends along the frontage of civic address 1920 Concession Road 8 (Lot 19, Concession 8). Details of the crossing design were enclosed in the 1975 Engineer's Report. The 1975 Engineer's Report did not however detail the breakdown of how future replacement was to be assessed. It is my recommendation that the costs associated with the replacement of this crossing be borne by the Municipality of the Nation as per Section 26 of the Drainage Act. It is noted that a catch basin and additional pipe network has been installed along the west side of Rejean Levac Sideroad which is understood to tie into Enclosure 3. This additional tie-in is considered a lateral connection and would not be considered part of the drain and instead part of municipal infrastructure maintained by the Municipality of the Nation.

11.0 ADIP GRANT

Properties that are registered with the Ontario Ministry of Agriculture, Food and Agribusiness (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.

12.0 CLOSING

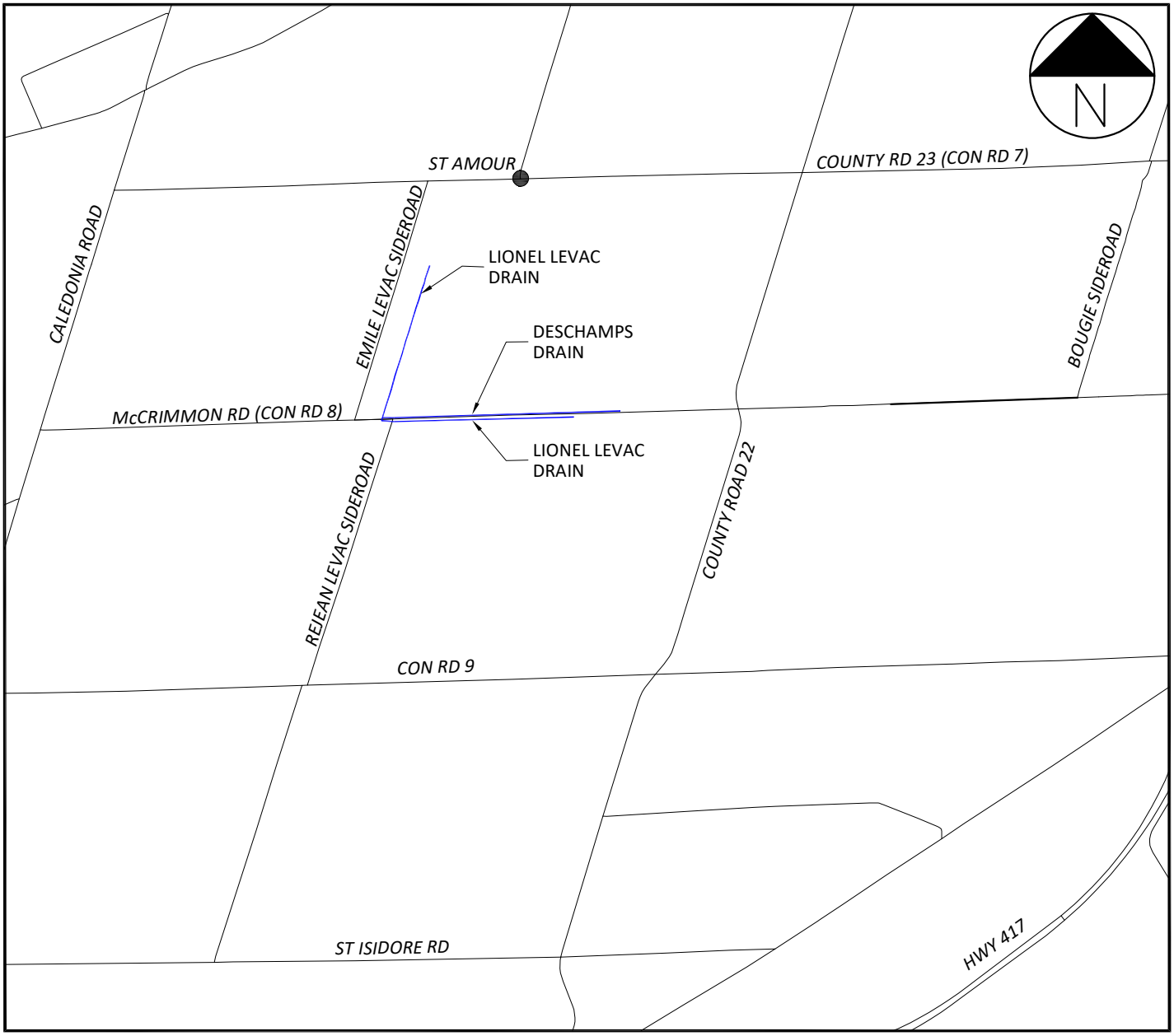
This final copy is respectfully submitted to the Council of the Municipality of The Nation for consideration.

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

LOCATION PLAN



LOCATION PLAN
N.T.S.

LIONEL LEVAC MUNICIPAL DRAIN
DESCHAMPS MUNICIPAL DRAIN

GEOGRAPHIC TOWNSHIP OF SOUTH PLANTAGENET
THE NATION MUNICIPALITY

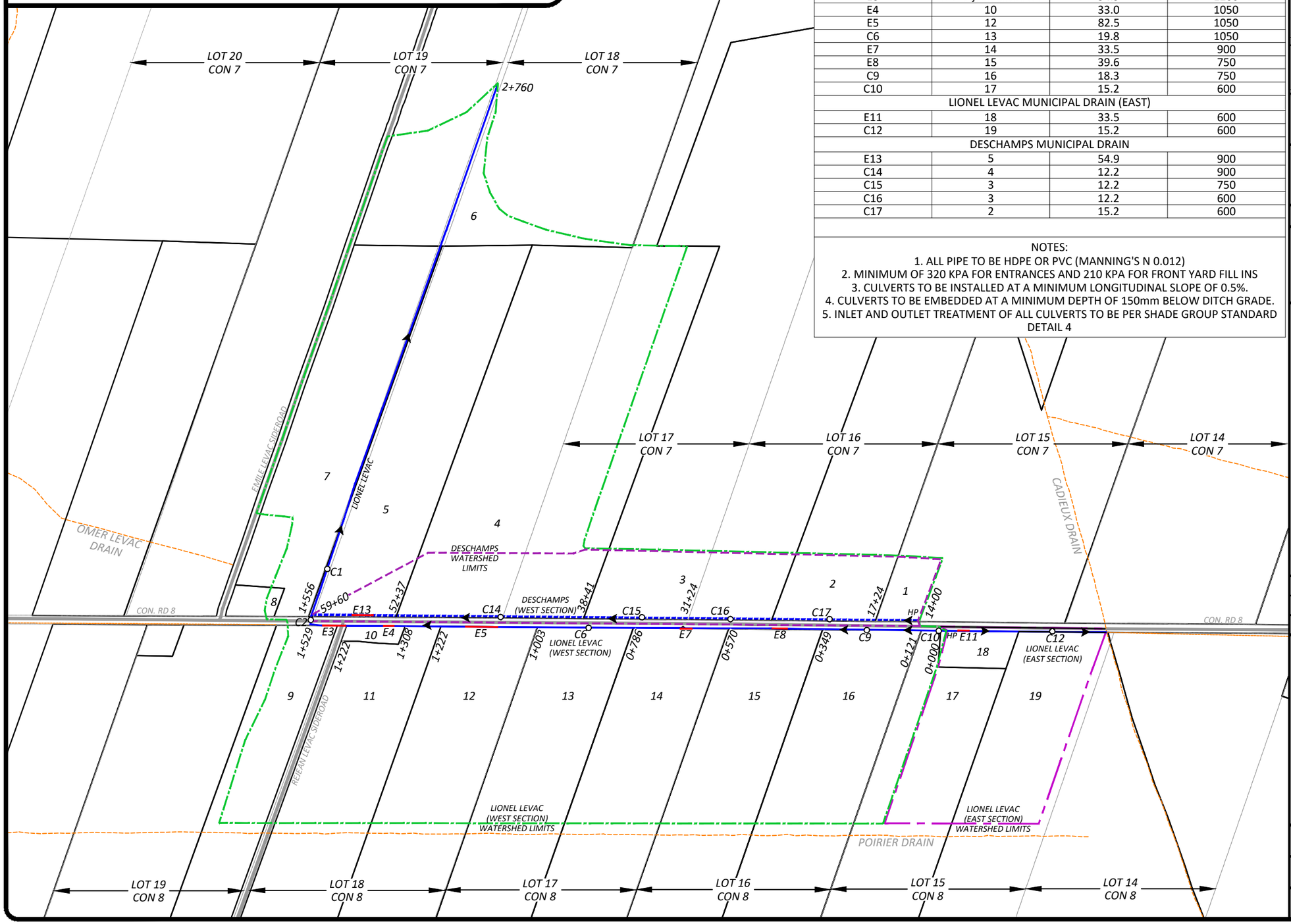
SHADE GROUP INC

APPENDIX B

DRAINAGE PLAN

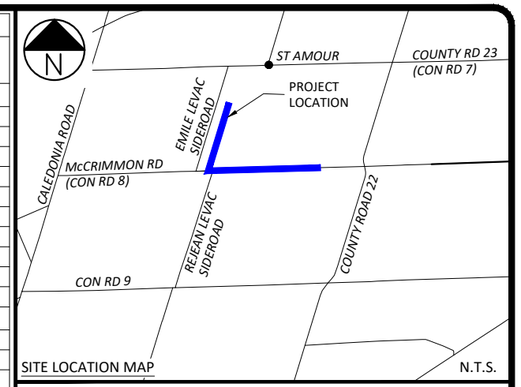
LIONEL LEVAC + DESCHAMPS MUNICIPAL DRAINS

GEOGRAPHIC TOWNSHIP OF CALEDONIA



CROSSING SUMMARY TABLE			
CROSSING I.D. NUMBER	PROPERTY I.D. REF.	LENGTH (m)	DIAMETER (mm)
LIONEL LEVAC MUNICIPAL DRAIN (WEST)			
C1	7	18.3	1200
C2	Con Rd 8	18.3	1200
E3	9 + Rejean Levac Rd	54.9	1200
E4	10	33.0	1050
E5	12	82.5	1050
C6	13	19.8	1050
E7	14	33.5	900
E8	15	39.6	750
C9	16	18.3	750
C10	17	15.2	600
LIONEL LEVAC MUNICIPAL DRAIN (EAST)			
E11	18	33.5	600
C12	19	15.2	600
DESCHAMPS MUNICIPAL DRAIN			
E13	5	54.9	900
C14	4	12.2	900
C15	3	12.2	750
C16	3	12.2	600
C17	2	15.2	600

NOTES:
1. ALL PIPE TO BE HDPE OR PVC (MANNING'S N 0.012)
2. MINIMUM OF 320 KPA FOR ENTRANCES AND 210 KPA FOR FRONT YARD FILL INS
3. CULVERTS TO BE INSTALLED AT A MINIMUM LONGITUDINAL SLOPE OF 0.5%.
4. CULVERTS TO BE EMBEDDED AT A MINIMUM DEPTH OF 150mm BELOW DITCH GRADE.
5. INLET AND OUTLET TREATMENT OF ALL CULVERTS TO BE PER SHADE GROUP STANDARD DETAIL 4



SCALE BAR 0 100 200 300 450m

DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING

PAGE SIZE 11" x 17" | SCALE 1:9,000

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

LEGEND

- APPROX. PROPERTY LINES (GIS DATA)
- ROAD
- LIONEL LEVAC MUNICIPAL DRAIN
- DESCHAMPS MUNICIPAL DRAIN
- LIONEL LEVAC MUNICIPAL DRAIN (WEST) WATERSHED
- LIONEL LEVAC MUNICIPAL DRAIN (EAST) WATERSHED
- DESCHAMPS MUNICIPAL DRAIN (WEST) WATERSHED
- WATERCOURSES
- 14+00 — APPROX. PREVIOUS STATIONS (FT) PER 1974 ENGINEER'S REPORT (DESCHAMPS)
- 0+000 — APPROX. PREVIOUS STATIONS (m) PER 1982 ENGINEER'S REPORT (LIONEL LEVAC WEST)
- LOT AND CONCESSION LINES
- C1 — LOCATION OF CULVERT
- E11 — LOCATION OF ENCLOSURE
- DIRECTION OF FLOW
- HP — HIGH POINT

REV.	DESCRIPTION	DATE
00	ISSUED W. ENGINEER'S REPORT	SEPT 5, 2025

STAMP

LICENSED PROFESSIONAL ENGINEER
M. K. SHADE
100170998
SEP 5, 2025
PROVINCE OF ONTARIO

PROJECT TITLE: LIONEL LEVAC MUNICIPAL DRAIN
DESCHAMPS MUNICIPAL DRAIN

DRAWING TITLE: DRAINAGE PLAN

DRAWING NO.: 1 OF 1

APPENDIX C

ASSESSMENT SCHEDULES

SHADE GROUP INC

Assessment Schedule - Updated 2025

Schedule 'A'

Lionel Levac Municipal Drain - West Section

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
1	0212012-007-03800	S15	7	1.4	$ 249.82	$ -	**$ 249.82**
2	0212012-007-03850	SE16	7	3.2	$ 807.79	$ -	**$ 807.79**
3	0212012-007-04100	SW 16 + SE 17	7	6.4	$ 1,615.58	$ -	**$ 1,615.58**
4	0212012-007-04800	SW 17 + SE 18	7	29.6	$ 6,000.62	$ -	**$ 6,000.62**
5	0212012-007-05000	SW18	7	18.6	$ 3,767.34	$ 38,447.31	**$ 42,214.66**
6	0212012-007-04900	N18+NE19	7	5.4	$ 586.23	$ 15,336.58	**$ 15,922.81**
7	0212012-007-05005	E19	7	16.2	$ 3,743.56	$ 41,554.95	**$ 45,298.52**
8	0212012-007-05100	Pt E 19	7	0.3	$ 65.67	$ -	**$ 65.67**
9	0212012-008-05000	E 19	8	5.3	$ 2,443.68	$ 3,123.65	**$ 5,567.33**
10	0212012-008-04910	N Pt NW 18	8	0.4	$ 719.49	$ 3,639.51	**$ 4,359.00**
11	0212012-008-04900	S Pt Nw 18	8	9.7	$ 4,575.13	$ 5,222.09	**$ 9,797.23**
12	0212012-008-04750	NE 18	8	10.1	$ 5,593.34	$ 9,205.52	**$ 14,798.86**
13	0212012-008-04700	NW 17	8	10.1	$ 6,509.72	$ 9,042.16	**$ 15,551.88**
14	0212012-008-04600	E17	8	10.1	$ 6,910.24	$ 7,520.37	**$ 14,430.60**
15	0212012-008-04500	W16	8	10.1	$ 7,380.88	$ 7,013.10	**$ 14,393.98**
16	0212012-008-04320	NE 16	8	10.1	$ 7,749.74	$ 7,933.06	**$ 15,682.79**
17	0212012-008-04310	S Pt W 15	8	2.2	$ 2,240.05	$ 1,040.63	**$ 3,280.68**
				Sub-Total	**$ 60,958.87**	**$ 149,078.94**	**$ 210,037.81**

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

Assessment Schedule - Updated 2025

Schedule 'A'

Lionel Levac Municipal Drain - West Section

Roads

Road Name	Owner	Outlet	Benefit	Net Assessment
Rejean Levac Sideroad	The Nation Municipality	$ 509.10	$ 1,199.54	**$ 1,708.64**
Emile Levac Sideroad		$ 305.46	$ -	**$ 305.46**
Con Rd 8		$ 1,815.61	$ 5,342.48	**$ 7,158.09**
	Sub-Total	**$ 2,630.18**	**$ 6,542.02**	**$ 9,172.19**

Summary

Real Properties	$ 60,958.87	$ 149,078.94	**$ 210,037.81**
The Nation Municipality	$ 2,630.18	$ 6,542.02	**$ 9,172.19**
Sub-Total (Pre-Tax/Grant)	**$ 63,589.05**	**$ 155,620.95**	**$ 219,210.00**

Assessment Schedule - Updated 2025

Schedule 'B'

Lionel Levac Municipal Drain - East Section

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
19	0212012-008-04100	15	8	5.8	$ 3,486.75	$ 8,973.24	**$ 12,459.99**
18	0212012-008-04300	15	8	1.3	$ 2,265.33	$ 1,794.65	**$ 4,059.98**
17	0212012-008-04310	15	8	5.5	$ 4,642.26	$ -	**$ 4,642.26**
				Sub-Total	**$ 10,394.34**	**$ 10,767.89**	**$ 21,162.23**

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

Roads

ID/Name	Owner	Outlet	Benefit	Net Assessment
Concession Rd 8	The Nation Municipality	$ 1,410.66	$ 5,547.11	**$ 6,957.77**
	Sub-Total	**$ 1,410.66**	**$ 5,547.11**	**$ 6,957.77**

Summary

Real Properties	$ 10,394.34	$ 10,767.89	**$ 21,162.23**
The Nation Municipality	$ 1,410.66	$ 5,547.11	**$ 6,957.77**
Sub-Total (Pre-Tax/Grant)	**$ 11,805.00**	**$ 16,315.00**	**$ 28,120.00**

Assessment Schedule - Updated 2025

Schedule 'C'

Deschamps Municipal Drain - West Section

Property ID No.	Roll No.	Lot	Concession	Area Drained (Hectares)	Outlet	Benefit	Net Assessment *
1	0212012-007-03800	S15	7	1.4	$ 878.80	$ 7,488.33	**$ 8,367.12**
2	0212012-007-03850	SE16	7	3.2	$ 3,352.04	$ 8,502.36	**$ 11,854.41**
3	0212012-007-04100	SE17 + SW16	7	6.5	$ 5,189.75	$ 16,949.52	**$ 22,139.27**
4	0212012-007-04800	SE18 + SW17	7	6.5	$ 3,281.06	$ 14,638.58	**$ 17,919.64**
5	0212012-007-05000	SW18	7	1.6	$ 378.58	$ 18,700.47	**$ 19,079.05**
				Sub-Total	**$ 13,080.24**	**$ 66,279.25**	**$ 79,359.49**

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

Roads

ID/Name	Owner	Outlet	Benefit	Net Assessment
Concession Rd 8	The Nation Municipality	$ 2,411.90	$ 12,738.62	**$ 15,150.51**
	Sub-Total	**$ 2,411.90**	**$ 12,738.62**	**$ 15,150.51**

Summary

Real Properties	$ 13,080.24	$ 66,279.25	**$ 79,359.49**
The Nation Municipality	$ 2,411.90	$ 12,738.62	**$ 15,150.51**
Sub-Total (Pre-Tax/Grant)	**$ 15,492.13**	**$ 79,017.87**	**$ 94,510.00**

APPENDIX D

HYDROLOGIC/HYDRAULIC ANALYSIS

CULVERT 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 the Ministry of Agriculture, Food and Agribusiness, for reference to the soil conditions of the watershed. AgMaps identifies the Hydrologic Soil Group within the Lionel Levac and Deschamps Municipal Drain as Class 'C' and class 'D' soils.

The soils are described as Bainsville and Bearbrook. Bainsville soils are described as being silt loam, stonefree, fine sandy loam soils with layered silt and fine sand parent material, with poor drainage. Bearbrook is described as clay, stonefree, dark grey soils with non-calcareous layered red and grey clay parent materials with poor drainage. These descriptions have been extracted from Soil Survey of Russell & Prescott Counties (Report No. 33 of the Ontario Soil Survey, Soils Research Institute, Ontario Agricultural College, Guelph, 1962).

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, 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 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. The single farm crossing (C1) was sized to a 5-year storm event in fitting with the recommendations for a "field crossing" from *A Guide for Engineer's Working under the Drainage Act in Ontario – Publication 852*.

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 general benchmark of 100m or 100ft. Where in feet (i.e. Lionel Levac East and Deschamps West) 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, and instead the resulting Culvert Summary Table data has been enclosed.

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C1**
Location	**Lot 15, Concession 8 - ID 7**
Use	**Agricultural**
Design Storm	5-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 93.74 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	91.755	86.25
Impervious	98.00	1.985	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	91.755	0.56
Impervious	0.90	1.985	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.48
Ia =	6.07

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	82

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1580	0.12	0.16	166

Total Tc (min)	Total Tp (hr)
248	**2.77**

Intensity

Return Period	Intensity (mm/hr)
2-Year	7.3
5-Year	9.8
10-Year	11.4
25-Year	13.4
50-Year	14.9
100-Year	16.4

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	1.07	0.67	0.83	1.07	
5-Year	1.42	1.10	1.33	1.42	Design Storm
10-Year	1.65	1.41	1.68	1.68	
25-Year	1.95	1.82	2.14	2.14	
50-Year	2.16	2.13	2.48	2.48	
100-Year	2.38	2.44	2.82	2.82	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C1**
Pipe Diameter	**1200mm Ø HDPE**
Pipe Length	18.3m
Design Storm	5-Year
Check Storm	100-Year

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)
1.07	1.07	97.20	0.85	0.99	1.05	0.48	0.78	0.78	1.25	0.64
1.24	1.24	97.29	0.94	1.09	1.05	0.53	0.83	0.83	1.38	0.66
1.42	1.42	97.39	1.04	1.19	1.05	0.57	0.88	0.88	1.50	0.69
1.59	1.59	97.51	1.14	1.31	1.05	0.61	0.92	0.92	1.62	0.71
1.77	1.77	97.68	1.25	1.47	1.05	0.65	0.97	0.97	1.75	0.72
1.94	1.94	97.85	1.37	1.64	1.05	0.68	1.00	1.00	1.89	0.74
2.12	2.12	98.02	1.50	1.82	1.05	0.72	1.05	1.04	2.03	0.76
2.29	2.29	98.18	1.65	1.98	1.05	0.75	1.05	1.08	2.20	0.77
2.47	2.47	98.35	1.81	2.15	1.05	0.78	1.05	1.11	2.37	0.79
2.64	2.64	98.53	1.98	2.32	1.05	0.81	1.05	1.14	2.53	0.80
2.82	2.82	98.70	2.17	2.50	1.05	0.83	1.05	1.17	2.70	0.81

5-Year Check

Design Criteria HW/D < 1.5

HW =	1.04	m
D =	1.2	m
HW/D =	0.87	**Pass**

100-Year Check

HW Elev =	98.70	m
CL Elev =	98.95	m
Overtopping =	N/A	m
Freeboard=	0.25	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C2**
Location	**Road Crossing - Concession Rd 8**
Use	**Local Road**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 70.29 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	68.305	86.34
Impervious	98.00	1.985	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	68.305	0.56
Impervious	0.90	1.985	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.19
Ia =	6.03

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	82

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1455	0.12	0.16	153

Total Tc (min)	Total Tp (hr)
235	**2.62**

Intensity

Return Period	Intensity (mm/hr)
2-Year	7.6
5-Year	10.2
10-Year	11.8
25-Year	13.9
50-Year	15.5
100-Year	17.0

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.83	0.53	0.65	0.83	
5-Year	1.11	0.87	1.05	1.11	
10-Year	1.29	1.11	1.32	1.32	Design Storm
25-Year	1.53	1.43	1.68	1.68	
50-Year	1.69	1.67	1.95	1.95	
100-Year	1.86	1.92	2.22	2.22	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C2**
Pipe Diameter	**1200mm Ø HDPE**
Pipe Length	18.3m
Design Storm	10-Year
Check Storm	100-Year

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)
0.83	0.83	97.20	0.72	0.86	1.05	0.41	0.69	0.70	1.09	0.60
0.97	0.97	97.28	0.79	0.94	1.05	0.45	0.74	0.74	1.19	0.62
1.11	1.11	97.36	0.87	1.01	1.05	0.49	0.79	0.79	1.29	0.64
1.25	1.25	97.44	0.94	1.09	1.05	0.53	0.83	0.83	1.38	0.66
1.32	1.32	97.48	0.98	1.13	1.05	0.54	0.85	0.85	1.44	0.67
1.52	1.52	97.60	1.10	1.25	1.05	0.59	0.90	0.91	1.58	0.70
1.66	1.66	97.72	1.18	1.37	1.05	0.62	0.94	0.94	1.68	0.71
1.80	1.80	97.85	1.27	1.50	1.05	0.65	0.97	0.97	1.78	0.73
1.94	1.94	97.98	1.37	1.63	1.05	0.68	1.00	1.00	1.89	0.74
2.08	2.08	98.11	1.47	1.77	1.05	0.71	1.03	1.03	2.00	0.75
2.22	2.22	98.25	1.58	1.90	1.05	0.73	1.05	1.06	2.13	0.77

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.98	m
D =	1.2	m
HW/D =	0.82	**Pass**

100-Year Check

HW Elev =	98.25	m
CL Elev =	99.47	m
Overtopping =	N/A	m
Freeboard=	1.22	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E3**
Location	**Lot 19, Concession 8 (ID 9) + Rejean Levac Road**
Use	**Local Road + Residential + Agricultural Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 66.29 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	65.118	86.21
Impervious	98.00	1.173	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	65.118	0.56
Impervious	0.90	1.173	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.62
Ia =	6.09

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	82

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1375	0.12	0.16	145

Total Tc (min)	Total Tp (hr)
227	**2.53**

Intensity

Return Period	Intensity (mm/hr)
2-Year	7.8
5-Year	10.4
10-Year	12.1
25-Year	14.3
50-Year	15.9
100-Year	17.4

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.80	0.51	0.63	0.80	
5-Year	1.07	0.84	1.01	1.07	
10-Year	1.24	1.07	1.28	1.28	Design Storm
25-Year	1.46	1.38	1.62	1.62	
50-Year	1.63	1.62	1.88	1.88	
100-Year	1.79	1.85	2.14	2.14	Check Storm

Methodology	**HY-8 RESULTS**
Description	**E3**
Pipe Diameter	**1200mm Ø HDPE**
Pipe Length	54.9m
Design Storm	10-Year
Check Storm	100-Year

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)
0.80	0.80	97.25	0.70	1.00	1.05	0.40	0.88	0.68	0.84	0.59
0.93	0.93	97.35	0.77	1.10	1.05	0.44	0.93	0.73	0.94	0.62
1.07	1.07	97.53	0.85	1.28	1.05	0.48	0.98	0.78	1.05	0.64
1.20	1.20	97.74	0.92	1.49	1.05	0.52	1.02	0.82	1.16	0.66
1.28	1.28	97.87	0.96	1.62	1.05	0.53	1.05	0.84	1.23	0.67
1.47	1.47	98.10	1.07	1.85	1.05	0.58	1.05	0.89	1.41	0.69
1.60	1.60	98.27	1.15	2.02	1.05	0.61	1.05	0.93	1.54	0.71
1.74	1.74	98.45	1.23	2.20	1.05	0.64	1.05	0.96	1.66	0.72
1.87	1.81	98.56	1.28	2.31	1.05	0.66	1.05	0.99	1.74	0.73
2.01	1.81	98.59	1.28	2.34	1.05	0.66	1.05	1.02	1.74	0.75
2.14	1.81	98.61	1.28	2.36	1.05	0.66	1.05	1.05	1.73	0.76

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.96	m
D =	1.2	m
HW/D =	0.80	**Pass**

100-Year Check

HW Elev =	98.61	m
CL Elev =	98.53	m
Overtopping =	0.08	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E4**
Location	**Lot 18, Concession 8 - ID 10**
Use	**Residential Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 58.26 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	57.635	86.13
Impervious	98.00	0.625	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	57.635	0.55
Impervious	0.90	0.625	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.91
Ia =	6.14

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1265	0.12	0.16	133

Total Tc (min)	Total Tp (hr)
216	**2.41**

Intensity

Return Period	Intensity (mm/hr)
2-Year	8.1
5-Year	10.8
10-Year	12.6
25-Year	14.8
50-Year	16.4
100-Year	18.1

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.73	0.46	0.57	0.73	
5-Year	0.97	0.76	0.92	0.97	
10-Year	1.13	0.97	1.16	1.16	Design Storm
25-Year	1.33	1.26	1.48	1.48	
50-Year	1.47	1.47	1.72	1.72	
100-Year	1.62	1.69	1.95	1.95	Check Storm

Methodology	**HY-8 RESULTS**
Description	**E4**
Pipe Diameter	**1050mm Ø HDPE**
Pipe Length	33.0m
Design Storm	10-Year
Check Storm	100-Year

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)
0.73	0.73	97.47	0.72	0.89	0.90	0.40	0.66	0.66	1.15	0.58
0.85	0.85	97.56	0.80	0.98	0.90	0.44	0.70	0.70	1.26	0.60
0.97	0.97	97.70	0.88	1.12	0.90	0.48	0.75	0.75	1.38	0.62
1.10	1.10	97.89	0.97	1.31	0.90	0.51	0.79	0.79	1.49	0.64
1.16	1.16	97.99	1.01	1.41	0.90	0.53	0.81	0.81	1.55	0.65
1.34	1.34	98.27	1.16	1.69	0.90	0.58	0.86	0.86	1.73	0.68
1.46	1.46	98.47	1.27	1.89	0.90	0.61	0.90	0.89	1.86	0.69
1.58	1.58	98.67	1.40	2.09	0.90	0.63	0.90	0.92	2.02	0.70
1.71	1.71	98.87	1.53	2.29	0.90	0.66	0.90	0.95	2.17	0.72
1.83	1.73	98.94	1.56	2.36	0.90	0.67	0.90	0.98	2.21	0.73
1.95	1.75	98.97	1.59	2.39	0.90	0.67	0.90	1.01	2.23	0.74

10-Year Check

Design Criteria HW/D < 1.5

HW =	1.01	m
D =	1.05	m
HW/D =	0.96	**Pass**

100-Year Check

HW Elev =	98.97	m
CL Elev =	98.89	m
Overtopping =	0.08	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E5**
Location	**Lot 18, Concession 8 - ID 12**
Use	**Agricultural + Residential Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 47.87 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	47.365	86.13
Impervious	98.00	0.505	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	47.365	0.55
Impervious	0.90	0.505	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.91
Ia =	6.14

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1025	0.12	0.16	108

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	0.65	0.42	0.52	0.65	
5-Year	0.87	0.69	0.84	0.87	
10-Year	1.01	0.88	1.05	1.05	Design Storm
25-Year	1.19	1.14	1.34	1.34	
50-Year	1.32	1.34	1.55	1.55	
100-Year	1.45	1.53	1.77	1.77	Check Storm

Methodology	**HY-8 RESULTS**
Description	**E5**
Pipe Diameter	**1050mm Ø HDPE**
Pipe Length	82.5m
Design Storm	10-Year
Check Storm	100-Year

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)
0.65	0.65	97.78	0.66	0.91	0.90	0.38	0.62	0.62	1.07	0.56
0.76	0.76	97.95	0.74	1.08	0.90	0.41	0.67	0.67	1.18	0.59
0.87	0.87	98.23	0.81	1.36	0.90	0.45	0.71	0.71	1.28	0.61
0.99	0.99	98.50	0.89	1.63	0.90	0.48	0.75	0.75	1.39	0.63
1.05	1.05	98.67	0.93	1.80	0.90	0.50	0.77	0.77	1.45	0.64
1.21	1.20	99.03	1.04	2.16	0.90	0.54	0.82	0.82	1.58	0.66
1.32	1.20	99.08	1.04	2.21	0.90	0.54	0.85	0.85	1.55	0.67
1.43	1.19	99.11	1.04	2.24	0.90	0.54	0.88	0.88	1.52	0.69
1.55	1.18	99.14	1.03	2.27	0.90	0.54	0.90	0.91	1.51	0.70
1.66	1.18	99.16	1.03	2.29	0.90	0.54	0.90	0.94	1.51	0.71
1.77	1.18	99.18	1.03	2.31	0.90	0.54	0.90	0.97	1.50	0.72

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.93	m
D =	1.05	m
HW/D =	0.89	**Pass**

100-Year Check

HW Elev =	99.18	m
CL Elev =	99.02	m
Overtopping =	0.16	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C6**
Location	**Lot 17, Concession 8 - ID 13**
Use	**Agricultural**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 37.40 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	37.003	86.13
Impervious	98.00	0.398	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	37.003	0.55
Impervious	0.90	0.398	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.91
Ia =	6.14

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
815	0.12	0.16	86

Total Tc (min)	Total Tp (hr)
168	**1.88**

Intensity

Return Period	Intensity (mm/hr)
2-Year	9.6
5-Year	12.8
10-Year	14.9
25-Year	17.6
50-Year	19.5
100-Year	21.5

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.55	0.36	0.45	0.55	
5-Year	0.74	0.59	0.72	0.74	
10-Year	0.86	0.76	0.91	0.91	Design Storm
25-Year	1.01	0.98	1.15	1.15	
50-Year	1.13	1.15	1.34	1.34	
100-Year	1.24	1.32	1.52	1.52	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C6**
Pipe Diameter	**1050mm Ø HDPE**
Pipe Length	19.8m
Design Storm	10-Year
Check Storm	100-Year

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)
0.55	0.55	97.85	0.59	0.73	0.90	0.34	0.58	0.58	0.97	0.54
0.65	0.65	97.92	0.66	0.80	0.90	0.38	0.63	0.62	1.06	0.56
0.74	0.74	97.98	0.73	0.86	0.90	0.41	0.67	0.66	1.15	0.58
0.84	0.84	98.05	0.79	0.93	0.90	0.44	0.70	0.70	1.24	0.60
0.91	0.91	98.10	0.84	0.98	0.90	0.46	0.73	0.72	1.31	0.61
1.03	1.03	98.21	0.92	1.09	0.90	0.50	0.77	0.77	1.43	0.63
1.13	1.13	98.33	0.99	1.21	0.90	0.52	0.80	0.80	1.52	0.65
1.23	1.23	98.45	1.07	1.33	0.90	0.55	0.83	0.83	1.61	0.66
1.33	1.33	98.58	1.15	1.46	0.90	0.57	0.86	0.85	1.71	0.67
1.42	1.42	98.71	1.24	1.59	0.90	0.60	0.88	0.88	1.82	0.69
1.52	1.52	98.83	1.33	1.71	0.90	0.62	0.90	0.90	1.93	0.70

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.84	m
D =	1.05	m
HW/D =	0.80	**Pass**

100-Year Check

HW Elev =	98.83	m
CL Elev =	99.50	m
Overtopping =	N/A	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E7**
Location	**Lot 17, Concession 8 - ID 14**
Use	**Agricultural + Residential Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 27.47 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	27.188	86.12
Impervious	98.00	0.283	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	27.188	0.55
Impervious	0.90	0.283	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.93
Ia =	6.14

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
580	0.12	0.16	61

Total Tc (min)	Total Tp (hr)
144	**1.60**

Intensity

Return Period	Intensity (mm/hr)
2-Year	10.8
5-Year	14.3
10-Year	16.7
25-Year	19.7
50-Year	21.8
100-Year	24.0

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.45	0.30	0.37	0.45	
5-Year	0.61	0.50	0.60	0.61	
10-Year	0.71	0.64	0.76	0.76	Design Storm
25-Year	0.83	0.82	0.96	0.96	
50-Year	0.92	0.96	1.12	1.12	
100-Year	1.02	1.10	1.27	1.27	Check Storm

Methodology	**HY-8 RESULTS**
Description	**E7**
Pipe Diameter	**900mm Ø HDPE**
Pipe Length	33.5m
Design Storm	10-Year
Check Storm	100-Year

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)
0.45	0.45	98.13	0.57	0.73	0.75	0.32	0.53	0.53	1.01	0.51
0.53	0.53	98.21	0.64	0.81	0.75	0.35	0.57	0.57	1.12	0.53
0.61	0.61	98.36	0.71	0.96	0.75	0.39	0.61	0.61	1.23	0.55
0.70	0.70	98.54	0.78	1.14	0.75	0.42	0.64	0.64	1.33	0.57
0.76	0.76	98.68	0.85	1.28	0.75	0.44	0.67	0.67	1.42	0.59
0.86	0.86	98.90	0.95	1.50	0.75	0.47	0.71	0.71	1.56	0.60
0.94	0.94	99.09	1.04	1.69	0.75	0.50	0.75	0.74	1.68	0.62
1.02	1.02	99.27	1.15	1.87	0.75	0.52	0.75	0.76	1.82	0.63
1.11	1.10	99.46	1.26	2.06	0.75	0.54	0.75	0.79	1.96	0.64
1.19	1.11	99.50	1.27	2.10	0.75	0.55	0.75	0.81	1.97	0.66
1.27	1.11	99.53	1.27	2.13	0.75	0.55	0.75	0.84	1.97	0.67

10-Year Check

Design Criteria	HW/D < 1.5	
HW =	0.85	m
D =	0.9	m
HW/D =	0.94	**Pass**

100-Year Check

HW Elev =	99.53	m
CL Elev =	99.46	m
Overtopping =	0.07	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E8**
Location	**Lot 16, Concession 8 - ID 15**
Use	**Agricultural + Residential Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 17.31 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	17.138	86.12
Impervious	98.00	0.173	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	17.138	0.55
Impervious	0.90	0.173	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.94
Ia =	6.14

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
365	0.12	0.16	38

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

Intensity

Return Period	Intensity (mm/hr)
2-Year	12.1
5-Year	16.2
10-Year	18.8
25-Year	22.2
50-Year	24.6
100-Year	27.1

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.32	0.21	0.27	0.32	
5-Year	0.43	0.36	0.43	0.43	
10-Year	0.50	0.46	0.54	0.54	Design Storm
25-Year	0.59	0.59	0.69	0.69	
50-Year	0.66	0.69	0.80	0.80	
100-Year	0.72	0.80	0.91	0.91	Check Storm

SHADE GROUP INC

Methodology	**HY-8 RESULTS**
Description	**E8**
Pipe Diameter	**750mm Ø HDPE**
Pipe Length	39.6m
Design Storm	10-Year
Check Storm	100-Year

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)
0.32	0.32	98.38	0.52	0.72	0.60	0.28	0.45	0.45	1.01	0.47
0.38	0.38	98.60	0.58	0.94	0.60	0.31	0.49	0.49	1.13	0.49
0.44	0.44	98.82	0.65	1.16	0.60	0.34	0.52	0.52	1.24	0.51
0.50	0.50	99.04	0.73	1.38	0.60	0.37	0.55	0.55	1.36	0.53
0.54	0.54	99.21	0.80	1.55	0.60	0.38	0.57	0.57	1.45	0.54
0.61	0.61	99.52	0.92	1.86	0.60	0.41	0.60	0.61	1.63	0.56
0.67	0.66	99.70	1.01	2.04	0.60	0.43	0.60	0.63	1.76	0.57
0.73	0.66	99.73	1.01	2.07	0.60	0.43	0.60	0.66	1.76	0.58
0.79	0.66	99.75	1.01	2.09	0.60	0.43	0.60	0.68	1.76	0.59
0.85	0.66	99.77	1.01	2.11	0.60	0.43	0.60	0.70	1.76	0.60
0.91	0.66	99.78	1.01	2.12	0.60	0.43	0.60	0.72	1.76	0.61

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.80	m
D =	0.75	m
HW/D =	1.07	**Pass**

100-Year Check

HW Elev =	99.78	m
CL Elev =	99.69	m
Overtopping =	0.09	m

SHADE GROUP INC

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C9**
Location	**Lot 16, Concession 8 - ID 16**
Use	**Agricultural**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 8.29 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	8.210	86.12
Impervious	98.00	0.080	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	8.210	0.55
Impervious	0.90	0.080	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.95
Ia =	6.14

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
175	0.12	0.16	18

Total Tc (min)	Total Tp (hr)
101	**1.13**

Intensity

Return Period	Intensity (mm/hr)
2-Year	13.8
5-Year	18.3
10-Year	21.3
25-Year	25.2
50-Year	27.9
100-Year	30.7

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.18	0.12	0.15	0.18	
5-Year	0.23	0.20	0.24	0.24	
10-Year	0.27	0.25	0.30	0.30	Design Storm
25-Year	0.32	0.33	0.38	0.38	
50-Year	0.36	0.38	0.44	0.44	
100-Year	0.39	0.44	0.50	0.50	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C9**
Pipe Diameter	**750mm Ø HDPE**
Pipe Length	18.3m
Design Storm	10-Year
Check Storm	100-Year

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)
0.18	0.18	98.33	0.35	0.44	0.60	0.20	0.35	0.34	0.73	0.40
0.21	0.21	98.38	0.39	0.49	0.60	0.22	0.38	0.37	0.79	0.42
0.24	0.24	98.42	0.43	0.53	0.60	0.24	0.40	0.40	0.86	0.44
0.28	0.28	98.46	0.47	0.57	0.60	0.25	0.43	0.42	0.92	0.45
0.30	0.30	98.49	0.49	0.60	0.60	0.27	0.44	0.44	0.97	0.46
0.34	0.34	98.54	0.54	0.65	0.60	0.29	0.47	0.47	1.05	0.48
0.37	0.37	98.59	0.57	0.70	0.60	0.31	0.49	0.49	1.11	0.49
0.40	0.40	98.67	0.61	0.78	0.60	0.32	0.51	0.50	1.17	0.50
0.44	0.44	98.76	0.65	0.87	0.60	0.34	0.52	0.52	1.23	0.51
0.47	0.47	98.84	0.69	0.95	0.60	0.35	0.54	0.54	1.29	0.52
0.50	0.50	98.92	0.74	1.03	0.60	0.37	0.56	0.56	1.36	0.53

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.49	m
D =	0.75	m
HW/D =	0.65	**Pass**

100-Year Check

HW Elev =	98.92	m
CL Elev =	100.25	m
Overtopping =	N/A	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C10**
Location	**Lot 15, Concession 8 - ID 17**
Use	**Agricultural**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 1.34 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	1.338	86.02
Impervious	98.00	0.003	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	1.338	0.55
Impervious	0.90	0.003	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	41.27
Ia =	6.19

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
470	0.10	83

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
5	0.12	0.16	1

Total Tc (min)	Total Tp (hr)
84	**0.93**

Intensity

Return Period	Intensity (mm/hr)
2-Year	15.7
5-Year	20.9
10-Year	24.4
25-Year	28.7
50-Year	31.9
100-Year	35.1

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.03	0.02	0.03	0.03	
5-Year	0.04	0.04	0.04	0.04	
10-Year	0.05	0.05	0.06	0.06	Design Storm
25-Year	0.06	0.06	0.07	0.07	
50-Year	0.07	0.07	0.08	0.08	
100-Year	0.07	0.08	0.09	0.09	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C10**
Pipe Diameter	**600mm Ø HDPE**
Pipe Length	15.2m
Design Storm	10-Year
Check Storm	100-Year

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)
0.03	0.03	98.26	0.12	0.17	0.19	0.07	0.14	0.14	0.38	0.25
0.04	0.04	98.28	0.14	0.19	0.22	0.08	0.15	0.15	0.41	0.26
0.04	0.04	98.30	0.15	0.21	0.24	0.08	0.17	0.17	0.44	0.27
0.05	0.05	98.32	0.17	0.23	0.26	0.09	0.18	0.18	0.47	0.28
0.05	0.05	98.33	0.18	0.24	0.28	0.10	0.19	0.19	0.50	0.29
0.06	0.06	98.35	0.20	0.26	0.30	0.11	0.20	0.20	0.52	0.30
0.07	0.07	98.36	0.21	0.27	0.32	0.11	0.21	0.21	0.54	0.31
0.07	0.07	98.37	0.22	0.28	0.35	0.12	0.22	0.22	0.57	0.32
0.08	0.08	98.39	0.23	0.30	0.37	0.13	0.23	0.23	0.59	0.32
0.08	0.08	98.40	0.25	0.31	0.41	0.13	0.24	0.24	0.61	0.33
0.09	0.09	98.41	0.26	0.32	0.45	0.14	0.25	0.25	0.63	0.34

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.18	m
D =	0.6	m
HW/D =	0.30	**Pass**

100-Year Check

HW Elev =	98.41	m
CL Elev =	99.59	m
Overtopping =	N/A	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E11**
Location	**Lot 15, Concession 8 - ID 18**
Use	**Residential Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 1.67 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	1.650	86.14
Impervious	98.00	0.020	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	1.650	0.55
Impervious	0.90	0.020	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.86
Ia =	6.13

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
455	0.10	81

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
25	0.10	0.14	3

Total Tc (min)	Total Tp (hr)
84	**0.94**

Intensity

Return Period	Intensity (mm/hr)
2-Year	15.6
5-Year	20.9
10-Year	24.3
25-Year	28.6
50-Year	31.8
100-Year	34.9

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.04	0.03	0.03	0.04	
5-Year	0.05	0.05	0.06	0.06	
10-Year	0.06	0.06	0.07	0.07	Design Storm
25-Year	0.07	0.08	0.09	0.09	
50-Year	0.08	0.09	0.10	0.10	
100-Year	0.09	0.10	0.12	0.12	Check Storm

Methodology **HY-8 RESULTS**
Description **E11**
Pipe Diameter **600mm Ø HDPE**
Pipe Length 33.5m
Design Storm 10-Year
Check Storm 100-Year

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)
0.04	0.04	29.68	0.15	0.23	0.25	0.08	0.18	0.18	0.38	0.26
0.05	0.05	29.70	0.17	0.25	0.28	0.09	0.20	0.20	0.41	0.28
0.06	0.06	29.72	0.19	0.27	0.31	0.10	0.22	0.21	0.45	0.29
0.06	0.06	29.75	0.21	0.30	0.35	0.11	0.23	0.23	0.48	0.30
0.07	0.07	29.76	0.22	0.31	0.38	0.12	0.24	0.24	0.50	0.31
0.08	0.08	29.79	0.24	0.34	0.45	0.13	0.26	0.26	0.53	0.32
0.09	0.09	29.81	0.25	0.36	0.45	0.14	0.27	0.27	0.56	0.33
0.10	0.10	29.83	0.27	0.38	0.45	0.14	0.29	0.28	0.58	0.33
0.10	0.10	29.85	0.28	0.40	0.45	0.15	0.30	0.29	0.61	0.34
0.11	0.11	29.87	0.30	0.42	0.45	0.16	0.31	0.30	0.63	0.35
0.12	0.12	29.88	0.31	0.43	0.45	0.17	0.32	0.32	0.66	0.35

10-Year Check
Design Criteria HW/D < 1.5
HW = 0.22 m
D = 0.60 m
HW/D = 0.37 **Pass**

100-Year Check
HW Elev = 29.88 m
CL Elev = 30.92 m
Overtopping = N/A m
Freeboard= 1.04 m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C12**
Location	**Lot 15, Concession 8 - ID 19**
Use	**Agricultural Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 10.73 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	10.605	86.14
Impervious	98.00	0.125	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	10.605	0.55
Impervious	0.90	0.125	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.87
Ia =	6.13

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
455	0.10	81

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
235	0.10	0.14	27

Total Tc (min)	Total Tp (hr)
108	**1.21**

Intensity

Return Period	Intensity (mm/hr)
2-Year	13.1
5-Year	17.5
10-Year	20.3
25-Year	24.0
50-Year	26.6
100-Year	29.3

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.22	0.15	0.18	0.22	
5-Year	0.29	0.24	0.29	0.29	
10-Year	0.34	0.31	0.37	0.37	Design Storm
25-Year	0.40	0.40	0.47	0.47	
50-Year	0.44	0.47	0.54	0.54	
100-Year	0.48	0.54	0.62	0.62	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C12**
Pipe Diameter	**600mm Ø HDPE**
Pipe Length	15.2m
Design Storm	10-Year
Check Storm	100-Year

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)
0.04	0.04	29.45	0.15	0.21	0.25	0.08	0.18	0.18	0.39	0.26
0.05	0.05	29.47	0.17	0.23	0.29	0.09	0.20	0.20	0.42	0.28
0.06	0.06	29.49	0.19	0.25	0.32	0.10	0.21	0.21	0.45	0.29
0.06	0.06	29.51	0.21	0.27	0.36	0.11	0.23	0.23	0.48	0.30
0.07	0.07	29.53	0.22	0.29	0.39	0.12	0.24	0.24	0.50	0.31
0.08	0.08	29.55	0.24	0.31	0.45	0.13	0.26	0.26	0.54	0.32
0.09	0.09	29.57	0.25	0.33	0.45	0.14	0.27	0.27	0.56	0.33
0.10	0.10	29.59	0.27	0.35	0.45	0.14	0.28	0.28	0.59	0.33
0.10	0.10	29.60	0.28	0.36	0.45	0.15	0.30	0.29	0.61	0.34
0.11	0.11	29.62	0.30	0.38	0.45	0.16	0.31	0.30	0.64	0.35
0.12	0.12	29.63	0.31	0.39	0.45	0.17	0.32	0.32	0.66	0.35

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.22	m
D =	0.60	m
HW/D =	0.37	**Pass**

100-Year Check

HW Elev =	29.63	m
CL Elev =	30.72	m
Overtopping =	N/A	m
Freeboard=	1.09	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**E13**
Location	**Lot 18, Concession 7 - ID 5**
Use	**Residential + Agricultural Access**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 20.18 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	19.553	86.37
Impervious	98.00	0.628	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	19.553	0.56
Impervious	0.90	0.628	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.07
Ia =	6.01

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
150	0.10	46

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
1250	0.08	0.13	161

Total Tc (min)	Total Tp (hr)
207	**2.31**

Intensity

Return Period	Intensity (mm/hr)
2-Year	8.3
5-Year	11.1
10-Year	12.9
25-Year	15.2
50-Year	16.9
100-Year	18.6

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.26	0.17	0.21	0.26	
5-Year	0.35	0.28	0.33	0.35	
10-Year	0.41	0.35	0.42	0.42	Design Storm
25-Year	0.48	0.46	0.54	0.54	
50-Year	0.53	0.53	0.62	0.62	
100-Year	0.58	0.61	0.71	0.71	Check Storm

SHADE GROUP INC

Methodology	**HY-8 RESULTS**
Description	**E13**
Pipe Diameter	**900mm Ø HDPE**
Pipe Length	54.9m
Design Storm	10-Year
Check Storm	100-Year

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)
0.26	0.26	28.82	0.40	0.59	0.75	0.23	0.49	0.49	0.63	0.40
0.31	0.31	28.87	0.45	0.64	0.75	0.25	0.53	0.53	0.69	0.42
0.35	0.35	28.93	0.49	0.70	0.75	0.27	0.56	0.56	0.75	0.43
0.40	0.40	28.99	0.53	0.76	0.75	0.30	0.60	0.60	0.80	0.44
0.42	0.42	29.02	0.55	0.79	0.75	0.31	0.61	0.61	0.83	0.45
0.48	0.48	29.20	0.60	0.97	0.75	0.33	0.65	0.65	0.92	0.47
0.53	0.53	29.34	0.64	1.11	0.75	0.35	0.68	0.68	0.98	0.48
0.57	0.54	29.41	0.65	1.18	0.75	0.36	0.71	0.71	0.98	0.49
0.62	0.53	29.44	0.64	1.21	0.75	0.35	0.73	0.73	0.95	0.50
0.66	0.52	29.46	0.63	1.23	0.75	0.35	0.75	0.76	0.92	0.51
0.71	0.51	29.47	0.63	1.24	0.75	0.35	0.75	0.78	0.91	0.52

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.55	m
D =	0.90	m
HW/D =	0.61	**Pass**

100-Year Check

HW Elev =	29.47	m
CL Elev =	29.39	m
Overtopping =	0.08	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C14**
Location	**Lot 18, Concession 7 - ID 4**
Use	**Agricultural Crossing**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 15.62 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	15.140	86.37
Impervious	98.00	0.480	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	15.140	0.56
Impervious	0.90	0.480	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.09
Ia =	6.01

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
150	0.10	46

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
950	0.08	0.13	122

Total Tc (min)	Total Tp (hr)
169	**1.88**

Intensity

Return Period	Intensity (mm/hr)
2-Year	9.6
5-Year	12.8
10-Year	14.9
25-Year	17.6
50-Year	19.5
100-Year	21.5

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.23	0.15	0.19	0.23	
5-Year	0.31	0.25	0.30	0.31	
10-Year	0.36	0.32	0.38	0.38	Design Storm
25-Year	0.43	0.42	0.49	0.49	
50-Year	0.48	0.49	0.56	0.56	
100-Year	0.52	0.56	0.64	0.64	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C14**
Pipe Diameter	**900mm Ø HDPE**
Pipe Length	12.2m
Design Storm	10-Year
Check Storm	100-Year

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)
0.23	0.23	28.97	0.37	0.51	0.70	0.21	0.46	0.46	0.59	0.39
0.27	0.27	29.02	0.41	0.56	0.75	0.23	0.50	0.50	0.65	0.40
0.31	0.31	29.06	0.45	0.60	0.75	0.25	0.53	0.53	0.70	0.42
0.35	0.35	29.10	0.49	0.64	0.75	0.28	0.56	0.56	0.75	0.43
0.38	0.38	29.13	0.51	0.67	0.75	0.29	0.58	0.58	0.78	0.44
0.43	0.43	29.19	0.56	0.73	0.75	0.31	0.62	0.62	0.85	0.46
0.48	0.48	29.23	0.60	0.77	0.75	0.33	0.65	0.65	0.91	0.47
0.52	0.52	29.27	0.63	0.81	0.75	0.35	0.67	0.67	0.96	0.48
0.56	0.56	29.31	0.66	0.85	0.75	0.36	0.70	0.70	1.02	0.49
0.60	0.60	29.38	0.70	0.92	0.75	0.38	0.72	0.72	1.07	0.49
0.64	0.64	29.46	0.73	1.00	0.75	0.40	0.75	0.74	1.14	0.50

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.51	m
D =	0.90	m
HW/D =	0.57	**Pass**

100-Year Check

HW Elev =	29.46	m
CL Elev =	29.62	m
Overtopping =	N/A	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C15**
Location	**Lot 17, Concession 7 - ID 3**
Use	**Agricultural Crossing**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 10.30 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	9.980	86.37
Impervious	98.00	0.320	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	9.980	0.56
Impervious	0.90	0.320	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.07
Ia =	6.01

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
150	0.10	46

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
625	0.08	0.13	81

Total Tc (min)	Total Tp (hr)
127	**1.41**

Intensity

Return Period	Intensity (mm/hr)
2-Year	11.7
5-Year	15.7
10-Year	18.2
25-Year	21.5
50-Year	23.9
100-Year	26.2

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	0.13	0.16	0.19	
5-Year	0.25	0.21	0.25	0.25	
10-Year	0.29	0.27	0.32	0.32	Design Storm
25-Year	0.34	0.34	0.40	0.40	
50-Year	0.38	0.40	0.47	0.47	
100-Year	0.42	0.46	0.53	0.53	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C15**
Pipe Diameter	**750mm Ø HDPE**
Pipe Length	12.2m
Design Storm	10-Year
Check Storm	100-Year

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)
0.19	0.19	29.20	0.37	0.48	0.60	0.20	0.42	0.42	0.64	0.37
0.22	0.22	29.25	0.41	0.53	0.60	0.22	0.45	0.45	0.71	0.38
0.26	0.26	29.30	0.45	0.58	0.60	0.24	0.49	0.49	0.77	0.40
0.29	0.29	29.34	0.48	0.62	0.60	0.26	0.52	0.52	0.83	0.41
0.32	0.32	29.38	0.52	0.66	0.60	0.28	0.54	0.54	0.89	0.42
0.36	0.36	29.48	0.56	0.76	0.60	0.30	0.57	0.57	0.97	0.43
0.39	0.39	29.56	0.60	0.84	0.60	0.32	0.60	0.59	1.05	0.44
0.43	0.43	29.63	0.64	0.91	0.60	0.33	0.60	0.62	1.14	0.45
0.46	0.46	29.70	0.69	0.98	0.60	0.35	0.60	0.64	1.23	0.46
0.50	0.50	29.77	0.73	1.05	0.60	0.36	0.60	0.66	1.32	0.47
0.53	0.53	29.84	0.78	1.12	0.60	0.38	0.60	0.68	1.41	0.48

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.52	m
D =	0.75	m
HW/D =	0.69	**Pass**

100-Year Check

HW Elev =	29.84	m
CL Elev =	29.95	m
Overtopping =	N/A	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C16**
Location	**Lot 16, Concession 7 - ID 3**
Use	**Agricultural Crossing**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 6.91 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	6.695	86.37
Impervious	98.00	0.215	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	6.695	0.56
Impervious	0.90	0.215	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.07
Ia =	6.01

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
150	0.10	46

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
425	0.08	0.13	55

Total Tc (min)	Total Tp (hr)
101	**1.13**

Intensity

Return Period	Intensity (mm/hr)
2-Year	13.8
5-Year	18.4
10-Year	21.4
25-Year	25.2
50-Year	28.0
100-Year	30.8

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.15	0.10	0.13	0.15	
5-Year	0.20	0.17	0.20	0.20	
10-Year	0.23	0.21	0.25	0.25	Design Storm
25-Year	0.27	0.28	0.32	0.32	
50-Year	0.30	0.32	0.37	0.37	
100-Year	0.33	0.37	0.42	0.42	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C16**
Pipe Diameter	**600mm Ø HDPE**
Pipe Length	12.2m
Design Storm	10-Year
Check Storm	100-Year

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)
0.15	0.15	29.35	0.36	0.47	0.45	0.19	0.37	0.37	0.73	0.35
0.18	0.18	29.42	0.40	0.54	0.45	0.21	0.41	0.41	0.81	0.36
0.20	0.20	29.53	0.45	0.65	0.45	0.23	0.43	0.43	0.91	0.38
0.23	0.23	29.63	0.50	0.75	0.45	0.25	0.45	0.46	1.02	0.39
0.25	0.25	29.70	0.53	0.82	0.45	0.26	0.45	0.48	1.10	0.40
0.29	0.29	29.82	0.61	0.94	0.45	0.29	0.45	0.51	1.26	0.41
0.31	0.31	29.91	0.67	1.03	0.45	0.30	0.45	0.53	1.38	0.42
0.34	0.34	30.02	0.75	1.14	0.45	0.32	0.45	0.55	1.50	0.43
0.37	0.37	30.12	0.83	1.24	0.45	0.33	0.45	0.57	1.62	0.44
0.39	0.38	30.18	0.87	1.30	0.45	0.34	0.45	0.59	1.67	0.44
0.42	0.38	30.20	0.86	1.32	0.45	0.34	0.45	0.61	1.67	0.45

10-Year Check

Design Criteria HW/D < 1.5

HW =	0.53	m
D =	0.60	m
HW/D =	0.88	**Pass**

100-Year Check

HW Elev =	30.20	m
CL Elev =	29.95	m
Overtopping =	N/A	m

Methodology	**VISUAL OTTHYMO**
Unit Hydrograph	**NASHYD**
Description	**C17**
Location	**Lot 16, Concession 7 - ID 2**
Use	**Agricultural Crossing**
Design Storm	10-Year HW/D < 1.5
Check Storm	100-Year

Watershed Area A= 3.24 ha

Curve Number

Land Use	Curve Number	Area (ha)	Balanced Curve Number
Pervious	86.00	3.138	86.38
Impervious	98.00	0.103	

*Reference Source: MTO Management Manual - Design Chart 1.09

Runoff Coefficient

Land Use	Runoff Coefficient	Area (ha)	Balanced Runoff Coefficient
Pervious	0.55	3.138	0.56
Impervious	0.90	0.103	

*Reference Source: MTO Management Manual - Design Chart 1.07

Initial Abstraction

CN > 80<90	Ia = 0.15S
S =	40.05
Ia =	6.01

Time of Concentration

Total Overland Flow Distance (m)	Slope of Land (%)	Overland Flow Tc (min)
150	0.10	46

Ditch Length (m)	Ditch Slope (%)	Ditch Velocity (m/s)	Ditch Tc (min)
200	0.08	0.13	26

Total Tc (min)	Total Tp (hr)
72	**0.80**

Intensity

Return Period	Intensity (mm/hr)
2-Year	17.5
5-Year	23.3
10-Year	27.1
25-Year	31.9
50-Year	35.5
100-Year	39.0

Peak Flow

Return Period	Results (m^3/s)				
	Rationale Method	12-Hour SCS Type II	24-Hour SCS Type II	Max	
2-Year	0.09	0.06	0.08	0.09	
5-Year	0.12	0.10	0.12	0.12	
10-Year	0.14	0.13	0.15	0.15	Design Storm
25-Year	0.16	0.17	0.19	0.19	
50-Year	0.18	0.20	0.22	0.22	
100-Year	0.20	0.22	0.25	0.25	Check Storm

Methodology	**HY-8 RESULTS**
Description	**C17**
Pipe Diameter	**600mm Ø HDPE**
Pipe Length	15.2m
Design Storm	10-Year
Check Storm	100-Year

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)
0.09	0.09	29.42	0.26	0.35	0.45	0.14	0.29	0.29	0.54	0.30
0.11	0.11	29.45	0.29	0.38	0.45	0.15	0.32	0.31	0.59	0.32
0.12	0.12	29.49	0.31	0.42	0.45	0.17	0.34	0.34	0.64	0.33
0.14	0.14	29.52	0.34	0.45	0.45	0.18	0.36	0.36	0.69	0.34
0.15	0.15	29.55	0.36	0.48	0.45	0.19	0.38	0.37	0.72	0.35
0.17	0.17	29.62	0.39	0.55	0.45	0.21	0.40	0.40	0.79	0.36
0.19	0.19	29.68	0.42	0.62	0.45	0.22	0.42	0.42	0.84	0.37
0.20	0.20	29.75	0.44	0.68	0.45	0.23	0.44	0.43	0.90	0.37
0.22	0.22	29.82	0.47	0.75	0.45	0.24	0.45	0.45	0.96	0.38
0.23	0.23	29.88	0.50	0.81	0.45	0.25	0.45	0.46	1.03	0.39
0.25	0.25	29.94	0.53	0.87	0.45	0.26	0.45	0.48	1.10	0.40

10-Year Check

Design Criteria HW/D < 1.5

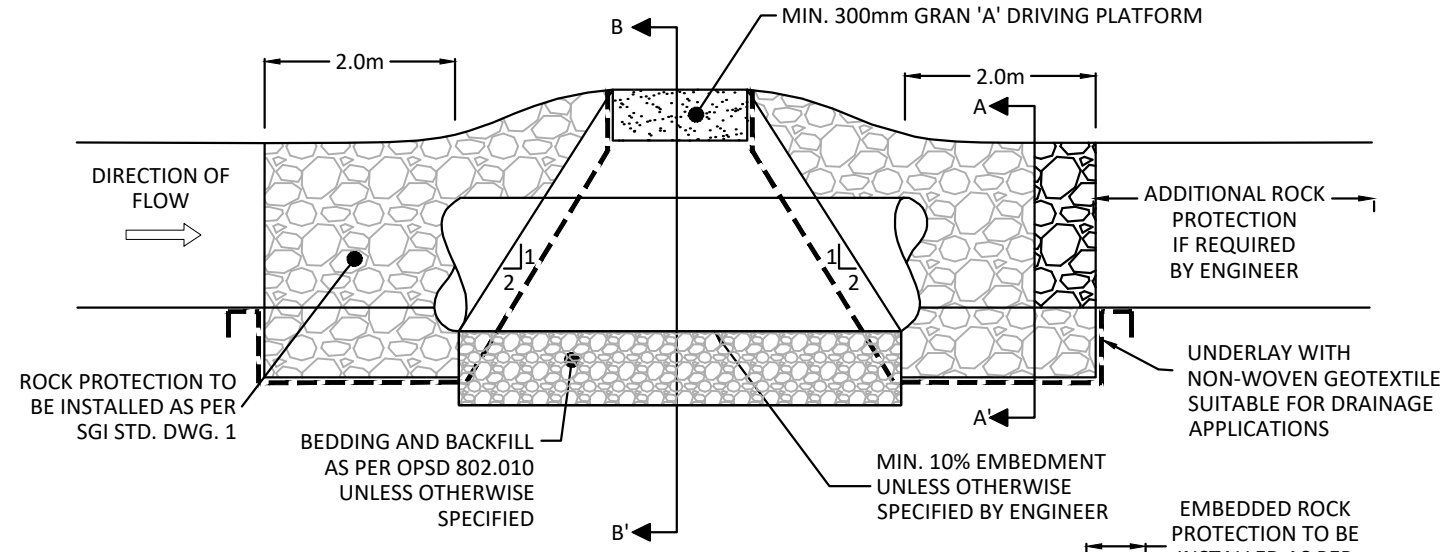
HW =	0.36	m
D =	0.60	m
HW/D =	0.60	**Pass**

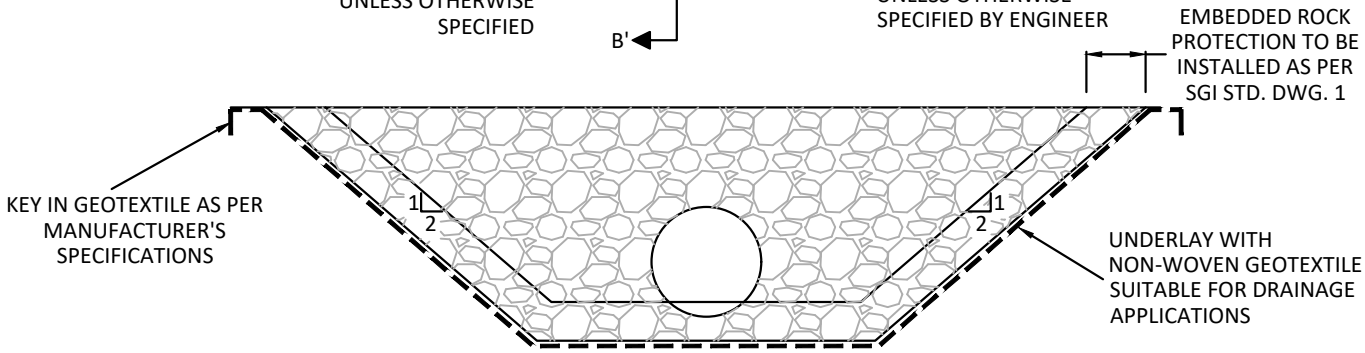
100-Year Check

HW Elev =	29.94	m
CL Elev =	29.95	m
Overtopping =	N/A	m

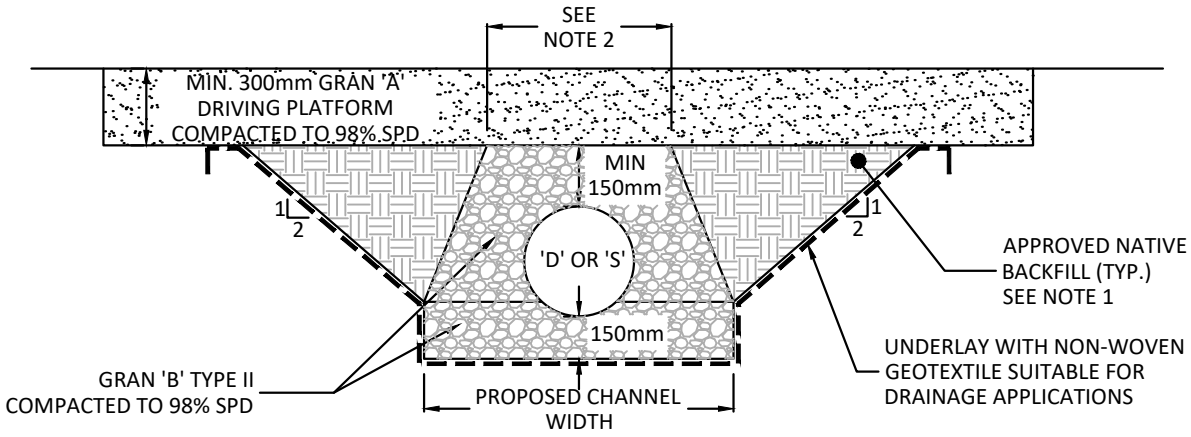
APPENDIX E

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

DETAIL DWG.NO.
SGI STD. DWG. 4

SHADE GROUP INC

CULVERT INLET/END PROTECTION

REVISION	DATE
00	FEB/24

SCALE
N.T.S

APPENDIX F

CONSTRUCTION COST ESTIMATES

Project Cost Estimate

Lionel Levac Municipal Drain - West Section - Estimated Construction Cost

Construction Estimate				
Item	**Unit**	**Quantity**	**Cost/Unit**	**Total**
Remove and Replace Crossing C1 Remove existing pipe + dispose, Install 1200mm Ø HDPE x 18.3m, Install applicable end treatment, Reinstatement of gravel crossing	m	18.3	$ 780.00	$ 14,274.00
Remove and Replace Enclosure E4 Remove existing pipe + dispose, Install 1050mm Ø HDPE x 33.0m, Install applicable end treatment Reinstatement of gravel entrance Reinstatement of front lawn (topsoil/seed)	m	33.0	$ 665.00	$ 21,945.00
Remove and Replace Enclosure E5 Remove existing pipe + dispose, Install 1050mm Ø HDPE x 82.5m, Install applicable end treatment Reinstatement of 2 laneways Reinstatement to gravel only Reinstatement of front lawn (topsoil/seed)	m	82.5	$ 750.00	$ 61,875.00
Remove and Replace Crossing C6 Remove existing pipe + dispose, Install 1050mm Ø HDPE x 19.8m, Install applicable end treatment Reinstatement of gravel crossing	m	19.8	$ 700.00	$ 13,860.00
Remove and Replace Enclosure E7 Remove existing pipe + dispose, Install 900mm Ø HDPE x 33.5m, Install applicable end treatment Reinstatement of gravel entrance Reinstatement of front lawn (topsoil/seed)	m	33.5	$ 550.00	$ 18,425.00
Remove and Replace Enclosure E8 Remove existing pipe + dispose, Install 750mm Ø HDPE x 39.6m, Install applicable end treatment Reinstatement of gravel entrance Reinstatement of front lawn (topsoil/seed)	m	39.6	$ 390.00	$ 15,444.00
Remove and Replace Crossing C9 Remove existing pipe + dispose, Install 750mm Ø HDPE x 18.3m, Install applicable end treatment Reinstatement of gravel crossing	m	18.3	$ 530.00	$ 9,699.00

SHADE GROUP INC

Project Cost Estimate

Lionel Levac Municipal Drain - West Section - Estimated Construction Cost

Remove and Replace Crossing C10 Remove existing pipe + dispose, Install 600mm Ø HDPE x 15.2m, Install applicable end treatment Reinstatement of gravel crossing	m	15.2	$ 460.00	$ 6,992.00
Open Channel Maintenance	m	2,510	$ 10.00	$ 25,100.00

Sub-Total - Construction Costs		$ 187,614.00
Contingency Allowance - Construction	10%	$ 18,761.40
Sub-Total - Construction Costs (Pre-Tax)		**$ 206,375.40**

Engineering Estimate

Item	Unit	Quantity	Cost/Unit	Total
Engineer's Report	Lump Sum	61%	$ 21,000.00	$ 12,834.62
Sub-Total - Engineering Costs (Pre-Tax)				**$ 12,834.62**

Summary

Sub-Total - Construction Costs (Pre-Tax)	$ 206,375.40
Sub-Total - Engineering Costs (Pre-Tax)	$ 12,834.62
Estimated Project Total	**$ 219,210.02**

SHADE GROUP INC

Project Cost Estimate

Lionel Levac Municipal Drain - East Section - Estimated Construction Cost

Construction Estimate				
Item	**Unit**	**Quantity**	**Cost/Unit**	**Total**
Remove and Replace Crossing E11 Brushing and clearing as needed Remove existing pipe + dispose Install 600mm Ø HDPE x 33.5m Install applicable end treatment Reinstatement of gravel entrance	m	33.5	$ 410.00	$ 13,735.00
Remove and Replace Crossing C12 Remove existing culvert, Install 600mm Ø HDPE x 15m Incl. applicable End Treatment Reinstate gravel entrance	m	15	$ 465.00	$ 6,975.00
Open Channel Maintenance	m	330	$ 10.00	$ 3,300.00
Sub-Total - Construction Costs				$ 24,010.00
Contingency Allowance - Construction		10%		$ 2,401.00
Sub-Total - Construction Costs (Pre-Tax)				**$ 26,411.00**

Engineering Estimate				
Item	**Unit**	**Quantity**	**Cost/Unit**	**Total**
Engineer's Report	Lump Sum	8%	$ 21,000.00	$ 1,706.34
Sub-Total - Engineering Costs (Pre-Tax)				**$ 1,706.34**

Summary	
Sub-Total - Construction Costs (Pre-Tax)	$ 26,411.00
Sub-Total - Engineering Costs (Pre-Tax)	$ 1,706.34
Estimated Project Total	**$ 28,117.34**

SHADE GROUP INC

Project Cost Estimate

Deschamps Municipal Drain - Estimated Construction Cost

Construction Estimate

Item	Unit	Quantity	Cost/Unit	Total
Remove and Replace Crossing E13 Remove existing pipe + dispose, Install 900mm Ø HDPE x 54.9m, Install applicable end treatment Reinstatement of gravel entrance Reinstate front lawn (topsoil/seed)	m	54.9	$ 675.00	$ 37,057.50
Remove and Replace Crossing C14 Remove existing culvert, Install 900mm Ø HDPE x 12.2m, Incl. applicable End Treatment Reinstate gravel entrance	m	12.2	$ 800.00	$ 9,760.00
Remove and Replace Crossing C15 Remove existing culvert, Install 600mm Ø HDPE x 15m Incl. applicable End Treatment Reinstate gravel entrance	m	12.2	$ 610.00	$ 7,442.00
Remove and Replace Crossing C16 Remove existing culvert, Install 600mm Ø HDPE x 15m Incl. applicable End Treatment Reinstate gravel entrance	m	12.2	$ 485.00	$ 5,917.00
Remove and Replace Crossing C17 Remove existing culvert, Install 600mm Ø HDPE x 15m Incl. applicable End Treatment Reinstate gravel entrance	m	15.2	$ 465.00	$ 7,068.00
Open Channel Maintenance	m	1,280	$ 10.00	$ 12,800.00
Sub-Total - Construction Costs				$ 80,044.50
Contingency Allowance - Construction		10%		$ 8,004.45
Sub-Total - Construction Costs (Pre-Tax)				**$ 88,048.95**

Engineering Estimate

Item	Unit	Quantity	Cost/Unit	Total
Engineer's Report	Lump Sum	31%	$ 21,000.00	$ 6,459.04
Sub-Total - Engineering Costs (Pre-Tax)				**$ 6,459.04**

Summary

Sub-Total - Construction Costs (Pre-Tax)	$ 88,048.95
Sub-Total - Engineering Costs (Pre-Tax)	$ 6,459.04
Estimated Project Total	**$ 94,507.99**

SHADE GROUP INC

APPENDIX G

SPECIES AT RISK REVIEW

Species at Risk Screening Memo

To: Monica Shade

Cc: Eric Leroux

From: Heather Lunn

Date: September 2, 2025

Subject: Species at Risk screening for the Lionel Levac + Deschamps Municipal Drains Municipal Drain

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Introduction

The following memo provides background information and a preliminary screening and assessment for the potential presence of species at risk (SAR) and their habitat within the Lionel Levac + Deschamps Municipal Drain (see attached Figure 1 for study area location). It also provides a rationale (where required), for avoiding prohibited impacts as a result of proposed drain-clean out works to SAR potentially present within the study area.

Background Information

Species listed as endangered or threatened on the Species at Risk in Ontario list, and their habitat, are afforded protection under the Endangered Species Act, 2007.

The following sources of background information were investigated to determine potential presence of SAR within the study area:

- Ministry of Natural Resources National Heritage Information Centre (Make A Map Natural Heritage Areas)
- Ontario Breeding Bird Atlas
- Ontario Reptile and Amphibian Atlas

According to the above sources, the following SAR have the potential to be present within the study area:

- Eastern Meadowlark (*Sturnella magna*) - Threatened
- Bobolink (*Dolichonyx oryzivorus*) – Threatened
- Eastern Wood-pewee (*Contopus virens*) – Special Concern

Potential Impacts & Mitigation

The Eastern Meadowlark and Bobolink are species of birds that nest within grassland and field habitat. They are not aquatic or semi-aquatic species, and do not utilize drainage features for breeding, nesting or foraging purposes. Similarly, the Eastern Wood-pewee, a bird that nests within forested habitat, does not use drainage features for breeding, nesting or foraging purposes.

Given that all SAR identified within background information are not aquatic or semi-aquatic species, it can be assumed that they would not be present or have habitat within the drains proposed for clean-out activities. In addition, recent aerial imagery of the study area shows habitat within the study area to be consistent with those species identified by background information as potentially present.

Due to the lack of SAR habitat present within the drains, mitigation measures are not deemed required for the drain clean-out projects.

Conclusion

As a result of the above information, negative impacts to SAR or their habitat are not anticipated due to the proposed drain-clean out projects within the study area.

Heather Lunn
V.P. of Environmental
Shade Group Inc.
heather@shadegroup.ca

Figure 1: Lionel Levac + Deschamps Municipal Drains

APPENDIX H

BY-LAWS

CORPORATION OF THE NATION MUNICIPALITY

BY-LAW NO. 83-2025

Being a by-law to appoint Shade Group Inc. to review the **Deschamps and Lionel Levac** Municipal Drains, under Section 78(1), major improvement, upon examination and report of engineer, of the *Drainage Act.*

REFERENCE: Section 78(1) of the Drainage Act, R.S.O. 1990, c. D. 17.

WHEREAS the original report by Ghislain E. Seguin and Associates Limited for the Deschamps Municipal Drain and Lionel Levac Municipal Drain was adopted by the Township of Caledonia in 1975;

WHEREAS an Engineer's Report was presented for Major Improvements under Sections 74 and 75 of the *Drainage Act* for the Lionel Levac Municipal Drain in 1982.

AND WHEREAS, The Nation Municipality's Drainage Superintendent found significant changes made to the crossing infrastructure along the Lionel Levac Municipal Drain since the adoption of the current governing Engineer's Report;

AND WHEREAS field observations by the Drainage Superintendent have revealed that additional culverts and front yard enclosures have been installed which are not accounted for in the existing report, and that many of the existing crossings are narrower than current design standards and include headwalls that warrant technical reassessment;

AND WHEREAS The Nation Municipality deems it appropriate and beneficial to initiate a review of the Lionel Levac Municipal Drain under Section 78(1) of the Drainage Act, R.S.O. 1990, to update the Engineer's Report in order to reflect the current infrastructure and to assess whether further improvements are required to meet modern design standards;

AND WHEREAS the Deschamps Municipal Drain shares the same watershed boundary and outlets into the Lionel Levac Municipal Drain, and has historically been addressed in conjunction with it in past Engineer's Reports;

AND WHEREAS undertaking a joint review of the Deschamps and Lionel Levac Municipal Drains through a single engineering appointment will result in both technical consistency and cost savings, and will proactively address infrastructure of similar age and condition within a unified system;

AND WHEREAS the costs associated with the preparation of this new engineering report shall be apportioned among affected landowners within the watershed, relevant road authorities contributing to the watershed flow, in accordance with the *Drainage Act*;

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

1. THAT Council appoint Shade Group Inc. to review the **Deschamps and Lionel Levac** Municipal Drains existing engineer's reports.

2. THAT the landowners, including road authorities within the **Deschamps and Lionel Levac** Municipal Drains watershed as deemed proper by the engineer's cost shares, to be responsible for the costs of the revised Engineer's Report.

3. THAT by-law shall come into force on June 30, 2025.

READ A FIRST, SECOND AND DULY PASSED UPON THE THIRD READING IN OPEN COUNCIL THIS **23rd day of June 2025**.

Francis Brière, Mayor

Aimée Roy, Clerk