# REGULAR COUNCIL AGENDA

**C-07/2021 - Regular Council**
**Monday, April 19, 2021**
**5:30 PM**
**Town of Pelham Municipal Office - Council Chambers**
**20 Pelham Town Square, Fonthill**

During the ongoing global pandemic, Novel Coronavirus COVID-19, the Town of Pelham Council will continue to convene meetings in compliance with Provincial directives. Attendance by most Members of Council will be electronic. Public access to meetings will be provided via Livestream www.youtube.com/townofpelham/live and subsequent publication to the Town's website at www.pelham.ca.

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Pages

1. **Call to Order and Declaration of Quorum**

2. **Approval of Agenda**

3. **Disclosure of Pecuniary Interests and General Nature Thereof**

4. **Hearing of Presentation, Delegations, Regional Report**

   4.1. **Presentations**

      4.1.1. **COVID-19 Pandemic Update - CEMC**

      B. Lymburner, Community Emergency Management Co-Ordinator

      4.1.2. **COVID-19 Pandemic Update - CAO**

1. By-law #4338(2021) - Being a by-law to appoint an Emergency Management Control Group for the Town of Pelham, and to Repeal and Replace By-law #3874(2017);

2. By-law #4339(2021) - Being a by-law to amend By-law No. 4299(2020) to establish 2021 Fees and Charges to be collected by the Corporation of the Town of Pelham; And to amend Schedule “1”, Recreation & Culture Services.

3. By-law #4340(2021) - Being a by-law to Authorize the Execution of Grant Funding Agreements between the Town of Pelham and Her Majesty the Queen in Right of Ontario, as represented by the Minister of Transportation Relating to Funding Provided as follows: $58,854 Dedicated Gas Tax Funds for Public Transportation Program 2020-2021

4. By-law #4341(2021) - Being a by-law to adopt the estimates for the Town of Pelham for its own operations for the year 2021

## 14. Motions and Notices of Motion

### 14.1. Motion Re: Request to Region of Niagara to Delay Official Plan Update

Referred from April 6, 2021

Moved by Councillor Stewart

Seconded by Councillor Haun

WHEREAS the Province of Ontario, through the Planning Act, requires that the Region of Niagara conduct a municipal comprehensive review (MCR) of its Official Plan whereby decisions must be made as to how all of the population and employment growth is to be accommodated in the local municipalities for the years 2031 to 2051;

AND WHEREAS since June 2019 the Province has amended a number of Provincial Statutes and policies that impact how municipalities plan for growth including the following:

- The Provincial Policy Statement,
- A Place to Grow: The Growth Plan for the Greater Golden Horseshoe,
- The Development Charges Act,
- The Planning Act,
- The Environmental Assessment Act, and
- The Conservation Authorities Act;

AND WHEREAS these significant Provincial changes include:

• reduced density targets in new greenfield development from 80 persons and jobs per hectare to 50 persons and jobs per hectare,
• reduced intensification targets from 60% beyond 2031 to 50%,
• setting minimum population and employment growth forecasts that can be exceeded subject to Provincial approval,
• extended the planning horizon from 2041 to the year 2051,
• introduced market demand as a consideration in determining the housing mix, and
• revisions to how municipalities fund growth;

AND WHEREAS these Provincial changes signal an abrupt shift from the emphasis on creating compact and complete communities to a planning regime that facilitates lower density and car dependent communities;

AND WHEREAS several Regions throughout Ontario have declared climate change emergencies and must consider the role of land use planning in their strategies to reduce their greenhouse gas emissions;

AND WHEREAS these Provincial changes create pressure to convert more class 1, 2 and 3 farmland in to urban uses than would otherwise be necessary which is contrary to Niagara's Official Plan as it relates to the protection of the agricultural system in Niagara;

AND WHEREAS ensuring that Ontarians have access to healthy safe food in the future requires thoughtful consideration of the long term impact of converting thousands of acres of prime agricultural lands in the Greater Golden Horseshoe to urban uses;

AND WHEREAS the change of the planning horizon to 2051 by the Province means that future municipal councils and the public will have little power to change decisions where they will grow after 2031 to the 2051 planning horizon;

AND WHEREAS in the rural areas internet service is often poor, making it difficult for rural residents to participate in zoom calls;

AND WHEREAS Niagara Region has adopted a public engagement initiative for the Niagara Official Plan review that includes public surveys, stakeholder input, direct public input and a Planning Advisory Committee;

AND WHEREAS the current pandemic is making effective, in person public consultation impossible at a time when robust, informed public consultation is needed more than ever;

AND WHEREAS the nature of work has evolved in response to the pandemic which may cause long term changes to the assumptions underlying the province's Land Needs Assessment.

NOW THEREFORE BE IT RESOLVED THAT Pelham Council request the Niagara Regional Chair to write to request the Province to allow the Region to delay its final report on its Official Plan Review until proper, in person, informed consultation with the public has been conducted on the growth concepts and the preferred growth concept;

AND FURTHER THAT the Province be requested to allow the new Regional Official Plan which identifies non-discretionary components of a Regional Urban Structure that support local plans and priorities inside the current urban boundaries, exempt from the requirement for in-person consultation with the public;

AND FURTHER THAT the Province be requested to suspend the timetable for municipal conformity to the Growth Plan and the Provincial Policy Statement to ensure that the public can fully participate in the process of planning their communities for the growth planning period covering 2031 to 2051;

AND FURTHER THAT the Province suspend the deadlines it has set for conformity until the Land Needs Assessment Framework can be revisited to adjust to the significant changes to the nature of work that are reducing office space and parking space needs.

AND FURTHER THAT this resolution be circulated to Premier Doug Ford, the Honourable Steve Clark, Minister of Municipal Affairs and Housing, Niagara's Local Municipalities, the Association of Municipalities of Ontario, the leaders of the Provincial opposition parties, Niagara's MPP's, and the Greater Golden Horseshoe municipalities.

### 14.2. Motion Re: Request for Erosion Mitigation - Headwaters of Twelve Mile Creek

Moved by Mayor Junkin

Seconded by Councillor Olson

WHEREAS an erosion condition present at the Headwaters of the Twelve Mile Creek has been deemed critical by experts in fish and fish habitat;

AND WHEREAS there is significant potential for increased damage to said Headwaters as a result of heavy rains;

AND WHEREAS Council for the Town of Pelham is desirous to expeditiously move forward to find solutions to resolve this erosion problem;

AND WHEREAS the Treasurer for the Town of Pelham has provided assurance that funds are available in the Roads Reserve in the amount of $60,000 to $70,000, being an estimated cost to remediate erosion problems;

NOW THEREFORE BE IT RESOLVED that Council direct staff to issue a Request for Proposals to undertake a Design/Build initiative to determine an optimal solution to identify, remediate and resolve the erosion problems at the Headwaters of the Twelve Mile Creek, immediately north of Regional Road 20 (Highway 20);

AND THAT as the Town moves forward with said repairs, Staff be further directed to contact the Regional Municipality of Niagara, Upper Canada Consultants, Trout Unlimited and the

Niagara Peninsula Conservation Authority to seek contributions toward the cost of said repairs, in consideration of the paramount environmental significance of the erosion;

AND THAT Staff provide regular update reports to Council on the project.

## 14.3. Motion Re: Solar Generators at the Meridian Community Centre and Other Municipal Structures

Moved by Councillor Olson

Seconded by Councillor Wink

WHEREAS Council for the Town of Pelham wishes to explore the potential of retrofitting solar generators at the Meridian Community Centre and all municipal structures as a power source;

AND WHEREAS Council is aware that a two ice-rink facility with solar generators is operated within Komoka within Middlesex Centre;

AND WHEREAS Council believes solar generators at the Meridian Community Centre and other municipal structures may result in cost-savings while supporting the strategic goal of supporting financial sustainability;

NOW THEREFORE BE IT RESOLVED that Council direct Staff to investigate the potential of retrofitting solar generators at the Meridian Community Centre and other municipal structures as a power source and report back to Council by June 21, 2021.

## 14.4. Motion Re: Rescind Previous Decision - Transfer of Operating Authority Niagara Central Dorothy Rungeling Airport and Niagara District Airport

Moved by Councillor Haun

Seconded by Councillor Stewart

WHEREAS Town of Pelham Council approved a motion on July 20th, 2015 supporting the common position resolution regarding the uptake of governance and the transfer of operating authority of the Niagara Central Dorothy Rungeling Airport (NCDRA) and Niagara District Airport (NDA); and

WHEREAS the NCDRA Commission can be self-sustaining under proper management;

THEREFORE BE IT RESOLVED THAT the Council of the Town of Pelham rescinds the approved motion of council regarding the uptake of governance for the transfer and operating authority of the NCDRA and NDA to the Niagara Region;

AND THAT Town of Pelham Council approves retaining the governance and ownership of NCDRA;

AND THAT a copy of this resolution be forwarded to the City of Welland, City of Port Colborne and Township of Wainfleet for consideration and support;

AND FURTHER THAT a copy of this resolution be forwarded to the Niagara Region and Niagara Municipalities for support.

## 15. Matters for Committee of the Whole or Policy and Priorities Committee

## 16. Matters Arising Out of Committee of the Whole or Policy and Priorities Committee

## 17. Resolution to Move in Camera

Section 239(2)(k): a position, plan, procedure, criteria or instruction to be applied to any negotiations carried on or to be carried on by or on behalf of the municipality or local board (1 item)

## 18. Rise From In Camera

## 19. Confirming By-Law 445 - 445

## 20. Adjournment

# Report of Regional Councillor

Diana Huson

# Overview of Updates

- Niagara Peninsula Conservation Authority
- Economic Development
- EMS Services

NIAGARA PENINSULA CONSERVATION AUTHORITY

# Restoration Program Update

## *What is it?*

In 2019 the NPCA re-launched its restoration program that aimed to:
*'Fostering collaboration among partners in the watershed to protect and restore water quality and diverse habitats by completing projects that meet the long-term mandate of the NPCA.'*

## *Goals of the Program*

1. ***Improve*** water quality, wildlife habitat, and forest cover to the benefit of local ecosystems and the overall health of the watershed;
2. ***Monitor, assess, and communicate the change*** of these conditions in the watershed; and
3. ***Enable innovative approaches, partnerships, and solutions*** to improve water quality, wildlife habitat, and forest cover.

NIAGARA PENINSULA
CONSERVATION
AUTHORITY

## Who can apply?

1. Private and Public Landowners
2. Incorporated Non-Governmental Organizations (NGOs)
3. Non-incorporated organizations (Nature Clubs, "Friends of" organizations)

## Restoration Work in Pelham

| Year | Projects & Work Achieved |
|---|---|
| 2019 | # of projects = 3 (1 wetland creation, 2 tree-plantings)<br>Area restored = 4.5 ha (1 wetland created, 2 areas reforested)<br># of trees planted = 7,660 |
| 2020 | # of projects = 4 (1 tree-planting, 2 riparian plantings, 1 upland and riparian planting)<br>Area restored = 1.9 ha (1 area reforested, 3 riparian areas restored, 1 upland habitat area restored)<br># of trees planted = 3,650<br># of shrubs planted = 255<br># of herbaceous plants planted = 1165 |

NIAGARA PENINSULA CONSERVATION AUTHORITY

## Strategic Plan – Currently in Progress

The NPCA is developing a new 10-year strategic plan to establish its direction and guide future operational activities. Currently collecting public input via a survey tool available now through to May 6, 2021.

## Getinvolved.npca.ca

The completed strategic plan will be presented to the Board of Directors in Summer 2021.

# Economic Development

## Business Impact Survey

- The Niagara Economic Rapid Response Team is conducting a 3rd business impact survey
- Survey aims to better understand the impacts of the COVID-19 pandemic on Niagara's business
- Also is assessing the needs of Niagara businesses going into a post-pandemic future
- A final report of the data will be made publicly available online

**NiagaraCanada.ca**

# EMS
# Emergency Management Services

## Mobile Integrated Health Services Update

- MIH is a community-based health care model adopted by EMS
- Partners paramedics with other health care professionals to provide care needs within the home
- Service has been expanded to include the Community Paramedicine for Long Term Care program
- Will assist home bound individuals needing additional support with needs-based, on-site, urgent and non-urgent care
- Patients must qualify for long-term care and have a referral from the LHIN

# Questions?

# SPECIAL COUNCIL MINUTES

| | |
|---|---|
| **Meeting #:** | **SC-06/2021 Special Meeting of Council** |
| **Date:** | **Monday, March 29, 2021, 5:00 pm** |
| **Location:** | **Town of Pelham Municipal Office - Council Chambers**<br>**20 Pelham Town Square, Fonthill** |
| **Members Present** | **Marvin Junkin**<br>**Lisa Haun**<br>**Bob Hildebrandt**<br>**Wayne Olson**<br>**Marianne Stewart**<br>**John Wink** |
| **Regrets** | **Ron Kore** |
| **Staff Present** | **David Cribbs**<br>**Nancy Bozzato**<br>**Jason Marr**<br>**Teresa Quinlin**<br>**Jennifer Stirton**<br>**Barbara Wiens**<br>**Sarah Leach**<br>**Holly Willford** |

## 1. Call to Order and Declaration of Quorum

Noting that a quorum was present, the Mayor called the meeting to order at approximately 5:00 pm.

## 2. Approval of the Agenda

**Moved By** Wayne Olson
**Seconded By** John Wink
**BE IT RESOLVED THAT the agenda for the March 29th, 2021 Special Meeting of Council be adopted as circulated.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Wayne Olson | X | |
| Marianne Stewart | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 3. Disclosure of Pecuniary Interest and General Nature Thereof

Councillor Hildebrandt and Councillor Haun each declared a pecuniary interest with respect to the second closed session agenda item. Each vacated the meeting at that point and did not return to the meeting following.

## 4. Resolution to Move in Camera

**Moved By** Lisa Haun
**Seconded By** Bob Hildebrandt
**BE IT RESOLVED THAT the next portion of the meeting be closed to the public in order to consider a matter under Section 239 (2) of the Municipal Act, as follows:**

**(e) - litigation or potential litigation, including matters before administrative tribunals, affecting the municipality; and (f) - advice that is subject to solicitor-client privilege, including communications necessary for that purpose; and Section 239(3.1) - Educational or training sessions. (2 Items)**

**(f) - advice that is subject to solicitor-client privilege, including communications necessary for that purpose; and (j) - a trade secret or scientific, technical, or financial information that belongs to the municipality or local board and has monetary value or potential monetary value (1 item)**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| Marianne Stewart | X | |
| John Wink | X | |
| **Results** | **7** | **0** |

**Carried (7 to 0)**

## 5. Rise From In Camera

**Moved By** Marianne Stewart
**Seconded By** John Wink

**BE IT RESOLVED THAT Council adjourn the In Camera Session and that Council do now Rise: With Report.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Wayne Olson | X | |
| Marianne Stewart | X | |
| John Wink | X | |
| **Results** | **4** | **0** |

**Carried (4 to 0)**

**Moved By** Wayne Olson
**Seconded By** John Wink
**BE IT RESOLVED THAT the Chief Administrative Officer and the Town's External Legal Counsel be and are hereby authorized to undertake the directions provided during the In Camera meeting of March 29th, 2021.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Wayne Olson | X | |
| Marianne Stewart | X | |
| John Wink | X | |
| **Results** | **4** | **0** |

**Carried (4 to 0)**

## 6. Confirming By-law

**Moved By** Marianne Stewart
**Seconded By** John Wink
**BE IT RESOLVED THAT the following By-law be read a first, second and third time and passed:**

**Being a By-law No. 4332(2021) to Adopt, Ratify and Confirm the proceedings of Council of the Town of Pelham at its Special Meeting held on the 29th day of March, 2021.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Wayne Olson | X | |
| Marianne Stewart | X | |

| | | |
|---|---|---|
| John Wink | X | |
| **Results** | **4** | **0** |

**Carried (4 to 0)**

## 7. Adjournment

**Moved By** Wayne Olson
**Seconded By** John Wink
**BE IT RESOLVED THAT this Special Meeting of Council be adjourned until the next regular meeting scheduled for April 6, 2021 at 5:30 pm.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Wayne Olson | X | |
| Marianne Stewart | X | |
| John Wink | X | |
| **Results** | **4** | **0** |

**Carried (4 to 0)**

Mayor Marvin Junkin

Deputy Clerk, Holly Willford

# REGULAR COUNCIL
# MINUTES

| | |
|---|---|
| **Meeting #:** | **C-06/2021 - Regular Council** |
| **Date:** | **Tuesday, April 6, 2021** |
| **Time:** | **5:30 PM** |
| **Location:** | **Town of Pelham Municipal Office - Council Chambers**<br>**20 Pelham Town Square, Fonthill** |
| **Members Present:** | **Marvin Junkin**<br>**Lisa Haun**<br>**Bob Hildebrandt**<br>**Ron Kore**<br>**Wayne Olson**<br>**John Wink** |
| **Regrets** | **Marianne Stewart** |
| **Staff Present:** | **David Cribbs**<br>**Nancy Bozzato**<br>**Bob Lymburner**<br>**Jason Marr**<br>**Teresa Quinlin**<br>**Vickie vanRavenswaay**<br>**Barbara Wiens**<br>**Holly Willford** |
| **Other:** | **R. Cook**<br>**R. Salewytsch, Item 4.2.1** |

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## 1. Call to Order and Declaration of Quorum

Noting that a quorum was present, the Mayor called the meeting to order at approximately 5:30 p.m.

## 2. Approval of Agenda

**Moved By** Bob Hildebrandt
**Seconded By** Wayne Olson

**BE IT RESOLVED THAT the agenda for the April 6, 2021 Regular meeting of Council be adopted, as amended to postpone**

**consideration of Item 14.2, and noting that the Mayor intends to bring a Notice of Motion, Item 14.3.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 3. Disclosure of Pecuniary Interests and General Nature Thereof

Councillor Wink noted that he has previously declared a pecuniary interest as it related to matters concerning Mountainview Homes, given that a principal of that corporation was a donor to his election campaign. However, given that the individual has now retired from this organization, Councillor Wink no longer has a conflict. This was confirmed with the Integrity Commissioner.

## 4. Hearing of Presentation, Delegations, Regional Report

### 4.1 Presentations

#### 4.1.1 COVID-19 Pandemic Update - CEMC

Fire Chief and Community Emergency Management Co-Ordinator presented updated information as it relates tot he ongoing worldwide pandemic, COVID-19. He specifically highlighted the current strain on the Ontario Hospital system due to this virus.

**Moved By** Ron Kore
**Seconded By** John Wink

**BE IT RESOLVED THAT Council receive the COVID-19 update presentation from B. Lymburner, Fire Chief and Community Emergency Management Co-Ordinator, for information.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |

| | | |
|---|---|---|
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

### 4.1.2 COVID-19 Pandemic Update - CAO

The CAO noted that the Meridian Community Centre is now set up and ready to serve as an inoculation site on April 8th. Further, he reported that due to the closure of the MCC two members of staff have been laid off and others will continue with digitizing corporate records. It was noted that while the Meridian Community Centre is closed for programs and activities, it will be open as a vaccination site as scheduled by Niagara Public Health.

**Moved By** John Wink
**Seconded By** Lisa Haun

**BE IT RESOLVED THAT Council receive the COVID-19 update presentation from D. Cribbs, Chief Administrative Officer, for information.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 4.2 Delegations

### 4.2.1 Regional Transit

Mr. Robert Salewytsch, Program Manager, Transit Services presented information as it relates to the Niagara Region Transit On Demand Pilot

Renewal. He provided updated statistics as they relate to Pelham ridership.

**Moved By** Wayne Olson
**Seconded By** John Wink

**BE IT RESOLVED THAT Council receive the delegation from Mr. Robert Salewytsch, Program Manager - Transit Services regarding the Niagara Region Transit On Demand Pilot Renewal, for information;**

**AND THAT Council approve the renewal of the Region - Town service partnership for year 2 of the Region's "On-Demand" pilot program with Via Mobility.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**4.3 Report of Regional Councillor**

No report.

**5. Adoption of Minutes**

**Moved By** Bob Hildebrandt
**Seconded By** John Wink

**BE IT RESOLVED THAT the following minutes be adopted as printed, circulated and read:**

**1. C05/2021 - Council Minutes - March 22, 2021**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |

| | | |
|---|---|---|
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**5.1 C05/2021 - Council Minutes - March 22, 2021**

**6. Business Arising from Council Minutes**

**6.1 Mountainview Letter - Park Place South Development**

Staff was provided guidance as to what additional information to include in the staff report.

**Moved By** Wayne Olson
**Seconded By** Bob Hildebrandt

**BE IT RESOLVED THAT Council receive correspondence from Mountainview Building Group dated March 26, 2021, regarding the Park Place South Development application 26T19-02-2020 and AM-08-20;**

**AND THAT Council refer the matter back to staff for further review specifically as it pertains to the construction of eight-unit back-to-back townhouse development;**

**AND THAT Council direct staff to provide an up-date report based on the concept drawings appended to this correspondence.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 7. Request(s) to Lift Consent Agenda Item(s) for Separate Consideration

Item 8.5.1 - Town of Brock Resolution was lifted for separate consideration.

## 8. Consent Agenda Items to be Considered in Block

**Moved By** Ron Kore
**Seconded By** John Wink

BE IT RESOLVED THAT the Consent Agenda items as listed on the April 6, 2021 Council Agenda be received and the recommendations contained therein be approved, as applicable:

- - - - - - - - - - - - - - - - - - - - - - -- - - - - - - - - - - - - - - - - - -

8.4 Action Correspondence of a Routine Nature

8.4.1 Proclamation Request - Pitch in Week

BE IT RESOLVED THAT the Corporation of the Town of Pelham hereby proclaim April 18th - 24th, 2021 as PITCH-IN Week.

8.4.2 Proclamation Request - Melanoma and Skin Cancer Awareness Month

BE IT RESOLVED THAT The Corporation of the Town of Pelham hereby proclaim May 2021 as Melanoma and Skin Cancer Awareness Month.

8.5 Information Correspondence Items

~~8.5.1 Town of Brock Resolution re: Cannabis Licencing and Enforcement~~

~~BE IT RESOLVED THAT Council receive correspondence from the Town of Brock regarding Cannabis Licencing and Enforcement, for information.~~ n (lifted for separate consideration)

8.5.2 Norfolk County Resolution re: Carbon Tax

BE IT RESOLVED THAT Council receive correspondence from Norfolk County regarding Carbon Tax, for information.

8.5.3 Regional Report CSD 81-2020 re Amending Agreement to the Niagara Region Courts Inter-Municipal Agreement

BE IT RESOLVED THAT Council receive Regional Report CSD 81-2020 regarding Amending Agreement to the Niagara Region Court Inter-Municipal Agreement, for information.

8.5.4 Annual Report of Integrity Commissioner

BE IT RESOLVED THAT Council receive for information the 2020 Annual Report of the Integrity Commissioner for the Town of Pelham;

AND THAT staff be directed to make the  necessary arrangements to conduct an education seminar as outlined therein.

8.5.5 Integrity Commissioner Review Report: IC-12627-0221

BE IT RESOLVED THAT Council receive for information the Integrity Commissioner correspondence, File IC-12627-0221, Town of Pelham File IC-03/2021.

8.5.6 Ontario News Release - Consultation to Strengthen Municipal Codes of Conduct

BE IT RESOLVED THAT Council receive for information the Ontario News Release - Consultation to Strengthen Municipal Codes of Conduct

8.7 Committee Minutes for Information

8.7.1 Pelham Library Board Minutes

BE IT RESOLVED THAT Council receive the Pelham Library Board minutes dated January 27, 2021, for information.

8.7.2 Cannabis Control Committee Minutes

BE IT RESOLVED THAT Council receive the Cannabis Control Committee minutes dated January 20, 2021, for information.

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 9. Items for Separate Consideration, if Any

### 9.1 Town of Brock Resolution re: Cannabis Licencing and Enforcement

**Moved By** Ron Kore
**Seconded By** John Wink

BE IT RESOLVED THAT Council receive correspondence from the Town of Brock regarding Cannabis Licencing and Enforcement, for information.

**Amendment**:
**Moved By** Bob Hildebrandt
**Seconded By** Lisa Haun

**THAT the motion be amended by replacing the words "for information" with "And that the motion be endorsed and supported".**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**Moved By** Ron Kore
**Seconded By** John Wink

**BE IT RESOLVED THAT Council receive correspondence from the Town of Brock regarding Cannabis Licensing and Enforcement;**

**AND THAT the motion be endorsed and supported.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 10. Presentation & Consideration of Reports

### 10.1 Reports from Members of Council:

No reports.

### 10.2 Staff Reports Requiring Action

### 10.2.1 By-law Enforcement Policy 2021, 2021-0069-Fire Dept

**Moved By** Bob Hildebrandt
**Seconded By** Ron Kore

**BE IT RESOLVED THAT Council receive Report #2021-0069;**

**AND THAT Policy #S502-05, By-law Enforcement Policy be submitted for Council approval at their next regular meeting.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

### 10.2.2 2021 Events and Festivals Update , 2021-0067-Recreation

**Moved By** Lisa Haun
**Seconded By** Wayne Olson

**BE IT RESOLVED THAT Council receive Report # 2021-0067-Recreation, 2021 Events and Festivals Update; and that recommendations within be accepted:**

**AND THAT staff be directed to submit two applications for the Reconnect funding opportunity through the Ontario Ministry of Heritage, Sport, Tourism and Culture Industries**

**AND THAT Council authorize the Clerk to make an application for a Special Occasion Permit for the Summer Chill Series,**

**AND THAT Council designate the Summer Chill Series as a Municipally Significant Event that will be held in the Peace Park on the following dates:**

**July 8, 2021 4:00pm-10:00pm Peace Park, Pelham Town Square**

**July 15, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**July 22, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**July 29, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**August 5, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**August 12, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**August 19, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**August 26, 20214:00pm-10:00pm Peace Park, Pelham Town Square**

**Sept, 2, 2021 4:00pm-10:00pm Peace Park, Pelham Town Square**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**10.2.3 Pelham Tennis Operations 2021, 2021-0066-Recreation**

**Moved By** Bob Hildebrandt
**Seconded By** Wayne Olson

**BE IT RESOLVED THAT Council receive Report #2021-0066-Recreation, Pelham Tennis Operations 2021;**

**AND THAT the Town of Pelham assist both pickleball volunteers and the Pelham Tennis Association in providing programs at the Centennial Park Tennis Court;**

**AND THAT the following fees, effective immediately, be included in the Town of Pelham user fee guide:**
**Family Membership $150.00**
**Single Adult Membership $100.00**

**Single Student Membership $50.00**
**Single Senior Membership $50.00**
**Children (12 years and under) Free**
**Lesson Fees will be determined based on competitive rates;**

**AND THAT staff be directed to update the Fees and Charges By-law to reflect these new fees;**

**AND THAT staff investigate funding opportunities for capital improvements to the tennis courts, due to base failure, resulting in cracking.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**10.2.4 2021 Gypsy Moth Management Program, 2021-0065-Public Works**

**Moved By** Ron Kore
**Seconded By** Bob Hildebrandt

**BE IT RESOLVED THAT Council receive Report #2021-0065, 2021 Gypsy Moth Management Program;**

**AND THAT the blocks identified in Report #2021-0065 be aerially sprayed for the Gypsy Moth in 2021;**

**AND THAT Council consider repealing and replacing By-Law 4208(2020) with By-law No.4334(2021) to allow for the implementation of an aerial spray program in 2021;**

**AND THAT Council approve the use of Zimmer Air Services to conduct the 2021 aerial spray program.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 11. Unfinished Business

### 11.1 Update Report - Proxy Voting for Members of Council, 2021-0064-Clerks

**Moved By** John Wink
**Seconded By** Wayne Olson

**BE IT RESOLVED THAT Council receive Report #2021-00064, Update Report – Proxy Voting for Members of Council;**

**AND THAT Council further receive Report 2021-0001, consideration of Procedure By-law Amendment, Proxy Voting for Absent Municipal Council Members, Bill 197, attached as Appendix 1, which was referred to a future meeting;**

**AND THAT Council not proceed with amendments to the Procedure By-law to permit Proxy Voting by Members of Council.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 12. New Business

None

## 13. Presentation and Consideration of By-Laws

**Moved By** John Wink
**Seconded By** Lisa Haun

**THAT consideration of proposed By-law 4336(2021) as it relates to File AM-08-20, Mountainview Homes (Niagara) Ltd. be referred back to staff, to be presented at a future Council meeting once a recommendation relating to this proposed development has been adopted.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**Moved By** Bob Hildebrandt
**Seconded By** Lisa Haun

**BE IT RESOLVED THAT the Council of the Town of Pelham, having given due consideration to the following By-laws do now read a first, second and third time and do pass same, and**

**THAT the Mayor and Clerk be and are hereby authorized to sign and seal the by-laws:**

**1. By-law 4333(2021) - Being a by-law to amend By-law #4068(2019) confirming various appointments to Boards, Commissions, and Committees of the Town of Pelham; And to remove and appoint members to the Pelham Public Art Committee (Schedule O).**

**2. By-law 4334(2021) - Being a by-law authorizing the implementation of a 2021 spray program respecting the gypsy moth, and to Repeal and Replace By-Law 4208(2020)**

**3. By-law 4335(2021) - Being a by-law to amend Zoning By-law 1136 (1987), as amended, for lands located at 855 Chantler Road (north side of Chantler Road lying west of Church Street), legally described as Concession 12 and Part of Lot 17 in the Town of Pelham. The Zoning By-law Amendment rezones the lands from the Agricultural (A) zone to the following site-specific zones: Agricultural – 304 (A-304) & Agricultural – 305 (A-305). Joyce and John Sonneveld, File No. AM-01-2021**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

## 14. Motions and Notices of Motion

### 14.1 Motion Re: Snow Clearing on Paved Portion of Steve Bauer Trail, Line Avenue to Port Robinson Road

Mayor Junkin vacated the Chair to present this motion. Deputy Mayor Hildebrandt presided.

**Moved By** Marvin Junkin
**Seconded By** Wayne Olson

**WHEREAS Council for the Town of Pelham recently approved hard surfacing along the Steve Bauer Trail between 1106 Line Avenue and Port Robinson Road,**

**AND WHEREAS it is recognized that the Minimum Maintenance Standards (MMS) and Pelham's Winter Operations Policy provide that paved sidewalks and multi-use paths are cleared of snow and ice, however due to the fact that the Steve Bauer Trail is a recreation trail that is not maintained during the winter months as noted in the Staff Report #2020-0080, winter maintenance has not been undertaken during the 2020-2021 winter season;**

**AND WHEREAS this hard surfaced area of the Steve Bauer Trail between 1106 Line Avenue and Port Robinson Road has**

**experienced a significant increase in multi-use participants since the paving has been completed;**

**NOW THEREFORE BE IT RESOLVED THAT Staff be directed to provide a report outlining the estimated additional costs that would be associated with including this portion of the Trail in the contract for sidewalk and multi-use path snow clearing as part of the 2022 budget;**

**AND THAT the report be provided for Council's consideration prior to the 2022 budget deliberations.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

### 14.2 Motion Re: Request to Region of Niagara to Delay Official Plan Update

Due to the absence of Councillor Stewart, this motion will be postponed for consideration at the next meeting, scheduled for April 19, 2021 in accordance with the Procedure By-law.

### 14.3 Notice of Motion: Mayor Junkin

The Mayor advised of his intention to bring a motion to the April 19th meeting which will request a staff report determining the cost and methods available for erosion control as it pertains to the headwaters of the 12 Mile Creek, north of Regional Road 20 as a result of the Stormwater Pond at the corner of Rice Road and Regional Road (Highway) 20.

### 14.4 Notice of Motion: Councillor Haun

Councillor Haun advised of her intention to bring a motion to the April 19th meeting requesting that Council rescind the previous Council's motion to upload the Niagara Central Dorothy Rungeling Airport to the Region of Niagara.

Mayor Junkin resumed the Chair at this point in the meeting.

**15. Matters for Committee of the Whole or Policy and Priorities Committee**

None

**16. Matters Arising Out of Committee of the Whole or Policy and Priorities Committee**

None

**17. Resolution to Move in Camera**

No closed session scheduled.

**18. Rise From In Camera**

Not applicable

**19. Confirming By-Law**

**Moved By** Ron Kore
**Seconded By** Lisa Haun

**BE IT RESOLVED THAT the following By-law be read a first, second and third time and passed:**

**Being a By-law No. 4337(2021) to Adopt, Ratify and Confirm the proceedings of Council of the Town of Pelham at its Regular Meeting held on the 06th day of April, 2021.**

| | For | Against |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

**20. Adjournment**

The Mayor, on behalf of the Town of Pelham, thanked Town Clerk, Nancy Bozzato, for her service to the Town of Pelham for more than 20 years and Niagara for the past 40. Ms. Bozzato will retire from civil service in the coming weeks, this being her final meeting of Council. Ms. Bozzato was presented flowers and a gift to celebrate this milestone event.

**Moved By** Wayne Olson
**Seconded By** Ron Kore

**BE IT RESOLVED THAT this Regular Meeting of Council be adjourned until the next regular meeting scheduled for April 19, 2021 at 5:30 pm.**

| | **For** | **Against** |
|---|---|---|
| Marvin Junkin | X | |
| Lisa Haun | X | |
| Bob Hildebrandt | X | |
| Ron Kore | X | |
| Wayne Olson | X | |
| John Wink | X | |
| **Results** | **6** | **0** |

**Carried (6 to 0)**

Mayor: Marvin Junkin

Town Clerk: Nancy J. Bozzato

Pelham NIAGARA

**CLERK'S OFFICE QUARTERLY REPORT**
Monday, April 19, 2021

**Reporting Period:** Clerk's Office Quarterly Report for the period: January – March 2021

**Recommendation:**

**BE IT RESOLVED THAT the Q1/2021 Clerk's Report be received for information.**

**Department Overview and Statistics:**

| Year | 2019 | 2020 | | | | 2021 | | | |
|---|---|---|---|---|---|---|---|---|---|
| Quarter (Year to Date) | Year End | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Insurance or Small Claims Processed (incl.potential) | 29 | 5 | 8 | 16 | 21 | 4 | | | |
| Pelham Deaths Registered | 68 | 11 | 36 | 53 | 64 | 28 | | | |
| Deaths Outside of Pelham Registered | 96 | 28 | 53 | 77 | 110 | 31 | | | |
| Lottery Licenses Issued | 33 | 7 | 7 | 9 | 12 | 1 | | | |
| Council Meetings Attended/Minuted | 21 | 5 | 11 | 17 | 21 | 5 | | | |
| Special Council Meetings Attended/Minuted | 41 | 6 | 10 | 15 | 18 | 7 | | | |
| COW Meetings Attended/Minuted | 17 | 2 | 2 | 4 | 6 | - | | | |
| Public Meetings Attended/Minuted | 6 | 2 | 2 | 4 | 8 | 3 | | | |
| P & P Meetings Attended/Minuted | 8 | 1 | 1 | 1 | 1 | - | | | |
| Affidavits Sworn | 127 | 38 | 39 | 58 | 79 | | | | |
| FOI Requests Received/Processed | 5 | 4 | 8 | 13 | 15 | 2 | | | |
| FOI Appeal or Complaint | 0 | - | - | - | 1 | - | | | |
| Closed Meeting Investigation | 0 | 1 | 1 | 1 | 1 | - | | | |
| Committee of Adjustment – Variances | 29 | 22 | 23 | 26 | 28 | 18 | | | |
| Committee of Adjustment – Consents | 12 | 9 | 9 | 11 | 11 | 18 | | | |
| Committee of Adjustment – Hearings | 13 | 6 | 11 | 15 | 15 | 4 | | | |
| LPAT Appeals C of A | 4 | 3 | 3 | 3 | 3 | - | | | |
| Property Standards Appeals | 0 | - | - | - | 0 | - | | | |
| Fence Viewing Meetings | 0 | - | - | - | 0 | - | | | |
| By-laws | 120 | 37 | 63 | 96 | 114 | 27 | | | |
| Itinerant Seller/Vehicle Licenses Issued | 1 | - | 1 | 1 | 1 | 1 | | | |
| Short Term Accommodation Licences Issued | - | - | - | 0 | 1 | 2 | | | |
| Wet/Dry Status to AGCO | 1 | - | 3 | 4 | 4 | - | | | |
| Sidewalk Patio/Sidewalk Sale Permits | 2 | - | - | 4 | 4 | | | | |
| Special Event Permit – Private | 1 | - | - | - | 0 | - | | | |
| Livestock Valuer Claims | 2 | - | - | - | 0 | - | | | |
| AMP Review Hearings | 19 | 23 | 23 | 28 | 29 | 1 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **AMP Review Decision Appeals** | **0** | **-** | **-** | **-** | **0** | **-** |
| **Marriage Licenses Issued** | **31** | **5** | **5** | **27** | **29** | **5** |
| **Civil Marriage Ceremonies Officiated** | **13** | **-** | **-** | **10** | **15** | **1** |
| **Proclamations** | **8** | **5** | **5** | **5** | **5** | **1** |
| **Press Releases** | **27** | **12** | **31** | **44** | **51** | **13** |
| **News Briefs** | **66** | **42** | **92** | **136** | **164** | **33** |
| **PSR** | **-** | **-** | **-** | **-** | **0** | **-** |

Please note, many of the statistics above have been influenced by the COVID-19 pandemic.

**Projects:**

**PR/ Marketing Analytics, January – March 2021**

Website

| Page Views | Unique | Average Time on Page |
|---|---|---|
| 83,336 | 69,844 | 2:07 minutes |

Top 5 pages: Careers, zoning, property taxes, MCC, building permits

Twitter

| Tweets | Impressions | New Followers |
|---|---|---|
| 95 | 68k | 58 |

Facebook

| Engagement | Page Views | Total Reach |
|---|---|---|
| 15,254 | 1,503 | 89,027 |

<u>Bang the Table</u>

The Town launched Engaging Pelham on Feb. 17, 2021. Since its launch, there have been nearly 1,400 page visits and 175 registered users. There are currently eight live projects on the site, with several more on their way.   The tool has been advertised in the local newspaper and on the Town's social media pages. One of the largest bumps in traffic to the page came immediately following the first Life in Pelham insert on March 10, 2021.

The Deputy Clerk and Administrative Assistant attended Bang the Table Training and expect to be able to further engage the community with this tool.

<u>AMCTO Peer to Peer</u>

On behalf of the Town of Pelham the Deputy Clerk is working with the Pandemic By-Election Group being comprised of members from the City of Ottawa, Cambridge and Windsor to present at this year's AMCTO Peer to Peer discussion.  The presentation is intended to allow other municipality's understand the challenges and hurdles these municipalities overcame to run an election during a pandemic.

NextGen Leadership Certificate

The Deputy Clerk has begun the leadership certificate program entitled NextGen from Brock University.  The program is ran Tuesday and Thursday mornings via Zoom until June 2021.  This program is exclusively tailored toward the needs of municipal leaders.

**Constituent Concerns and Issues Arising:**
General ongoing citizen enquiries.

**Employee Updates:**

Nancy Bozzato, Pelham Clerk since 2010 and a Pelham employee since 1999, is retiring this spring after more than 40 years of municipal service in Niagara.

Her impact as a municipal leader is evidenced by decades of outstanding work, including her most recent success: the safe and successful 2020 Pelham Ward One by-election, which occurred during the COVID-19 pandemic. This achievement was recently, and deservedly, featured in *Municipal World* magazine.

A third-generation and life-long Pelham resident, Bozzato says she is honoured to have served the residents and community she calls home for so many years.

Holly Willford, Deputy Clerk since 2018, will officially assume the role of Pelham Town Clerk at the end of May.  Recruitment is underway for the Deputy Clerk position.

The Communications and Public Relations Specialist has transferred to the CAO's department. In the past four years, reporting to the Clerk, Marc was able to glean a great deal of knowledge about the municipal machine from the Town Clerk. The reporting structure at the time was a good fit.

**Grants, Concerns, RFPs, Agreements:**

Mr. MacDonald has taken on an active role in grand writing for the Town of Pelham.

**Meetings:**

Town Clerk
SLT – Weekly
Emergency Operations Centre and Committee – (2X per week)
Committee of Adjustment Hearings
TabFusion RMS – Electronic Records Management

Deputy Clerk
Committee of Adjustment Hearings

Committee of Adjustment Applicant Meetings
Pre-consultation Meetings (1 a month)
PW Open House Meeting

<u>PR/ Marketing Specialist</u>
EOC 2-3x/week
Bang the Table engagement software demonstration
Niagara Emergency Communicators bi-weekly

<u>Administrative Assistant</u>
Committee of Adjustment
TabFusion RMS – Electronic Records Management
eScribe Training X2

**CORPORATE SERVICES QUARTERLY REPORT**
Monday, April 19, 2021

# **Reporting Period:** Corporate Services Department Quarterly Report for the period: January 1 to March 31, 2021

**Recommendation:**

> **BE IT RESOLVED THAT the Q1/2021 Corporate Services Department Report be received for information.**

**Department Overview and Statistics:**

In the month of February, the Corporate Services department was working on year-end invoices, closing processes, adjustments and accruals. Interim tax bills were sent out with a due date of February 26th, and payments were collected. Asset management plan data continued to be entered by the GIS Asset Management Specialist with a view toward the July 2021 due date.

During the month of March, year-end procedures and audit working papers were finalized and the draft financial statements were prepared in advance of the audit in April.

## Accounts Payable

Accounts Payable module for 2020 Year End was closed without issue on February 12, 2021 bringing a smooth transition into 2021. Accounts Payable is also actively engaged with the lean review team for 2021. Partaking in weekly meetings to identify bottlenecks in the process with resolution to better streamline the Accounts Payable and Purchasing processes to make better use of time for staff and still adhere with best accounting practices.

## Taxes

In Q1 of 2021, the Tax Clerk processed and mailed the interim bill to approximately 5,300 properties. Despite COVID-19, collections of the interim at February 26th were consistent with prior years with 5% of the first installment being unpaid. Vacancy rebate applications were sent to eligible businesses for the final year in the vacancy program phase-out, 38 applications were received and sent to MPAC for valuation. The Tax Clerk attended both the Municipal Connect administration and user training for the launch of MPAC's new platform and assisted with setting up staff and helping them transition to the program. The Tax Clerk is currently enrolled in Core 1 of the CPA Professional Education Program.

**Information Technology**
Adobe Fill and Sign (e-signature) implementation and training was accomplished. Majority of staff that have an Adobe Acrobat Pro DC software license, can now send PDF documents to be signed and completed electronically which eliminates the process of printing and using the traditional 'ink to paper' method. Now documents can be signed when working remotely from laptops and mobile devices, which has increased productivity during the pandemic. All documents are fully secured and contain an audit trail of when and who sent out the document and when the document was signed.

Tice Road portable office had all the networking cabling, wall data ports, printer, layer two switch and WiFi access point installed and functioning. Three office desks are currently in this location. External security camera has been installed which covers the main entrance of the portable office.

Immunization Clinic wireless upgrade for MCC. An additional two Wireless Access Points have been installed in GYM 1 at the MCC to provide a robust wireless backup for Niagara Region Public Health. Niagara Region will bring in their own LTE internet hubs, however they have asked the Town to provide another wireless SSID as a backup to ensure continuous connectivity for system applications.

Video live streaming for MCC ice and basketball. Separate internet provider service has already been installed at the MCC. GOS (Game on Stream) will be providing live streaming services for hockey and basketball games. Existing network ports will be provided to GOS, in order to eliminate the amount of surface mounted conduit for GOS cameras.

Bang the Table – NRBN Rural Broadband survey has been implemented. Survey was created by NRBN in order to attain feedback from residents regarding internet connectivity. Data will be analyzed in the coming months.

**Projects:**

**Constituent Concerns and Issues Arising:**

None identified.

**Employee Updates:**

The Deputy Treasurer and Taxation Clerk attended training for Bang The Table.

The Deputy Treasurer, Fixed Assets Accountant and Property Tax Clerk attended Deloitte's Public Sector Accounting Update webinar.

The Payroll Clerk completed the Payroll Fundamentals 2 course and now has received his designation.

IT attended the Ministry of Government and Consumer Service's Cyber Security Division shares the latest updates and advice on cyber security threats and topics of interest to the community, on Friday, March 19, Friday, February 19 and Friday, January 15.

IT attended MISA Zero Trust Security with Next-Gen Network Access Control, on Thursday, February 25. The overview of the webinar was about how some municipalities enhance their network visibility by leveraging Device Platform Intelligence, which combines and correlates the technology, business, and risk context information of all network-connected devices.

IT also attended MPAC's Working From Home: IT Best Practices Learned from COVID-19 on February 2.

**Grants, Concerns, RFPs, Agreements:**

In Q1, the following is a list of grants that the Town has applied for, have been approved for and for those in which the Town has received funding.

| Applied For | Grant | Amount |
|---|---|---|
| Municipal Modernization Program - Ontario | ITS Improvement of web-based services for residents | $30,000 to $40,000 |
| Municipal Modernization Program - Ontario | HR Digitization of HR Performance Management System | $40,000 to $60,000 |
| Municipal Modernization Program - Ontario | Corporate Services Review: for automating processes | $115,875 to $143,500 |
| Municipal Modernization Program - Ontario | Shared Libraries Review with Town of Lincoln | $40,000 to $60,000 |

| | | |
|---|---|---|
| Healthy Communities Initiative – Community Foundation-Canada | Peace Park Safety and Accessibility (Fencing) | $50,000 |
| Rural Economic Development - Ontario | Bikes mean Business – Wayfinding signs | $15,000 |
| Investing in Canada Infrastructure Program – COVID Resilience Stream Canada & Ontario | Splash Pad Centennial Park | $112,331 |
| Ontario Trillium Foundation | Library Self-serve kiosks | $146,900 |
| Inclusive Community Grants – Ontario | Installation of Video Streaming Equipment – MCC | $60,000 |
| Farm Credit Canada AgriSpirit Fund | Digital pagers for 100-member emergency volunteer fire fighters | $25,000 |
| OMFRA – Grant for employing a drainage superintendent | Drainage Superintendent | $8,425 |

| **Approved For** | **Grant** | **Amount** |
|---|---|---|
| 2021 COVID-19 Recovery Funding for Municipalities | Funding for COVID pressures for 2021 | $347,890 |
| Niagara Region Buy Local Grant | Pelham Bucks issued for local business support | $5,000 |
| SALC Special Grant Funding | Shade structures for the MCC courtyard on Meridian Way | $11,314 |

| **Funding Received** | **Grant** | **Amount** |
|---|---|---|
| Niagara Region Bicycle Grant (2020 Program) | Cycling Lanes | $50,000 |
| Enbridge Grant (Jazz Up the Park) | Peace Park Upgrade | $5,000 |
| Niagara Region Bicycle Grant (2021 Program) | Cycling Lanes on Pelham Street South | $30,000 |

**Invitation to Bid# 2021-VEH-01 – Purchase of Compact Tractor and/or Grooming mower**

| **Bidders** | **Amount** |
|---|---|
| Connect Equipment | $72,984.00 |
| Premier Equipment | $67,718.00 |
| RedTrac International D&W Group | $70,005.00 |
| Ben Berg Farm & Industrial | $67,500.00 |

**Award is to *Ben Berg Farm & Industrial* with a contract value of $67,500.**
**Note:** This purchase reflected two capital accounts (VEH 04-21 & VEH 05-21)
**Budget: $85,000.00**

**Meetings:**

- Marmak
- Questica
- Pelham Library CEO
- Pelham Finance and Audit Committee
- Deliotte
- F.H. Black & Company
- Area Treasurers

**RECREATION, CULTURE & WELLNESS QUARTERLY REPORT**
Monday, April 19, 2021

## **Reporting Period:** Recreation, Culture and Wellness Quarterly Report: January, February & March 2021

**Recommendation:**

> **BE IT RESOLVED THAT the Q1/2021 Recreation, Culture and Wellness Department Report 2021-0073-Recreation be received for information.**

### DEPARTMENT OVERVIEW & STATISTICS

The Recreation, Culture & Wellness department has been following the color coded provincial framework for all programming and facility operations during the months of January, February & March.

### PROJECTS

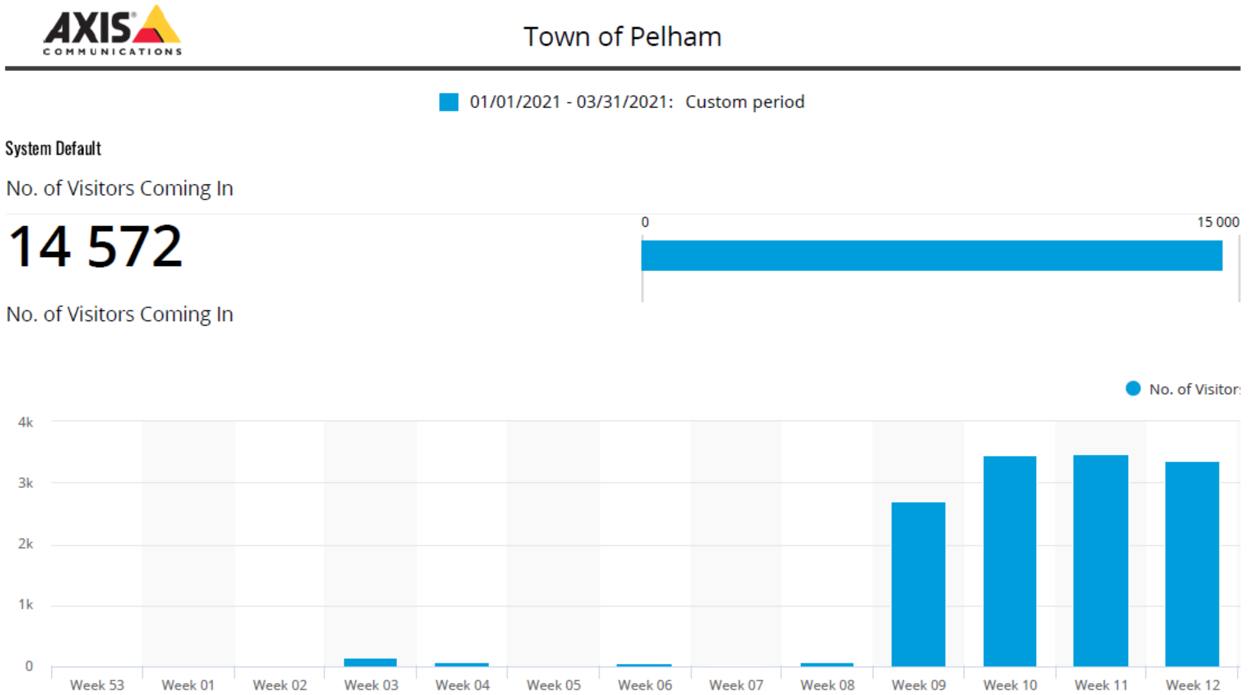
**Highlights from the Meridian Community Centre & Facilities Update**
The MCC was closed for the months of January, February and part of March as the Region was in Grey lockdown. The building did host some internal training during this time. The closure allowed time for the replacement of the suction valve on compressor two. This day long refrigeration plant shutdown would have disrupted regular building renters had the facility been open.

During the lockdown one facility staff accepted layoff, and other facility staff assisted the Public Works department with trail inspections, fire hydrant testing and garbage pickup. The remaining staff, continued to paint areas of the building that had not yet been touched up and sealing of concrete throughout the facility. Old Pelham Town Hall also had its main hall and washrooms painted. Staff also participated in a 'dry run' vaccination set up and were trained on the cleaning of the vaccination space by the Region.

Below is an image of the MCC Gymnasium vaccination clinic:


The Gym floor covering was delivered in March and is currently in use protecting the hardwood floor in the Gymnasium currently set up for Pelham's vaccination clinic. Below is an image of the gym mats stored in the receiving bay:


The facility reopened in Red Zone on March 1 and was restricted to 10 participants per space. The facility averaged 458 people per day for a total of 14219 visitors for the month. Below is an image of the average people per day through the MCC:

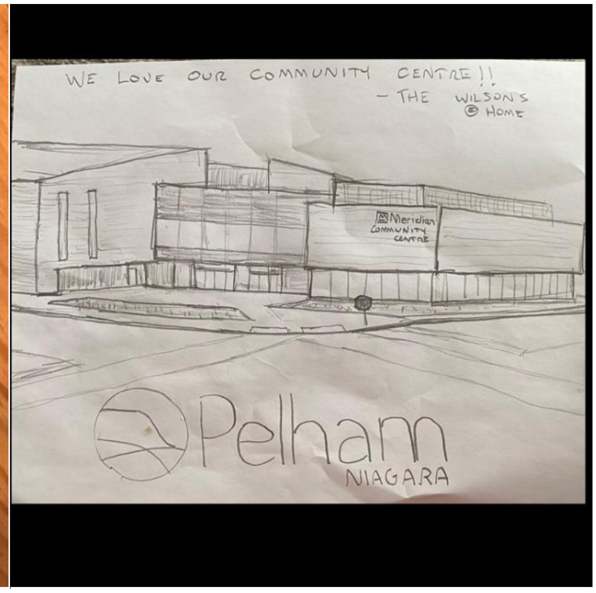



**Programming & Rentals at the Meridian Community Centre**
Due to the Covid-19 pandemic, programming at the MCC continued to be limited to Brock Senior Fit and Ladies Stick & puck.
Ice rentals continued to be in high demand with both rinks operational during the month of March with bookings 7 days a week from 7am – 10pm daily. January was the beginning of the winter rental season.
Pelham Minor Basketball were the main users of the gym, with an odd rental to individuals for shooting hoops only.

**SAY IT! On Stage** (Seniors & Youth Intergenerational Theatre, On Stage)
The SAY IT! On stage group have continued to meet virtually since the beginning of January. It is a mixed group of 15 seniors & youth, they group have been able to develop a script for a video production that is titled "Millennium Mission to Mars" the video production is set to be completed by the end of June 2021. [www.pelham.ca/arts](www.pelham.ca/arts)

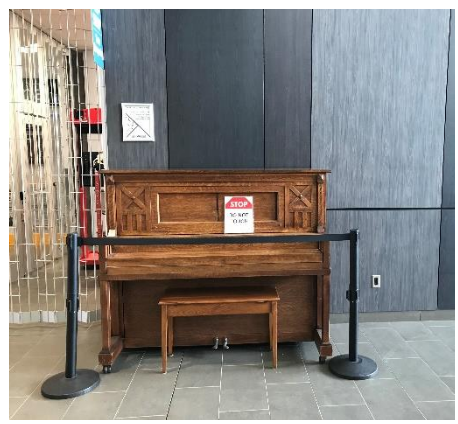
**Family Day – Virtual Scavenger Hunt**
The Family Day Adventure in Pelham took place from February 12 – 15. During that period, Niagara was issued a stay at home order; Staff were able to offer a virtual scavenger hunt. Staff utilized the community expo contacts from previous Family Day Events and requested that community groups participate in the virtual scavenger hunt by submitting "missions" which residents could complete from the safety of their home. In total, there were 64 missions, 2,022 submissions and 74 teams registered. The virtual scavenger hunt ended with a 7 way first place tie, the prizes were awarded to each winner with the support

from Peter Pipers and a donated Ancestry DNA kit from the "Find Your Ancestors Genealogical Services" that operates in Fonthill. Overall, the Family Day Adventure in Pelham was a success. Below are two images from submissions on the goose chase app: The first photo was from a mission called "recreate the Pelham logo" and the second photo was a mission called "Pelham Proud"




**Davis Hall Piano – Sam Derreck**

The piano that sits in the atrium of the Meridian Community Centre (MCC) is the original piano from Davis Hall. The piano will be dedicated to the previous Recreation Director Sam Derreck (1957 – 1983) for his contributions to Recreation in Pelham. The dedication will feature the story about Davis Hall, images of Sam Derreck playing the piano and a tribute to Sam Derreck and his dedication to the development of recreational programming in Pelham. Staff are hopeful that the tribute will be installed in the MCC atrium by the end of May 2021.



**Pelham Farmers Market**

The Pelham Farmers Market Executive met in January and in March to confirm operational details for the 2021 season and select vendors based on application submissions. The 2021 Farmers Market season will be identical to operations from 2020, and operate as a covid-market, with one entrance and one exit and minimal social interaction. The Farmers Market will also be releasing a virtual scavenger hunt starting Thursday May 6 called Junior Growers; it is an opportunity for Market goers to participate in an all season virtual event. All the information about the virtual scavenger hunt and list of vendors can be found on the Pelham Farmers Market website: www.pelham.ca/farmers-market

**Community Clean Up – Pitch in Week April 18 – 24**

Staff have worked with Pitch in Canada, Parks and Roads departments through the month of February & March to organize Pitch in Week. Pitch in week has 100 participants signed up to date. More information about pitch in week can be found www.pelham.ca/cleanup

**River Estates Park Development**

Staff have been working with Parks & Purchasing department to develop the draft RFP for the River Estates Park Development at 30 Bergenstein Crescent. The anticipated completion date in the RFP is September 2021. Updates on the project will be available through https://engagingpelham.ca/ platform.

**55+ Programs:**

**Art Your Service**

The Senior's Advisory Committee made the decision to renew Pelham's Art Your Service membership through the winter months, offering free virtual programs to residents in an effort to combat feelings of isolation, while encouraging healthy practices from the comfort of their own home. Art Your Service offers programs over Zoom, twice a day, five days a week, including both active and social programs for individuals of all ages and abilities. These programs help to promote healthy living and encourage socialization, both live, or for individuals to complete on their own time, following recordings made available to all members. This program has received great feedback from all of those who have participated.

**Brock Fit**

Functional Independent Training (FIT) with Brock was able to resume as restrictions allowed, beginning March 8th for 12 weeks. This program is run in partnership with Brock University Kinesiology students, who use what they have learned in their studies to offer circuit activities that focus on supervised functional strength, cardiovascular and balance training. This program has always been extremely popular, with this session running with 18 participants out of 20 available spaces.

**Fraud Webinar**

The Pelham Senior's Advisory Committee in partnership with the Ontario Securities Commission offered a free Fraud webinar to help educate the public around current topics around how to stay protected from current scams taking place. This virtual webinar took place on Tuesday January 12 from 10:30-11:30am and had 24 residents registered to attend.

**Youth Programs**
**March Break Camp**
The Town of Pelham was ready, prepared and excited to offer March Break Camp this year. Staff were hired, registration was open, campers were registered and the programming was planned. Unfortunately, COVID-19 had different plans, causing the March Break to be postponed until April. The recent Lockdown announcement cancelled plans for camp. The Town of Pelham will be prepared to offer this camp at a later time if the opportunity is available and restrictions allow.

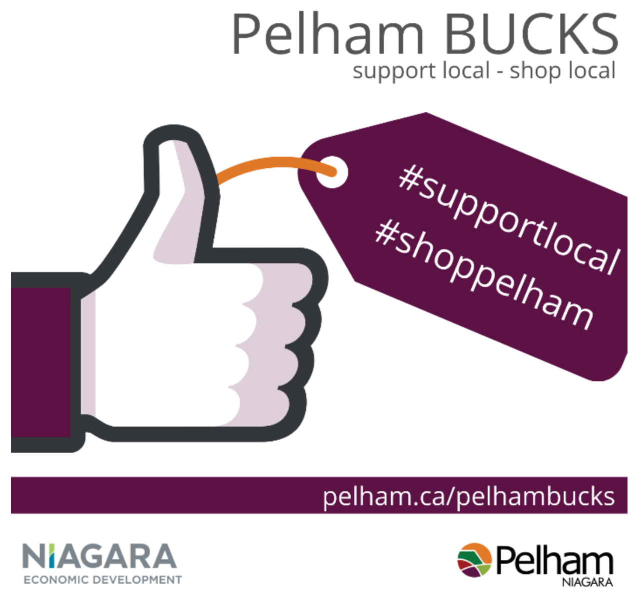
**Virtual Drawing Class**
The Town of Pelham was able to take a program that was once ran in person, and turn it into a virtual experience for youth! This 5-week virtual anime drawing class was a great success, and enjoyed by all participants. 11 young artists joined into weekly classes from January 9th to February 6th, learning new artistic skills and techniques. All supplies were included in the registration fee, and were delivered to participants by porch drop off before the start of the program. This program was a great success, and the Town would consider running a similar program again, but would be aware of doing so during a time when schooling is not running as virtual. This will help to ensure that the youth participating are not getting screen exhaustion, and could potentially increase registration.

**Preparation for Summer Programs**
In preparation for the summer season, all camp and pool interviews have taken place, and all positions have been filled. The planning of programs and activities have already begun, with hopes that updated guidelines will be released shortly by the Province and Public Health. Once these guidelines have been released, registration will be open to Pelham residents for 2 weeks, before opening for the rest of the Region.

**MYAC Updates**
MYAC has continued to work hard virtually, holding meetings within each subcommittee, and continuing to set goals for the future. MYAC has been contributing ideas for events such as Family Day and Easter, and is excited to participate in Pitch-In week this Spring. Looking to the future, MYAC is looking forward to hosting a Youth Forum, to allow them to best serve and support the Youth of Pelham, and have the their voices and ideas heard.

**Pelham Bucks: #shoppelham #supportlocal**

With support from a grant from Niagara Economic Development, the Pelham Bucks program was highlighted as part of a social media and newsprint campaign to encourage the #shoplocal and #shoppelham and support local area business. An online call for a "why you love local" was completed and 79 entries were received showing support for Pelham area business locations. The marketing support for the initiative included; a media brief, newspaper advertisements in the Voice of Pelham, digital advertisement in mypelham.com


and inclusion in the mypelham digital newsletter, distribution with Country 89 digital newsletter, sponsored social media posts and rolling banner ads on the Niagara this week digital publication. As a result of the campaign an additional 14 Pelham area business locations joined to be part of the Pelham Buck program.

**Hoppin' Easter in Pelham**

The annual Easter event in Pelham moved to a hybrid style to adhere to pandemic protocols. The Hoppin' Easter in Pelham included four key elements.

1. Hoppin' By Bunny Visits. Residents pre-registered for a curbside delivery from the Easter Bunny, which were available on April 1- 3. 128 families across Pelham received a curbside delivery over the three delivery days, accounting for 280 Pelham youth.

2. Hoppin' Virtual Magic show was a live virtual show over zoom that had interactive audience participation. The show ran April 3 at 3pm and had 45 families logged in to be part of the show; the Easter Bunny also made a virtual visit to the start of the show. . Overall event attendance estimated at 150-175 viewers based on average family size. Local magician Scoop McCoy presented the show and provided an at home printable magic trick kit so participants could learn three magic tricks as part of the show. The at home printable magic kit was distributed by Town staff and included additional sponsor information. The virtual magic show event was sponsored by Xplornet.

3. The Hoppin’ Easter Hunt, Sponsored by Policella Homes was provided on the virtual goosechase all platform. Families registered as a team ranging from 2 to 8 players per family to complete in virtual scavenger hunt missions over the four days of the Easter weekend. In total 84 different missions were released that focused on safe exploration of parks and trails, and Easter geared family fun ranging from egg races to coloured item hunts. From the 84 missions that were released the 55 active teams completed a total of 2352 missions. Specific prize missions of minimum value of $25 were released that were sponsored by local businesses including; The Voice of Pelham, Hamiltons of Pelham, Everyday Market, Churchill Meats, DeVries Farm, and Allure Spa and Wellness. The overall leaderboard provided prizes for the first place winner, as well as a three way tie for 2nd and 9 additional runners-up prizes, provided with support from the overall event sponsor Policella Homes


Pelham NIAGARA

4. The Hoppin’ Easter Colouring Contest had 99 entries from youth across Pelham ranging in age from 2 to 12 years old. A draw from all submission took place on April 6th and two prizes were awarded.

Community feedback from the event was positive and included messages from participants:
*Thank you so much for doing this for everyone! This is great fun to do as a family and helps keep the kids busy and excited! We are proud to live in such a great town.* – Jennifer

*Can I just say these Easter activities have been so amazing... We had the Easter bunny come yesterday, and kids loved it! The activities have been so fun to help fill up the weekend and get everyone excited, especially in these uncertain times. Seriously GREAT JOB!!! I feel very lucky to be part of this community! Keep up the great work!* – Melissa

*I just want to say how much gratitude I have for you and everyone behind these events. With so much bad news this is such a welcomed change. Our kids had so much fun and we feel so lucky to be in such a wonderful place. Thank you !* - Michelle

**Canada Day Celebration 2021**
Planning for this years Canada Day celebration has continued with the assistance of the Pelham Canada Day planning group. Various elements are being explored that would allow for a celebration that could adjust to pandemic restrictions within the coloured framework. A Bang The Table (BTT) community engagement survey was made available for feedback regarding the elements being considered for Canada Day, and has been promoted via social media channels. There have been 29 responses to date, which rank in order from most interested to least interested activity. The current ranking shows the top five elements requested to be:
1. App Based Scavenger Hunt
2. Celebrations Kits
3. Drive-thru parade experience
4. Home decorating contest
5. Pelham Canada Day T-shirt with proceeds to charity.

The Canada Day Regional planning group, which includes representation of programmers from municipalities across the region in addition to the Niagara Parks, have been meeting monthly to discuss a joint Canada Day the Niagara Way element that will continue on the success of the 2020 event. Utilizing the digital platform "goosechase" municipalities are working towards a regional goosechase element and marketing campaign to support the event.

Pelham will also offer a drive thru Canada Day parade as long as the provincial framework allows, based on the framework used in the Santa Claus Parade. Staff have been involved in correspondence regarding the annual Canada Day grant, applied for in the fall, and have been advised that modified virtual/hybrid will be considered for funding and revised plans can be submitted for review. Staff continue to consult with event programmers across municipalities in Ontario. Staff are evaluating and researching logistical implications and best practices for the event for both in person and virtual programming. The impact for in person events will be contingent on gathering limits and Public Health requirements.

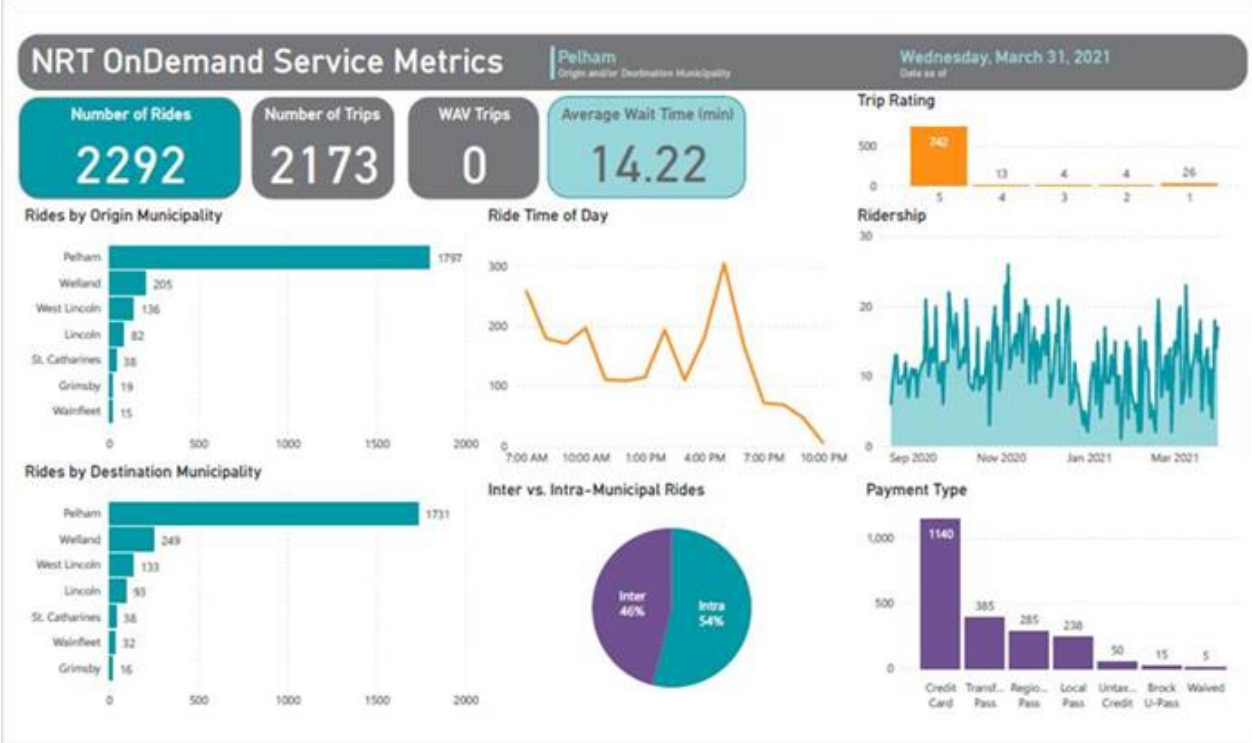
**Pelham Summerfest**
As detailed in the report #2021-0067- Recreation, 2021 Events and Festivals Update The current pandemic gathering limits do not support the annual four day event in Pelham. A discussion with a limited number of Summerfest Committee members occurred on March 22 2021 to review the impact of COVID-19 and the Provincial framework for events. With the diverse nature of the event, a virtual event, or modified is not recommended as an alternate. Based on the large gatherings that result from the different elements of the event, the recommendation is to cancel the event for 2021. Committee members present were supportive of using the Town funds allocated to Summerfest for the support of applications for grant requests for alternate mini events.

**Street Pole Banners/Honour our Veterans Banner Program**
The Veterans Banner program for inclusion in the 2021 installation are now open. Staff will continue to support the program with the assistance of coordinating location installations for any new banners added to the program.

**Transit Update**
**January 30, 2021:**


**February 27, 2021**:


**March 31, 2021:**




## STAFF NOTES

Ryan Cook Acting Director of Recreation returned to Manager of Public Works on February 25, 2021

Vickie vanRavenswaay returned as the Director of Recreation, Culture & Wellness February 25, 2021

Julie Cook will be retiring on April 16, and Halee Braun has started as the Recreation Facilities Coordinator on March 22

Kathy Haist has been hired as the Recreation Administrative Assistant and started March 31

Brittany MacLean attended the Aquatic Information Sharing Group Meeting (February 23, 2021)

Brittany MacLean attended a ActiveNet Introduction to Restorative Justice webinar (March 25, 2021)

Brittany MacLean attended the Recreation Program Sharing Group Meeting (January 21, 2021)

Brittany MacLean attended the OACAO Regional Quarterly Check in Meeting (February 23, 2021)

Leah Letford; Special Events and Festivals Programmer completed ORFA – Legal 1 training

Leah Letford & Jodi Shishkov attended Festivals & Events Ontario Virtual Summit

## Grants, Contracts, RFPs & Agreements

Healthy Communities Initiative – Pelham Minor Baseball Application submitted March 9, 2021
Healthy Communities Initiative – Peace Park March 9, 2021
Niagara Investment in Culture Grant Application submitted March 9, 2021 – Culture Crawl
Reconnect Festival and Event Grant Program (replaced Celebrate Ontario) – deadline is April 20, 2021
Application for Participaction Community 2021 June Grant program

## Meetings

MCC User group roundtable zoom meetings
Niagara Parks and Recreation bi-weekly information exchange zoom meeting
Niagara Community Foundation Grant Information Session
Reconnect Information session with Minister Lisa MacLeod
Meeting with Paul Samson Ministry of Heritage, tourism, sport and culture industries, Niagara Regional Advisor
Network of Municipal Event Planners Meeting
Farmers Market Executive Meeting
Thursday Night Experience Meeting
TD Friends of the Environment Tree Plant Event Discussion
Pelham Seniors Advisory Zoom Meeting
Mayor’s Youth Advisory Zoom Meetings
The Pelham Tennis Association Meeting
Summerfest Committee met, without quorum March 22 2021
Pelham Canada Day Planning Group met virtually – February 18th and March 18th

**COMMUNITY PLANNING & DEVELOPMENT QUARTERLY REPORT**
Wednesday, March 31, 2021

# **Reporting Period:** Community Planning and Development Department Quarterly Report for the period: January 1 – March 31, 2021

**Recommendation:**

> **BE IT RESOLVED THAT the Q1/2021 Community Planning and Development Department Report be received for information.**

**Department Overview and Statistics:**

**Planning:**
The Planning Department continues to work on the following development applications: 6 Subdivision Applications, 4 condominium applications, 3 Official Plan Amendment applications, 11 Zoning By-Law Amendments, 6 applications for Site Plan Approvals, 12 consent applications, 18 minor variance applications and 3 Niagara Escarpment Development Permit applications.

There is one LPAT appeal relating to Development Charges By-law Amendment; one LPAT appeal relating to the extension of the Interim Control By-law that are pending; 3 LPAT appeals on the Cannabis Official Plan Amendment and 3 LPAT appeals relating to the Cannabis Zoning By-law Amendment. The court application by Woodstock Biomed with regards to the initial Interim Control By-law is also pending and the responding material was filed with the Courts. An appeal has been received with regards to Council's refusal to pass a zoning by-law amendment for 1307 Haist Street. Further there is a court application by C. Montemurro relating to the issuance of a building permit, responding materials have been filed with the courts and staff were deposed and the hearing date scheduled in March 2021 was cancelled by the courts and a new date is pending.

Public Meetings were held with regards to 1522 Pelham Street Zoning By-law Amendment application, Second Dwelling Unit Official Plan and Zoning By-law Amendments and 855 Chantler Road Zoning By-law Amendment application.

## Building:

The Building Department continues to receive incoming permit applications consistent with seasonal trends and remains occupied with inspections. The building department was able to conduct a total of 514 inspections since the 2020 fourth quarterly report.

### Building Activity Statistics from January 1 – March 31, 2021:

| Months | Building Permits | Inspections | Demolitions | Commercial | Sq. Ft. | New Dwellings | Value of Construction |
|---|---|---|---|---|---|---|---|
| January | 15 | 184 | 1 | 2 | 3,530 | 9 | $4,052,801 |
| February | 50 | 112 | 0 | 0 | | 24 | $10,634,541 |
| March | 41 | 218 | 2 | 3 | 24,416 | 23 | $13,971,300 |
| **Total:** | **106** | **514** | **3** | **5** | **27,946** | **56** | **$28,658,642** |

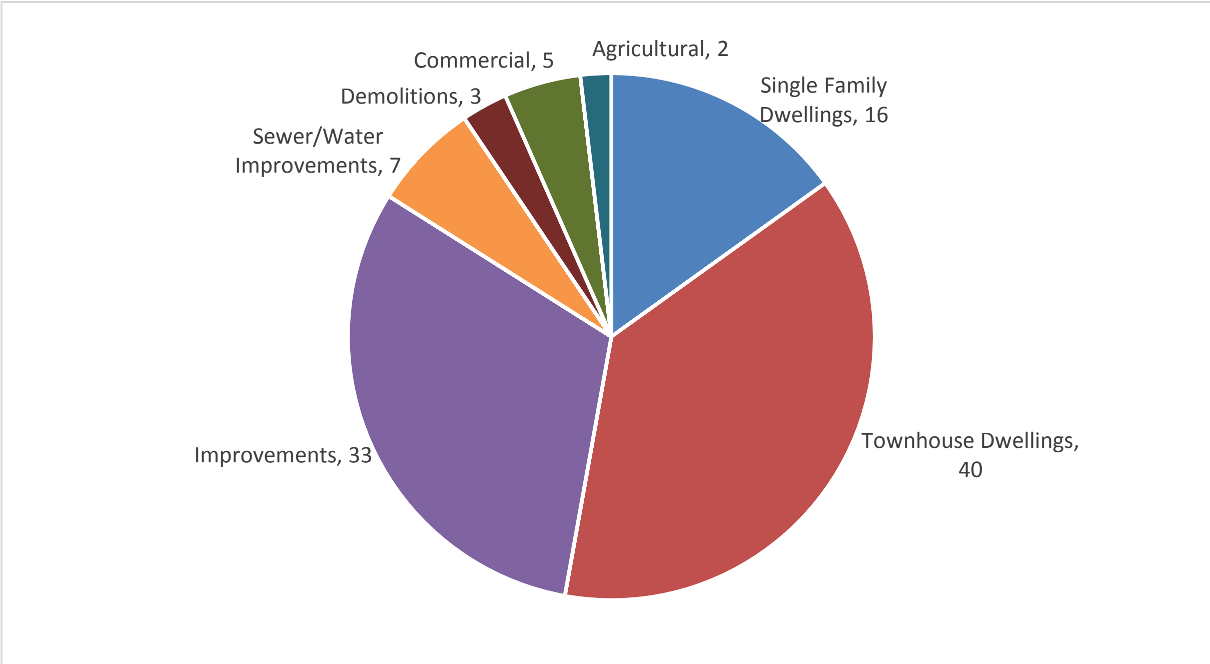
### Building Permit Time Frames from January 1 – March 31, 2021:

| Building Type and Number of required days to issue | | Number of Permits Issued | Average Number of Days to Issue Permit |
|---|---|---|---|
| House: | 10 days | 57 | 9 |
| Small Building: | 15 days | 45 | 9 |
| Large Building: | 20 days | 4 | 6 |
| Complex Building: | 30 days | 0 | |
| **Total:** | | 106 | |

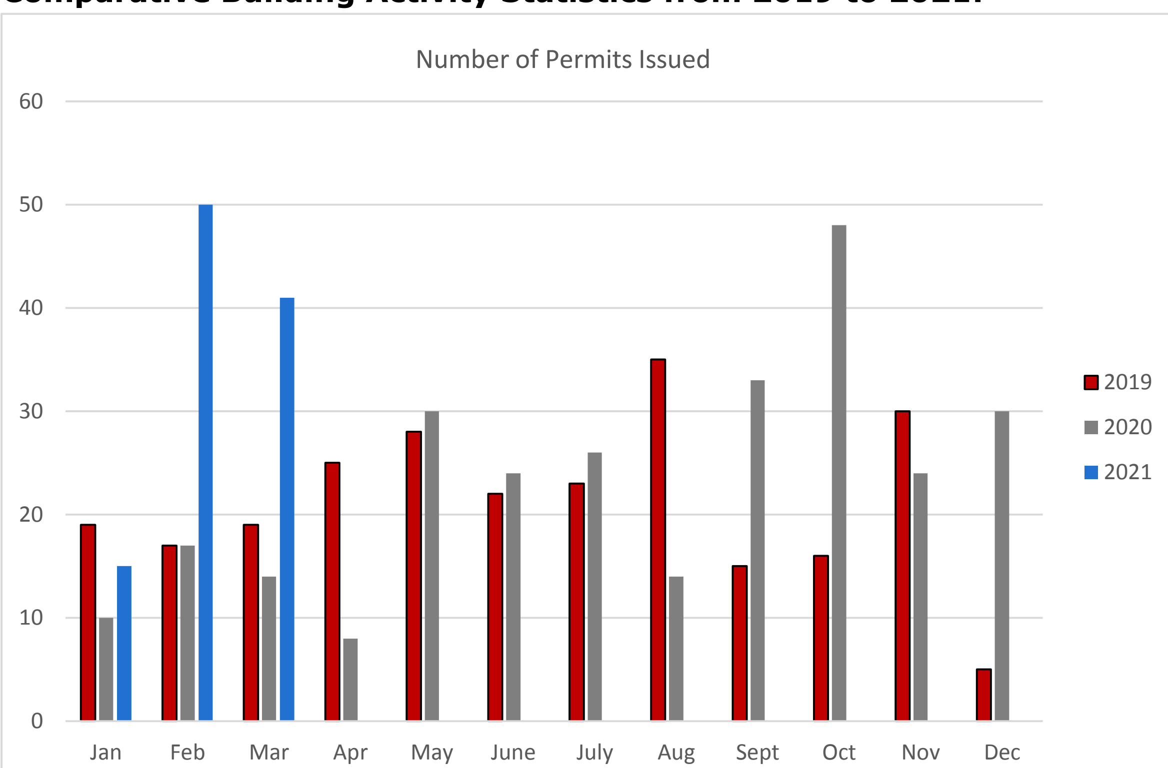
**Major Building Projects Over $250,000** (excluding single family dwelling units): Barn Reconstruction $400,000, Restaurant Café $500,000, Restaurant $1,300,000, Interior Alterations $500,000, Retail Plaza $4,475,000

**Town Development Charges collected by the Finance Department** for the period January 1 to March 31, 2021 total $706,604.15.

## Building Permit Breakdown (Year to Date):




## Comparative Building Activity Statistics from 2019 to 2021:



**Projects:**

**Cannabis** PG Compliance Management Inc. met with the Cannabis Control Committee a second time and reviewed the proposed terms of reference for the ambient odour neighbourhood monitoring program. The Consultant is finalizing the terms of reference and once finalized the request for proposals will be released. Work related to the ambient odour monitoring program is being managed by By-law Staff as it deals with implementation of the Odorous Industries Nuisance By-law.

Staff are awaiting the scheduling by LPAT of a Case Management Conference which will determine the logistics of a future hearing(s) on the appeals on the Official Plan and Zoning By-law amendments addressing cannabis land use.

**Comprehensive Zoning By-law** The first phase of public consultation has been initiated and the public engagement page regarding the Zoning By-law review and update has been launched on the Town website at the following link https://engagingpelham.ca/comprehensive-zoning-bylaw-review. Planning staff has also initiated 'Tuesday's with Tara' where Planning Staff are available to take one-on-one questions via calls and meetings with the public on matters related to the Zoning By-law review. The Zoning By-law review and update is a significant undertaking and involves looking at the By-law in its entirety.

**Second Dwelling Unit Official Plan and Zoning By-law Amendment** Of particular interest by the public is second dwelling unit permissions to comply with *More Homes, More Choice Act*. A public meeting on this topic was held on February 8th and a public on-line engagement page was launched on the Town website at the following link https://engagingpelham.ca/second-dwelling-units. Planning staff are awaiting comments back from agencies prior to bringing an amended Official Plan and Zoning By-law amendment back to the public and Council for consideration.

**Big Creek Municipal Drain Assessment Schedule Update** K. Smart Associates is completing this work on behalf of the Town. The project has been expanded to include an update to the assessment schedules for the Nunn, Disher, Swayze and Ridgeville drains.

**Constituent Concerns and Issues Arising:**

Planning, Building, By-law and NPCA staff dealt with complaints regarding the placement of fill in the floodplain of the Welland River at Farr and River Road. As a result, work at this location has stopped until appropriate approvals have been obtained.

**Employee Updates:**
The Director, Chief Building Official and Administrative Assistant completed Adobe Fill and Sign Training.

All Department Staff completed The Crisis Prevention Institute De-escalation Training, and attended MPAC's Municipal Connect Training in addition to the following training to update skills and development in their related fields.

Director of Community Planning and Development attended a webinar on the 2021 Economic Outlook for the Planning Profession in Ontario that explored trends in the housing market, employment, demographics and risks and opportunities for city building that have emerged as a result of the pandemic.

Senior Planner and Policy Planner attended Bang the Table Engagement Strategy and Bang the Table Analysis and Reporting Training and the Ontario Farmland Trust forum on shifting landscapes of farmland protection.

Building Inspector attended Ontario Plumbing Inspectors Association Educational Seminar on Wet Venting and Ontario Building Officials Association Niagara Chapter Meeting.

Building Intake/Zoning Technician completed House and Powers and Duties of the CBO courses and examinations offered by the Ministry of Municipal Affairs and Housing.

Administrative Assistant completed COVID-19 Conflict Prevention, attended MPAC's Modernization Opportunities for Ontario's Building Permit Process Webinar and completed training for WHMIS and Workplace Violence.

**Grants, Concerns, RFPs, Agreements:**
None

**Meetings:**

On-going meetings:

- EOC Meetings
- Cannabis Control Committee Meetings
- OBOA Niagara Chapter Meetings
- Pre-Consultation Meetings
- SLT Meetings

- Joint Health & Safety Meetings
- Area Planners Meetings

In addition to the various conversations with property owners and consultants regarding potential development applications, Staff have been involved in meetings regarding the following substantive matters:

- Merritt Road Class EA Stakeholder and Agency Meeting
- Meeting with Region of Niagara Planning Staff on Regional Official Plan update
- Workshop with Region of Niagara Staff, Council members and CAO on proposed Region of Niagara Official Plan
- Town Clerk Interviews
- Merritt Road Class EA Public Information Centre (PIC)

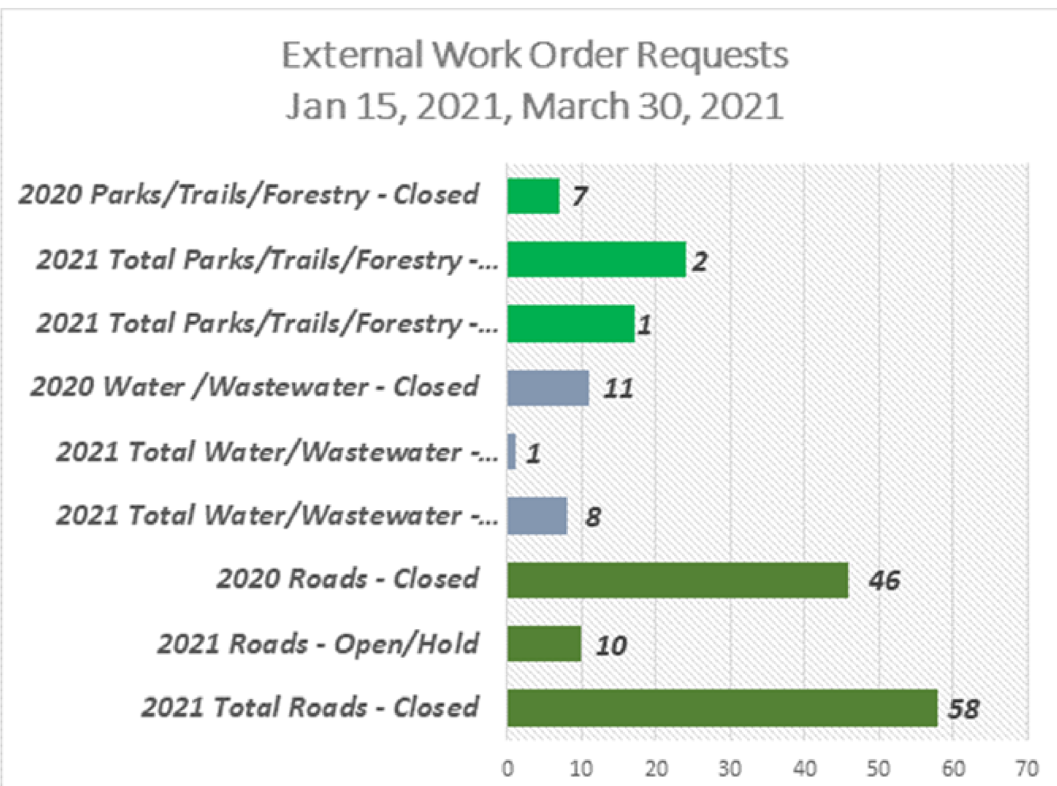
PUBLIC WORKS DEPARTMENT QUARTERLY REPORT
Monday, April 19, 2021

**Reporting Period:** Public Works Department Quarterly Report for the period: January – March 2021

**Recommendation:**

**BE IT RESOLVED THAT the Q1/2021 Public Works Department Report be received for information.**

**Department Overview and Statistics:**



**Projects:**

**ROADS**

Roads Staff continue to perform maintenance activities identified during routine road patrols as per the Ontario Regulation 239/02; Minimum Maintenance Standards (MMS) for Municipal Highways, passed pursuant to the *Municipal Act, 2001.*

April 1, 2021 marks the end of the 2020-2021 Winter Season. Roads staff have begun to decommission the winter fleet in order to transition into spring operations. Although staff have not received the contracted service invoices for March, it is believed the budget is healthy and may result in savings at the end of 2021 depending on winter weather in December and November.

Roads staff have concentrated their efforts on patching roads, completing signage improvements, and general road maintenance activities. QPR cold patch has been utilized to patch potholes throughout the Town's transportation system during this period. Warning signage improvements are continuing along Effingham including new curve warning signs and chevrons guided by the MTO's Ontario Traffic Manual. Flashing warning beacons have been ordered and will be installed along Effingham to warn drivers of upcoming intersections and sharp curves as per Public Works Report 2020-0123. In addition, staff are in the process of procuring four (4) additional speed indicator signs to be placed strategically throughout the road network.

**BEAUTIFICATION**

Beautification staff are responsible for the set-up and removal of Christmas lights in parks and assist in the installation of decorations on hydro poles. An increase in litter continues to be observed in all of the Town's municipal parks throughout this period. Help was received from the Recreation, Culture & Wellness Department to assist in garbage and litter pick up throughout the provincial lockdown.

When not assisting with winter operations, staff continued pruning tree branches and limb removals from storm damage, rebuilding picnic tables, cemetery operations and working on completing an inventory and basic inspection of municipally owned boulevard trees.

**WATER/WASTEWATER**

Water/wastewater maintenance activities continue throughout the year. Operators perform system pressure monitoring, flush water mains to ensure adequate chlorine residual, and respond to customer complaints or concerns.

Staff responded to and repaired a watermain break on College Street, replaced a galvanized water service on Canboro Road, thawed two frozen water services, and oversaw the commissioning of two new private water systems in east Fonthill developments.

After investigating low pressure complaints along Canboro Road and Fenwick it was determined that the pressure control valves owned and operated by the Niagara Region required maintenance. Staff worked in conjunction with Regional maintenance staff to address the issue.

A sanitary lateral repair was completed on Pelham Street utilizing a local contractor due to the working depth and traffic volume on the road section. The lateral was replaced and funded through the annual sewer lateral replacement program.

**ENGINEERING**

The following is a summary of the activities that have occurred in the Engineering Department between January 2021 and March 2021:

**Sulphur Springs Rehabilitation** – The Design & Build RFP for this project has been awarded to Duffin Contracting. Duffin is currently working with its engineering consultant to generate a design working in conjunction with the various environmental approval agencies. Town staff are still awaiting the preliminary design for review. The contractor remains optimistic that approvals and permits will be in place to allow construction to commence in July of 2021. Due to in water working restrictions this project needs to be completed between July 1st and August 31st.

**Pelham Street North** – Works for this project are complete with the exception of top course asphalt and final pavement marking, which will happen in the Spring of 2021. Staff are still in the process of considering the petition received regarding excessive speeding on this section of roadway and are considering possible traffic calming measures including the potential implementation of a 3-way stop controlled intersection at the intersection of Pelham Street and Shorthills Place. Engineering and Public Works staff have engaged in a warrant study to determine if a 3-way stop is required at this intersection.

**Pelham Street South** – The Town has received Federal and Provincial funding towards completing a total reconstruction of Pelham Street to the Town Boundary south of Welland Road. The works include new storm sewers, updates to existing water mains, as well as new curb, asphalt, the construction of on-road bicycle lanes and new sidewalks. Design for this work was originally completed in 2013. Staff prepared an RFP for an engineering consultant to confirm the existing design and update it in accordance with current standards. Engineering works for this project were awarded to Associated Engineering, which completed design for Phase 1 of the project (College Street to Port Robinson and Pelham Street intersection) and Phase 2 (Port Robinson Road to John Street). The design for Phase 1 was tendered in the fall of 2020 and was awarded to Rankin Construction Inc. Work for Phase 1 commenced November 2020, and as of December 23, 2020 the project is substantially complete and on hold for the winter season. Outstanding works for Phase 1 include the relocation of utilities at the intersection of Port Robinson Road and Pelham Street, the placement of top course asphalt, final pavement markings, the installation of a solar powered flashing school zone sign and speed indicator sign and landscape restorations.

Associated Engineering has completed approximately 90% design for Phase 2, which will be from Port Robinson Road including the intersection to a south limit of approximately 50m south of the Pancake Lane intersection. The works include complete urbanization of Pelham Street including new curb and gutter, new sidewalks, new storm sewers and new watermain. This section of road will also receive dedicated 1.5 m on-road bicycle lanes in both directions. In addition, because the intersection at Port Robinson Road and Pelham Street experiences high traffic volumes and given the fact that it is within a school zone particular attention has been given to ensure it is designed with pedestrian safety in mind while accommodating all types of active transportation. A virtual Public Information Centre (PIC) was completed in March using the "Bang the Table" software. Staff received four questions and comments regarding the project through this media platform and met and discussed issues with three (3) other residents regarding the information that was presented. The detailed design is now 100 percent complete, following the feedback received from the public, and staff are anticipating tendering the project in early April.

**Road Rehabilitation Program (2020)** - This program was awarded to Norjohn Contracting and Paving and work commenced in November of 2020. A number of streets within Fonthill were identified as candidates for resurfacing. Due to inclement weather, the contractor was only able to complete a portion of the works before asphalt plants closed for the winter. The streets that were completed included Welland Road between Arbour Circle and Hunters Court, Arbour Circle, Townsend Square, and Milburn Drive. The remainder of the streets under this contract will be completed Spring 2021. The streets that will be completed in the spring of 2021 include Woodside Square, Meadowvale Crescent, Kevin Drive (between Haist Street and Sherri Lee Cres.) and Sherri Lee Crescent. It is anticipated that this work will commence in late April or early May once the asphalt plants open.

**Road Base and Patching Repair Program** – Engineering Staff and Public Works Operations Staff are reviewing the road locations that will require patching. The purpose of this annual program is to preserve the condition of the pavement and extend the pavement life. This was a recommendation made in the recent 2019 Pavement Condition report prepared by ARA Consultants. Currently the project is in the tender preparation phase. It is expected that this tender will be issued in May of 2021.

**Road Rehabilitation and Resurfacing Program (2021)** – Engineering Staff are currently working with Public Works Operations Staff to develop a list of candidates for the 2021 Road Rehabilitation and Resurfacing program. The candidates are being selected based on the information contained in the 2019 Pavement Condition study and based on the road patrols completed by Operations Staff. The program will most likely focus on rural roads with emphasis placed on road segments located on the cycling race route for the 2022 Canada Summer Games. It is anticipated that the tender for this project will be issued in May or June of 2021.

**Concrete Repair and Replacement Program** – Staff are currently in the process of determining the locations for the concrete repair and replacement program. The majority of the work completed as part of this annual project is concrete curb and sidewalk repairs so that the Town is in compliance with the Minimum Maintenance Standards (MMS). It is anticipated that this tender will be issued in April of 2021.

**Sixteen Road Bridge Replacement Program** – The detailed design work for this project is now 100 percent complete. Engineering Staff are currently working with the Purchasing Department to finalize the tender documents. It is anticipated that this project will go out for tender in April of 2021 with a projected construction start date of July 2, 2021. Due to in-water working restrictions regulated by the NPCA and Department of Fisheries no in-water work can commence until the fish spawning season is finished. The project is anticipated to be completed by September of 2021,

**Roadside Ditching Program** – Engineering Staff are currently working with Public Works Operation Staff to determine locations for this year's program. The tender is expected to be issued in the spring of 2021.

**Station Street Storm Pond Rehabilitation** – This project has been awarded to Duffin Contracting Inc. The commencement of the project has been delayed as a result of receiving permits from the NPCA and permission to enter and gain access over a hydro easement that runs between Station Street and Cataract Road directly adjacent to the storm water pond outlet. Engineering Staff, the contractor, and the design consultants are working together to get the approvals necessary to complete the work. It is anticipated that the construction will commence in the summer of 2021 and will be completed in the fall of 2021.

**Foss Road Sanitary Sewer Design Upgrades** – This project is currently at 90% design stage with GHD. However, there have been some challenges with regards to the CPR crossing which is delaying the finalization of design. Coordination with relevant agencies is being conducted in order to bring this project to completion and be construction ready.

**Church Street Sanitary Sewer Design Upgrades** – This project is currently at 50% design with AE and is currently being updated with Public Works' review comments.

Engineering staff continue to thoroughly review all Planning and Committee of Adjustment applications. Reviews entail a site visit and detailed analysis of drawings and reports, to ensure Town standards are adhered to. For more complex applications, this process sometimes involves several re-submissions and repeated reviews by staff. Engineering staff also continue to manage requests for assumption of subdivisions, and for reduction of securities at various stages of the development process. In addition, Engineering Staff complete reviews on lot grading plans for building permits received through the Planning Department.

Further, Engineering Staff continue to support the Pelham Active Transportation Committee (PATC), generating reports for other departments to be sent back to the federal government, and coordinating with other Town departments for assistance.

Engineering staff are also participating in the development of the Niagara Region Stormwater Management Guidelines. The Guidelines are at 70% Draft Stage and are currently being reviewed by other Departments at the Town.

## CORPORATE CLIMATE CHANGE ADAPTATION STRATEGY AND ADAPTATION PLAN

The following is an update on the development of the Town's Corporate Climate Change Adaptation Plan since October 2020:

The Climate Change Coordinator compiled a list of adaptation options based on the feedback from the Adaptation Steering Committee (ASC) and Niagara Adapts Team. The adaptation options were then used to create an implementation plan which outlines the action, its description, lead departments, relevant departments, resources required (budget and staff), and the implementation timeline for each action. The climate change coordinator attended Workshop #5 with Niagara Adapts on Monitoring & Evaluation which is the fifth milestone of the planning process. The information gained was utilized to build an M&E plan for the Town's Corporate Climate Change Adaptation Plan. The M&E plan outlines indicators for tracking each action, the lead department for the collection of data, the duration for collection of data and the resource requirement for the same. Also, the stakeholder survey was successfully implemented, and the desired results were achieved. The monthly breakdown is listed in the next paragraphs.

In October, the Climate Change Coordinator compiled the results from Workshop #4: Part One to consolidate Adaptation Vision & Goals. Simultaneously, Niagara Adapts prepared a stakeholder engagement survey based on the Adaptation Vision and Goals provided by the Town's planning team for further solidification of the vision and goals, and the inclusion of Town's stakeholders in the planning process. The coordinator further developed and defined Adaptation Actions & Goals selected by the previous coordinator.

In November, the Climate Change Coordinator administered the Workshop #4: Part 2 to the ASC to gain consensus on adaptation options. The adaptation options were simultaneously circulated to the Niagara Adapts Team for their feedback. Once the process was complete, a final list of adaptation options was prepared. The Climate Change Coordinator decided on the 45 most suitable adaptation options divided amongst 8 Adaptation Goals for the Town. The coordinator attended an M&E workshop on November 16 conducted by Niagara Adapts. The Stakeholder Engagement Survey was administered in late November and the feedback from internal stakeholders (i.e. staff and council members) was recorded.

In December, the climate change coordinator prepared an implementation plan as well as an M&E plan based on the workshop conducted by Niagara Adapts Team in November. Both the plans have been drafted and ready to be added to the Adaptation Plan. The Stakeholder Engagement survey was opened to external stakeholders (i.e. Town residents; community at large). The results were recorded, and the Niagara Adapts Team is preparing a summary to be added to the Adaptation Plan.

In the coming months, the plan will be drafted, designed, completed, and circulated for feedback. The main sections include Introduction, Planning Process, Climate Change, Climate Projections, Impacts Summary, Risk and Vulnerability Assessment, Adaptation Vision, Goals and Actions, Implementation, and Monitoring & Evaluation. The required updates will be accommodated in the Engineering Design Guide. The Corporate Climate Change Adaptation Plan will be shared with the council for approval. Niagara Adapts will conduct two more workshops on Implementation and

Knowledge Mobilization and these will be attended by the Climate Change Coordinator.

**Constituent Concerns and Issues Arising:**

COVID-19 PUBLIC WORKS RESPONSE The Public Works Department has implemented measures to help reduce the spread of COVID-19 and provide a safe work environment for staff. Where possible and appropriate staff have been directed to work from home. The Engineering Department consists of five (5) staff all of whom are currently working from home and the office on a rotating schedule. In order to maintain safe numbers of employees at Town Hall, engineering and administration staff are working approximately 50 percent of the time from home and 50 percent of the time in the office. This work schedule is coordinated with the Planning Department as the office space is shared with this department. Engineering staff are busy preparing tenders and RFPs for the 2021 Capital and Operating program, continue to complete administration and site inspection on projects and operations that are considered essential, and work with the review of development related items.

Pursuant to the Provincial guidelines, Public Works Operations staff are considered to provide essential services. Public Works has continued to operate with an adjusted work day schedule to include eight hours per shift with a paid working lunch. This is an attempt to limit the amount of interaction employees have with each other during lunch and scheduled breaks. With this work schedule staff are encouraged to take their breaks on the jobsite in order to limit potential contact at the Tice Road Operations Centre. Further, in order to further protect staff, most vehicles have been equipped with plexi-glass shielding between the passengers and driver. Vehicles not equipped with shielding are limited to single driver operation. Finally, Public Works has continued to operate with increased levels and frequency of cleaning and disinfecting.

Public Works staff are concentrating on critical and essential activities related to providing safe drinking water, safe wastewater collection and disposal, and maintaining safe roadways (including winter maintenance) in accordance with the minimum maintenance standards as set forth by the Province and *the Municipal Act, 2001.* Staff are continuing with capital projects in accordance with Provincial Guidelines. In addition, Public Works staff continue to issue Request for Proposals (RFPs), and Tenders as the Town's method of procuring these services is fully digital and does not require hand delivered submissions.

**Employee Updates:**

The completion date for the Climate Change Adaption Plan has been extended due to programming difficulties associated with COVID 19.  As a result, the Town has been able to extend the Climate Change Coordinator position until December 10th, 2021.  The position has been fully funded through unused grant dollars through the Federation of Canadian Municipalities, as well as through labour cost savings related to this position.

**Grants, Concerns, RFPs, Agreements:**

Please see Corporate Services report regarding contract assignments and grant submissions and approvals.

**Meetings:**

The following meetings have been attended:
1) Public Works Officials (PWO) Meetings
2) Niagara Peninsula Standard Contract Document Meetings
3) Niagara Region Wet Weather Committee
4) Trout Unlimited Low Impact Development Webinars
5) Municipal Class EA for Merritt Road Extension
6) Various Committee Meetings (PATC, Beautification)

Climate Change Adaptation Plan, January-February-March 2021

The Climate Change Coordinator completed the Corporate Climate Change Adaptation Plan. The main sections include Introduction, Planning Process, Climate Change, Climate Projections, Impacts Summary, Risk and Vulnerability Assessment, Adaptation Vision, Goals and Actions, Implementation, and Monitoring & Evaluation. The plan was shared with Niagara Adapts, ASC and SLT for their feedback. The feedback was accommodated as it was received and it was an ongoing process that is underway. The climate change coordinator attended Workshop #8 with Niagara Adapts on Implementation. The Coordinator also reviewed Town's Engineering Design Guide to accommodate the changes based on adaptation planning. The monthly breakdown is listed in the next paragraphs.

In January, the Climate Change Coordinator prepared a first draft of the final plan which was shared with Niagara Adapts for their feedback. The process included compiling different sections, writing the sections, research climate change data and information for various sections of the plan. The Niagara Adapts team provided their feedback on the draft plan which was considered and the changes were made.

In February, the Climate Change Coordinator attended Workshop #8 on implementation conducted by Niagara Adapts and Savanta. The Climate Change Coordinator continued working on the plan. The process and receiving and accommodating feedback continued along with formatting the plan according to brand guidelines while also personalizing the plan for the Town using the defining and iconic Town pictures.

In March, the climate change coordinator presented the plan to the Senior Leadership Team. The feedback that will be received will be accommodated to the plan before the plan is shared with the Council for approval. Additionally, the Climate Change Coordinator met with David Cribbs, Jason Marr, and Derek Young to delve into the Town's mitigation planning. The Climate Change Coordinator reviewed the Town's Engineering Design Guide.  The Climate Change Coordinator also attended a Panel discussion on Implementation organized by Niagara Adapts.

In the coming months, the Corporate Climate Change Adaptation Plan will be shared with the Council for approval. The required updates will be accommodated in the Engineering Design Guide to accommodate for adaptation planning. Moreover, the Town will look into mitigation activities along with the beginning of the implementation of the adaptation plan. Besides, Niagara Adapts will conduct a Knowledge Mobilization workshop (last in the series) in May which will be attended by the Climate Change Coordinator.

**FIRE AND BY-LAW ENFORCEMENT QUARTERLY REPORT**
Monday, April 19, 2021

# **Reporting Period:** Fire and By-law Enforcement Department Quarterly Report for the period: Quarter 1 (one) January – March 2021

**Recommendation:**

**BE IT RESOLVED THAT the Q1/2021 Fire and By-law Enforcement Department Report be received for information.**

**Department Overview and Statistics:**

**By-law**
**January 2021** 5 Cannabis odor complaints were received for the month of January 2021 (4 from Pelham, 1 from Welland).

The by-law department continues to perform random cannabis odor testing at the property lines of the known Industrial cannabis growing facilities in Pelham. These pro-active tests were in addition to the re-active tests completed based on citizen complaints. **46** odour tests were completed for the month, which resulted in no violations of the Towns industrial odorous control by-law.

Covid complaints and inquiries continued to be received by the By-law Department. One warning was issued by the By-law Department to a Pelham Business in regard to not controlling the number of patrons permitted into the establishment at one time as per Covid restrictions.

**February 2021** 12 Cannabis odor complaints received for the month (9 from Pelham and 3 from Welland). By-law department continued random cannabis odor testing at the property lines of the known Industrial Cannabis Growing Facilities in Pelham. Pro-active testing was in addition to the re-active tests completed based on citizen complaints. **30** Random odour tests were completed for the month, which resulted in no violations of the Towns Industrial Odorous Control By-law.

Covid inquiries continued to be received by the By-law Department in February. No violations were issued.

**March 2021 16** Cannabis odour complaints were received for the month of (**6** new complaints and **10** repeat complaints). By-law Department continues to perform random cannabis odor testing at the property lines of the known industrial cannabis growing facilities in Pelham. Pro-active tests were in addition to the re-active tests completed based on citizen complaints. **41** Random odour tests were completed for the month, which resulted in no violations of the Towns industrial odorous control By-law.

Covid complaints and inquiries continued to be receive and dealt with by the By-law Department in March.

**Fire Prevention**

Fire Prevention has been busy over the last three months. With spring arriving a little earlier than normal this year many property owners have been starting there spring clean up increasing agricultural brush burns this year. Fire department responded to multiple grass fires, as conditions have been dry this year.
There also has been an increase with residents inquiring & receiving recreational burn permits (back yard fire pits). Due to current travel restriction with Covid, more people are staying home and enjoys there yards. With permit increases, fire department has not seen an increase in burning complaints.

Fire prevention has teamed up with Public Health inspector to start inspection of Migrant worker housing. So far, inspections have gone very well and living quarters have been fire safe for workers.

With the help of fire department co-op student, we have been keeping up on inventory and distribution of PPE and cleaning supplies for all town buildings.
fire department still has a very health stock of PPE and cleaning products.

**Emergency Management**

The Town of Pelham remains in a declared state of emergency and the EOC is in partial activation. The emergency control group meets virtually Monday & Thursday @ 0900.

Town of Pelham has received their 2020 compliance from the province for emergency management.

**Suppression**

The fire department continues to respond to all types of incidents with the exception of some modified medical responses. The modified medical responses are to:

1. Reduce risk to firefighters relating to COVID-19

2. To preserve personal protective equipment as the equipment inventories are low.

Fire equipment is being cleaned after each use and at least once per week if no responses occur. Resources are not compromised at this time and the Town continues to respond with full compliment.

**Projects:**

Projects completed in quarter one: issuance of RFP for new SCBA air system and a new By-law enforcement policy was developed and approved by council.

**Constituent Concerns and Issues Arising:**

Ongoing COVID-19 pandemic

**Employee Updates:**

Pelham fire department along with HR have been testing, interviewing & completing practical testing for a new training officer. Successful candidate was by-law officer Greg Young.

Since receiving promotion to training officer, by-law department along with HR have conducted interviews for new full-time by-law officer. Melissa Grodesky will start her new position April 19/21.

Hiring of seasonal by-law position has been completed Cerara Obdeyn will start May 1st.

Continuing with in person firefighter training at all stations, maintaining social distancing and cleaning procedures of all areas and equipment. Pelham firefighters were able to receive vaccines as part of emergency services department.

**Grants, Concerns, RFPs, Agreements:**

Pelham fire department has been awarded $8800.00 through the Ontario fire marshall, fire safety grant.

**Meetings:**

SLT (senior leadership team), EOC (emergency operations centre), MEG (municipal emergency group), REOC (regional emergency operations centre), MAC (medical assist committee), DC (district chiefs), JHSC (joint health & safety committee), regional chiefs, mayor, council, cannabis control committee

FIRE & BY-LAW ADMINISTRATION

| FIRE RESPONSES | | | | |
|---|---|---|---|---|
| | Total | JAN | FEB | MAR |
| STRUCTURE/VEHICLE FIRE | 5 | 0 | 4 | 1 |
| MUTUAL AID OTHER DEPT | 4 | 0 | 2 | 2 |
| MVC | 16 | 7 | 5 | 4 |
| REMOTE ALARMS | 8 | 3 | 2 | 3 |
| MEDICAL ASSIST | 27 | 9 | 14 | 4 |
| EMERG. & NON EMERG ASSIST | 7 | 2 | 2 | 3 |
| PUBLIC ASSISTANCE | 0 | 0 | | |
| GRASS/BRUSH FIRE/COMPLAINT | 12 | 2 | 2 | 8 |
| RESCUES | 0 | 0 | | |
| ODOUR INVESTIGATION | 0 | 0 | | |
| CO INVESTIGATIONS | 6 | 0 | 5 | 1 |
| | | | | |
| Monthly Totals | | 23 | 36 | 26 |
| Annual Total 2021 | 85 | | | |
| Total Responses for 2020 | 286 | | | |
| | | | | |

| FIRE PREVENTION 2020 | | | | | |
|---|---|---|---|---|---|
| INSPECTIONS | | | | | |
| | Total | JAN | FEB | MAR | APR |
| Inspections | 17 | 5 | 7 | 5 | |
| Town Monthly Building Inspect. | 36 | 12 | 12 | 12 | |
| Plan reviews | 7 | 2 | 1 | 4 | |
| Tapp-C | 0 | 0 | 0 | 0 | |
| Fireworks Permit | 0 | 0 | 0 | 0 | |
| Open Air Burning Permit | 69 | 7 | 4 | 58 | |
| Observed fire drill | 0 | 0 | 0 | 0 | |
| Court appearance | 0 | 0 | 0 | 0 | |
| | | | | | |
| Monthly Totals | | 26 | 24 | 79 | 0 |
| Annual Total 2021 | 129 | | | | |
| Total Responses for 2020 | 333 | | | | |
| NTHLY COMMITTEE/ASSOCIATION MEETINGS | | | | | |
| | Total | JAN | FEB | MAR | APR |
| OMFPOA | 2 | 0 | 1 | 1 | |
| Arson Committee | 1 | 0 | 1 | 0 | |
| TAPP-C | 0 | 0 | 0 | 0 | |
| Development Coordinator Meeting | 0 | 0 | 0 | 0 | |
| Town staff meeting | 0 | 0 | 0 | 0 | |
| Meetings, various (n.o.s.) | 12 | 5 | 4 | 3 | |
| | | | | | |
| Monthly Totals | | 5 | 6 | 4 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Annual Total 2021 | 15 | | | | |
| Total Responses for 2020 | 61 | | | | |
| FIRE INVESTIGATIONS | | | | | |
| | Total | JAN | FEB | MAR | APR |
| | 0 | 0 | 0 | 0 | 0 |
| | | | | | |
| Monthly Totals | | 0 | 0 | 0 | 0 |
| Annual Total 2021 | 0 | | | | |
| Total Responses for 2020 | 2 | | | | |
| PUBLIC EDUCATION | | | | | |
| | Total | JAN | FEB | MAR | APR |
| Station Visit School | 0 | 0 | 0 | 0 | |
| Fire Prevention Education Event | 0 | 0 | 0 | 0 | |
| Child / Children Visit Station | 4 | 0 | 1 | 3 | |
| Public Education Presentation | 0 | 0 | 0 | 0 | |
| General inquiries | 36 | 10 | 12 | 14 | |
| Facebook Public Education Posts | 66 | 24 | 20 | 22 | |
| Other Public Education Activities | 0 | 0 | 0 | 0 | |
| | | | | | |
| Monthly Totals | | 34 | 33 | 39 | 0 |
| Annual Total 2021 | 106 | | | | |
| Total Responses for 2020 | 445 | | | | |
| OTHER ACTIVITIES | | | | | |
| | Total | JAN | FEB | MAR | APR |
| Compliance Letter | 2 | 1 | 1 | 0 | |
| Fire safety plan/drill scenario reviews | 0 | 0 | 0 | 0 | |
| Training for firefighters | 1 | 1 | 0 | 0 | |
| Training Course | 4 | 1 | 2 | 1 | |
| | | | | | |
| Monthly Totals | | 3 | 3 | 1 | 0 |
| Annual Total 2021 | 7 | | | | |
| Total Responses for 2020 | 17 | | | | |

| BY-LAW SERVICES REPORT 2021 | | | | | | | |
|---|---|---|---|---|---|---|---|
| BY-LAW COMPLAINTS RECEIVED | | | | | | | |
| | TOTAL | JAN | FEB | MAR | APR | MAY | JUN |
| Complaints Received | | 5 | 14 | 26 | | | |
| | | | | | | | |
| Monthly Total | | 5 | 14 | 26 | 0 | 0 | 0 |
| Y-T-D Total 2021 | 45 | | | | | | |
| 2020 Total | 209 | | | | | | |
| | | | | | | | |
| PARKING INFRACTIONS ISSUED | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| Tickets Issued | Total | 11 | 6 | 0 | | | |
| | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Monthly Total | | 11 | 6 | 0 | 0 | 0 | 0 |
| Y-T-D Total 2021 | 17 | | | | | | |
| 2020 Total | 108 | | | | | | |
| | | | | | | | |
| **PARKING WARNINGS ISSUED** | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| Warnings issued | Total | 0 | 0 | 0 | | | |
| | | | | | | | |
| Y-T-D Total 2021 | 0 | | | | | | |
| 2020 Total | 64 | | | | | | |
| | | | | | | | |
| **ENVIRONMENTAL BY-LAW FILL APPLICATIONS RECEIVED** | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| | Total | 0 | 0 | 0 | | | |
| Received | 0 | | | | | | |
| Authorized | 0 | | | | | | |
| Properties Exempt | 0 | | | | | | |
| Denied | 0 | | | | | | |
| | | | | | | | |
| Monthly Total | | 0 | 0 | 0 | 0 | 0 | 0 |
| Y-T-D Total 2021 | 0 | | | | | | |
| 2020 Total | 12 | | | | | | |
| | | | | | | | |
| **POLICE REPORTS FILED** | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| | Total | 0 | 0 | 0 | 0 | 0 | 0 |
| Mischief | 0 | | | | | | |
| Vandalism | 0 | | | | | | |
| Trespassing | 0 | | | | | | |
| Graffiti | 0 | | | | | | |
| Other | 0 | | | | | | |
| | | | | | | | |
| Monthly Total | | 0 | 0 | 0 | 0 | 0 | 0 |
| Y-T-D Total 2021 | 0 | | | | | | |
| 2020 Total | 2 | | | | | | |
| | | | | | | | |
| **CANNABIS ODOUR COMPLAINTS RECEIVED** | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| | TOTALS | 5 | 12 | 16 | | | |
| NEW Complaints | 10 | 2 | 2 | 6 | | | |
| REPEAT Complaint | 23 | 3 | 10 | 10 | | | |
| | | | | | | | |
| Number of Violations | | 0 | 0 | 0 | | | |
| Nasal Ranger detection | | 2 | 1 | 0 | | | |
| fresh air detection | | 4 | 3 | 0 | | | |
| | | | | | | | |
| From PELHAM | 28 | 4 | 9 | 15 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| From WELLAND | 5 | 1 | 3 | 1 | | | |
| | | | | | | | |
| Monthly Total | | 5 | 12 | 16 | 0 | 0 | 0 |
| Y-T-D Total 2021 | 33 | | | | | | |
| 2020 Total | 79 | | | | | | |
| | | | | | | | |
| | | | | | RANDOM CANNABIS ODOR TESTING | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| Tests Completed | | 46 | 30 | 41 | | | |
| Number of Violations | | 0 | 0 | 0 | | | |
| Nasal Ranger detection | | 2 | 2 | 3 | | | |
| fresh air detection | | 4 | 1 | 8 | | | |
| | | | | | | | |
| Monthly Total | | 46 | 30 | 41 | 0 | 0 | 0 |
| Annual Total 2021 | 117 | | | | | | |
| 2020 Total | 60 | | | | | | |
| CANNABIS OPERATIONS LIGHT POLLUTION COMPLAINTS RECEIVED | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| | TOTALS | 0 | 0 | 1 | | | |
| NEW Complaints | 0 | | | | | | |
| REPEAT Complaints | 0 | | | | | | |
| | | | | | | | |
| From PELHAM | 0 | | | 1 | | | |
| From WELLAND | 0 | | | | | | |
| | | | | | | | |
| Monthly Total | | 0 | 0 | 1 | 0 | 0 | 0 |
| Y-T-D Total 2021 | 1 | | | | | | |
| 2020 Total | 2 | | | | | | |
| | | | | | | | |
| | | | | | NOISE COMPLAINTS | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| | TOTALS | 0 | 0 | | | | |
| NEW Complaints | 0 | | | | | | |
| REPEAT Complaints | 0 | | | | | | |
| | | | | | | | |
| Monthly Total | | 0 | 0 | 0 | 0 | 0 | 1 |
| Y-T-D Total 2021 | 0 | | | | | | |
| 2020 Total | 25 | | | | | | |
| | | | | | NON-PARKING AMP CITATIONS ISSUED | | |
| | | JAN | FEB | MAR | APR | MAY | JUN |
| AMPS ISSUED | | 0 | 0 | 0 | | | |
| | | | | | | | |
| Y-T-D Total 2021 | 0 | | | | | | |
| 2020 Total | 9 | | | | | | |

# Year-End Report 2020

PELHAM PUBLIC LIBRARY



Since May 25th, over 50% of patrons have utilized our curbside service.

# Our COVID-19 Response

Friday, March 13, 2020, public libraries in the Niagara Region and beyond closed their doors with the hopes of preventing COVID-19 from gaining momentum and spreading.

March 16, 2020, Pelham Public Library staff began working from home, programs were canceled, LiNC delivery and Inter-Library Loans stopped - all with the hopes that we would return to our high level of service and program offerings in the coming weeks. However, as the province began to respond to the pandemic, the library's doors remained closed. On May 1, 2020, six staff members were laid off indefinitely, while the remaining four worked to implement digital services and connections with the Pelham community.

With provincial and municipal guidance, on May 25, 2020, PPL opened its doors to a new type of service - curbside - in which community members placed holds on items and received them outside of the library from a table. Books began to be quarantined upon return for a minimum of 96 hours, late fees were removed, and staff worked diligently to provide the same high-quality customer service, donning masks, shields, and safety glasses while sanitizing and disinfecting touchpoints and regularly used surfaces. Staff may have looked different, but still served our patrons in every way possible. Hours were limited during this reopening stage, but our staff were once again able to provide materials and services to the community.

July 24, 2020, the region moved to stage 3, "Short Stay." Stage 3 services began to approach a new normal that included COVID-19 screening at the door, mandatory masks, a limited number of people in our buildings, and social distancing during in-person browsing. Computer access was time-limited. Programs were being offered online, digitally if able, and patrons could browse the stacks in a "short stay" fashion, with a maximum of 15 people in the building at one time. LiNC sharing and Inter-library loans began. Despite the reintroduction of in-person browsing, our curbside numbers remained strong throughout the fall, with just over 50% of our patrons continuing to use curbside pickup at both of our branches.

Ontario experienced increasing COVID-19 numbers in the fall of 2020, and in late December 2020, the Niagara Region once again enforced restrictions and a lockdown. For PPL, this meant a return to curbside pickup only, no in-person browsing or computer use. However, many of our digital programs and opportunities remained, providing higher service levels to the Pelham community than the first lockdown, with hopes to continue to expand our digital presence and offerings into 2021.

# Meeting Community Needs Digitally

In response to COVID-19, PPL has evolved to meet the ever-changing digital needs of our community.

With no in-person programming from March onwards, staff responded to programming needs in a variety of ways. YouTube videos were created for children's storytime and on how to use Hoopla for children. Our newest software, Beanstack, allowed programmers to offer reading challenges, such as the summer reading challenge, for all age groups, with patrons earning badges and entries for prizes.

A book club was offered online through our Facebook platform, gaining the attention of over 30 participants discussing a variety of fiction and nonfiction materials. Children and teen at-home digital resources were also researched, and links were provided through our website, making Pelham Public Library a one-stop resource for homeschooling, virtual, and in-class learning.

Ancestry.com provided free at-home genealogy researching using your library card, and our databases, such as Global Road Warrior and NoveList, were marketed for use.

PPL introduced RB Digital in January 2020, providing patrons with access to over 3000 magazine titles digitally on any device with a simple creation of an account using their library card.

Our digital ebook and audiobook resources, Hoopla and Overdrive/Libby, both saw a significant surge in use. In response to this escalation, PPL increased the number of monthly Hoopla borrows from four a month to 10, and we purchased a more extensive selection of book titles from OverDrive/Libby

10,191
ITEMS RECEIVED
THRU LiNC

**5,660**
ITEMS SENT
THRU LiNC


## The Future is LiNC

Despite the pandemic, 2020 brought some fantastic gains in our LiNC sharing. While LiNC initially halted during the spring lockdown, by summer 2020, it was back up and running. With staff delivering materials weekly, libraries were able to share resources efficiently.

November 2020 welcomed four new libraries to the Libraries in Niagara Consortium: Grimsby Public Library, Port Colborne Public Library, Welland Public Library and West Lincoln Public Library. While our catalogue expanded significantly, sharing did not begin until January 2021, but Evergreen allowed patrons and staff to see all the available materials.

In the spring of 2021, we look forward to welcoming Wainfleet Public Library to LiNC, rounding us out to ten public libraries sharing our collections and collaborating on various aspects of collection development. It is also the hope of the LiNC libraries' CEOs to propose a delivery system to initiate a more sustainable, regular delivery solution that benefits the environment and all ten public libraries.

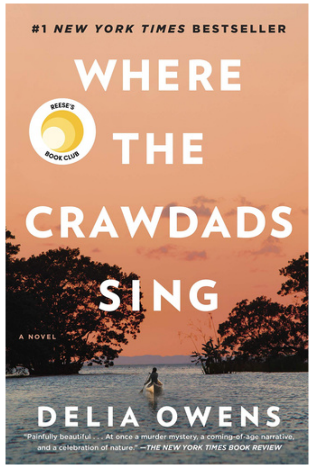
## Repurposing Our Space

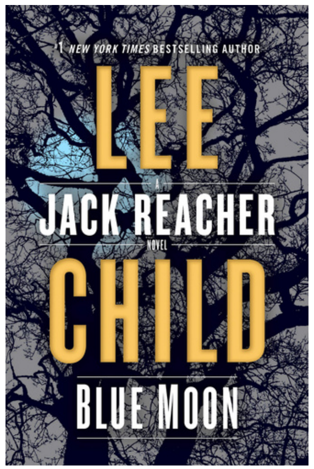
COVID-19 brought with it the dawn of curbside pickup for PPL. At both the Fonthill and Maple Acre branches staff adapted library building entrances with tables, signs and materials to make curbside simpler for patrons while continuing to offer needed resources. Fonthill further expedited the curbside service by moving a circulation computer closer to the door to allow for faster customer service. Doorbells were installed at both branches allowing patrons to ring for fast, easy service while maintaining social distancing, sanitization and proper PPE.

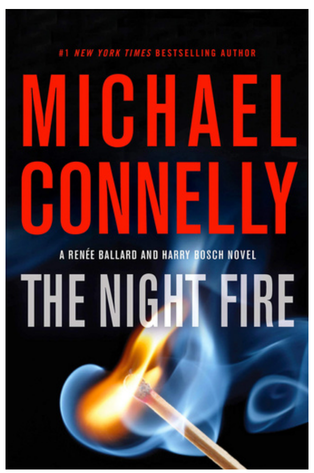
With the introduction of in-person browsing from July 24, 2020, until December 21, 2020, PPL implemented 'short stay' guidelines that allowed patrons to come in, but only for short periods. All furniture not essential for basic library services was removed and stored to help enforce this, including lounge chairs, reading tables and chairs, and all but one of our study booths. Public computers were separated and relocated to follow social distancing guidelines.

During "short stay" availability, both branches set up screening stations at their main entrances. Patrons had to pass a Public Health screening questionnaire to enter the buildings while maintaining capacity restrictions. At the Maple Acre branch, to control the numbers of patrons inside the building, the front door entrance facing Canboro Road was closed, allowing patrons to enter only at the rear accessible door off the parking lot. This allowed staff to monitor patrons coming and going from the Maple Acre branch, ensuring proper screening and cleaning procedures.

Most Borrowed E-books in 2020




# 2020 was full of challenges and changes...

But your PPL card continued to open up a world of possibilities.

**651** individuals WHO STARTED USING OUR eResources THIS YEAR

You enjoyed a variety of digital content, such as e-books, music, movies and more.

**36,255** eResources DOWNLOADED

**8,472** Hoopla CHECKOUTS

**25,160** E-BOOKS downloaded

**2,623** RB DIGITAL downloads

**402** individuals acquired new LIBRARY CARDS

You often browsed our online catalogue to see what was new and placed holds for curbside pickup.

**94** thousand ITEMS borrowed

**1,081** CURBSIDE SERVICE HOURS

From May to December you were supported by PPL staff by phone, email, and curbside service.

# COLLECTIONS AND SERVICES

| | 2020 | % Change | 2019 |
|---|---|---|---|
| In-Person Visits | 22,578 | -78% | 103,660* |
| Curbside Visits | 7,899* | - | -* |
| Short Stay Visits | 5,117 | - | -* |
| Virtual Visits | 58,699 | 21.5% | 48,310 |
| **Total Visits** | **94,293** | **-38%** | **151,970** |
| New Members (Fonthill) | 360 | -46% | 669 |
| New Members (Maple Acre) | 42 | -58% | 100 |
| **Total New Members** | **402** | **-47.7%** | **769** |
| Checkouts (Fonthill) | 70,709 | -46.5% | 132,280 |
| Checkouts (Maple Acre) | 8,814 | -60% | 22,103 |
| Renewals (Fonthill) | 12,832 | -37% | 20,364 |
| Renewals (Maple Acre) | 1,211 | -55% | 2,672 |
| **Total Items Borrowed** | **93,566** | **-47%** | **177,419** |
| Hoopla Checkouts | 8,472 | 166% | 3,180 |
| OverDrive/Libby Checkouts | 25,160 | 37% | 18,345 |
| RB Digital Checkouts | 2,623 | - | -* |
| **Total Digital Checkouts** | **36,255** | **68%** | **21,525** |
| Hoopla New Registrations | 249 | 42% | 175 |
| OverDrive/Libby New Registrations | 256 | 97% | 130 |
| RB Digital New Registrations | 146 | - | -* |
| **Total New Registrations** | **651** | **113%** | **305** |

* People Count was down for one month during 2019
* Curbside Service was only available from May - December
* Not applicable for 2019
* RB Digital was a new service that began in 2020

# FINANCIAL SUSTAINABILITY

## 2020 Donation Summary

### TOTAL = $19,735.00

| | |
|---|---|
| Donations Online | $4,935.00 |
| Donations In-Person or Mailed in | $11,800.00 |
| Kiwanis | $2,500 (towards childrens programming) |
| Fonthill Lioness | $500 (towards collection development) |

***On December 1, 2020 we participated in Giving Tuesday, a global fundraising event geared towards community transformation. On this day, we had 41 generous individuals that donated.***

## 2020 Fundraising Event Summary

### TOTAL = $5,545.00

| | |
|---|---|
| Spring Book Sale | $3,798.00 |
| Booksale Room (until mid-March) | $1,409.00 |
| Christmas Basket Sale | $338.00 |

# Something New at PPL

In March 2020, PPL launched its newest initiative - Pelham Plants, our seed library. With funding from the Niagara Community Initiative, Pelham Plants offered ten types of seeds, including multiple varieties of vegetables and herbs. When PPL shut its doors, Pelham Plants was easily converted online, allowing patrons to request various types of seed packages to be mailed to them with the hopes of initiating backyard gardens throughout our community. With Pelham Plants' success, we hope to grow our seed offering in 2021 while incorporating gardening programming for all ages.

With limited in-person browsing in 2020 and a push for short stay visits, the children's department implemented Grab and Go Bags. Grab and go bags are reusable, zippered bags filled with topic-specific materials for children. For example, one Grab and Go is filled with books about trucks; another is filled with books about princesses, while others are staff favourites or books about being kind. Parents and children alike enjoy the ability to grab a bag of books tailored to their children's interests without the time it takes to browse the shelves.

For children and teens, Take and Make craft bags were provided for curbside pickup. Each bag contained craft supplies to create a specific craft. Boredom Buster bags were made available for adults with books, puzzles, and games, offered for curbside pickup, for free, without the need for checkout.



# What to look forward to at the Pelham Public Library in 2021

Currently, library staff are researching the option to implement an online tutor service through the library for children, teens, and adults alike. While we're still in the exploration stage, we hope to be able to connect patrons with an online platform that offers 1:1 tutoring, test prep, and revision assistance for a variety of subjects, grades, and learning levels.

While our large print and audiobook ARP began in 2020, COVID-19 put a halt to any real benefit of sharing and building these materials collectively. In 2021 we hope to see both large print and audiobook collections shared and developed together with other participating LiNC libraries.

Pelham NIAGARA

**PUBLIC WORKS DEPARTMENT**
Monday, April 19, 2021

# **Subject:** Operation of the Rice Road and Hwy 20 Storm Water Management Pond in East Fonthill

**Recommendation:**

> **BE IT RESOLVED THAT Council receive Report #2021-0048, Operation of the Rice Road and Highway 20 Storm Water Management Pond in East Fonthill, for information;**
>
> **AND THAT Council authorize Staff to complete further engineering studies including an updated erosion survey of the outlet of the Storm Water Management Pond at an estimated value of $7,950 (plus HST);**
>
> **AND THAT Council direct Staff to fund the additional erosion study from the 2021 Capital Account RD-04-21 (Engineering);**
>
> **AND THAT Council direct Staff to prepare a report regarding the findings of the Engineering Analysis including recommendations.**

**Background:**

At the November 2nd, 2020, meeting of Council, a resolution was made instructing staff to prepare a report regarding the design and performance of the storm water management facility located at Hwy 20 and Rice Road. Of particular concern was the impact that the storm water management facility was having with respect to erosion on the outlet located north of Hwy 20. This outlet is significant since it outlets storm water from a portion of the East Fonthill development into the headwaters of the 12 Mile Creek. The 12 Mile Creek is a sensitive water course and concerns have been brought to council regarding the quantity and quality of water discharging into its headwaters from various stakeholders including Trout Unlimited Niagara Chapter, Pelham Cares, and the Fonthill Lions Club.

The proposed Village of East Fonthill development is located in the East Fonthill area of the Town of Pelham. The site is located directly west of Rice

Road (Regional Road 54), north of Port Robinson Road and The River Realty development lands, east of Station Street, and south of Regional Road 20. The lands that comprise of the Village of East Fonthill include the commercial plazas south of Hwy 20 (Market Place and Shops on 20), Wellspring, the Meridian Community Centre, the Better Life Development, Hwy 20 (between Pelham Street and Rice Road), and some residential development to the west of the commercial plazas. The lands that contribute to the Rice Road and Hwy 20 SWM facility are only a portion of the Village of East Fonthill development. The lands that contribute directly to the Rice Road and Hwy 20 SWM facility include the two commercial plazas (Market Place and the Shops on 20), a portion of the Park Place North residential development, the Better Life residential development, the Regional Road right of way on Hwy 20 between Pelham Street and Rice Road and a pre-existing development located at the south east corner of Rice Road and Hwy 20 intersection.

In essence the Rice Road and Hwy 20 storm water management facility receives storm runoff from everything north of the Food Basics Plaza. The remainder of the East Fonthill subdivision drains into other storm water management facilities that outlet into the Singers Drain.

In June of 2015, Upper Canada Consultants prepared a Storm water management plan for the Village of East Fonthill subdivision (see Appendix A – Village of East Fonthill Storm water Management Plan, June 2015).

The proposed Village of East Fonthill development site consists of approximately 18.75 hectares of development area, a watercourse channel block and two storm water management facility blocks. The proposed storm water management blocks convey flows to the respective storm water outlets at the 12 Mile Creek and the Singers Drain.

The storm water management plan was designed to control the post-development storm water flows to both outlets (12 Mile Creek and Singers Drain) to pre-development levels with two (2) storm water management facilities within the subject lands of The Village of East Fonthill.

The storm water management wet pond facility, located at the southwest corner of the intersection of Regional Road 20 (Canboro Road) and Regional

Road 54 (Rice Road), discharges peak storm water flows to Twelve Mile Creek from a total drainage area of 27.07 hectares with an overall imperviousness of 85%.

The storm water management pond was designed to receive peak storm water flows from approximately 14.78 hectares of Town of Pelham lands and approximately 12.29 hectares conveyed from the adjacent Regional Roads (Hwy 20 and Rice Road). (See Appendix B - Drainage Area Plan for the storm water shed for the Rice Road and Hwy 20 SWM pond).

Lands internal to the drainage area are serviced with a conventional storm water management system, including both a minor and major system. The storm water system shall include concrete curb and gutter, asphalt pavement, grassed swales, concrete catch basins, and storm sewers. Major storm water flows, beyond the design capacity of the storm sewers, shall be conveyed overland within the paved portion of the road, and convey storm water flows to the storm water outlets.

**Analysis:**

All new developments within the province of Ontario are required to provide storm water management according to provincial and municipal policies including: (1) Storm water Quality Guidelines for New Development (MOEE/MNR, May 1991); and (2) Storm water Management Planning and Design Manual (MOE, March 2003).

Based on the comments and outstanding policies from the various agencies including the Town of Pelham, Niagara Region, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of Environment (MOE), the following site specific considerations were identified within the Fonthill East Secondary Plan report and have been used in the design of the storm water management plan:

(1) The northern outlet receiving waters (Twelve Mile Creek) is considered Type 1 (Critical) fish habitat. Based on this fish habitat and corresponding NPCA criteria, the MOE level of protection for new developments within this watershed is to be Enhanced (Level 1).

(2) The northern outlet receiving waters (Twelve Mile Creek) is considered a Cold Water Fishery. Based on this fish habitat, storm water thermal mitigation measures are required to minimize the increase in temperature associated with any storm water management controls.

(3) The Municipal Class Environmental Assessment (EA) and associated Part II Order for Regional Road 20 required that flows from the previously reconstructed road be provided with storm water quantity controls within the adjacent storm water management facility located at Hwy 20 and Rice Road.

(4) The eastern outlet receiving waters (Singers Drain) are considered Type 2 (Important) fish habitat. Based on this fish habitat and corresponding NPCA criteria, the MOE level of protection for new developments within this watershed shall be Normal (Level 2).

(5) The downstream outlets (Singer's Drain and Twelve Mile Creek) contain natural elements and, therefore, downstream erosion controls are considered necessary in compliance with the 25mm MOE erosion guidelines.

(6) The downstream outlets (Singer's Drain and Twelve Mile Creek) contain lands that would be negatively impacted by increased flooding levels, and, therefore, storm water quantity control is considered necessary to maintain the downstream peak water elevations.

Based on the above policies and site specific considerations, the following storm water management criteria were established for these outlets as part of the storm water management design:

(1) Storm water quality controls are to be provided for the internal storm system conveying storm water flows to Twenty Mile Creek to provide Enhanced (Level 1) Protection according to MOE guidelines.

(2) Storm water quality controls are to be provided for the internal storm system conveying storm water flows to Singer's Drain to provide Normal (Level 2) Protection according to MOE guidelines.

(3) Storm water thermal improvements are to be provided for storm water flows to Twelve Mile Creek.

(4) Storm water erosion controls are to be provided to detain and release the 25mm storm event volume for a minimum of 24 hours.

(5) Quantity controls are to be provided for the outlet to limit the future post- development peak flows from the 25mm, five and 100-year storm events to pre- development peak flow levels.

A variety of storm water management alternatives are available to control the quantity and quality of storm water runoff. Most of these are described in the Storm Water Management Planning and Design Manual (MOE, March 2003). Alternatives for the East Fonthill site considered as part of the storm water management design included the following: lot level controls, vegetative alternatives, infiltration alternatives, and surface storage controls. General comments on each category are provided below:

(1) Lot Level Controls: Lot level controls are not usually suitable as the primary control facility for quality control. They are generally used to enhance storm water quality levels in conjunction with other types of control facilities.

(2) Vegetative Alternatives: Vegetative storm water management practices are generally not suitable as the primary control facility for quantity or quality controls. They are generally used to reduce the rate of runoff and to enhance storm water quality in conjunction with other types of control facilities.

(3) Infiltration Alternatives: Where soils are suitable, infiltration alternatives can be very effective in providing both quality and quantity controls. However, infiltration rates generally limit the use of these techniques. Soils in the East Fonthill site are predominantly clay with infiltration rates of less than 12 mm/hr. Infiltration alternatives may provide some quality benefits. Due to the low infiltration rates and large development site, infiltration alternatives were not considered feasible as primary control facilities for this site.

(3) Surface Storage: Surface storage techniques can be very effective in

providing both quality and quantity control. Wetlands are generally the most efficient for water quality control, however require more maintenance than a wet pond and are more subject to negative public perception. Both the onsite and additional offsite lands will generate sufficient storm water to maintain a permanent pool. Therefore, two wet ponds were recommended as storm water management facilities to provide quality and quantity protection for the two storm water outlets.

(5) Thermal Controls: Surface storage techniques can be very effective in providing both quality and quantity controls, however solar radiation results in increased water temperatures that can have negative impacts upon the downstream habitat, specifically the Cold Water Fishery designation of Twelve Mile Creek. Vegetative cover can mitigate some of these effects, and proper landscape design including shade trees is important. A more aggressive measure that was considered in the design of the north SWM pond outlet (Hwy 20 and Rice Road) included directing low flow through underground clear stone filter beds to cool the outflow water through thermal transfer.

Based on the above considerations there were special considerations given to the design and construction of the Storm Water Management Pond for the discharge water into the 12 Mile Creek. Of particular importance and concern were design measures to mitigate against Quantity (flow) concerns, Temperature concerns and Quality concerns (sediment reduction). (See Appendix C - Upper Canada Design Brief dated February 2021).

With respect to reduction of flows, the Ministry of Environment (as it then was), Town of Pelham design standards, and NPCA regulations require that future storm water flow from the proposed development projects are equal to or less than the storm water flows that occurred prior to development. The storm water management pond at Rice Road and Hwy 20 was designed recognizing that the downstream headwaters of the 12 Mile Creek were experiencing significant erosion prior to development taking place. As a result, the SWM facility was over-designed to reduce the peak flows (25mm rain event) by 90 percent and by 62 percent for the 100-year design storm event.

The Ministry of Environment requires that the volume of storm water produced by a 25mm rain event be detained and released slowly over a minimum period of 24 hours.

The wet pond facility provides approximately 4,592 $m^3$ of permanent pool storage to provide storm water quality improvements and a total active storage volume of 23,897 $m^3$ to detain storm water flows up to and including the 100-year design storm event.

Further, the facility was designed and constructed with both a 225mm orifice control in which a smaller outlet is provided to reduce the amount of discharge. In addition, flow controls are achieved by the implementation of a geothermal bed where flows entering the pond are forced through a series of perforated pipes and clear stone contained around the perimeter of the SWM pond. The geothermal beds act to provide storage and reduce quantities as well as reduce the temperature of the storm water. The Rice Road and Highway 20 SWM facility is designed to retain the storm water for 24.8 hours prior to discharge into the downstream outlet.

During the planning and design process, there was recognition that 12 Mile Creek supports a cold-water fishery and that temperature increases normally associated with standing water in the pond needs to be reduced. In the design of the SWM pond, this issue was addressed through the implementation of a geothermal bed and the strategic planting of trees and aquatic vegetation.

The geothermal bed acts to reduce the temperature of the storm water discharge by forcing the water entering the pond through a series of perforated pipes and clear stone wrapped in geotextile. The storm water trickles through the stone bed that is at a temperature below the surface temperature and acts to cool the water.

In addition, the pond block was heavily vegetated including numerous trees of various species. The plantings and aquatic vegetation play an important role in providing shade and reducing the increase in temperature associated with the exposed water surface. (See Appendix D - Design drawings and Landscaping Plans for Rice Road and Hwy 20 Stormwater Management Facility).

The storm water management pond also functions to reduce the sediment contained in the storm water being discharged into the outlet of the 12 Mile Creek. Due to the sensitive nature of the outlet, the Ministry of Environment required an enhanced level of design, which included the removal of 80 percent of the total suspended solids in the storm water. This requirement is a result of the critical aquatic environment of the 12 Mile Creek.

Approval for the design and construction of the Rice Road Hwy 20 SWM facility was received from the MECP, NPCA, Niagara Region and the Town of Pelham.

In 2007, prior to the reconstruction of Hwy 20 the Region retained WSP (formerly Jagger Hims Limited) to complete monitoring of the storm water outlet at Rice Road in response to a Part 2 order initiated during the Municipal Class Environmental Assessment process related to the widening of Hwy 20. The monitoring was a requirement from the Ministry of Environment in response to the Part 2 order. The Region monitored the outlet from 2007 (pre-construction) to 2016 (post SWM Pond construction). The monitoring included water quality and water quantity including the measurement for suspended solids, chemical analysis, temperature, quantity flows and erosion impacts. (See Appendix E - Monitoring report completed for Niagara Region).

The results of the monitoring indicated that post SWM Pond construction peak flows were attenuated to pre-Regional Road 20 redevelopment levels or better, temperature measurements reflected the changes in seasonal temperatures and were similar to pre-construction temperatures and water quality was generally similar to pre-construction measurements. With regard to downstream erosion, surveys of the downstream outlet showed erosion and accretion was generally less than 0.5 m with small areas of greater erosion/accretion in some locations.

As part of the MOE approval for the East Fonthill development SWM Pond at Rice Road and Hwy 20, the Town of Pelham was required to continue with the monitoring for a period of 5 years following the construction of the pond.

The construction of the SWM pond commenced in June of 2015 with successful completion in October of 2015.

Upper Canada Consultants and the Town of Pelham retained the services of WSP Canada Limited to complete the hydrologic monitoring of the storm water management pond. The monitoring included surface water flow monitoring and surface water quality. The monitoring that was completed considered the same parameters as identified above save and except the erosion monitoring. Pre-construction monitoring was conducted from March to May of 2015 with post-construction monitoring beginning in October of 2016 following the one-year construction maintenance period. (See Appendix F - Rice Road Storm Water Management Monitoring Reports completed for the Town of Pelham, dated 2017 and 2018).

Recently, Staff retained the services of WSP to review the monitoring completed from 2007 to present and provide a summary of the performance of the SWM pond located at Rice Road and Hwy 20. (See Appendix G - East Fonthill Development Storm water Management Pond Monitoring Data Review report).

Based on the data presented in the assessment completed by WSP the following conclusions were made:

1) The average and maximum total suspended solids concentrations in the effluent are lower in the post pond-construction monitoring than the pre-development monitoring.

2) The average and maximum electronically and manually measured temperatures in the effluent and downstream locations are lower in the post pond-construction monitoring than the pre-development monitoring, with the exception of the average manual temperatures at the downstream location, which are greater in the post pond-construction period. It was noted that the database is limited for manual measurements at the downstream location during the development/construction and post pond-construction monitoring periods.

3) Peak flow rates in the effluent and downstream location are lower in the post pond-construction monitoring than the pre-development monitoring.

4) Erosion monitoring has indicated the erosion/accretion in the surveyed

reach is generally less than 0.5 m between April 2007 and April 2016.

In general, the conclusion from WSP regarding the performance of the Rice Road SWM Pond is that the pond is effectively attenuating peak total suspended solids concentrations, temperatures, and flow rates to pre-development levels or better.

**Financial Considerations:**

There are no financial considerations as this report is for information only. Should council wish to proceed with additional engineering studies there will be additional costs involved which will need to be included as part of the 2022 Capital Budget request.

The Town of Pelham has retained the services of WSP to continue with the annual monitoring of the SWM pond. The annual cost to complete this work is $3,450 (plus HST), which is being funded through the annual capital-engineering project (RD04-21).

Since the scope of WSP's assignment does not include erosion monitoring it is recommended that a new erosion survey be completed. The last erosion survey was completed in 2015 by WSP on behalf of Niagara Region. The estimated cost to complete a new erosion survey is $7,950 (Plus HST). There are sufficient funds available in the 2021 Capital Budget under account RD04-21 to complete this work. Staff recommends that the Town's procurement policy be waived in this particular instance to provide a direct award to WSP. WSP has the prior knowledge, experience and available data (from previous monitoring assignments) to complete this assignment efficiently and provide continuity when summarizing and comparing previous monitoring reports and studies.

**Alternatives Reviewed:**

There were no alternatives reviewed in the preparation of this report, as its basic purpose is to provide information on the history, design and operating function of the Rice Road and Hwy 20 SWM Facility.

**Strategic Plan Relationship: Risk Management**

The design and monitoring program of the Rice Road and Hwy 20 SWM facility was completed to reduce risk and provide for the appropriate quantity and quality control features taking into consideration the sensitive environment related to the 12 Mile Creek.

**Consultation:**

Staff consulted with the following agencies and professional firms in the preparation of this report:

Upper Canada Consultants (Professional Engineers and Designers)

WSP Canada (Professional Engineers)

Region of Niagara Transportation and Engineering Department

Region of Niagara Planning Department

Town of Pelham Engineering Department

Town of Pelham Planning Department

**Other Pertinent Reports/Attachments:**

Appendix A – Village of East Fonthill Storm water Management Plan, June 2015

Appendix B - Drainage Area Plan for the storm water shed for the Rice Road and Hwy 20 SWM pond

Appendix C - Upper Canada Consultants Design Brief dated February, 2021

Appendix D - Design drawings and Landscaping Plans for Rice Road Hwy 20 Stormwater Management Facility

Appendix E - Monitoring report completed for Niagara Region

Appendix F - Rice Road Storm Water Management Monitoring Reports completed for the Town of Pelham, dated 2017 and 2018

Appendix G - East Fonthill Development Storm water Management Pond Monitoring Data Review report

**Prepared and Recommended by:**

Jason Marr, P. Eng.
Director of Public Works

**Prepared and Submitted by**:

David Cribbs, BA, MA, JD, MPA
Chief Administrative Officer

# STORMWATER MANAGEMENT PLAN

# THE VILLAGE OF EAST FONTHILL

# TOWN OF PELHAM

**Prepared for:**

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4211 Yonge Street, Suite 230
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**And**

The Corporation of the Town of Pelham
20 Pelham Town Square
Fonthill ON L0S 1E0

**Prepared by:**

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**261 Martindale Road, Unit 1**
**St. Catharines, Ontario**
**L2W 1A1**

**June 2015**

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## Appendices

## References


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

2. Environmental Planning Report for the East Fonthill Secondary Plan Area
   LCA Environmental Consulting
   Upper Canada Consultants
   Trow Associates Inc.(November 2011)

3. Stormwater Management Guidelines
   Niagara Peninsula Conservation Authority
   AECOM (March 2010)

4. Town of Pelham Official Plan
   (1974)/ Consolidated version- November 2003

5. Geotechnical Investigation & Hydrogeological Evaluation, Proposed Development Site, Merrit Road and Regional Road #20, West of Rice Road, Pelham, Ontario
   Trow Associates Inc. (2007)

6. Part 654 Stream Restoration Design National Engineering Handbook
   Chapter 11- Rosgen Geomorphic Channel Design
   United States Department of Agriculture (August 2007)

# STORMWATER MANAGEMENT PLAN

# THE VILLAGE OF EAST FONTHILL

### TOWN OF PELHAM

## 1.0 INTRODUCTION

### 1.1 Study Area

This stormwater management report addresses the northern development portion of the East Fonthill Secondary Plan Area within the Town of Pelham. The study area encompasses two major development lands, being developed through two Draft Plan of Subdivision applications to the Town of Pelham.

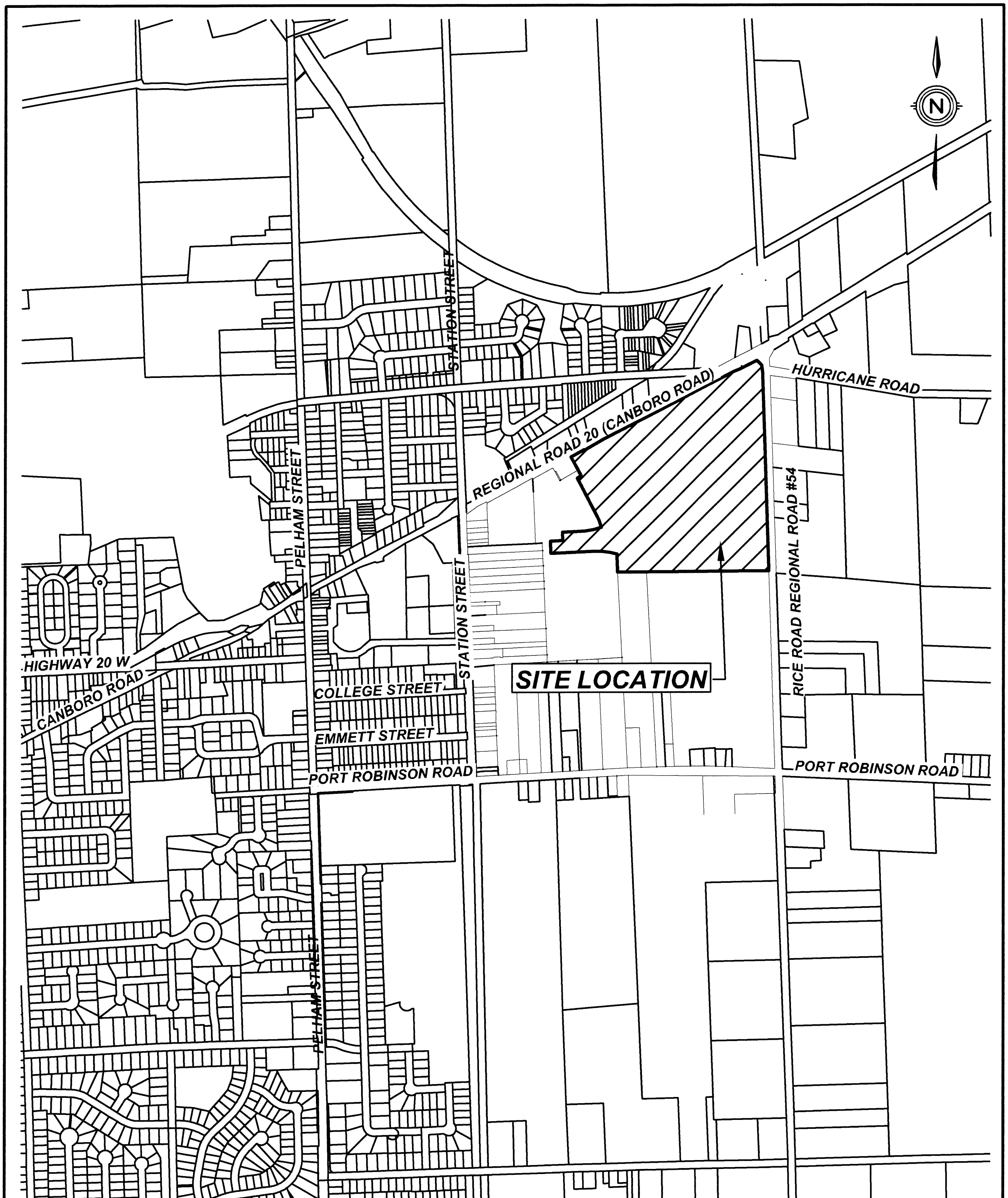
This stormwater management report has been prepared in support of the Draft Plan of Subdivision application for *The Village of East Fonthill.*

These projects are; lands under development by River Realty along Rice Road and known within this report as *"Rice Road Development"* and the lands previously known as the "Allen Property/Town Lands" identified as the *"The Village of East Fonthill"*.

As shown in the Site Location Plan (Figure 1), the study area is located directly west of Rice Road, north of Port Robinson Road, east of Station Street, and generally south of Regional Road 20.

For the purpose of this stormwater management plan, the study area includes the proposed developments, existing residential/commercial lands to the west, the existing Regional Road 20 and 54 to the North and the proposed reconstruction of Port Robinson Road to the south. The development of the adjacent River Realty lands are identified as part of the *"Ultimate"* Stormwater conditions.

The stormwater outlets for the study area are both Twelve Mile Creek (Lake Ontario) and the Singer's Drain. This area has been previously addressed for overall stormwater management as part of the East Fonthill Secondary Plan process (Upper Canada Consultants, 2011). Existing conditions and recommendations are obtained from that report and are generally followed herein; and have been previously identified as outlets A & B.

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**THE VILLAGE OF EAST FONTHILL**

**TOWN OF PELHAM**

**SITE LOCATION PLAN**

| | |
|---|---|
| DATE | 2014–04–22 |
| SCALE | NTS |
| REF. No. | - |
| DWG No. | **FIGURE 1** |

## 1.2 Objectives

The objectives of this study are as follows:

- Establish criteria for the management of stormwater from this site.
- Determine the impact of development on the peak flow of stormwater from this site.
- Investigate alternatives for controlling the quality of stormwater from this site.
- Confirm the extent of lands necessary for stormwater management as identified in the approved Draft Plan of Subdivision.

## 1.3 Existing and Future Conditions

Existing Conditions

The proposed *The Village of East Fonthill* residential development is located in the East Fonthill area of the Town of Pelham. The site is located directly west of Rice Road (Regional Road 54), north of Port Robinson Road and *The River Realty* development lands, east of Station Street, and south of Regional Road 20.

The study area covers approximately 74.7 hectares of existing active agricultural land, with an impervious level of approximately 5.6%. This subcatchment includes *The Village of East Fonthill* and the adjacent *Rice Road (River Realty)* development site as well as adjacent future development lands to the west. External lands (Area '102') include a higher concentration of existing single family residences, as well as commercial lands located along Regional Road 20, and have a corresponding imperviousness of 49.3%.

The existing topography of the study area is undulating, with slopes ranging from 2.5 to 16.5%, and a general west to east tendency. A break point located midway through the development site delineates flows between the north Twelve Mile Creek watershed (Outlet A) and the east Singers Drain watershed (Outlet B).

Soils within the study area are characterized by the Geotechnical Investigation & Hydrogeological Evaluation as being of moderate to low imperviousness, as "the site is underlain mostly by clayey silt" (Trow, 2007). An SCS curve number of 74 was assumed to be representative of the soil conditions present within the study area, based upon land usage and soil characteristics.

Future Conditions

External lands within the drainage shed are based upon the respective Draft Plan of Subdivision applications of the adjacent land owners (where available), or the Secondary Plan. These generally follow the watershed boundary established for the post-development future storm drainage conditions.

The proposed *The Village of East Fonthill* development site will consist of approximately 18.75 hectares of development area, a channel block and two stormwater management facility blocks. The proposed stormwater management blocks will convey stormwater flows to the respective stormwater outlets, Outlets A and B.

Drainage areas to the stormwater management facilities (SWMF) will include flows from the development site, Regional Road 20 and future development lands to the west.

Stormwater flows from the existing Regional Road 20 redevelopment are required to be contained within the Outlet 'A' stormwater management facility located at the northern limit of the site. External flows from adjacent lands to the west of Station Street shall continue to outlet through the study area, and are to be channelized to a watercourse block running through the development site generally within the proposed alignment.

Stormwater within this watercourse will combine with flows from the Outlet 'B1' stormwater management facility and the future 'B2' stormwater management facility associated with the adjacent River Realty (Rice Road) development project, and flow south-east to Singer's Drain (Outlet B as identified in the Secondary Plan Document).

Flows from part of the existing lands west of the development site and south of Regional Road 20 shall be diverted along Station Street south to the drainage channel and ultimately to Outlet D. As required by the Secondary Plan Document, this flow diversion shall reduce the overall flows required to be conveyed internally to Outlet B. A corresponding level of overcontrol will be required within the watershed confluencing to Singer's Drain in order that the post-development peak flow remain consistent with the pre-development flows.

Lands internal to the study area are to be serviced with a conventional stormwater management system, including both a minor and major system. The stormwater system shall include concrete curb and gutter, asphalt pavement, grassed swales, concrete catch basins, and storm sewers. Major stormwater flows, beyond the design capacity of the storm sewers, shall be conveyed overland within the paved portion of the road, and convey stormwater flows to the stormwater outlet. The realigned and constructed drainage channels shall be designed to accommodate major flows to the stormwater outlet.

# 2.0 STORMWATER MANAGEMENT CRITERIA

All new developments within the province of Ontario are required to provide stormwater management according to provincial and municipal policies including:

- Stormwater Quality Guidelines for New Development (MOEE/MNR, May 1991).
- Stormwater Management Planning and Design Manual (MOE, March 2003)

Based on the comments and outstanding policies from the various agencies (Town of Pelham, Region of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of Environment (MOE), and others) the following site specific considerations were identified within the Fonthill East Secondary Plan report and have been confirmed herein:

- The northern (Outlet A) receiving waters (Twelve Mile Creek) are considered Type 1 (Critical) fish habitat. Based on this fish habitat and corresponding NPCA criteria, the MOE level of protection for new developments within this watershed shall be Enhanced (Level 1).
- The northern (Outlet A) receiving waters (Twelve Mile Creek) are considered a Cold Water Fishery. Based on this fish habitat, stormwater thermal mitigation measures are required to minimize the increase in temperature associated with any stormwater management controls.
- The Municipal Class Environmental Assessment (EA) and associated Part II Order for Regional Road 20 requires that flows from the previously reconstructed road be provided with stormwater quantity controls within the adjacent stormwater management facility. Stormwater quality controls for Regional Road 20 are provided by existing oil/grit separators and based on this stormwater quality protection is not required for these flows.
- The eastern outlets (Outlet B-C) receiving waters (Singers Drain) are considered Type 2 (Important) fish habitat. Based on this fish habitat and corresponding NPCA criteria, the MOE level of protection for new developments within this watershed shall be Normal (Level 2).
- The downstream outlets (Singer's Drain and Twelve Mile Creek) contain natural elements and, therefore, downstream erosion controls are considered necessary in compliance with the 25mm MOE erosion guidelines.
- The downstream outlets (Singer's Drain and Twelve Mile Creek) contain lands that would be negatively impacted by increased flooding levels, and, therefore, stormwater quantity control is considered necessary to maintain the downstream peak water elevations.

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

- Stormwater quality controls are to be provided for the internal storm system conveying stormwater flows to Twenty Mile Creek to provide Enhanced (Level 1) Protection according to MOE guidelines.

- Stormwater quality controls are to be provided for the internal storm system conveying stormwater flows to Singer's Drain to provide Normal (Level 2) Protection according to MOE guidelines.

- Stormwater thermal improvements are to be provided for stormwater flows to Twelve Mile Creek.

- Stormwater erosion controls are to be provided to detain and release the 25mm storm event volume for a minimum of 24 hours.

- Quantity controls are to be provided for the outlet to limit the future post-development peak flows from the 25mm, 5 and 100 year storm events to pre-development peak flow levels.

## 3.0 STORMWATER ANALYSIS

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

A hydrologic modelling schematic for existing and future conditions are shown below in Figure 3.

MIDUSS output files for existing and future conditions can be found in Appendices B-D.

### 3.1 Design Storms

Design storm hyetographs for the storm system design uses a Chicago distribution based on the City of Welland Intensity-Duration-Frequency (IDF) curves that are used within the Town of Pelham. Hyetographs for the 25mm, 5 and 100 year events were developed using a 4-hour Chicago distribution.

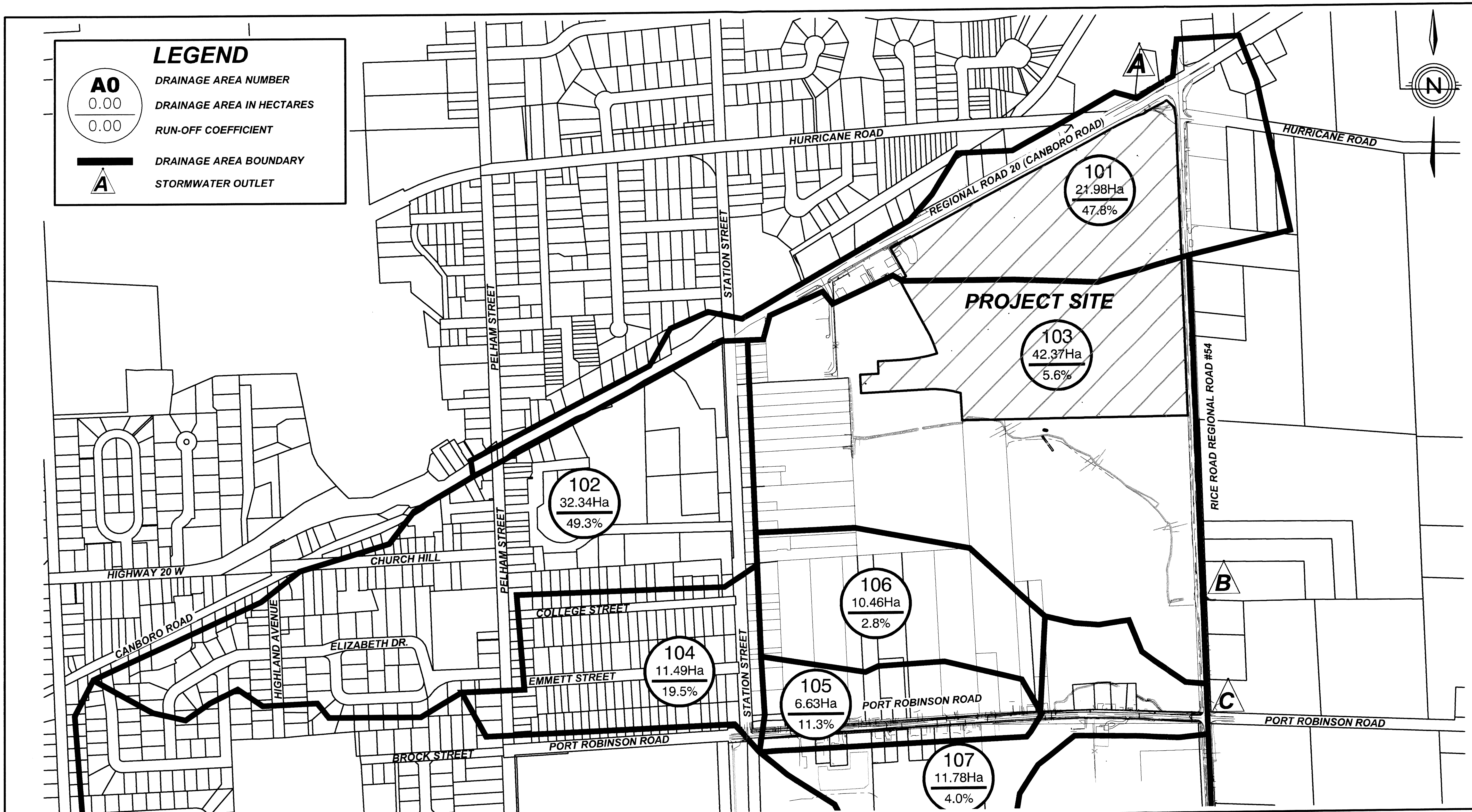
Table 1 summarizes the rainfall data applied in the stormwater modelling. The 4-hour storm event was used due to the large drainage areas and extended flow lengths.

| Table 1. Rainfall Data | | | | |
|---|---|---|---|---|
| **Design Storm (Return Period )** | **Chicago Distribution Parameters** | | | **Duration (minutes)** |
| | **a** | **b** | **c** | |
| 25mm | 500.00 | 8.100 | 0.810 | 240 |
| 5- Year | 830.00 | 7.300 | 0.777 | 240 |
| 100- Year | 1,020.00 | 4.700 | 0.731 | 240 |
| $\text{Intensity}\left(\frac{\text{mm}}{\text{hr}}\right) = \frac{a}{(t_c + b)^c}$ | | | | |

### 3.2 Existing Conditions

The study area, existing subcatchment areas, and existing storm outlets are shown below in Figure 2. Input parameters for the computer modeling of existing conditions are shown in Table 2. Detailed computational inputs for existing conditions are attached in Appendix B.

| Table 2. Hydrologic Parameters for Existing Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area No.** | **Area (ha)** | **Length (m)** | **Slope (%)** | **Manning 'n'** | | **Soil type** | **SCS CN** | **Percent Impervious** |
| | | | | **Perv** | **Imperv** | | | |
| 101 | 21.98 | 385 | 3.33 | 0.25 | 0.015 | C | 74 | 47.8% |
| 102 | 32.34 | 465 | 16.46 | 0.25 | 0.015 | C | 74 | 49.3% |
| 103 | 42.37 | 530 | 2.45 | 0.25 | 0.015 | C | 74 | 5.6% |
| 104 | 11.49 | 275 | 4.43 | 0.25 | 0.015 | C | 74 | 19.5% |
| 105 | 6.63 | 210 | 2.63 | 0.25 | 0.015 | C | 74 | 11.3% |
| 106 | 10.46 | 265 | 2.00 | 0.25 | 0.015 | C | 74 | 2.8% |
| 107 | 11.78 | 280 | 2.78 | 0.25 | 0.015 | C | 74 | 4.0% |
| | | | | | | | | |
| **Total area** | **137.05** | | | | | | | |

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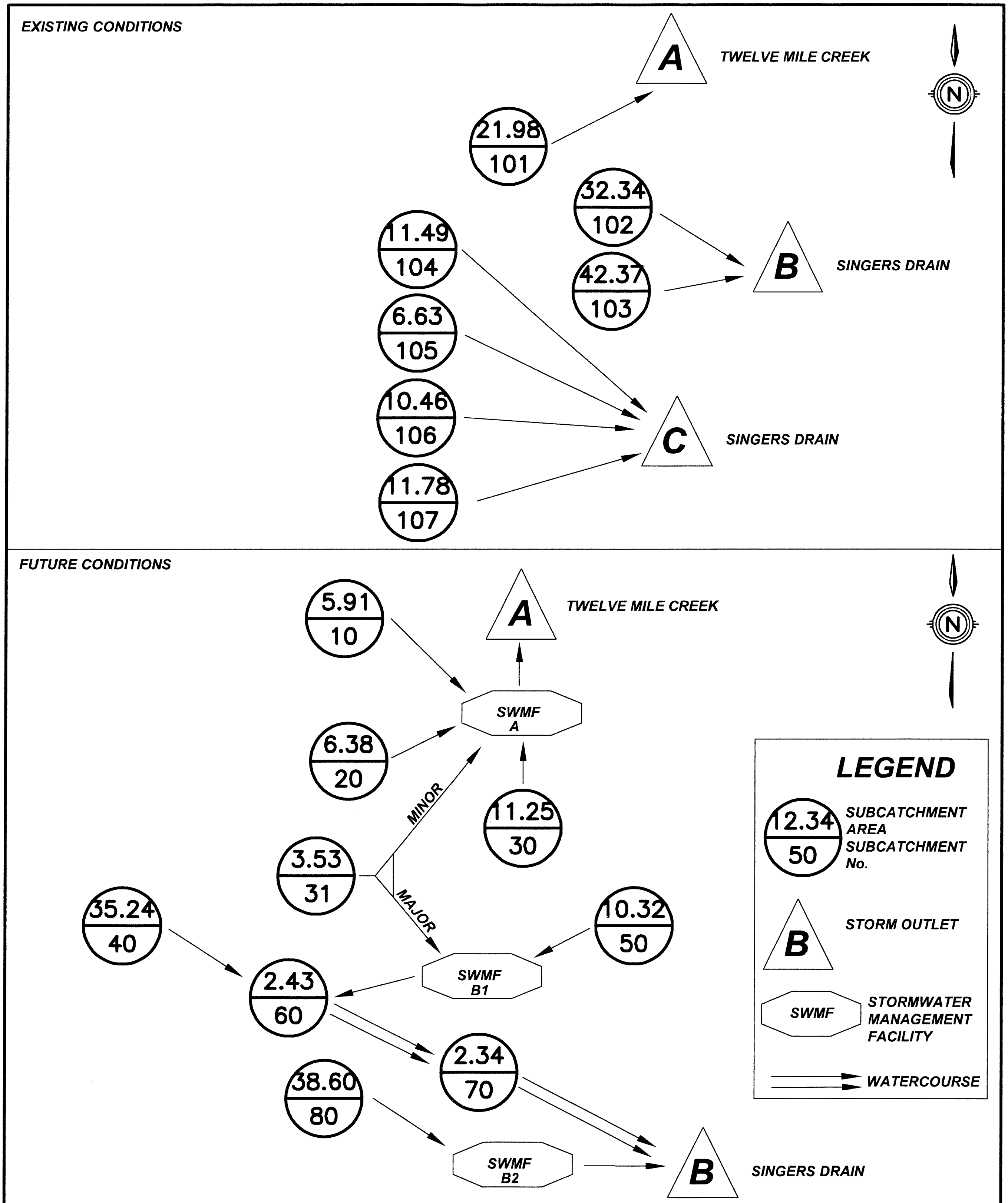
# THE VILLAGE OF EAST FONTHILL EXISTING STORM DRAINAGE AREA PLAN

TOWN OF PELHAM

| | |
|---|---|
| DATE | 2014-04-22 |
| SCALE | NTS |
| REF. No. | - |
| DWG No. | FIGURE 2 |





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**THE VILLAGE OF EAST FONTHILL**

**TOWN OF PELHAM**

**SHEMATIC OF HYDRAULIC MODELING CONDITIONS**

| | |
|---|---|
| DATE | 2014-04-22 |
| SCALE | NTS |
| REF. No. | - |
| DWG No. | FIGURE 3 |

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### 3.3 Future Conditions

The post-development future storm drainage conditions are shown in Figure . It is proposed to control the post-development stormwater flows to both Outlet A and B to pre-development levels with two (2) stormwater management facilities within the subject lands *of The Village of East Fonthill.*

A proposed future external stormwater management facility is included within the modelling and is located downstream of the site, and conveys adjacent development flows from the *River Realty (Rice Road)* lands to the realigned naturalized channel prior to stormwater flows exiting the *Fonthill East Secondary Plan* area and Outlet B.

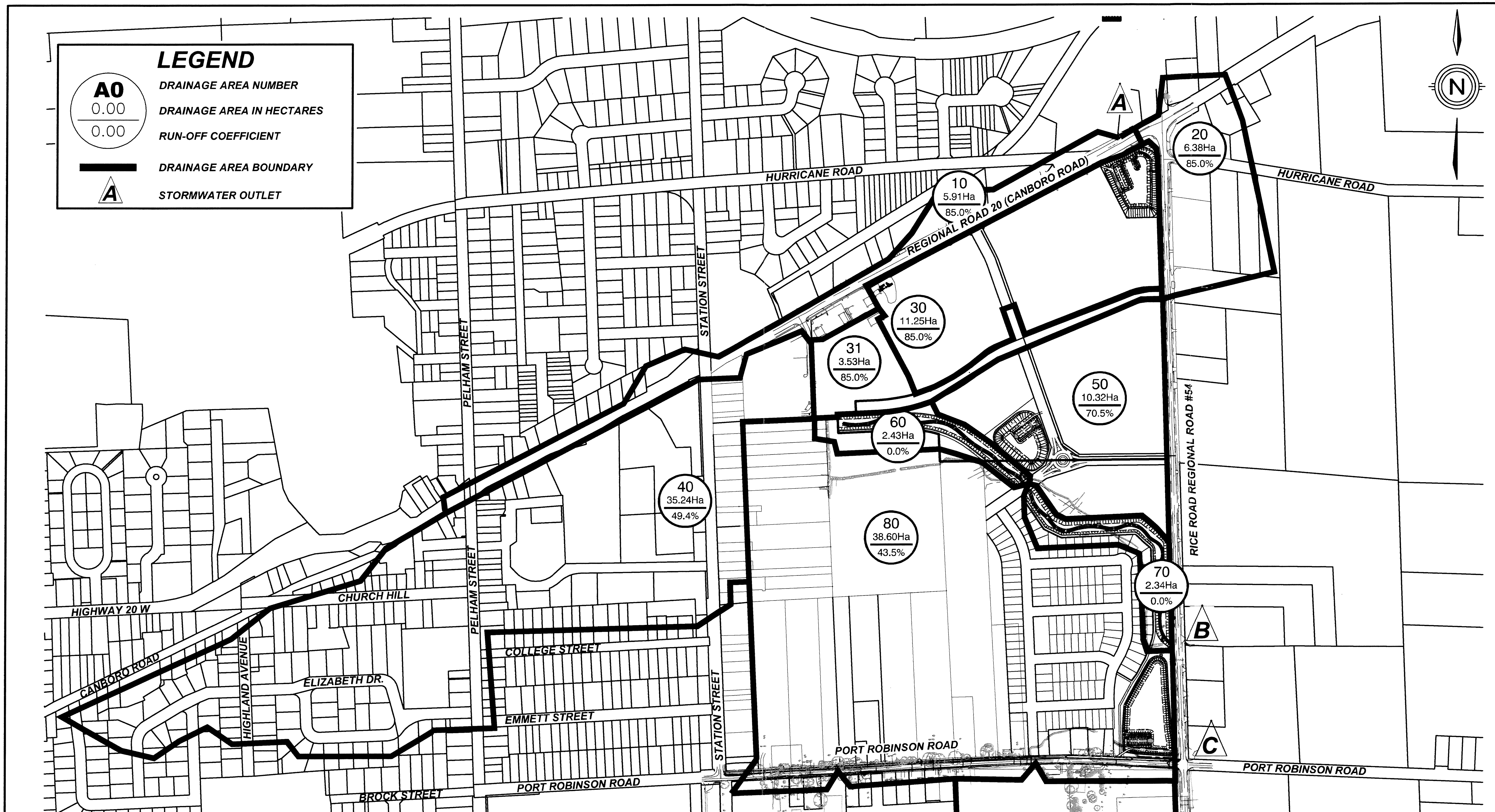
Sizing for this facility is based upon the sizing found within the Fonthill East Secondary Plan and has been refined in concert with that development proposal in preparation for their submission for Draft Plan of Subdivision Approvals.

Imperviousness for each subcatchment was determined based on the proposed land use and external land future area use computational parameters obtained from the Environmental Planning Report for the East Fonthill Secondary Plan Area. Subcatchment Area '31' (Street 'C') shall have the minor system (sewers) convey stormwater flows to the north SWM Facility (Outlet 'A'); while major flows shall be directed south to the south SWM Facility and Outlet 'B'.

Input parameters for the computer modeling of future conditions are shown below in Table 3. Detailed computational inputs are attached in Appendix C for future conditions without SWM, and Appendix D for future conditions with SWM.

**Table 3. Hydrologic Parameters for Future Conditions**

| Area No. | Area (ha) | Length (m) | Slope (%) | Manning 'n' | | Soil type | SCS CN | Percent Impervious |
|---|---|---|---|---|---|---|---|---|
| | | | | Perv | Imperv | | | |
| 10 | 5.91 | 200 | 2.0 | 0.25 | 0.015 | C | 74 | 85.0% |
| 20 | 6.38 | 205 | 2.0 | 0.25 | 0.015 | C | 74 | 85.0% |
| 30 | 11.25 | 260 | 2.0 | 0.25 | 0.015 | C | 74 | 85.0% |
| 31 | 3.53 | 155 | 2.0 | 0.25 | 0.015 | C | 74 | 85.0% |
| 40 | 35.24 | 485 | 15.48 | 0.25 | 0.015 | C | 74 | 49.4% |
| 50 | 10.32 | 260 | 2.0 | 0.25 | 0.015 | C | 74 | 70.5% |
| 60 | 2.43 | 125 | 2.0 | 0.25 | 0.015 | C | 74 | 0% |
| 70 | 2.34 | 120 | 2.0 | 0.25 | 0.015 | C | 74 | 0% |
| 80 | 38.60 | 510 | 2.0 | 0.25 | 0.015 | C | 74 | 43.5% |
| | | | | | | | | |
| **Total area (ha)** | **116.0116** | | | | | | | |

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# THE VILLAGE OF EAST FONTHILL
# FUTURE STORM DRAINAGE AREA PLAN

## TOWN OF PELHAM

| | |
|---|---|
| DATE | 2014-04-22 |
| SCALE | NTS |
| REF. No. | - |
| DWG No. | **FIGURE 4** |

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# 4.0 STORMWATER MANAGEMENT ALTERNATIVES

## 4.1 Screening of Stormwater Management Alternatives

A variety of stormwater management alternatives are available to control the quantity and quality of stormwater runoff. Most of these are described in the Stormwater Management Planning and Design Manual (MOE, March 2003). Alternatives for this site were considered in the following broad categories: lot level, vegetative, infiltration, and surface storage controls. General comments on each category are provided below. Individual alternatives for the proposed development are listed in Table 4 with comments on their effectiveness and applicability to this site.

a. <u>Lot Level Controls</u>

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

b. <u>Vegetative Alternatives</u>

Vegetative stormwater management practices are generally not suitable as the primary control facility for quantity or quality controls. They are generally used to reduce the rate of runoff and to enhance stormwater quality in conjunction with other types of control facilities.

c. <u>Infiltration Alternatives</u>

Where soils are suitable, infiltration alternatives can be very effective in providing both quality and quantity controls. However, infiltration rates generally limit the use of these techniques. Soils on this site are predominantly clay with infiltration rates of less than 12 mm/hr. Infiltration alternatives may provide some quality benefits. Due to the low infiltration rates and large development site, infiltration alternatives are not considered feasible as primary control facilities for this site.

d. <u>Surface Storage</u>

Surface storage techniques can be very effective in providing both quality and quantity control. Wetlands are generally the most efficient for water quality control, however require more maintenance than a wet pond and are more subject to negative public perception. Both the onsite and additional offsite lands will generate sufficient stormwater to maintain a permanent pool. Therefore, two wet ponds are recommended as stormwater management facilities to provide quality protection for the two stormwater Outlets A and B.

e. Thermal Controls

Surface storage techniques can be very effective in providing both quality and quantity controls, however solar radiation results in increased water temperatures that can have negative impacts upon the downstream habitat, specifically the Cold Water Fishery designation of Twelve Mile Creek. Vegetative cover can mitigate some of these effects, and proper landscape design including shade trees is important. More aggressive measure includes directing low flow through underground clear stone filter beds to cool the outflow water through thermal transfer.

## 4.2 Selection of Stormwater Management Alternatives

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

a) **Lot grading** to be kept as flat as practical in order to slow down runoff and encourage infiltration.

b) **Roof water leaders to be discharged to the ground surface** in order to slow down runoff and encourage infiltration.

c) **Grassed swales** to be used to collect and convey rear lot drainage. These tend to filter sediments, and slow down the rate of runoff.

d) That a stormwater management **wet pond** facility be constructed to provide an Enhanced level of stormwater quality protection for frequent storms and provide quantity control to **Outlet A** – Twelve Mile Creek.

e) That an **underground thermal contact bed** be constructed to accommodate the 10mm storm event for stormwater flows conveyed to **Outlet A** – Twelve Mile Creek.

f) That a stormwater management **wet pond** facility be constructed to provide a Normal level of stormwater quality protection for frequent storms and provide quantity control to **Outlet B** – Singer`s Drain.

## Table 4. Evaluation of Stormwater Management Practices

| The Village of Fonthill East | Criteria for Implementation of Stormwater Management Practices (SWMP) | | | | | Technical Effectiveness (10 high) | Recommend Application Yes/No | Comments |
|---|---|---|---|---|---|---|---|---|
| | **Topography** | **Soils** | **Bedrock** | **Groundwater** | **Area** | | | |
| ***Site Conditions*** | ***Variable 1 to 2%*** | ***Clay <12mm/hr*** | ***At Considerable Depth*** | ***At Considerable Depth*** | ***±90.4ha*** | | | |
| **Lot Level Controls** | | | | | | | | |
| Lot Grading | <5% | nlc | nlc | nlc | nlc | 2 | Yes | Quality/quantity benefits |
| Roof Leaders to Surface | nlc | nlc | nlc | nlc | nlc | 2 | Yes | Quality/quantity benefits |
| Roof Ldrs.to Soakaway Pits | nlc | loam, infiltr. > 15 mm/hr | >1m Below Bottom | >1m Below Bottom | < 0.5 ha | 6 | No | Unsuitable site soil conditions |
| Sump Pump Fdtn. Drains | nlc | nlc | nlc | nlc | nlc | 2 | No | Unsuitable site soil conditions |
| **Vegetative** | | | | | | | | |
| Grassed Swales | < 5 % | nlc | nlc | nlc | nlc | 7 | Yes | Quality/quantity benefits |
| Filter Strips(Veg. Buffer) | < 10 % | nlc | nlc | >.5m Below Bottom | < 2 ha | 5 | No | Unsuitable site conditions |
| **Infiltration** | | | | | | | | |
| Infiltration Basins | nlc | loam, infiltr. > 15 mm/hr | >1m Below Bottom | >1m Below Bottom | < 5 ha | 2 | No | Unsuitable site soil conditions |
| Infiltration Trench | nlc | loam, infiltr. > 15 mm/hr | >1m Below Bottom | >1m Below Bottom | < 2 ha | 4 | No | Unsuitable site soil conditions |
| Rear Yard Infiltration | < 2.0 % | loam, infiltr. > 15 mm/hr | >1m Below Bottom | >1m Below Bottom | < 0.5 ha | 7 | No | Unsuitable site soil conditions |
| Perforated Pipes | nlc | loam, infiltr. > 15 mm/hr | >1m Below Bottom | >1m Below Bottom | nlc | 4 | No | Unsuitable site soil conditions |
| Pervious Catch basins | nlc | loam, infiltr. > 15 mm/hr | >1m Below Bottom | >1m Below Bottom | nlc | 3 | No | Unsuitable site soil conditions |
| Sand Filters | nlc | nlc | nlc | >.5m Below Bottom | < 5 ha | 5 | No | High maintenance/poor aesthetics |
| **Surface Storage** | | | | | | | | |
| Dry Ponds | nlc | nlc | nlc | nlc | > 5 ha | 10 | No | Less effective than wet facilities |
| Wet Ponds | nlc | nlc | nlc | nlc | > 5 ha | 10 | Yes | Greater volume of storage required |
| Wet Lands | nlc | nlc | nlc | nlc | > 5 ha | 9 | No | Very effective quality control |
| **Other** | | | | | | | | |
| Oil/Grit Separator | nlc | nlc | nlc | nlc | < 2.7 ha** | 3 | No | Limited benefit/area too large |

Reference: Stormwater Management Practices Planning and Design Manual - 1994
Nlc - No Limiting Criteria
** As per Stormceptor Technical Manual

# 5.0 STORMWATER MANAGEMENT PLAN

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

## 5.1 North Stormwater Management Pond

This facility is located within the *The Village of East Fonthill* development site. Detailed plans showing the proposed grading, servicing and landscaping information are enclosed in Appendix G. This pond was identified as Facility 701 within the Secondary Plan Document.

Water Quality

The ultimate stormwater drainage outlet for this facility is Twelve Mile Creek (Lake Ontario), where *Enhanced* protection is recommended in accordance with MOE requirements. Based on Table 3.2 of SWMP & Design Manual, the *Enhanced* water quality storage requirement for wet pond facilities in a development with an effective impervious area of 65% is approximately 213 $m^3$/ha. The effective imperviousness is based upon a weighted calculation where quality controls for area 20 (6.38ha) is provided by the existing stormwater management system (Oil/grit separator) upstream of the north stormwater management pond and is proposed to remain in place post construction.

For this stormwater management facility, it will not be necessary to provide stormwater quality control for the portion of stormwater runoff generated by Rice Road and Regional Road 20 east of the facility. Quality control for these flows will be provided by an existing oil/grit separator (OGS) located adjacent to the proposed stormwater management facility. The existing Regional Road 20 OGS will be decommissioned and quality controls for Regional Road 20 west of the facility will be provided by the proposed facility.

Quality volume calculations have been provided for the 27.07 ha portion of the development site and Regional Road 20 which will discharge to this facility.

| Table 5. North Pond Stormwater Quality Volume Calculations | |
|---|---|
| Total Water Quality Volume<br>= 27.07ha x 213 $m^3$/ha<br>= 5,766 $m^3$ | Reference: Table 3.2, SWMP & Design Manual, (MOE 2003) |
| Permanent Pool Volume<br>= 27.07ha x 173$m^3$/ha<br>= 4683 $m^3$ | Active Pool Volume<br>= 27.07ha x 40$m^3$/ha<br>= 1,083 $m^3$ |

Thermal Controls

To provide a measure of thermal mitigation, it is proposed to use an underground contact chamber comprising a volume of clear stone wrapped in filter cloth which to provide heat transfer from the earth. Based on the US Geological Service the Mean Earth Temperature for this latitude is approximately 9.5 degrees-C. Twin 150mm diameter perforated pipe are to be laid within the chamber with a 5.0m separation. Stormwater flows from the 10mm storm event are conveyed through these pipes and directed to the outlet.

The 10mm storm event produces approximately 1,307 $m^3$ of stormwater, which based on the average outflow flow rate of 21 L/s will have an average bed velocity of 0.81mm/s, and a contact time of 102.5 minutes, which will serve to mitigate the increase in temperature.

Calculations have been included in Appendix F.

Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for the entire 27.07 hectares (development site and Regional Road 20) is 4,211 $m^3$. Table 6 shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

| **Table 6. North Pond Stormwater Quality Volume Requirements** | |
|---|---|
| A. Permanent Pool Volume | 4,683 $m^3$ |
| B. Extended Detention Volume | 1,083 $m^3$ |
| C. Stormwater Volume from 25mm - 4 hour rainfall event | 4,211 $m^3$ |
| D. Maximum Extended Detention Volume (greater of B & C) | 4,211 $m^3$ |
| **Total Quality and Extended Detention Volume (A+D)** | **8,894 $m^3$** |

A four stage outlet control structure for the pond is suggested. The first stage of control consists of an orifice to detain the 25mm storm event extended detention volume and release it slowly over an extended period of time, minimum 24 hours.

The second stage consists of a perforated pipe contact chamber to slowly release the 10mm storm event thermal volume of an extended period of time. The third stage of control is provided by a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The fourth stage of control is provided by an overflow spillway which provides an outlet for flows exceeding the capacity of the ditch inlet catch basin and outlet pipe. The proposed configuration is summarized below in Table 7.

| **Table 7. North Stormwater Management Pond Design Criteria** | |
|---|---|
| Permanent pool depth | 1.75 m |
| Total depth of facility | 5.25 m |
| Facility side slopes (horizontal : vertical) | 5:1 |
| Permanent pool volume | 4,745 $m^3$ |
| Active storage volume | 4,376 $m^3$ |
| Maximum storage volume | 23,897 $m^3$ |
| Quality control orifice diameter | 225mm |
| Outlet weir length | 1.2 m |
| Outlet weir elevation above permanent pool | 0.83 m |
| Outflow pipe orifice plate diameter | 0.675 m |
| Emergency overflow spillway width | 20.0 m |
| Emergency overflow spillway elevation | 189.58 |

A sediment forebay was included in this stormwater management facility to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility, and to localize maintenance activities. Calculations for the forebay sizing follow MOE Guidelines and are shown below in Table 8.

| **Table 8. North Pond Forebay Sizing** | | | |
|---|---|---|---|
| **a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)** | | | |
| $\text{Settling length} = \sqrt{\frac{r * Q_p}{V_s}}$ | r= | 10.0 | (Length: width ratio) |
| | Qp= | 0.05 | (25mm storm pond discharge) - $m^3/s$ |
| | Vs= | 0.00035 | (Settling velocity) – m/s |
| | Settling Length= | **37.80m** | |
| **b) Dispersion Length (MOE SWMP & D, Equation 4.6)** | | | |
| $\text{Dispersion length} = \frac{8 * Q}{D * V_f}$ | Q= | 3.815 | 5-yr storm sewer design inflow ($m^3/s$) |
| | **D=** | **1.50m** | Depth of forebay |
| | Vf= | 0.55 m/s | Desired velocity |
| | Dispersion Length= | **37.0 m** | |
| **c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP &D, Equation 4.7)** | | | |
| $\text{Width} = \frac{\text{Dispersion length}}{\text{L: W}}$ | Minimum Forebay Length from Equations 3.3 and 3.4 | 37.1 m | (Minimum required length) |
| | Width= | **3.71 m** | Minimum required width |
| **d) Average Velocity of Flow** | | | |
| $\text{Average Velocity} = \frac{Q}{A}$ | **Q=** | **1.836** | Quality design inflow ($m^3/s$) |
| | A= | 12.00 | (Cross sectional area) - $m^2$ |
| | **D=** | **1.50 m** | (Depth of forebay) |
| | **W=** | **4.00 m** | (Proposed bottom width) |
| | S= | 3:1 | (Side slopes- minimum) |
| | Average Velocity = | **0.15** | **m/s** |
| | Is this Acceptable? | **Yes** | Maximum velocity of flow= 0.15m/s) |
| **e) Cleanout Frequency** | | | |
| | **L=** | **40.0 m** | (Proposed bottom length) |
| | ASL= | 3.8 | (Annual sediment loading) - $m^3/ha$ |
| | A= | 20.69 | (Drainage area) – ha |
| | FRC= | 80% | (Facility removal efficiency) |
| | FV= | 792 | (Forebay volume) - $m^3$ |
| | Cleanout Frequency= | **12.59** | (Minimum 10 Years) |
| | Is this Acceptable? | **Yes** | |

Based on the MIDUSS model, Table 9 shows the maximum wet pond depth of 1.58 m, and an active storage volume of 9,171 m3 for the 100 year design storm event.

| **Table 9. Proposed North Pond Characteristics** | | | | |
|---|---|---|---|---|
| **Design Storm (Return Period)** | **Peak Flows ($m^3/s$)** | | **Maximum Depth (m)** | **Maximum Volume ($m^3$)** |
| | **Inflow** | **Outflow** | | |
| 25mm | 1.836 | 0.079 | 0.67 | 3,412 |
| 5- Year | 3.815 | 0.602 | 1.1 | 6,053 |
| 100- Year | 5.644 | 1.089 | 1.58 | 9,171 |

## 5.2 South Stormwater Management Pond

This facility is located within The Village of East Fonthill development site at the southern limit, and east of the drainage channel. Detailed plans showing the proposed grading, servicing and landscaping information are enclosed in Appendix G. This pond was identified as Facility 706 within the Secondary Plan Document.

<u>Water Quality</u>

The ultimate stormwater drainage outlet for the study area is Singers Drain, where *Normal* protection is recommended in accordance with MOE requirements. Based on Table 3.2 of SWMP & Design Manual, the *Normal* water quality storage requirement for wet pond facilities in a development with 85% impervious area is approximately 150 $m^3$/ha. The total drainage area of approximately 10.32 hectares was used to determine the quality control sizing requirements.

| **Table 10. South Pond Stormwater Quality Volume Calculations** | |
|---|---|
| Total Water Quality Volume<br>= 10.32ha x 150 $m^3$/ha<br>= 1,548$m^3$ | Reference: Table 3.2, SWMP & Design Manual, (MOE 2003) |
| Permanent Pool Volume<br>= 10.32ha x 110$m^3$/ha<br>= 1,135 $m^3$ | Active Pool Volume<br>= 10.32ha x 40$m^3$/ha<br>= 413 $m^3$ |

Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for 10.32 hectares is 1,623 $m^3$. Table 11 shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

| **Table 11. South Pond Stormwater Quality Volume Requirements** | |
|---|---|
| A. Permanent Pool Volume | 1,135 |
| B. Extended Detention Volume | 413 |
| C. Stormwater Volume from 25mm - 6 hour rainfall event | 1,623 |
| D. Maximum Extended Detention Volume (greater of B & C) | 1,623 |
| **Total Quality and Extended Detention Volume (A+D)** | **2,758** |

Quantity Control

A three stage outlet control structure for the pond is suggested. The first stage of control consists of an orifice to detain the extended detention volume and release it slowly over an extended period of time. The second stage of control is provided by a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The third stage of control is provided by an overflow spillway which provides an outlet for flows exceeding the capacity of the ditch inlet catch basin and outlet pipe. The proposed configuration is summarized below in Table 12.

| **Table 12. South Stormwater Management Pond Design Criteria** | |
|---|---|
| Permanent pool depth | 1.0 m |
| Total depth of facility | 3.5m |
| Facility side slopes (horizontal : vertical) | 5:1 |
| Permanent pool volume | 1,789 $m^3$ |
| Active storage volume | 2,027 $m^3$ |
| Maximum storage volume | 8,534 $m^3$ |
| Quality control orifice diameter | 127 mm |
| Outlet weir length | 600 mm |
| Outlet weir elevation above permanent pool | 0.78 m |
| Outflow pipe orifice plate diameter | 450 mm |
| Emergency overflow spillway width | 2.44 m |
| Emergency overflow spillway elevation above permanent pool | 1.2 m |

A sediment forebay was included in this stormwater management facility to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility, and to localize maintenance activities. Calculations for the forebay sizing follow MOE Guidelines and are shown below in Table 13.

| **Table 13. South Pond Forebay Sizing** | | | |
|---|---|---|---|
| **a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)** | | | |
| $\text{Settling length} = \sqrt{\frac{r * Q_p}{V_s}}$ | r= | 5.9 | (Length: width ratio) |
| | Qp= | 0.02 | (25mm storm pond discharge) - $m^3/s$ |
| | Vs= | 0.00035 | (Settling velocity) – m/s |
| | Settling Length= | **18.36m** | |
| **b) Dispersion Length (MOE SWMP & D, Equation 4.6)** | | | |
| $\text{Dispersion length} = \frac{8 * Q}{D * V_f}$ | Q= | 1.480 | 5-yr storm sewer design inflow ($m^3/s$) |
| | **D=** | **1.50m** | Depth of forebay |
| | Vf= | 0.55 m/s | Desired velocity |
| | Dispersion Length= | **14.4 m** | |
| **c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP &D, Equation 4.7)** | | | |
| $\text{Width} = \frac{\text{Dispersion length}}{\text{L: W}}$ | Minimum Forebay Length from Equations 3.3 and 3.4 | 18.36 m | (Minimum required length) |
| | Width= | **1.85 m** | Minimum required width |
| **d) Average Velocity of Flow** | | | |
| $\text{Average Velocity} = \frac{Q}{A}$ | **Q=** | **0.703** | Quality design inflow ($m^3/s$) |
| | A= | 12.75 | (Cross sectional area) - $m^2$ |
| | **D=** | **1.50 m** | (Depth of forebay) |
| | **W=** | **4.50 m** | (Proposed bottom width) |
| | S= | 3:1 | (Side slopes- minimum) |
| | Average Velocity = | **0.06** | **m/s** |
| | Is this Acceptable? | **Yes** | Maximum velocity of flow= 0.15m/s) |
| **e) Cleanout Frequency** | | | |
| | **L=** | **26.5 m** | (Proposed bottom length) |
| | ASL= | 3.8 | (Annual sediment loading) - $m^3$/ha |
| | A= | 10.32 | (Drainage area) – ha |
| | FRC= | 70% | (Facility removal efficiency) |
| | FV= | 583.31 | (Forebay volume) - $m^3$ |
| | Cleanout Frequency= | **21.2** | (Minimum 10 Years) |
| | Is this Acceptable? | **Yes** | |

Based on the MIDUSS model, Table 13 shows the maximum wet pond depth of 1.31m and an active storage volume of 3,734 $m^3$ for the 100 year design storm event.

| Table 13. Proposed South Pond Characteristics | | | | |
|---|---|---|---|---|
| **Design Storm (Return Period)** | **Peak Flows ($m^3/s$)** | | **Maximum depth (m)** | **Maximum Volume ($m^3$)** |
| | **Inflow** | **Outflow** | | |
| 25mm | 0.703 | 0.023 | 0.54 | 1,365 |
| 5 Year | 1.480 | 0.187 | 0.94 | 2,520 |
| 100 Year | 2.455 | 0.460 | 1.31 | 3,734 |

## 5.3 Impact of Stormwater Management Ponds on Outlet

The proposed stormwater management methods were assessed by the MIDUSS modeling program. The results are summarized below in Table 14 for each of the design storms

Future post- development peak flows can be controlled to pre- development peak flows for all storm events up to and including the 100- year event using the stormwater management techniques described herein.

| Table 14. Peak Flow Values | | | | |
|---|---|---|---|---|
| **Design Storm (Return Period)** | **Peak Flow ($m^3/s$)** | | | |
| | **Existing** | **Future without SWMP** | **Future with SWMP** | **Change** |
| ***OUTLET A (TWELVE MILE CREEK)*** | | | | |
| 25mm Storm | 0.831 | 1.836 | 0.079 | -90.49% |
| 5 Year Storm | 1.796 | 3.815 | 0.602 | -66.48% |
| 100 Year Storm | 2.875 | 5.644 | 1.089 | -62.12% |
| ***OUTLET B (SINGER'S DRAIN)*** | | | | |
| 25mm Storm | 1.455 | 1.612 | 1.172 | -19.45% |
| 5 Year Storm | 3.051 | 3.943 | 2.487 | -18.49% |
| 100 Year Storm | 4.969 | 6.869 | 4.713 | -5.15% |

## 5.4 Stormwater Management Pond Facility Maintenance

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

The stormwater management facilities for this development may be subjected to infrequent wetting and deposition of sediments as a result of infrequent high intensity storm events. The purpose of these facilities is to reduce suspended solids loading on the receiving waterways and minimize potential downstream erosion. For the initial operation period of the stormwater management facilities, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the home construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the effectiveness of sediment and erosion control techniques employed.

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

The following points should be addressed during inspections of the facilities:

a. Standing water above the outlet structure bottom a few days or more after a storm may indicate a blockage in the outlet or orifice. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.

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

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

d. The facility has been created by excavating a detention volume. The integrity of the embankment should be periodically checked to ensure that it remains stable and the side slopes have not sloughed.

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

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

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically. For sediment removal operations, typical grading/excavating equipment should be used to remove sediment from detention areas. Care should be taken to ensure that limited damage occurs to existing vegetation and habitat.

Generally, the sediment which is removed from the wet ponds will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options. The MOE publishes sediment disposal guidelines which should be consulted for up-to-date information pertaining to the exact parameters and acceptable levels for the various disposal options.

# 6.0 CHANNEL DESIGN

As part of the development works, it is proposed to realign and deepen the existing channel. The design of this channel has been undertaken following Rosgen geomorphic channel design for the existing drainage corridor. It is proposed to construct a 29.0 m wide channel that shall consist of a northern and southern portion, and has been designed to accommodate stormwater flows from the development site and external areas for all storm events up to and including the 100 year storm event.

Proposed geometries for the northern portion of the channel are described below in Table 15.

| **Table 15. Natural Channel Design Parameters for Northern portion of Channel to Culvert** | |
|---|---|
| Meander Slope | 0.75% |
| Bottom Width (m) | 1.50 |
| Side Slope (H:V) | 4.0 |
| 25mm Storm Event Depth of Flow (m) | 0.207 |
| 2 Year Storm Event Depth of Flow (m) | 0.260 |
| 100 Year Storm Event Depth of Flow (m) | 0.432 |
| Meander Ratio | 1.1 |
| Width/ Depth Ratio | 13.8 |
| Entrenchment Ratio | 1.4 |

In order to comply with natural channel design, it will be necessary to develop four separate profiles for the southern portion of the channel. These geometries are detailed below in Table 16 to Table 19.

| **Table 16. Natural Channel Design Parameters for First Flat Portion of Southern Channel** | |
|---|---|
| Meander Slope | 0.19% |
| Bottom Width (m) | 1.50 |
| Side Slope (H:V) | 4.0 |
| 25mm Storm Event Depth of Flow (m) | 0.285 |
| 2 Year Storm Event Depth of Flow (m) | 0.384 |
| 100 Year Storm Event Depth of Flow (m) | 0.664 |
| Meander Ratio | 1.1 |
| Width/ Depth Ratio | 11.9 |
| Entrenchment Ratio | 1.5 |

| **Table 17. Natural Design Parameters for First Steep Portion of Southern Channel** | |
|---|---|
| Meander Slope | 0.79% |
| Bottom Width (m) | 1.50 |
| Side Slope (H:V) | 3.0 |
| 25mm Storm Event Depth of Flow (m) | 0.206 |
| 2 Year Storm Event Depth of Flow (m) | 0.278 |
| 100 Year Storm Event Depth of Flow (m) | 0.480 |
| Meander Ratio | 1.1 |
| Width/ Depth Ratio | 11.4 |
| Entrenchment Ratio | 1.4 |

| **Table 18. Natural Design Parameters for Second Flat Portion of Southern Channel** | |
|---|---|
| Meander Slope | 0.19% |
| Bottom Width (m) | 1.50 |
| Side Slope (H:V) | 3.0 |
| 25mm Storm Event Depth of Flow (m) | 0.314 |
| 2 Year Storm Event Depth of Flow (m) | 0.424 |
| 100 Year Storm Event Depth of Flow (m) | 0.734 |
| Meander Ratio | 1.1 |
| Width/ Depth Ratio | 9.5 |
| Entrenchment Ratio | 1.5 |

| Table 19. Natural Design Parameters for Second Steep Portion of Southern Channel | |
|---|---|
| Meander Slope | 1.73% |
| Bottom Width (m) | 1.50 |
| Side Slope (H:V) | 3.0 |
| 25mm Storm Event Depth of Flow (m) | 0.162 |
| 2 Year Storm Event Depth of Flow (m) | 0.219 |
| 100 Year Storm Event Depth of Flow (m) | 0.378 |
| Meander Ratio | 1.1 |
| Width/ Depth Ratio | 122.9 |
| Entrenchment Ratio | 1.3 |

Detailed natural channel design calculations for the northern and southern portions of the drainage channel are enclosed in Appendix E.

## 7.0 100 YEAR STORM EVENT BACKWATER ELEVATION

It is proposed to direct stormwater flows from the realigned channel through an existing 1350 x 900mm arch culvert located north of Port Robinson Road running under Rice Road. During the 100 year storm event, the channel flow rate of $4.938m^3/s$ will cause a headwater elevation of 190.54m. This will overtop the road and cause a flooding depth of 0.05m over Rice Road. This depth of flooding is not considered significant, and no additional modifications to the arch culvert will be required.

Stormwater flows at this culvert are less than the existing 100 year storm event flows and therefore the post development overtopping is less than that occurring during the predevelopment condition; and therefore consistent with the guidelines of the Region of Niagara.

Detailed calculations for backwater elevation have been attached in Appendix F.

## 8.0 SEDIMENT AND EROSION CONTROL

Sediment and erosion controls are required during all construction phases of this development to limit the transport of sediment into downstream watercourses. Proposed sediment and erosion controls will be provided during for the final design and will include:

- Silt control fencing to minimize the transport of sediment offsite from the construction process.
- Straw bale filters in accordance with MNR/MOE guidelines.
- Re-vegetate disturbed areas as soon as possible after grading works have been completed.

# 9.0 CONCLUSIONS AND RECOMMENDATIONS

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

- Infiltration techniques are not suitable for this site as the primary control facility due to the site size and soil conditions.
- Roof water leaders shall discharge to grade to enhance the future infiltration levels.
- Two wet pond facilities shall be constructed on this site to provide water quality controls.
- A thermal mitigation contact system shall be constructed to provide thermal controls.
- The existing channel be realigned according to Natural Channel Design principals.
- Various lot level and vegetative stormwater management practices can be implemented to enhance stormwater quality.
- This report was prepared in accordance with the provincial guidelines contained in "Stormwater Management Planning and Design Manual, March 2003".

The above conclusions lead to the following recommendations:

- That the stormwater management criteria established in this report be accepted.
- That two wet pond facilities shall be constructed to provide stormwater quality control.
- That a thermal mitigation contact system be constructed to provide thermal controls.
- That the existing channel be realigned according to Natural Channel Design principals.
- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.
- That sediment and erosion controls during construction as described in this report be implemented.

Respectfully submitted,

LICENSED PROFESSIONAL ENGINEER
A. S. KEANE
100109861
PROVINCE OF ONTARIO

Adam Keane, P.Eng.

# APPENDICES

# <u>APPENDIX A</u>

## Detailed Calculations for Stormwater Management Facilities

**Upper Canada Consultants**
**261 Martindale Road, Unit 1,**
**St. Catharines, Ontario L2W 1A1**

**PROJECT NAME:** **THE VILLAGE OF EAST FONTHILL (NORTH POND), FONTHILL, TOWN OF PELHAM**
**PROJECT NO.:** **0473**

**BY:** **A. Keane**
**DATE:** **Jun-15**

## WET POND FACILITY

**Quality Requirements**
Qlty Drng. Area (ha) = 20.69
Qnty Drng. Area (ha) = 27.07
Lvl 1 @ 85% (m3/ha) = 250
Perm Pool (m3/ha) = 210
Perm Pool Vol (m3) = 4,345
Active Vol (m3) 1,083
25mm MOEE (m3) 4,211
10mm MOEE (m3) 1,307
**Perm. Pool Elev. =** 186.55 m

**Quality Orifice**
Diameter (m) = 0.225
Cd = 0.63
Invert (m) = 186.55
1470.000

**Ditch Inlet Weir**
OPSD: 705.040 (TYPE A)
Flow Width (m) = 1.20
Inlet Depth (m) = 0.60
Grate Slope (X:1) = 4
Inlet Elevation (m) = 187.38
Cd = 1.32
Hydraulic Diameter = 0.40

**Outflow Pipe Orifice**
Diameter (m) = 0.675
Cd = 0.65
Invert (m) = 186.55
Overt (m) = 187.23

**Overflow Spillway**
Minor Length (m) = 0.00
Minor Slopes (X:1) = 0.00
Major Slopes (X:1) = 3.00
Minor Invert (m) = 189.58
Major Length (m) = 20.00
Major Invert (m) = 189.58

MOE Equation 4.10 Drawdown Coefficient 'C2' = 2,163
MOE Equation 4.10 Drawdown Coefficient 'C3' = 4,346
MOE Equation 4.10 Drawdown Time (h) = **24.8**

| Elevation | Increment Depth (m) | Active Depth (m) | Surface Area (m2) | Average Surface Area (m2) | Increment Volume (m3) | Permanent Volume (m3) | Active Volume (m3) | Quality Orifice (m3/s) | Ditch Inlet (m3/s) | Max Pipe Orifice (m3/s) | Overflow Spillway (m3/s) | Total Outflow (m3/s) | Average Discharge (m3/s) | Side Slope (H:V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **184.80** | | -1.75 | **1,556** | | | 0 | | | | | | | | |
| | 0.75 | | | 2,020.50 | 1,515.38 | | | | | | | | | 5:1 |
| 185.55 | | -1.00 | 2,485 | | | 1,515 | | | | | | | | |
| | 1.00 | | | 3,076.50 | 3,076.50 | | | | | | | | | 5:1 |
| **186.55** | | 0.00 | **3,668** | | | **4,592** | *<--5.7% Safety Buffer* | | | | | | | PERM |
| | 0.00 | | | 3,973.50 | 3.97 | | | | | | | | 0.041 | 5:1 |
| **186.55** | | 0.00 | **4,279** | | | 0 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | PERM |
| | 0.29 | | | 4,644.71 | 1,342.32 | | | | | | | | 0.021 | 5:1 |
| 186.84 | | 0.29 | 5,010 | | | | 1,342 | 0.042 | 0.000 | 0.074 | 0.000 | 0.042 | | 10mm Vol |
| | 0.31 | | | 5,402.71 | 1,674.84 | | | | | | | | 0.058 | 5:1 |
| 187.15 | | 0.60 | **5,795** | | | | 3,017 | 0.074 | 0.000 | 0.275 | 0.000 | 0.074 | | |
| | 0.23 | | | 5,906.43 | 1,358.48 | | | | | | | | 0.083 | 5:1 |
| **187.38** | | 0.83 | 6,018 | | | | **4,376** | 0.091 | 0.000 | 0.635 | 0.000 | 0.091 | | EXTND |
| | 0.44 | | | 6,233.46 | 2,773.89 | | | | | | | | 0.514 | 5:1 |
| 187.83 | | 1.27 | 6,449 | | | | 7,150 | 0.118 | 1.238 | 0.936 | 0.000 | 0.936 | | |
| | 0.44 | | | 6,664.65 | 2,965.77 | | | | | | | | 1.049 | 5:1 |
| 188.27 | | 1.72 | 6,880 | | | | 10,115 | 0.139 | 2.314 | 1.161 | 0.000 | 1.161 | | |
| | 0.45 | | | 7,095.84 | 3,157.65 | | | | | | | | 1.255 | 5:1 |
| 188.72 | | 2.16 | 7,311 | | | | 13,273 | 0.158 | 3.029 | 1.349 | 0.000 | 1.349 | | |
| | 0.44 | | | 7,527.03 | 3,349.53 | | | | | | | | 1.240 | 5:1 |
| 189.16 | | 2.61 | 7,743 | | | | 16,622 | 0.174 | 3.606 | 1.514 | 0.000 | 1.514 | | |
| | 0.44 | | | 7,958.22 | 3,541.41 | | | | | | | | 1.655 | 5:1 |
| 189.61 | | 3.05 | 8,174 | | | | 20,164 | 0.189 | 4.102 | 1.663 | 0.133 | 1.797 | | |
| | 0.44 | | | 8,389.41 | 3,733.29 | | | | | | | | 6.503 | 5:1 |
| **190.05** | | 3.50 | **8,605** | | | | 23,897 | 0.203 | 4.544 | 1.800 | 9.411 | 11.210 | | |

**Notes**
1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Ditch Inlet flow is calculated using MTO charts and 50% debris coverage.
3. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
4. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
5. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

**Upper Canada Consultants**
**261 Martindale Road, Unit 1,**
**St. Catharines, Ontario L2W 1A1**

**BY: A. Keane, P.Eng.**
**DATE: October 9, 2014**

**PROJECT NAME:** **THE VILLAGE OF EAST FONTHILL (SOUTH POND), FONTHILL, TOWN OF PELHAM**
**PROJECT NO.:** **0482**

# WETPOND FACILITY

**Quality Requirements**
Drainage Area (ha) = 10.32
Level 2 (m3/ha) = 150 @85%
Perm Pool (m3/ha) = 110
Perm Pool Vol (m3) = 1,135
Active Vol (m3) 413
25mm MOE (m3) 1,623
**Perm. Pool Elev.** = 189.90 m

**Quality Orifice**
Diameter (m) = 0.127
Cd = 0.63
Invert (m) = 189.90
Avg. Discharge (m3/s) 0.0123

**Ditch Inlet Weir**
OPSD: 705.03
Flow Width (m) = 0.60
Inlet Depth (m) = 0.60
Grate Slope (X:1) = 4
Inlet Elevation (m) = 190.68
Cd = 1.32
Hydraulic Diameter = 0.30

**Outflow Pipe Orifice**
Diameter (m) = 0.450
Cd = 0.65
Invert (m) = 189.90
Overt (m) = 190.35

**Overflow Spillway**
Minor Length (m) = 0.00
Slopes (X:1) = 1.00
Minor Invert (m) = 192.10
Major Length (m) = 2.44
Major Invert (m) = 192.10

MOE Equation 4.10 Drawdown Coefficient 'C2' = 947
MOE Equation 4.10 Drawdown Coefficient 'C3' = 2,230
MOE Equation 4.10 Drawdown Time (h) = **36.5**

| Elevation | Increment Depth (m) | Active Depth (m) | Surface Area (m2) | Average Surface Area (m2) | Increment Volume (m3) | Permanent Volume (m3) | Active Volume (m3) | Quality Orifice (m3/s) | Ditch Inlet (m3/s) | Max Pipe Orifice (m3/s) | Overflow Spillway (m3/s) | Total Outflow (m3/s) | Average Discharge (m3/s) | Side Slope (H:V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **188.90** | | -1.00 | 1,348 | | | 0.00 | | | | | | | | |
| | 0.50 | | | 1,568.50 | 784.25 | | | | | | | | | 5:1 |
| 189.40 | | -0.50 | 1,789 | | | 784.3 | | | | | | | | |
| | 0.50 | | | 2,009.50 | 1,004.75 | | | | | | | | | 5:1 |
| **189.90** | | 0.00 | 2,230 | | | **1,789.0** | <-Safety Factor 57.6% | | | | | | | |
| | 0.00 | | | 2,230.00 | 0.02 | | | | | | | | | 5:1 |
| **189.90** | | 0.00 | 2,230 | | | 0.0 | 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | | |
| | 0.17 | | | 2,308.91 | 384.82 | | | | | | | | 0.005 | 5:1 |
| 190.07 | | 0.17 | 2,388 | | | | 385 | 0.010 | 0.000 | 0.022 | 0.000 | 0.010 | | |
| | 0.17 | | | 2,466.71 | 411.12 | | | | | | | | 0.014 | 5:1 |
| 190.23 | | 0.33 | 2,546 | | | | 796 | 0.018 | 0.000 | 0.076 | 0.000 | 0.018 | | |
| | 0.45 | | | 2,757.06 | 1,231.47 | | | | | | | | 0.024 | 5:1 |
| 190.68 | | 0.78 | 2,969 | | | | **2,027** | 0.029 | 0.000 | 0.317 | 0.000 | 0.029 | | |
| | 0.02 | | | 2,977.98 | 59.56 | | | | | | | | 0.031 | 5:1 |
| 190.70 | | 0.80 | 2,987 | | | | 2,087 | 0.030 | 0.003 | 0.324 | 0.000 | 0.033 | | |
| | 0.03 | | | 3,003.23 | 100.12 | | | | | | | | 0.038 | 5:1 |
| 190.73 | | 0.83 | 3,019 | | | | 2,187 | 0.031 | 0.013 | 0.334 | 0.000 | 0.043 | | |
| | 0.17 | | | 3,097.91 | 516.32 | | | | | | | | 0.155 | 5:1 |
| 190.90 | | 1.00 | 3,177 | | | | 2,703 | 0.034 | 0.233 | 0.383 | 0.000 | 0.267 | | |
| | 0.17 | | | 3,255.71 | 542.62 | | | | | | | | 0.192 | 5:1 |
| 191.07 | | 1.17 | 3,335 | | | | 3,246 | 0.037 | 0.712 | 0.426 | 0.000 | 0.426 | | |
| | 0.17 | | | 3,413.51 | 568.91 | | | | | | | | 0.446 | 5:1 |
| 191.23 | | 1.33 | 3,492 | | | | 3,815 | 0.040 | 0.980 | 0.466 | 0.000 | 0.466 | | |
| | 1.17 | | | 4,044.70 | 4,718.82 | | | | | | | | 0.799 | 5:1 |
| **192.40** | | 2.50 | 4,597 | | | | 8,534 | 0.055 | 2.033 | 0.679 | 0.453 | 1.132 | | |

**Notes**
1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Ditch Inlet flow is calculated using MTO charts and 50% debris coverage.
3. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
4. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
5. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

# APPENDIX B

## MIDUSS Output Files – Existing Drainage Conditions

```
      Output File (4.7) EX.OUT       opened 2014-04-25  15:30
      Units used are defined by G =     9.810
         24   144    10.000        are MAXDT MAXHYD & DTMIN values
      Licensee: UPPER CANADA CONSULTANTS
 35   COMMENT
     3     line(s) of comment
      THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
      STORMWATER MANAGEMENT PLAN, APRIL 2014
      EXISTING CONDITIONS
 35   COMMENT
     1     line(s) of comment
      25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
  2   STORM
        1       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
  500.000       Coefficient  a
    8.100       Constant  b    (min)
     .810       Exponent  c
     .400       Fraction to peak  r
  240.000       Duration ó  240 min
             22.981 mm     Total depth
  3   IMPERVIOUS
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .015       Manning "n"
   98.000       SCS Curve No or C
     .100       Ia/S Coefficient
     .518       Initial Abstraction
 35   COMMENT
     3     line(s) of comment
      *********************************************
      * OUTLET A                                  *
      *********************************************
  4   CATCHMENT
  101.000       ID No.ó 99999
   21.980       Area in hectares
  385.000       Length (PERV) metres
    3.330       Gradient (%)
   47.800       Per cent Impervious
  385.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .831        .000        .000        .000 c.m/s
           .083        .787        .420       C perv/imperv/total
 15   ADD RUNOFF
           .831        .831        .000        .000 c.m/s
 27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .2116845E+04 c.m
 14   START
     1     1=Zero; 2=Define
 35   COMMENT
     3     line(s) of comment
      *********************************************
      * OUTLET B                                  *
      *********************************************
  4   CATCHMENT
  102.000       ID No.ó 99999
   32.340       Area in hectares
  465.000       Length (PERV) metres
   16.460       Gradient (%)
   49.300       Per cent Impervious
  465.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.280        .000        .000        .000 c.m/s
           .083        .785        .429       C perv/imperv/total
 15   ADD RUNOFF
          1.280       1.280        .000        .000 c.m/s
  4   CATCHMENT
  103.000       ID No.ó 99999
   42.370       Area in hectares
  530.000       Length (PERV) metres
    2.450       Gradient (%)
    5.600       Per cent Impervious
  530.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .175       1.280        .000        .000 c.m/s
           .083        .793        .123       C perv/imperv/total
 15   ADD RUNOFF
           .175       1.455        .000        .000 c.m/s
 27   HYDROGRAPH DISPLAY
     4     is # of Hyeto/Hydrograph chosen
      Volume  =  .1197006E+04 c.m
 14   START
     1     1=Zero; 2=Define
 35   COMMENT
     3     line(s) of comment
      *********************************************
      * OUTLET C                                  *
      *********************************************
  4   CATCHMENT
  104.000       ID No.ó 99999
   11.490       Area in hectares
  275.000       Length (PERV) metres
    4.430       Gradient (%)
   19.500       Per cent Impervious
  275.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .179        .000        .000        .000 c.m/s
           .083        .789        .221       C perv/imperv/total
 15   ADD RUNOFF
           .179        .179        .000        .000 c.m/s
  4   CATCHMENT
  105.000       ID No.ó 99999
    6.630       Area in hectares
  210.000       Length (PERV) metres
    2.630       Gradient (%)
   11.300       Per cent Impervious
  210.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .060        .179        .000        .000 c.m/s
           .083        .788        .163       C perv/imperv/total
 15   ADD RUNOFF
           .060        .240        .000        .000 c.m/s
  4   CATCHMENT
  106.000       ID No.ó 99999
   10.460       Area in hectares
  265.000       Length (PERV) metres
    2.000       Gradient (%)
    2.800       Per cent Impervious
  265.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .024        .240        .000        .000 c.m/s
           .083        .791        .103       C perv/imperv/total
 15   ADD RUNOFF
           .024        .263        .000        .000 c.m/s
  4   CATCHMENT
  107.000       ID No.ó 99999
   11.780       Area in hectares
  280.000       Length (PERV) metres
    2.780       Gradient (%)
    4.000       Per cent Impervious
  280.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .037        .263        .000        .000 c.m/s
           .083        .792        .112       C perv/imperv/total
 15   ADD RUNOFF
           .037        .301        .000        .000 c.m/s
 27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1380951E+04 c.m
 14   START
     1     1=Zero; 2=Define
 14   START
     1     1=Zero; 2=Define
 35   COMMENT
     3     line(s) of comment
      ************************************************************
      * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
      ************************************************************
  2   STORM
        1       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
  830.000       Coefficient  a
    7.300       Constant  b    (min)
     .777       Exponent  c
     .400       Fraction to peak  r
  240.000       Duration ó  240 min
             45.876 mm     Total depth
  3   IMPERVIOUS
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .015       Manning "n"
   98.000       SCS Curve No or C
     .100       Ia/S Coefficient
     .518       Initial Abstraction
 35   COMMENT
     3     line(s) of comment
      *********************************************
      * OUTLET A                                  *
      *********************************************
  4   CATCHMENT
  101.000       ID No.ó 99999
   21.980       Area in hectares
  385.000       Length (PERV) metres
    3.330       Gradient (%)
   47.800       Per cent Impervious
  385.000       Length (IMPERV)
     .000       %Imp. with Zero Dpth
        1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250       Manning "n"
   74.000       SCS Curve No or C
     .100       Ia/S Coefficient
    8.924       Initial Abstraction
        1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.796        .000        .000        .000 c.m/s
           .236        .881        .544       C perv/imperv/total
 15   ADD RUNOFF
          1.796       1.796        .000        .000 c.m/s
 27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .5489694E+04 c.m
 14   START
```

```
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *******************************************
      * OUTLET B                                *
      *******************************************
 4    CATCHMENT
    102.000      ID No.ó 99999
     32.340      Area in hectares
    465.000      Length (PERV) metres
     16.460      Gradient (%)
     49.300      Per cent Impervious
    465.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          2.605       .000        .000        .000 c.m/s
           .236       .872        .549      C perv/imperv/total
15    ADD RUNOFF
          2.605      2.605        .000        .000 c.m/s
 4    CATCHMENT
    103.000      ID No.ó 99999
     42.370      Area in hectares
    530.000      Length (PERV) metres
      2.450      Gradient (%)
      5.600      Per cent Impervious
    530.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .446      2.605        .000        .000 c.m/s
           .236       .880        .272      C perv/imperv/total
15    ADD RUNOFF
           .446      3.051        .000        .000 c.m/s
27    HYDROGRAPH DISPLAY
     4     is # of Hyeto/Hydrograph chosen
      Volume  =  .5285372E+04 c.m
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *******************************************
      * OUTLET C                                *
      *******************************************
 4    CATCHMENT
    104.000      ID No.ó 99999
     11.490      Area in hectares
    275.000      Length (PERV) metres
      4.430      Gradient (%)
     19.500      Per cent Impervious
    275.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .392       .000        .000        .000 c.m/s
           .236       .866        .359      C perv/imperv/total
15    ADD RUNOFF
           .392       .392        .000        .000 c.m/s
 4    CATCHMENT
    105.000      ID No.ó 99999
      6.630      Area in hectares
    210.000      Length (PERV) metres
      2.630      Gradient (%)
     11.300      Per cent Impervious
    210.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .139       .392        .000        .000 c.m/s
           .236       .867        .307      C perv/imperv/total
15    ADD RUNOFF
           .139       .531        .000        .000 c.m/s
 4    CATCHMENT
    106.000      ID No.ó 99999
     10.460      Area in hectares
    265.000      Length (PERV) metres
      2.000      Gradient (%)
      2.800      Per cent Impervious
    265.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .110       .531        .000        .000 c.m/s
           .236       .876        .254      C perv/imperv/total
15    ADD RUNOFF
           .110       .600        .000        .000 c.m/s
 4    CATCHMENT
    107.000      ID No.ó 99999
     11.780      Area in hectares
    280.000      Length (PERV) metres
      2.780      Gradient (%)
      4.000      Per cent Impervious
    280.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
```

```
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .132       .600        .000        .000 c.m/s
           .236       .872        .261      C perv/imperv/total
15    ADD RUNOFF
           .132       .704        .000        .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .5452904E+04 c.m
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********************************************************
      * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
      ***********************************************************
 2    STORM
          1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   1020.000      Coefficient  a
      4.700      Constant  b    (min)
       .731      Exponent  c
       .400      Fraction to peak  r
    240.000      Duration ó  240 min
             73.207 mm     Total depth
 3    IMPERVIOUS
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015      Manning "n"
     98.000      SCS Curve No or C
       .100      Ia/S Coefficient
       .518      Initial Abstraction
35    COMMENT
     3     line(s) of comment
      *******************************************
      * OUTLET A                                *
      *******************************************
 4    CATCHMENT
    101.000      ID No.ó 99999
     21.980      Area in hectares
    385.000      Length (PERV) metres
      3.330      Gradient (%)
     47.800      Per cent Impervious
    385.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          2.875       .000        .000        .000 c.m/s
           .367       .907        .625      C perv/imperv/total
15    ADD RUNOFF
          2.875      2.875        .000        .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1006246E+05 c.m
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *******************************************
      * OUTLET B                                *
      *******************************************
 4    CATCHMENT
    102.000      ID No.ó 99999
     32.340      Area in hectares
    465.000      Length (PERV) metres
     16.460      Gradient (%)
     49.300      Per cent Impervious
    465.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          4.439       .000        .000        .000 c.m/s
           .367       .916        .638      C perv/imperv/total
15    ADD RUNOFF
          4.439      4.439        .000        .000 c.m/s
 4    CATCHMENT
    103.000      ID No.ó 99999
     42.370      Area in hectares
    530.000      Length (PERV) metres
      2.450      Gradient (%)
      5.600      Per cent Impervious
    530.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.137      4.439        .000        .000 c.m/s
           .367       .925        .399      C perv/imperv/total
15    ADD RUNOFF
          1.137      4.969        .000        .000 c.m/s
27    HYDROGRAPH DISPLAY
     4     is # of Hyeto/Hydrograph chosen
      Volume  =  .1236434E+05 c.m
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *******************************************
      * OUTLET C                                *
      *******************************************
 4    CATCHMENT
    104.000      ID No.ó 99999
     11.490      Area in hectares
```

```
      275.000      Length (PERV) metres
        4.430      Gradient (%)
       19.500      Per cent Impervious
      275.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .697        .000        .000        .000 c.m/s
              .367        .915        .474      C perv/imperv/total
 15     ADD RUNOFF
              .697        .697        .000        .000 c.m/s
  4     CATCHMENT
      105.000      ID No.ó 99999
        6.630      Area in hectares
      210.000      Length (PERV) metres
        2.630      Gradient (%)
       11.300      Per cent Impervious
      210.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .284        .697        .000        .000 c.m/s
              .367        .915        .429      C perv/imperv/total
 15     ADD RUNOFF
              .284        .977        .000        .000 c.m/s
  4     CATCHMENT
      106.000      ID No.ó 99999
       10.460      Area in hectares
      265.000      Length (PERV) metres
        2.000      Gradient (%)
```

```
        2.800      Per cent Impervious
      265.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .361        .977        .000        .000 c.m/s
              .367        .903        .382      C perv/imperv/total
 15     ADD RUNOFF
              .361       1.167        .000        .000 c.m/s
  4     CATCHMENT
      107.000      ID No.ó 99999
       11.780      Area in hectares
      280.000      Length (PERV) metres
        2.780      Gradient (%)
        4.000      Per cent Impervious
      280.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .426       1.167        .000        .000 c.m/s
              .368        .908        .389      C perv/imperv/total
 15     ADD RUNOFF
              .426       1.519        .000        .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5      is # of Hyeto/Hydrograph chosen
        Volume  =  .1235576E+05 c.m
 14     START
       1      1=Zero; 2=Define
 20     MANUAL
```

# APPENDIX C

## MIDUSS Output Files - Future Drainage Conditions without SWM

```
     Output File (4.7) OCTNONE.OUT  opened 2014-10-10  11:22
     Units used are defined by G =     9.810
         24   144    10.000        are MAXDT MAXHYD & DTMIN values
     Licensee: UPPER CANADA CONSULTANTS
  35 COMMENT
    3    line(s) of comment
     THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
     STORMWATER MANAGEMENT PLAN, OCT 2014
     FUTURE CONDITIONS - WITH STORMWATER MANAGEMENT
  35 COMMENT
    1    line(s) of comment
     25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
   2 STORM
        1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   500.000    Coefficient  a
     8.100    Constant  b    (min)
      .810    Exponent  c
      .400    Fraction to peak  r
   240.000    Duration ó  240 min
          22.981 mm     Total depth
   3 IMPERVIOUS
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .015    Manning "n"
    98.000    SCS Curve No or C
      .100    Ia/S Coefficient
      .518    Initial Abstraction
  35 COMMENT
    3    line(s) of comment
     ******************************************
     * OUTLET A                               *
     ******************************************
  14 START
    1    1=Zero; 2=Define
   4 CATCHMENT
    31.000    ID No.ó 99999
     3.530    Area in hectares
   155.000    Length (PERV) metres
     2.000    Gradient (%)
    85.000    Per cent Impervious
   155.000    Length (IMPERV)
      .000    %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250    Manning "n"
    74.000    SCS Curve No or C
      .100    Ia/S Coefficient
    11.953    Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           .241       .000       .000       .000 c.m/s
           .053       .784       .674     C perv/imperv/total
  15 ADD RUNOFF
           .241       .241       .000       .000 c.m/s
  35 COMMENT
    3    line(s) of comment
     ******************************************
     * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)    *
     ******************************************
  12 DIVERT
        9     U/S Node No.ó 99999
      .478    Threshold Discharge
      .574    Max. Outflow reqd.
          Qmax & Vol.Diverted =      .000 c.m/s         .0 c.m
          No flow diverted
           .241       .241       .241       .000 c.m/s
  16 NEXT LINK
           .241       .241       .241       .000 c.m/s
   4 CATCHMENT
    10.000    ID No.ó 99999
     5.910    Area in hectares
   200.000    Length (PERV) metres
     2.000    Gradient (%)
    85.000    Per cent Impervious
   200.000    Length (IMPERV)
      .000    %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250    Manning "n"
    74.000    SCS Curve No or C
      .100    Ia/S Coefficient
    11.953    Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           .399       .241       .241       .000 c.m/s
           .053       .791       .680     C perv/imperv/total
  15 ADD RUNOFF
           .399       .640       .241       .000 c.m/s
   4 CATCHMENT
    20.000    ID No.ó 99999
     6.380    Area in hectares
   205.000    Length (PERV) metres
     2.000    Gradient (%)
    85.000    Per cent Impervious
   205.000    Length (IMPERV)
      .000    %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250    Manning "n"
    74.000    SCS Curve No or C
      .100    Ia/S Coefficient
    11.953    Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           .430       .640       .241       .000 c.m/s
           .053       .791       .680     C perv/imperv/total
  15 ADD RUNOFF
           .430      1.069       .241       .000 c.m/s
  27 HYDROGRAPH DISPLAY
    5    is # of Hyeto/Hydrograph chosen
     Volume  =  .2459709E+04 c.m
   4 CATCHMENT
    30.000    ID No.ó 99999
    11.250    Area in hectares
   260.000    Length (PERV) metres
     2.000    Gradient (%)
    85.000    Per cent Impervious
   260.000    Length (IMPERV)
      .000    %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250    Manning "n"
    74.000    SCS Curve No or C
      .100    Ia/S Coefficient
    11.953    Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           .767      1.069       .241       .000 c.m/s
           .053       .791       .680     C perv/imperv/total
  15 ADD RUNOFF
           .767      1.836       .241       .000 c.m/s
  27 HYDROGRAPH DISPLAY
    5    is # of Hyeto/Hydrograph chosen
     Volume  =  .4211089E+04 c.m
  35 COMMENT
    3    line(s) of comment
     ******************************************
     * NORTH VILLAGE OF EAST FONTHILL POND    *
     ******************************************
   9 ROUTE
      .000    Conduit Length
      .000    No Conduit defined
      .000    Zero lag
      .000    Beta weighting factor
      .000    Routing timestep
        0     No. of sub-reaches
           .767      1.836      1.836       .000 c.m/s
  16 NEXT LINK
           .767      1.836      1.836       .000 c.m/s
  14 START
    1    1=Zero; 2=Define
  35 COMMENT
    3    line(s) of comment
     ******************************************
     * OUTLET B                               *
     ******************************************
   4 CATCHMENT
    40.000    ID No.ó 99999
    35.240    Area in hectares
   485.000    Length (PERV) metres
    15.480    Gradient (%)
    49.400    Per cent Impervious
   485.000    Length (IMPERV)
      .000    %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250    Manning "n"
    74.000    SCS Curve No or C
      .100    Ia/S Coefficient
     8.924    Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          1.395       .000      1.836       .000 c.m/s
           .083       .787       .431     C perv/imperv/total
  15 ADD RUNOFF
          1.395      1.395      1.836       .000 c.m/s
  11 CHANNEL
     2.000    Base Width     =
     3.000    Left  bank slope  1:
     3.000    Right bank slope  1:
      .040    Manning's "n"
     1.500    O/a Depth in metres
      .900    Select Grade in %
     Depth          =      .414 metres
     Velocity       =     1.040 m/sec
     Flow Capacity  =    20.730 c.m/s
     Critical depth =      .312 metres
   9 ROUTE
   393.000    Conduit Length
      .470    Supply X-factor <.5
   283.376    Supply K-lag (sec)
      .500    Beta weighting factor
   300.000    Routing timestep
        1     No. of sub-reaches
          1.395      1.395      1.212       .000 c.m/s
  16 NEXT LINK
          1.395      1.212      1.212       .000 c.m/s
   4 CATCHMENT
    60.000    ID No.ó 99999
     2.430    Area in hectares
   125.000    Length (PERV) metres
     2.000    Gradient (%)
      .000    Per cent Impervious
   125.000    Length (IMPERV)
      .000    %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250    Manning "n"
    74.000    SCS Curve No or C
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         .100      Ia/S Coefficient
        8.924      Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .003       1.212       1.212        .000 c.m/s
              .083        .000        .083      C perv/imperv/total
   15      ADD RUNOFF
              .003       1.212       1.212        .000 c.m/s
    9      ROUTE
      452.000      Conduit Length
         .475      Supply X-factor <.5
      339.120      Supply K-lag (sec)
         .500      Beta weighting factor
      300.000      Routing timestep
           1       No. of sub-reaches
              .003       1.212       1.141        .000 c.m/s
   17      COMBINE
      1       Junction Node No.
              .003       1.212       1.141       1.141 c.m/s
   14      START
      1       1=Zero; 2=Define
   22      FILE HYDROGRAPH
      1       1=READ: 2=WRITE
     12       DIV00009.25M          is Filename
      2       1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
              .003        .000       1.141       1.141 c.m/s
    4      CATCHMENT
       50.000      ID No.ó 99999
       10.320      Area in hectares
      260.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      260.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .703        .000       1.141       1.141 c.m/s
              .083        .791        .685      C perv/imperv/total
   15      ADD RUNOFF
              .703        .703       1.141       1.141 c.m/s
   27      HYDROGRAPH DISPLAY
      4       is # of Hyeto/Hydrograph chosen
      Volume  =  .1623832E+04 c.m
   35      COMMENT
      3       line(s) of comment
      ************************************************************
      * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND              *
      ************************************************************
    9      ROUTE
         .000      Conduit Length
         .500      Supply X-factor <.5
         .000      Supply K-lag (sec)
         .500      Beta weighting factor
      600.000      Routing timestep
           1       No. of sub-reaches
              .703        .703        .703       1.141 c.m/s
   17      COMBINE
      1       Junction Node No.
              .703        .703        .703       1.599 c.m/s
   14      START
      1       1=Zero; 2=Define
   18      CONFLUENCE
      1       Junction Node No.
              .703       1.599        .703        .000 c.m/s
    4      CATCHMENT
       70.000      ID No.ó 99999
        2.340      Area in hectares
      120.000      Length (PERV) metres
        2.000      Gradient (%)
         .000      Per cent Impervious
      120.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .003       1.599        .703        .000 c.m/s
              .083        .000        .083      C perv/imperv/total
   15      ADD RUNOFF
              .003       1.599        .703        .000 c.m/s
    9      ROUTE
         .000      Conduit Length
         .500      Supply X-factor <.5
         .000      Supply K-lag (sec)
         .500      Beta weighting factor
      600.000      Routing timestep
           1       No. of sub-reaches
              .003       1.599       1.599        .000 c.m/s
   17      COMBINE
      2       Junction Node No.
              .003       1.599       1.599       1.599 c.m/s
   14      START
      1       1=Zero; 2=Define
    4      CATCHMENT
       80.000      ID No.ó 99999
       38.600      Area in hectares
      510.000      Length (PERV) metres
        2.000      Gradient (%)
       43.500      Per cent Impervious
      510.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             1.077        .000       1.599       1.599 c.m/s
              .083        .792        .392      C perv/imperv/total
   15      ADD RUNOFF
             1.077       1.077       1.599       1.599 c.m/s
   27      HYDROGRAPH DISPLAY
      4       is # of Hyeto/Hydrograph chosen
      Volume  =  .3466319E+04 c.m
   35      COMMENT
      3       line(s) of comment
      ************************************************************
      * FUTURE STORMWATER MANAGEMENT FACILITY 706                 *
      ************************************************************
   10      POND
     10 Depth - Discharge - Volume sets
      187.500         .000          .0
      187.670        .0140       1300.3
      187.830        .0570       2689.4
      187.960        .0760       3804.3
      188.170         .234       5733.6
      188.330         .334       7388.8
      188.500         .383       9132.6
      188.670         .426      10965.2
      188.830         .637      12886.5
      189.000         .954      14896.4
      Peak Outflow    =       .054 c.m/s
      Maximum Depth   =    187.820 metres
      Maximum Storage =      2599. c.m
             1.077       1.077        .054       1.599 c.m/s
   17      COMBINE
      2       Junction Node No.
             1.077       1.077        .054       1.612 c.m/s
   14      START
      1       1=Zero; 2=Define
   18      CONFLUENCE
      2       Junction Node No.
             1.077       1.612        .054        .000 c.m/s
   27      HYDROGRAPH DISPLAY
      4       is # of Hyeto/Hydrograph chosen
      Volume  =  .3466319E+04 c.m
   14      START
      1       1=Zero; 2=Define
   35      COMMENT
      3       line(s) of comment
      **********************************************************
      * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
      **********************************************************
    2      STORM
           1       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      830.000      Coefficient  a
        7.300      Constant  b    (min)
         .777      Exponent  c
         .400      Fraction to peak  r
      240.000      Duration ó  240 min
                45.876 mm     Total depth
    3      IMPERVIOUS
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015      Manning "n"
       98.000      SCS Curve No or C
         .100      Ia/S Coefficient
         .518      Initial Abstraction
   35      COMMENT
      3       line(s) of comment
      *******************************************
      * OUTLET A                                *
      *******************************************
   14      START
      1       1=Zero; 2=Define
    4      CATCHMENT
       31.000      ID No.ó 99999
        3.530      Area in hectares
      155.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      155.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
       11.953      Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              .478        .000        .054        .000 c.m/s
              .204        .873        .773      C perv/imperv/total
   15      ADD RUNOFF
              .478        .478        .054        .000 c.m/s
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 35     COMMENT
    3     line(s) of comment
        *******************************************
        * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)     *
        *******************************************
 12     DIVERT
           9     U/S Node No.ó 99999
        .478     Threshold Discharge
        .574     Max. Outflow reqd.
            Qmax & Vol.Diverted =      .000 c.m/s          .0 c.m
            No flow diverted
             .478       .478       .478       .000 c.m/s
 16     NEXT LINK
             .478       .478       .478       .000 c.m/s
  4     CATCHMENT
    10.000     ID No.ó 99999
     5.910     Area in hectares
   200.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   200.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .829       .478       .478       .000 c.m/s
             .204       .864       .765     C perv/imperv/total
 15     ADD RUNOFF
             .829      1.306       .478       .000 c.m/s
  4     CATCHMENT
    20.000     ID No.ó 99999
     6.380     Area in hectares
   205.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   205.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .897      1.306       .478       .000 c.m/s
             .204       .866       .767     C perv/imperv/total
 15     ADD RUNOFF
             .897      2.203       .478       .000 c.m/s
 27     HYDROGRAPH DISPLAY
    5     is # of Hyeto/Hydrograph chosen
     Volume  =  .5569779E+04 c.m
  4     CATCHMENT
    30.000     ID No.ó 99999
    11.250     Area in hectares
   260.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   260.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            1.613      2.203       .478       .000 c.m/s
             .204       .876       .775     C perv/imperv/total
 15     ADD RUNOFF
            1.613      3.815       .478       .000 c.m/s
 27     HYDROGRAPH DISPLAY
    5     is # of Hyeto/Hydrograph chosen
     Volume  =  .9569145E+04 c.m
 35     COMMENT
    3     line(s) of comment
        *******************************************
        * NORTH VILLAGE OF EAST FONTHILL POND     *
        *******************************************
  9     ROUTE
      .000     Conduit Length
      .500     No Conduit defined
      .000     Zero lag
      .500     Beta weighting factor
   600.000     Routing timestep
         1     No. of sub-reaches
            1.613      3.815      3.815       .000 c.m/s
 16     NEXT LINK
            1.613      3.815      3.815       .000 c.m/s
 14     START
    1     1=Zero; 2=Define
 35     COMMENT
    3     line(s) of comment
        *******************************************
        * OUTLET B                                *
        *******************************************
  4     CATCHMENT
    40.000     ID No.ó 99999
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    35.240     Area in hectares
   485.000     Length (PERV) metres
    15.480     Gradient (%)
    49.400     Per cent Impervious
   485.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            2.869       .000      3.815       .000 c.m/s
             .236       .869       .548     C perv/imperv/total
 15     ADD RUNOFF
            2.869      2.869      3.815       .000 c.m/s
 11     CHANNEL
     2.000     Base Width     =
     3.000     Left  bank slope  1:
     3.000     Right bank slope  1:
      .040     Manning's "n"
     1.500     O/a Depth in metres
      .900     Select Grade in %
     Depth         =      .596 metres
     Velocity      =     1.269 m/sec
     Flow Capacity  =    20.730 c.m/s
     Critical depth =      .468 metres
  9     ROUTE
   393.000     Conduit Length
      .458     Supply X-factor <.5
   232.207     Supply K-lag (sec)
      .500     Beta weighting factor
   200.000     Routing timestep
         1     No. of sub-reaches
            2.869      2.869      2.802       .000 c.m/s
 16     NEXT LINK
            2.869      2.802      2.802       .000 c.m/s
  4     CATCHMENT
    60.000     ID No.ó 99999
     2.430     Area in hectares
   125.000     Length (PERV) metres
     2.000     Gradient (%)
      .000     Per cent Impervious
   125.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .035      2.802      2.802       .000 c.m/s
             .236       .000       .236     C perv/imperv/total
 15     ADD RUNOFF
             .035      2.813      2.802       .000 c.m/s
  9     ROUTE
   452.000     Conduit Length
      .464     Supply X-factor <.5
   268.490     Supply K-lag (sec)
      .500     Beta weighting factor
   200.000     Routing timestep
         1     No. of sub-reaches
             .035      2.813      2.413       .000 c.m/s
 17     COMBINE
    1     Junction Node No.
             .035      2.813      2.413      2.413 c.m/s
 14     START
    1     1=Zero; 2=Define
 22     FILE HYDROGRAPH
    1     1=READ: 2=WRITE
   12     DIV00009.5YR          is Filename
    2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
             .035       .000      2.413      2.413 c.m/s
  4     CATCHMENT
    50.000     ID No.ó 99999
    10.320     Area in hectares
   260.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   260.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            1.480       .000      2.413      2.413 c.m/s
             .236       .876       .780     C perv/imperv/total
 15     ADD RUNOFF
            1.480      1.480      2.413      2.413 c.m/s
 27     HYDROGRAPH DISPLAY
    4     is # of Hyeto/Hydrograph chosen
     Volume  =  .3691582E+04 c.m
 35     COMMENT
    3     line(s) of comment
        ************************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND              *
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     ************************************************************
  9    ROUTE
        .000      Conduit Length
        .500      Supply X-factor <.5
        .000      Supply K-lag (sec)
        .500      Beta weighting factor
     600.000      Routing timestep
          1       No. of sub-reaches
            1.480      1.480      1.480      2.413 c.m/s
 17    COMBINE
      1     Junction Node No.
            1.480      1.480      1.480      3.893 c.m/s
 14    START
      1     1=Zero; 2=Define
 18    CONFLUENCE
      1     Junction Node No.
            1.480      3.893      1.480       .000 c.m/s
  4    CATCHMENT
      70.000      ID No.ó 99999
       2.340      Area in hectares
     120.000      Length (PERV) metres
       2.000      Gradient (%)
        .000      Per cent Impervious
     120.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .034      3.893      1.480       .000 c.m/s
             .236       .000       .236     C perv/imperv/total
 15    ADD RUNOFF
             .034      3.904      1.480       .000 c.m/s
  9    ROUTE
        .000      Conduit Length
        .500      Supply X-factor <.5
        .000      Supply K-lag (sec)
        .500      Beta weighting factor
     600.000      Routing timestep
          1       No. of sub-reaches
             .034      3.904      3.904       .000 c.m/s
 17    COMBINE
      2     Junction Node No.
             .034      3.904      3.904      3.904 c.m/s
 14    START
      1     1=Zero; 2=Define
  4    CATCHMENT
      80.000      ID No.ó 99999
      38.600      Area in hectares
     510.000      Length (PERV) metres
       2.000      Gradient (%)
      43.500      Per cent Impervious
     510.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           2.876       .000      3.904      3.904 c.m/s
             .236       .877       .515     C perv/imperv/total
 15    ADD RUNOFF
           2.876      2.876      3.904      3.904 c.m/s
 27    HYDROGRAPH DISPLAY
      4     is # of Hyeto/Hydrograph chosen
       Volume  =  .9116987E+04 c.m
 35    COMMENT
      3     line(s) of comment
       ************************************************************
       * FUTURE STORMWATER MANAGEMENT FACILITY 706                  *
       ************************************************************
 10    POND
     10 Depth - Discharge - Volume sets
       187.500        .000          .0
       187.670       .0140      1300.3
       187.830       .0570      2689.4
       187.960       .0760      3804.3
       188.170        .234      5733.6
       188.330        .334      7388.8
       188.500        .383      9132.6
       188.670        .426     10965.2
       188.830        .637     12886.5
       189.000        .954     14896.4
       Peak Outflow    =       .247 c.m/s
       Maximum Depth   =   188.191 metres
       Maximum Storage =      5955. c.m
           2.876      2.876       .247      3.904 c.m/s
 17    COMBINE
      2     Junction Node No.
           2.876      2.876       .247      3.943 c.m/s
 14    START
      1     1=Zero; 2=Define
 18    CONFLUENCE
      2     Junction Node No.
           2.876      3.943       .247       .000 c.m/s
 27    HYDROGRAPH DISPLAY
      4     is # of Hyeto/Hydrograph chosen
       Volume  =  .9116987E+04 c.m
 14    START
      1     1=Zero; 2=Define
 35    COMMENT
      3     line(s) of comment
       ************************************************************
       * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
       ************************************************************
  2    STORM
          1       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1020.000      Coefficient  a
       4.700      Constant  b    (min)
        .731      Exponent  c
        .400      Fraction to peak  r
     240.000      Duration ó  240 min
               73.207 mm     Total depth
  3    IMPERVIOUS
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015      Manning "n"
      98.000      SCS Curve No or C
        .100      Ia/S Coefficient
        .518      Initial Abstraction
 35    COMMENT
      3     line(s) of comment
       ******************************************
       * OUTLET A                               *
       ******************************************
 14    START
      1     1=Zero; 2=Define
  4    CATCHMENT
      31.000      ID No.ó 99999
       3.530      Area in hectares
     155.000      Length (PERV) metres
       2.000      Gradient (%)
      85.000      Per cent Impervious
     155.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
      11.953      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .826       .000       .247       .000 c.m/s
             .340       .916       .830     C perv/imperv/total
 15    ADD RUNOFF
             .826       .826       .247       .000 c.m/s
 35    COMMENT
      3     line(s) of comment
       ******************************************
       * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)    *
       ******************************************
 12    DIVERT
          9       U/S Node No.ó 99999
        .478      Threshold Discharge
        .574      Max. Outflow reqd.
            Qmax & Vol.Diverted =      .252 c.m/s       254.0 c.m
            No flow diverted
             .826       .826       .574       .000 c.m/s
 16    NEXT LINK
             .826       .574       .574       .000 c.m/s
  4    CATCHMENT
      10.000      ID No.ó 99999
       5.910      Area in hectares
     200.000      Length (PERV) metres
       2.000      Gradient (%)
      85.000      Per cent Impervious
     200.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
      11.953      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           1.311       .574       .574       .000 c.m/s
             .340       .914       .828     C perv/imperv/total
 15    ADD RUNOFF
           1.311      1.885       .574       .000 c.m/s
  4    CATCHMENT
      20.000      ID No.ó 99999
       6.380      Area in hectares
     205.000      Length (PERV) metres
       2.000      Gradient (%)
      85.000      Per cent Impervious
     205.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
      11.953      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           1.407      1.885       .574       .000 c.m/s
             .340       .913       .827     C perv/imperv/total
 15    ADD RUNOFF
           1.407      3.292       .574       .000 c.m/s
```

```
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .9333898E+04 c.m
  4     CATCHMENT
       30.000      ID No.ó 99999
       11.250      Area in hectares
      260.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      260.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
       11.953      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            2.487      3.292       .574       .000 c.m/s
             .341       .904       .820     C perv/imperv/total
 15     ADD RUNOFF
            2.487      5.644       .574       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       5     is # of Hyeto/Hydrograph chosen
        Volume  =  .1608601E+05 c.m
 35     COMMENT
       3     line(s) of comment
        *******************************************
        * NORTH VILLAGE OF EAST FONTHILL POND     *
        *******************************************
  9     ROUTE
         .000      Conduit Length
         .500      No Conduit defined
         .000      Zero lag
         .500      Beta weighting factor
      600.000      Routing timestep
            1      No. of sub-reaches
            2.487      5.644      5.644       .000 c.m/s
 16     NEXT LINK
            2.487      5.644      5.644       .000 c.m/s
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        *******************************************
        * OUTLET B                                *
        *******************************************
  4     CATCHMENT
       40.000      ID No.ó 99999
       35.240      Area in hectares
      485.000      Length (PERV) metres
       15.480      Gradient (%)
       49.400      Per cent Impervious
      485.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            4.772       .000      5.644       .000 c.m/s
             .367       .915       .638     C perv/imperv/total
 15     ADD RUNOFF
            4.772      4.772      5.644       .000 c.m/s
 11     CHANNEL
        2.000      Base Width     =
        3.000      Left  bank slope  1:
        3.000      Right bank slope  1:
         .040      Manning's "n"
        1.500      O/a Depth in metres
         .900      Select Grade in %
        Depth          =      .764 metres
        Velocity       =     1.454 m/sec
        Flow Capacity  =    20.730 c.m/s
        Critical depth =      .615 metres
  9     ROUTE
      393.000      Conduit Length
         .448      Supply X-factor <.5
      202.682      Supply K-lag (sec)
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
            4.772      4.772      4.594       .000 c.m/s
 16     NEXT LINK
            4.772      4.594      4.594       .000 c.m/s
  4     CATCHMENT
       60.000      ID No.ó 99999
        2.430      Area in hectares
      125.000      Length (PERV) metres
        2.000      Gradient (%)
         .000      Per cent Impervious
      125.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .113      4.594      4.594       .000 c.m/s
             .367       .000       .367     C perv/imperv/total
 15     ADD RUNOFF
             .113      4.654      4.594       .000 c.m/s
  9     ROUTE
      452.000      Conduit Length
         .455      Supply X-factor <.5
      234.662      Supply K-lag (sec)
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
             .113      4.654      4.238       .000 c.m/s
 17     COMBINE
       1     Junction Node No.
             .113      4.654      4.238      4.238 c.m/s
 14     START
       1     1=Zero; 2=Define
 22     FILE HYDROGRAPH
       1     1=READ: 2=WRITE
      12     DIV00009.100         is Filename
       2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
             .113       .252      4.238      4.238 c.m/s
  4     CATCHMENT
       50.000      ID No.ó 99999
       10.320      Area in hectares
      260.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      260.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            2.284       .252      4.238      4.238 c.m/s
             .367       .904       .824     C perv/imperv/total
 15     ADD RUNOFF
            2.284      2.455      4.238      4.238 c.m/s
 27     HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .6224218E+04 c.m
 35     COMMENT
       3     line(s) of comment
        ***********************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND            *
        ***********************************************************
  9     ROUTE
         .000      Conduit Length
         .500      Supply X-factor <.5
         .000      Supply K-lag (sec)
         .500      Beta weighting factor
      600.000      Routing timestep
            1      No. of sub-reaches
            2.284      2.455      2.455      4.238 c.m/s
 17     COMBINE
       1     Junction Node No.
            2.284      2.455      2.455      6.693 c.m/s
 14     START
       1     1=Zero; 2=Define
 18     CONFLUENCE
       1     Junction Node No.
            2.284      6.693      2.455       .000 c.m/s
  4     CATCHMENT
       70.000      ID No.ó 99999
        2.340      Area in hectares
      120.000      Length (PERV) metres
        2.000      Gradient (%)
         .000      Per cent Impervious
      120.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .109      6.693      2.455       .000 c.m/s
             .368       .000       .368     C perv/imperv/total
 15     ADD RUNOFF
             .109      6.752      2.455       .000 c.m/s
  9     ROUTE
         .000      Conduit Length
         .500      Supply X-factor <.5
         .000      Supply K-lag (sec)
         .500      Beta weighting factor
      600.000      Routing timestep
            1      No. of sub-reaches
             .109      6.752      6.752       .000 c.m/s
 17     COMBINE
       2     Junction Node No.
             .109      6.752      6.752      6.752 c.m/s
 14     START
       1     1=Zero; 2=Define
  4     CATCHMENT
       80.000      ID No.ó 99999
       38.600      Area in hectares
```

```
        510.000      Length (PERV) metres
          2.000      Gradient (%)
         43.500      Per cent Impervious
        510.000      Length (IMPERV)
           .000      %Imp. with Zero Dpth
              1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
           .250      Manning "n"
         74.000      SCS Curve No or C
           .100      Ia/S Coefficient
          8.924      Initial Abstraction
              1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
                4.773       .000      6.752      6.752 c.m/s
                 .368       .925       .610      C perv/imperv/total
   15      ADD RUNOFF
                4.773      4.773      6.752      6.752 c.m/s
   27      HYDROGRAPH DISPLAY
         4     is # of Hyeto/Hydrograph chosen
           Volume  =  .1723819E+05 c.m
   35      COMMENT
         3     line(s) of comment
           ***********************************************************
           * FUTURE STORMWATER MANAGEMENT FACILITY 706                 *
           ***********************************************************
   10      POND
        10 Depth - Discharge - Volume sets
           187.500        .000          .0
           187.670       .0140      1300.3
           187.830       .0570      2689.4
           187.960       .0760      3804.3
           188.170        .234      5733.6
           188.330        .334      7388.8
           188.500        .383      9132.6
           188.670        .426     10965.2
           188.830        .637     12886.5
           189.000        .954     14896.4
           Peak Outflow    =      .464 c.m/s
           Maximum Depth   =   188.699 metres
           Maximum Storage =    11313. c.m
                 4.773      4.773       .464      6.752 c.m/s
   17      COMBINE
         2     Junction Node No.
                 4.773      4.773       .464      6.869 c.m/s
   14      START
         1     1=Zero; 2=Define
   18      CONFLUENCE
         2     Junction Node No.
                 4.773      6.869       .464       .000 c.m/s
   27      HYDROGRAPH DISPLAY
         4     is # of Hyeto/Hydrograph chosen
           Volume  =  .1723819E+05 c.m
   20      MANUAL
```

# APPENDIX D

## MIDUSS Output Files - Future Drainage Conditions with SWM

```
     Output File (4.7) SWMNEW.OUT   opened 2014-10-06  16:28
     Units used are defined by G =     9.810
        24   144    10.000       are MAXDT MAXHYD & DTMIN values
     Licensee: UPPER CANADA CONSULTANTS
 35  COMMENT
     3    line(s) of comment
     THE VILLAGE OF EAST FONTHILL, TOWN OF PELHAM
     STORMWATER MANAGEMENT PLAN, OCT 2014
     FUTURE CONDITIONS - WITH STORMWATER MANAGEMENT
 35  COMMENT
     1    line(s) of comment
     25mm - 4HOUR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES
  2  STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   500.000     Coefficient  a
     8.100     Constant  b     (min)
      .810     Exponent  c
      .400     Fraction to peak  r
   240.000     Duration ó  240 min
             22.981 mm     Total depth
  3  IMPERVIOUS
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .015     Manning "n"
    98.000     SCS Curve No or C
      .100     Ia/S Coefficient
      .518     Initial Abstraction
 35  COMMENT
     3    line(s) of comment
     *******************************************
     * OUTLET A                                *
     *******************************************
 14  START
     1    1=Zero; 2=Define
  4  CATCHMENT
    31.000     ID No.ó 99999
     3.530     Area in hectares
   155.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   155.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .241        .000        .000        .000 c.m/s
          .053        .784        .674      C perv/imperv/total
 15  ADD RUNOFF
          .241        .241        .000        .000 c.m/s
 35  COMMENT
     3    line(s) of comment
     *******************************************
     * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)     *
     *******************************************
 12  DIVERT
          9    U/S Node No.ó 99999
      .478     Threshold Discharge
      .574     Max. Outflow reqd.
        Qmax & Vol.Diverted =       .000 c.m/s          .0 c.m
        No flow diverted
          .241        .241        .241        .000 c.m/s
 16  NEXT LINK
          .241        .241        .241        .000 c.m/s
  4  CATCHMENT
    10.000     ID No.ó 99999
     5.910     Area in hectares
   200.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   200.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .399        .241        .241        .000 c.m/s
          .053        .791        .680      C perv/imperv/total
 15  ADD RUNOFF
          .399        .640        .241        .000 c.m/s
  4  CATCHMENT
    20.000     ID No.ó 99999
     6.380     Area in hectares
   205.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   205.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .430        .640        .241        .000 c.m/s
          .053        .791        .680      C perv/imperv/total
 15  ADD RUNOFF
          .430       1.069        .241        .000 c.m/s
 27  HYDROGRAPH DISPLAY
     5    is # of Hyeto/Hydrograph chosen
     Volume  =  .2459709E+04 c.m
  4  CATCHMENT
    30.000     ID No.ó 99999
```

```
    11.250     Area in hectares
   260.000     Length (PERV) metres
     2.000     Gradient (%)
    85.000     Per cent Impervious
   260.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
    11.953     Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .767       1.069        .241        .000 c.m/s
          .053        .791        .680      C perv/imperv/total
 15  ADD RUNOFF
          .767       1.836        .241        .000 c.m/s
 27  HYDROGRAPH DISPLAY
     5    is # of Hyeto/Hydrograph chosen
     Volume  =  .4211089E+04 c.m
 35  COMMENT
     3    line(s) of comment
     *******************************************
     * NORTH VILLAGE OF EAST FONTHILL POND     *
     *******************************************
 10  POND
    10 Depth - Discharge - Volume sets
   186.550        .000          .0
   186.840        .0420       1342.3
   187.150        .0740       3017.2
   187.380        .0910       4375.6
   187.830        .936        7149.5
   188.270       1.161       10115.3
   188.720       1.349       13272.9
   189.160       1.514       16622.5
   189.610       1.797       20163.9
   190.050      11.210       23897.2
     Peak Outflow    =       .079 c.m/s
     Maximum Depth   =    187.217 metres
     Maximum Storage =     3412. c.m
          .767       1.836        .079        .000 c.m/s
 16  NEXT LINK
          .767        .079        .079        .000 c.m/s
 14  START
     1    1=Zero; 2=Define
 35  COMMENT
     3    line(s) of comment
     *******************************************
     * OUTLET B                                *
     *******************************************
  4  CATCHMENT
    40.000     ID No.ó 99999
    35.240     Area in hectares
   485.000     Length (PERV) metres
    15.480     Gradient (%)
    49.400     Per cent Impervious
   485.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         1.395        .000        .079        .000 c.m/s
          .083        .787        .431      C perv/imperv/total
 15  ADD RUNOFF
         1.395       1.395        .079        .000 c.m/s
 11  CHANNEL
     2.000     Base Width      =
     3.000     Left  bank slope  1:
     3.000     Right bank slope  1:
      .040     Manning's "n"
     1.500     O/a Depth in metres
      .900     Select Grade in %
     Depth           =       .414 metres
     Velocity        =      1.040 m/sec
     Flow Capacity   =     20.730 c.m/s
     Critical depth  =       .312 metres
  9  ROUTE
   393.000     Conduit Length
      .470     Supply X-factor <.5
   283.376     Supply K-lag (sec)
      .500     Beta weighting factor
   300.000     Routing timestep
          1    No. of sub-reaches
         1.395       1.395       1.212        .000 c.m/s
 16  NEXT LINK
         1.395       1.212       1.212        .000 c.m/s
  4  CATCHMENT
    60.000     ID No.ó 99999
     2.430     Area in hectares
   125.000     Length (PERV) metres
     2.000     Gradient (%)
      .000     Per cent Impervious
   125.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
          1    Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
          1    Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
          .003       1.212       1.212        .000 c.m/s
          .083        .000        .083      C perv/imperv/total
 15  ADD RUNOFF
          .003       1.212       1.212        .000 c.m/s
```

```
  9     ROUTE
     452.000      Conduit Length
        .475      Supply X-factor <.5
     339.120      Supply K-lag (sec)
        .500      Beta weighting factor
     300.000      Routing timestep
           1      No. of sub-reaches
            .003      1.212       1.141       .000 c.m/s
 17     COMBINE
       1     Junction Node No.
            .003      1.212       1.141      1.141 c.m/s
 14     START
       1     1=Zero; 2=Define
 22     FILE HYDROGRAPH
       1     1=READ: 2=WRITE
      12     DIV00009.25M          is Filename
       2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
            .003       .000       1.141      1.141 c.m/s
  4     CATCHMENT
      50.000      ID No.ó 99999
      10.320      Area in hectares
     260.000      Length (PERV) metres
       2.000      Gradient (%)
      85.000      Per cent Impervious
     260.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            .703       .000       1.141      1.141 c.m/s
            .083       .791        .685     C perv/imperv/total
 15     ADD RUNOFF
            .703       .703       1.141      1.141 c.m/s
 27     HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .1623832E+04 c.m
 35     COMMENT
       3     line(s) of comment
        *************************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND              *
        *************************************************************
 10     POND
     10 Depth - Discharge - Volume sets
       189.900        .000         .0
       190.070      .01000        384.8
       190.230       .0180        795.9
       190.680       .0290       2027.4
       190.700       .0330       2087.0
       190.730       .0430       2187.1
       190.900        .267       2703.4
       191.070        .426       3246.0
       191.230        .466       3814.9
       192.400       1.132       8533.8
       Peak Outflow    =       .023 c.m/s
       Maximum Depth   =    190.438 metres
       Maximum Storage =      1365. c.m
            .703       .703        .023      1.141 c.m/s
 17     COMBINE
       1     Junction Node No.
            .703       .703        .023      1.159 c.m/s
 14     START
       1     1=Zero; 2=Define
 18     CONFLUENCE
       1     Junction Node No.
            .703      1.159        .023       .000 c.m/s
  4     CATCHMENT
      70.000      ID No.ó 99999
       2.340      Area in hectares
     120.000      Length (PERV) metres
       2.000      Gradient (%)
        .000      Per cent Impervious
     120.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            .003      1.159        .023       .000 c.m/s
            .083       .000        .083     C perv/imperv/total
 15     ADD RUNOFF
            .003      1.159        .023       .000 c.m/s
  9     ROUTE
        .000      Conduit Length
        .475      No Conduit defined
     339.120      Zero lag
        .500      Beta weighting factor
     300.000      Routing timestep
           1      No. of sub-reaches
            .003      1.159       1.159       .000 c.m/s
 17     COMBINE
       2     Junction Node No.
            .003      1.159       1.159      1.159 c.m/s
 14     START
       1     1=Zero; 2=Define
  4     CATCHMENT
      80.000      ID No.ó 99999
      38.600      Area in hectares
     510.000      Length (PERV) metres
       2.000      Gradient (%)
      43.500      Per cent Impervious
     510.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
           1.077       .000       1.159      1.159 c.m/s
            .083       .792        .392     C perv/imperv/total
 15     ADD RUNOFF
           1.077      1.077       1.159      1.159 c.m/s
 27     HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .3466319E+04 c.m
 35     COMMENT
       3     line(s) of comment
        *************************************************************
        * FUTURE STORMWATER MANAGEMENT FACILITY 706                 *
        *************************************************************
 10     POND
     10 Depth - Discharge - Volume sets
       187.500        .000         .0
       187.670       .0140       1300.3
       187.830       .0570       2689.4
       187.960       .0760       3804.3
       188.170        .234       5733.6
       188.330        .334       7388.8
       188.500        .383       9132.6
       188.670        .426      10965.2
       188.830        .637      12886.5
       189.000        .954      14896.4
       Peak Outflow    =       .054 c.m/s
       Maximum Depth   =    187.820 metres
       Maximum Storage =      2599. c.m
           1.077      1.077        .054      1.159 c.m/s
 17     COMBINE
       2     Junction Node No.
           1.077      1.077        .054      1.172 c.m/s
 14     START
       1     1=Zero; 2=Define
 18     CONFLUENCE
       2     Junction Node No.
           1.077      1.172        .054       .000 c.m/s
 27     HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .3466319E+04 c.m
 14     START
       1     1=Zero; 2=Define
 35     COMMENT
       3     line(s) of comment
        ************************************************************
        * 5 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
        ************************************************************
  2     STORM
           1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     830.000      Coefficient  a
       7.300      Constant  b    (min)
        .777      Exponent  c
        .400      Fraction to peak  r
     240.000      Duration ó  240 min
              45.876 mm     Total depth
  3     IMPERVIOUS
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015      Manning "n"
      98.000      SCS Curve No or C
        .100      Ia/S Coefficient
        .518      Initial Abstraction
 35     COMMENT
       3     line(s) of comment
        ******************************************
        * OUTLET A                               *
        ******************************************
 14     START
       1     1=Zero; 2=Define
  4     CATCHMENT
      31.000      ID No.ó 99999
       3.530      Area in hectares
     155.000      Length (PERV) metres
       2.000      Gradient (%)
      85.000      Per cent Impervious
     155.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
      11.953      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            .478       .000        .054       .000 c.m/s
            .204       .873        .773     C perv/imperv/total
 15     ADD RUNOFF
            .478       .478        .054       .000 c.m/s
 35     COMMENT
       3     line(s) of comment
        ******************************************
        * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)    *
        ******************************************
 12     DIVERT
           9      U/S Node No.ó 99999
        .478      Threshold Discharge
        .574      Max. Outflow reqd.
           Qmax & Vol.Diverted =       .000 c.m/s          .0 c.m
           No flow diverted
            .478       .478        .478       .000 c.m/s
 16     NEXT LINK
            .478       .478        .478       .000 c.m/s
  4     CATCHMENT
      10.000      ID No.ó 99999
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        5.910      Area in hectares
      200.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      200.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
       11.953      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .829         .478        .478        .000 c.m/s
             .204         .864        .765       C perv/imperv/total
  15    ADD RUNOFF
             .829        1.306        .478        .000 c.m/s
   4    CATCHMENT
       20.000      ID No.ó 99999
        6.380      Area in hectares
      205.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      205.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
       11.953      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .897        1.306        .478        .000 c.m/s
             .204         .866        .767       C perv/imperv/total
  15    ADD RUNOFF
             .897        2.203        .478        .000 c.m/s
  27    HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .5569779E+04 c.m
   4    CATCHMENT
       30.000      ID No.ó 99999
       11.250      Area in hectares
      260.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      260.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
       11.953      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            1.613        2.203        .478        .000 c.m/s
             .204         .876        .775       C perv/imperv/total
  15    ADD RUNOFF
            1.613        3.815        .478        .000 c.m/s
  27    HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
        Volume  =  .9569145E+04 c.m
  35    COMMENT
        3     line(s) of comment
        ***********************************************
        * NORTH VILLAGE OF EAST FONTHILL POND         *
        ***********************************************
  10    POND
      10 Depth - Discharge - Volume sets
        186.550        .000           .0
        186.840       .0420        1342.3
        187.150       .0740        3017.2
        187.380       .0910        4375.6
        187.830        .936        7149.5
        188.270       1.161       10115.3
        188.720       1.349       13272.9
        189.160       1.514       16622.5
        189.610       1.797       20163.9
        190.050      11.210       23897.2
        Peak Outflow    =        .602 c.m/s
        Maximum Depth   =     187.652 metres
        Maximum Storage =       6053. c.m
            1.613        3.815        .602        .000 c.m/s
  16    NEXT LINK
            1.613         .602        .602        .000 c.m/s
  14    START
        1     1=Zero; 2=Define
  35    COMMENT
        3     line(s) of comment
        ***********************************************
        * OUTLET B                                    *
        ***********************************************
   4    CATCHMENT
       40.000      ID No.ó 99999
       35.240      Area in hectares
      485.000      Length (PERV) metres
       15.480      Gradient (%)
       49.400      Per cent Impervious
      485.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            2.869         .000        .602        .000 c.m/s
             .236         .869        .548       C perv/imperv/total
  15    ADD RUNOFF
            2.869        2.869        .602        .000 c.m/s
  11    CHANNEL
        2.000      Base Width      =
        3.000      Left  bank slope  1:
        3.000      Right bank slope  1:
         .040      Manning's "n"
        1.500      O/a Depth in metres
         .900      Select Grade in %
        Depth          =       .596 metres
        Velocity       =      1.269 m/sec
        Flow Capacity  =     20.730 c.m/s
        Critical depth =       .468 metres
   9    ROUTE
      393.000      Conduit Length
         .458      Supply X-factor <.5
      232.207      Supply K-lag (sec)
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
            2.869        2.869       2.802        .000 c.m/s
  16    NEXT LINK
            2.869        2.802       2.802        .000 c.m/s
   4    CATCHMENT
       60.000      ID No.ó 99999
        2.430      Area in hectares
      125.000      Length (PERV) metres
        2.000      Gradient (%)
         .000      Per cent Impervious
      125.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
             .035        2.802       2.802        .000 c.m/s
             .236         .000        .236       C perv/imperv/total
  15    ADD RUNOFF
             .035        2.813       2.802        .000 c.m/s
   9    ROUTE
      452.000      Conduit Length
         .464      Supply X-factor <.5
      268.490      Supply K-lag (sec)
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
             .035        2.813       2.413        .000 c.m/s
  17    COMBINE
        1     Junction Node No.
             .035        2.813       2.413       2.413 c.m/s
  14    START
        1     1=Zero; 2=Define
  22    FILE HYDROGRAPH
        1     1=READ: 2=WRITE
       12     DIV00009.5YR          is Filename
        2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
             .035         .000       2.413       2.413 c.m/s
   4    CATCHMENT
       50.000      ID No.ó 99999
       10.320      Area in hectares
      260.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      260.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
            1.480         .000       2.413       2.413 c.m/s
             .236         .876        .780       C perv/imperv/total
  15    ADD RUNOFF
            1.480        1.480       2.413       2.413 c.m/s
  27    HYDROGRAPH DISPLAY
        4     is # of Hyeto/Hydrograph chosen
        Volume  =  .3691582E+04 c.m
  35    COMMENT
        3     line(s) of comment
        ************************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND             *
        ************************************************************
  10    POND
      10 Depth - Discharge - Volume sets
        189.900        .000           .0
        190.070      .01000         384.8
        190.230       .0180         795.9
        190.680       .0290        2027.4
        190.700       .0330        2087.0
        190.730       .0430        2187.1
        190.900        .267        2703.4
        191.070        .426        3246.0
        191.230        .466        3814.9
        192.400       1.132        8533.8
        Peak Outflow    =        .187 c.m/s
        Maximum Depth   =     190.840 metres
        Maximum Storage =       2520. c.m
            1.480        1.480        .187       2.413 c.m/s
  17    COMBINE
        1     Junction Node No.
            1.480        1.480        .187       2.437 c.m/s
  14    START
        1     1=Zero; 2=Define
  18    CONFLUENCE
        1     Junction Node No.
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        1.480       2.437        .187        .000 c.m/s
  4    CATCHMENT
     70.000     ID No.ó 99999
      2.340     Area in hectares
    120.000     Length (PERV) metres
      2.000     Gradient (%)
       .000     Per cent Impervious
    120.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         .034       2.437        .187        .000 c.m/s
         .236        .000        .236       C perv/imperv/total
 15    ADD RUNOFF
         .034       2.448        .187        .000 c.m/s
  9    ROUTE
       .000     Conduit Length
       .464     No Conduit defined
    268.490     Zero lag
       .500     Beta weighting factor
    200.000     Routing timestep
          1     No. of sub-reaches
         .034       2.448       2.448        .000 c.m/s
 17    COMBINE
     2     Junction Node No.
         .034       2.448       2.448       2.448 c.m/s
 14    START
     1     1=Zero; 2=Define
  4    CATCHMENT
     80.000     ID No.ó 99999
     38.600     Area in hectares
    510.000     Length (PERV) metres
      2.000     Gradient (%)
     43.500     Per cent Impervious
    510.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        2.876        .000       2.448       2.448 c.m/s
         .236        .877        .515       C perv/imperv/total
 15    ADD RUNOFF
        2.876       2.876       2.448       2.448 c.m/s
 27    HYDROGRAPH DISPLAY
     4     is # of Hyeto/Hydrograph chosen
     Volume  =  .9116987E+04 c.m
 35    COMMENT
     3     line(s) of comment
       ************************************************************
       * FUTURE STORMWATER MANAGEMENT FACILITY 706                 *
       ************************************************************
 10    POND
    10 Depth - Discharge - Volume sets
     187.500        .000         .0
     187.670       .0140       1300.3
     187.830       .0570       2689.4
     187.960       .0760       3804.3
     188.170        .234       5733.6
     188.330        .334       7388.8
     188.500        .383       9132.6
     188.670        .426      10965.2
     188.830        .637      12886.5
     189.000        .954      14896.4
     Peak Outflow    =       .247 c.m/s
     Maximum Depth   =    188.191 metres
     Maximum Storage =      5955. c.m
        2.876       2.876        .247       2.448 c.m/s
 17    COMBINE
     2     Junction Node No.
        2.876       2.876        .247       2.487 c.m/s
 14    START
     1     1=Zero; 2=Define
 18    CONFLUENCE
     2     Junction Node No.
        2.876       2.487        .247        .000 c.m/s
 27    HYDROGRAPH DISPLAY
     4     is # of Hyeto/Hydrograph chosen
     Volume  =  .9116987E+04 c.m
 14    START
     1     1=Zero; 2=Define
 35    COMMENT
     3     line(s) of comment
       ************************************************************
       * 100 YEAR DESIGN STORM EVENT - CITY OF WELLAND IDF VALUES *
       ************************************************************
  2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   1020.000     Coefficient  a
      4.700     Constant  b    (min)
       .731     Exponent  c
       .400     Fraction to peak  r
    240.000     Duration ó  240 min
          73.207 mm     Total depth
  3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
 35    COMMENT
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     3     line(s) of comment
       ******************************************
       * OUTLET A                               *
       ******************************************
 14    START
     1     1=Zero; 2=Define
  4    CATCHMENT
     31.000     ID No.ó 99999
      3.530     Area in hectares
    155.000     Length (PERV) metres
      2.000     Gradient (%)
     85.000     Per cent Impervious
    155.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
     11.953     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
         .826        .000        .247        .000 c.m/s
         .340        .916        .830       C perv/imperv/total
 15    ADD RUNOFF
         .826        .826        .247        .000 c.m/s
 35    COMMENT
     3     line(s) of comment
       ******************************************
       * DIVERT 5-YR PEAK FLOW (MAJOR/MINOR)    *
       ******************************************
 12    DIVERT
          9     U/S Node No.ó 99999
       .478     Threshold Discharge
       .574     Max. Outflow reqd.
        Qmax & Vol.Diverted =       .252 c.m/s       254.0 c.m
        No flow diverted
         .826        .826        .574        .000 c.m/s
 16    NEXT LINK
         .826        .574        .574        .000 c.m/s
  4    CATCHMENT
     10.000     ID No.ó 99999
      5.910     Area in hectares
    200.000     Length (PERV) metres
      2.000     Gradient (%)
     85.000     Per cent Impervious
    200.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
     11.953     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        1.311        .574        .574        .000 c.m/s
         .340        .914        .828       C perv/imperv/total
 15    ADD RUNOFF
        1.311       1.885        .574        .000 c.m/s
  4    CATCHMENT
     20.000     ID No.ó 99999
      6.380     Area in hectares
    205.000     Length (PERV) metres
      2.000     Gradient (%)
     85.000     Per cent Impervious
    205.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
     11.953     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        1.407       1.885        .574        .000 c.m/s
         .340        .913        .827       C perv/imperv/total
 15    ADD RUNOFF
        1.407       3.292        .574        .000 c.m/s
 27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
     Volume  =  .9333898E+04 c.m
  4    CATCHMENT
     30.000     ID No.ó 99999
     11.250     Area in hectares
    260.000     Length (PERV) metres
      2.000     Gradient (%)
     85.000     Per cent Impervious
    260.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
     11.953     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
        2.487       3.292        .574        .000 c.m/s
         .341        .904        .820       C perv/imperv/total
 15    ADD RUNOFF
        2.487       5.644        .574        .000 c.m/s
 27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
     Volume  =  .1608601E+05 c.m
 35    COMMENT
     3     line(s) of comment
       ******************************************
       * NORTH VILLAGE OF EAST FONTHILL POND    *
       ******************************************
 10    POND
    10 Depth - Discharge - Volume sets
```

```
        186.550        .000          .0
        186.840       .0420      1342.3
        187.150       .0740      3017.2
        187.380       .0910      4375.6
        187.830        .936      7149.5
        188.270       1.161     10115.3
        188.720       1.349     13272.9
        189.160       1.514     16622.5
        189.610       1.797     20163.9
        190.050      11.210     23897.2
        Peak Outflow     =      1.089 c.m/s
        Maximum Depth    =    188.130 metres
        Maximum Storage =      9171. c.m
              2.487       5.644       1.089       .000 c.m/s
  16    NEXT LINK
              2.487       1.089       1.089       .000 c.m/s
  14    START
       1     1=Zero; 2=Define
  35    COMMENT
       3     line(s) of comment
        ********************************************
        * OUTLET B                                 *
        ********************************************
   4    CATCHMENT
       40.000      ID No.ó 99999
       35.240      Area in hectares
      485.000      Length (PERV) metres
       15.480      Gradient (%)
       49.400      Per cent Impervious
      485.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              4.772        .000       1.089       .000 c.m/s
               .367        .915        .638     C perv/imperv/total
  15    ADD RUNOFF
              4.772       4.772       1.089       .000 c.m/s
  11    CHANNEL
        2.000      Base Width     =
        3.000      Left  bank slope  1:
        3.000      Right bank slope  1:
         .040      Manning's "n"
        1.500      O/a Depth in metres
         .900      Select Grade in %
        Depth          =       .764 metres
        Velocity       =      1.454 m/sec
        Flow Capacity  =     20.730 c.m/s
        Critical depth =       .615 metres
   9    ROUTE
      393.000      Conduit Length
         .448      Supply X-factor <.5
      202.682      Supply K-lag (sec)
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
              4.772       4.772       4.594       .000 c.m/s
  16    NEXT LINK
              4.772       4.594       4.594       .000 c.m/s
   4    CATCHMENT
       60.000      ID No.ó 99999
        2.430      Area in hectares
      125.000      Length (PERV) metres
        2.000      Gradient (%)
         .000      Per cent Impervious
      125.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               .113       4.594       4.594       .000 c.m/s
               .367        .000        .367     C perv/imperv/total
  15    ADD RUNOFF
               .113       4.654       4.594       .000 c.m/s
   9    ROUTE
      452.000      Conduit Length
         .455      Supply X-factor <.5
      234.662      Supply K-lag (sec)
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
               .113       4.654       4.238       .000 c.m/s
  17    COMBINE
       1     Junction Node No.
               .113       4.654       4.238      4.238 c.m/s
  14    START
       1     1=Zero; 2=Define
  22    FILE HYDROGRAPH
       1     1=READ: 2=WRITE
      12     DIV00009.100          is Filename
       2     1=Overland: 2=Inflow: 3=Outflow: 4=Temp'ary
               .113        .252       4.238      4.238 c.m/s
   4    CATCHMENT
       50.000      ID No.ó 99999
       10.320      Area in hectares
      260.000      Length (PERV) metres
        2.000      Gradient (%)
       85.000      Per cent Impervious
      260.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
```

```
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              2.284        .252       4.238      4.238 c.m/s
               .367        .904        .824     C perv/imperv/total
  15    ADD RUNOFF
              2.284       2.455       4.238      4.238 c.m/s
  27    HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .6224218E+04 c.m
  35    COMMENT
       3     line(s) of comment
        ***********************************************************
        * PROPOSED SOUTH VILLAGE OF EAST FONTHILL POND            *
        ***********************************************************
  10    POND
      10 Depth - Discharge - Volume sets
        189.900        .000          .0
        190.070      .01000       384.8
        190.230       .0180       795.9
        190.680       .0290      2027.4
        190.700       .0330      2087.0
        190.730       .0430      2187.1
        190.900        .267      2703.4
        191.070        .426      3246.0
        191.230        .466      3814.9
        192.400       1.132      8533.8
        Peak Outflow     =       .460 c.m/s
        Maximum Depth    =    191.207 metres
        Maximum Storage =      3734. c.m
              2.284       2.455        .460      4.238 c.m/s
  17    COMBINE
       1     Junction Node No.
              2.284       2.455        .460      4.537 c.m/s
  14    START
       1     1=Zero; 2=Define
  18    CONFLUENCE
       1     Junction Node No.
              2.284       4.537        .460       .000 c.m/s
   4    CATCHMENT
       70.000      ID No.ó 99999
        2.340      Area in hectares
      120.000      Length (PERV) metres
        2.000      Gradient (%)
         .000      Per cent Impervious
      120.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
               .109       4.537        .460       .000 c.m/s
               .368        .000        .368     C perv/imperv/total
  15    ADD RUNOFF
               .109       4.596        .460       .000 c.m/s
   9    ROUTE
         .000      Conduit Length
         .455      No Conduit defined
      234.662      Zero lag
         .500      Beta weighting factor
      200.000      Routing timestep
            1      No. of sub-reaches
               .109       4.596       4.596       .000 c.m/s
  17    COMBINE
       2     Junction Node No.
               .109       4.596       4.596      4.596 c.m/s
  14    START
       1     1=Zero; 2=Define
   4    CATCHMENT
       80.000      ID No.ó 99999
       38.600      Area in hectares
      510.000      Length (PERV) metres
        2.000      Gradient (%)
       43.500      Per cent Impervious
      510.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin.
Reserv
              4.773        .000       4.596      4.596 c.m/s
               .368        .925        .610     C perv/imperv/total
  15    ADD RUNOFF
              4.773       4.773       4.596      4.596 c.m/s
  27    HYDROGRAPH DISPLAY
       4     is # of Hyeto/Hydrograph chosen
        Volume  =  .1723819E+05 c.m
  35    COMMENT
       3     line(s) of comment
        ***********************************************************
        * FUTURE STORMWATER MANAGEMENT FACILITY 706               *
        ***********************************************************
  10    POND
      10 Depth - Discharge - Volume sets
        187.500        .000          .0
        187.670       .0140      1300.3
        187.830       .0570      2689.4
        187.960       .0760      3804.3
        188.170        .234      5733.6
        188.330        .334      7388.8
```

```
        188.500          .383        9132.6
        188.670          .426       10965.2
        188.830          .637       12886.5
        189.000          .954       14896.4
        Peak Outflow     =         .464 c.m/s
        Maximum Depth    =    188.699 metres
        Maximum Storage =     11313. c.m
              4.773        4.773          .464        4.596 c.m/s
 17     COMBINE
       2      Junction Node No.
              4.773        4.773          .464        4.713 c.m/s
```

```
 14     START
       1      1=Zero; 2=Define
 18     CONFLUENCE
       2      Junction Node No.
              4.773        4.713          .464         .000 c.m/s
 27     HYDROGRAPH DISPLAY
       4      is # of Hyeto/Hydrograph chosen
        Volume  =  .1723819E+05 c.m
 14     START
       1      1=Zero; 2=Define
 20     MANUAL
```

# APPENDIX E

## Detailed Channel Design Calculations

## NATURAL CHANNEL DESIGN

Upper Canada Consultants
1-261 Martindale Road
St. Catharines, ON L2W 1A1

| | | | |
|---|---|---|---|
| Project : | Saffron Meadows, Town of Pelham | Design: | Adam Keane, P.Eng. |
| Project No : | 0478 | Reviewed: | Jason Schooley, P.Eng. |
| Watercourse: | Tributary of Singer's Drain | Date: | July 3, 2014 |

| | | | |
|---|---|---|---|
| Upstream Elevation: | 187.60 | Strait Block Length (m): | 165.0 m |
| Downstream Elevation: | 187.38 | Thoretical Strait Slope (%): | 0.13% |
| Fall (m): | 0.22 | Meander Length (m): | 191.0 m |
| | | Meander Slope (%): | 0.12% |
| Block Width (m): | 33 | Mean Meander Wavelength (m): | 96.7 *(C.W.Carlston, 1965)* |
| | | Curvature of Meander Radius (±15%) (m): | 27.2 to 36.9 *(B.P.Leopold, 1957)* |

## STORM FLOWS (Leave Blank If Not Known)

| | | | |
|---|---|---|---|
| $Q_{100}$ = | **5.550** | $m^3/s$ | (Flood Full Storm Event) |
| $Q_{25}$ = | 3.987 | $m^3/s$ | |
| $Q_{10}$ = | 3.151 | $m^3/s$ | |
| $Q_5$ = | ***2.780*** | $m^3/s$ | |
| $Q_2$ = | 2.084 | $m^3/s$ | (Bank Full Storm Event) |
| $Q_{25mm}$ = | ***1.260*** | $m^3/s$ | |

**NOTE:** Minor storm events determined from standard curve fitting to *EPA Normalized Type Storm Distribution*.

## CHANNEL GEOMETRY

Soil Type: *Sandy Loam* Maximum Stable Slope: 32°
Bottom Width = 2.00 Substrate : *Gravel beds, straight*
Side Slopes (H:V) = 3.0 (18.4°) Manning's n: 0.025 Safety Factor: 5.0

| | Height (m) | Top Width (m) | Flow Area ($m^2$) | $R_{(hydraulic)}$ | Flow ($m^3/s$) | Velocity (m/s) | Shear Stress ($N/m^2$) Strait | Shear Stress ($N/m^2$) Bend | Stable $D_{50}$ (mm) |
|---|---|---|---|---|---|---|---|---|---|
| $Depth_{100}$ = | 0.852 | 7.111 | 4.259 | 0.517 | 5.550 | **1.30** | 7.2 | 8.7 | 79.1 |
| $Depth_{25}$ = | 0.696 | 6.175 | 3.479 | 0.426 | 3.987 | **1.15** | 5.9 | 7.1 | 64.7 |
| $Depth_{10}$ = | 0.603 | 5.618 | 3.015 | 0.371 | 3.151 | **1.04** | 5.1 | 6.1 | 56.0 |
| $Depth_5$ = | 0.559 | 5.354 | 2.795 | 0.345 | 2.780 | **0.99** | 4.7 | 5.7 | 51.9 |
| $Depth_2$ = | 0.469 | 4.817 | 2.347 | 0.291 | 2.084 | **0.89** | 4.0 | 4.8 | 43.4 |
| $Depth_{25mm}$ = | 0.347 | 4.079 | 1.733 | 0.216 | 1.260 | **0.73** | 2.9 | 3.5 | 31.8 |

Calculate Flow Values

## ROSGEN CLASSIFICATION OF NATURAL RIVERS

| | | |
|---|---|---|
| MEANDER RATIO : | 1.2 | *: MODERATE SINUOSITY* |
| WIDTH / DEPTH RATIO : | 10.3 | *: LOW WIDTH / DEPTH RATIO* |
| ENTRENCHMENT RATIO : | 1.5 | *: MODERATELY ENTRENCHED* |

STREAM TYPE :

*B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.*

## NATURAL CHANNEL DESIGN

Upper Canada Consultants
1-261 Martindale Road
St. Catharines, ON L2W 1A1

| | | | |
|---|---|---|---|
| Project : | Allen Property, Fonthill, ON | Design: | Adam Keane, P.Eng. |
| Project No : | 0473 | Reviewed: | Jason Schooley, P.Eng. |
| Watercourse: | Unknown | Date: | July 3, 2014 |

| | | | |
|---|---|---|---|
| Upstream Elevation: | 189.33 | Strait Block Length (m): | 220.0 m |
| Downstream Elevation: | 188.90 | Thoretical Strait Slope (%): | 0.20% |
| Fall (m): | 0.43 | Meander Length (m): | 230.0 m |
| | | Meander Slope (%): | 0.19% |
| Block Width (m): | 33 | Mean Meander Wavelength (m): | 95.1 *(C.W.Carlston, 1965)* |
| | | Curvature of Meander Radius (±15%) (m): | 26.6 to 36.1 *(B.P.Leopold, 1957)* |

## STORM FLOWS (Leave Blank If Not Known)

| | | | |
|---|---|---|---|
| $Q_{100}$ = | **4.938** | $m^3/s$ | (Flood Full Storm Event) |
| $Q_{25}$ = | 3.685 | $m^3/s$ | |
| $Q_{10}$ = | 2.950 | $m^3/s$ | |
| $Q_5$ = | ***2.730*** | $m^3/s$ | |
| $Q_2$ = | 1.996 | $m^3/s$ | (Bank Full Storm Event) |
| $Q_{25mm}$ = | ***1.214*** | $m^3/s$ | |

**NOTE:** Minor storm events determined from standard curve fitting to *EPA Normalized Type Storm Distribution*.

## CHANNEL GEOMETRY

Soil Type: *Sandy Loam* Maximum Stable Slope: 32°

Bottom Width = 1.50 Substrate : *Gravel beds, straight*

Side Slopes (H:V) = 4.0 (14°) Manning's n: 0.025 Safety Factor: 5.0

| | Height (m) | Top Width (m) | Flow Area ($m^2$) | $R_{(hydraulic)}$ | Flow ($m^3/s$) | Velocity (m/s) | Shear Stress Strait ($N/m^2$) | Shear Stress Bend ($N/m^2$) | Stable $D_{50}$ (mm) |
|---|---|---|---|---|---|---|---|---|---|
| $Depth_{100}$ = | 0.664 | 6.812 | 3.652 | 0.380 | 4.937 | **1.35** | 9.1 | 11.0 | 57.4 |
| $Depth_{25}$ = | 0.556 | 5.950 | 3.059 | 0.319 | 3.684 | **1.20** | 7.7 | 9.2 | 47.9 |
| $Depth_{10}$ = | 0.486 | 5.391 | 2.675 | 0.280 | 2.949 | **1.10** | 6.7 | 8.0 | 41.7 |
| $Depth_5$ = | 0.464 | 5.214 | 2.553 | 0.267 | 2.730 | **1.07** | 6.4 | 7.7 | 39.8 |
| $Depth_2$ = | 0.384 | 4.575 | 2.114 | 0.222 | 1.995 | **0.94** | 5.3 | 6.3 | 32.7 |
| Depth = | 0.285 | 3.780 | 1.568 | 0.165 | 1.214 | **0.77** | 3.9 | 4.7 | 24.0 |

Calculate Flow Values

## ROSGEN CLASSIFICATION OF NATURAL RIVERS

| | | |
|---|---|---|
| MEANDER RATIO : | 1.1 | *: LOW SINUOSITY* |
| WIDTH / DEPTH RATIO : | 11.9 | *: LOW WIDTH / DEPTH RATIO* |
| ENTRENCHMENT RATIO : | 1.5 | *: MODERATELY ENTRENCHED* |

STREAM TYPE :

*B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.*

## NATURAL CHANNEL DESIGN

Upper Canada Consultants
1-261 Martindale Road
St. Catharines, ON L2W 1A1

| | | | |
|---|---|---|---|
| Project : | Allen Property, Fonthill, ON | Design: | Adam Keane, P.Eng. |
| Project No : | 0473 | Reviewed: | Jason Schooley, P.Eng. |
| Watercourse: | Unknown | Date: | July 3, 2014 |

| | | | |
|---|---|---|---|
| Upstream Elevation: | 188.90 | Strait Block Length (m): | 49.6 m |
| Downstream Elevation: | 188.50 | Thoretical Strait Slope (%): | 0.81% |
| Fall (m): | 0.40 | Meander Length (m): | 50.9 m |
| | | Meander Slope (%): | 0.79% |
| Block Width (m): | 33 | Mean Meander Wavelength (m): | 95.1 *(C.W.Carlston, 1965)* |
| | | Curvature of Meander Radius (±15%) (m): | 26.6 to 36.1 *(B.P.Leopold, 1957)* |

### STORM FLOWS (Leave Blank If Not Known)

$Q_{100}$ = **4.938** $m^3/s$ (Flood Full Storm Event)
$Q_{25}$ = 3.685 $m^3/s$
$Q_{10}$ = 2.950 $m^3/s$
$Q_5$ = ***2.730*** $m^3/s$
$Q_2$ = 1.996 $m^3/s$ (Bank Full Storm Event)
$Q_{25mm}$ = ***1.214*** $m^3/s$

**NOTE:** Minor storm events determined from standard curve fitting to *EPA Normalized Type Storm Distribution*.

### CHANNEL GEOMETRY

Soil Type: *Sandy Loam* Maximum Stable Slope: 32°
Bottom Width = 1.50 Substrate : *Gravel beds, straight*
Side Slopes (H:V) = 3.0 (18.4°) Manning's n: 0.025 Safety Factor: 5.0

| | Height (m) | Top Width (m) | Flow Area ($m^2$) | $R_{(hydraulic)}$ | Flow ($m^3/s$) | Velocity (m/s) | Shear Stress ($N/m^2$) Strait | Shear Stress ($N/m^2$) Bend | Stable $D_{50}$ (mm) |
|---|---|---|---|---|---|---|---|---|---|
| $Depth_{100}$ = | 0.480 | 4.378 | 2.158 | 0.285 | 4.939 | **2.29** | 27.8 | 33.3 | 42.5 |
| $Depth_{25}$ = | 0.402 | 3.911 | 1.808 | 0.239 | 3.685 | **2.04** | 23.3 | 27.9 | 35.5 |
| $Depth_{10}$ = | 0.351 | 3.608 | 1.581 | 0.210 | 2.950 | **1.87** | 20.3 | 24.4 | 30.9 |
| $Depth_5$ = | 0.335 | 3.512 | 1.509 | 0.200 | 2.730 | **1.81** | 19.4 | 23.3 | 29.4 |
| $Depth_2$ = | 0.278 | 3.166 | 1.250 | 0.166 | 1.996 | **1.60** | 16.1 | 19.3 | 24.2 |
| Depth = | 0.206 | 2.736 | 0.927 | 0.123 | 1.214 | **1.31** | 11.9 | 14.3 | 17.8 |

Calculate Flow Values

### ROSGEN CLASSIFICATION OF NATURAL RIVERS

MEANDER RATIO : 1.1 *: LOW SINUOSITY*
WIDTH / DEPTH RATIO : 11.4 *: LOW WIDTH / DEPTH RATIO*
ENTRENCHMENT RATIO : 1.4 *: MODERATELY ENTRENCHED*

STREAM TYPE :

*B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.*

## NATURAL CHANNEL DESIGN

Upper Canada Consultants
1-261 Martindale Road
St. Catharines, ON L2W 1A1

| | | | |
|---|---|---|---|
| Project : | Allen Property, Fonthill, ON | Design: | Adam Keane, P.Eng. |
| Project No : | 0473 | Reviewed: | Jason Schooley, P.Eng. |
| Watercourse: | Unknown | Date: | July 3, 2014 |

| | | | |
|---|---|---|---|
| Upstream Elevation: | 188.25 | Strait Block Length (m): | 57.7 m |
| Downstream Elevation: | 187.20 | Thoretical Strait Slope (%): | 1.82% |
| Fall (m): | 1.05 | Meander Length (m): | 60.5 m |
| | | Meander Slope (%): | 1.73% |
| Block Width (m): | 33 | Mean Meander Wavelength (m): | 95.1 *(C.W.Carlston, 1965)* |
| | | Curvature of Meander Radius (±15%) (m): | 26.6 to 36.1 *(B.P.Leopold, 1957)* |

### STORM FLOWS (Leave Blank If Not Known)

| | | | |
|---|---|---|---|
| $Q_{100}$ = | **4.938** | $m^3/s$ | (Flood Full Storm Event) |
| $Q_{25}$ = | 3.685 | $m^3/s$ | |
| $Q_{10}$ = | 2.950 | $m^3/s$ | |
| $Q_5$ = | ***2.730*** | $m^3/s$ | |
| $Q_2$ = | 1.996 | $m^3/s$ | (Bank Full Storm Event) |
| $Q_{25mm}$ = | ***1.214*** | $m^3/s$ | |

**NOTE:** Minor storm events determined from standard curve fitting to *EPA Normalized Type Storm Distribution*.

### CHANNEL GEOMETRY

Soil Type: *Sandy Loam* — Maximum Stable Slope: 32°
Bottom Width = 1.50 — Substrate : *Gravel beds, straight*
Side Slopes (H:V) = 3.0 (18.4°) — Manning's n: 0.025 — Safety Factor: 5.0

| | Height (m) | Top Width (m) | Flow Area ($m^2$) | $R_{(hydraulic)}$ | Flow ($m^3/s$) | Velocity (m/s) | Shear Stress Strait ($N/m^2$) | Shear Stress Bend ($N/m^2$) | Stable $D_{50}$ (mm) |
|---|---|---|---|---|---|---|---|---|---|
| $Depth_{100}$ = | 0.378 | 3.766 | 1.700 | 0.225 | 4.938 | **2.91** | 48.2 | 57.8 | 33.3 |
| $Depth_{25}$ = | 0.317 | 3.400 | 1.425 | 0.189 | 3.685 | **2.59** | 40.4 | 48.5 | 27.7 |
| $Depth_{10}$ = | 0.277 | 3.162 | 1.246 | 0.166 | 2.950 | **2.37** | 35.3 | 42.4 | 24.1 |
| $Depth_5$ = | 0.264 | 3.086 | 1.189 | 0.158 | 2.730 | **2.30** | 33.7 | 40.5 | 23.0 |
| $Depth_2$ = | 0.219 | 2.814 | 0.985 | 0.131 | 1.996 | **2.03** | 27.9 | 33.5 | 18.9 |
| Depth = | 0.162 | 2.475 | 0.731 | 0.097 | 1.215 | **1.66** | 20.7 | 24.9 | 13.9 |

Calculate Flow Values

### ROSGEN CLASSIFICATION OF NATURAL RIVERS

| | | |
|---|---|---|
| MEANDER RATIO : | 1.1 | *: LOW SINUOSITY* |
| WIDTH / DEPTH RATIO : | 12.9 | *: MODERATE WIDTH / DEPTH RATIO* |
| ENTRENCHMENT RATIO : | 1.3 | *: ENTRENCHED* |

STREAM TYPE :

*B - STABLE Moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools. Very stable plan and profile. Stable banks.*

# APPENDIX F

## Form 22 Output File for 100- Year Culvert Backwater Calculation

**HWY. NO.** ____________
**W.P. NO.** ____________

# CONVENTIONAL CULVERT DESIGN

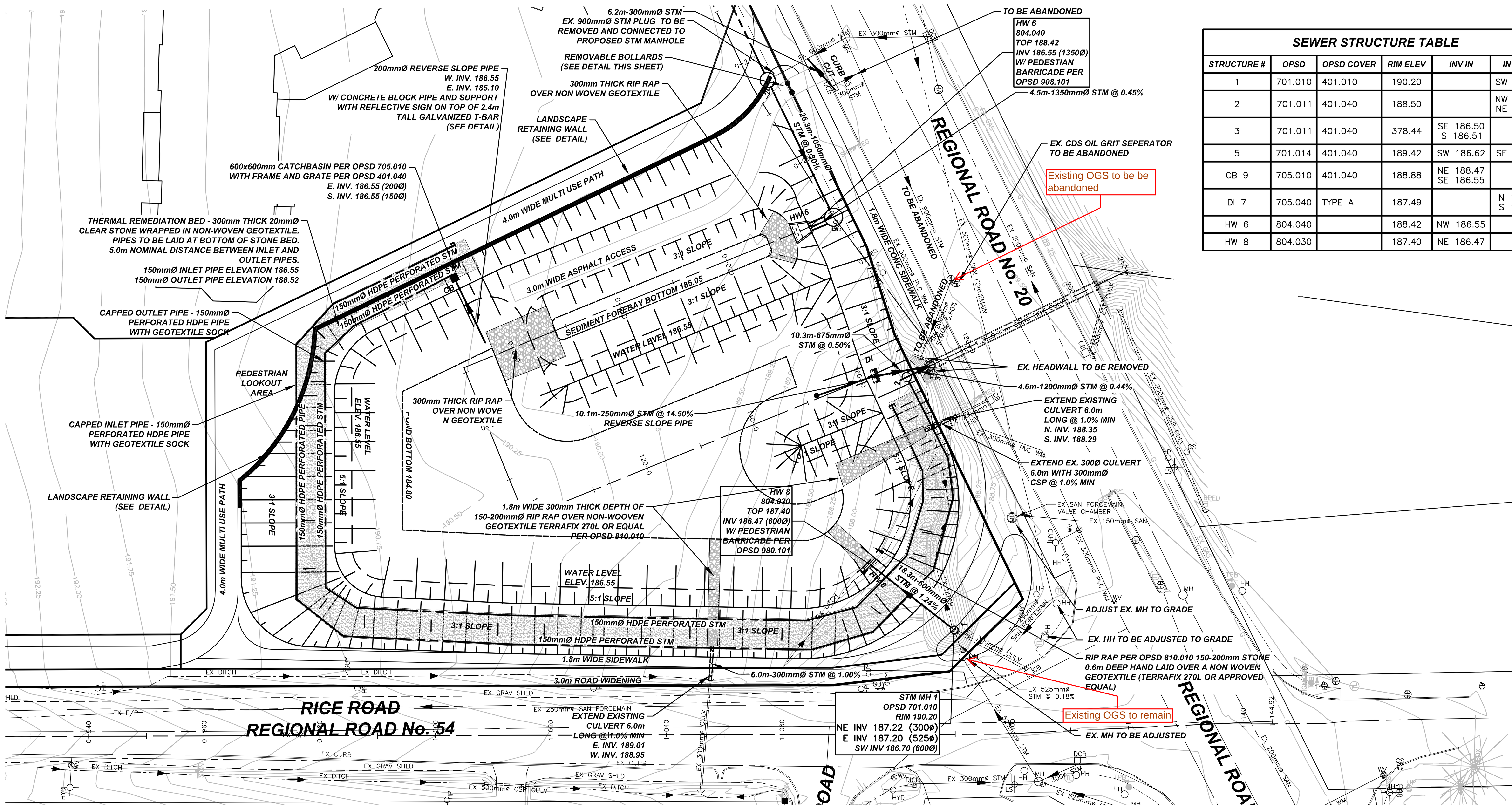
**Prepared By:** A. Keane **Date:** 19-Nov-14
**Checked By:** ____________ **Date:** ____________

| | DESIGN DATA | | | | | | | CULVERT DATA | | | | | INLET CONTROL | | | OUTLET CONTROL | | | | | | | | GOV'N | VEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STA. | Q<br>m3/s | d<br>m | de<br>m | AHW<br>m | Skew No | L<br>m | S<br>m/m | Descrip | D or B x D | N | Q/N<br>m3/s | A (Each)<br>m2 | Q/NB<br>m3/s/m | HW/(Each) | HW<br>m | ke | H<br>m | dc<br>m | dc + D/2<br>m | TW<br>m | ho<br>m | LS<br>m | HW<br>m | HW<br>m | Vo<br>m/s |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Proposed box culvert under Rice Road - 100yr Storm Event* | | | | | | | | | | | | | | | | | | | | | | | | | |
| | *4.950* | *0.378* | *0.00* | *0.38* | | *44.0* | *0.0011* | *1.5x2.4* | *3.600* | *1* | *4.950* | *3.600* | *2.063* | *1.611* | *1.611* | *0.500* | *0.116* | *0.252* | *0.126* | *0.378* | *0.378* | *0.050* | *0.444* | ***1.611*** | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |

2 From form PH-D-533, col 12.
3 Flood Depth - Downstream.
4 Embedment below channel invert.
5 Col. 3 + col. 4 + allowable bkwtr.
7 Allow for skew if applicable.
8 Culvert slope.
10 D (Circular) or B x D (other).
11 No. of barrels.
13 Area per barrel.
14 For box only.
15 Charts D5-1A to C and E to J.
16 HW = col. 15 x D (col. 10).
17 Chart D5-8.
18 Charts D5-2A to G.
19 Charts D6-3A to F:(dc D).
21 Col. 3 + 4.
22 ho = larger of cols. 20 and 21.
23 Col. 7 x 8.
24 HW = col 18 + col. 22 - col. 23.
25 Larger of cols. 16 and 24.
26 Outlet vel. if req'd (Subsec. 3.2.3.1).

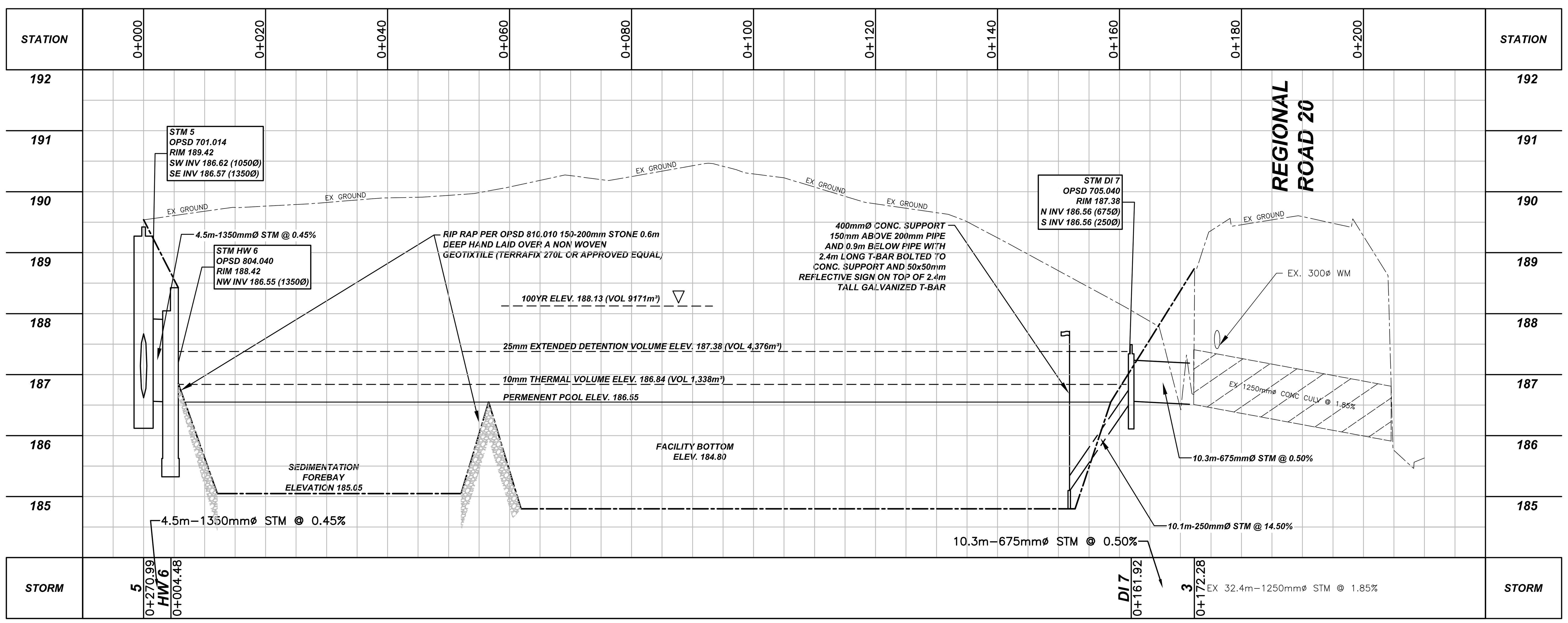
# APPENDIX G

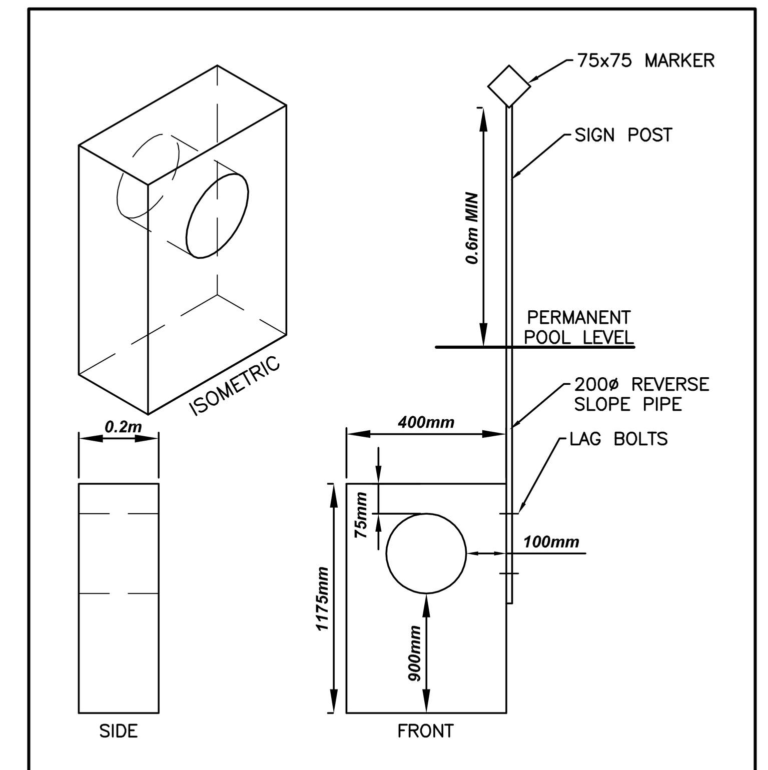
**Drawings**



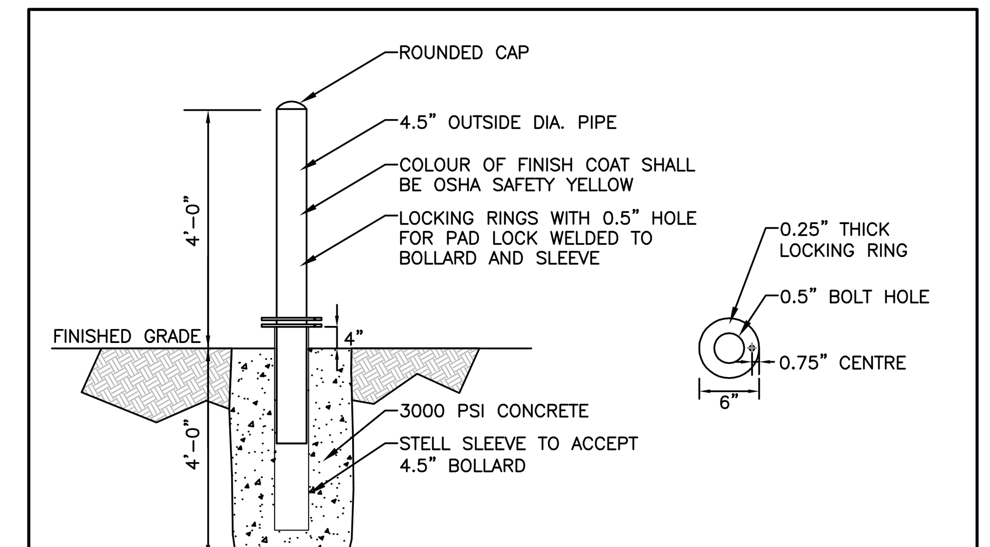

**SEWER STRUCTURE TABLE**

| STRUCTURE # | OPSD | OPSD COVER | RIM ELEV | INV IN | INV OUT |
|---|---|---|---|---|---|
| 1 | 701.010 | 401.010 | 190.20 | | SW 186.70 |
| 2 | 701.011 | 401.040 | 188.50 | | NW 186.52<br>NE 186.52 |
| 3 | 701.011 | 401.040 | 378.44 | SE 186.50<br>S 186.51 | |
| 5 | 701.014 | 401.040 | 189.42 | SW 186.62 | SE 186.57 |
| CB 9 | 705.010 | 401.040 | 188.88 | NE 188.47<br>SE 186.55 | |
| DI 7 | 705.040 | TYPE A | 187.49 | | N 186.56<br>S 186.56 |
| HW 6 | 804.040 | | 188.42 | NW 186.55 | |
| HW 8 | 804.030 | | 187.40 | NE 186.47 | |

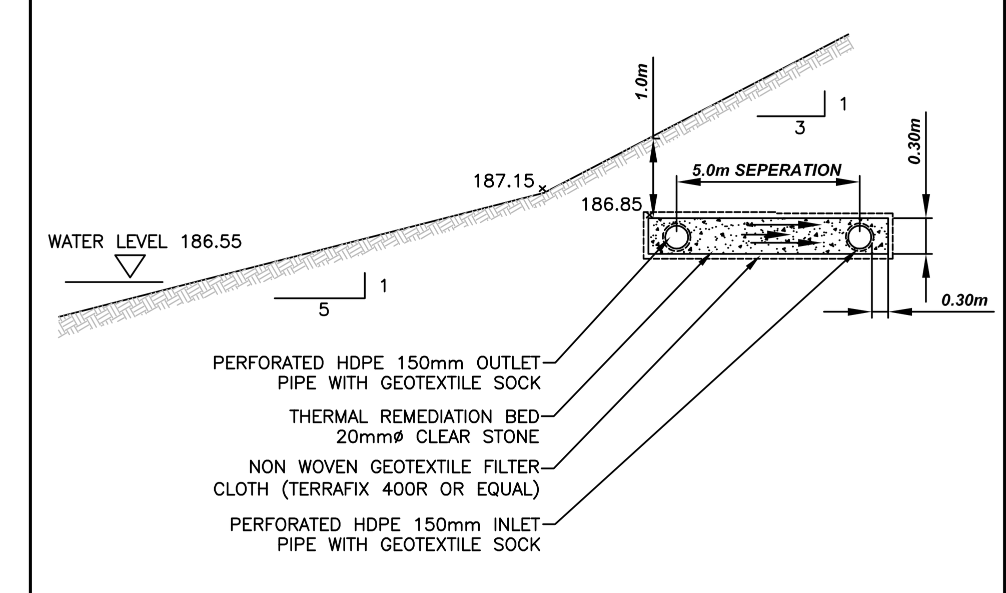



**CONCRETE SUPPORT BLOCK**
N.T.S



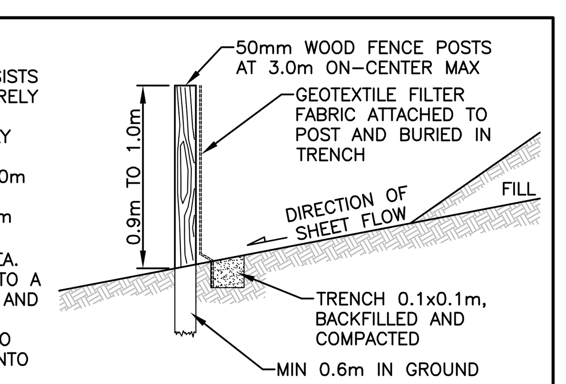

**REMOVEABLE BOLLARD**
N.T.S.




**THERMAL REMEDIATION BED DETAIL**
NTS

**NOTES:**

1. THIS TYPE OF FILTER BARRIER CONSISTS OF GEOTEXTILE FILTER FABRIC SECURELY ATTACHED ON THE UPSTREAM SIDE.
2. SILT FENCES SHOULD BE USED ONLY FOR INTERCEPTING SHEET FLOWS OF DRAINAGE AREA NO LONGER THAN 30m AND NO STEEPER THAN 2:1.
3. THE FENCE HEIGHT SHOULD BE 0.9m TO 1.0m AND THE LENGTH APPROX. 30m PER 1000m² OF DRAINAGE AREA.
4. THE FABRIC IS TO BE RECESSED INTO A TRENCH 0.1m x 0.1m, BACKFILLED AND COMPACTED.
5. FENCE POST SHOULD BE SPACED NO MORE THAN 3.0m APART AND SET INTO THE GROUND AT LEAST 0.6m.




**SILT FENCE DETAIL**
NTS

| NO | REVISION | DATE | INIT |
|---|---|---|---|
| 0 | ISSUED FOR MOE APPROVAL | 2014-10-07 | M.C. |

NOTES/LEGEND
1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING M.C.
DESIGN A.K.
CHECKED BY M.H.
APPROVED BY A.K.

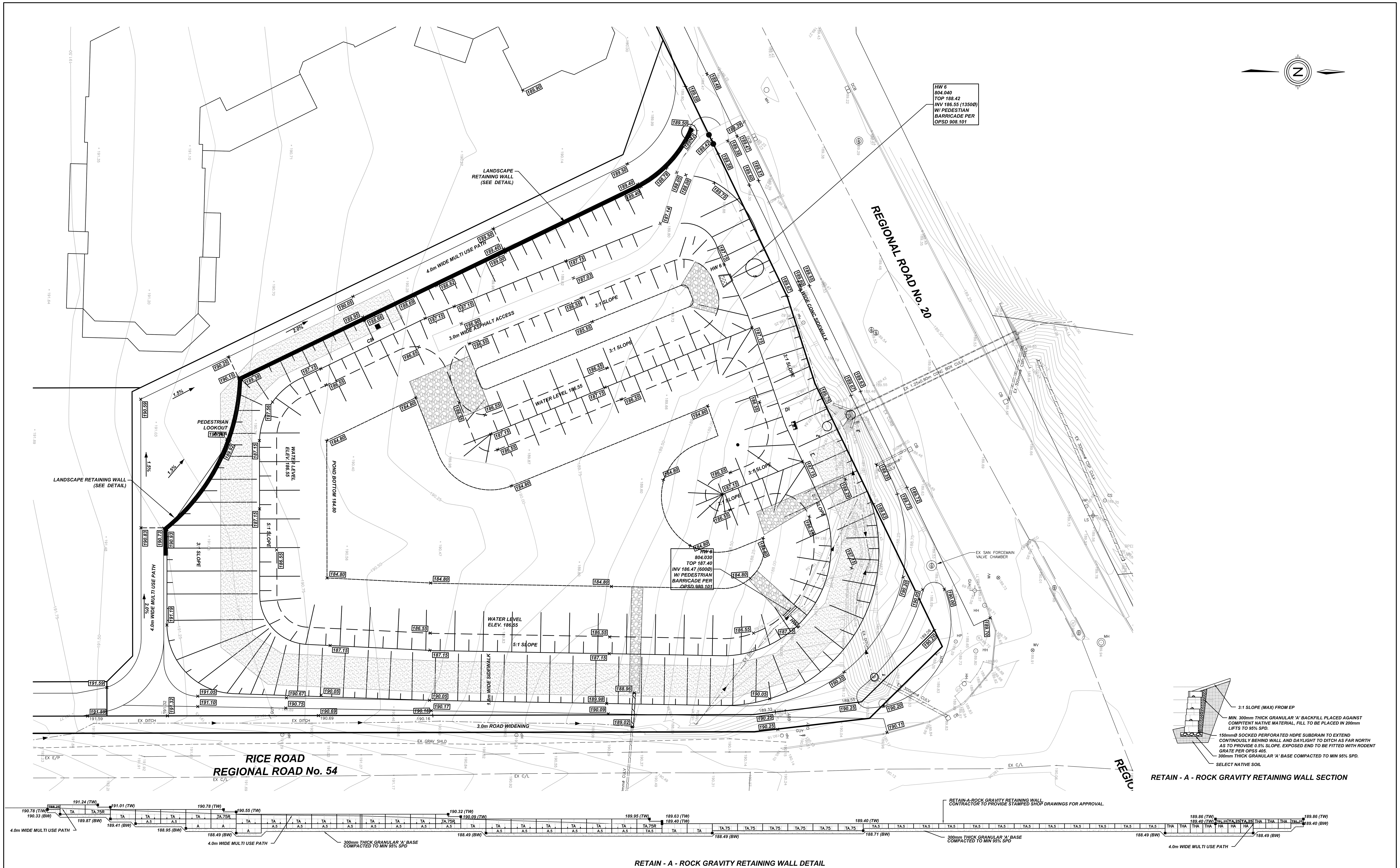
LICENSED PROFESSIONAL ENGINEER A. S. KEANE 100109861 Oct 7/14 PROVINCE OF ONTARIO

Pelham NIAGARA

UPPER CANADA CONSULTANTS ENGINEERS | PLANNERS
261 Martindale Road Unit #1 St. Catharines, ON L2W 1A1 Phone: (905)688-9400 Fax: (905)688-5274

**FONTHILL EAST NORTH POND**
**PLAN AND PROFILE**
**FROM STA 0+000 to STA 0+210.00**
**TOWN OF PELHAM**

CONSULTANT FILE No. 0473
DATE 2014-01-21
SCALE 1 : 500m
REF. No. -
DWG No. 0473PP
REV. 0




| NO | REVISION | DATE | INIT |
|---|---|---|---|
| 0 | ISSUED FOR MOE APPROVAL | 2014.10.10 | M.C. |

NOTES/LEGEND

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING M.C.
DESIGN A.K.
CHECKED BY M.H.
APPROVED BY A.K.

LICENSED PROFESSIONAL ENGINEER
A. S. KEANE
100109861
2014/10/14
PROVINCE OF ONTARIO

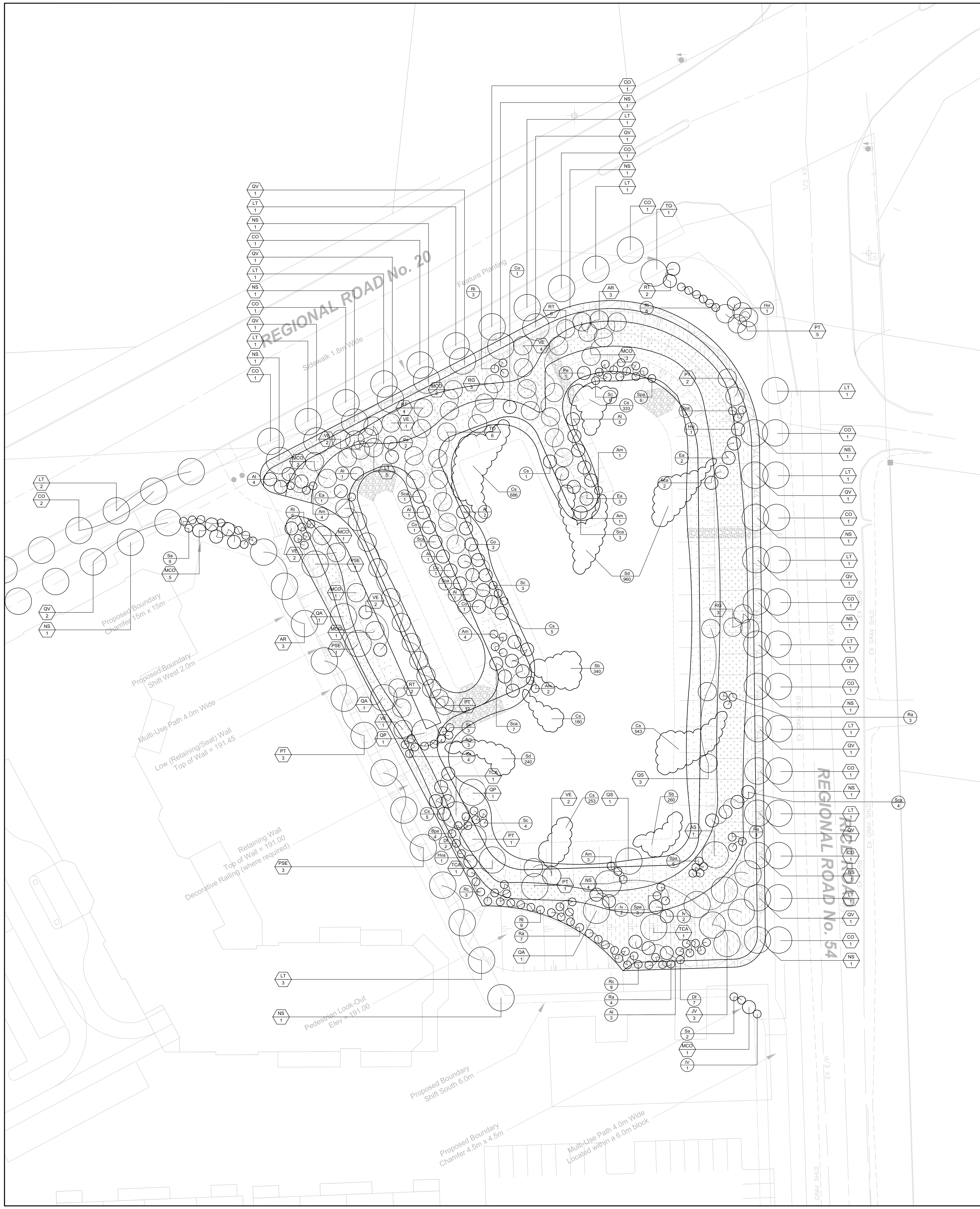
Pelham NIAGARA


UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS
261 Martindale Road
Unit #1
St. Catharines, ON
L2W 1A1
Phone: (905)688-9400
Fax: (905)688-5274


**FONTHILL EAST**
**NORTH POND**
**GRADING PLAN**

**TOWN OF PELHAM**

CONSULTANT FILE No. 0473
DATE 2014-01-21
SCALE 1 : 300m
REF. No. -
DWG No. 0473GP
REV. 0




## PLANTING LIST

| Key | Botanical Name | Common Name | Qty. | Size | Spacing |
|---|---|---|---|---|---|
| **DECIDUOUS TREES / LARGE SHRUBS** | | | | | |
| AR | *Acer rubrum* | Red Maple | 3 | 70MM B+B | AS INDICATED |
| AR | *Acer rubrum* | Red Maple | 3 | 45MM W.B. | AS INDICATED |
| AS | *Acer saccharinum* | Silver Maple | 1 | 70MM B+B | AS INDICATED |
| CO | *Celtis occidentalis* | Common Hackberry | 15 | 70MM B+B | AS INDICATED |
| LT | *Liriodendron tulipifera* | Tulip Tree | 14 | 70MM B+B | AS INDICATED |
| LT | *Liriodendron tulipifera* | Tulip Tree | 5 | 45MM W.B. | AS INDICATED |
| MCO | *Malus coronaria* | Wild Crabapple | 16 | 70MM B+B | AS INDICATED |
| NS | *Nyssa sylvatica* | Black Gum | 18 | 70MM B+B | AS INDICATED |
| PT | *Populus tremuloides* | Trembling Aspen | 13 | 70MM B+B | AS INDICATED |
| PT | *Populus tremuloides* | Trembling Aspen | 12 | 45MM W.B | AS INDICATED |
| PSE | *Prunus serotina* | Black Cherry | 5 | 70MM B+B | AS INDICATED |
| QA | *Quercus alba* | White Oak | 3 | 70MM B+B | AS INDICATED |
| QP | *Quercus palustris* | Pin Oak | 2 | 70MM B+B | AS INDICATED |
| QS | *Quercus shumardii* | Shumard Oak | 1 | 70MM B+B | AS INDICATED |
| QS | *Quercus shumardii* | Shumard Oak | 3 | 50MM W.B. | AS INDICATED |
| QV | *Quercus velutina* | Black Oak | 12 | 70MM B+B | AS INDICATED |
| RG | *Rhus glabra* | Smooth Sumac | 6 | 70MM B+B | AS INDICATED |
| RT | *Rhus typhina* | Staghorn Sumac | 14 | 70MM B+B | AS INDICATED |
| VE | *Viburnum lentago* | Nannyberry | 14 | 70MM B+B | AS INDICATED |
| Coniferous Trees | | | | | |
| JV | *Juniperus virginiana* | Red Cedar | 3 | 125cm W.B. | AS INDICATED |
| TO | *Thuja occidentalis* | White Cedar | 7 | 125cm W.B. | AS INDICATED |
| TCA | *Tsuga canadensis* | Eastern Hemlock | 3 | 125cm W.B. | AS INDICATED |
| **Shrubs** | | | | | |
| Ai | *Alnus incana* | Speckled Alder | 5 | 1 gal. | AS INDICATED |
| Al | *Amelanchier laevis* | Smooth Serviceberry | 13 | 1 gal. | AS INDICATED |
| Am | *Aronia melanocarpa* | Black Chokeberry | 19 | 1 gal. | AS INDICATED |
| Co | *Cephalanthus occidentalis* | Buttonbush | 7 | 1 gal. | AS INDICATED |
| Cs | *Cornus sericea* | Red-Osier Dogwood | 11 | 1 gal. | AS INDICATED |
| Cob | *Cornus obliqua* | Silky Dogwood | 1398 | live stakes | 0.15m O.C. |
| Df | *Dasiphora fruticosa* | Shrubby Cinquefoil | 9 | 1 gal. | AS INDICATED |
| Ea | *Euonymous atropurpurea* | Burning Bush / Wahoo | 6 | 1 gal. | AS INDICATED |
| Hvi | *Hamamelis virginiana* | Witch Hazel | 3 | 1 gal. | AS INDICATED |
| Iv | *Ilex verticillata* | Winterberry | 6 | 1 gal. | AS INDICATED |
| Pe | *Prunus pennsylvanica* | Pin Cherry | 3 | 1 gal. | AS INDICATED |
| Ra | *Ribes americanum* | Wild Black Currant | 17 | 1 gal. | AS INDICATED |
| Rc | *Rosa carolina* | Pasture Rose | 12 | 1 gal. | AS INDICATED |
| Ri | *Rubus idaeus* | Red Raspberry | 24 | 1 gal. | AS INDICATED |
| Sa | *Symphoricarpos albus* | Snowberry | 13 | 1 gal. | AS INDICATED |
| Sc | *Salix candida* | Sageleaf Willow | 16 | 1 gal. | AS INDICATED |
| Sc | *Salix candida* | Sageleaf Willow | 846 | live stakes | 0.15m O.C. |
| Sb | *Salix bebbiana* | Bebb's Willow | 260 | live stakes | 0.15m O.C. |
| Sd | *Salix discolor* | Pussy Willow | 160 | live stakes | 0.15m O.C. |
| Sca | *Sambucus canadensis* | Elderberry | 17 | 1 gal. | AS INDICATED |
| Spa | *Spiraea alba* | Meadowsweet | 21 | 1 gal. | AS INDICATED |
| **Perennial Seed Mixes** | | | | | |
| Dry Mix | | | | | |
| af | *Agastache foeniculum* | Blue Giant Hyssop | 175 | 14 lbs./ha | |
| at | *Asclepias tuberosa* | Butterfly Milkweed | 0 | 14 lbs./ha | |
| bc | *Bouteloua curtipendula* | Side Oats Grama | 0 | 14 lbs./ha | |
| cp | *Carex pensylvanica* | Pennsylvania Sedge | 0 | 14 lbs./ha | |
| cr | *Campanula rotundifolia* | Harebells | 0 | 14 lbs./ha | |
| ec | *Elymus canadensis* | Canada Wild Rye | 0 | 14 lbs./ha | |
| mf | *monarda fistulosa* | Wild Bergamot | 0 | 14 lbs./ha | |
| ob | *Oenothera biennis* | Common Evening Primrose | 0 | 14 lbs./ha | |
| rp | *Ratibida pinnata* | Green Headed Coneflower | 0 | 14 lbs./ha | |
| ss | *Solidago speciosa* | Showy Goldenrod | 0 | 14 lbs./ha | |
| sna | *Symphiotrichum novae-angliae* | New England Aster | 0 | 14 lbs./ha | |
| Normal Mix | | | | | |
| ac | *Aquilegia canadensis* | Wild Columbine | 0 | 14 lbs./ha | |
| ag | *Andropogon gerardii* | Big Bluestem | 0 | 14 lbs./ha | |
| dc | *Desmodium canadense* | Showy Tick Trefoil | 0 | 14 lbs./ha | |
| ec | *Elymus canadensis* | Canada Wild Rye | 0 | 14 lbs./ha | |
| hd | *Helianthus decapitalus* | Thin Leaf Sunflower | 0 | 14 lbs./ha | |
| pd | *Penstemon digitalis* | Foxglove Beardtongue | 0 | 14 lbs./ha | |
| pv | *Physostegia virginiana* | Obedient Plant | 0 | 14 lbs./ha | |
| rp | *Ratibida pinnata* | Green Headed Coneflower | 0 | 14 lbs./ha | |
| se | *Symphiotrichum ericoides* | Heath Aster | 0 | 14 lbs./ha | |
| sna | *Symphiotrichum novae-angliae* | New England Aster | 0 | 14 lbs./ha | |
| st | *Silphium terebinthinaceum* | Prairie Dock | 0 | 14 lbs./ha | |
| Wet Mix | | | 0 | | |
| aa | *Acorus americanus* | Sweet Flag | 263 | 14 lbs./ha | 25cm O.C. |
| as | *Asclepias syriaca* | Common Milkweed | 0 | 14 lbs./ha | |
| bce | *Bidens cernua* | Nodding Wild Marigold | 0 | 14 lbs./ha | |
| cs | *Carex stipata* | Awlfruit Sedge | 656 | 14 lbs./ha | 10cm O.C. |
| iv | *Iris versicolor* | Blue Flag Iris | 0 | 14 lbs./ha | |
| lc | *Lobelia cardinalis* | Cardinal Flower | 0 | 14 lbs./ha | |
| tl | *Typha latifolia* | Common Cattail | 0 | 14 lbs./ha | |
| sa | *Scirpus atrovirens* | Gree Bullrush | 0 | 14 lbs./ha | |
| sc | *Scirpus cyperinus* | Wool Grass | 0 | 14 lbs./ha | |
| vh | *Verbena hastata* | Blue Vervain | 0 | 14 lbs./ha | |
| Sidewalk Mix | | | | | |
| rh | *Rudbeckia hirta* | Black Eyed Susan | 5 | 14 lbs./ha | 25cm O.C. |
| ssc | *Schizachyrium soparium* | Little Bluestem | 25 | 14 lbs./ha | |
| sc | *Sporobolus cryptandrus* | Sand Dropseed | 30 | 14 lbs./ha | |
| pc | *Poa compressa* | Canada Bluegrass | 30 | 14 lbs./ha | 10cm O.C. |
| pd | *Penstemon digitalis* | Foxglove Beardtongue | 5 | 14 lbs./ha | |
| am | *Achillea Millefolium* | Yarrow | 5 | 14 lbs./ha | |

## PLANTING NOTES

1. NO W.B. BURLAP TO BE ROLLED BACK TO REVEAL TOP $\frac{1}{3}$ - $\frac{1}{2}$ OF ROOT BALL. NO TRUNK WRAP. NO ANTI-DESICCANT.
2. ALL PLANT MATERIAL SHALL MEET SPECIFICATIONS FOR SIZE, HEIGHT, SPREAD, GRADING, QUALITY, METHOD OF CULTIVATION, AND BALLING AND BURLAP SPECIFICATIONS AS SET OUT IN THE LATEST GUIDE SPECIFICATION FOR NURSERY STOCK PREPARED BY THE CNTA.
3. NO SUBSTITUTIONS IN SPECIES, CULTIVAR, QUANTITY, SIZE OR CONDITION WILL BE PERMITTED WITHOUT THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT. ANY UNAPPROVED SUBSTITUTED MATERIAL WILL BE REQUIRED TO BE REMOVED FROM THE SITE.
4. ANY INCONSISTENCIES FOUND IN THE QUANTITIES AS SHOWN ON THE PLAN AND THE PLANT LIST SHALL IMMEDIATELY BE REPORTED TO THE LANDSCAPE ARCHITECT.
5. STAKE-OUT OF PLANT LOCATIONS AND DELIVERED PLANT MATERIAL TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLACEMENT.
6. NATIVE OR IMPORTED TOPSOIL SHALL BE TESTED AS SPECIFIED AND APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO PLACEMENT. PLANTING MIX, WHERE INDICATED, SHALL FOLLOW THE MIX SPECIFICATIONS.
7. PLANT MATERIAL SHALL BE THOROUGHLY WATERED AT THE TIME OF PLANTING.
8. THE CONTRACTOR SHALL PROVIDE MAINTENANCE IMMEDIATELY AFTER THE PLANTS ARE INSTALLED AND CONTINUE THROUGHOUT THE ENTIRE WARRANTY PERIOD. MAINTENANCE REQUIREMENTS SHALL INCLUDE ALL PROCEDURES CONSISTENT WITH PROPER HORTICULTURAL PRACTICES TO ENSURE NORMAL, VIGOROUS, AND HEALTHY GROWTH OF ALL MATERIAL PLANTED. ALL STAKES, WIRE, HOSE, AND OTHER ACCESSORIES MUST BE REMOVED PRIOR TO FINAL WARRANTY INSPECTION.
9. ALL PLANT MATERIAL USED AS REPLACEMENTS FOR UNACCEPTABLE MATERIAL SHALL BE OF THE SAME QUALITY AND REQUIREMENTS PRESCRIBED FOR THE ORIGINAL MATERIAL INCLUDING THE APPLICABLE WARRANTY PERIOD. REPLACEMENTS SHALL BE MADE ONCE UNDER THE WARRANTY.
10. ALL TREES LOCATIONS TO BE STAKED OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOUR NOTICE. ALL SHRUBS TO BE LAİD OUT AND APPROVED BY LANDSCAPE ARCHİTECT PRİOR TO PLANTİNG. PROVİDE 48 HOURS NOTİCE.
11. SINGLE-NET STRAW BLANKET TO COVER FIRST 2 METRES OF SEED MIX EXTENDING UPWARDS FROM BASE OF SLOPE TO ENSURE MINIMAL SEED DISPLACEMENT BY WATER OR BY WILDLIFE.SHOP DRAWINGS TO BE PREPARED BY CONTRACTOR AND REVIEWED BY LANDSCAPE ARCHITECT.
12. CONTRACTOR TO STAKE OUT THERMAL BED LOCATION AND LOCATE ROOTBALLS ACCORDINGLY SO AS NOT TO PENETRATE THERMAL BED DURING PLANTING.

## LEGEND

- Large Tree
- Small Tree
- Large Shrub
- Small Shrub
- Sidewalk Seed Mix
- Dry Seed Mix
- Medium Seed Mix
- Wet Seed Mix
- Live Staking
- Concrete Paving
- Asphalt Path
- Decking
- Railing
- Seatwall

TOWN OF PELHAM
# EAST FONTHILL

Project /Client

TOWN OF PELHAM

20 PELHAM TOWN SQUARE
FONTHILL, ON L0S 1E0
T: (905) 892-2607 F: (905) 892-5055

Legend:

Issue / Revisions

| No. | Description | Date | By |
|---|---|---|---|
| 1 | Planting Plan - For Discussion | 2014-09-08 | TB |

Stamp

THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNTIL SIGNED BY THE LANDSCAPE ARCHITECT.

Drawn By: TB
Checked By: MOH/DL/WD
Date: SEPT. 8, 2014


The Planning Partnership
urban design . landscape architecture . planning . communications
1255 Bay Street, Suite 201 Toronto. Ontario. Canada M5R 2A9
**t.** 416.975.1556 **f.** 416.975.1580 info@planpart.ca


General Notes

BUILDING PERMIT ISSUANCE SHALL BE SUBJECT TO THE BUILDING PERMIT DRAWINGS NOT BEING IN CONTRAVENTION WITH THESE APPROVED PLANS AND DRAWINGS INCLUDING, BUT NOT LIMITED TO, THE EXTERIOR DESIGN OF THE BUILDING AND EXTERIOR BUILDING MATERIALS



Drawing Title

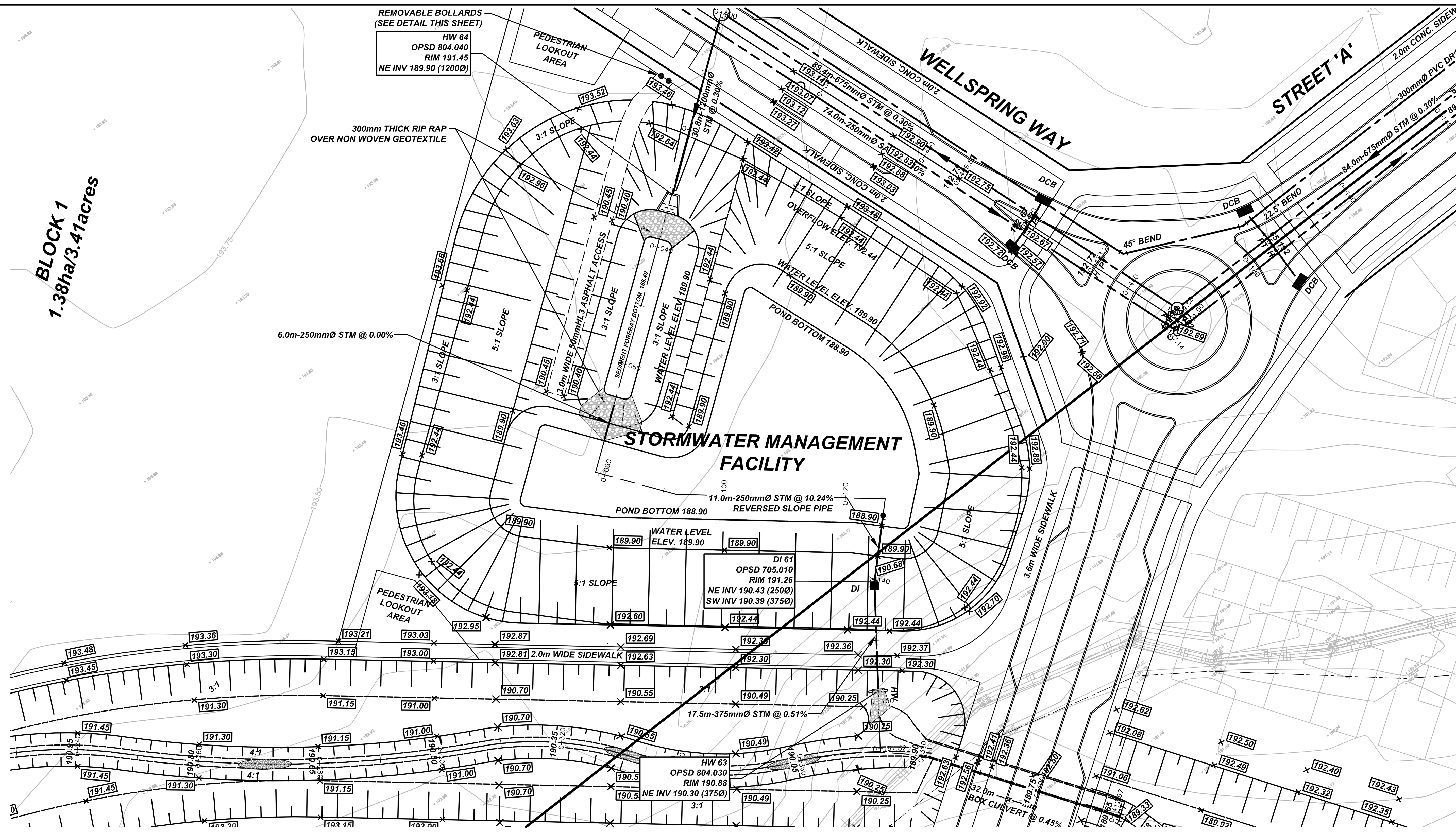
North Storm Water Pond and Gateway Planting Plan

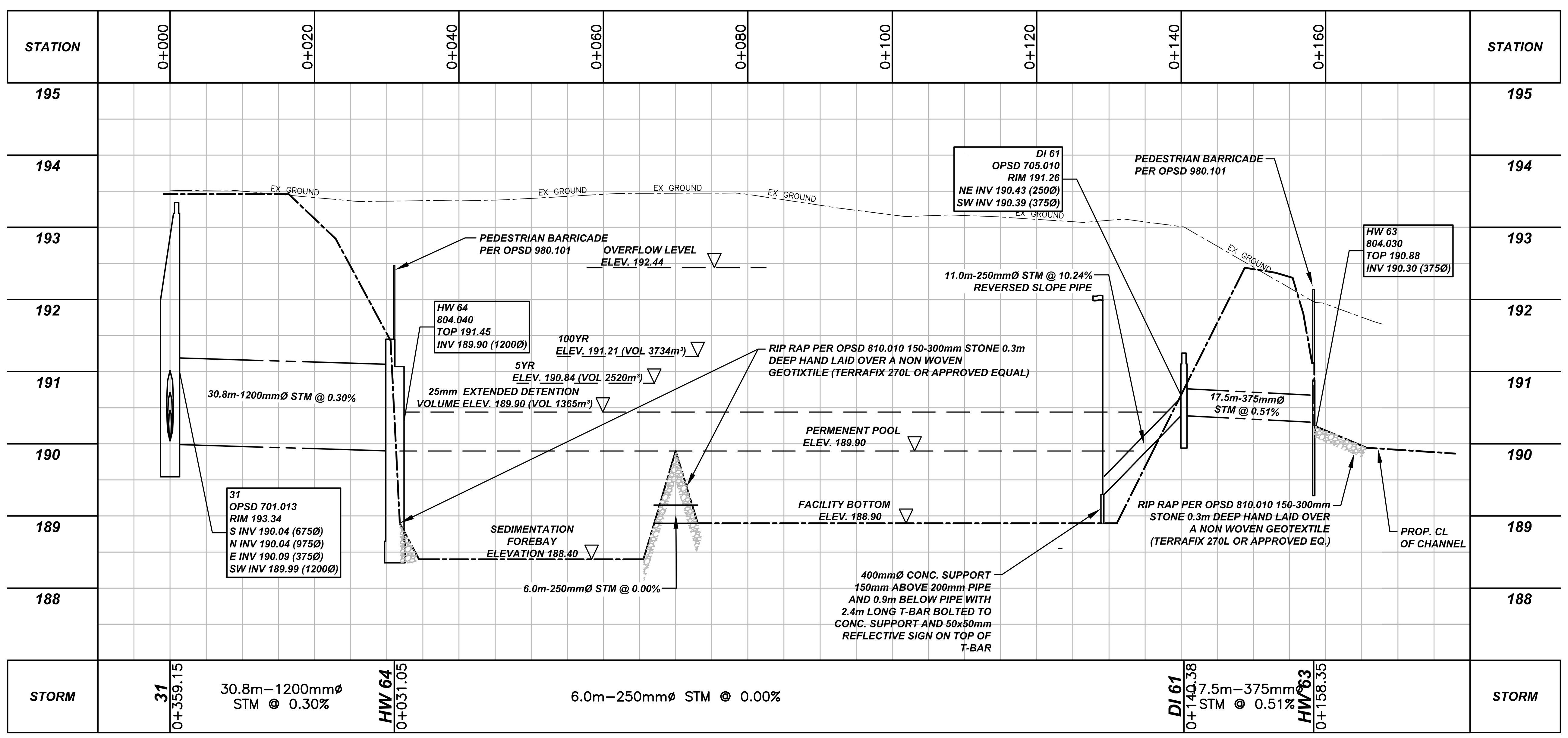
Scale: 1:400

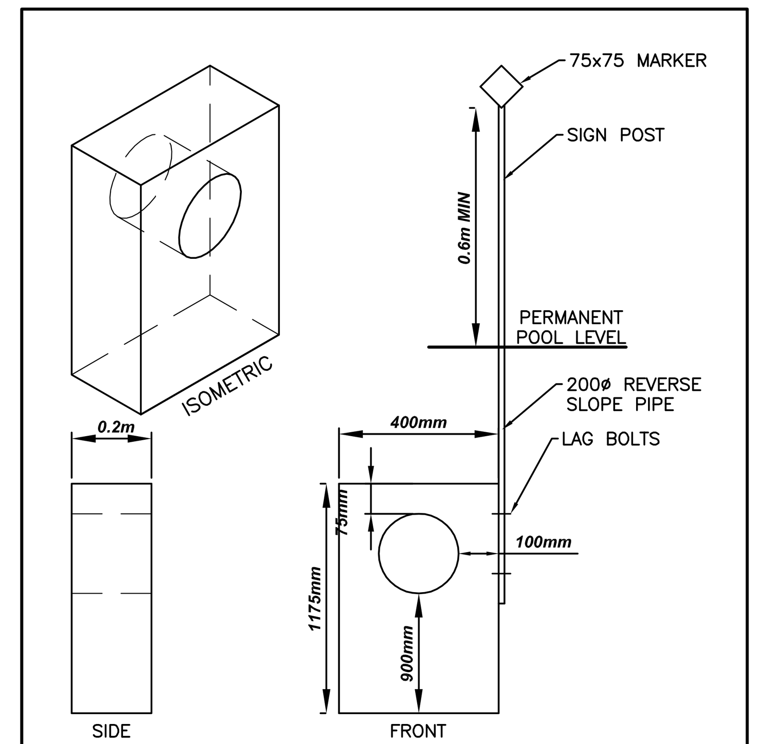
Proj. No.: 1453

Drawing No.: L-2

Rev.

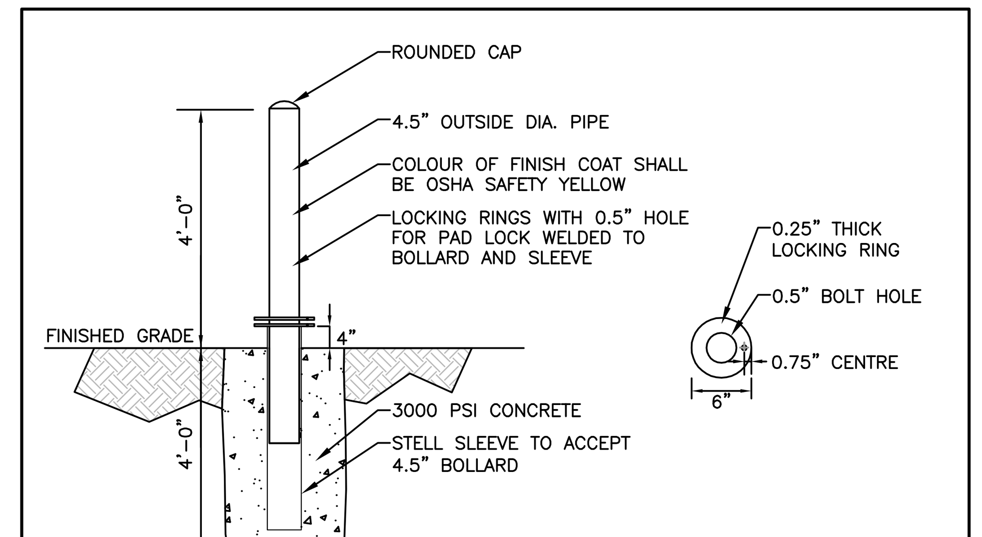



## CONCRETE SUPPORT BLOCK

N.T.S

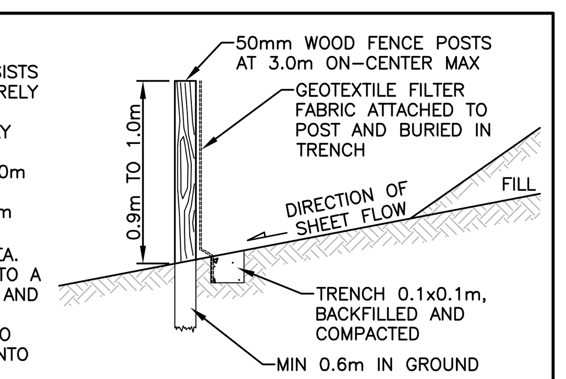



## REMOVEABLE BOLLARD

N.T.S.

**NOTES:**

1. THIS TYPE OF FILTER BARRIER CONSISTS OF GEOTEXTILE FILTER FABRIC SECURELY ATTACHED ON THE UPSTREAM SIDE.
2. SILT FENCES SHOULD BE USED ONLY FOR INTERCEPTING SHEET FLOWS OF DRAINAGE AREA NO LONGER THAN 30m AND NO STEEPER THAN 2:1.
3. THE FENCE HEIGHT SHOULD BE 0.9m TO 1.0m AND THE LENGTH APPROX. 30m PER 1000m² OF DRAINAGE AREA.
4. THE FABRIC IS TO BE RECESSED INTO A TRENCH 0.1m x 0.1m, BACKFILLED, AND COMPACTED.
5. FENCE POST SHOULD BE SPACED NO MORE THAN 3.0m APART AND SET INTO THE GROUND AT LEAST 0.6m.




## SILT FENCE DETAIL

NTS

| NO | REVISION | DATE | INIT |
|---|---|---|---|
| 0 | ISSUED FOR MOE APPROVAL | 2014-10-07 | M.C. |

NOTES/LEGEND

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING M.C.
DESIGN A.K.
CHECKED BY M.H.
APPROVED BY A.K.

LICENSED PROFESSIONAL ENGINEER
A. S. KEANE
100109861
08/14
PROVINCE OF ONTARIO

Pelham NIAGARA


UPPER CANADA CONSULTANTS
ENGINEERS | PLANNERS
261 Martindale Road
Unit #1
St. Catharines, ON
L2W 1A1
Phone: (905)688-9400
Fax: (905)688-5274


# FONTHILL EAST
# SOUTH POND
## PLAN AND PROFILE + GRADING PLAN
## FROM STA 0+000 to STA 0+177.95
## TOWN OF PELHAM

CONSULTANT FILE No. 0473
DATE 2014-01-21
SCALE 1 : 500m
REF. No. -
DWG No. 0473PP+GP
REV. 0

## PLANTING LIST

| Key | Botanical Name | Common Name | Qty. | Size | Spacing |
|---|---|---|---|---|---|
| **DECIDUOUS TREES / LARGE SHRUBS** | | | | | |
| AN | *Acer nigrum* | Black Maple | 9 | 70MM B+B | AS INDICATED |
| AT | *Asimina triloba* | Paw Paw | 3 | 40MM B+B | AS INDICATED |
| CC | *Cercis canadensis* | Eastern Redbud | 5 | 50MM B+B | AS INDICATED |
| CCO | *Carya cordiformis* | Bitternut Hickory | 3 | 60MM B+B | AS INDICATED |
| CCG | *Crataegus crus-galli* | Cockspur Hawthorn | 5 | 60MM B+B | AS INDICATED |
| CF | *Crataegus flabellata* | Fanleaf Hawthorn | 6 | 60MM B+B | AS INDICATED |
| JC | *Juglans cinerea* | Butternut | 3 | 70MM B+B | AS INDICATED |
| JN | *Juglans nigra* | Black Walnut | 4 | 70MM B+B | AS INDICATED |
| PD | *Populus deltoides* | Cottonwood | 5 | 60MM B+B | AS INDICATED |
| PD | *Populus deltoides* | Cottonwood | 15 | 35MM 15GAL | AS INDICATED |
| PG | *Populus grandidenta* | Big-Tooth Aspen | 18 | 70MM B+B | AS INDICATED |
| QB | *Quercus bicolor* | Swamp White Oak | 9 | 70MM B+B | AS INDICATED |
| QM | *Quercus macrocarpa* | Burr Oak | 8 | 70MM B+B | AS INDICATED |
| RG | *Rhus glabra* | Smooth Sumac | 21 | 50MM B+B | AS INDICATED |
| Coniferous Trees | | | | | |
| PL | *Picea glauca* | White Spruce | 8 | 125CM W.B. | AS INDICATED |
| PS | *Pinus strobus* | White Pine | 12 | 125CM W.B. | AS INDICATED |
| **Shrubs** | | | | | |
| Aa | *Amelanchier alnifolia* | Saskatoon Serviceberry | 13 | 1 gal. | AS INDICATED |
| Am | *Aronia melanocarpa* | Black Chokeberry | 11 | 1 gal. | AS INDICATED |
| Ap | *Andromeda polifolia* | Bog Rosemary | 26 | 1 gal. | AS INDICATED |
| Co | *Cornus obliqua* | Silky Dogwood | 10 | 1 gal. | AS INDICATED |
| Cs | *Cornus sericea* | Red Osier Dogwood | 1995 | live stakes | 0.15m O.C. |
| Cr | *Cornus racemosa* | Grey Dogwood | 23 | 1 gal. | AS INDICATED |
| Dl | *Diervilla lonicera* | Low Bush Honeysuckle | 36 | 1 gal. | AS INDICATED |
| Eo | *Euonymus obovata* | Running Serviceberry | 37 | 1 gal. | AS INDICATED |
| Hvi | *Hamamelis virginiana* | Witch Hazel | 20 | 1 gal. | AS INDICATED |
| Lb | *Lindera benzoin* | Spice Bush | 11 | 1 gal. | AS INDICATED |
| Lg | *Ledum groenlandicum* | Labrador Tea | 23 | 1 gal. | AS INDICATED |
| Po | *Physocarpos opulifolius* | Ninebark | 5 | 1 gal. | AS INDICATED |
| Ro | *Rubus odoratus* | Purple Flowering Raspberry | 28 | 1 gal. | AS INDICATED |
| Sd | *Salix discolor* | Pussy Willow | 10 | 1 gal. | AS INDICATED |
| Sd | *Salix discolor* | Pussy Willow | 1300 | live stakes | 0.15m O.C. |
| Sb | *Salix bebbiana* | Bebb's Willow | 6 | 1 gal. | AS INDICATED |
| Sb | *Salix bebbiana* | Bebb's Willow | 600 | live stakes | 0.15m O.C. |
| Vt | *Viburnum trilobum* | Highbush Cranberry | 7 | 1 gal. | AS INDICATED |
| **Perennial Seed Mixes** | | | | | |
| Dry Mix | | | | | |
| af | *Agastache foeniculum* | Blue Giant Hyssop | 175 | 14 lbs./ha | |
| at | *Asclepias tuberosa* | Butterfly Milkweed | 0 | 14 lbs./ha | |
| bc | *Bouteloua curtipendula* | Side Oats Grama | 0 | 14 lbs./ha | |
| cp | *Carex pensylvanica* | Pennsylvania Sedge | 0 | 14 lbs./ha | |
| cr | *Campanula rotundifolia* | Harebells | 0 | 14 lbs./ha | |
| ec | *Elymus canadensis* | Canada Wild Rye | 0 | 14 lbs./ha | |
| mf | *monarda fistulosa* | Wild Bergamot | 0 | 14 lbs./ha | |
| ob | *Oenothera biennis* | Common Evening Primrose | 0 | 14 lbs./ha | |
| rp | *Ratibida pinnata* | Green Headed Coneflower | 0 | 14 lbs./ha | |
| ss | *Solidago speciosa* | Showy Goldenrod | 0 | 14 lbs./ha | |
| sna | *Symphiotrichum novae-angliae* | New England Aster | 0 | 14 lbs./ha | |
| Normal Mix | | | | | |
| ac | *Aquilegia canadensis* | Wild Columbine | 0 | 14 lbs./ha | |
| ag | *Andropogon gerardii* | Big Bluestem | 0 | 14 lbs./ha | |
| dc | *Desmodium canadense* | Showy Tick Trefoil | 0 | 14 lbs./ha | |
| ec | *Elymus canadensis* | Canada Wild Rye | 0 | 14 lbs./ha | |
| hd | *Helianthus decapitalus* | Thin Leaf Sunflower | 0 | 14 lbs./ha | |
| pd | *Penstemon digitalis* | Foxglove Beardtongue | 0 | 14 lbs./ha | |
| pv | *Physostegia virginiana* | Obedient Plant | 0 | 14 lbs./ha | |
| rp | *Ratibida pinnata* | Green Headed Coneflower | 0 | 14 lbs./ha | |
| se | *Symphiotrichum ericoides* | Heath Aster | 0 | 14 lbs./ha | |
| sna | *Symphiotrichum novae-angliae* | New England Aster | 0 | 14 lbs./ha | |
| st | *Silphium terebinthinaceum* | Prairie Dock | 0 | 14 lbs./ha | |
| Wet Mix | | | 0 | | |
| aa | *Acorus americanus* | Sweet Flag | 263 | 14 lbs./ha | 25cm O.C. |
| as | *Asclepias syriaca* | Common Milkweed | 0 | 14 lbs./ha | |
| bce | *Bidens cernua* | Nodding Wild Marigold | 0 | 14 lbs./ha | |
| cs | *Carex stipata* | Awlfruit Sedge | 656 | 14 lbs./ha | 10cm O.C. |
| iv | *Iris versicolor* | Blue Flag Iris | 0 | 14 lbs./ha | |
| lc | *Lobelia cardinalis* | Cardinal Flower | 0 | 14 lbs./ha | |
| tl | *Typha latifolia* | Common Cattail | 0 | 14 lbs./ha | |
| sa | *Scirpus atrovirens* | Gree Bullrush | 0 | 14 lbs./ha | |
| sc | *Scirpus cyperinus* | Wool Grass | 0 | 14 lbs./ha | |
| vh | *Verbena hastata* | Blue Vervain | 0 | 14 lbs./ha | |
| Sidewalk Mix | | | | | |
| rh | *Rudbeckia hirta* | Black Eyed Susan | 5 | 14 lbs./ha | 25cm O.C. |
| ssc | *Schizachyrium soparium* | Little Bluestem | 25 | 14 lbs./ha | |
| sc | *Sporobolus cryptandrus* | Sand Dropseed | 30 | 14 lbs./ha | |
| pc | *Poa compressa* | Canada Bluegrass | 30 | 14 lbs./ha | 10cm O.C. |
| pd | *Penstemon digitalis* | Foxglove Beardtongue | 5 | 14 lbs./ha | |
| am | *Achillea Millefolium* | Yarrow | 5 | 14 lbs./ha | |

## PLANTING NOTES

1. NO W.B. BURLAP TO BE ROLLED BACK TO REVEAL TOP $\frac{1}{3}$ - $\frac{1}{2}$ OF ROOT BALL. NO TRUNK WRAP. NO ANTI-DESICCANT.
2. ALL PLANT MATERIAL SHALL MEET SPECIFICATIONS FOR SIZE, HEIGHT, SPREAD, GRADING, QUALITY, METHOD OF CULTIVATION, AND BALLING AND BURLAP SPECIFICATIONS AS SET OUT IN THE LATEST GUIDE SPECIFICATION FOR NURSERY STOCK PREPARED BY THE CNTA.
3. NO SUBSTITUTIONS IN SPECIES, CULTIVAR, QUANTITY, SIZE OR CONDITION WILL BE PERMITTED WITHOUT THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT. ANY UNAPPROVED SUBSTITUTED MATERIAL WILL BE REQUIRED TO BE REMOVED FROM THE SITE.
4. ANY INCONSISTENCIES FOUND IN THE QUANTITIES AS SHOWN ON THE PLAN AND THE PLANT LIST SHALL IMMEDIATELY BE REPORTED TO THE LANDSCAPE ARCHITECT.
5. STAKE-OUT OF PLANT LOCATIONS AND DELIVERED PLANT MATERIAL TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLACEMENT.
6. NATIVE OR IMPORTED TOPSOIL SHALL BE TESTED AS SPECIFIED AND APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO PLACEMENT. PLANTING MIX, WHERE INDICATED, SHALL FOLLOW THE MIX SPECIFICATIONS.
7. PLANT MATERIAL SHALL BE THOROUGHLY WATERED AT THE TIME OF PLANTING.
8. THE CONTRACTOR SHALL PROVIDE MAINTENANCE IMMEDIATELY AFTER THE PLANTS ARE INSTALLED AND CONTINUE THROUGHOUT THE ENTIRE WARRANTY PERIOD. MAINTENANCE REQUIREMENTS SHALL INCLUDE ALL PROCEDURES CONSISTENT WITH PROPER HORTICULTURAL PRACTICES TO ENSURE NORMAL, VIGOROUS, AND HEALTHY GROWTH OF ALL MATERIAL PLANTED. ALL STAKES, WIRE, HOSE, AND OTHER ACCESSORIES MUST BE REMOVED PRIOR TO FINAL WARRANTY INSPECTION.
9. ALL PLANT MATERIAL USED AS REPLACEMENTS FOR UNACCEPTABLE MATERIAL SHALL BE OF THE SAME QUALITY AND REQUIREMENTS PRESCRIBED FOR THE ORIGINAL MATERIAL INCLUDING THE APPLICABLE WARRANTY PERIOD. REPLACEMENTS SHALL BE MADE ONCE UNDER THE WARRANTY.
10. ALL TREES LOCATIONS TO BE STAKED OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOUR NOTICE. ALL SHRUBS TO BE LAİD OUT AND APPROVED BY LANDSCAPE ARCHİTECT PRİOR TO PLANTİNG. PROVİDE 48 HOURS NOTİCE.
11. SINGLE-NET STRAW BLANKET TO COVER FIRST 2 METRES OF SEED MIX EXTENDING UPWARDS FROM BASE OF SLOPE TO ENSURE MINIMAL SEED DISPLACEMENT BY WATER OR BY WILDLIFE. SHOP DRAWINGS TO BE PREPARED BY CONTRACTOR AND REVIEWED BY LANDSCAPE ARCHITECT.

## LEGEND

- Large Tree
- Small Tree
- Large Shrub
- Small Shrub
- Sidewalk Seed Mix
- Dry Seed Mix
- Medium Seed Mix
- Wet Seed Mix
- Live Staking
- Concrete Paving
- Asphalt Path
- Decking
- Railing
- Seatwall

TOWN OF PELHAM
EAST FONTHILL

Project /Client

TOWN OF PELHAM

20 PELHAM TOWN SQUARE
FONTHILL, ON L0S 1E0
T: (905) 892-2607 F: (905) 892-5055

Legend:

Issue / Revisions

| No. | Description | Date | By |
|---|---|---|---|
| 1 | Planting Plan - For Discussion | 2014-09-08 | TB |

Stamp

THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNTIL SIGNED BY THE LANDSCAPE ARCHITECT.

Drawn By TB
Checked By MOH/DL/WD
Date SEPT. 8, 2014

The Planning Partnership
urban design . landscape architecture . planning . communications
1255 Bay Street, Suite 201 Toronto. Ontario. Canada M5R 2A9
t. 416.975.1556 f. 416.975.1580 info@planpart.ca

General Notes

BUILDING PERMIT ISSUANCE SHALL BE SUBJECT TO THE BUILDING PERMIT DRAWINGS NOT BEING IN CONTRAVENTION WITH THESE APPROVED PLANS AND DRAWINGS INCLUDING, BUT NOT LIMITED TO, THE EXTERIOR DESIGN OF THE BUILDING AND EXTERIOR BUILDING MATERIALS



Drawing Title

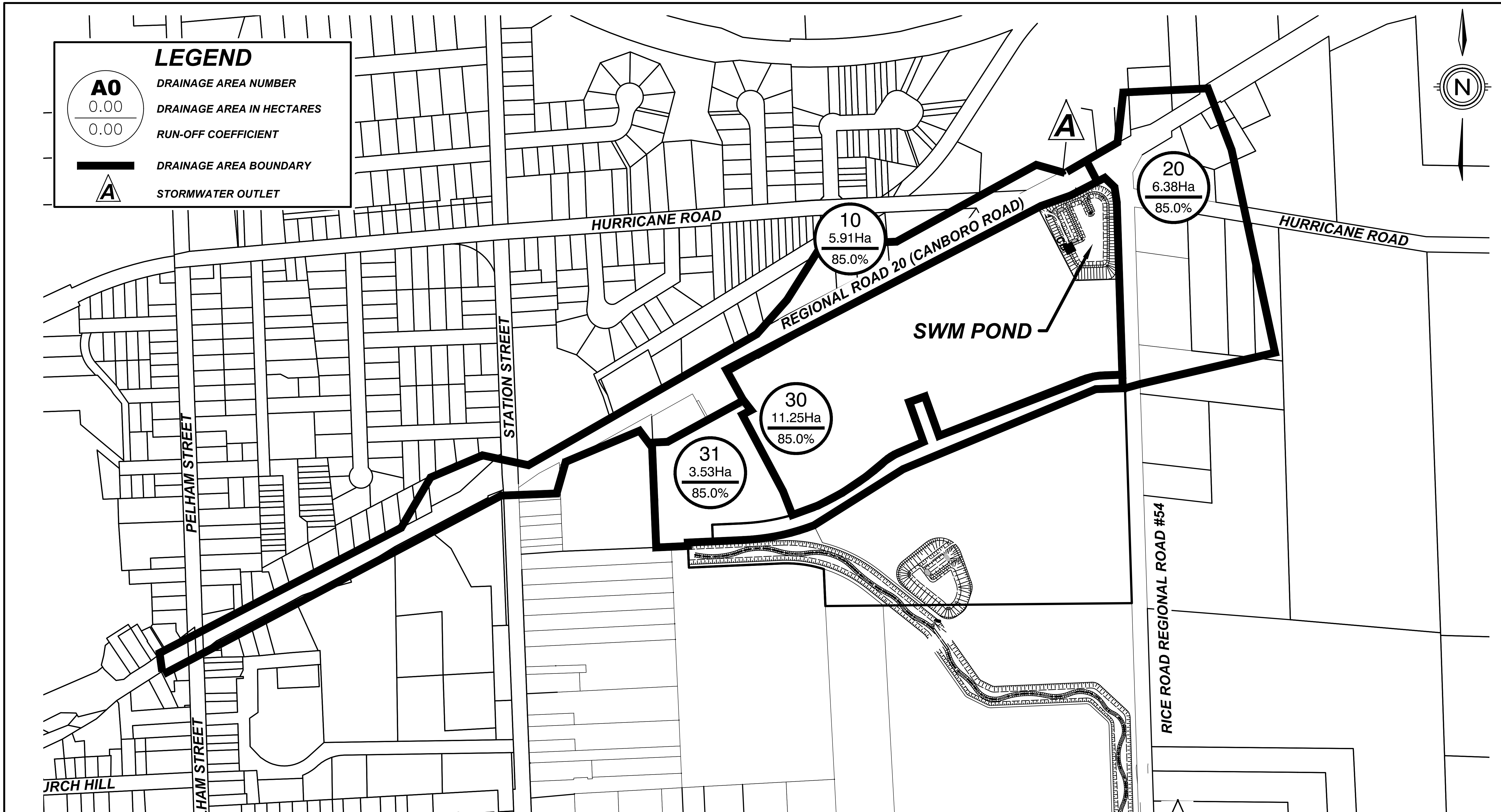
South Storm
Water Pond and
Gateway Planting Plan

Scale
1:400

Proj. No.
1453

Drawing No.
L-4

Rev.




UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

# THE VILLAGE OF EAST FONTHILL
# FUTURE STORM DRAINAGE AREA PLAN

## NORTH SWM POND
## TOWN OF PELHAM

| | |
|---|---|
| DATE | 2021-04-01 |
| SCALE | NTS |
| REF. No. | - |
| DWG No. | - |

DRAWING FILE: F:\0473\SWM\0473_FOR COUNCIL REPORT 2021.dwg PLOTTED: Apr 01, 2021 – 1:35pm PLOTTED BY: brendan

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

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

February 12, 2021

File: **0473**

Town of Pelham
20 Pelham Town Square
Fonthill, ON L0S 1E0

***Attn:*** *Jason Marr, P.Eng – Director of Public Works*

**Background Information**
**Village of East Fonthill SWM Facility (Rice and RR20), Town of Pelham**

We are pleased to provide a summary of the function and design overview of the SWM facility constructed at the south-west corner of Rice Road and Regional Road 20.

**Reduction in Flows (Quantity Controls)**

1) The Region of Niagara reconstruction of Regional Road 20 resulted in a Part II order where the Ministry of the Environment required that the Region implement stormwater controls on their project. The Region contributed to the construction of the SWM facility to lower flows to the outlet to Twelve Mile Creek.

2) Prior to the pond construction the outlet sewer from the Regional Road was 900mm (36") in diameter which outlet to the existing box culvert. Once the pond was in place the largest outlet to the box culvert was reduced in size to a 675mm (27") diameter which is approximately 1.8 times smaller.

3) The Ministry of the Environment, Town of Pelham Design Standards, and NPCA regulations requires that the future stormwater flows from proposed development projects match the existing stormwater flows that occurred prior to development (where these lands were agricultural) to prevent increasing downstream flooding or erosion.

   See Table 14 of the SWM Report (UCC, 2015) Outlet A (Twelve Mile Creek) for reductions.

| Table 14. Peak Flow Values | | | | |
|---|---|---|---|---|
| Design Storm (Return Period) | Peak Flow ($m^3/s$) | | | |
| | Existing | Future without SWMP | Future with SWMP | Change |
| ***OUTLET A (TWELVE MILE CREEK)*** | | | | |
| 25mm Storm | 0.831 | 1.836 | 0.079 | -90.49% |
| 5 Year Storm | 1.796 | 3.815 | 0.602 | -66.48% |
| 100 Year Storm | 2.875 | 5.644 | 1.089 | -62.12% |
| ***OUTLET B (SINGER'S DRAIN)*** | | | | |
| 25mm Storm | 1.455 | 1.612 | 1.172 | -19.45% |
| 5 Year Storm | 3.051 | 3.943 | 2.487 | -18.49% |
| 100 Year Storm | 4.969 | 6.869 | 4.713 | -5.15% |

The SWM facility was design recognizing that the downstream Twelve Mile Creek is experiencing erosion and was overdesigned to further reduce the peak flows by 90% in a rainfall event where 25mm (1") of rain occurs; and by 62% in the 100 year design storm event.

4) The Ministry of the Environment regulates flows that are most impactful to erosion (small low flows vs large flash floods) and require that the volume of stormwater water produced by a 25mm (1") rainfall be detained and released slowly over a minimum period of 24 hours.

   The facility was constructed with both the typical orifice control where a small outlet is used to control these flows as well as a "geothermal bed" where flows from smaller 10mm (3/8") storm events are contained and forced though a series of perforated pipes and gravel (clear stone) beds which both slow the flow and reduce the temperature of the stormwater.

| | |
|---|---|
| MOE Equation 4.10 Drawdown Coefficient 'C2' = | 2,163 |
| MOE Equation 4.10 Drawdown Coefficient 'C3' = | 4,346 |
| MOE Equation 4.10 Drawdown Time (h) = | **24.8** |

   The SWM facility retains the water for 24.8 hours which exceeds the Ministry requirements and industry best practices.

**Temperature Concerns**

5) There was recognition that Twelve Mile Creek supports cold water fishery and that the temperature increase normally associated with standing water (SWM facilities) should be reduced. The implementation of the geothermal bed, where low flows trickle through stone at the temperature of the earth to lower temperatures has been confirmed by WSP testing results to be functioning to reduce the temperature of water leaving the pond.

6) Plantings and aquatic vegetation play an important role in providing shade and reducing the increase in temperature associated with the exposed water surface. The pond block was heavily vegetated, far in excess of what would be typical for a subdivision or other municipal pond. Included where numerous tree as shown of the attached planning list.

## PLANTING LIST

| Key | Botanical Name | Common Name | Qty. | Size | Spacing |
|---|---|---|---|---|---|
| DECIDUOUS TREES / LARGE SHRUBS | | | | | |
| AR | *Acer rubrum* | Red Maple | 3 | 70MM B+B | AS INDICATED |
| AR | *Acer rubrum* | Red Maple | 3 | 45MM W.B. | AS INDICATED |
| AS | *Acer saccharinum* | Silver Maple | 1 | 70MM B+B | AS INDICATED |
| CO | *Celtis occidentalis* | Common Hackberry | 15 | 70MM B+B | AS INDICATED |
| LT | *Liriodendron tulipifera* | Tulip Tree | 14 | 70MM B+B | AS INDICATED |
| LT | *Liriodendron tulipifera* | Tulip Tree | 5 | 45MM W.B. | AS INDICATED |
| MCO | *Malus coronaria* | Wild Crabapple | 16 | 70MM B+B | AS INDICATED |
| NS | *Nyssa sylvatica* | Black Gum | 18 | 70MM B+B | AS INDICATED |
| PT | *Populus tremuloides* | Trembling Aspen | 13 | 70MM B+B | AS INDICATED |
| PT | *Populus tremuloides* | Trembling Aspen | 12 | 45MM W.B | AS INDICATED |
| PSE | *Prunus serotina* | Black Cherry | 5 | 70MM B+B | AS INDICATED |
| QA | *Quercus alba* | White Oak | 3 | 70MM B+B | AS INDICATED |
| QP | *Quercus palustris* | Pin Oak | 2 | 70MM B+B | AS INDICATED |
| QS | *Quercus shumardii* | Shumard Oak | 1 | 70MM B+B | AS INDICATED |
| QS | *Quercus shumardii* | Shumard Oak | 3 | 50MM W.B. | AS INDICATED |
| QV | *Quercus velutina* | Black Oak | 12 | 70MM B+B | AS INDICATED |
| RG | *Rhus glabra* | Smooth Sumac | 6 | 70MM B+B | AS INDICATED |
| RT | *Rhus typhina* | Staghorn Sumac | 14 | 70MM B+B | AS INDICATED |
| VE | *Viburnum lentago* | Nannyberry | 14 | 70MM B+B | AS INDICATED |
| Coniferous Trees | | | | | |
| JV | *Juniperus virginiana* | Red Cedar | 3 | 125cm W.B. | AS INDICATED |
| TO | *Thuja occidentalis* | White Cedar | 7 | 125cm W.B. | AS INDICATED |
| TCA | *Tsuga canadensis* | Eastern Hemlock | 3 | 125cm W.B. | AS INDICATED |

7) These trees were 70mm (2.5") diameter in size when installed and they will continue to grow, increasing the shading provided. Additional large tree plantings cannot be installed without negatively impacting the function of the thermal remediation bed which is regulated as part of the Ministry of Environment ECA (Environmental Compliance Approval) certificate, issued to the Town of Pelham that governs the operation of this SWM facility. The only remaining bank are with tree is immediately above this bed and installation would risk damage.

**Sediment Reduction (Quality Improvements)**

8) The stormwater management pond also functions to reduce sediment contained within stormwater flows, being transported to the facility. The MECP requires that 80% of total suspended solids be removed by the SWM facility to protect the most critical of aquatic environments such as Twelve Mile Creek. This SWM facility is therefore designed to an Enhanced level (80% TSS Removal) which is a higher standard than a typical stormwater management facility, such as others found within Niagara.

   The Town's sampling program carried out by WSP indicate that the SWM facility is operating as designed to reduce the sediment carried downstream.

   This sediment accumulates within the first area of the stormwater facility known as the Sediment Forebay, this area, immediately beyond the pipe inlet to the pond and adjacent to the access route was sized to provide a location where the majority of sediment is accumulated and can be cleaned out when full.

   Sizing follows MECP guidelines, but should require cleaning approximately every 12.5 years as shown below from Table 8 of the SWMP (UCC, 2015).

| **e) Cleanout Frequency** | | | |
|---|---|---|---|
| | L= | **40.0 m** | (Proposed bottom length) |
| | ASL= | 3.8 | (Annual sediment loading) - $m^3$/ha |
| | A= | 20.69 | (Drainage area) – ha |
| | FRC= | 80% | (Facility removal efficiency) |
| | FV= | 792 | (Forebay volume) - $m^3$ |
| | Cleanout Frequency= | **12.59** | (Minimum 10 Years) |
| | Is this Acceptable? | **Yes** | |

**Approvals and Monitoring**

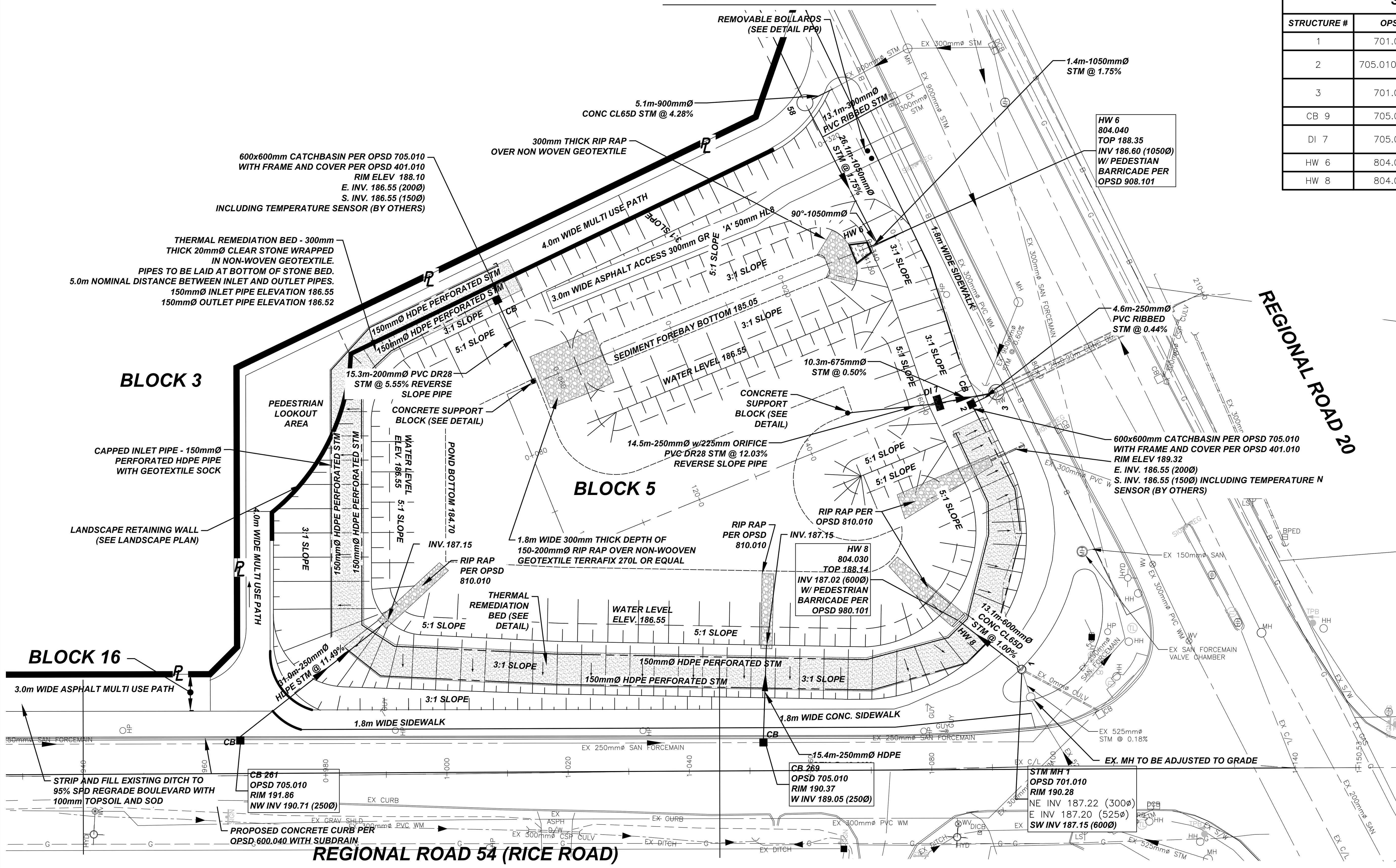
9) The design and operation of the SWM facility is regulated by the MECP under the ECA held by the Town of Pelham and monitoring is a requirement of the approval. The Town's consultant WSP has undertaken testing and determined that the SWM facility is operating to provide controls as required.

If there are any further questions or concerns please do not hesitate to contact the undersigned.

Sincerely,

Adam Keane, P.Eng.
Engineering Manager
Upper Canada Consultants

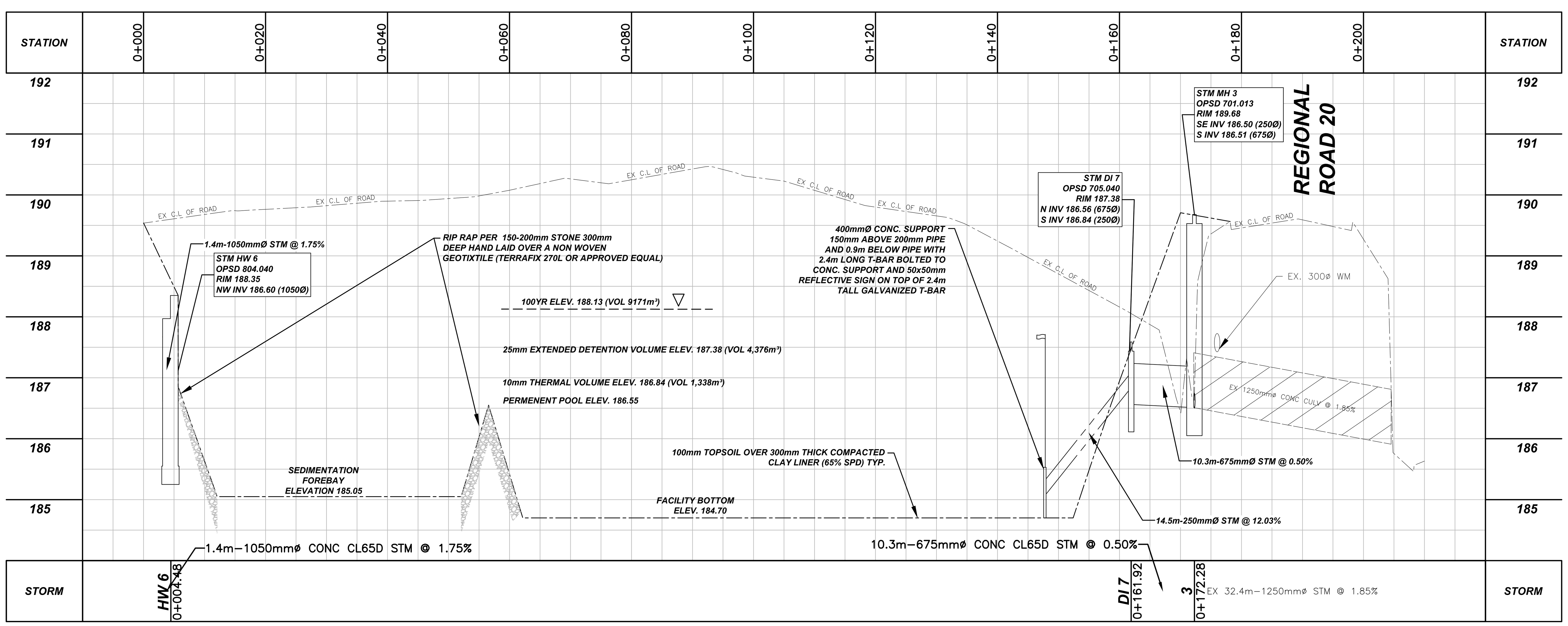
SEE SHEET 0473-BLOCK 3 PP8

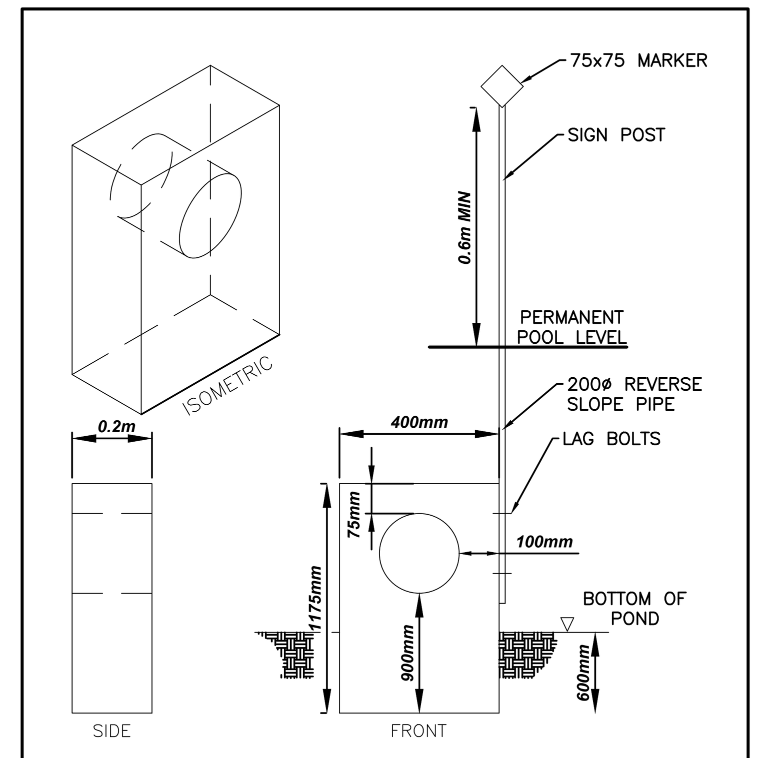



## AS CONSTRUCTED PLAN

MEASUREMENTS RECORDED:
DATE: FEBRUARY 5, 2018

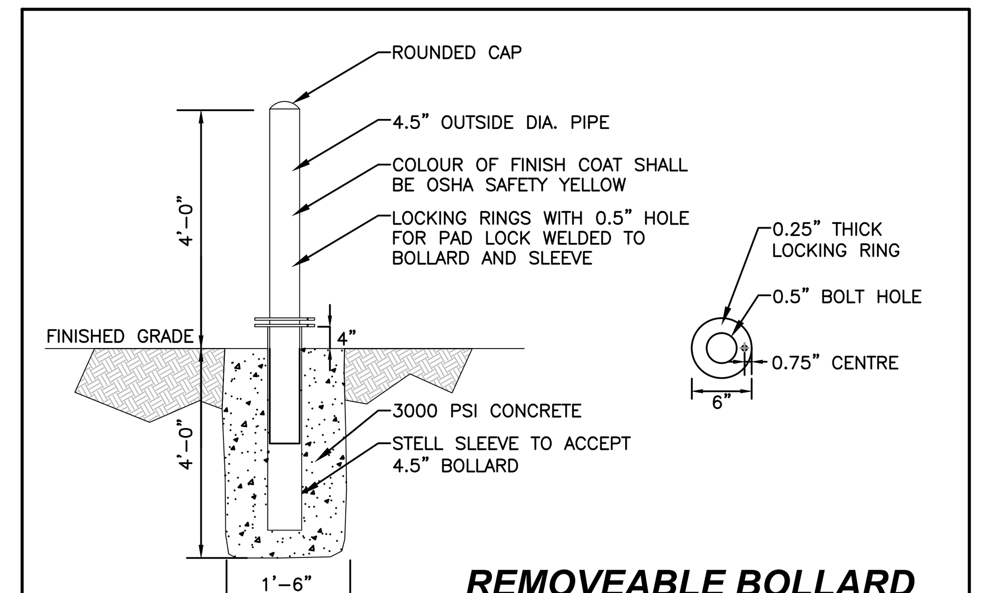
| SEWER STRUCTURE TABLE | | | | | |
|---|---|---|---|---|---|
| STRUCTURE # | OPSD | OPSD COVER | RIM ELEV | INV IN | INV OUT |
| 1 | 701.010 | 401.010 | 190.28 | | SW 187.15 |
| 2 | 705.010 RYCB | Standard | 189.32 | | NW 186.52<br>NE 186.52 |
| 3 | 701.013 | Standard | 189.68 | SE 186.50<br>S 186.51 | |
| CB 9 | 705.010 | 401.040 | 188.21 | SE 186.55 | NE 186.55 |
| DI 7 | 705.040 | TYPE A | 187.38 | | N 186.56<br>S 186.84 |
| HW 6 | 804.040 | | 188.35 | NW 186.60 | |
| HW 8 | 804.030 | | 187.94 | NE 187.02 | |



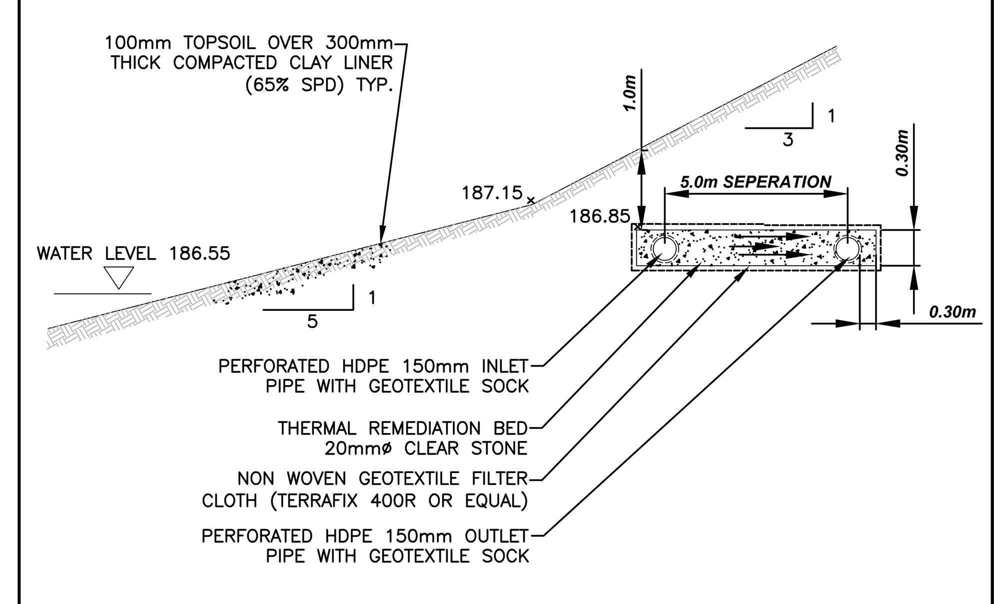

## CONCRETE SUPPORT BLOCK

N.T.S




## REMOVEABLE BOLLARD

N.T.S.

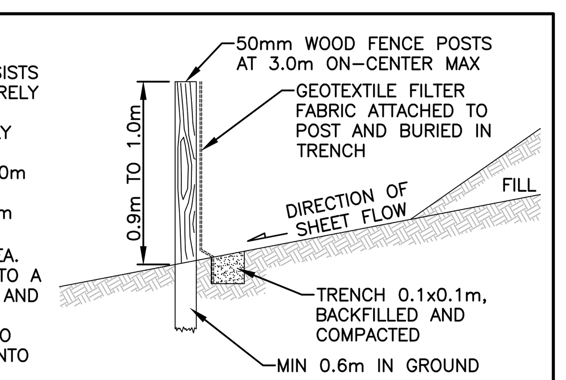



## THERMAL REMEDIATION BED DETAIL

NTS

**NOTES:**

1. THIS TYPE OF FILTER BARRIER CONSISTS OF GEOTEXTILE FILTER FABRIC SECURELY ATTACHED ON THE UPSTREAM SIDE.
2. SILT FENCES SHOULD BE USED ONLY FOR INTERCEPTING SHEET FLOWS OF DRAINAGE AREA NO LONGER THAN 30m AND NO STEEPER THAN 2:1.
3. THE FENCE HEIGHT SHOULD BE 0.9m TO 1.0m AND THE LENGTH APPROX. 30m PER 1000m² OF DRAINAGE AREA.
4. THE FABRIC IS TO BE RECESSED INTO A TRENCH 0.1m x 0.1m, BACKFILLED, AND COMPACTED.
5. FENCE POST SHOULD BE SPACED NO MORE THAN 3.0m APART AND SET INTO THE GROUND AT LEAST 0.6m.




## SILT FENCE DETAIL

NTS

| NO | REVISION | DATE | INIT |
|---|---|---|---|
| 5 | AS CONSTRUCTED | 2018-02-06 | J.C. |
| 4 | ISSUED FOR CONSTRUCTION | 2015-06-08 | M.C. |
| 3 | ISSUED FOR TENDER | 2015-03-20 | M.C. |
| 2 | REVISED PER REGIONAL COMMENTS | 2015-03-05 | M.C. |
| 1 | REVISED PER REGIONAL COMMENTS | 2015-02-25 | M.C. |
| 0 | ISSUED FOR MOE APPROVAL | 2014-10-07 | M.C. |

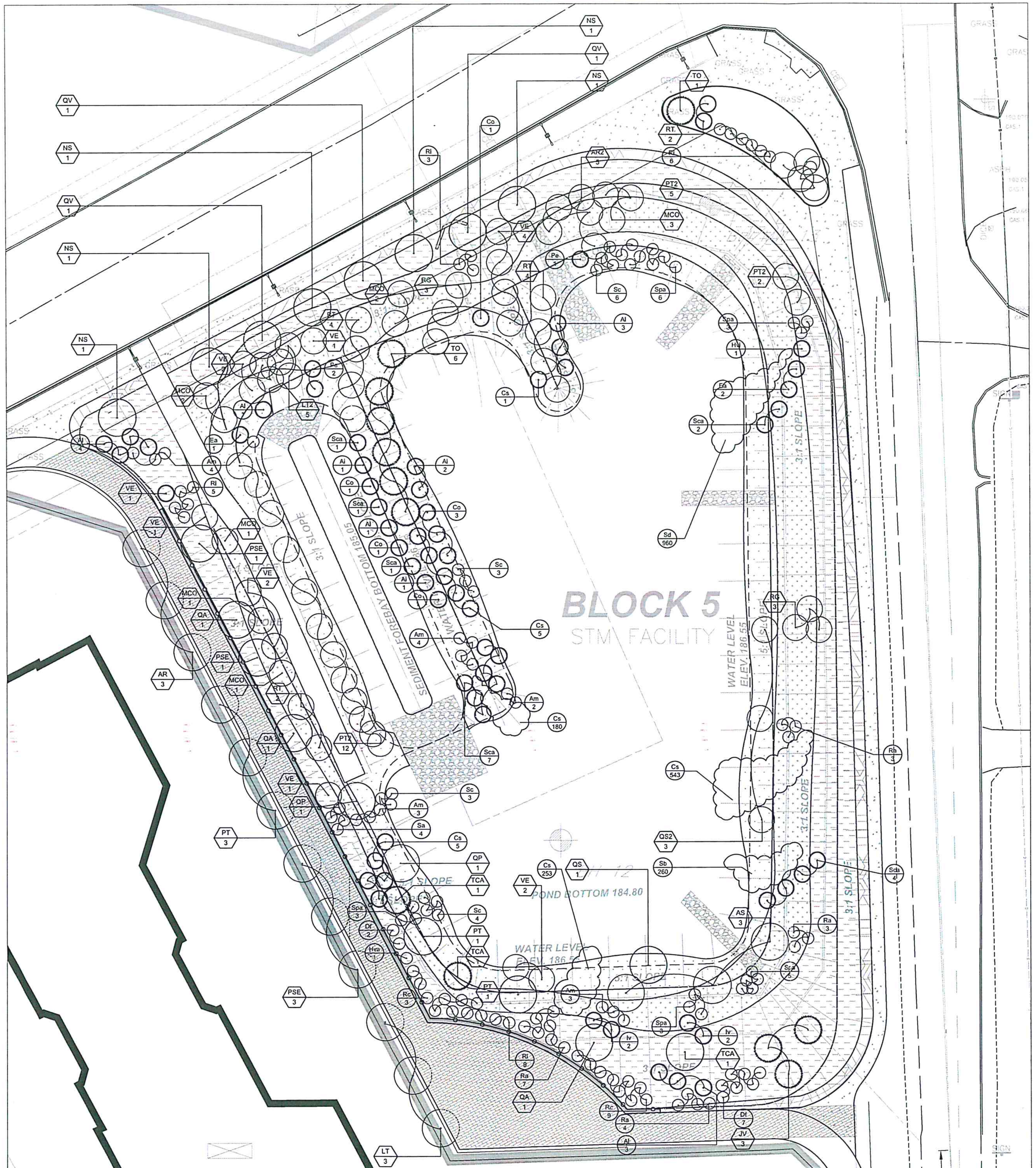
NOTES/LEGEND

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING M.C.
DESIGN A.K.
CHECKED BY M.H.
APPROVED BY A.K.

# THE VILLAGE OF EAST FONTHILL
# NORTH POND
## PLAN AND PROFILE
## FROM STA 0+000 to STA 0+210.00
### TOWN OF PELHAM

CONSULTANT FILE No. 0473
DATE 2015-06-08
SCALE 1 : 500m
REF. No. -
DWG No. 0473PP9
REV. 4




## PLANTING LIST

| Key | Botanical Name | Common Name | Qty. | Size | Spacing |
|---|---|---|---|---|---|
| DECIDUOUS TREES / LARGE SHRUBS | | | | | |
| AR | Acer rubrum | Red Maple | 3 | 70MM B+B | AS INDICATED |
| AR2 | Acer rubrum | Red Maple | 5 | 45MM W.B. | AS INDICATED |
| AS | Acer saccharinum | Silver Maple | 3 | 70MM B+B | AS INDICATED |
| LT | Liriodendron tulipifera | Tulip Tree | 3 | 70MM B+B | AS INDICATED |
| LT2 | Liriodendron tulipifera | Tulip Tree | 5 | 45MM W.B. | AS INDICATED |
| MCO | Malus coronaria | Wild Crabapple | 10 | 70MM B+B | AS INDICATED |
| NS | Nyssa sylvatica | Black Gum | 4 | 70MM B+B | AS INDICATED |
| PT | Populus tremuloides | Trembling Aspen | 5 | 70MM B+B | AS INDICATED |
| PT2 | Populus tremuloides | Trembling Aspen | 19 | 45MM W.B | AS INDICATED |
| PSE | Prunus serotina | Black Cherry | 5 | 70MM B+B | AS INDICATED |
| QA | Quercus alba | White Oak | 3 | 70MM B+B | AS INDICATED |
| QP | Quercus palustris | Pin Oak | 2 | 70MM B+B | AS INDICATED |
| QS | Quercus shumardii | Shumard Oak | 1 | 70MM B+B | AS INDICATED |
| QS2 | Quercus shumardii | Shumard Oak | 3 | 50MM W.B. | AS INDICATED |
| QV | Quercus velutina | Black Oak | 3 | 70MM B+B | AS INDICATED |
| RG | Rhus glabra | Smooth Sumac | 6 | 50MM B+B | AS INDICATED |
| RT | Rhus typhina | Staghorn Sumac | 10 | 50MM B+B | AS INDICATED |
| VE | Viburnum lentago | Nannyberry | 14 | 50MM B+B | AS INDICATED |
| Coniferous Trees | | | | | |
| JV | Juniperus virginiana | Red Cedar | 3 | 125cm W.B. | AS INDICATED |
| TO | Thuja occidentalis | White Cedar | 7 | 125cm W.B. | AS INDICATED |
| TCA | Tsuga canadensis | Eastern Hemlock | 2 | 125cm W.B. | AS INDICATED |
| Shrubs | | | | | |
| AI | Alnus incana | Speckled Alder | 5 | 1 gal. | AS INDICATED |
| AI | Amelanchier laevis | Smooth Serviceberry | 11 | 1 gal. | AS INDICATED |
| Am | Aronia melanocarpa | Black Chokeberry | 17 | 1 gal. | AS INDICATED |
| Co | Cephalanthus occidentalis | Buttonbush | 7 | 1 gal. | AS INDICATED |
| Cs | Cornus sericea | Red-Osier Dogwood | 11 | 1 gal. | AS INDICATED |
| Cob | Cornus obliqua | Silky Dogwood | 1398 | live stakes | 0.15m O.C. |
| Df | Dasiphora fruticosa | Shrubby Cinquefoil | 9 | 1 gal. | AS INDICATED |
| Ea | Euonymus atropurpurea | Burning Bush / Wahoo | 3 | 1 gal. | AS INDICATED |
| Hvi | hamamelis virginiana | Witch Hazel | 2 | 1 gal. | AS INDICATED |
| Iv | Ilex verticillata | Winterberry | 6 | 1 gal. | AS INDICATED |
| Pe | Prunus pensylvanica | Pin Cherry | 3 | 1 gal. | AS INDICATED |
| Ra | Ribes americanum | Wild Black Currant | 17 | 1 gal. | AS INDICATED |
| Rc | Rosa carolina | Pasture Rose | 12 | 1 gal. | AS INDICATED |
| Ri | Rubus idaeus | Red Raspberry | 23 | 1 gal. | AS INDICATED |
| Sa | Symphoricarpos albus | Snowberry | 4 | 1 gal. | AS INDICATED |
| Sc | Salix candida | Sageleaf Willow | 16 | 1 gal. | AS INDICATED |
| Sc | Salix candida | Sageleaf Willow | 846 | live stakes | 0.15m O.C. |
| Sb | Salix bebbiana | Bebb's Willow | 260 | live stakes | 0.15m O.C. |
| Sca | Sambucus canadensis | Elderberry | 14 | 1 gal. | AS INDICATED |
| Spa | Spiraea alba | Meadowsweet | 20 | 1 gal. | AS INDICATED |
| Perennial Seed Mixes | | | | | |
| Dry Mix | | | | | |
| af | Agastache foeniculum | Blue Giant Hyssop | 5 | 14 lbs./ha | |
| at | Asclepias tuberosa | Butterfly Milkweed | 8 | 14 lbs./ha | |
| bc | Bouteloua curtipendula | Side Oats Grama | 15 | 14 lbs./ha | |
| cp | Carex pensylvanica | Pennsylvania Sedge | 15 | 14 lbs./ha | |
| cr | Campanula rotundifolia | Harebells | 5 | 14 lbs./ha | |
| ec | Elymus canadensis | Canada Wild Rye | 15 | 14 lbs./ha | |
| mf | monarda fistulosa | Wild Bergamot | 5 | 14 lbs./ha | |
| ob | Oenothera biennis | Common Evening Primrose | 5 | 14 lbs./ha | |
| rp | Ratibida pinnata | Green Headed Coneflower | 7 | 14 lbs./ha | |
| ss | Solidago speciosa | Showy Goldenrod | 10 | 14 lbs./ha | |
| sna | Symphyotrichum novae-angliae | New England Aster | 10 | 14 lbs./ha | |
| Normal Mix | | | | | |
| ac | Aquilegia canadensis | Wild Columbine | 5 | 14 lbs./ha | |
| ag | Andropogon gerardii | Big Bluestem | 25 | 14 lbs./ha | |
| dc | Desmodium canadense | Showy Tick Trefoil | 5 | 14 lbs./ha | |
| ec | Elymus canadensis | Canada Wild Rye | 15 | 14 lbs./ha | |
| hd | Helianthus decapetalus | Thin Leaf Sunflower | 15 | 14 lbs./ha | |
| pd | Penstemon digitalis | Foxglove Beardtongue | 5 | 14 lbs./ha | |
| pv | Physostegia virginiana | Obedient Plant | 5 | 14 lbs./ha | |
| rp | Ratibida pinnata | Green Headed Coneflower | 10 | 14 lbs./ha | |
| se | Symphyotrichum ericoides | Heath Aster | 10 | 14 lbs./ha | |
| sna | Symphyotrichum novae-angliae | New England Aster | 3 | 14 lbs./ha | |
| st | Silphium terebinthinaceum | Prairie Dock | 2 | 14 lbs./ha | |
| Wet Mix | | | | | |
| aa | Acorus americanus | Sweet Flag | 10 | 14 lbs./ha | |
| as | Asclepias syriaca | Common Milkweed | 10 | 14 lbs./ha | |
| bce | Bidens cernua | Nodding Wild Marigold | 5 | 14 lbs./ha | |
| cs | Carex stipata | Awlfruit Sedge | 15 | 14 lbs./ha | |
| Iv | Iris versicolor | Blue Flag Iris | 5 | 14 lbs./ha | |
| lc | Lobelia cardinalis | Cardinal Flower | 3 | 14 lbs./ha | |
| tl | Typha latifolia | Common Cattail | 20 | 14 lbs./ha | |
| sa | Scirpus atrovirens | Gree Bullrush | 10 | 14 lbs./ha | |
| sc | Scirpus cyperinus | Wool Grass | 15 | 14 lbs./ha | |
| vh | Verbena hastata | Blue Vervain | 7 | 14 lbs./ha | |
| Sidewalk Mix | | | | | |
| rh | Rudbeckia hirta | Black Eyed Susan | 5 | 14 lbs./ha | |
| ssc | Schizachyrium scoparium | Little Bluestem | 25 | 14 lbs./ha | |
| sc | Sporobolus cryptandrus | Sand Dropseed | 25 | 14 lbs./ha | |
| pc | Poa compressa | Canada Bluegrass | 30 | 14 lbs./ha | |
| pd | Penstemon digitalis | Foxglove Beardtongue | 5 | 14 lbs./ha | |
| am | Achillea Millefolium | Yarrow | 10 | 14 lbs./ha | |

## PLANTING NOTES

1. NO W.B. BURLAP TO BE ROLLED BACK TO REVEAL TOP $\frac{1}{3}$-$\frac{1}{2}$ OF ROOT BALL. NO TRUNK WRAP. NO ANTI-DESICCANT.
2. ALL PLANT MATERIAL SHALL MEET SPECIFICATIONS FOR SIZE, HEIGHT, SPREAD, GRADING, QUALITY, METHOD OF CULTIVATION, AND BALLING AND BURLAP SPECIFICATIONS AS SET OUT IN THE LATEST GUIDE SPECIFICATION FOR NURSERY STOCK PREPARED BY THE CNTA.
3. NO SUBSTITUTIONS IN SPECIES, CULTIVAR, QUANTITY, SIZE OR CONDITION WILL BE PERMITTED WITHOUT THE WRITTEN APPROVAL OF THE LANDSCAPE ARCHITECT. ANY UNAPPROVED SUBSTITUTED MATERIAL WILL BE REQUIRED TO BE REMOVED FROM THE SITE.
4. ANY INCONSISTENCIES FOUND IN THE QUANTITIES AS SHOWN ON THE PLAN AND THE PLANT LIST SHALL IMMEDIATELY BE REPORTED TO THE LANDSCAPE ARCHITECT.
5. STAKE-OUT OF PLANT LOCATIONS AND DELIVERED PLANT MATERIAL TO BE APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLACEMENT.
6. NATIVE OR IMPORTED TOPSOIL SHALL BE TESTED AS SPECIFIED AND APPROVED BY THE LANDSCAPE ARCHITECT PRIOR TO PLACEMENT. PLANTING MIX, WHERE INDICATED, SHALL FOLLOW THE MIX SPECIFICATIONS.
7. PLANT MATERIAL SHALL BE THOROUGHLY WATERED AT THE TIME OF PLANTING.
8. THE CONTRACTOR SHALL PROVIDE MAINTENANCE IMMEDIATELY AFTER THE PLANTS ARE INSTALLED AND CONTINUE THROUGHOUT THE ENTIRE WARRANTY PERIOD. MAINTENANCE REQUIREMENTS SHALL INCLUDE ALL PROCEDURES CONSISTENT WITH PROPER HORTICULTURAL PRACTICES TO ENSURE NORMAL, VIGOROUS, AND HEALTHY GROWTH OF ALL MATERIAL PLANTED. ALL STAKES, WIRE, HOSE, AND OTHER ACCESSORIES MUST BE REMOVED PRIOR TO FINAL WARRANTY INSPECTION.
9. ALL PLANT MATERIAL USED AS REPLACEMENTS FOR UNACCEPTABLE MATERIAL SHALL BE OF THE SAME QUALITY AND REQUIREMENTS PRESCRIBED FOR THE ORIGINAL MATERIAL INCLUDING THE APPLICABLE WARRANTY PERIOD. REPLACEMENTS SHALL BE MADE ONCE UNDER THE WARRANTY.
10. ALL TREES LOCATIONS TO BE STAKED OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOUR NOTICE. ALL SHRUBS TO BE LAID OUT AND APPROVED BY LANDSCAPE ARCHITECT PRIOR TO PLANTING. PROVIDE 48 HOURS NOTICE.
11. SINGLE-NET STRAW BLANKET TO COVER FIRST 2 METRES OF SEED MIX EXTENDING UPWARDS FROM BASE OF SLOPE TO ENSURE MINIMAL SEED DISPLACEMENT BY WATER OR BY WILDLIFE.SHOP DRAWINGS TO BE PREPARED BY CONTRACTOR AND REVIEWED BY LANDSCAPE ARCHITECT.
12. CONTRACTOR TO STAKE OUT THERMAL BED LOCATION AND LOCATE ROOTBALLS ACCORDINGLY SO AS NOT TO PENETRATE THERMAL BED DURING PLANTING.

## LEGEND

- LARGE TREE
- SMALL TREE
- CONIFEROUS TREE
- LARGE SHRUB
- SMALL SHRUB
- SIDEWALK SEED MIX
- DRY SEED MIX
- MEDIUM SEED MIX
- WET SEED MIX
- LIVE STAKING
- CONCRETE PAVING
- UNIT PAVING
- RAILING
- GRAVITY WALL

# EAST FONTHILL

TOWN OF PELHAM

Project /Client

XXXXX

XXXXXXXXXXXXXXX

Project /Client

Issue / Revisions

| No. | Description | Date | By |
|---|---|---|---|
| 1 | ISSUED FOR COORDINATION | 15/03/05 | DM |
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Stamp

THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNTIL SIGNED BY THE LANDSCAPE ARCHITECT.

Drawn By XX

Checked By DM/BH

Date MARCH 05, 2015

The Planning Partnership
urban design . landscape architecture . planning . communications
1255 Bay Street, Suite 201 Toronto, Ontario, Canada M5R 2A9
t. 416.975.1556 f. 416.975.1580 info@planpart.ca



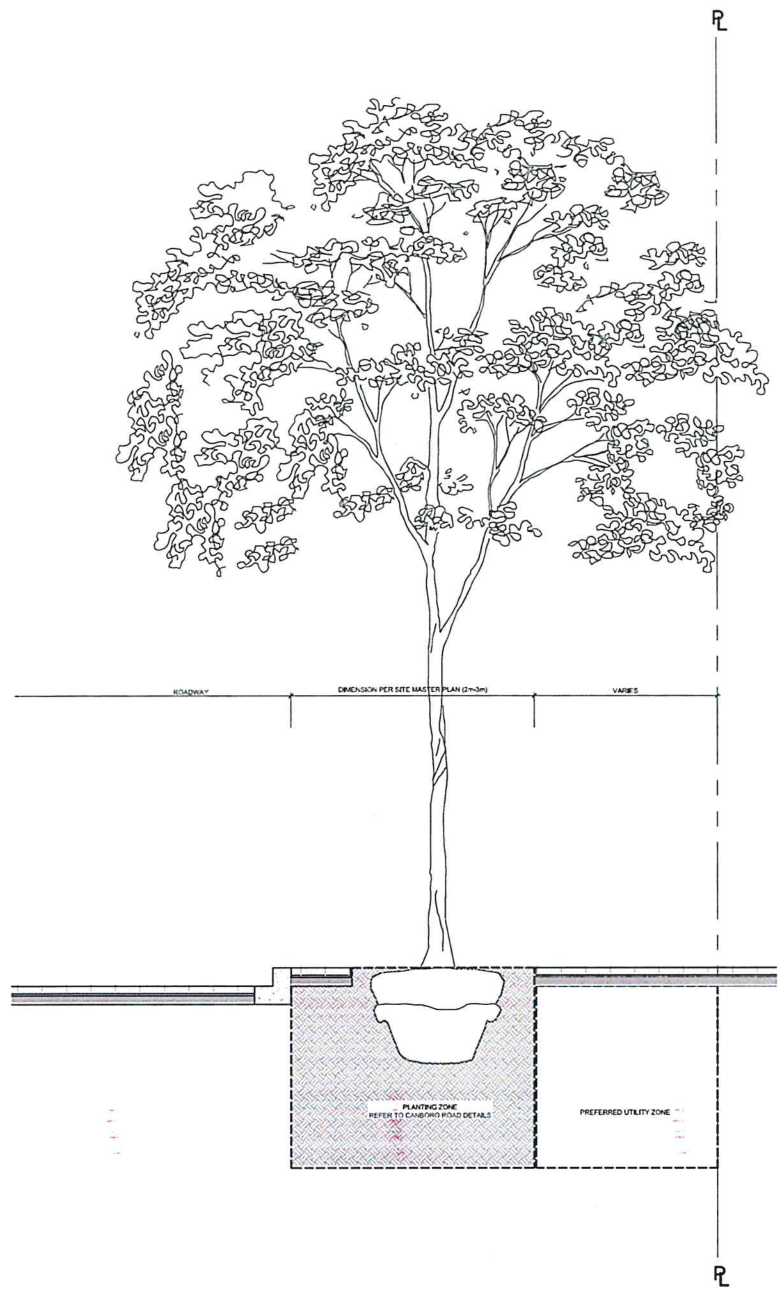
Drawing Title

PLANTING PLAN (SWM POND 1 - BLOCK 5)

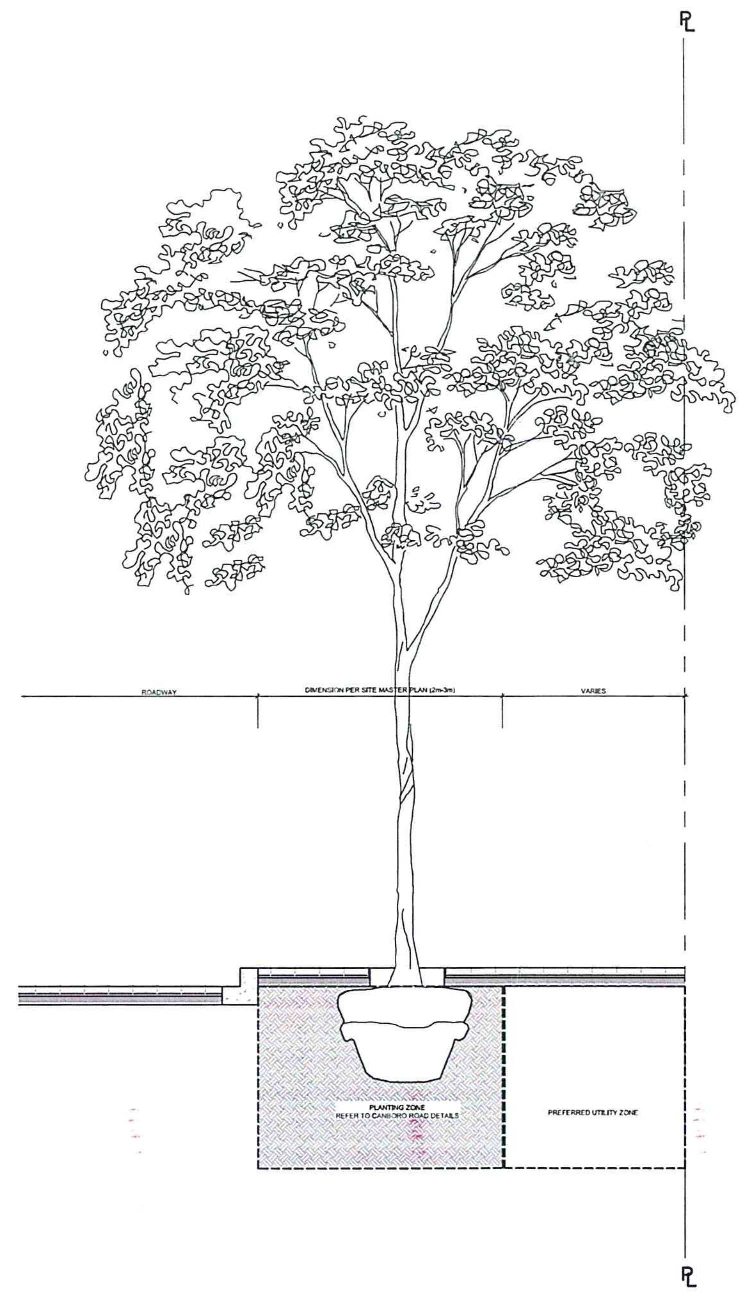
| Scale | Proj. No. |
|---|---|
| 1:200 | 1543 |

Drawing No.

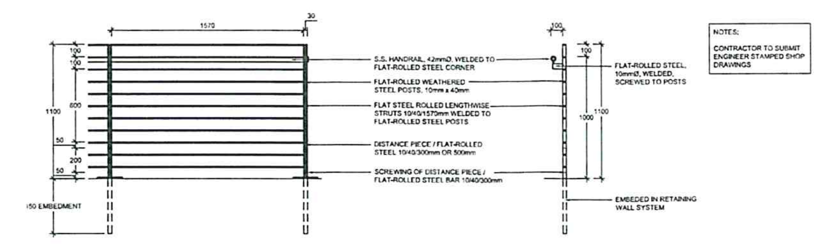
L-200



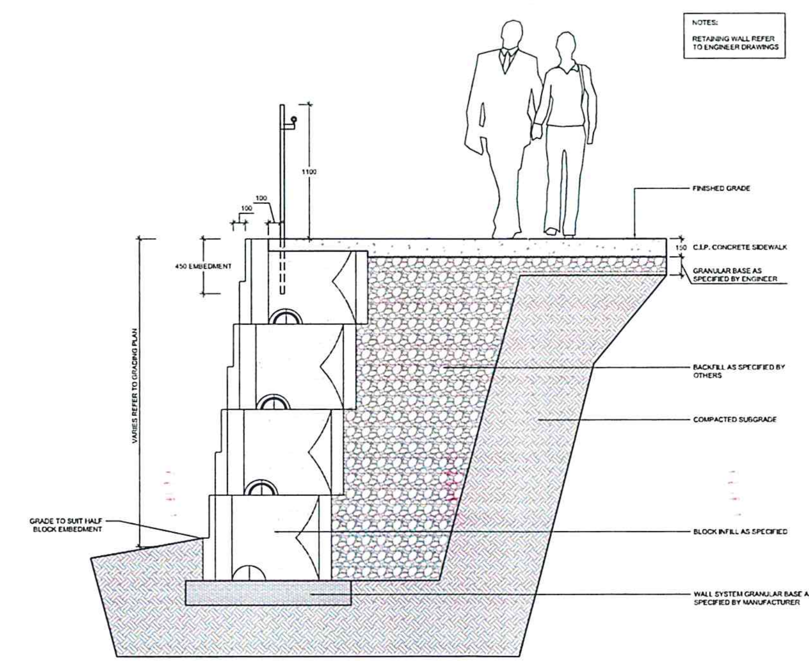

1 L-400 OPEN TREE PIT SCHEMATIC — SCALE - 1:20



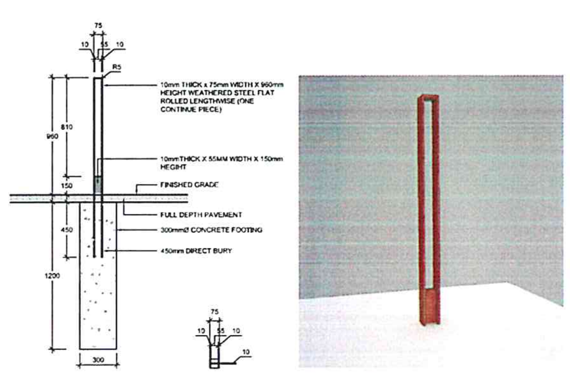

2 L-400 CLOSED TREE PIT SCHEMATIC — SCALE - 1:20



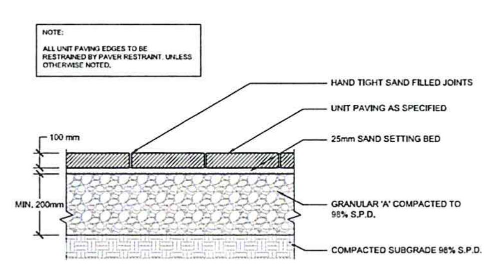

3 L-400 STEEL RAILING WITH HANDRAIL — SCALE - 1:20




4 L-400 RETAINING WALL — SCALE - 1:20




5 L-400 FIXED PEDESTRIAN BOLLARD — SCALE - 1:20




6 L-400 LIGHT DUTY PAVING — SCALE - 1:10

# EAST FONTHILL

TOWN OF PELHAM

Project /Client

XXXXX

XXXXXXXXXXXXXXX

Project /Client

Issue / Revisions

| No. | Description | Date | By |
|---|---|---|---|
| 1 | XXXXX | 15/XX/XX | |
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Stamp

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Drawn By XX

Checked By DM/BH

Date MARCH 05, 2015

The Planning Partnership
urban design . landscape architecture . planning . communications
1255 Bay Street, Suite 201 Toronto, Ontario, Canada M5R 2A9
t. 416.975.1556 f. 416.975.1580 info@planpart.ca



Drawing Title

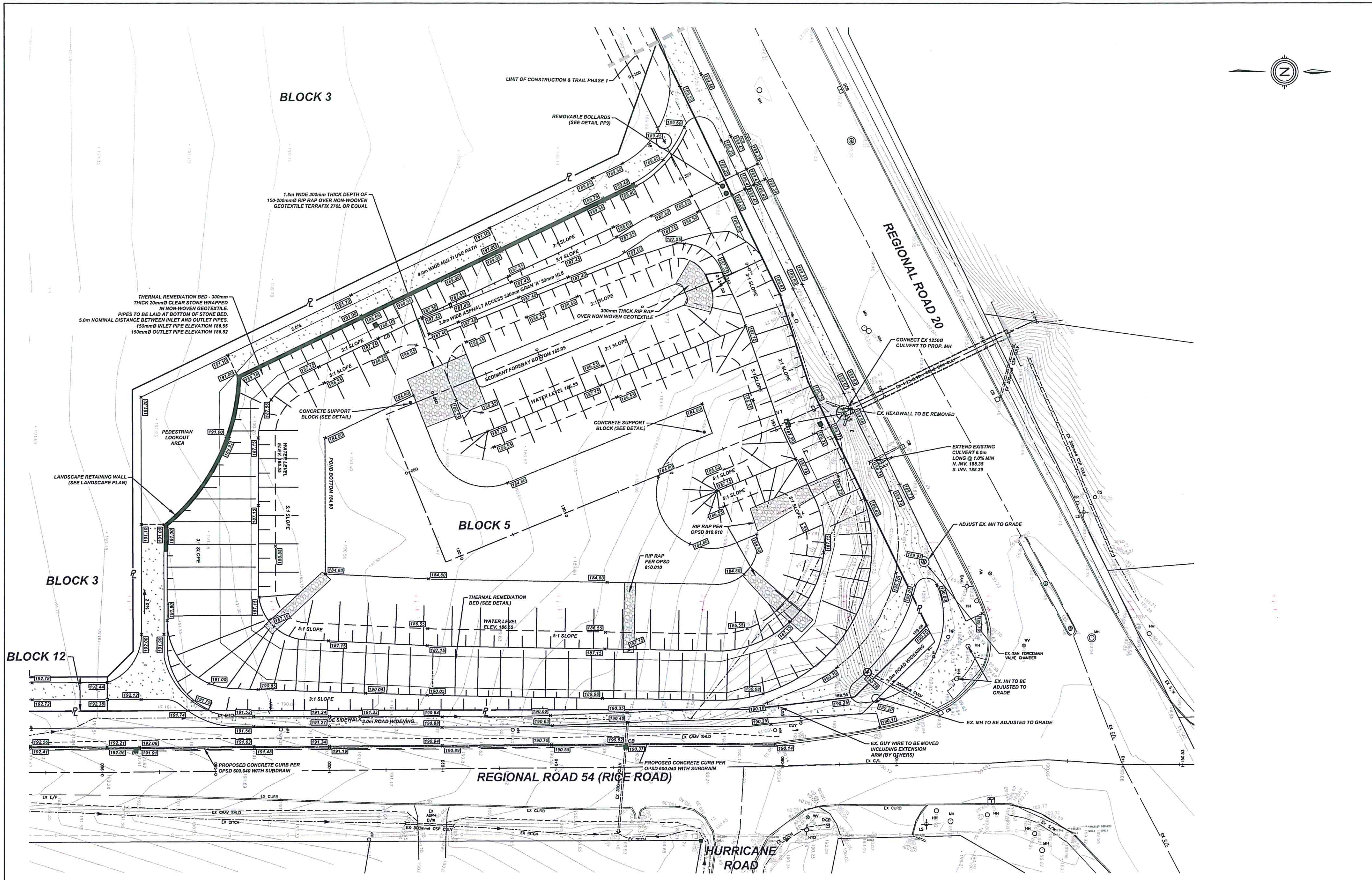
DETAILS

Scale AS SHOWN

Proj. No. 1543

Drawing No.

L-400




| | | | |
|---|---|---|---|
| 4 | ISSUED FOR TENDER | 2015-03-20 | M.C. |
| 3 | REVISED PER REGIONAL COMMENTS | 2015-03-05 | M.C. |
| 2 | REVISED PER REGIONAL COMMENTS | 2015-02-25 | M.C. |
| 1 | REVISED WALL AND PATHS | 2015-02-18 | M.C. |
| 0 | ISSUED FOR MOE APPROVAL | 2014-10-10 | M.C. |
| NO | REVISION | DATE | INIT |

NOTES/LEGEND

1. THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWER AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
2. PROPERTY LINES WERE PLOTTED USING REGISTERED PLANS AND BARS LOCATED IN THE FIELD. TO VERIFY THE ACCURACY OF THESE PROPERTY LINES, A LEGAL SURVEY SHOULD BE PERFORMED PRIOR TO CONSTRUCTION.
3. ALL CONSTRUCTION MUST COMPLY WITH THE NIAGARA PENINSULA STANDARD CONTRACT DOCUMENT.

DRAFTING M.C.
DESIGN A.K.
CHECKED BY M.H.
APPROVED BY A.K.

LICENSED PROFESSIONAL ENGINEER
A.S. KEANE
100109861
Mar 20/15
PROVINCE OF ONTARIO

Pelham NIAGARA

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS
261 Martindale Road
Unit #1
St. Catharines, ON
L2W 1A1
Phone: (905)688-9400
Fax: (905)688-5274

**THE VILLAGE OF EAST FONTHILL**
**NORTH POND**
**GRADING PLAN**

TOWN OF PELHAM

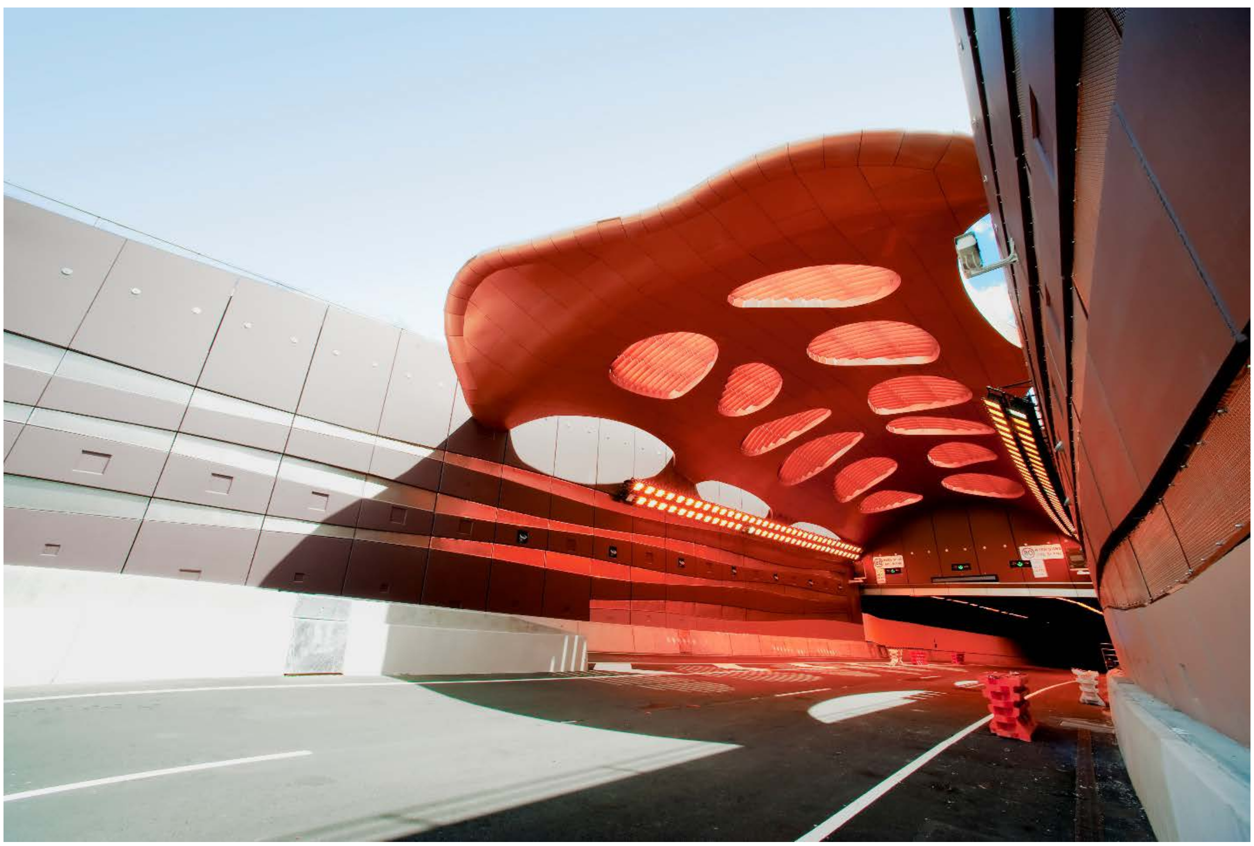
CONSULTANT FILE No. 0473
DATE 2015-03-20
SCALE 1 : 300m
REF. No. -
DWG No. 0473GP
REV. 4

REGIONAL MUNICIPALITY OF NIAGARA

# REGIONAL ROAD 20 REDEVELOPMENT

## POST-DEVELOPMENT MONITORING REPORT

December 11, 2018



11 December 2018

Frank Tassone
Regional Municipality of Niagara
1815 Sir Isaac Brock Way
P.O. Box 1042
Thorold, Ontario
Canada L2V 4T7

Dear Sir:

Subject: Regional Road 20 Redevelopment – Post-Development Monitoring Report

Client ref.: O.01.06 77 020 0841

We are pleased to provide four copies of the Post-development Surface Water and Erosion Monitoring Report for the Regional Road 20 Redevelopment. Copies have been forwarded to the Niagara Peninsula Conservation Authority and the Town of Pelham on your behalf.

The report provides background information on the physical setting, details of the work program completed, and a presentation of the construction monitoring data for the Regional Road 20 Redevelopment. Conclusions and recommendations for future monitoring programs, as necessary, are included in the report. Relevant technical data is appended.

We trust that this report satisfies your requirements.

Yours sincerely,

Bailey Walters

Bailey Walters, MSc, PGeo
Senior Geoscientist

Encl.

cc: Town of Pelham
Niagara Peninsula Conservation Authority

WSP ref.: 111-53018-00

Suite 300
4 Hughson Street South
Hamilton, ON, Canada L8N 3Z1

Tel.: +1 905 529-4414
wsp.com

# SIGNATURES

PREPARED BY

Karen Bailey, BASc
Environmental Consultant

REVIEWED BY

Bailey Walters, MSc, PGeo, $QP_{ESA|RA}$
Senior Geoscientist

This report was prepared by WSP Canada for the account of the Regional Municipality of Niagara, in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

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# TABLE OF CONTENTS

## *TABLES*



## *FIGURES*

## APPENDICES

# 1 INTRODUCTION

The Regional Municipality of Niagara has redeveloped approximately three kilometres of Regional Road 20, between the Highway 406 junction and the Town of Pelham. The development area, shown on Figure 1, is located in the Town of Pelham and the City of Thorold, in the Regional Municipality of Niagara.

## 1.1 BACKGROUND

Jagger Hims Limited (now WSP Canada Limited) completed the 2007-2008 pre-construction surface water and erosion monitoring program, including the field investigation and reporting, which was finalized in April 2009.

Construction for the Redevelopment of Regional Road 20 began in May 2009 and was to be completed in a phased approach over the three years. Phase 1 construction was completed in May to October 2009. Phase 2 construction was completed in June to November 2010. Phase 3 construction, scheduled to be completed in 2011, was postponed and completed in April to October 2012.

Post-construction monitoring was initiated following completion of each construction phase. Phase 1 post-construction monitoring was undertaken from October 2009 to October 2014. Phase 2 post-construction monitoring was undertaken from November 2010 to November 2015. Phase 3 post-construction monitoring began in October 2012 and was completed October 2016. The construction and environmental monitoring phases are outlined in Table 1-1, below.

Environmental monitoring undertaken at the three phase locations after 2008 and prior to the actual start date of the construction is considered as pre-construction monitoring at that location.

**Table 1-1 Regional Road 20 Redevelopment Construction and Monitoring Phases**

| CONSTRUCTION PHASE | LOCATION | CONSTRUCTION PHASE ENVIRONMENTAL MONITORING | POST-CONSTRUCTION ENVIRONMENTAL MONITORING |
|---|---|---|---|
| Phase 1 | East of Rice Road to east of Cataract Road | May 2009 - October 2009 | October 2009 – October 2014 |
| Phase 2 | East of Cataract Road to Hwy 406 | June – November 2010 | November 2010 - November 2015 |
| Phase 3 | West of Station Street to east of Rice Road | April – October 2012 | October 2012 to October 2016 |

This report provides final summary of the monitoring completed between 2008 and 2016, which includes pre-construction, construction, and post-construction monitoring at the Regional Road 20 Redevelopment, located within the Twelve Mile Creek watershed. Phase 1 monitoring requirements were satisfied as of October 2014. The historical monitoring data for Phase 1 is included in the report for reference purposes. Monitoring locations at Cataract Road (SW4 and SW5) are within the area affected by Phase 1 construction, monitoring locations at Rice Road (SW1, SW2 and SW3) are within the area affected by Phase 1 and Phase 3 construction, and the locations at the Merrittville Highway (SW6 and SW7) are affected by Phase 2 construction.

## 1.2 OBJECTIVE AND SCOPE

The principal objective of the construction monitoring program for the Regional Road 20 Redevelopment is to evaluate the impacts from development against the baseline information collected during the pre-construction phase of monitoring. If an unacceptable impact is identified, mitigation measures will be recommended.

The monitoring program included a data collection component, and an analysis and interpretation component. This report provides the results of the surface water and erosion monitoring program activities that occurred over the period of 2016 calendar year.

## 1.3 PHYSICAL SETTING

This section describes the local geology, hydrogeology, and hydrology. Within the Surface Water section, the monitoring locations are described in the physical context.

### *1.3.1 GEOLOGY AND HYDROGEOLOGY*

The redeveloped area between Station Street and Highway 406 in Pelham and Thorold is located to the northeast of the Fonthill Kame Complex.

The site is located within the Haldimand Clay Plain physiographic region (Chapman and Putnam, 1984). The fine-grained glaciolacustrine overburden in the area, deposited by pro-glacial Lake Warren, varies in thickness between 23 and 35 metres.

Local overburden thickness is mapped as approximately 21 m at the eastern end of the project site to 38 m at the west (Vos, 1969). The bedrock contact is located at approximately 160 mASL at the eastern end of the project site to 145 mASL in the west (Feenstra, 1981). The underlying bedrock is a succession of Palaeozoic beds that dip slightly southward, toward Lake Erie.

Typical quaternary geology of the area (Fenco MacLaren, 1995) includes the following units:

**Table 1-2 Quaternary Geology**

| GEOLOGIC UNIT | DESCRIPTION |
|---|---|
| **QUATERNARY DEPOSITS** | **Upper Glaciolacustrine Unit**<br>The surficial overburden in the area is mapped as an upper glaciolacustrine unit that is composed of a brown, reddish, and grey silty clay to clayey silt that is massive to thinly-stratified. This unit may be present from ground surface to approximately 10 metres below ground surface. |

| GEOLOGIC UNIT | DESCRIPTION |
|---|---|
| | **Halton Till**<br>Underlying the upper glaciolacustrine unit is the Halton Till, a brown to grey, massive to laminated clayey silt with a sand content of less than 20 percent. The till is approximately 10 metres thick. |
| | **Lower Glaciolacustrine Unit**<br>Beneath the Halton Till is a lower glaciolacustrine unit of silty clay that is approximately 10 metres thick. |
| | **Lower Till Unit**<br>The Lower Till unit consists of sandy silt with lenses of silt, sand, and gravel. The Lower Till unit is approximately 5 metres thick. |
| **BEDROCK** | **Salina Formation**<br>The bedrock consists of inter-bedded dolostones and shales of the Salina Formation. |

The upper glaciolacustrine unit, the Halton Till, and the lower glaciolacustrine unit are reportedly fairly uniform and predictable. The sand and gravel lenses within the lower till unit are considered non-uniform and unpredictable since they are laterally variable and discontinuous.

Generally, hydraulic conductivity in overburden soils is low due to the fine-grained nature of the material. Local topography (including existing ditches and swales) and seasonal precipitation strongly influence groundwater flow through fractures in the shallow, weathered overburden.

### *1.3.2 SURFACE WATER*

The study area is located within the Twelve Mile Creek watershed, which drains to the north, ultimately to Lake Ontario.

#### 1.3.2.1 CATARACT ROAD TRIBUTARY (SW4 & SW5)

In the vicinity of the intersection of Cataract Road and Regional Road 20, the area is drained to the north, via a roadside ditch and swale through agricultural fields, before joining the Twelve Mile Creek in the northeast of the study area.

Surface water station SW4 is located at the intersection of Cataract Road and Regional Road 20, at the evert of the culvert beneath Regional Road 20. The logger in the culvert was removed on 7 May 2009 to facilitate the replacement of the culvert. The logger was re-installed on 5 June 2009. The original circular corrugated steel pipe culvert was replaced with an elliptical concrete culvert (975 mm x 1535 mm) in May 2009.

From the culvert, the flow continues north in the roadside ditch on the west side of Cataract Road for approximately 460 m. North of the culvert, the roadside ditch collects additional road runoff from Cataract Road and McSherry Lane before flowing east through a culvert under Cataract Road and continuing northeast in a drainage swale.

Surface water station SW5 is located approximately 70 m east of Cataract Road, near the beginning of the agricultural drainage swales.

No natural channel was encountered in the vicinity of the intersection of Regional Road 20 and Cataract Road.

#### 1.3.2.2 RICE ROAD TRIBUTARY (SW1, SW2 & SW3)

The southwestern area of the site drains to Twelve Mile Creek through the Rice Road Tributary of Twelve Mile Creek. A square, closed-bottom concrete culvert (approximately 1.22 m wide) beneath Regional Road 20 drains away water from the area surrounding the intersection with Rice Road.

There are three surface water stations established on the Rice Road Tributary. From 2009 to 2015, SW1 was located at the culvert invert on the south side of Regional Road 20. Runoff collected from the properties northeast, southeast and southwest of the Rice Road intersection flows into the culvert. Following construction of a storm-water management pond in 2015, the invert at the south side was reconfigured making it inaccessible for monitoring and surface water flow that formerly joined into the box culvert beneath RR20 was redirected into the SWM Pond; as a consequence, SW1 was relocated to near the evert (north end) of the box culvert. The result is that roadside drainage that previous discharged directly to the Rice Road Tributary (by-passing SW1) was now directed to the SWM Pond and the resultant (attenuated) discharge was now captured by SW1 monitoring.

SW2 is located approximately 3 m north of the box culvert evert.

Between SW1 and SW2, the tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north side of Regional Road 20. The storm drains collect road runoff from Regional Road 20, west of the Rice Road Tributary. The roadside ditch collects water from Regional Road 20 and Hurricane Road, west of the Rice Road Tributary and east as far as Rice Road. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary.

SW3 is located approximately 40 metres north of the confluence of these inputs, in the natural channel.

#### 1.3.2.3 MERRITTVILLE HIGHWAY TRIBUTARY (SW6 & SW7)

A watercourse, south of Regional Road 20 and east of the Merrittville Highway collects excess surface water and flows north through a concrete box culvert under Regional Road 20. Surface water station SW6 is located approximately 80 m east of the intersection of Merrittville Highway and Regional Road 20.

Surface water flowing from the box culvert joins water collected from the short roadside ditches on the north side of Regional Road 20. The runoff then enters a smaller underground culvert leading from Regional Road 20 on the east side of a restaurant, located at the corner property.

The runoff flows northwest via the buried concrete culvert, crossing beneath Merrittville Highway approximately 140 m north of the Regional Road 20 intersection. Approximately 15 m downstream of the culvert evert the roadside ditch transitions to a natural channel and continues to the north.

Surface water station SW7 is located approximately 50 m downstream of the Merrittville Highway culvert, in the natural watercourse.

# 2 MONITORING PROGRAM

The monitoring program for the Regional Road 20 Redevelopment included surface water flow monitoring, surface water quality sampling and erosion monitoring in accordance with the monitoring requirements detailed in Appendix A. The program has been approved by the Niagara Peninsula Conservation Authority (NPCA).

## 2.1 SURFACE WATER

Surface water flow monitoring stations are shown on Figure 1. Flow monitoring was conducted on a continuous basis at monitoring stations at SW1 at Rice Road and at SW6 at the Merrittville Highway. This monitoring included 10-minute interval measurements of water level, velocity and calculated discharge rate. In addition, water temperatures were recorded electronically by submerged temperature loggers at 10-minute intervals. The water level and temperature at the SW3 monitoring station on the Rice Road Tributary were recorded at hourly intervals by a Levelogger located in a stilling well in the watercourse. Manual flow measurements were made during each site inspection of the monitoring stations. Flows were measured manually generally following the USGS area-velocity method.

Annual surface water quality monitoring was completed to correspond with specific weather conditions that included spring runoff, twice during dry periods, and twice during precipitation. The locations of the surface water monitoring stations are shown on Figure 1, as required by the Terms of Reference (Appendix A). The surface water monitoring protocols are presented in Table 2-1.

**Table 2-1 Monitoring Protocols and Procedures**

| SURFACE WATER SAMPLING |
|---|
| Attempts are made to schedule surface water monitoring events to correspond with intended freshet, dry, or wet event monitoring. |
| Surface water samples at each location are collected prior to flow measurement. |
| Surface water samples are collected directly into the laboratory provided bottles that do not have preservatives. For bottles with preservatives added, standard grab sampling methods are used and then the water is decanted into laboratory provided bottles with the appropriate preservatives. The sample container is pointed upstream and care is taken to avoid particulate and organic matter in the water. |
| Sample bottles are marked, labelled, and sealed in the field. |
| Samples are stored in ice packed coolers and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures. |
| Field parameters (pH, conductivity, dissolved oxygen, and temperature) are measured from a separate beaker of water using calibrated instruments. |
| When the flows are present, stream flow discharge is calculated based on the cross-sectional area of the stream, and the water velocity. |
| A cross-sectional profile of the stream is determined by measuring the cross-sectional width and depth of the wetted stream at incremental sections. The velocity is measured using an electromagnetic velocity meter by measuring the average velocity of each section. |
| Field notes including date, weather, time, sampling data, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book. |

Surface water sampling was conducted during five occasions in 2015 (one spring freshet event, two dry events, and two wet events). Surface water stations SW1, SW2, SW3, SW6 and SW7 were sampled successfully on all five occasions.

Dissolved oxygen, temperature, pH, and conductivity were measured in the field during sampling collection.

Surface water samples were submitted to AGAT Laboratories of Mississauga for analysis of the following parameters, as set out in the Terms of Reference (Appendix A).

- Total Suspended Solids
- Chloride
- Nitrogen Species: Total Ammonia, Nitrate + Nitrite, and Total Kjeldahl Nitrogen
- $BOD_5$
- E. coli
- Total Phosphorus

## 2.2 EROSION

A section of the Rice Road Tributary, from Regional Road 20 northward for approximately 150 m, was surveyed by William A. Mascoe Surveying Limited annually in April from 2007 to 2016. The creek was surveyed at approximately one-metre intervals along the watercourse to obtain breaks in grade, including lowest points, defined stream banks, and the edges of the creek.

Field benchmarks were established relative to the Regional Niagara co-ordinate system in Universal Transverse Mercator (UTM) system co-ordinates in metres of easting and northing referenced to the North American Datum 1983 (NAD83).

# 3 MONITORING PROGRAM RESULTS

Section 3 provides a summary of the results of surface water and erosion monitoring.

## 3.1 SURFACE WATER

Section 3.1 provides a summary of the surface water flow monitoring, automated and manual, and the surface water quality, including temperature and chemical characteristics.

### *3.1.1 AUTOMATED MONITORING STATIONS*

Automated surface water flow monitoring stations were installed on 31 March 2016 and removed on 9 December 2016. Stations were installed at stations SW1 (south side of Regional Road 20 near Rice Road), SW3 (north side of Regional Road 20 near Rice Road), and SW6 (Regional Road 20 and Merrittville Highway), as shown in Figure 1. These stations, except for SW3, consisted of data logging equipment to collect velocity and temperature at 10-minute intervals.

Three types of monitoring station equipment were used. Station SW1 was equipped with a Greyline Stingray™ Portable Level-Velocity logger with submerged depth/velocity sensor. Station SW6 was equipped with an American Sigma 910™ Portable Area-Velocity flow meter with submerged depth/velocity sensor. Surface water station SW6 was also equipped with an Onset StowAway™ Tidbit underwater temperature logger.

As the American Sigma flow meter was routinely found to silt up in the natural channel at SW3, it was replaced with a Solinst Levelogger™ installed within a stilling well in 2010. The stilling well was installed such that its screen transects the creek bed, ensuring that the creek stage is accurately measured. The logger is located in a well sump below the ground surface and is programmed to record water levels at hourly intervals.

The discharge rates were calculated from the direct measurements of velocity and depth using the fixed shape and dimension of the culvert/structure in which each was installed. Discharge rates are calculated using area-velocity method and the water level and velocity data from the American Sigma open channel flow meters. In instances where a positive, non-zero water level was recorded but the velocity was zero, calculated discharge is zero, and vice versa.

At SW3, where creek stage is monitored by the Levelogger located in the stilling well, the discharge rate was related to the recorded water levels through an empirical relationship between the manual discharge rate measurements and the water levels recorded by the logger at the time of the manual discharge rate reading.

The monitoring period was determined based on the occurrence of freezing weather. While the equipment can handle temperatures close to freezing, the pressure transducers use diaphragms that can rupture when frozen.

As noted above, the monitoring station equipment was installed in March or early April of each year, as this was the earliest the equipment could be installed due to freezing weather conditions. Similarly, the monitoring station equipment was removed in November or December of each year due to freezing conditions. While the equipment can handle some temperatures close to freezing, the pressure transducers use diaphragms that can be ruptured when frozen. The exception is the Levelogger, installed below ground surface at SW3, which can remain in situ year-round.

The monitoring equipment was inspected during each site visit. In a number of cases, debris (soil, twigs, worms, etc.) around the sensors was removed. Data from the monitoring equipment were downloaded to a portable laptop in the field. During inspections, spot manual measurements of flow and water depths were made and noted in the field book.

Stream flow was measured manually during each site inspection of the monitoring stations and the results are included in Table B-6, Appendix B. Flows were measured manually at all surface water stations using the USGS area velocity method whereby the depth of the station profile was measured at 10 cm intervals and the velocity measured at 60% of the depth.

The results of the automated flow monitoring are presented graphically on Figures B-1 through B-8, and a summary of the flow data is included in Tables B-1 through B-5, Appendix B.

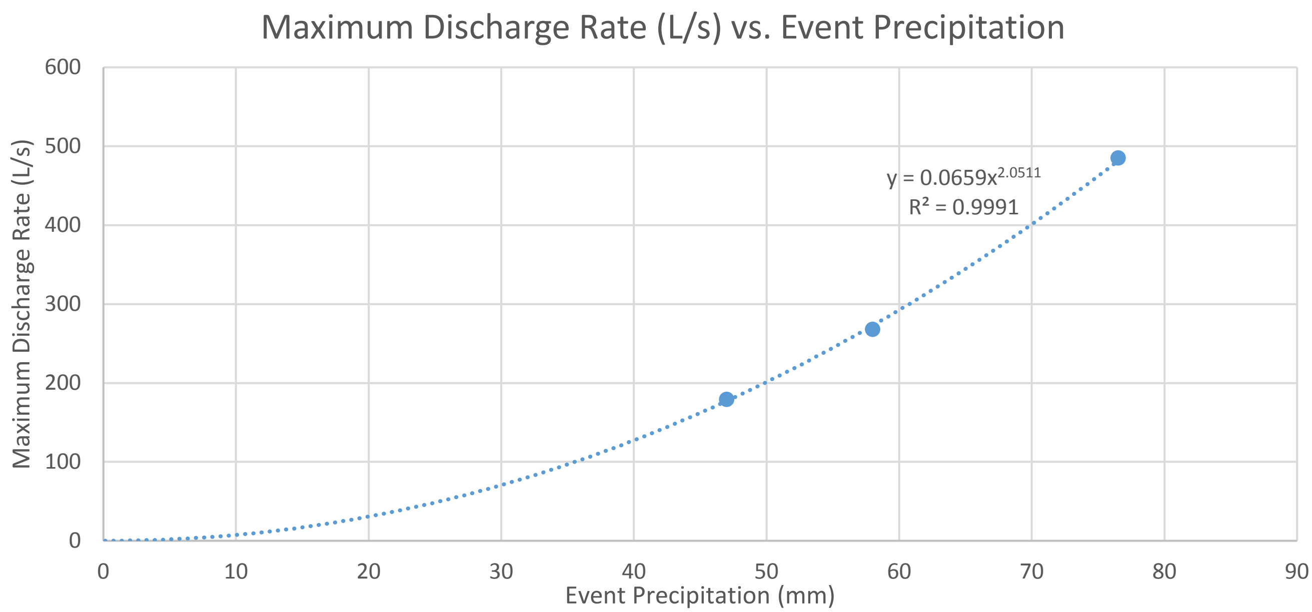
#### 3.1.1.1 CATARACT ROAD TRIBUTARY (SW4)

At station SW4, the five-years of post-development monitoring period ended in 2014. The historical results of the automated flow data collection at SW4 are presented on Figure B-1 for reference purposes. Table B-1 presents a summary of the flow data from SW4.

The maximum discharge rates during each construction period are summarized in the following table and graph.

**Table 3-1 Summary of Maximum Discharges – Cataract Road Tributary SW4**

| Period | Precipitation (mm) 1-week Lead-up | Precipitation (mm) Event | Max 1-hour intensity (mm/h) | Maximum Discharge Rate (L/s) |
|---|---|---|---|---|
| Pre-Construction | 29 | 47 | 5.5 | 179 |
| Construction | 9 | 58 | 39.5 | 268 |
| Post-Construction | 58 | 76.5 | 4.75 | 485 |




Pre-construction maximum discharge was calculated to be 179 L/s. (47 mm storm event with maximum 1-hour intensity of 5.5 mm/h). The maximum discharge calculated for the construction period (May through October 2009) was 268 L/s. The maximum post-construction discharge occurred in late October 2012 and was calculated to be 485 L/s. The discharge

#### 3.1.1.2 RICE ROAD TRIBUTARY (SW1 & SW3)

The results of the automated flow and temperature data collection for SW1 and SW3 are presented on Figures B-2 through B-5 of Appendix B.

Automated flow and temperature measurement at SW1 was recorded with a Greyline Stingray™ Portable Level-Velocity logger installed in the 120-cm concrete box culvert that was constructed during the 2012 monitoring period. The box culvert was extended by approximately 10 m with a concrete pipe between June and September 2015. Table B-2 presents a summary of the 2016 and the historical flow data from SW1. The results of the automated flow and temperature data collection at SW1 are presented on Figures B-2 and B-3. During the 2016 monitoring season, surface water temperature at SW1 on the Rice Road tributary showed seasonal temperature fluctuations.

The precipitation events were determined based on regional climatic data provided in Appendix D.

The results of manual flow measurements, obtained using USGS method, are presented in Table B-6.

The monitoring station at SW3 is located in a natural channel and therefore required modification for automated flow monitoring. A 100 cm-diameter steel half-pipe was installed to house the submerged flow meter sensor, which allows for a uniform correlation between depth, velocity, and flow, in the irregularly shaped natural channel.

Automated flow data at SW3 may be unreliable for some periods during 2009 based on the following issues encountered during periodic site visits:

- Silt accumulation: during the 18 June inspection event, it was noted that silt had accumulated on the submerged flow meter sensor. The silt was removed and the flow meter repositioned to minimise further accumulations.
- Recalibration: during the 24 July inspection event, it was noted that although the sensor was submerged, the meter was recording no depth. The meter was recalibrated in the field, which seemed to correct the issue.
- Dislodgment of monitoring equipment: during the 26 August monitoring event, the half-pipe at this station had been dislodged and washed downstream. The data indicated that this had occurred on 9 August, following very high flows resulting from a substantial rain event.

Due to the issues with the flow meter installation at SW3, in spring 2010, the American Sigma open-channel flow meter and Onset StowAway™ Tidbit were replaced with a Solinst Levelogger™ installed within a stilling well in the stream channel. The Levelogger recorded water levels and temperature. As the logger is installed within the well sump, it is protected from temperature extremes and can remain in place throughout the year.

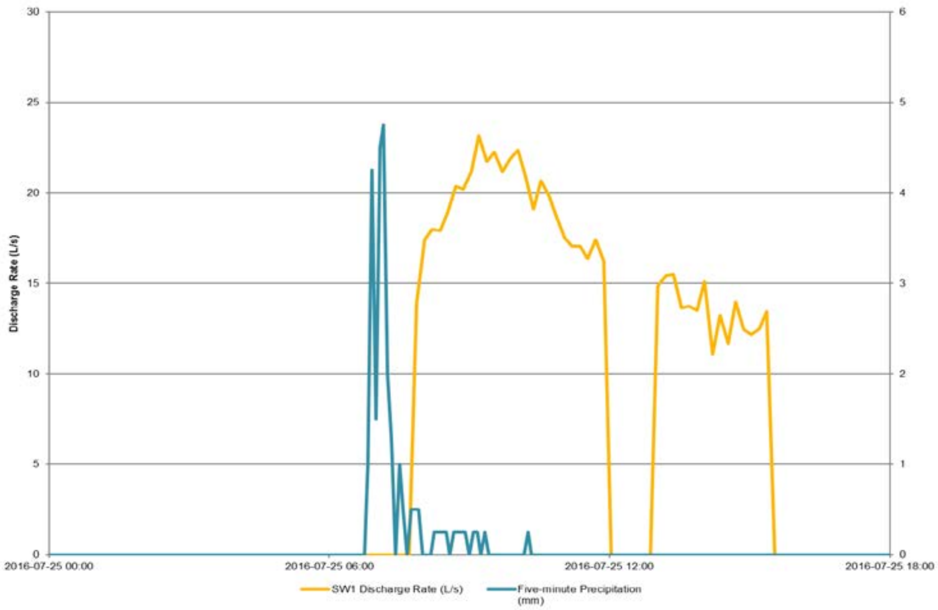
The SW3 flow data from the American Sigma flow meter and the water level data from the Levelogger are presented in Table B-3 and Table B-4, respectively. Water level and discharge rates at SW3 over the 2016 monitoring period in relation to precipitation events are presented graphically in Figures B-5 and B-6, respectively. During the 2016 monitoring season, surface water temperature at SW3 on the Rice Road tributary showed seasonal temperature fluctuations.

The highest discharge rate calculated from the automated flow velocities and depths for the 2016 monitoring period (31 March to 9 December) was approximately 39 L/s (188 L/s in 2015) at the SW1 monitoring station. The average discharge rate, based on the automated measurement rate of ten minutes, was 0.9 L/s (1.2 L/s in 2015). The calculated total discharge over the monitoring period is approximately 70 900 $m^3$ (24800 $m^3$ in 2015).

At downstream station SW3, the highest calculated discharge rate for the 2016 monitoring period (1 April through 9 December 2016) was approximately 39 L/s (134 L/s in 2015) and the average discharge rate was 0.9 L/s (3.6L/s in 2015). The calculated total discharge during the monitoring period is approximately 7 390 $m^3$ (12860 $m^3$ in 2015).

The discharge rates recorded at SW1 in response to a storm event that occurred from 25 July 2016 are summarized on the following figure.

**Figure 3-1 Rice Road Tributary Discharge Hydrograph – 25 July 2016Storm Event**



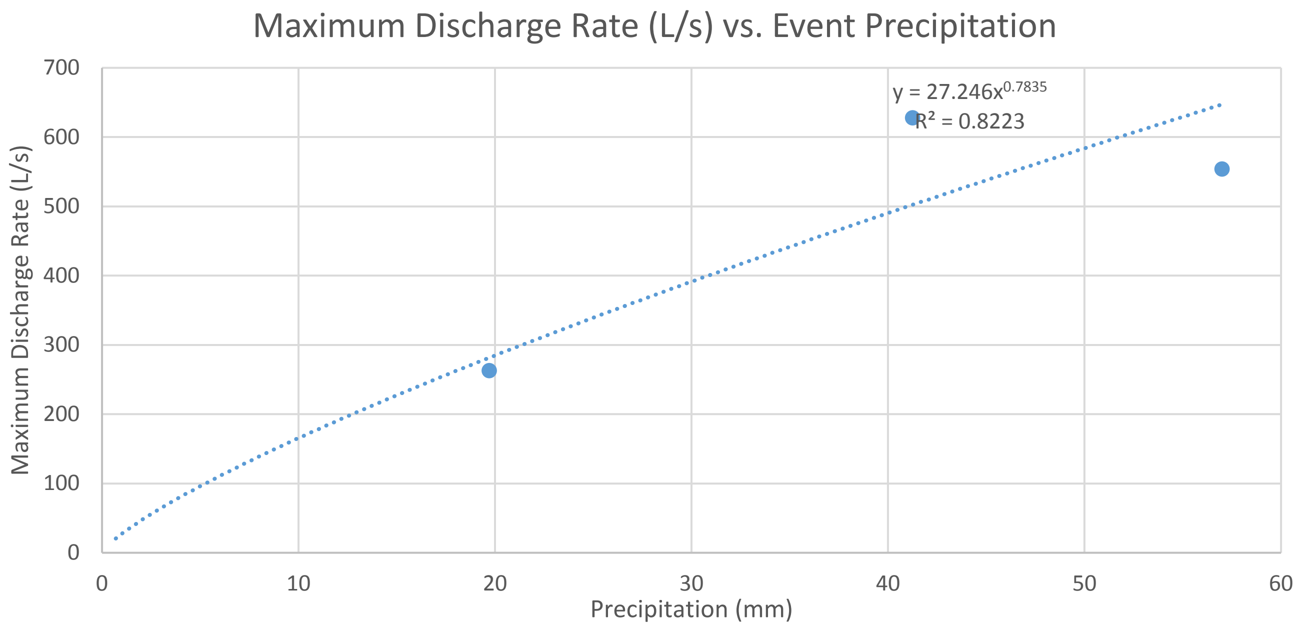

The maximum discharge rate during the storm event was approximately 23 L/s and the lag time (time between the peak precipitation and peak stream discharge) was about 2 hours (the Levelogger is programmed to take measurements every ten minutes).

The larger lag time reflects retention in the storm water management pond (installed in 2014-2015) prior to discharge; in the years prior to installation of the pond, lag times were short with the peaks generally about 10 minutes apart.

The maximum discharge rates during each construction period are summarized in the following table and graph.

**Table 3-2 Summary of Maximum Discharges – Rice Road Tributary SW1**

| Period | Date | Precipitation (mm) 1-week Lead-up | Precipitation (mm) Event | Max 1-hour intensity (mm/h) | Maximum Discharge Rate (L/s) |
|---|---|---|---|---|---|
| Pre-Construction | 2008-07-24 | 32 | 19.7 | 17.5 | 263 |
| Construction | 2009-08-20 | 0.25 | 57 | 10.25 | 554 |
| Post-Construction | 2013-06-10 | 56 | 41.25 | 23.5 | 628 |




#### 3.1.1.3 MERRITTVILLE HIGHWAY TRIBUTARY (SW6)

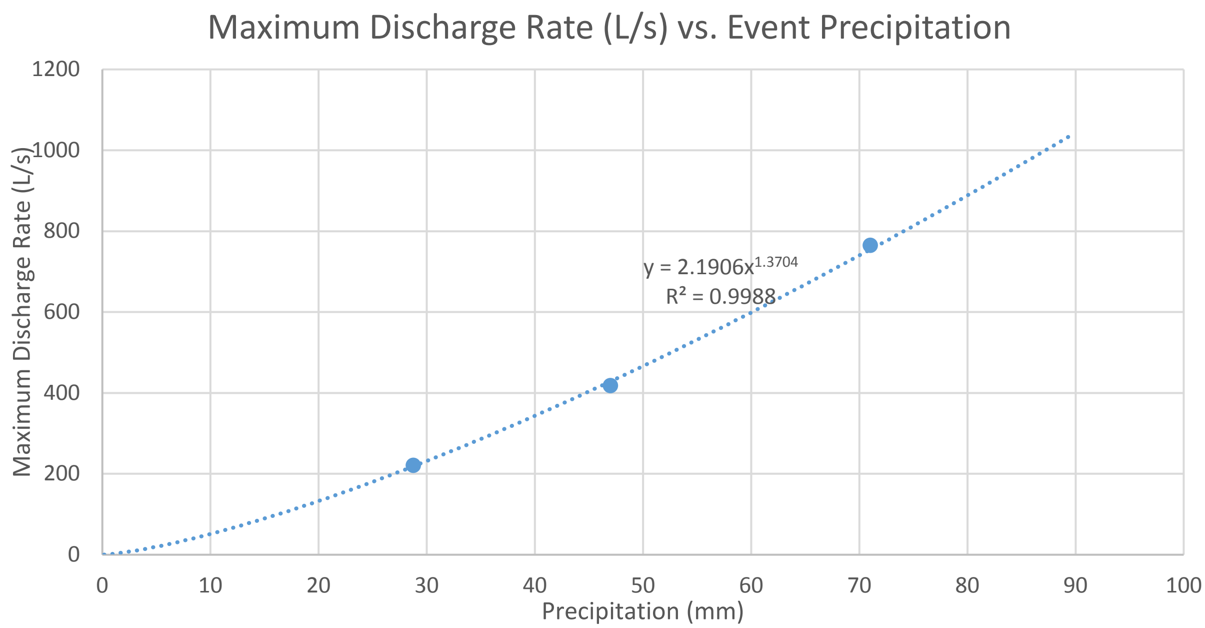
At station SW6, the five-years of post-development monitoring period ended in 2015. The historical results of the automated flow data collection at SW6 are presented on Figure B-6 of Appendix B for reference purposes.

Table B-5 presents a summary of the flow data from SW6 monitoring period in relation to precipitation events. The precipitation events were determined based on regional climatic data from Appendix D.

The results of manual flow measurements, obtained using USGS method, are presented in Table B-6. The discharge rates were calculated from direct measurements of velocity and depth and the fixed dimensions of the concrete storm sewer pipe (92 cm diameter).

**Table 3-3 Summary of Maximum Discharge Rates**

| Period | Date | Precipitation (mm) | | Max 1-hour intensity (mm/h) | Maximum Discharge Rate (L/s) |
|---|---|---|---|---|---|
| | | 1-week Lead-up | Event | | |
| **Pre-Construction** | 2009-04-04 | 26.75 | 47 | 5.5 | 418 |
| **Construction** | 2010-06-06 | 44.5 | 28.75 | 11.25 | 221 |
| **Post-Construction** | 2014-07-28 | 6 | 71 | 44.75 | 764.5 |




### 3.1.2 MANUAL SURFACE WATER FLOW

As shown on Table B-6, Appendix B, manual flow measurements were made during each site inspection of the monitoring stations. The results of the flow monitoring are used for calibration purposes, and to refine the empirical relationship between creek stage and discharge at surface water station, SW3.

### 3.1.3 SURFACE WATER TEMPERATURE

In 2016, the surface water temperature was recorded at SW1 and SW3. The results of 2016 temperature logging are shown graphically, on the figures in Appendix B.

In general, the measured temperatures reflect seasonal variations. Ambient temperatures in the pipes between flow events may be 2 to 5 degrees warmer than the recorded atmospheric temperatures but decrease during storm events, with the exception of temperatures recorded at SW3. Surface water temperatures at SW3 are moderated, as the logger is located within the sump of the stilling well, below the creek bed; thus, recorded temperatures at SW3 reflect seasonal surface water temperatures moderated by the temperature in the shallow sub-surface.

### 3.1.4 SURFACE WATER QUALITY

Collection of surface water quality samples was attempted five times during 2004, 2007, 2008, 2009, and 2011, 2013, 2014, 2015, and 2016, four times during 2005, 2006, and 2010, six times in 2012, to coincide with the spring freshet, two dry events and two wet events. Samples were obtained at the following specific weather events:

**Table 3-4 Surface Water Sampling Dates**

| Year | Spring Freshet | Dry Events (with no precipitation) | Wet Events (with precipitation) |
|---|---|---|---|
| **2007** | | 2007-12-05 | 2007-10-19 |
| **2008** | 2008-03-27 | 2008-10-31 | 2008-08-06<br>2008-12-16 |
| **2009** | 2009-04-06 | 2009-02-13<br>2009-09-10 | 2009-06-18<br>2009-12-01 |
| **2010** | 2010-03-09 | 2010-09-03 | 2010-06-16<br>2010-10-05 |
| **2011** | 2011-06-06 | 2011-03-29<br>2011-09-30 | 2011-06-24<br>2011-11-29 |
| **2012** | 2012-04-25 | 2012-03-15<br>2012-07-27 | 2012-10-10<br>2012-12-05 |
| **2013** | 2013-03-27 | 2013-05-02<br>2013-10-10 | 2013-06-13<br>2013-12-10 |
| **2014** | 2014-03-18 | 2014-04-25<br>2014-09-24 | 2014-06-04<br>2014-12-01 |
| **2015** | 2015-03-12 | 2015-05-13<br>2015-09-30 | 2015-06-09<br>2015-10-29 |
| **2016** | 2016-03-22 | 2016-06-29<br>2016-09-01 | 2016-04-26<br>2016-10-21 |

Water quality results were compared to the Provincial Water Quality Objectives (PWQO) and are presented in Table C-1; Appendix C. Laboratory certificates of analysis for the current reporting period are included in Appendix C.

As presented in the pre-construction monitoring report, existing water quality was generally degraded with respect to concentrations of total phosphorus, *E. coli* bacteria, chloride, TSS, and nitrate. In general, the results of the 2016 analytical testing indicated that:

— Concentrations of total phosphorus generally exceed the PWQO at the sampled surface water monitoring stations.
— Concentrations of *E. coli* bacteria generally exceed the PWQO at the sampled surface water monitoring stations.
— Chloride and conductivity concentrations were periodically elevated at the sampled surface water monitoring stations, likely due to road runoff.
— Concentrations of TSS are periodically elevated in samples from each water course.
— Concentrations of nitrate are periodically elevated at the sampled surface water monitoring stations, likely due to local agricultural activities.

#### 3.1.4.1 CATARACT ROAD TRIBUTARY (SW4 & SW5)

Stations SW4 and SW5 were not sampled in 2016 since the monitoring requirement for these stations ended in 2014. A summary of the historical pre-construction, construction and post-construction results of surface water field and laboratory analyses are included in Table C-1 for reference purposes. Time-concentration graphs of historical parameter concentrations at the Cataract Road Tributary surface monitoring stations are presented in Figure C-1 for reference purposes. Post-development, there has been an increasing trend in chloride, and associated conductivity; a road salt management plan should be established to reduce the road salt entering the stream to pre-development (i.e., pre-2010) concentrations.

#### 3.1.4.2 RICE ROAD TRIBUTARY (SW1, SW2 & SW3)

A summary of the pre-construction, construction and post-construction results of surface water field and laboratory analyses are included in Table C-1. Time-concentration graphs of parameter concentrations at the Rice Road Tributary surface monitoring stations are presented in Figure C-2.

Comparing the post-construction phase water quality results from the surface water stations on the Rice Road Tributary to those of the pre-construction phase, the mean concentrations generally were similar; however as seen in Figure C-2, several parameter concentrations were somewhat variable during the construction phases relative to the pre-construction ranges.

Post-construction parameter concentrations in 2016 generally were similar to the pre-construction phase, with the exception of un-ionized ammonia, which has had increasing peak concentrations since 2014. This may be related to on-going construction project in the vicinity of the intersection and Regional Road 20, which includes construction of a storm water management pond that discharges to the Rice Road Tributary. Water quality in the discharge from the storm water management pond should include sampling for un-ionized ammonia; this should be addressed in the environmental compliance approval (ECA) for the pond.

#### 3.1.4.3 MERRITTVILLE HIGHWAY TRIBUTARY (SW6 & SW7)

Stations SW6 and SW7 were not sampled in 2016 since the monitoring requirement for these stations ended in 2015. A summary of the pre-construction, construction, and post-construction results of surface water field and laboratory analyses are included in Table C-1 for reference purposes. Time-concentration graphs of parameter concentrations at the Merrittville Highway Tributary surface monitoring stations are presented in Figure C-3.

## 3.2 EROSION MONITORING RESULTS

Licensed Ontario Land Surveyors (William A. Mascoe Surveying Limited) surveyed the creek reach annually in April from 2007 to April 2016 following the snow melt/spring freshet, using Total Station survey equipment. The creek profile was surveyed at approximately one-metre intervals, including breaks in grade, lowest point, edge of creek, and top of bank. Field benchmarks were established, and the work was completed relative to the Regional Niagara UTM system for future monitoring purposes.

The survey points from 2007 and 2016 are presented on Figures 2 and 3, respectively, with interpreted topographic contours. The survey points have accuracies of three decimal places, but for presentation purposes the contours are presented at one-metre intervals in metres above sea level (mASL).

Figure 4 presents the difference between 2016 and 2007 surveys, identifying areas of either erosion or accretion relative to the original 2007 survey. The differences were interpolated using the ESRI's ArcGIS using the "Topo to Raster" tool which is a technique used to create a hydrologically correct surface. The algorithm used is based on that of ANUDEM (developed by Hutchinson et al at the Australian National University). Between April 2007 and April 2016, the erosion/accretion in the surveyed reach is generally less than 0.5 m, as seen in Figure 4, with small areas of greater erosion/accretion, which may be related to the removal (by others) of the tree canopy in the area or the natural advancement of the stream meander. Figure 5 presents the difference between 2016 and 2015 survey; during this period, the erosion/accretion in the surveyed reach is generally less than 0.25 m.

## 3.3 CLIMATE DATA

The 5-minute interval climatic data was provided by Regional Niagara's station located at the Town of Pelham offices approximately one kilometre to the southwest. The climate data is included in Appendix D. Precipitation data from the nearest Environment Canada station was used whenever possible. The Regional Niagara Pelham climate station data and the Environment Canada Welland-Pelham data generally agree on total precipitation amounts for 2016.

Normal annual precipitation for the area is approximately 873 mm, based on the 1971-2000 30-Year Normals calculated from Environment Canada climatological station data located at St. Catharines Power Glen (approximately six kilometres north of the study area). St. Catharines Power Glen is the nearest Environment Canada Climatological Station with sufficient data to calculate 30-Year Normals.

There was 646 mm of precipitation received in 2016 in the area, based on the total precipitation measured at the Environment Canada Welland-Pelham climatological station, indicating that 2016 was a below average precipitation year.

# 4 DEVELOPMENT MONITORING PROGRAM

The post-construction monitoring program was initiated at Cataract Road Tributary in October 2009, when Phase 1 construction had been completed. Phase 2 construction was completed in November 2010, at which point post-construction monitoring at Merrittville Highway Tributary began. Phase 3 construction occurred between April and October 2012, therefore construction phase monitoring at the Rice Road Tributary was completed after October 2012; post-construction monitoring at the Rice Road Tributary was initiated in November 2012.

As of October 2014, the five-year post-construction monitoring period at Phase 1 (SW4 and SW5) had been satisfied. As of October 2015, the five-year post-construction monitoring period at Phase 2 (SW6 and SW7) had been satisfied. As of October 2016, five years of post-construction monitoring has been completed at Phase 3 (SW1 and SW3) locations. Thus 5 years of post-construction monitoring has been completed.

Long-term monitoring reports will be compiled and should be circulated to the NPCA, for review, on an annual basis. This is the final monitoring report.

A draft report will be made available to the client for comment, prior to submission to the regulatory agencies. Digital copy of final annual reports will be made available for download by Regional Niagara.

# 5 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the monitoring program presented in this report, the following conclusions are provided:

- In the vicinity of the intersection of Cataract Road and Regional Road 20, surface water and run-off flow north from the culvert (SW4) in the roadside ditch on the west side of Cataract Road until it enters drainage swale (SW5) more than 350 m from the Regional Road 20 intersection and continues on through drainage swales in agricultural fields toward Twelve Mile Creek.
- In the vicinity of Rice Road, the site drains to Twelve Mile Creek through the Rice Road Tributary. A 1.2 m wide, square, concrete culvert (SW1 at invert, SW2 near evert) drains the area surrounding the intersection of Rice Road and Regional Road 20. The creek then flows into a narrow confined, densely wooded creek channel (SW3) converge with Twelve Mile Creek, downstream.
- Runoff from the area southeast of the intersection of Merrittville Highway and Regional Road 20 (SW6) flows through a 0.9 m-diameter concrete culvert, eventually crossing beneath Merrittville Highway. Flow enters a natural channel (SW7) soon after and continues toward Twelve Mile Creek.
- Surface water flow meters at surface water stations SW1, and SW6 collected flow data intermittently for the 2015 monitoring period. The Levelogger at SW3 collected creek stage data successfully for the entire monitoring period.
- Temperatures measured within the channel at SW1 on the Rice Road Tributary, and within the channel at SW6 on the Merrittville Highway reflected seasonal temperature fluctuations of surface water runoff during flow conditions and ambient temperatures when dry. Temperatures recorded at SW3 reflect shallow sub-surface temperatures beneath the streambed.
- Pre-construction water quality generally was degraded with respect to concentrations of total phosphorus, E. coli bacteria, chloride, TSS, and nitrate in each of the watercourses.
- Post-construction surface water quality results generally were consistent with the pre-construction results with the following exceptions:
  - At the Cataract Road Tributary:
    - There is an increasing trend in the concentrations of chloride and conductivity
    - Dissolved oxygen has decreased somewhat
    - Concentrations of *E. coli* have episodic peaks in summer greater that pre-development maxima.
    - Nitrates have decreased (improved)
    - Temperature (relative to ambient air temperature) has decreased somewhat (improved)
  - At the Rice Road Tributary:
    - Chloride and conductivity increased markedly post construction but has decreased since 2014; 2016 concentrations were within pre-construction range
    - Concentrations of un-ionized ammonia at the three sampling locations generally exceeded the pre-construction maxima; an increasing trend since 2014 is observed.
    - Concentrations of *E. coli* have episodic peaks in summer greater that pre-development maxima.
  - At the Merrittville Highway Tributary:
    - There is an increasing trend in the concentrations of chloride and conductivity

- Concentrations of *E. coli* have episodic peaks in summer greater that pre-development maxima.

- Increased conductivity and chloride concentrations relative to pre-construction ranges are generally attributed to an increased total mass of road salt used at the newly-widened roadway. Increased *E.coli* and un-ionized ammonia concentrations relative to pre-construction ranges are attributed to summer seasonal effects (i.e., low water levels and less flow having a concentrating effect).
- Annual erosion surveys of the Rice Road Tributary were conducted annually in April from 2007 to April 2016. Analysis of the annual change in survey points indicated that annual erosion and accretion at any one point is generally less than 0.5 m.

Based on the findings of the monitoring program, the following recommendations are provided for consideration:

- Post-development monitoring at RR20 may be discontinued.
- A road salt management plan should be established to reduce the road salt entering the streams to pre-development (i.e., pre-2010) concentrations.
- Water quality in the discharge from the storm water management pond at the intersection of RR 20 and Rice Road should include sampling for un-ionized ammonia; this should be addressed in the environmental compliance approval (ECA) for the pond.
- Future considerations:
  - Future monitoring programs designed to monitor the effects of development should consider increased pre-development monitoring to grow the base-line database over a greater range of climatic conditions to improve the comparison of development and post-development conditions. Post-development monitoring, could then be reduced.
  - In development areas where there are significant natural features, the features should have some level of continuous monitoring, rather than project-specific monitoring.

# 6 REFERENCES

Chapman, L.J. and D.F. Putnam. 1984. The Physiography of Southern Ontario; Ontario Geological Survey, Special Volume 2, 270 p. Accompanied by Map P.2715 (coloured), scale 1:600 000.

Feenstra, B.H. 1981. Quaternary Geology and Industrial Minerals of the Niagara-Welland Area, Southern Ontario. Ontario Geological Survey, OFR 5361, 260 p.

Feenstra, B.H. 1981: Bedrock Topography of the Niagara and Niagara-on-the-Lake Area, Southern Ontario; Ontario Geological Survey Preliminary Map P.2400, Bedrock Topography Series. Scale 1:50 000

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Fenco MacLaren Inc. 1995. Port Colborne/Fort Erie Waste Management Master Plan, Summary of EPA Activities – Geology/Hydrogeology.

Telford, P.G., B.A. Liberty, and B.H. Feenstra. 1976. Palaeozoic Geology of the Niagara Area, Southern Ontario. Ontario Division of Mines, Map 2344.

Waterloo Hydrogeologic Inc. 2005. Niagara Peninsula Conservation Authority Groundwater Study Final Report.

Vos, M.A. 1969. Drift Thickness of Southern Ontario, Niagara Sheet. Ontario Geological Survey, Preliminary Map No. P.537, Drift Thickness Series, scale 1:50 000.


LEGEND

- SW7 ▲ SURFACE WATER SAMPLING STATION AND DESIGNATION
- SW1 ▲ SURFACE WATER SAMPLING AND CONTINUOUS FLOW MONITORING STATION
- EROSION SURVEY AREA
- REDEVELOPMENT AREA

SOURCE: Aerial photograph taken from the Your Niagara, Public Navigator, Niagara Region, 2009.

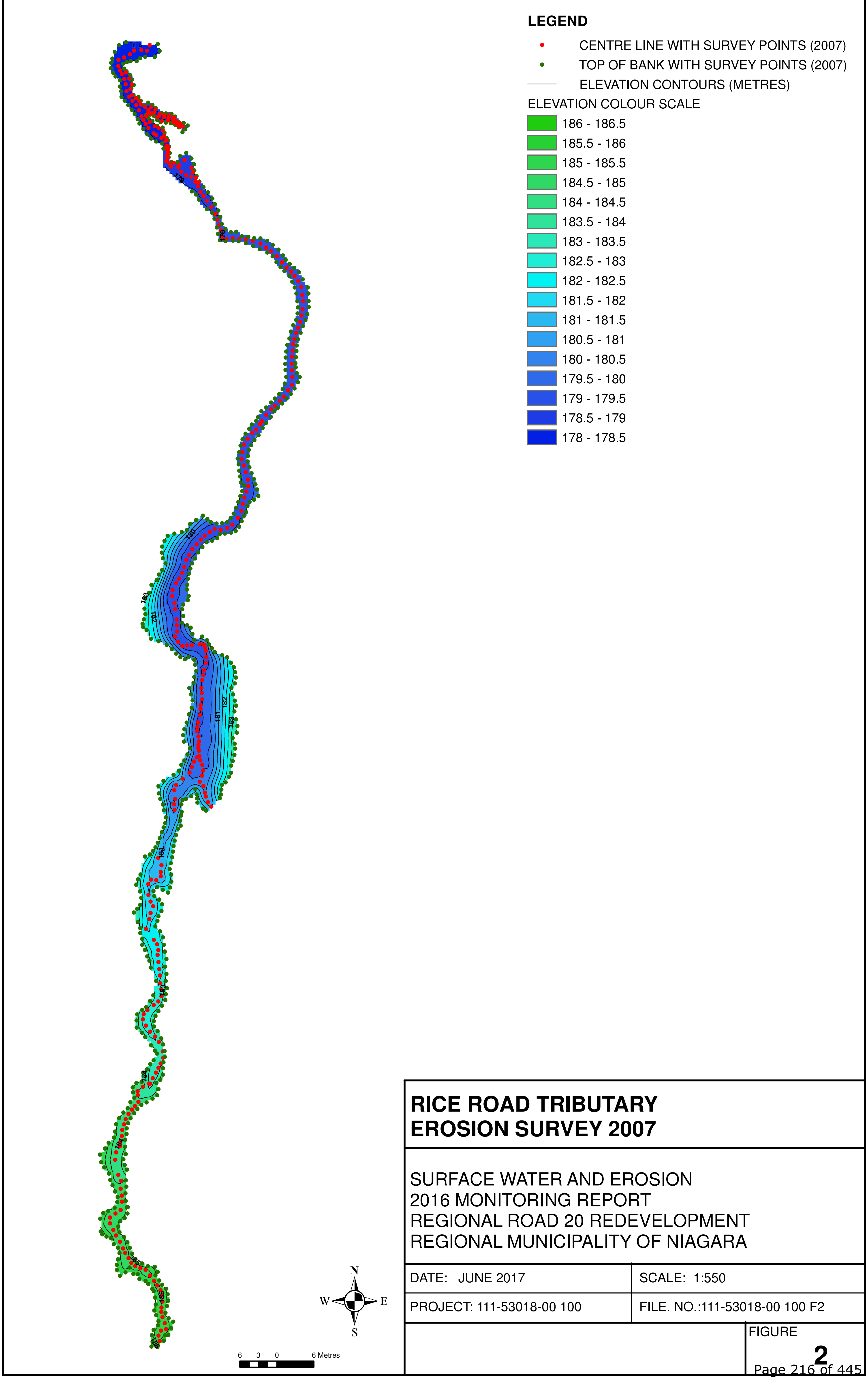
# SITE PLAN

Surface Water and Erosion Monitoring Report
Regional Road 20 Redevelopment
Regional Municipality of Niagara

| | |
|---|---|
| DATE: DECEMBER 2018 | SCALE: 1:6000 |
| PROJECT: 111-53018-00 | REF. NO.: 111-53018-00 F1-SP |

wsp

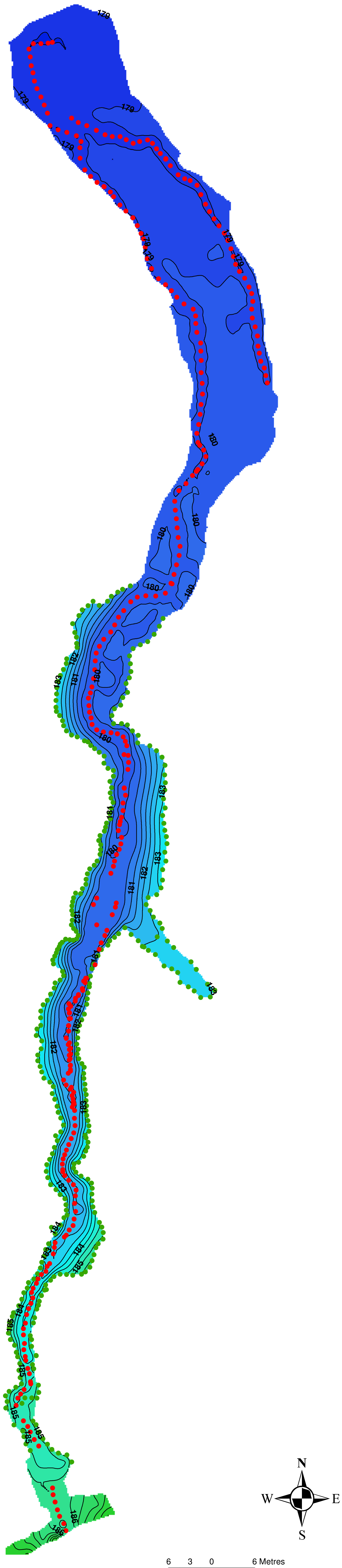
FIGURE 1




# RICE ROAD TRIBUTARY EROSION SURVEY 2007

SURFACE WATER AND EROSION
2016 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: JUNE 2017 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100 | FILE. NO.:111-53018-00 100 F2 |
| | FIGURE 2 |




**LEGEND**

- CENTRE LINE WITH SURVEY POINTS (2016)
- TOP OF BANK WITH SURVEY POINTS (2016)
- ELEVATION CONTOURS (METRES)

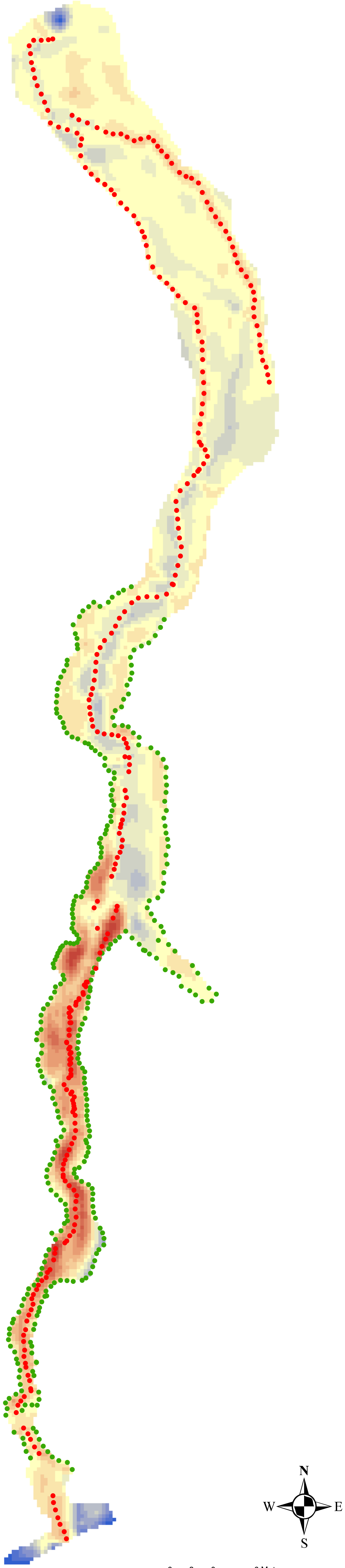
ELEVATION COLOUR SCALE

- 188.5 - 189
- 188 - 188.5
- 187.5 - 188
- 187 - 187.5
- 186.5 - 187
- 186 - 186.5
- 185.5 - 186
- 185 - 185.5
- 184.5 - 185
- 184 - 184.5
- 183.5 - 184
- 183 - 183.5
- 182.5 - 183
- 182 - 182.5
- 181.5 - 182
- 181 - 181.5
- 180.5 - 181
- 180 - 180.5
- 179.5 - 180
- 179 - 179.5
- 178.5 - 179
- 178 - 178.5

## RICE ROAD TRIBUTARY EROSION SURVEY 2016

SURFACE WATER AND EROSION
2016 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: JUNE 2017 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100 | FILE. NO.:111-53018-00 100 F3 |
| | FIGURE 3 |




**LEGEND**

- CENTRE LINE WITH SURVEY POINTS (2016)
- TOP OF BANK WITH SURVEY POINTS (2016)

EROSION/ACCRETION COLOUR SCALE

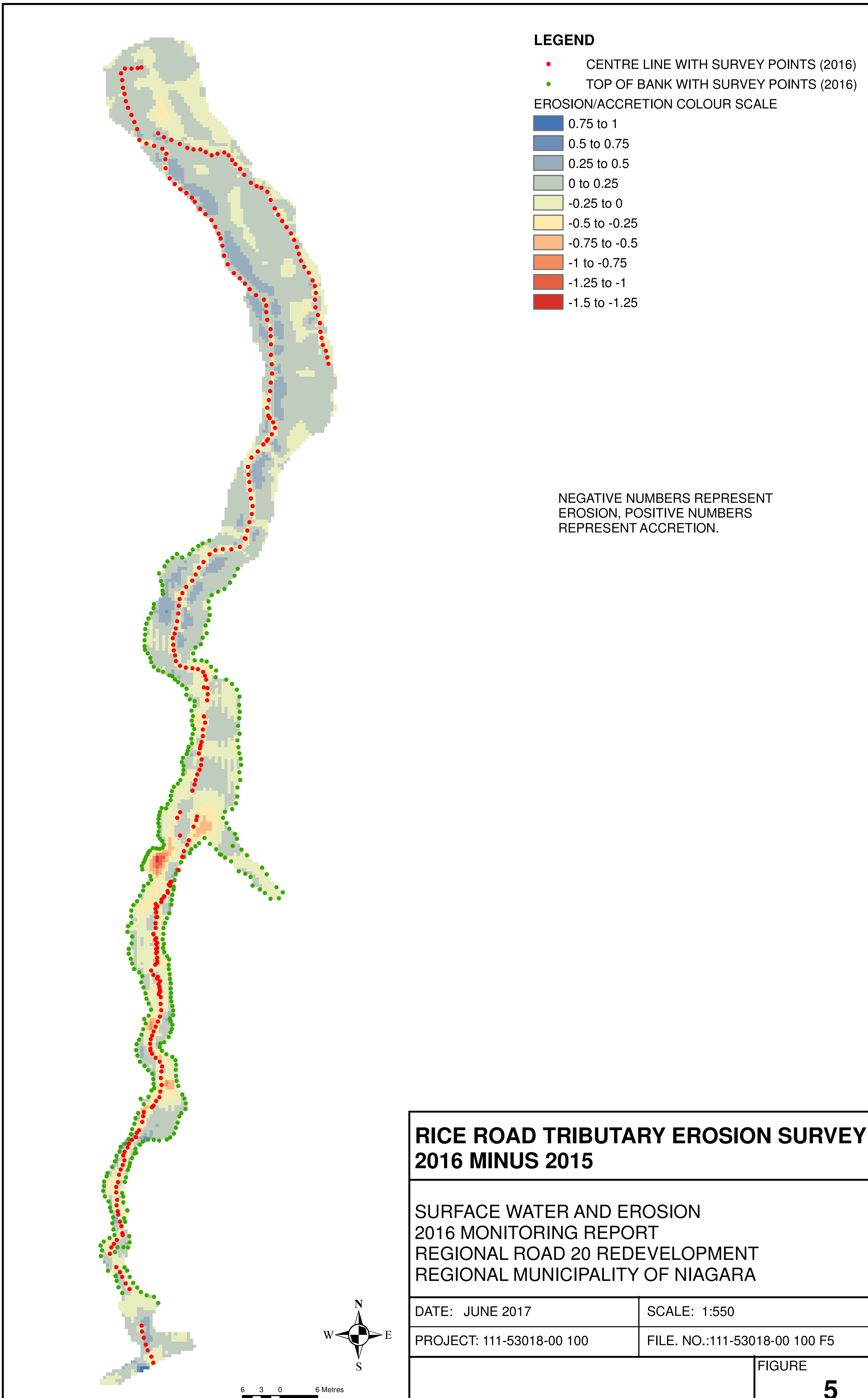
- 2 to 2.25
- 1.75 to 2
- 1.5 to 1.75
- 1.25 to 1.5
- 1 to 1.25
- 0.75 to 1
- 0.5 to 0.75
- 0.25 to 0.5
- 0 to 0.25
- -0.25 to 0
- -0.5 to -0.25
- -0.75 to -0.5
- -1 to -0.75
- -1.25 to -1
- -1.5 to -1.25
- -1.75 to -1.5
- -1.75 to -2

NEGATIVE NUMBERS REPRESENT EROSION, POSITIVE NUMBERS REPRESENT ACCRETION.

# RICE ROAD TRIBUTARY EROSION SURVEY 2016 MINUS 2007

SURFACE WATER AND EROSION
2016 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: JUNE 2017 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100 | FILE. NO.:111-53018-00 100 F4 |
| | FIGURE 4 |




**RICE ROAD TRIBUTARY EROSION SURVEY 2016 MINUS 2015**

SURFACE WATER AND EROSION
2016 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: JUNE 2017 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100 | FILE. NO.:111-53018-00 100 F5 |
| | FIGURE 5 |

# APPENDIX

# A

## TERMS OF REFERENCE

JAGGER HIMS LIMITED
Environmental Consulting Engineers

One St. Paul Street, Suite 601
St. Catharines, Ontario, L2R 7L2
Telephone 905-687-1771
Facsimile 905-687-1773
Toll Free 1-800-668-2598

9 August 2007

David MacLeod, C.E.T.
Project Manager
Public Works Department -Transportation Division
Regional Municipality Niagara
2201 St. David's Road
P.O. Box 1042
Thorold, Ontario,
Canada
L2V 4T7

Dear Mr. MacLeod:

Re: Surface Water Work Program (Revised 9 August 2007)
Regional Municipality of Niagara
Regional Road 20 (Station Street to Highway 406) Redevelopment
File 1070359.00

---

The work program has been revised based on discussion with Mr. Steve Miller at Niagara Peninsula Conservation Authority on 9 August 2007 regarding clarification of erosion monitoring and surface water sampling locations.

## 1.0 PROJECT UNDERSTANDING

It is understood that Regional Road 20 will be redeveloped between Station Street and Highway 406 in Pelham and Thorold.

## 2.0 SCOPE OF WORK

This work program addresses the need for hydrologic monitoring with respect to storm water discharge to Twelve Mile Creek tributaries.

The Niagara Peninsula Conservation Authority (NPCA) staff have indicated that the monitoring requirements for this site will be the same as for the Chestnut Ridge Development, located on Regional Road 20, on the west side of Fonthill. NPCA’s recent evaluation of the long-term monitoring program for the Chestnut Ridge Phase I site indicated that the monitoring undertaken was adequate. The program proposed here is based upon that program.

The Sub-watershed and Environmental Impact Statement prepared for Pelham Area 1 (TSH, 2003) outlined monitoring requirements to provide for the evaluation of conditions for pre-, during and post-development periods. This letter is intended to outline the details for monitoring including location, frequency and timing.

The monitoring requirements are divided into three types:

- Water Quality
- Surface Water Flow
- Erosion

## 3.0 SURFACE WATER MONITORING PROGRAM

### 3.1 SURFACE WATER QUALITY MONITORING

**Monitoring Stations**

1. Regional Road 20, at Rice Road, south side of culvert
2. Regional Road 20, at Rice Road, north side of culvert
3. Rice Road Tributary to Twelve Mile Creek, approximately 30m downstream of Regional Road 20, within the natural channel
4. Regional Road 20, at Cataract Road, culvert outfall
5. Cataract Road tributary, approximately 30m downstream of Cataract Road, within the natural channel
6. Regional Road 20, at Merrittville Highway, culvert outfall
7. Regional Road 20, at Merrittville Highway, approximately 30m downstream of Regional Road 20

**Frequency of Sampling**

Annual Monitoring (spot sampling):

It is proposed that sampling be carried out annually and flow conditions noted for the sites chosen for the following:

- Spring runoff with melting snow. Obtain samples at all sites.
- Two dry period samples – samples are to be taken at all three sites. Because of a potential for lack of base flow, at least one sample should be taken in early spring.
- Two storm events, preferably thunderstorms or after significant rain in a frontal storm. Take samples at all three sites or record of lack of flow if no sample possible.

Flow should be measured whenever sample is taken at each site.

**Parameters to Sample**

General water quality parameters to include:

- Total suspended solids
- Total phosphorus
- Total Kjeldahl nitrogen, ammonia nitrogen, nitrite plus nitrate nitrogen
- BOD5
- Chloride
- E.coli.

- Temperature, pH, conductivity, DO (field parameters)

### 3.2 FLOW MONITORING (INCLUDING TEMPERATURE)

**Monitoring Locations:**

- Regional Road 20, at Rice Road, south side of culvert
- Rice Road Tributary to Twelve Mile Creek, approximately 30m downstream of Regional Road 20, within the natural channel
- Regional Road 20, culvert at Cataract Road
- Regional Road 20, culvert at Merrittville Highway

**Frequency, Parameters**

First year – continuous gauge at all locations (10 min interval) on a seasonal basis (including temperature probe). Duration - March to November (weather, specifically temperature, permitting).

Second year – Modify to reduce dry period monitoring, if encountered.

## 4.0 EROSION MONITORING PROGRAM

### 4.1 MONITORING SECTIONS

- Twelve Mile Creek, Rice Road tributary north from Regional Road 20 for approximately 150m downstream to the former railway.

### 4.2 EROSION SURVEY PARAMETERS

Annual Monitoring:

- Survey on cross-section at minimum 1m intervals, obtaining, as well, any break in grade including lowest point, edge of creek and top of bank.
- Profile at 1m intervals of lowest point (drainage/stream invert) for the reach length.
- Survey to be tied into UTM NAD83.
- Total station equipment to be used.

## 5.0 REPORTING

The results of the surface water monitoring program and the erosion monitoring program will be summarised in an annual report.

### Pre-Construction

The intent of the Year 1 Tasks and Report is to provide baseline data with respect to existing surface water flows, surface water quality and erosion within the receiving watercourse prior to construction at the site. A full year of monitoring shall be completed prior to the initiation of construction. This information will be compared to post-development data in order to determine if the proposed stormwater management strategy is functioning as designed.

### Monitoring During Construction

NPCA will require monthly sediment control inspection reports, circulated to NPCA and the Town of Pelham for review. The sediment control inspection reports will include:

- A description and photograph of all physical sediment control measures
- Commentary on the condition of all sediment control measures, including after all major storm events, including photographs.
- Commentary on all deficient controls, and the specified repair or replacement.
- Proposed measures to avoid the long-term exposure of soil.

Sediment control monitoring and reporting will be undertaken by on-site construction personnel. Therefore, costs for sediment control monitoring during construction have not been included in the estimate.

### Post-Development Monitoring

Prior to construction, a post-development monitoring plan will be submitted to NPCA for review and approval. The long-term monitoring reports will be compiled and circulated to the NPCA for review and approval. A final post-construction monitoring report will be prepared after the completion of five full years of monitoring. This report will also be circulated to the NPCA for approval.

A ‘draft’ report will be made available to the client for comment, prior to submission to the regulatory agencies. Two copies of final annual reports will be provided to Regional Niagara.

## 6.0 PROJECT COSTS

Estimated costs for Year 1 and subsequent years (Year 2 & 3 shown) are provided in the following tables. Costs assume that this work is undertaken in conjunction with monitoring program underway at Rice Road tributary. All costs are exclusive of GST.

| Year 1 Tasks | Professional Fees | Disbursements | Laboratory and Contractor Fees | Totals |
|---|---|---|---|---|
| SW Monitoring Program | 18700 | 12900 | 2700 | 34300 |
| Erosion Monitoring Program | 4300 | 100 | 6400 | 10800 |
| TOTALS | 23000 | 13000 | 9100 | 45100 |

One-time costs included in this estimate include set-up of the surface water flow stations and equipment purchases. The equipment, which will continue to be utilised throughout the long-term monitoring program includes: two American Sigma AV910 flowmeters at $5685 each; and two Tidbit temperature loggers at $150 each. Purchase of the equipment is the best option as rental fees for the monitoring equipment equals the purchase price after approximately 3 months.

A contingency cost of approximately $27000 per year for pre-construction monitoring should be included in order to continue the pre-construction monitoring program to the actual time that construction commences at the site, should construction not begin immediately after the Year 1 program.

| Year 2 & 3 Tasks | Professional Fees | Disbursements | Laboratory and Contractor Fees | Total |
|---|---|---|---|---|
| Surface Water Monitoring Program | 14800 | 900 | 2700 | 18400 |
| Erosion Monitoring Program | 3400 | 200 | 4600 | 8200 |
| TOTALS | 18200 | 1100 | 7300 | 26600 |

Included in the cost estimates for subsequent years is an annual calibration of the flow meters by Can-Am Instruments in their laboratory.

The costs to attend meetings at the request of the client/regulatory agency are not included in this cost estimate and shall be billed as extra at standard rates.

We trust this information is sufficient for your current purposes. If you have any questions or require further information, please call.

Yours truly
JAGGER HIMS LIMITED

C.W. Bailey Walters, M.Sc., P.Geo.
Project Hydrogeologist

## 7.0 REFERENCES

Niagara Peninsula Conservation Authority. 2005. Regional Groundwater Study.

Totten Sims Hubicki. 2003. Sub-Watershed and Environmental Impact Statement prepared for Pelham Area 1.

# APPENDIX

# B SURFACE WATER FLOW DATA

Data tables are not included in this report. Data tables can be provided upon request.

## Figure B-1 - Cataract Road Tributary Flow Monitoring and Precipitation

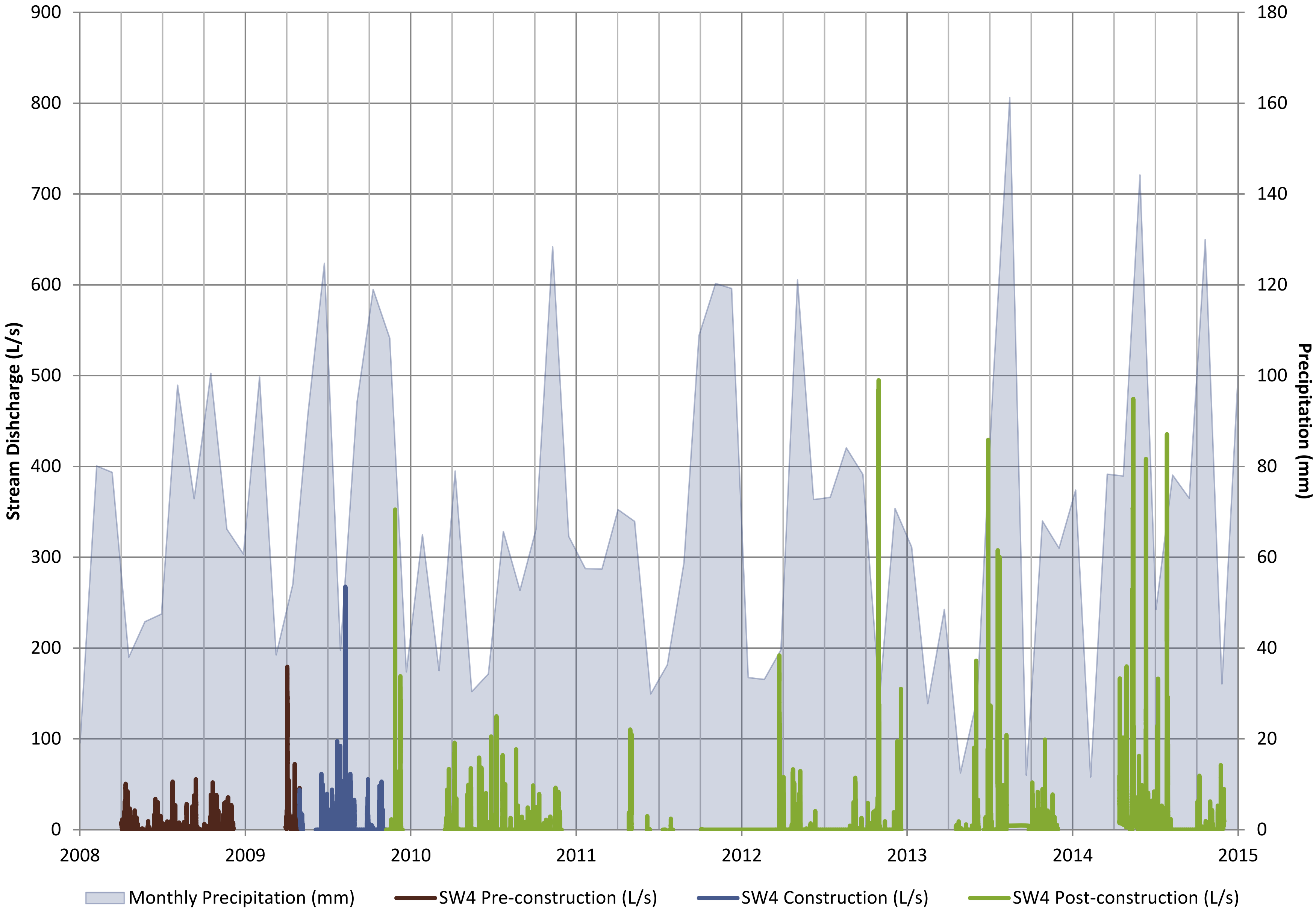


Figure B-2 - Rice Road Tributary Flow Monitoring and Precipitation

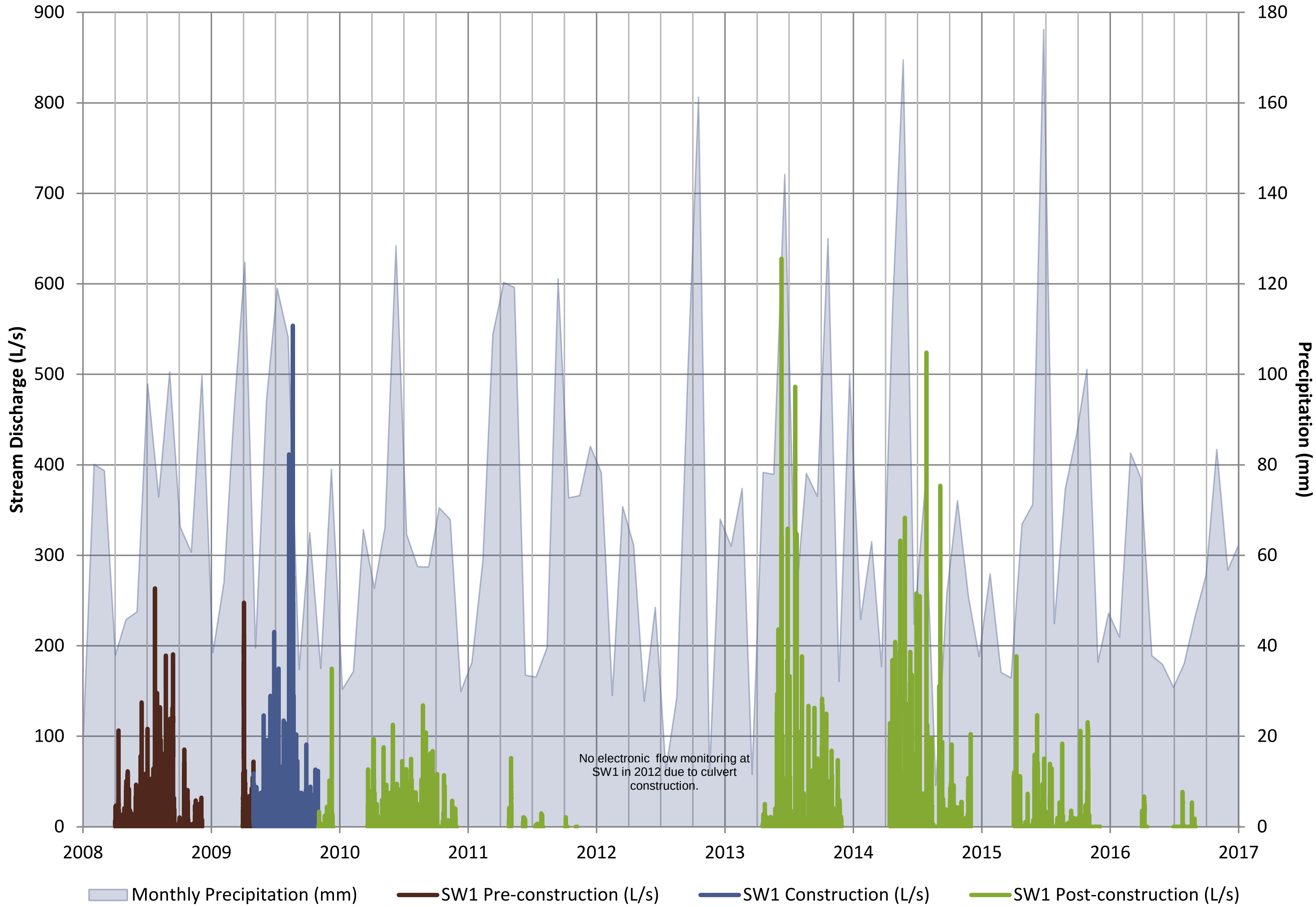
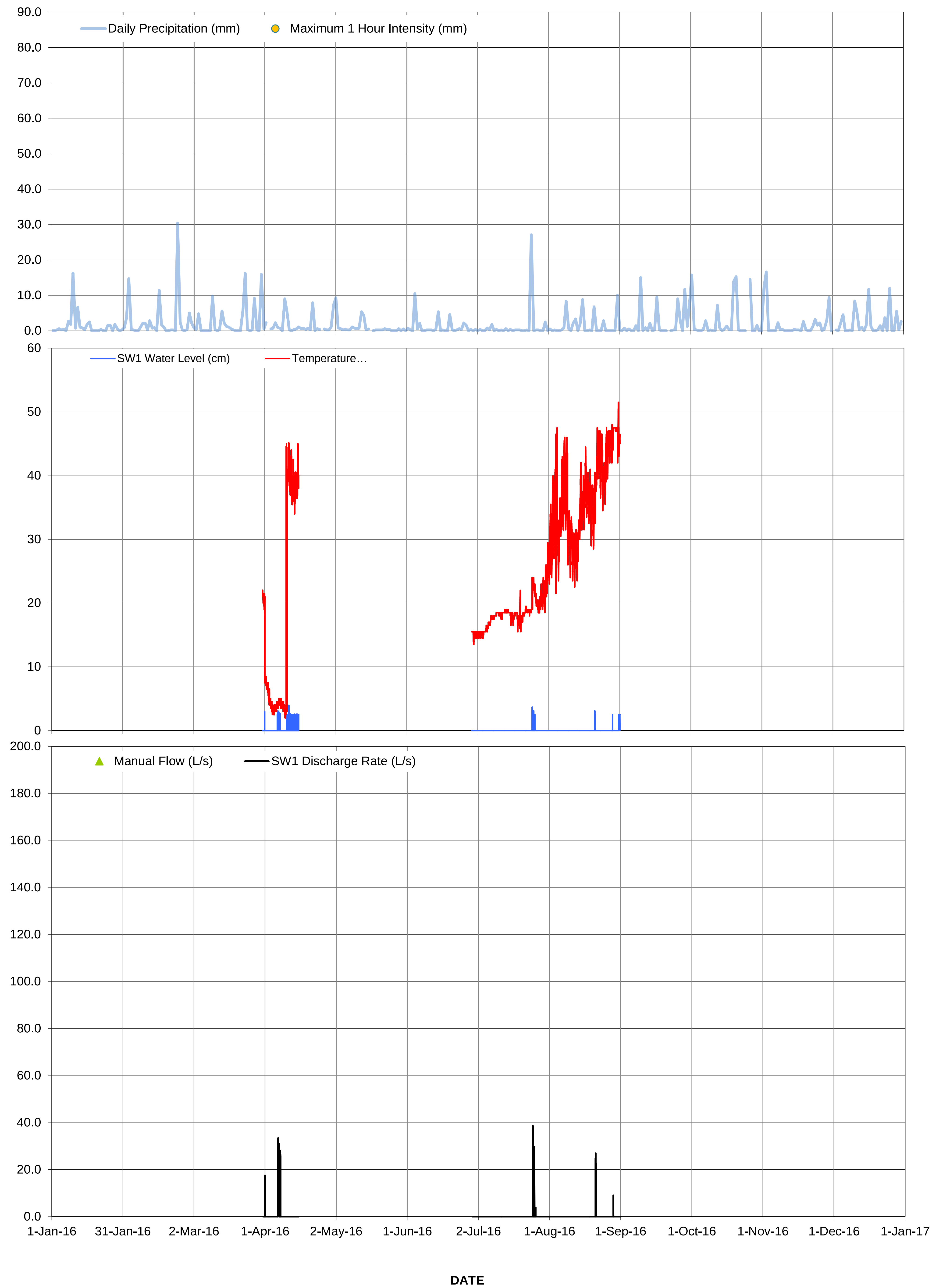
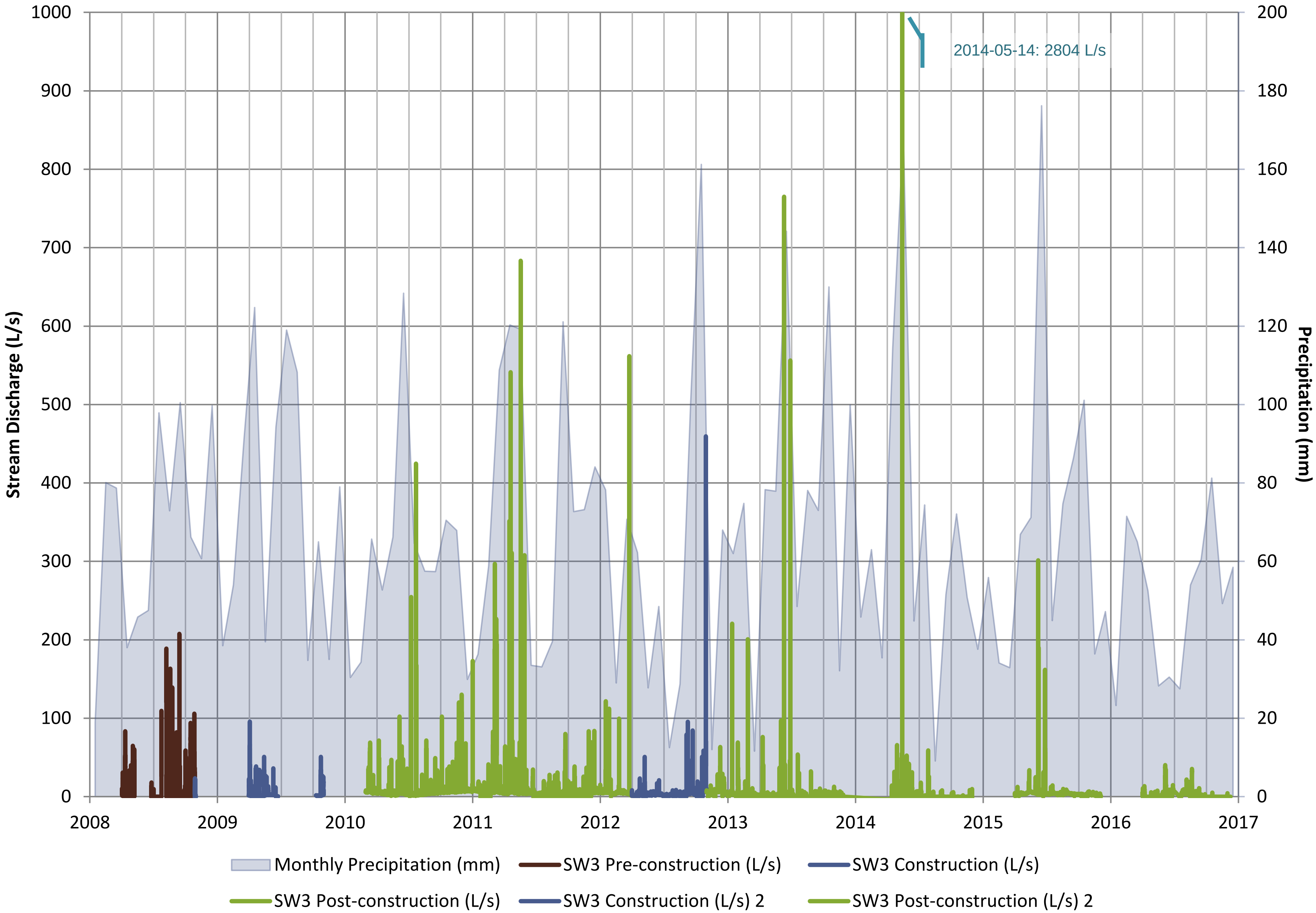


**FIGURE B-3**
**SW1 AUTOMATED AND MANUAL FLOW MEASUREMENTS**
**REGIONAL ROAD 20 REDEVELOPMENT**

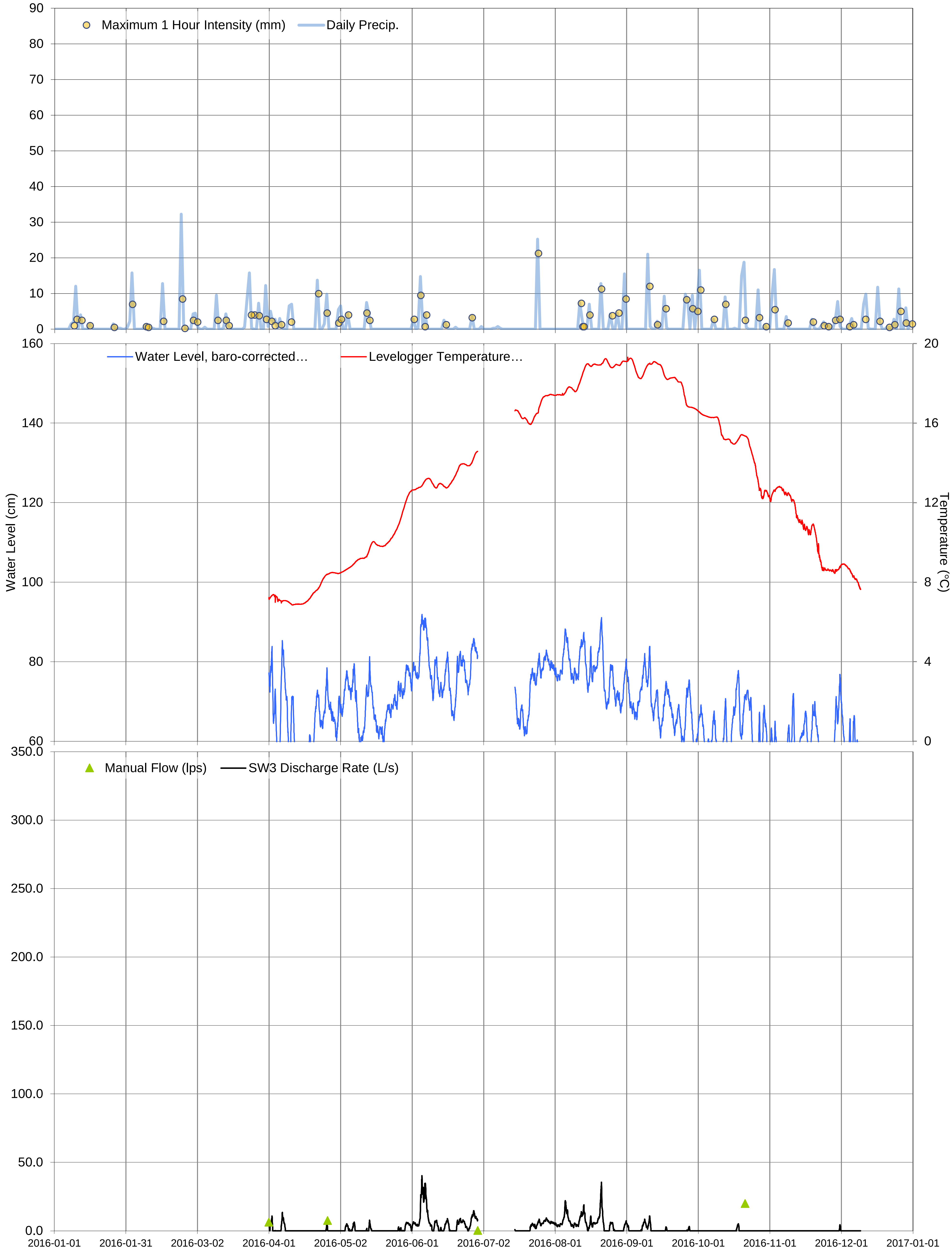



2017-06-3011:10 Z:\Projects\2011\111-53018-00 - Regional Road 20\100\1634010 - 2016 SW Monitoring\Tech\App B - SW Flows\SW1 Rice Road Flow Monitoring.xlsx

# Figure B-4 - Rice Road Tributary Flow Monitoring and Precipitation

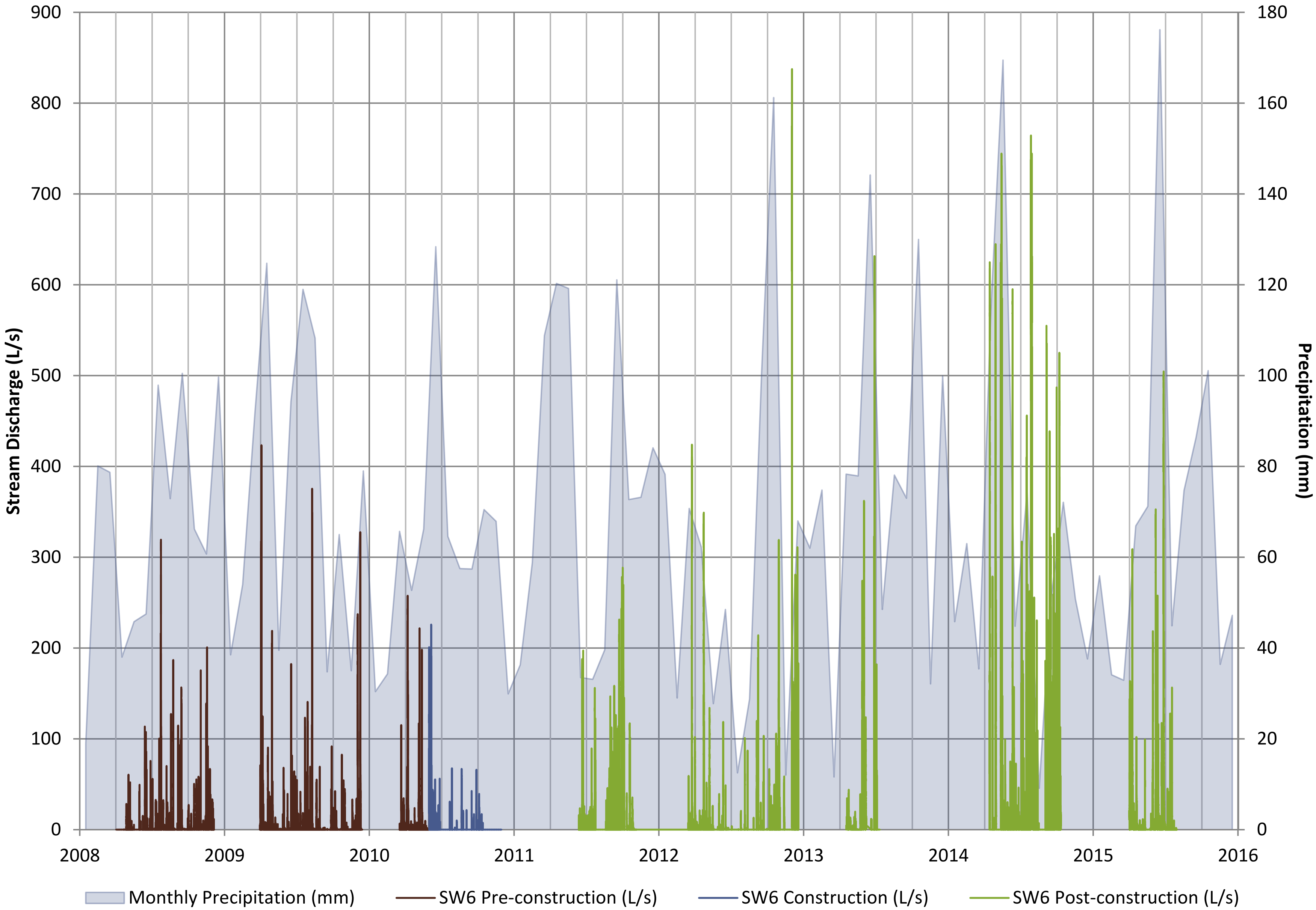


## FIGURE B-5
## SW3 AUTOMATED AND MANUAL FLOW MEASUREMENTS
## REGIONAL ROAD 20 REDEVELOPMENT




2017-05-3016:20 Z:\Projects\2011\111-53018-00 - Regional Road 20\100\1634010 - 2016 SW Monitoring\Tech\App B - SW Flows\SW3 Rice Road Flow Monitoring.xlsx

## Figure B-6 - Merrittville Highway Tributary Flow Monitoring and Precipitation



# APPENDIX

# C SURFACE WATER QUALITY DATA

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW1<br>Rice Rd.<br>2007-10-19 | SW1<br>Rice Rd.<br>2007-12-05 | SW1<br>Rice Rd.<br>2008-03-27 | SW1<br>Rice Rd.<br>2008-08-06 | SW1<br>Rice Rd.<br>2008-10-31 | SW1<br>Rice Rd.<br>2008-12-16 | SW1<br>Rice Rd.<br>2008-12-16 | SW1<br>Rice Rd.<br>2009-02-13 | SW1<br>Rice Rd.<br>2009-04-06 | SW1<br>Rice Rd.<br>2009-06-18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***DUP*** | ***Dry*** | ***Freshet*** | ***Wet*** |
| ***Event Phase*** | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 292.2 | 265.3 | 275.1 | 295.2 | 283.0 | 266.8 | 266.8 | 271.0 | 274.4 | 287.8 |
| pH (unitless) | 6.5 - 8.5 | 7.5 | 8.5 | 6.8 | 7.7 | 7.3 | 8.0 | 8.0 | 7.3 | 7.3 | 8.0 |
| Conductivity (µS/cm) | | 920 | 2450 | 138 | 887 | 1166 | 1194 | 1194 | 1881 | 333 | 1934 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 12.5 | 16.7 | 14.4 | 5.5 | 8.5 | 13.0 | 13.0 | 12.1 | 11.6 | 7.0 |
| Temperature (°C) | | 19.3 | 6.1 | 3.4 | 24.2 | 14.7 | 2.4 | 2.4 | 3.1 | 6.3 | 16.4 |
| Temperature-based DO objective* | calculated | 5.4 | 6.9 | 7.2 | 4.9 | 5.8 | 7.4 | 7.4 | 7.3 | 6.9 | 5.7 |
| Appearance | | slightly cloudy | clear | yellow-brown | clear | clear | yellow-brown | yellow-brown | clear | slightly cloudy | clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 7.7 | 7.7 | 7.9 | 8.0 | 8.0 | 8.0 | 7.9 | 7.9 | 7.8 |
| Total Kjeldahl Nitrogen (TKN) | | 0.36 | 0.33 | 0.52 | 0.35 | 0.12 | 0.21 | 0.17 | 0.34 | 1.01 | 0.38 |
| Total Ammonia (as N) | | <0.02 | <0.02 | 0.11 | 0.06 | 0.02 | 0.03 | 0.04 | 0.05 | 0.14 | 0.15 |
| Un-ionized Ammonia (as N) | 0.02 | <0.0003 | <0.001 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 |
| Total Ammonia (as N, for calculations) | | 0.0100 | 0.01 | 0.11 | 0.06 | 0.02 | 0.03 | 0.04 | 0.05 | 0.14 | 0.15 |
| Nitrate (as N) | | <0.10 | 1.13 | 0.28 | <0.10 | 0.26 | 0.79 | 0.78 | 1.27 | 0.30 | 2.35 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **560** | | **234** | **470** | **1650** | 82 | 63 | 4 | **180** | **740** |
| Total $BOD_5$ | | 1 | <1 | 3 | 2 | 1 | <1 | 1 | <1 | 3 | 1 |
| Chloride | | 57 | 330 | 16 | 77 | 139 | 180 | 183 | 480 | 32 | 261 |
| Total Phosphorus | 0.03 | **0.07** | <0.01 | **0.63** | **0.05** | **0.15** | **0.30** | **0.33** | **0.05** | **0.32** | **0.05** |
| Total Suspended Solids | | 4 | 2 | 91 | 18 | 239 | 24 | 46 | 3 | 39 | 6 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW1 Rice Rd. 2009-09-10 | SW1 Rice Rd. 2009-12-01 | SW1 Rice Rd. 2010-03-09 | SW1 Rice Rd. 2010-06-16 | SW1 Rice Rd. 2010-09-03 | SW1 Rice Rd. 2010-10-05 | SW1 Rice Rd. 2011-03-29 | SW1 Rice Rd. 2011-06-06 | SW1 Rice Rd. 2011-06-24 | SW1 Rice Rd. 2011-09-30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Dry*** | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Construction | Construction | Construction | Construction | Construction | Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 291.6 | 278.1 | 277.1 | 293.0 | 294.8 | 282.2 | 271.4 | 292.2 | 292.4 | 286.2 |
| pH (unitless) | 6.5 - 8.5 | **8.5** | **8.8** | 7.4 | 8.0 | **8.9** | 7.6 | **8.9** | 8.0 | 7.9 | 8.0 |
| Conductivity (µS/cm) | | 499 | 1133 | 178 | 860 | 800 | 414 | 1300 | 1500 | 1017 | 595 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 9.2 | 23.2 | | 13.1 | 17.1 | 9.5 | 7.8 | 12.7 | 6.4 | 7.1 |
| Temperature (°C) | | 23.9 | 9.1 | 2.7 | 25.8 | 27.6 | 14.3 | 7.6 | 22.6 | 18.7 | 16.2 |
| Temperature-based DO objective* | calculated | 4.9 | 6.5 | 7.3 | 4.7 | 4.6 | 5.9 | 6.7 | 5.0 | 5.4 | 5.7 |
| Appearance | | clear to cloudy | clear and colourless | clear yellowish | clear | Clear | light yellow | Clear yellowish | clear | clear | cloudy |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.1 | 8.5 | 7.5 | 8.1 | 8.4 | 7.8 | 8.2 | 8.2 | 7.8 | 7.0 |
| Total Kjeldahl Nitrogen (TKN) | | 0.52 | <0.10 | 0.61 | 0.57 | 1.77 | 0.38 | 0.32 | 0.21 | 0.59 | 0.48 |
| Total Ammonia (as N) | | 0.02 | <0.02 | 0.05 | <0.02 | <0.02 | 0.06 | <0.02 | <0.02 | 0.03 | 0.05 |
| Un-ionized Ammonia (as N) | 0.02 | 0.003 | <0.002 | 0.000 | <0.001 | <0.007 | 0.001 | 0.002 | 0.001 | 0.001 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.02 | 0.01 | 0.05 | 0.01 | 0.01 | 0.06 | 0.01 | 0.01 | 0.03 | 0.05 |
| Nitrate (as N) | | <0.10 | 0.33 | 0.22 | 0.24 | <0.10 | 0.20 | 0.73 | 0.27 | 0.45 | 0.44 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | 24 | 1 | 10 | **140** | **180** | **12300** | 5 | **700** | **340** | **730** |
| Total $BOD_5$ | | <1 | <1 | 3 | 2 | 11 | 1 | <1 | 2 | 2 | 4 |
| Chloride | | 56 | 138 | 25 | 172 | 128 | 58 | 221 | 301 | 177 | 86 |
| Total Phosphorus | 0.03 | **0.19** | 0.03 | **0.32** | **0.05** | **0.39** | **0.09** | **0.07** | **0.06** | 0.03 | **0.15** |
| Total Suspended Solids | | 23 | 11 | 152 | 15 | 281 | 28 | 15 | 158 | 11 | 79 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW1 Rice Rd. 2011-11-29 | SW1 Rice Rd. 2012-03-15 | SW1 Rice Rd. 2012-04-25 | SW1 Rice Rd. 2012-07-27 | SW1 Rice Rd. 2012-10-10 | SW1 Rice Rd. 2012-12-05 | SW1 Rice Rd. 2013-03-27 | SW1 Rice Rd. 2013-05-02 | SW1 Rice Rd. 2013-06-13 | SW1 Rice Rd. 2013-10-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Construction | Construction | Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 279.4 | 285.5 | 279.5 | 296.3 | 282.1 | 274.0 | 276.6 | 289.6 | 289.7 | 285.7 |
| pH (unitless) | 6.5 - 8.5 | 8.2 | 7.9 | 8.1 | 7.6 | 8.1 | 7.8 | 8.2 | 8.2 | 7.5 | 7.3 |
| Conductivity (µS/cm) | | 171 | 1490 | 1147 | 1418 | 740 | 1538 | 1715 | 2060 | 452 | 1630 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 11.1 | **2.5** | 9.1 | **4.6** | 7.2 | 8.2 | 12.3 | 11.0 | 11.7 | 8.5 |
| Temperature (°C) | | 7.1 | 5.9 | 14.1 | 23.7 | 12.9 | 6.3 | 7.0 | 11.0 | 17.0 | 13.9 |
| Temperature-based DO objective* | calculated | 6.8 | 6.9 | 5.9 | 4.9 | 6.0 | 6.9 | 6.8 | 6.3 | 5.6 | 5.9 |
| Appearance | | brownish | slightly cloudy | cloudy | slightly yellow | cloudy brown | Clear | Clear | Clear | Cloudy Brown | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.6 | 8.0 | 8.0 | 7.6 | 7.3 | 7.8 | 8.2 | 8.2 | 7.7 | 8.1 |
| Total Kjeldahl Nitrogen (TKN) | | 1.12 | 0.29 | 1.02 | 0.8 | 0.98 | 0.58 | 0.18 | 0.21 | 1.9 | 0.28 |
| Total Ammonia (as N) | | 0.05 | <0.02 | <0.02 | 0.07 | 0.23 | <0.02 | <0.02 | 0.04 | 0.59 | <0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | 0.000 | 0.001 | 0.001 | 0.006 | 0.000 | 0.000 | 0.001 | 0.006 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.05 | 0.01 | 0.01 | 0.07 | 0.23 | 0.01 | 0.01 | 0.04 | 0.59 | 0.01 |
| Nitrate (as N) | | 0.28 | 0.20 | 0.64 | 0.46 | 0.66 | 0.68 | 0.81 | 1.26 | 17.00 | 1.10 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **217** | 54 | 90 | 92 | **690** | 50 | **910** | 0 | **1090** | 73 |
| Total $BOD_5$ | | 4 | 2 | 3 | 4 | 5 | 5 | 1 | <1 | 2 | <1 |
| Chloride | | 9 | 308 | 177 | 129 | 51 | 235 | 342 | 364 | 21 | 252 |
| Total Phosphorus | 0.03 | **0.32** | **0.04** | **0.17** | **0.11** | **0.27** | **0.07** | <0.01 | 0.01 | **0.65** | 0.03 |
| Total Suspended Solids | | 88 | 11 | 68 | 77 | 51 | 39 | 3 | 4 | 65 | 12 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW1 Rice Rd. 2013-12-10 | SW1 Rice Rd. 2014-03-18 | SW1 Rice Rd. 2014-04-25 | SW1 Rice Rd. 2014-06-04 | SW1 Rice Rd. 2014-09-24 | SW1 Rice Rd. 2014-12-01 | SW1 Rice Rd. 2015-03-12 | SW1 Rice Rd. 2015-05-13 | SW1 Rice Rd. 2015-06-09 | SW1 Rice Rd. 2015-09-30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 267.9 | 273.0 | 283.1 | 288.5 | 288.7 | 273.9 | 272.2 | 273.2 | 289.7 | 285.9 |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 7.6 | 8.3 | 7.4 | 7.6 | 7.7 | 7.4 | 7.7 | 8.4 | 7.7 |
| Conductivity (µS/cm) | | 3340 | 4540 | 2860 | 2080 | 1571 | 2740 | 3120 | 1631 | 1626 | 376 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 7.8 | 11.8 | 11.0 | 9.7 | 9.3 | 8.6 | 11.0 | 10.4 | 8.2 | **3.4** |
| Temperature (°C) | | 4.3 | 3.1 | 8.5 | 16.7 | 15.0 | 2.1 | 0.4 | 11.9 | 17.8 | 16.2 |
| Temperature-based DO objective* | calculated | 7.1 | 7.3 | 6.6 | 5.6 | 5.8 | 7.4 | 7.7 | 6.2 | 5.5 | 5.7 |
| Appearance | | Clear | Clear | Clear | Clear | Clear | Clear | Clear | Clear | Cloudy brown | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.7 | 8.1 | 7.9 | 7.7 | 7.8 | 7.5 | 7.6 | 7.7 | 8.1 |
| Total Kjeldahl Nitrogen (TKN) | | 0.71 | 0.33 | 0.29 | 0.41 | 0.31 | 0.44 | 3.78 | 0.52 | 1.57 | 0.24 |
| Total Ammonia (as N) | | 0.08 | 0.11 | 0.06 | 0.05 | 0.12 | 0.05 | 1.29 | 0.1 | 0.03 | <0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.001 | 0.002 | 0.000 | 0.001 | 0.000 | 0.003 | 0.001 | 0.002 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.08 | 0.11 | 0.06 | 0.05 | 0.12 | 0.05 | 1.29 | 0.1 | 0.03 | 0.01 |
| Nitrate (as N) | | 1.29 | 1.44 | 1.63 | 0.96 | <0.10 | 0.56 | 1.50 | 0.50 | 0.26 | 0.17 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <1 | <0.5 | <0.05 | <0.05 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | 61 | 10 | 0 | 74 | 92 | **230** | **400** | **1100** | **10800** | 58 |
| Total $BOD_5$ | | 3 | 1 | <1 | 10 | 1 | 3 | 10 | <5 | <5 | <5 |
| Chloride | | 809 | 1260 | 639 | 398 | 205 | 715 | 1170 | 341 | 24 | 27 |
| Total Phosphorus | 0.03 | 0.01 | **0.07** | 0.03 | **0.07** | 0.02 | **0.12** | **0.78** | **0.05** | **0.55** | **0.04** |
| Total Suspended Solids | | 8 | 17 | 4 | 4 | 3 | 36 | 20 | <10 | 228 | 10 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW1 Rice Rd. 2015-10-29 | SW1 Rice Rd. 2016-03-22 | SW1 Rice Rd. 2016-04-26 | SW1 Rice Rd. 2016-06-29 | SW1 Rice Rd. 2016-09-01 | SW1 Rice Rd. 2016-10-21 |
|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | |
| Air Temperature (K) | | 283.0 | 275.5 | 273.2 | 292.1 | 291.5 | 282.2 |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 8.8 | 8.3 | 8.3 | 7.6 | 8.2 |
| Conductivity (µS/cm) | | 859 | 1929 | 1308 | 1530 | 1180 | 600 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | **8.2** | 13.2 | 12.0 | 5.2 | **3.9** | 7.9 |
| Temperature (°C) | | 11.9 | 6.7 | 8.0 | 23.8 | 24.4 | 16.0 |
| Temperature-based DO objective* | calculated | 6.2 | 6.8 | 6.6 | 4.9 | 4.9 | 5.7 |
| Appearance | | slightly cloudy | Cloudy | Light brown, cloudy | Clear, colourless | Light brown, cloudy | Slightly cloudy |
| **LABORATORY ANALYSES** | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.3 | 8.1 | 8.0 | 7.7 | 8.2 | 7.7 |
| Total Kjeldahl Nitrogen (TKN) | | 0.27 | 0.79 | 0.59 | 0.59 | 0.59 | 0.35 |
| Total Ammonia (as N) | | 0.23 | <0.02 | 0.11 | 0.13 | <0.02 | <0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.004 | 0.002 | 0.004 | 0.012 | 0.000 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.23 | 0.01 | 0.11 | 0.13 | 0.01 | 0.01 |
| Nitrate (as N) | | 1.84 | 1.20 | 0.59 | <0.25 | <0.25 | <0.05 |
| Nitrite (as N) | | <0.25 | <0.5 | <0.25 | <0.25 | <0.25 | <0.05 |
| Dissolved Nitrite + Nitrate | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | 84 | 0 | 90 | 16 | **400** | **186** |
| Total $BOD_5$ | | <5 | 6 | <5 | <5 | <5 | <5 |
| Chloride | | 43 | 415 | 253 | 351 | 193 | 49 |
| Total Phosphorus | 0.03 | **0.05** | 0.02 | **0.08** | **0.06** | **0.06** | **0.05** |
| Total Suspended Solids | | 103 | 14 | 60 | 36 | 34 | 15 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW2 Rice Rd. 2007-10-19 | SW2 Rice Rd. 2007-12-05 | SW2 Rice Rd. 2008-03-27 | SW2 Rice Rd. 2008-08-06 | SW2 Rice Rd. 2008-10-31 | SW2 Rice Rd. 2008-12-16 | SW2 Rice Rd. 2009-02-13 | SW2 Rice Rd. 2009-02-13 | SW2 Rice Rd. 2009-04-06 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***DUP*** | ***Freshet*** |
| ***Event Phase*** | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction |
| **Field Analyses** | | | | | | | | | | |
| Air Temperature (K) | | 292.2 | 265.3 | 275.1 | 295.2 | 283.0 | 266.8 | 271.0 | 271.0 | 274.4 |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 8.5 | 6.9 | 8.0 | 7.1 | 8.0 | 7.4 | 7.4 | 7.3 |
| Conductivity (µS/cm) | | 902 | 2800 | 214 | 1630 | 1795 | 1637 | 2297 | 2297 | 310 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 13.1 | 17.2 | 14.5 | 8.1 | 9.5 | 13.6 | | | 11.6 |
| Temperature (°C) | | 18.2 | 4.9 | 4.1 | 21.7 | 12.7 | 2.9 | 3.2 | 3.2 | 6.3 |
| Temperature-based DO objective* | calculated | 5.5 | 7.0 | 7.1 | 5.1 | 6.1 | 7.3 | 7.3 | 7.3 | 6.9 |
| Appearance | | clear | clear | yellow-brown | clear | clear | clear | clear | clear | slightly cloudy brown |
| **LABORATORY ANALYSES** | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.8 | 7.7 | 8.2 | 8.1 | 8.1 | 8.0 | 8.0 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.52 | 0.2 | 0.58 | 0.16 | <0.10 | 0.29 | 0.34 | 0.39 | 0.93 |
| Total Ammonia (as N) | | 0.03 | <0.02 | 0.11 | 0.03 | <0.02 | 0.03 | 0.03 | 0.03 | 0.1 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | <0.001 | 0.000 | 0.001 | <0.0001 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.03 | 0.01 | 0.11 | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 | 0.1 |
| Nitrate (as N) | | <0.10 | 1.28 | 0.34 | 0.25 | 0.87 | 1.45 | 1.59 | 1.59 | 0.34 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **4300** | | **342** | **195** | **780** | **105** | 7 | 28 | 60 |
| Total $BOD_5$ | | 2 | <1 | 1 | <1 | <1 | <1 | <1 | <1 | 3 |
| Chloride | | 52 | 434 | 38 | 246 | 323 | 307 | 619 | 612 | 37 |
| Total Phosphorus | 0.03 | **0.11** | <0.01 | **0.63** | **0.04** | 0.02 | 0.03 | **0.05** | **0.05** | **0.33** |
| Total Suspended Solids | | 19 | <2 | 111 | <2 | 8 | 3 | 3 | 3 | 46 |
| Notes: | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW2<br>Rice Rd.<br>2009-06-18 | SW2<br>Rice Rd.<br>2009-09-10 | SW2<br>Rice Rd.<br>2009-12-01 | SW2<br>Rice Rd.<br>2010-03-09 | SW2<br>Rice Rd.<br>2010-06-16 | SW2<br>Rice Rd.<br>2010-09-03 | SW2<br>Rice Rd.<br>2010-10-05 | SW2<br>Rice Rd.<br>2011-03-29 | SW2<br>Rice Rd.<br>2011-06-06 | SW2<br>Rice Rd.<br>2011-06-24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** |
| ***Event Phase*** | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 287.8 | 291.6 | 278.1 | 277.1 | 293.0 | 294.8 | 282.2 | 271.4 | 292.2 | 292.4 |
| pH (unitless) | 6.5 - 8.5 | 7.9 | **8.7** | 8.3 | 7.2 | 8.0 | 8.3 | 7.5 | **8.8** | 8.3 | 8.0 |
| Conductivity (µS/cm) | | 1967 | 478 | >4000 | 181 | 850 | 970 | 309 | 2140 | 1856 | 959 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 9.1 | 8.7 | 14.9 | 14.8 | 9.4 | 6.3 | 10.5 | 15.6 | 8.7 | 7.6 |
| Temperature (°C) | | 16.7 | 22.1 | 10.1 | 3.0 | 23.4 | 23.2 | 14.2 | 5.7 | 17.7 | 18.4 |
| Temperature-based DO objective* | calculated | 5.6 | 5.1 | 6.4 | 7.3 | 5.0 | 5.0 | 5.9 | 6.9 | 5.5 | 5.4 |
| Appearance | | clear | clear | clear and colourless | clear yellowish | clear | clear | brown | clear | clear | cloudy |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 8.2 | 8.2 | 7.6 | 8.0 | 8.3 | 7.9 | 8.1 | 8.3 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.36 | 0.53 | 0.31 | 0.54 | 0.57 | <0.10 | 0.15 | 0.74 | 0.41 | 0.64 |
| Total Ammonia (as N) | | 0.13 | 0.02 | 0.2 | 0.04 | 0.03 | <0.02 | 0.06 | <0.02 | 0.03 | 0.03 |
| Un-ionized Ammonia (as N) | 0.02 | 0.003 | 0.004 | 0.008 | 0.000 | 0.002 | <0.002 | 0.001 | 0.000 | 0.002 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.13 | 0.02 | 0.2 | 0.04 | 0.03 | 0.01 | 0.06 | 0.01 | 0.03 | 0.03 |
| Nitrate (as N) | | 2.32 | 0.11 | 0.55 | 0.19 | 0.5 | 0.1 | 0.21 | 1.05 | 0.72 | 0.50 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **790** | 30 | 13 | 20 | **1720** | 80 | **11400** | 6 | **300** | **1120** |
| Total $BOD_5$ | | 2 | <1 | <1 | 3 | 2 | 2 | 5 | 1 | <1 | 2 |
| Chloride | | 296 | 61 | 1670 | 29 | 212 | 183 | 34 | 403 | 430 | 205 |
| Total Phosphorus | 0.03 | 0.03 | **0.16** | 0.03 | **0.30** | **0.06** | 0.02 | **0.29** | **0.11** | 0.02 | **0.12** |
| Total Suspended Solids | | <2 | 14 | 6 | 158 | 13 | 18 | 268 | 80 | <2 | 11 |
| Notes: | | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

## Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW2 Rice Rd. 2011-09-30 | SW2 Rice Rd. 2011-11-29 | SW2 Rice Rd. 2012-03-15 | SW2 Rice Rd. 2012-04-25 | SW2 Rice Rd. 2012-10-10 | SW2 Rice Rd. 2012-12-05 | SW2 Rice Rd. 2013-03-27 | SW2 Rice Rd. 2013-05-02 | SW2 Rice Rd. 2013-06-13 | SW2 Rice Rd. 2013-10-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Construction | Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 286.2 | 279.4 | 285.5 | 279.5 | 282.1 | 274.0 | 276.6 | 289.6 | 289.7 | 285.7 |
| pH (unitless) | 6.5 - 8.5 | 8.1 | 8.3 | 8.0 | 8.1 | 7.8 | 8.0 | 8.2 | 8.2 | 7.5 | 7.4 |
| Conductivity (µS/cm) | | 505 | 144 | 1950 | 1402 | 814 | 1492 | 1991 | 2250 | 456 | 1942 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 8.2 | 11.1 | 10.6 | 9.5 | 7.8 | 8.1 | 13.2 | 9.8 | 11.4 | 8.9 |
| Temperature (°C) | | 16.3 | 7.1 | 6.2 | 12.8 | 13.2 | 7.1 | 5.5 | 10.9 | 12.1 | 14.8 |
| Temperature-based DO objective* | calculated | 5.7 | 6.8 | 6.9 | 6.1 | 6.0 | 6.8 | 7.0 | 6.3 | 6.1 | 5.8 |
| Appearance | | cloudy | brownish | clear and colourless | clear | cloudy grey | | Clear | Clear | Cloudy brown | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.4 | 7.7 | 8.2 | 8.1 | 7.6 | 8.0 | 8.3 | 8.2 | 7.7 | 8.2 |
| Total Kjeldahl Nitrogen (TKN) | | 0.33 | 0.82 | 0.51 | 0.64 | 0.95 | 0.35 | 0.22 | 0.21 | 1.61 | 0.33 |
| Total Ammonia (as N) | | 0.1 | 0.05 | 0.02 | <0.02 | 0.22 | <0.02 | <0.02 | 0.05 | 0.51 | 0.03 |
| Un-ionized Ammonia (as N) | 0.02 | 0.003 | 0.001 | 0.000 | 0.000 | 0.004 | 0.000 | 0.000 | 0.001 | 0.003 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.1 | 0.05 | 0.02 | 0.01 | 0.22 | 0.01 | 0.01 | 0.05 | 0.51 | 0.03 |
| Nitrate (as N) | | 0.58 | 0.26 | 1.01 | 0.80 | 0.70 | 0.56 | 1.02 | 1.42 | 13.60 | 1.10 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **850** | **235** | 18 | **150** | **940** | 20 | **690** | 0 | **1570** | 40 |
| Total $BOD_5$ | | 2 | 3 | <1 | 2 | 5 | 3 | 1 | 3 | 3 | 1 |
| Chloride | | 58 | 13 | 397 | 271 | 75 | 223 | 414 | 386 | 27 | 292 |
| Total Phosphorus | 0.03 | **0.16** | **0.23** | 0.02 | **0.18** | **0.26** | **0.04** | <0.01 | 0.02 | **0.57** | **0.04** |
| Total Suspended Solids | | 72 | 105 | 3 | 30 | 117 | 21 | <2 | 5 | 62 | 18 |
| Notes: | | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW2 Rice Rd. 2013-12-10 | SW2 Rice Rd. 2014-03-18 | SW2 Rice Rd. 2014-04-25 | SW2 Rice Rd. 2014-06-04 | SW2 Rice Rd. 2014-09-24 | SW2 Rice Rd. 2014-12-01 | SW2 Rice Rd. 2015-03-12 | SW2 Rice Rd. 2015-05-13 | SW2 Rice Rd. 2015-06-09 | SW2 Rice Rd. 2015-09-30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 267.9 | 273.0 | 283.1 | 288.5 | 288.7 | 273.9 | 272.2 | 273.2 | 289.7 | 285.9 |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 7.8 | 8.3 | 7.6 | 7.8 | 7.7 | 7.3 | 7.7 | 8.4 | 8.0 |
| Conductivity (µS/cm) | | 3800 | 5390 | 3120 | 2360 | 2040 | 2950 | 3820 | 1738 | 255 | 910 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 8.0 | 11.2 | 11.2 | 9.9 | 8.7 | 8.5 | 10.8 | 10.3 | 9.8 | 6.7 |
| Temperature (°C) | | 2.9 | 2.9 | 7.9 | 16.3 | 13.4 | 2.1 | 0.5 | 12.1 | 17.4 | 17.5 |
| Temperature-based DO objective* | calculated | 7.3 | 7.3 | 6.6 | 5.7 | 6.0 | 7.4 | 7.7 | 6.1 | 5.6 | 5.5 |
| Appearance | | Clear | Clear | Clear | Clear | Clear | Clear | Clear | Clear | Cloudy brown | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.0 | 7.9 | 8.1 | 8.0 | 7.9 | 7.9 | 7.7 | 8.0 | 7.7 | 8.1 |
| Total Kjeldahl Nitrogen (TKN) | | 0.42 | 0.36 | 0.29 | 0.44 | 0.2 | 0.38 | 3.42 | 0.41 | 1.28 | 0.24 |
| Total Ammonia (as N) | | 0.05 | 0.1 | 0.05 | 0.04 | 0.06 | 0.04 | 1.2 | 0.04 | 0.04 | 0.06 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.001 | 0.002 | 0.000 | 0.001 | 0.000 | 0.002 | 0.000 | 0.003 | 0.002 |
| Total Ammonia (as N, for calculations) | | 0.05 | 0.1 | 0.05 | 0.04 | 0.06 | 0.04 | 1.2 | 0.04 | 0.04 | 0.06 |
| Nitrate (as N) | | 1.21 | 1.44 | 1.57 | 1.07 | <0.10 | 0.55 | <2 | 0.60 | 0.22 | <0.25 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <2 | <0.05 | <0.05 | <0.25 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | 69 | 3 | 2 | 36 | **2200** | **460** | **380** | **1500** | **8700** | **180** |
| Total $BOD_5$ | | 2 | 1 | <1 | 11 | 1 | 3 | 10 | <5 | <5 | <5 |
| Chloride | | 764 | 1390 | 639 | 449 | 350 | 803 | 1370 | 381 | 29 | 107 |
| Total Phosphorus | 0.03 | 0.01 | **0.05** | 0.02 | **0.09** | 0.02 | **0.11** | **0.66** | **0.04** | **0.56** | 0.02 |
| Total Suspended Solids | | 6 | 12 | 5 | 3 | 3 | 16 | 13 | <10 | 272 | <10 |
| Notes: | | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW2 Rice Rd. 2015-10-29 | SW2 Rice Rd. 2016-03-22 | SW2 Rice Rd. 2016-04-26 | SW2 Rice Rd. 2016-06-29 | SW2 Rice Rd. 2016-09-01 | SW2 Rice Rd. 2016-10-21 |
|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | |
| Air Temperature (K) | | 283.0 | 275.5 | 273.2 | 292.1 | 291.5 | 282.2 |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.8 | 8.5 | 8.3 | 7.6 | 7.9 |
| Conductivity (µS/cm) | | 863 | 2600 | 2059 | 1519 | 1190 | 590 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | **8.1** | **9.0** | **11.5** | **4.5** | **9.5** | **8.0** |
| Temperature (°C) | | 11.8 | 6.4 | 10.2 | 16.8 | 23.4 | 15.7 |
| Temperature-based DO objective* | calculated | 6.2 | 6.8 | 6.4 | 5.6 | 5.0 | 5.7 |
| Appearance | | slightly cloudy | Clear | Light yellow, cloudy | Yellow brown, cloudy | Clear | Clear |
| **LABORATORY ANALYSES** | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.2 | 8.1 | 8.0 | 8.0 | 8.1 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.28 | 0.42 | 0.48 | 0.84 | 0.54 | 0.4 |
| Total Ammonia (as N) | | 0.22 | <0.02 | 0.03 | 0.19 | <0.02 | 0.04 |
| Un-ionized Ammonia (as N) | 0.02 | 0.004 | 0.000 | 0.002 | 0.011 | 0.000 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.22 | 0.01 | 0.03 | 0.19 | 0.01 | 0.04 |
| Nitrate (as N) | | 1.83 | 1.30 | 1.17 | <0.25 | <0.25 | <0.05 |
| Nitrite (as N) | | <0.25 | <1.0 | <0.25 | <0.25 | <0.25 | <0.05 |
| Dissolved Nitrite + Nitrate | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **136** | 0 | 8 | **316** | 46 | **250** |
| Total $BOD_5$ | | <5 | <5 | 5 | <5 | <5 | <5 |
| Chloride | | 59 | 625 | 456 | 305 | 193 | 50 |
| Total Phosphorus | 0.03 | **0.06** | 0.01 | **0.08** | **0.23** | **0.06** | **0.08** |
| Total Suspended Solids | | 102 | <10 | 92 | 506 | 17 | 11 |
| Notes: | | 40 | 41 | 42 | 43 | 44 | 45 |

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW3 Rice Rd. 2007-10-19 | SW3 Rice Rd. 2007-12-05 | SW3 Rice Rd. 2008-03-27 | SW3 Rice Rd. 2008-08-06 | SW3 Rice Rd. 2008-10-31 | SW3 Rice Rd. 2008-12-16 | SW3 Rice Rd. 2009-02-13 | SW3 Rice Rd. 2009-04-06 |
|---|---|---|---|---|---|---|---|---|---|
| *Event Type* | | *Wet* | *Dry* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* | *Freshet* |
| *Event Phase* | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction |
| **Field Analyses** | | | | | | | | | |
| Air Temperature (K) | | 292.2 | 265.3 | 275.1 | 295.2 | 283.0 | 266.8 | 271.0 | 274.4 |
| pH (unitless) | 6.5 - 8.5 | 7.8 | **8.6** | 6.9 | 8.1 | 7.1 | 8.1 | 7.5 | 7.3 |
| Conductivity (µS/cm) | | 890 | 2790 | 251 | 1556 | 1781 | 1760 | 2861 | 444 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 12.9 | 17.0 | 14.4 | - | 8.4 | 13.3 | | 11.6 |
| Temperature (°C) | | 18.9 | 4.3 | 5.5 | 22.1 | 12.5 | 2.7 | 3.1 | 6.2 |
| Temperature-based DO objective* | calculated | 5.4 | 7.1 | 7.0 | 5.1 | 6.1 | 7.3 | 7.3 | 6.9 |
| Appearance | | slightly cloudy | clear | yellow-brown | clear | clear | clear | clear | slightly cloudy light brown |
| **LABORATORY ANALYSES** | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.9 | 7.8 | 8.0 | 8.0 | 8.1 | 8.0 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.67 | 0.32 | 0.39 | 0.27 | <0.10 | 0.18 | 0.34 | 0.93 |
| Total Ammonia (as N) | | 0.02 | 0.02 | 0.11 | 0.04 | 0.02 | <0.02 | 0.02 | 0.12 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.001 | 0.000 | 0.002 | 0.000 | <0.0003 | 0.000 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.02 | 0.02 | 0.11 | 0.04 | 0.02 | 0.01 | 0.02 | 0.12 |
| Nitrate (as N) | | 0.16 | 1.39 | 0.37 | 0.23 | 0.78 | 1.64 | 2.04 | 0.54 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **2480** | | **103** | **156** | **580** | 85 | 12 | 100 |
| Total $BOD_5$ | | 3 | <1 | 1 | <1 | <1 | <1 | <1 | 3 |
| Chloride | | 50 | 467 | 44 | 265 | 320 | 331 | 800 | 64 |
| Total Phosphorus | 0.03 | **0.15** | 0.03 | **0.67** | **0.04** | 0.02 | **0.09** | **0.05** | **0.33** |
| Total Suspended Solids | | 20 | 11 | 111 | <2 | 3 | 44 | <2 | 44 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW3 Rice Rd. 2009-06-18 | SW3 Rice Rd. 2009-06-18 | SW3 Rice Rd. 2009-09-10 | SW3 Rice Rd. 2009-12-01 | SW3 Rice Rd. 2010-03-09 | SW3 Rice Rd. 2010-06-16 | SW3 Rice Rd. 2010-09-03 | SW3 Rice Rd. 2010-10-05 | SW3 Rice Rd. 2011-03-29 | SW3 Rice Rd. 2011-06-06 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***DUP*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** |
| ***Event Phase*** | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 287.8 | 287.8 | 291.6 | 278.1 | 277.1 | 293.0 | 294.8 | 282.2 | 271.4 | 292.2 |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.8 | **8.6** | 8.0 | 7.0 | 8.0 | 8.0 | 7.8 | **8.8** | 8.3 |
| Conductivity (µS/cm) | | 1928 | 1928 | 423 | >4000 | 385 | 860 | 1075 | 253 | 2210 | 1931 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 8.7 | 8.7 | 7.7 | 13.6 | 15.1 | 7.7 | 5.4 | 11.5 | 15.0 | 9.1 |
| Temperature (°C) | | 15.5 | 15.5 | 22.2 | 10.1 | 4.5 | 22.7 | 22.9 | 13.3 | 6.0 | 18.0 |
| Temperature-based DO objective* | calculated | 5.8 | 5.8 | 5.1 | 6.4 | 7.1 | 5.0 | 5.0 | 6.0 | 6.9 | 5.5 |
| Appearance | | clear | clear | clear to cloudy | clear and colourless | murky yellow | clear | - | brown | clear | clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.0 | 8.0 | 8.1 | 8.1 | 7.8 | 7.9 | 8.2 | 7.9 | 8.2 | 8.4 |
| Total Kjeldahl Nitrogen (TKN) | | 0.35 | 0.36 | 0.34 | 0.35 | 0.53 | 0.67 | 0.24 | 0.15 | 0.24 | <0.10 |
| Total Ammonia (as N) | | 0.12 | 0.12 | 0.02 | 0.17 | 0.05 | 0.03 | <0.02 | 0.07 | <0.02 | <0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.002 | 0.002 | 0.003 | 0.003 | 0.000 | 0.001 | <0.001 | 0.001 | 0.002 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.12 | 0.12 | 0.02 | 0.17 | 0.05 | 0.03 | 0.01 | 0.07 | 0.01 | 0.01 |
| Nitrate (as N) | | 2.07 | 2.02 | 0.12 | 0.56 | 0.36 | 0.55 | <0.10 | 0.17 | 1.07 | 0.78 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **1300** | **1300** | **800** | 14 | 30 | **920** | **4500** | **9300** | 5 | **220** |
| Total $BOD_5$ | | 1 | <1 | <1 | <1 | 2 | 1 | 3 | 5 | <1 | 1 |
| Chloride | | 307 | 312 | 47 | 1750 | 84 | 195 | 212 | 25 | 257 | 443 |
| Total Phosphorus | 0.03 | 0.02 | **0.12** | **0.23** | 0.03 | **0.32** | **0.07** | **0.05** | **0.33** | **0.04** | 0.03 |
| Total Suspended Solids | | 5 | 6 | 24 | 5 | 167 | 30 | 45 | 342 | 11 | 12 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW3 Rice Rd. 2011-06-24 | SW3 Rice Rd. 2011-09-30 | SW3 Rice Rd. 2011-11-29 | SW3 Rice Rd. 2012-03-15 | SW3 Rice Rd. 2012-04-25 | SW3 Rice Rd. 2012-07-04 | SW3 Rice Rd. 2012-07-27 | SW3 Rice Rd. 2012-10-10 | SW3 Rice Rd. 2012-12-05 | SW3 Rice Rd. 2013-03-27 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Construction | Construction | Construction | Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 292.4 | 286.2 | 279.4 | 285.5 | 279.5 | 273.2 | 296.3 | 282.1 | 274.0 | 276.6 |
| pH (unitless) | 6.5 - 8.5 | 8.0 | 8.4 | 8.4 | 8.0 | 8.2 | 7.9 | 7.9 | 7.9 | 7.9 | 8.1 |
| Conductivity (µS/cm) | | 894 | 361 | 135 | 2110 | 1565 | 2300 | 1275 | 903 | 1565 | 2070 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 7.2 | 8.9 | 11.5 | 10.3 | 9.9 | **4.4** | **4.9** | 7.4 | 9.3 | 14.4 |
| Temperature (°C) | | 18.4 | 15.9 | 7.1 | 6.2 | 12.5 | 22.4 | 22.0 | 13.3 | 7.1 | 5.8 |
| Temperature-based DO objective* | calculated | 5.4 | 5.7 | 6.8 | 6.9 | 6.1 | 5.0 | 5.1 | 6.0 | 6.8 | 6.9 |
| Appearance | | cloudy | cloudy | brownish | clear | cloudy | clear | clear | cloudy grey | | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.6 | 7.7 | 8.2 | 8.2 | 7.9 | 7.8 | 7.7 | 8.0 | 8.3 |
| Total Kjeldahl Nitrogen (TKN) | | 0.57 | 0.32 | 0.73 | 0.24 | 0.62 | 0.47 | 0.49 | 1.02 | 0.34 | 0.17 |
| Total Ammonia (as N) | | <0.02 | 0.04 | 0.03 | 0.03 | <0.02 | 0.2 | 0.11 | 0.23 | <0.02 | <0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | 0.003 | 0.001 | 0.000 | 0.001 | 0.007 | 0.004 | 0.005 | 0.000 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.01 | 0.04 | 0.03 | 0.03 | 0.01 | 0.2 | 0.11 | 0.23 | 0.01 | 0.01 |
| Nitrate (as N) | | 0.47 | 0.40 | 0.18 | 1.04 | 0.80 | 0.50 | 0.36 | 0.65 | 0.46 | 1.01 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | |
| *E.coli* (5TMPN/100ml) | 100 | **900** | **1130** | **203** | 18 | 60 | **490** | **244** | **610** | 10 | **670** |
| Total $BOD_5$ | | 2 | 1 | 3 | <1 | 2 | 1 | 3 | 7 | 2 | 1 |
| Chloride | | 166 | 44 | 11 | 414 | 285 | 427 | 135 | 85 | 231 | 439 |
| Total Phosphorus | 0.03 | **0.12** | **0.14** | **0.21** | 0.02 | **0.19** | **0.06** | **0.06** | **0.24** | 0.03 | 0.01 |
| Total Suspended Solids | | 42 | 42 | 124 | 4 | 58 | 73 | 187 | 107 | 19 | 3 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW3 Rice Rd. 2013-05-02 | SW3 Rice Rd. 2013-06-13 | SW3 Rice Rd. 2013-10-10 | SW3 Rice Rd. 2013-12-10 | SW3 Rice Rd. 2014-03-18 | SW3 Rice Rd. 2014-04-25 | SW3 Rice Rd. 2014-06-04 | SW3 Rice Rd. 2014-09-24 | SW3 Rice Rd. 2014-12-01 | SW3 Rice Rd. 2015-03-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 289.6 | 289.7 | 285.7 | 267.9 | 273.0 | 283.1 | 288.5 | 288.7 | 273.9 | 272.2 |
| pH (unitless) | 6.5 - 8.5 | 8.3 | 7.5 | 7.4 | 7.7 | 7.7 | 8.5 | 7.5 | 7.6 | 7.8 | 7.0 |
| Conductivity (µS/cm) | | 2190 | 462 | 1991 | 3780 | 5610 | 3150 | 2370 | 2350 | 2890 | 3890 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 10.0 | 11.5 | 8.5 | 8.0 | 11.3 | 12.2 | 8.8 | 8.2 | 8.6 | 10.9 |
| Temperature (°C) | | 10.8 | 17.0 | 14.7 | 2.8 | 3.1 | 8.0 | 16.3 | 14.3 | 2.0 | 0.5 |
| Temperature-based DO objective* | calculated | 6.3 | 5.6 | 5.8 | 7.3 | 7.3 | 6.6 | 5.7 | 5.9 | 7.4 | 7.7 |
| Appearance | | Clear | Cloudy Brown | Clear | Clear | Clear | Clear | Clear | Clear | Clear | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.2 | 7.6 | 8.2 | 8.0 | 7.9 | 8.2 | 8.0 | 7.9 | 7.9 | 7.7 |
| Total Kjeldahl Nitrogen (TKN) | | 0.21 | 2.15 | 0.23 | 0.41 | 0.29 | 0.27 | 0.42 | 0.83 | 0.35 | 3.34 |
| Total Ammonia (as N) | | 0.04 | 0.51 | 0.05 | 0.03 | 0.1 | 0.04 | 0.03 | 0.05 | 0.03 | 1.27 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | 0.005 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | 0.001 | 0.000 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.04 | 0.51 | 0.05 | 0.03 | 0.1 | 0.04 | 0.03 | 0.05 | 0.03 | 1.27 |
| Nitrate (as N) | | 1.39 | 13.60 | 0.96 | 1.15 | 1.45 | 1.54 | 0.98 | <0.10 | 0.49 | <2 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <2 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | 1 | **1420** | 55 | 89 | 8 | 4 | 38 | **243** | **470** | **330** |
| Total $BOD_5$ | | 1 | 2 | <1 | 2 | <1 | <1 | 8 | 3 | 3 | 10 |
| Chloride | | 398 | 27 | 297 | 838 | 1410 | 658 | 458 | 412 | 939 | 1410 |
| Total Phosphorus | 0.03 | 0.03 | **0.59** | 0.03 | 0.02 | **0.04** | 0.01 | **0.07** | **0.11** | **0.09** | **0.65** |
| Total Suspended Solids | | 4 | 60 | 6 | 7 | 8 | 2 | 3 | 16 | 18 | 16 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW3 Rice Rd. 2015-05-13 | SW3 Rice Rd. 2015-06-09 | SW3 Rice Rd. 2015-09-30 | SW3 Rice Rd. 2015-10-29 | SW3 Rice Rd. 2016-03-22 | SW3 Rice Rd. 2016-04-26 | SW3 Rice Rd. 2016-06-29 | SW3 Rice Rd. 2016-09-01 | SW3 Rice Rd. 2016-10-21 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | |
| Air Temperature (K) | | 273.2 | 289.7 | 285.9 | 283.0 | 275.5 | 273.2 | 292.1 | 291.5 | 282.2 |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 8.0 | 7.9 | 8.1 | 8.0 | 8.5 | **8.7** | 7.6 | 7.8 |
| Conductivity (µS/cm) | | 1990 | 664 | 936 | 861 | 2670 | 2081 | 1565 | 1200 | 580 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 10.3 | 13.8 | 7.2 | **8.2** | **9.3** | **12.0** | **6.6** | **5.9** | **8.4** |
| Temperature (°C) | | 12.3 | 17.1 | 17.2 | 11.6 | 6.4 | 10.5 | 17.0 | 23.0 | 15.7 |
| Temperature-based DO objective* | calculated | 6.1 | 5.6 | 5.6 | 6.2 | 6.8 | 6.3 | 5.6 | 5.0 | 5.7 |
| Appearance | | Clear | Cloudy brown grey | Clear | slightly cloudy | Clear | Light yellow, cloudy | Yellow-brown, cloudy | Cleat | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.0 | 7.7 | 8.1 | 7.4 | 8.2 | 8.0 | 8.1 | 7.9 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.44 | 1.37 | 0.22 | 0.37 | 0.46 | 0.5 | 0.42 | 0.51 | 0.39 |
| Total Ammonia (as N) | | 0.04 | 0.21 | 0.04 | 0.22 | <0.02 | 0.03 | 0.08 | <0.02 | <0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.007 | 0.001 | 0.005 | 0.000 | 0.002 | 0.010 | 0.000 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.04 | 0.21 | 0.04 | 0.22 | 0.01 | 0.03 | 0.08 | 0.01 | 0.01 |
| Nitrate (as N) | | <0.5 | 0.61 | <0.25 | 1.71 | 1.30 | 1.20 | <0.25 | <50 | <0.05 |
| Nitrite (as N) | | <0.5 | <0.10 | <0.25 | <0.25 | <1.0 | <0.5 | <0.25 | <50 | <0.05 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **1200** | **5800** | **138** | **132** | 0 | 8 | **340** | 46 | **320** |
| Total $BOD_5$ | | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Chloride | | 480 | 124 | 119 | 60 | 640 | 461 | 307 | 203 | 50 |
| Total Phosphorus | 0.03 | **0.05** | **0.45** | 0.02 | **0.05** | 0.02 | **0.07** | **0.08** | **0.07** | **0.06** |
| Total Suspended Solids | | 25 | 337 | <10 | 83 | <10 | 61 | 92 | 23 | 20 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

## Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW4 Cataract Rd. 2007-10-19 | SW4 Cataract Rd. 2007-12-05 | SW4 Cataract Rd. 2008-03-27 | SW4 Cataract Rd. 2008-08-06 | SW4 Cataract Rd. 2008-10-31 | SW4 Cataract Rd. 2008-12-16 | SW4 Cataract Rd. 2009-02-13 | SW4 Cataract Rd. 2009-04-06 | SW4 Cataract Rd. 2009-06-18 |
|---|---|---|---|---|---|---|---|---|---|---|
| *Event Type* | | *Wet* | *Dry* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* | *Freshet* | *Wet* |
| *Event Phase* | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Construction |
| **Field Analyses** | | | | | | | | | | |
| Air Temperature (K) | | 292.2 | 265.3 | 275.1 | 295.2 | 283.0 | 266.8 | 271.0 | 274.4 | 287.8 |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 8.4 | 7.0 | 7.9 | 7.0 | 7.3 | 7.7 | 7.0 | 8.0 |
| Conductivity (µS/cm) | | 2080 | 1510 | 309 | 2759 | 939 | 903 | 861 | 720 | 3092 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 11.3 | 18.2 | 10.6 | 18.0 | 9.8 | 12.5 | 11.3 | 11.3 | 8.2 |
| Temperature (°C) | | 19.1 | 2.2 | 4.1 | 29.0 | 11.9 | 3.1 | 3.2 | 6.1 | 16.4 |
| Temperature-based DO objective* | calculated | 5.4 | 7.4 | 7.1 | 4.5 | 6.2 | 7.3 | 7.3 | 6.9 | 5.7 |
| Appearance | | cloudy grey-green | clear | clear-cloudy yellow | | clear | clear | clear yellowish | slightly cloudy light brown | clear |
| **LABORATORY ANALYSES** | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.9 | 7.6 | 8.2 | 8.1 | 7.8 | 7.6 | 7.6 | 7.7 |
| Total Kjeldahl Nitrogen (TKN) | | 0.94 | 0.48 | 1.15 | 0.75 | 0.22 | 0.23 | 0.4 | 1.04 | 1.03 |
| Total Ammonia (as N) | | 0.08 | 0.04 | 0.11 | 0.06 | 0.02 | 0.03 | 0.03 | 0.1 | 0.42 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | 0.001 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.011 |
| Total Ammonia (as N, for calculations) | | 0.08 | 0.04 | 0.11 | 0.06 | 0.02 | 0.03 | 0.03 | 0.1 | 0.42 |
| Nitrate (as N) | | 1.20 | 3.67 | 0.90 | <0.10 | 8.36 | 3.23 | 2.28 | 1.67 | 8.34 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.23 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **18500** | | **6000** | 26 | **1850** | **7200** | **9280** | **3940** | **1300** |
| Total $BOD_5$ | | 3 | 1 | 2 | 3 | <1 | 4 | 1 | 2 | 2 |
| Chloride | | 534 | 334 | 34 | 719 | 87 | 107 | 192 | 119 | 464 |
| Total Phosphorus | 0.03 | **0.24** | **0.07** | **0.20** | **0.06** | **0.06** | **0.04** | **0.05** | **0.16** | 0.03 |
| Total Suspended Solids | | 31 | 5 | 33 | 16 | 15 | 53 | <2 | 22 | 15 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW4 Cataract Rd. 2009-12-01 | SW4 Cataract Rd. 2010-03-09 | SW4 Cataract Rd. 2010-06-16 | SW4 Cataract Rd. 2010-09-03 | SW4 Cataract Rd. 2010-10-05 | SW4 Cataract Rd. 2011-03-29 | SW4 Cataract Rd. 2011-06-24 | SW4 Cataract Rd. 2011-09-30 | SW4 Cataract Rd. 2011-11-29 | SW4 Cataract Rd. 2012-03-15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 278.1 | 277.1 | 293.0 | 294.8 | 282.2 | 271.4 | 292.4 | 286.2 | 279.4 | 285.5 |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.2 | 7.7 | 7.2 | 7.7 | 8.3 | 7.7 | 8.1 | 8.1 | 7.9 |
| Conductivity (µS/cm) | | 1180 | 370 | 600 | 1080 | 306 | 1157 | 1124 | 549 | 300 | 1360 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 15.6 | 13.5 | 10.5 | 5.0 | 9.6 | 12.7 | **2.3** | 7.5 | 10.5 | 8.6 |
| Temperature (°C) | | 9.9 | 5.4 | 19.8 | 25.6 | 13.3 | 3.5 | 18.7 | 16.3 | 7.8 | 5.7 |
| Temperature-based DO objective* | calculated | 6.4 | 7.0 | 5.3 | 4.8 | 6.0 | 7.2 | 5.4 | 5.7 | 6.7 | 6.9 |
| Appearance | | clear and colourless | clear yellowish | clear | Slightly Cloudy Brown | clear yellow | clear | clear | cloudy | yellowish | slightly cloudy |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.5 | 7.6 | 8.0 | 7.8 | 7.9 | 7.7 | 7.7 | 7.5 | 8.0 |
| Total Kjeldahl Nitrogen (TKN) | | 0.37 | 0.76 | 0.63 | 0.39 | 0.37 | 1.20 | 0.62 | 0.53 | 1.14 | 0.23 |
| Total Ammonia (as N) | | 0.02 | 0.10 | 0.05 | <0.02 | 0.20 | 0.02 | <0.02 | 0.05 | 0.06 | 0.03 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.000 | 0.001 | <0.0002 | 0.003 | 0.000 | 0.000 | 0.002 | 0.001 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.02 | 0.1 | 0.05 | 0.01 | 0.2 | 0.02 | 0.01 | 0.05 | 0.06 | 0.03 |
| Nitrate (as N) | | 2.91 | 0.76 | 0.84 | <0.10 | 0.26 | 1.58 | 0.49 | 1.39 | 0.99 | 1.66 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **11200** | **460** | **420** | 100 | **1860** | **5900** | 76 | **1590** | **313** | 69 |
| Total $BOD_5$ | | <1 | 4 | 1 | <1 | 2 | <1 | 2 | <1 | 4 | <1 |
| Chloride | | 150 | 58 | 75 | 112 | 28 | 281 | 197 | 57 | 22 | 189 |
| Total Phosphorus | 0.03 | **0.07** | **0.16** | **0.07** | **0.05** | **0.10** | 0.03 | **0.05** | **0.11** | **0.09** | 0.01 |
| Total Suspended Solids | | 2 | 16 | 4 | 65 | 21 | 7 | 11 | 8 | 56 | <2 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW4 | SW4 | SW4 | SW4 | SW4 | SW4 | SW4 | SW4 | SW4 | SW4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. | Cataract Rd. |
| | | 2012-04-25 | 2012-07-27 | 2012-10-10 | 2013-03-27 | 2013-05-02 | 2013-06-13 | 2013-12-10 | 2014-03-18 | 2014-04-25 | 2014-12-01 |
| ***Event Type*** | | ***Freshet*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 279.5 | 296.3 | 282.1 | 276.6 | 289.6 | 289.7 | 267.9 | 273.0 | 283.1 | 273.9 |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 7.6 | 8.4 | 8.4 | 8.2 | 7.4 | 7.9 | 7.3 | 8.2 | 7.7 |
| Conductivity (µS/cm) | | 828 | 1324 | 592 | 2190 | 2110 | 368 | 2690 | 2510 | 1119 | 2320 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 8.9 | **4.1** | 10.9 | 10.9 | **3.9** | **5.4** | 7.1 | 9.9 | 11.8 | **6.8** |
| Temperature (°C) | | 8.3 | 23.3 | 13.6 | 4.2 | 10.1 | 16.6 | 5.3 | 2.1 | 7.5 | 2.2 |
| Temperature-based DO objective* | calculated | 6.6 | 5.0 | 6.0 | 7.1 | 6.4 | 5.6 | 7.0 | 7.4 | 6.7 | 7.4 |
| Appearance | | clear | dark brown | clear | Clear | Clear | Cloudy brown | Clear | Clear | Clear | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.6 | 7.9 | 8.1 | 7.8 | 7.6 | 7.9 | 7.5 | 7.9 | 7.8 |
| Total Kjeldahl Nitrogen (TKN) | | 0.39 | 1.96 | 0.65 | 0.31 | 0.34 | 1.91 | 0.28 | 0.38 | 0.28 | 0.86 |
| Total Ammonia (as N) | | <0.02 | 0.04 | <0.02 | <0.02 | 0.03 | 0.09 | <0.02 | 0.14 | 0.03 | 0.05 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.01 | 0.04 | 0.01 | 0.01 | 0.03 | 0.09 | 0.01 | 0.14 | 0.03 | 0.05 |
| Nitrate (as N) | | 3.68 | 0.63 | 0.68 | 1.71 | 1.90 | 0.70 | 2.05 | 1.43 | 2.43 | 2.72 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **2580** | **137** | 28 | **580** | 3 | **5400** | **313** | **1940** | 60 | **4520** |
| Total $BOD_5$ | | 2 | 12 | 2 | 1 | 3 | 3 | <1 | <1 | <1 | 2 |
| Chloride | | 69 | 236 | 59 | 535 | 382 | 32 | 612 | 543 | 135 | 1020 |
| Total Phosphorus | 0.03 | **0.09** | **0.68** | **0.10** | **0.07** | **0.05** | **0.55** | 0.02 | **0.05** | 0.03 | **0.10** |
| Total Suspended Solids | | 24 | 187 | 121 | 17 | 24 | 56 | 5 | 9 | 6 | 13 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

## Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW5 Cataract Rd. 2007-10-19 | SW5 Cataract Rd. 2007-12-05 | SW5 Cataract Rd. 2008-03-27 | SW5 Cataract Rd. 2008-10-31 | SW5 Cataract Rd. 2008-12-16 | SW5 Cataract Rd. 2009-02-13 | SW5 Cataract Rd. 2009-04-06 | SW5 Cataract Rd. 2009-06-18 | SW5 Cataract Rd. 2009-09-10 | SW5 Cataract Rd. 2009-12-01 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Construction | Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 292.2 | 265.3 | 275.1 | 283.0 | 266.8 | 271.0 | 274.4 | 287.8 | 291.6 | 278.1 |
| pH (unitless) | 6.5 - 8.5 | 7.3 | **8.7** | 6.9 | 7.1 | 7.8 | 7.7 | 7.1 | 8.0 | **8.7** | **8.6** |
| Conductivity (µS/cm) | | 159 | 1200 | 1630 | 928 | 845 | 747 | 390 | 3143 | 1062 | 996 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 10.9 | 20.3 | 18.0 | 10.8 | 15.6 | 11.8 | 11.8 | 8.0 | 15.2 | 17.0 |
| Temperature (°C) | | 19.5 | 0.3 | 29.0 | 11.4 | 0.0 | 4.0 | 6.4 | 16.7 | 28.7 | 10.1 |
| Temperature-based DO objective* | calculated | 5.3 | 7.7 | 4.5 | 6.2 | 7.7 | 7.2 | 6.8 | 5.6 | 4.5 | 6.4 |
| Appearance | | cloudy brown | slightly cloudy | clear | clear | clear | clear yellowish | slightly cloudy light brown | clear | cloudy, green (lots of algae) | clear yellowish |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.5 | 7.9 | 7.7 | 8.2 | 8.1 | 7.9 | 7.7 | 7.9 | 8.3 | 8.4 |
| Total Kjeldahl Nitrogen (TKN) | | 4.72 | 1.07 | 1.64 | 0.35 | 0.63 | 0.57 | 1.48 | 1.45 | 1.5 | 0.55 |
| Total Ammonia (as N) | | 2.75 | 0.23 | 0.08 | 0.02 | 0.24 | 0.04 | 0.27 | 1.10 | 0.04 | 0.07 |
| Un-ionized Ammonia (as N) | 0.02 | **0.021** | 0.008 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | **0.032** | 0.010 | 0.005 |
| Total Ammonia (as N, for calculations) | | 2.75 | 0.23 | 0.08 | 0.02 | 0.24 | 0.04 | 0.27 | 1.1 | 0.04 | 0.07 |
| Nitrate (as N) | | <0.10 | 3.86 | 0.87 | 5.79 | 2.80 | 1.94 | 1.19 | 14.10 | <0.10 | 1.67 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.34 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **12300** | | **5030** | 31 | **2700** | **6130** | **2660** | **1720** | 10 | **205** |
| Total $BOD_5$ | | 29 | <1 | 1 | <1 | 1 | 2 | 4 | 3 | 4 | 1 |
| Chloride | | 207 | 192 | 20 | 87 | 99 | 117 | 48 | 322 | 202 | 126 |
| Total Phosphorus | 0.03 | **0.87** | **0.13** | **0.38** | **0.05** | **0.10** | **0.08** | **0.33** | 0.03 | **0.24** | **0.11** |
| Total Suspended Solids | | 584 | 13 | 67 | 3 | 4 | 3 | 44 | 9 | 57 | 10 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW5 Cataract Rd. 2010-03-09 | SW5 Cataract Rd. 2010-06-16 | SW5 Cataract Rd. 2010-10-05 | SW5 Cataract Rd. 2011-03-29 | SW5 Cataract Rd. 2011-06-06 | SW5 Cataract Rd. 2011-06-24 | SW5 Cataract Rd. 2011-09-30 | SW5 Cataract Rd. 2011-11-29 | SW5 Cataract Rd. 2012-03-15 | SW5 Cataract Rd. 2012-04-25 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Freshet*** | ***Wet*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 277.1 | 293.0 | 282.2 | 271.4 | 292.2 | 292.4 | 286.2 | 279.4 | 285.5 | 279.5 |
| pH (unitless) | 6.5 - 8.5 | 7.3 | 8.2 | 7.6 | **9.6** | 8.4 | 8.3 | 8.3 | 8.2 | 7.9 | 8.3 |
| Conductivity (µS/cm) | | 264 | 470 | 385 | 1440 | 809 | 964 | 401 | 205 | 1360 | 770 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 14.0 | 9.3 | 10.9 | 20.2 | 9.4 | 7.9 | 7.9 | 11.0 | 9.4 | 9.7 |
| Temperature (°C) | | 4.1 | 27.6 | 12.6 | 10.2 | 26.0 | 21.4 | 16.0 | 6.8 | 5.8 | 17.6 |
| Temperature-based DO objective* | calculated | 7.1 | 4.6 | 6.1 | 6.4 | 4.7 | 5.1 | 5.7 | 6.8 | 6.9 | 5.5 |
| Appearance | | cloudy yellow | clear | cloudy yellow | clear yellowish | clear | clear yellowish | cloudy | brownish | clear | clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.6 | 8.4 | 7.9 | **8.7** | 8.3 | 8.1 | 7.8 | 7.5 | 8.1 | 8.2 |
| Total Kjeldahl Nitrogen (TKN) | | 0.83 | 1.06 | 0.42 | 0.64 | 1 | 0.97 | 0.44 | 1.56 | 0.32 | 0.77 |
| Total Ammonia (as N) | | 0.15 | 0.03 | 0.14 | 0.05 | 0.14 | 0.05 | 0.1 | 0.02 | 0.02 | 0.04 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.003 | 0.001 | **0.022** | 0.019 | 0.004 | 0.005 | 0.000 | 0.000 | 0.002 |
| Total Ammonia (as N, for calculations) | | 0.15 | 0.03 | 0.14 | 0.05 | 0.14 | 0.05 | 0.1 | 0.02 | 0.02 | 0.04 |
| Nitrate (as N) | | 0.61 | <0.10 | 0.4 | 0.42 | <0.10 | 0.15 | 1.32 | 0.28 | 0.85 | 3.65 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **190** | **860** | **1220** | 31 | **52000** | **2800** | **1850** | **190** | 6 | **160** |
| Total $BOD_5$ | | 5 | 2 | 1 | <1 | 4 | 2 | <1 | 5 | <1 | 2 |
| Chloride | | 39.0 | 54.0 | 43 | 457 | 93 | 150 | 32 | 15 | 191 | 69 |
| Total Phosphorus | 0.03 | **0.38** | **0.15** | **0.12** | **0.07** | **0.06** | 0.03 | **0.11** | **0.12** | 0.02 | **0.11** |
| Total Suspended Solids | | 167 | 21 | 23 | 7 | 19 | 8 | 11 | 611 | 6 | 30 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW5 Cataract Rd. 2012-10-10 | SW5 Cataract Rd. 2012-12-05 | SW5 Cataract Rd. 2013-03-27 | SW5 Cataract Rd. 2013-05-02 | SW5 Cataract Rd. 2013-06-13 | SW5 Cataract Rd. 2013-10-10 | SW5 Cataract Rd. 2013-12-10 | SW5 Cataract Rd. 2014-03-18 | SW5 Cataract Rd. 2014-04-25 | SW5 Cataract Rd. 2014-06-04 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Event Type*** | | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 282.1 | 274.0 | 276.6 | 289.6 | 289.7 | 285.7 | 267.9 | 273.0 | 283.1 | 288.5 |
| pH (unitless) | 6.5 - 8.5 | 8.4 | 8.3 | 8.2 | 8.3 | 7.1 | 7.6 | 7.9 | 7.8 | 8.2 | 8.3 |
| Conductivity (µS/cm) | | 643 | 1038 | 2170 | 1939 | 238 | 1608 | 2990 | 1499 | 1105 | 1000 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 8.9 | 10.7 | 21.4 | 9.4 | 10.2 | 13.7 | 9.8 | 11.2 | 14.5 | 11.4 |
| Temperature (°C) | | 12.8 | 4.3 | 3.4 | 14.1 | 16.8 | 15.5 | 0.1 | 0.7 | 6.5 | 20.2 |
| Temperature-based DO objective* | calculated | 6.1 | 7.1 | 7.2 | 5.9 | 5.6 | 5.8 | 7.7 | 7.6 | 6.8 | 5.3 |
| Appearance | | clear | | Clear | Clear | Cloudy brown | Clear | Clear | Clear | Clear | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.1 | 8.1 | 8.4 | 8.1 | 7.6 | 8.4 | 8.1 | 7.9 | 8.3 | 8.3 |
| Total Kjeldahl Nitrogen (TKN) | | 0.39 | 0.66 | 0.45 | 0.61 | 2.49 | 0.32 | 0.37 | 0.52 | 0.4 | 0.52 |
| Total Ammonia (as N) | | <0.02 | 0.05 | <0.02 | 0.03 | 0.13 | 0.03 | 0.03 | 0.09 | <0.02 | 0.04 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | 0.001 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.003 |
| Total Ammonia (as N, for calculations) | | 0.01 | 0.05 | 0.01 | 0.03 | 0.13 | 0.03 | 0.03 | 0.09 | 0.01 | 0.04 |
| Nitrate (as N) | | 0.34 | 1.87 | 0.98 | <0.10 | 0.60 | <0.10 | 1.78 | 0.90 | 1.47 | <0.10 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **1090** | 80 | 1 | 4 | **6100** | 95 | 72 | **260** | 27 | **280** |
| Total $BOD_5$ | | 3 | 2 | 1 | 1 | 3 | <1 | 3 | 2 | <1 | 1 |
| Chloride | | 48 | 146 | 534 | 353 | 16 | 313 | 649 | 297 | 141 | 118 |
| Total Phosphorus | 0.03 | **0.05** | **0.08** | <0.01 | 0.03 | **0.91** | **0.05** | 0.03 | **0.08** | <0.01 | 0.03 |
| Total Suspended Solids | | 7 | 7 | 2 | 3 | 170 | 16 | 5 | 6 | <2 | 6 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW5 Cataract Rd. | SW5 Cataract Rd. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. | SW6 Merrittville Hwy. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014-09-24 | 2014-12-01 | 2007-10-19 | 2007-12-05 | 2008-03-27 | 2008-08-06 | 2008-10-31 | 2008-12-16 | 2009-02-13 | 2009-04-06 |
| ***Event Type*** | | ***Dry*** | ***Wet*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 288.7 | 273.9 | 292.2 | 265.3 | 275.1 | 295.2 | 283.0 | 266.8 | 271.0 | 274.4 |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.7 | 7.2 | 8.4 | 7.7 | 7.9 | 6.8 | 7.4 | 7.8 | 7.3 |
| Conductivity (µS/cm) | | 1231 | 2770 | 1249 | 1260 | 360 | 2343 | 1310 | 998 | 1295 | 480 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 9.9 | **7.0** | **10.9** | 19.4 | 14.1 | - | 7.4 | 14.4 | 11.8 | 11.8 |
| Temperature (°C) | | 13.7 | 2.0 | 19.6 | 0.5 | 4.5 | 29.7 | 10.5 | 0.8 | 2.4 | 6.4 |
| Temperature-based DO objective* | calculated | 6.0 | 7.4 | 5.3 | 7.7 | 7.1 | 4.4 | 6.3 | 7.6 | 7.4 | 6.8 |
| Appearance | | Clear | Clear | cloudy brown | clear | clear-light brownish | yellowish | clear | yellow-brownish | clear yellowish | slightly cloudy light brown |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.8 | 7.7 | 7.8 | 7.9 | 8.0 | 7.8 | 7.9 | 7.9 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.49 | 1.55 | 2.43 | 0.91 | 0.81 | 2.49 | 0.43 | 0.82 | 0.96 | 1.8 |
| Total Ammonia (as N) | | 0.08 | 0.24 | 0.13 | 0.019669 | 0.08 | 0.78 | 0.05 | 0.08 | 0.11 | 0.38 |
| Un-ionized Ammonia (as N) | 0.02 | 0.001 | 0.001 | 0.001 | 0.0004251 | 0.000 | **0.045** | 0.000 | 0.000 | 0.001 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.08 | 0.24 | 0.13 | 0.019669 | 0.08 | 0.78 | 0.05 | 0.08 | 0.11 | 0.38 |
| Nitrate (as N) | | <0.10 | 3.57 | 0.45 | 4.68 | 0.34 | <0.10 | 0.23 | 1.16 | 0.72 | 0.41 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | | | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | 29 | **3350** | **3600** | | **1370** | 69 | 70 | **840** | **1910** | 80 |
| Total $BOD_5$ | | <1 | 3 | 9 | 2 | 1 | 9 | 2 | 2 | <1 | 3 |
| Chloride | | 145 | 557 | 254 | 225 | 75 | 465 | 238 | 176 | 331 | 64 |
| Total Phosphorus | 0.03 | 0.02 | **0.20** | **0.25** | **0.11** | **0.11** | **0.54** | **0.21** | **0.16** | **0.12** | **0.28** |
| Total Suspended Solids | | 3 | 10 | 55 | 3 | 21 | 134 | 108 | 23 | 14 | 33 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. |
| | | 2009-06-18 | 2009-09-10 | 2009-09-10 | 2009-12-01 | 2009-12-01 | 2010-03-09 | 2010-06-16 | 2010-09-03 | 2010-10-05 | 2011-03-29 |
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***DUP*** | ***Wet*** | ***DUP*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Construction | Construction | Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 287.8 | 291.6 | 291.6 | 278.1 | 278.1 | 277.1 | 293.0 | 294.8 | 282.2 | 271.4 |
| pH (unitless) | 6.5 - 8.5 | 8.2 | 7.9 | 7.9 | 8.0 | 8.0 | 7.3 | 7.8 | 7.1 | 7.5 | 8.4 |
| Conductivity (µS/cm) | | 1473 | 2343 | 2343 | 877 | 877 | 386 | 840 | >4000 | 791 | 1221 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 6.7 | **3.2** | **3.2** | 13.7 | 13.7 | 13.1 | **4.3** | **2.2** | 10.8 | 13.3 |
| Temperature (°C) | | 17.4 | 23.7 | 23.7 | 8.0 | 8.0 | 5.9 | 23.5 | 24.5 | 12.3 | 5.0 |
| Temperature-based DO objective* | calculated | 5.6 | 4.9 | 4.9 | 6.6 | 6.6 | 6.9 | 4.9 | 4.9 | 6.1 | 7.0 |
| Appearance | | yellowish | cloudy, sediment in sample | | cloudy, sediment in sample | | clear yellowish | slightly cloudy | slight cloudy brown | brown | clear yellowish |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 7.9 | 7.8 | 7.9 | 8.0 | 7.7 | 7.9 | 7.9 | 7.8 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 0.54 | 0.89 | 0.92 | 0.87 | 0.72 | 0.77 | 0.79 | 1.74 | 1.71 | 1.73 |
| Total Ammonia (as N) | | 0.07 | 0.07 | 0.07 | 0.14 | 0.14 | 0.36 | 0.2 | 0.83 | 0.73 | 0.7 |
| Un-ionized Ammonia (as N) | 0.02 | 0.004 | 0.002 | 0.002 | 0.002 | 0.002 | 0.001 | 0.007 | 0.005 | 0.005 | **0.023** |
| Total Ammonia (as N, for calculations) | | 0.07 | 0.07 | 0.07 | 0.14 | 0.14 | 0.36 | 0.2 | 0.83 | 0.73 | 0.7 |
| Nitrate (as N) | | <1.0 | <0.10 | <0.10 | 0.55 | 0.51 | 0.29 | 0.14 | 7.62 | 1.20 | 0.24 |
| Nitrite (as N) | | <1.0 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **3600** | 80 | 100 | 92 | **103** | **1450** | **870** | **420** | **970** | **8400** |
| Total $BOD_5$ | | 3 | 2 | 3 | 1 | <1 | 4 | 2 | 8 | 2 | 4 |
| Chloride | | 301 | 725 | 715 | 130 | 132 | 62 | 181 | 978 | 137 | 584 |
| Total Phosphorus | 0.03 | **0.07** | **0.39** | **0.43** | **0.18** | **0.22** | **0.14** | **0.28** | **0.18** | **0.29** | **0.17** |
| Total Suspended Solids | | 15 | 217 | 357 | 18 | 11 | 21 | 83 | 175 | 459 | 10 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. |
| | | 2011-06-06 | 2011-06-24 | 2011-09-30 | 2011-11-29 | 2012-03-15 | 2012-04-25 | 2012-07-04 | 2012-07-27 | 2012-10-10 | 2012-12-05 |
| ***Event Type*** | | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Wet*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 292.2 | 292.4 | 286.2 | 279.4 | 285.5 | 279.5 | 273.2 | 296.3 | 282.1 | 274.0 |
| pH (unitless) | 6.5 - 8.5 | 7.6 | 7.7 | 8.1 | 8.1 | 7.6 | 7.8 | 7.4 | 7.4 | 7.8 | 7.8 |
| Conductivity (µS/cm) | | 3290 | 1826 | 633 | 202 | 2630 | 1163 | 2240 | 2000 | 745 | 1147 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 7.0 | **3.3** | 7.6 | 11.1 | **3.6** | 12.2 | 9.2 | **3.6** | 6.8 | 7.2 |
| Temperature (°C) | | 19.9 | 20.1 | 16.0 | 6.8 | 6.9 | 7.4 | 23.0 | 22.9 | 13.6 | 6.3 |
| Temperature-based DO objective* | calculated | 5.3 | 5.3 | 5.7 | 6.8 | 6.8 | 6.7 | 5.0 | 5.0 | 6.0 | 6.9 |
| Appearance | | yellowish | grayish | cloudy | brownish | yellowish | yellowish | brown | yellowish | yellowish | |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.0 | 7.7 | 7.8 | 7.6 | 8.0 | 7.9 | 7.7 | 7.4 | 7.8 | 8.0 |
| Total Kjeldahl Nitrogen (TKN) | | 1.68 | 3.63 | 0.75 | 1.04 | 0.67 | 1.25 | 6.73 | 2.96 | 1.14 | 0.73 |
| Total Ammonia (as N) | | 0.88 | 0.98 | 0.24 | 0.02 | 0.14 | 0.05 | 0.57 | 0.39 | 0.13 | 0.02 |
| Un-ionized Ammonia (as N) | 0.02 | 0.014 | **0.020** | 0.008 | 0.000 | 0.001 | 0.000 | 0.008 | 0.004 | 0.002 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.88 | 0.98 | 0.24 | 0.02 | 0.14 | 0.05 | 0.57 | 0.39 | 0.13 | 0.02 |
| Nitrate (as N) | | 0.26 | 0.19 | 0.70 | 0.28 | 0.26 | 0.36 | <0.10 | 0.30 | 0.72 | 0.30 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **790** | **4200** | **1970** | **161** | 89 | **570** | 50 | **860** | **1320** | **260** |
| Total $BOD_5$ | | 2 | 8 | 2 | 3 | <1 | 2 | 59 | 6 | 4 | 2 |
| Chloride | | 789 | 348 | 78 | 14 | 566 | 200 | 436 | 400 | 70 | 151 |
| Total Phosphorus | 0.03 | **0.21** | **0.44** | **0.14** | **0.05** | **0.06** | **0.14** | **0.83** | **0.28** | **0.14** | **0.11** |
| Total Suspended Solids | | 12 | 104 | 35 | 62 | 7 | 36 | 6780 | 317 | 37 | 9 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 | SW6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. |
| | | 2013-03-27 | 2013-05-02 | 2013-06-13 | 2013-10-10 | 2013-12-10 | 2014-03-18 | 2014-04-25 | 2014-06-04 | 2014-09-24 | 2014-12-01 |
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* |
| *Event Phase* | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 276.6 | 289.6 | 289.7 | 285.7 | 267.9 | 273.0 | 283.1 | 288.5 | 288.7 | 273.9 |
| pH (unitless) | 6.5 - 8.5 | 8.3 | 7.7 | 7.6 | 7.6 | 7.9 | 7.9 | 8.0 | 7.2 | 7.4 | 7.7 |
| Conductivity (µS/cm) | | 2770 | 4110 | 362 | 1454 | 3520 | 4570 | 3360 | 2920 | 1899 | 3060 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | **7.3** | **3.8** | 6.0 | **4.0** | **5.3** | 9.2 | **6.1** | 5.8 | 6.0 | 7.5 |
| Temperature (°C) | | 2.5 | 9.8 | 17.2 | 15.9 | 3.4 | 0.7 | 7.9 | 16.9 | 13.8 | 2.1 |
| Temperature-based DO objective* | calculated | 7.4 | 6.4 | 5.6 | 5.7 | 7.2 | 7.6 | 6.6 | 5.6 | 5.9 | 7.4 |
| Appearance | | Clear | Clear | Cloudy brown | Clear | Clear | Clear | Clear | Clear | Clear | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.1 | 7.8 | 7.8 | 8.0 | 7.9 | 7.6 | 7.9 | 7.8 | 7.7 | 7.7 |
| Total Kjeldahl Nitrogen (TKN) | | 1.22 | 0.71 | 1.14 | 0.58 | 0.66 | 0.82 | 0.81 | 0.74 | 0.54 | 1.06 |
| Total Ammonia (as N) | | 0.34 | 0.19 | 0.09 | 0.1 | 0.18 | 0.22 | 0.13 | 0.18 | 0.15 | 0.03 |
| Un-ionized Ammonia (as N) | 0.02 | 0.007 | 0.002 | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 | 0.001 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.34 | 0.19 | 0.09 | 0.1 | 0.18 | 0.22 | 0.13 | 0.18 | 0.15 | 0.03 |
| Nitrate (as N) | | 0.28 | 0.66 | 0.40 | 0.32 | 0.81 | 0.39 | 0.49 | 0.46 | <0.10 | 0.39 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **680** | 5 | **5200** | **164** | **1330** | **1420** | 17 | **190** | 42 | **130** |
| Total $BOD_5$ | | 2 | 1 | 2 | <1 | <1 | 2 | <1 | <1 | 3 | 2 |
| Chloride | | 792 | 943 | 34 | 170 | 790 | 1240 | 764 | 647 | 297 | 196 |
| Total Phosphorus | 0.03 | **0.10** | **0.09** | **0.29** | **0.08** | **0.07** | **0.11** | **0.08** | **0.12** | **0.08** | **0.20** |
| Total Suspended Solids | | 6 | 14 | 24 | 22 | 11 | 11 | 5 | 12 | 35 | 24 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW6 | SW6 | SW6 | SW6 | SW6 | SW7 | SW7 | SW7 | SW7 | SW7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. |
| | | 2015-03-12 | 2015-05-13 | 2015-06-09 | 2015-09-30 | 2015-10-29 | 2007-10-19 | 2007-12-05 | 2008-03-27 | 2008-08-06 | 2008-10-31 |
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Wet* | *Dry* | *Freshet* | *Wet* | *Dry* |
| *Event Phase* | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 272.2 | 273.2 | 289.7 | 285.9 | 283.0 | 292.2 | 265.3 | 275.1 | 295.2 | 283.0 |
| pH (unitless) | 6.5 - 8.5 | 6.7 | 7.8 | 7.5 | 8.0 | 7.9 | 7.1 | 8.4 | 8.3 | 7.8 | 6.9 |
| Conductivity (µS/cm) | | 4380 | 6020 | 1145 | 1295 | 785 | 1281 | 1360 | 515 | 1654 | 1171 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 9.1 | 8.9 | 13.4 | 6.1 | 7.3 | 9.7 | 19.6 | 13.4 | - | 7.8 |
| Temperature (°C) | | 0.2 | 12.3 | 17.3 | 17.6 | 11.0 | 19.6 | 0.4 | 3.8 | 24.3 | 11.0 |
| Temperature-based DO objective* | calculated | 7.7 | 6.1 | 5.6 | 5.5 | 6.3 | 5.3 | 7.7 | 7.2 | 4.9 | 6.3 |
| Appearance | | Clear | Clear | Slightly cloudy grey | Clear yellowish | slightly cloudy | cloudy brown | clear | clear yellow | clear yellowish | clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.6 | 7.7 | 7.9 | 8.1 | 7.7 | 7.5 | 7.8 | 7.9 | 7.8 | 7.9 |
| Total Kjeldahl Nitrogen (TKN) | | 1.87 | 0.75 | 1.37 | 0.63 | 1.04 | 1.56 | 1.27 | 0.78 | 1.53 | 0.41 |
| Total Ammonia (as N) | | 0.57 | 0.1 | 0.22 | 0.06 | 0.03 | 0.2 | 0.37 | 0.09 | 0.12 | 0.16 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.001 | 0.002 | 0.002 | 0.000 | 0.001 | 0.008 | 0.002 | 0.004 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.57 | 0.1 | 0.22 | 0.06 | 0.03 | 0.2 | 0.37 | 0.09 | 0.12 | 0.16 |
| Nitrate (as N) | | <2 | <5 | 0.35 | 0.29 | 2.96 | 0.52 | 4.30 | 0.49 | <0.10 | <0.10 |
| Nitrite (as N) | | <2 | <5 | <0.25 | <0.25 | <0.25 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | | | | | | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **1910** | **1300** | **7800** | **1250** | **1700** | **4300** | | **417** | **162** | 90 |
| Total $BOD_5$ | | 7 | <5 | <5 | <5 | <5 | 9 | 1 | <1 | 6 | 1 |
| Chloride | | 1640 | 3040 | 249 | 277 | 129 | 251 | 254 | 99 | 330 | 164 |
| Total Phosphorus | 0.03 | **0.20** | **0.06** | **0.18** | **0.06** | **0.12** | **0.39** | **0.10** | **0.10** | **0.24** | **0.10** |
| Total Suspended Solids | | 11 | <10 | 45 | <10 | 14 | 96 | 4 | 16 | 11 | 12 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. |
| | | 2008-12-16 | 2009-02-13 | 2009-04-06 | 2009-06-18 | 2009-09-10 | 2009-12-01 | 2010-03-09 | 2010-06-16 | 2010-09-03 | 2010-10-05 |
| ***Event Type*** | | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** |
| ***Event Phase*** | | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Pre-Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 266.8 | 271.0 | 274.4 | 287.8 | 291.6 | 278.1 | 277.1 | 293.0 | 294.8 | 282.2 |
| pH (unitless) | 6.5 - 8.5 | 7.5 | 7.8 | 7.2 | 8.2 | 7.9 | 7.9 | 7.5 | 7.9 | 7.3 | 7.6 |
| Conductivity (µS/cm) | | 1070 | 1429 | 470 | 1422 | 1810 | 922 | 375 | 960 | 1755 | 944 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 14.2 | 11.5 | 12.0 | 6.8 | **1.8** | 14.4 | 12.8 | 6.1 | **2.0** | 10.5 |
| Temperature (°C) | | 0.0 | 2.4 | 6.5 | 17.2 | 21.5 | 7.9 | 5.3 | 24.1 | 23.9 | 12.7 |
| Temperature-based DO objective* | calculated | 7.7 | 7.4 | 6.8 | 5.6 | 5.1 | 6.6 | 7.0 | 4.9 | 4.9 | 6.1 |
| Appearance | | clear yellowish | clear yellowish | slightly cloudy light brown | yellowish | cloudy greyish | clear yellowish | cloudy yellowish | clear | Cloudy Grey | cloudy brown |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.9 | 7.8 | 7.8 | 7.8 | 7.9 | 7.7 | 7.9 | 8.0 | 7.8 |
| Total Kjeldahl Nitrogen (TKN) | | 0.91 | 0.85 | 1.65 | 0.66 | 1.34 | 0.81 | 0.7 | 1.21 | 3.83 | 1.19 |
| Total Ammonia (as N) | | 0.08 | 0.14 | 0.1 | 0.14 | 0.67 | 0.18 | 0.17 | 0.2 | 1.18 | 0.19 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.001 | 0.000 | 0.007 | **0.021** | 0.002 | 0.001 | 0.008 | 0.012 | 0.002 |
| Total Ammonia (as N, for calculations) | | 0.08 | 0.14 | 0.1 | 0.14 | 0.67 | 0.18 | 0.17 | 0.2 | 1.18 | 0.19 |
| Nitrate (as N) | | 0.99 | 0.81 | 0.42 | 0.60 | <0.10 | 0.50 | 0.30 | 0.27 | <1.0 | 1.79 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <1.0 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **316** | **1200** | **360** | **4180** | 90 | **141** | **930** | **790** | 10 | **820** |
| Total $BOD_5$ | | 2 | 1 | 2 | 2 | 2 | <1 | 3 | 3 | 10 | 2 |
| Chloride | | 194 | 376 | 70 | 276 | 482 | 142 | 65 | 223 | 321 | 184 |
| Total Phosphorus | 0.03 | **0.19** | **0.15** | **0.30** | **0.10** | 0.01 | **0.20** | **0.15** | **0.21** | **0.95** | **0.14** |
| Total Suspended Solids | | 18 | 9 | 35 | 23 | 26 | 13 | 19 | 32 | 1980 | 185 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

## Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. | SW7 Merrittville Hwy. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011-03-29 | 2011-06-06 | 2011-06-24 | 2011-09-30 | 2011-11-29 | 2012-03-15 | 2012-04-25 | 2012-07-04 | 2012-07-27 | 2012-10-10 |
| ***Event Type*** | | ***Dry*** | ***Freshet*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Freshet*** | ***Wet*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 271.4 | 292.2 | 292.4 | 286.2 | 279.4 | 285.5 | 279.5 | 273.2 | 296.3 | 282.1 |
| pH (unitless) | 6.5 - 8.5 | 8.4 | 8.0 | 7.7 | 8.1 | 8.1 | 7.3 | 7.9 | 7.8 | 7.7 | 7.8 |
| Conductivity (µS/cm) | | 2710 | 2887 | 2093 | 622 | 215 | 2580 | 1200 | 2230 | 1536 | 740 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 14.2 | 17.5 | **2.0** | 7.4 | 11.1 | 8.1 | 8.9 | 6.1 | 5.6 | 7.7 |
| Temperature (°C) | | 5.5 | 24.5 | 21.0 | 16.0 | 6.9 | 6.4 | 12.2 | 24.7 | 25.3 | 12.6 |
| Temperature-based DO objective* | calculated | 7.0 | 4.9 | 5.2 | 5.7 | 6.8 | 6.8 | 6.1 | 4.8 | 4.8 | 6.1 |
| Appearance | | clear yellowish | | yellowish | cloudy | brownish | yellowish | clear | brownish | yellowish | cloudy brown |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.9 | 8.2 | 7.8 | 7.8 | 7.6 | 8.0 | 8.0 | 7.7 | 7.6 | 7.8 |
| Total Kjeldahl Nitrogen (TKN) | | 1.32 | 1.13 | 3.1 | 0.82 | 1.08 | 0.91 | 1.05 | 1.95 | 2.33 | 1.04 |
| Total Ammonia (as N) | | 0.3 | 0.49 | 0.83 | 0.03 | 0.02 | 0.14 | 0.12 | 0.22 | 0.42 | 0.16 |
| Un-ionized Ammonia (as N) | 0.02 | 0.009 | **0.025** | 0.017 | 0.001 | 0.000 | 0.000 | 0.002 | 0.007 | 0.011 | 0.002 |
| Total Ammonia (as N, for calculations) | | 0.3 | 0.49 | 0.83 | 0.03 | 0.02 | 0.14 | 0.12 | 0.22 | 0.42 | 0.16 |
| Nitrate (as N) | | 0.32 | 0.15 | <0.10 | 0.64 | 0.29 | 0.23 | 0.43 | 0.11 | 0.14 | 0.65 |
| Nitrite (as N) | | <0.10 | 0.11 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | - | - | - | - | - | - | - | - | - |
| *E.coli* (5TMPN/100ml) | 100 | **5700** | **750** | **170** | **1760** | **184** | **136** | **1060** | 60 | **670** | **810** |
| Total $BOD_5$ | | 2 | 3 | 4 | 1 | 3 | 2 | 2 | 7 | 5 | 5 |
| Chloride | | 572 | 668 | 395 | 74 | 15 | 526 | 206 | 330 | 242 | 72 |
| Total Phosphorus | 0.03 | **0.13** | **0.20** | **0.23** | **0.12** | **0.08** | **0.07** | **0.11** | **0.21** | **0.09** | **0.11** |
| Total Suspended Solids | | 14 | 11 | 34 | 24 | 78 | 24 | 19 | 96 | 72 | 52 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 | SW7 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. | Merrittville Hwy. |
| | | **2012-12-05** | **2013-03-27** | **2013-05-02** | **2013-06-13** | **2013-10-10** | **2013-12-10** | **2014-03-18** | **2014-04-25** | **2014-06-04** | **2014-09-24** |
| ***Event Type*** | | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** | ***Wet*** | ***Freshet*** | ***Dry*** | ***Wet*** | ***Dry*** |
| ***Event Phase*** | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | | | | | |
| Air Temperature (K) | | 274.0 | 276.6 | 289.6 | 289.7 | 285.7 | 267.9 | 273.0 | 283.1 | 288.5 | 288.7 |
| pH (unitless) | 6.5 - 8.5 | 7.9 | **8.7** | 7.8 | 7.7 | 7.5 | 7.8 | 7.6 | 8.3 | 7.5 | 7.4 |
| Conductivity (µS/cm) | | 1194 | 3150 | 3420 | 372 | 1452 | 3870 | 4660 | 2950 | 2540 | 2100 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 7.6 | 11.3 | **5.9** | 7.3 | 9.7 | 8.2 | 8.5 | 9.9 | 7.9 | 7.4 |
| Temperature (°C) | | 5.3 | 3.3 | 12.9 | 12.4 | 15.6 | 0.9 | 1.2 | 8.1 | 19.8 | 15.8 |
| Temperature-based DO objective* | calculated | 7.0 | 7.3 | 6.0 | 6.1 | 5.7 | 7.6 | 7.6 | 6.6 | 5.3 | 5.7 |
| Appearance | | | Clear | Clear | Cloudy brown | Clear | Clear | Clear | Clear | Clear | Clear |
| **LABORATORY ANALYSES** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.0 | 8.1 | 8.0 | 7.8 | 8.1 | 7.9 | 7.6 | 8.0 | 7.9 | 7.8 |
| Total Kjeldahl Nitrogen (TKN) | | 0.75 | 1.07 | 1.07 | 1.48 | 0.6 | 0.81 | 0.76 | 0.78 | 0.74 | 0.49 |
| Total Ammonia (as N) | | 0.02 | 0.26 | 0.1 | 0.11 | 0.07 | 0.22 | 0.18 | 0.08 | 0.12 | 0.07 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.013 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 | 0.001 | 0.000 |
| Total Ammonia (as N, for calculations) | | 0.02 | 0.26 | 0.1 | 0.11 | 0.07 | 0.22 | 0.18 | 0.08 | 0.12 | 0.07 |
| Nitrate (as N) | | 0.27 | 0.84 | 0.20 | 0.26 | 0.22 | 0.60 | 0.34 | 0.31 | 0.25 | <0.10 |
| Nitrite (as N) | | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Dissolved Nitrite + Nitrate | | - | | | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **210** | 78 | 13 | **5300** | 36 | **1070** | **480** | 7 | **210** | 5 |
| Total $BOD_5$ | | 3 | 2 | 2 | 3 | <1 | 3 | 2 | <1 | <1 | <1 |
| Chloride | | 155 | 924 | 729 | 36 | 166 | 962 | 1140 | 673 | 525 | 266 |
| Total Phosphorus | 0.03 | **0.09** | **0.08** | **0.07** | **0.26** | **0.08** | **0.08** | **0.10** | **0.09** | **0.13** | **0.09** |
| Total Suspended Solids | | 7 | 6 | 9 | 48 | 7 | 7 | 9 | 5 | 16 | 11 |

Notes:

· All parameters are mg/L unless otherwise indicated.

· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Table C-1

## Surface Water Quality

## Regional Road 20 Redevelopment

| Parameter | | SW7 Merrittville Hwy. 2014-12-01 | SW7 Merrittville Hwy. 2015-03-12 | SW7 Merrittville Hwy. 2015-05-13 | SW7 Merrittville Hwy. 2015-06-09 | SW7 Merrittville Hwy. 2015-09-30 | SW7 Merrittville Hwy. 2015-10-29 |
|---|---|---|---|---|---|---|---|
| *Event Type* | | *Wet* | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* |
| *Event Phase* | | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction | Post-Construction |
| **Field Analyses** | | | | | | | |
| Air Temperature (K) | | 273.9 | 272.2 | 273.2 | 289.7 | 285.9 | 283.0 |
| pH (unitless) | 6.5 - 8.5 | 7.7 | 6.5 | 7.9 | 7.3 | 8.1 | 8.1 |
| Conductivity (µS/cm) | | 3110 | 5520 | 5360 | 1583 | 1253 | 821 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8 | 7.7 | 9.2 | 8.8 | 16.4 | **5.1** | 7.0 |
| Temperature (°C) | | 2.1 | 0.0 | 14.8 | 17.5 | 16.5 | 11.2 |
| Temperature-based DO objective* | calculated | 7.4 | 7.7 | 5.8 | 5.5 | 5.6 | 6.2 |
| Appearance | | Clear | Clear | Slightly cloudy | Slight cloudy grey brown | Clear yellowish | slightly cloudy |
| **LABORATORY ANALYSES** | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.8 | 7.7 | 8.0 | 7.9 | 8.0 | 7.7 |
| Total Kjeldahl Nitrogen (TKN) | | 1.13 | 1.78 | 1.04 | 1.65 | 0.64 | 0.89 |
| Total Ammonia (as N) | | 0.03 | 0.55 | 0.04 | 0.23 | 0.02 | 0.03 |
| Un-ionized Ammonia (as N) | 0.02 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 |
| Total Ammonia (as N, for calculations) | | 0.03 | 0.55 | 0.04 | 0.23 | 0.02 | 0.03 |
| Nitrate (as N) | | 0.32 | <2.5 | <2.5 | 0.39 | 0.29 | 2.66 |
| Nitrite (as N) | | <0.10 | <2.5 | <2.5 | <0.25 | <0.25 | <0.25 |
| Dissolved Nitrite + Nitrate | | | | | | | |
| *E.coli* (5TMPN/100ml) | 100 | **190** | **1850** | **1000** | **11300** | **770** | **1700** |
| Total $BOD_5$ | | 2 | 7 | <5 | <5 | <5 | <5 |
| Chloride | | 237 | 2080 | 1670 | 354 | 261 | 141 |
| Total Phosphorus | 0.03 | **0.20** | **0.19** | **0.14** | **0.23** | **0.08** | **0.10** |
| Total Suspended Solids | | 12 | <10 | 16 | 34 | <10 | 13 |

Notes:

· All parameters are mg/L unless otherwise indicated.

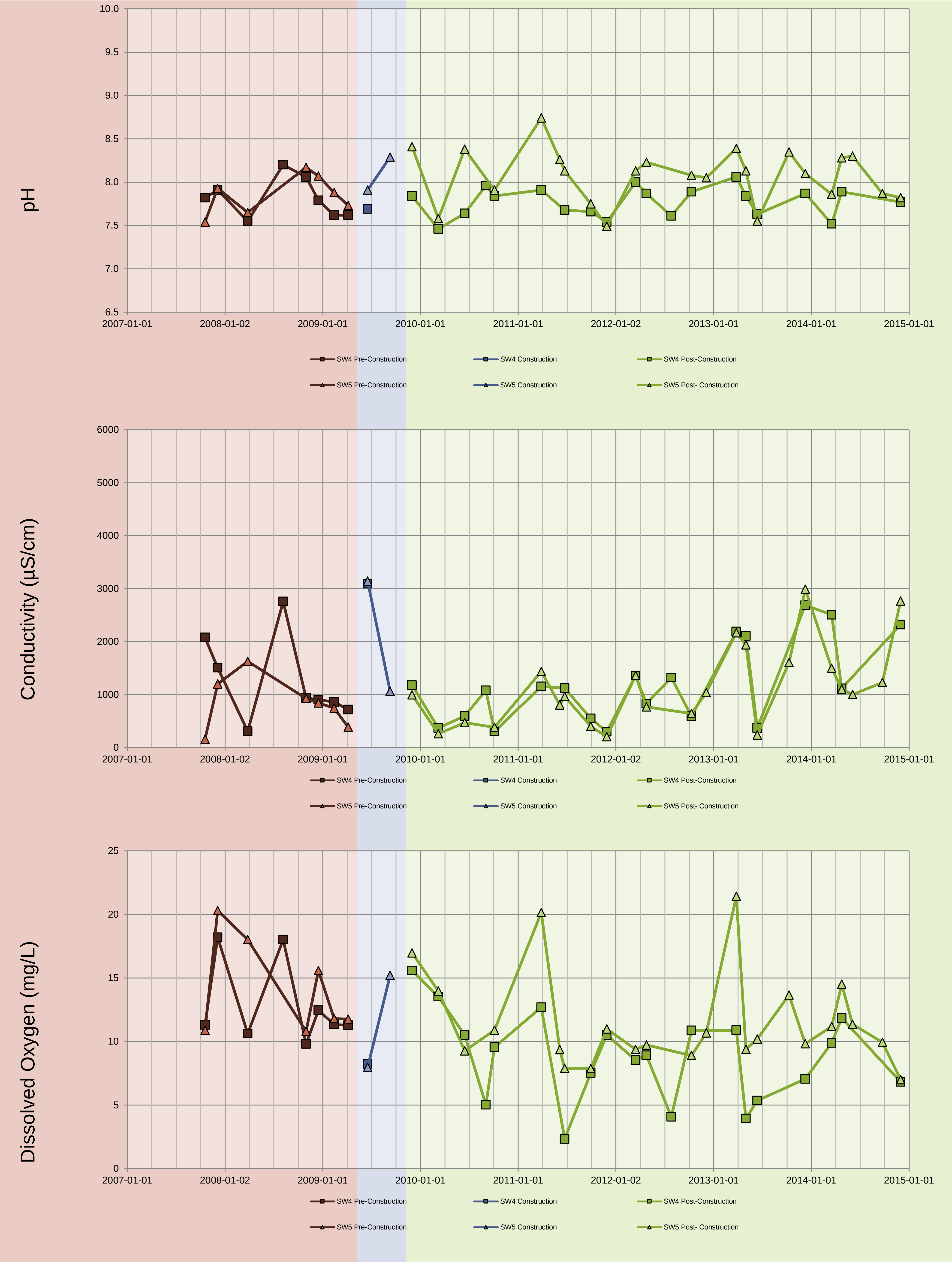
· PWQO - Provincial Water Quality Objectives (1999)

· Shading indicates parameters exceed PWQO

* - Twelve Mile Creek - Cold Water Biota Criteria relative to temperature ($y = 7.7259e^{-0.019x}$)

** - E.coli results may be elevated due to 1-day lab analysis delay

# Figure C-1 Surface Water Quality
# Cataract Road Tributary

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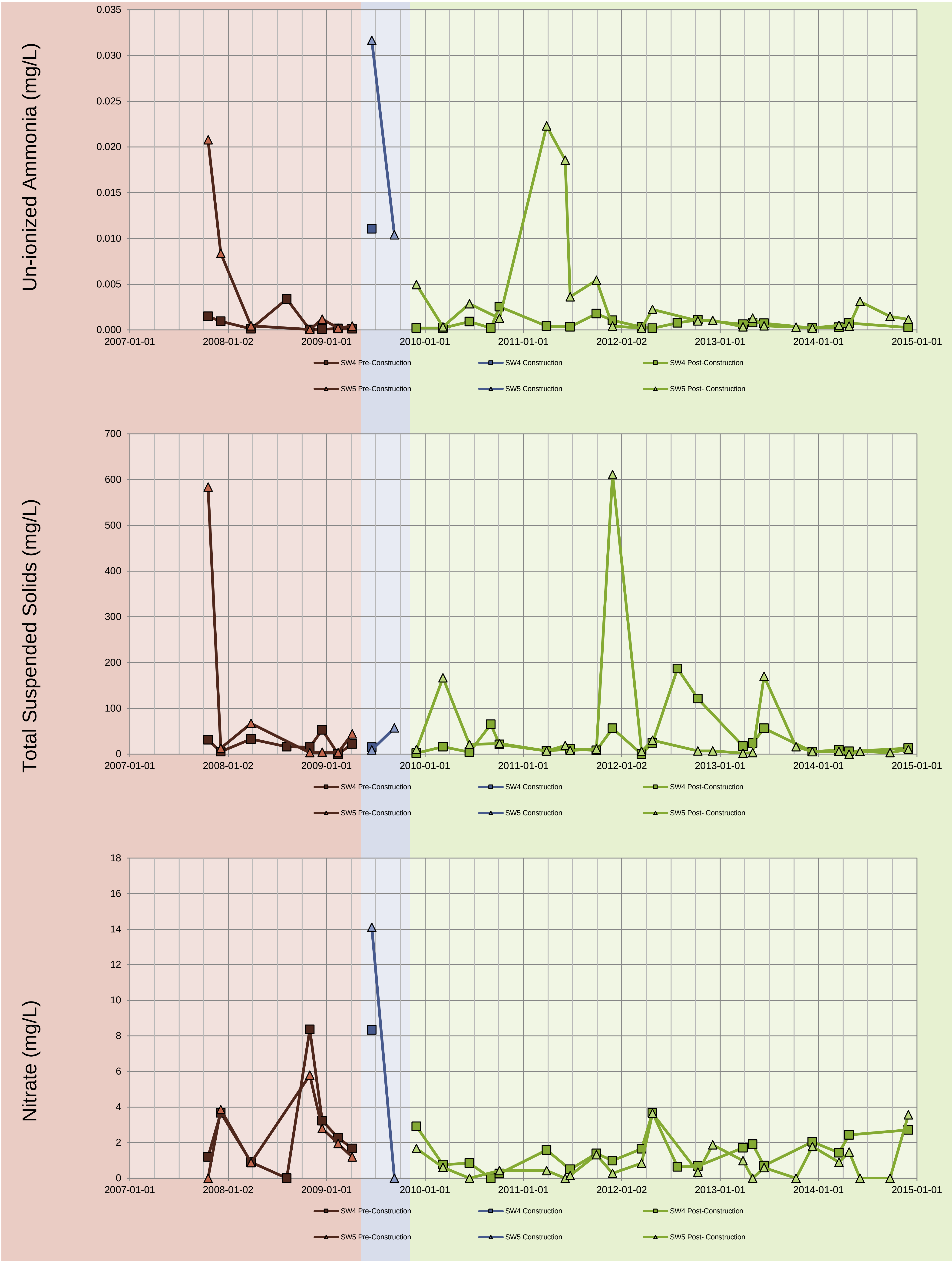
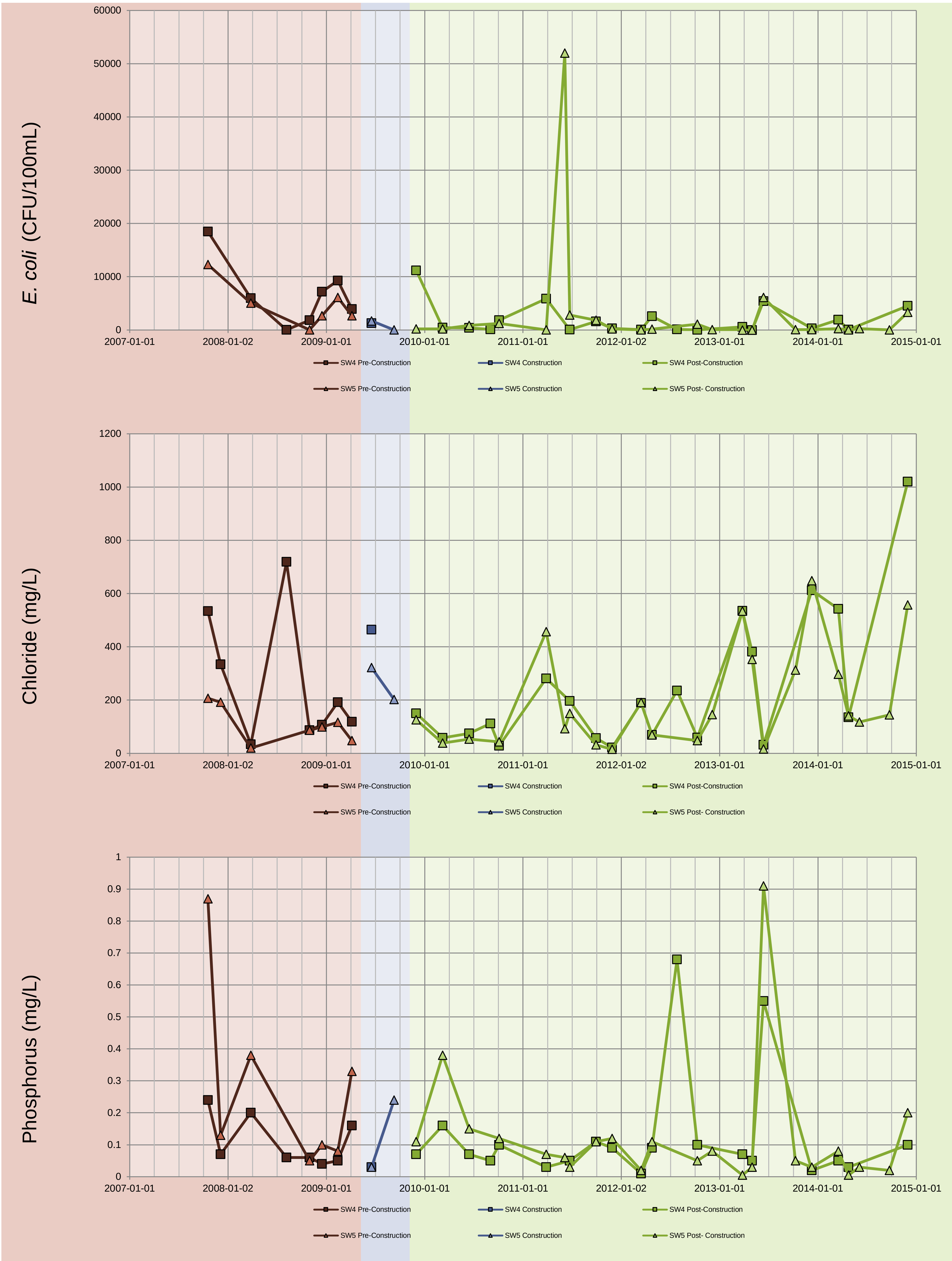
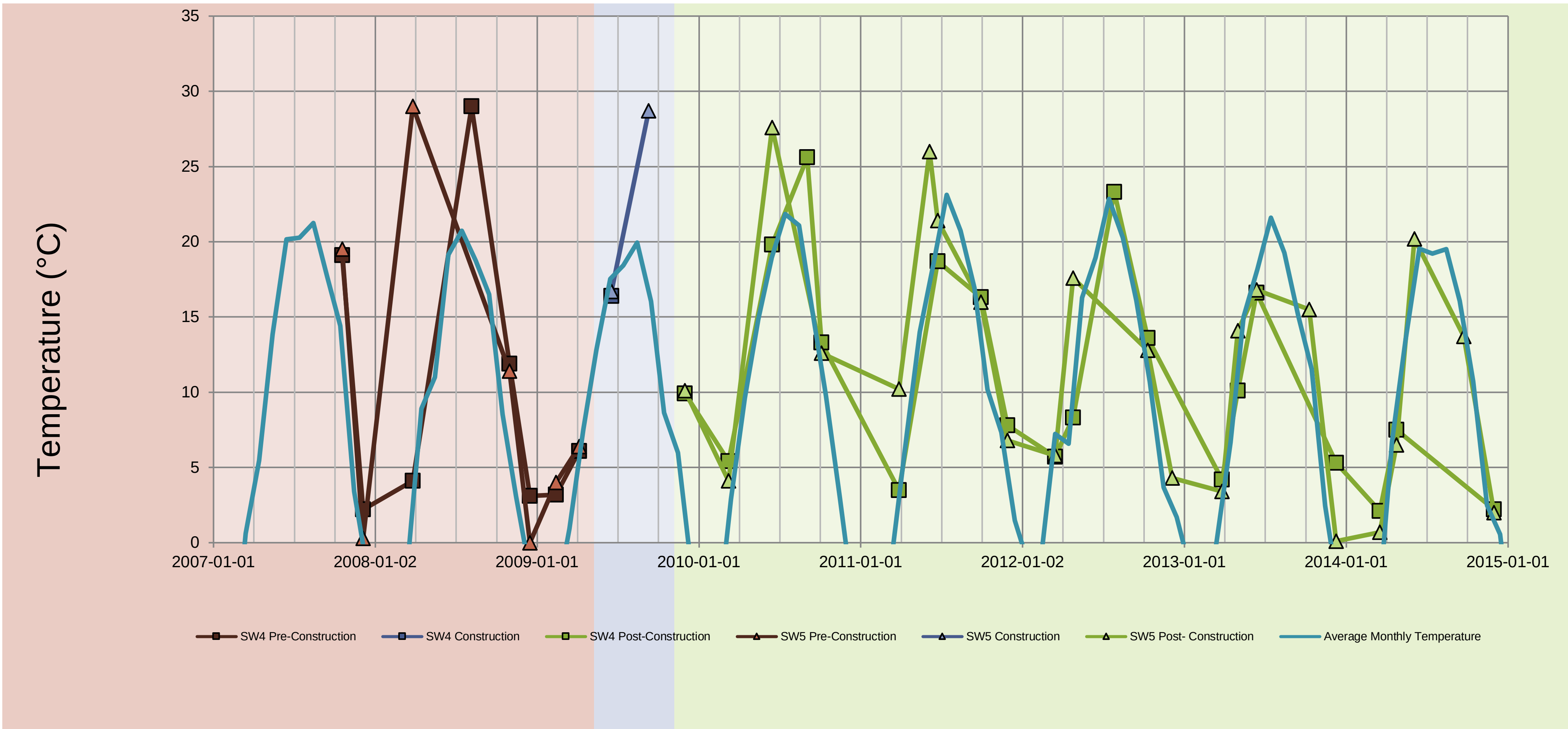
# Figure C-1 Surface Water Quality
# Cataract Road Tributary



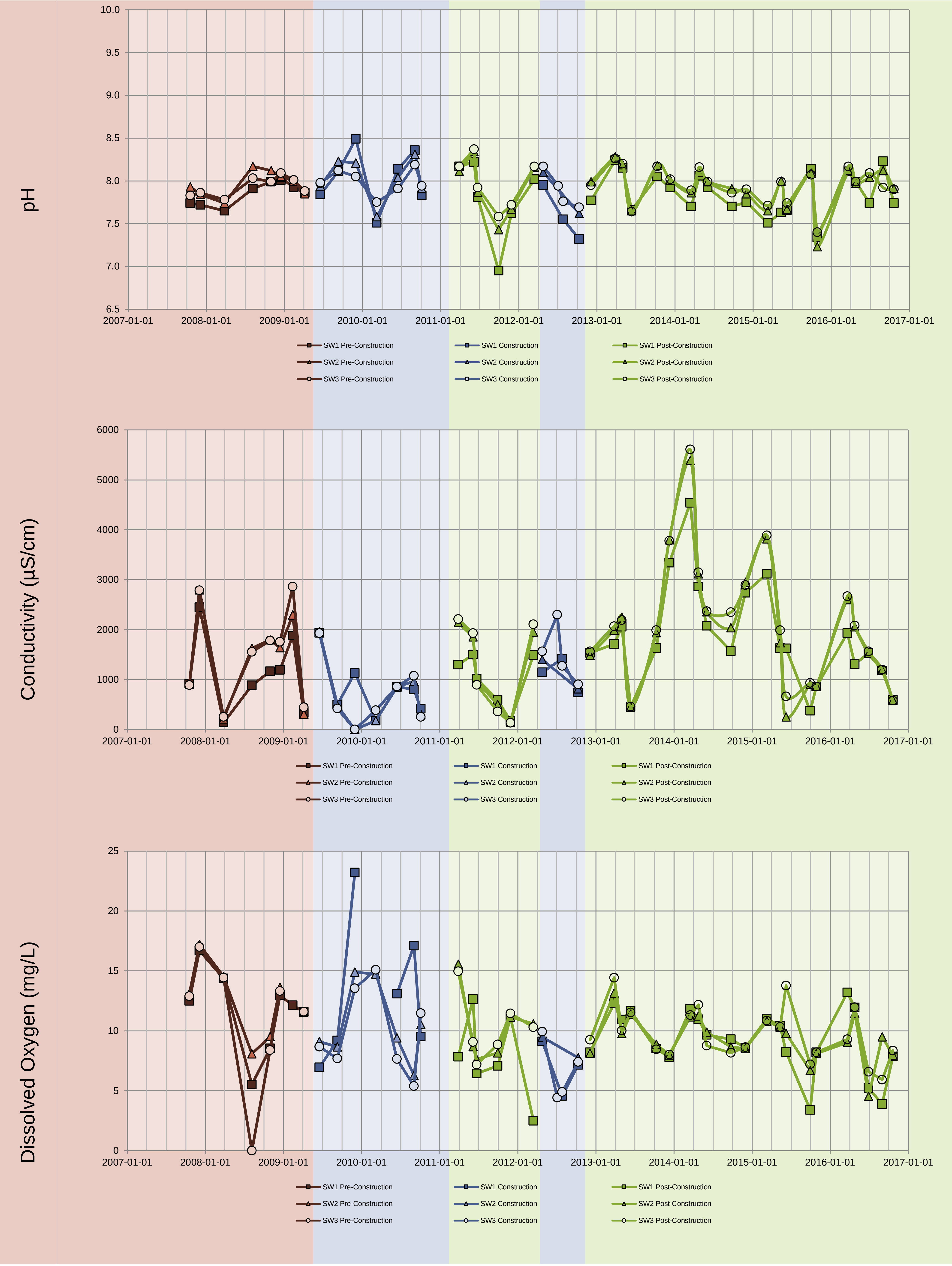
# Figure C-1 Surface Water Quality
# Cataract Road Tributary



# Figure C-1 Surface Water Quality
# Cataract Road Tributary



# Figure C-2 Surface Water Quality
# Rice Road Tributary

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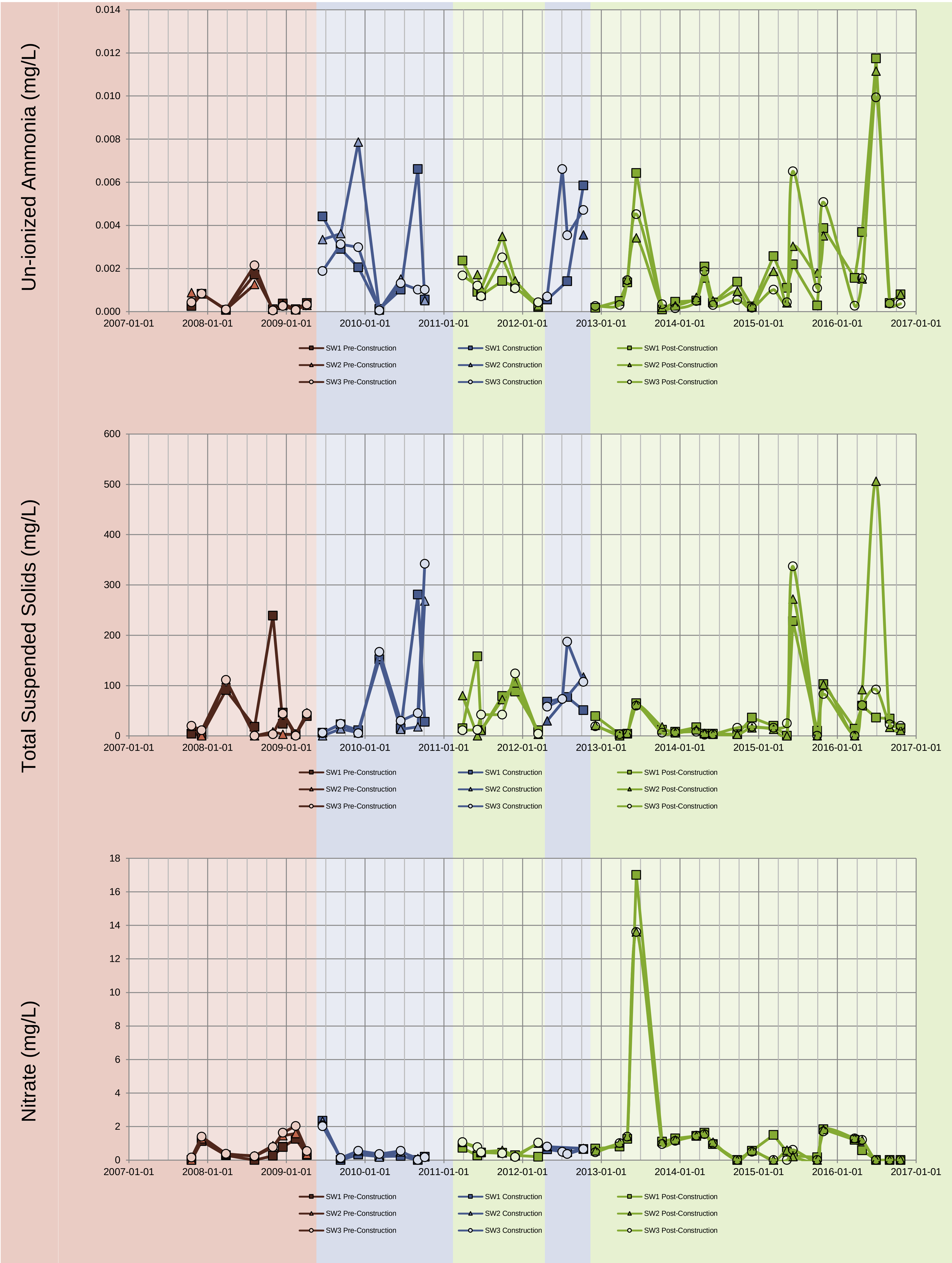
# Figure C-2 Surface Water Quality
# Rice Road Tributary

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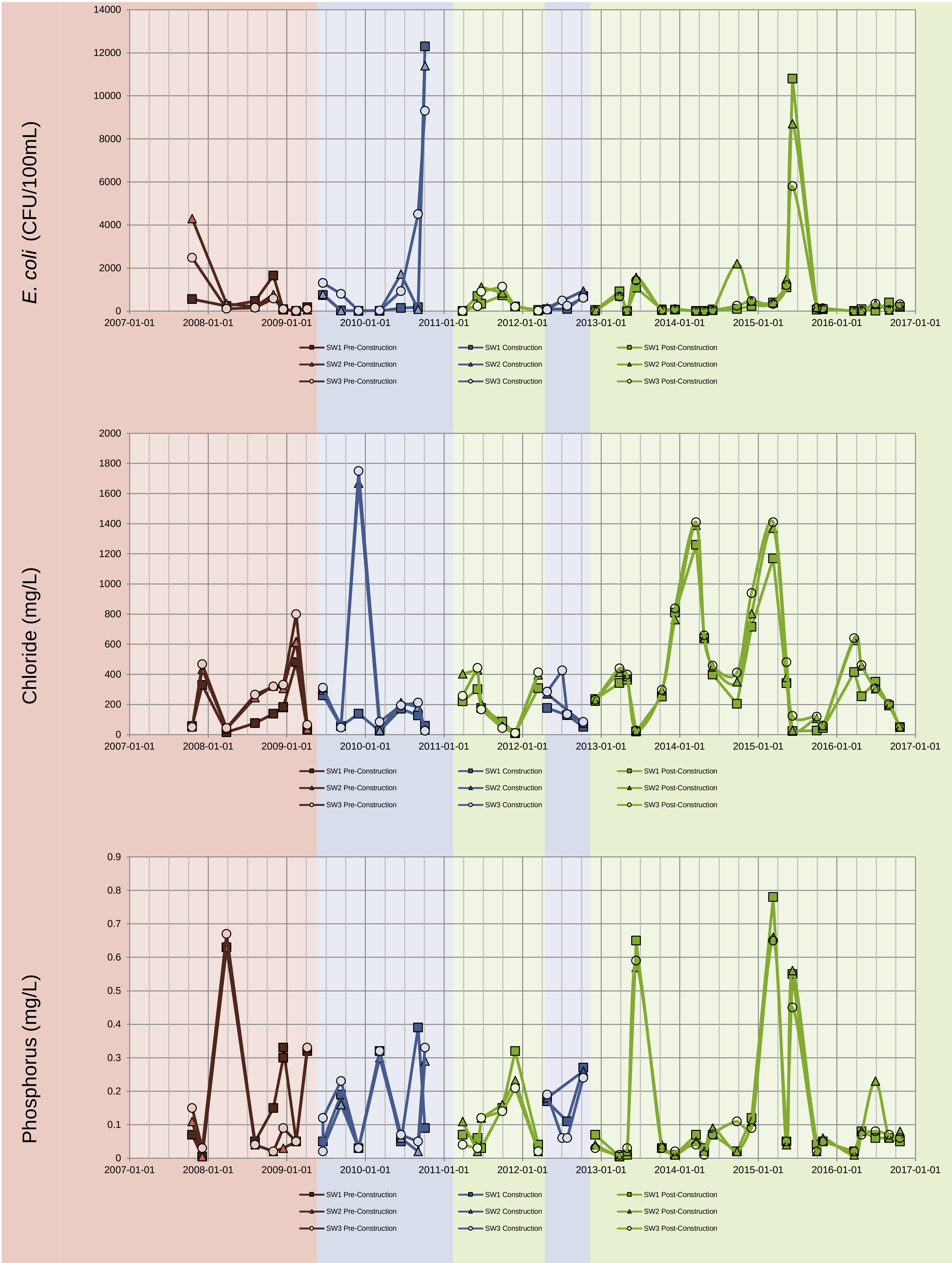
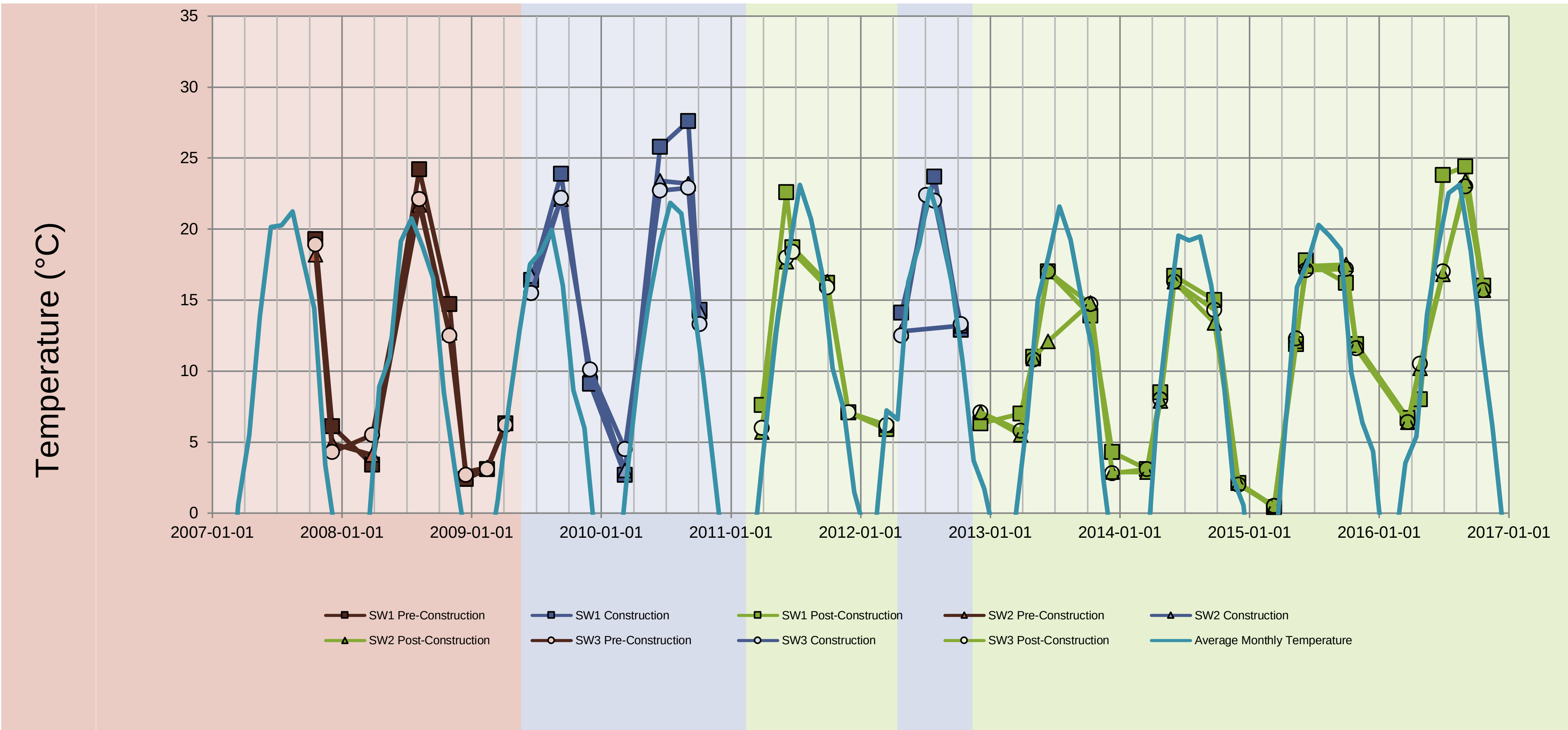
# Figure C-2 Surface Water Quality
# Rice Road Tributary

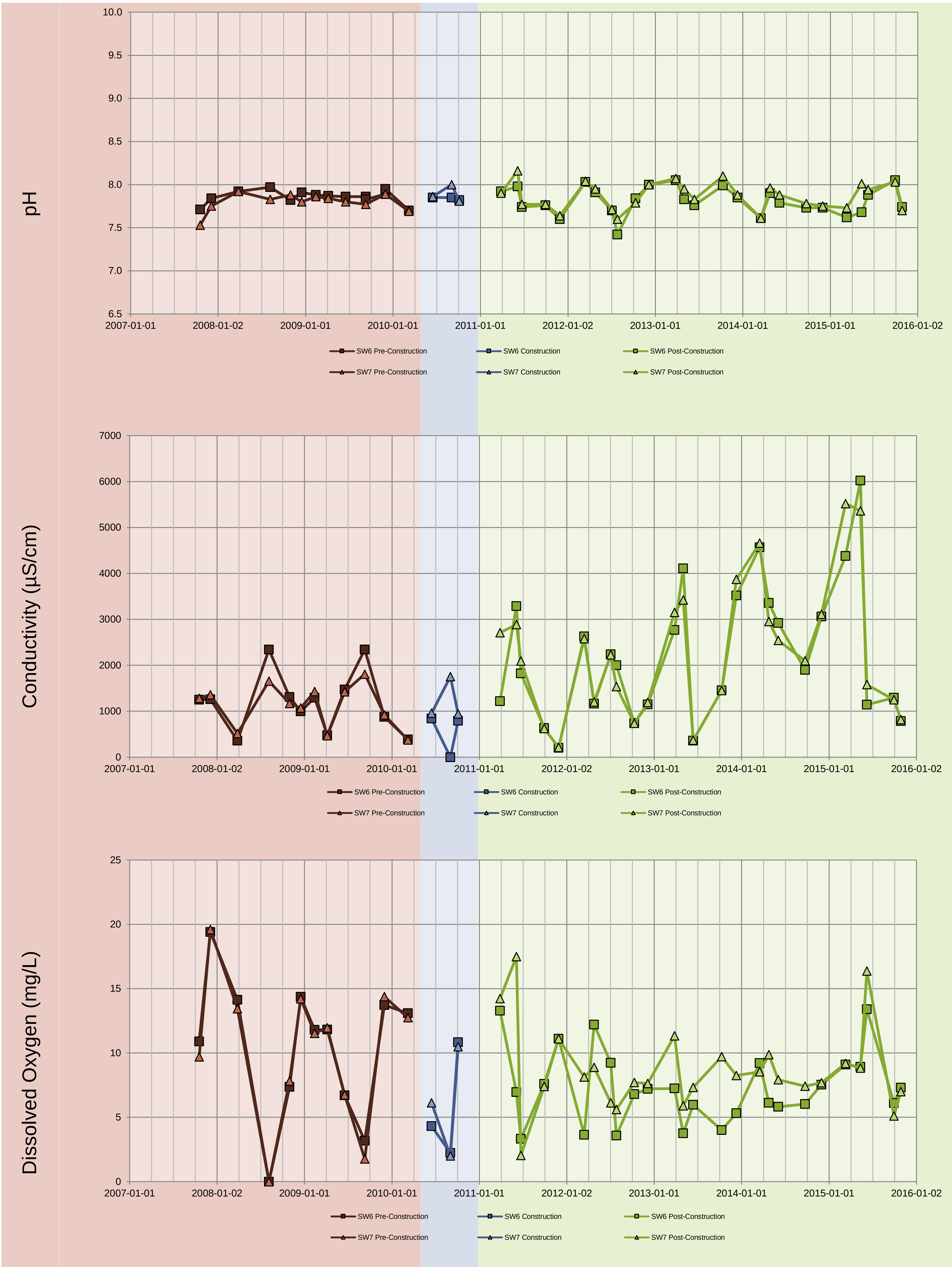



2017-06-2614:54
Z:\Projects\2011\111-53018-00 - Regional Road 20\100\1634010 - 2016 SW Monitoring\Tech\App C - SW Chem\Table C-1 SW Chem2016.xlsx

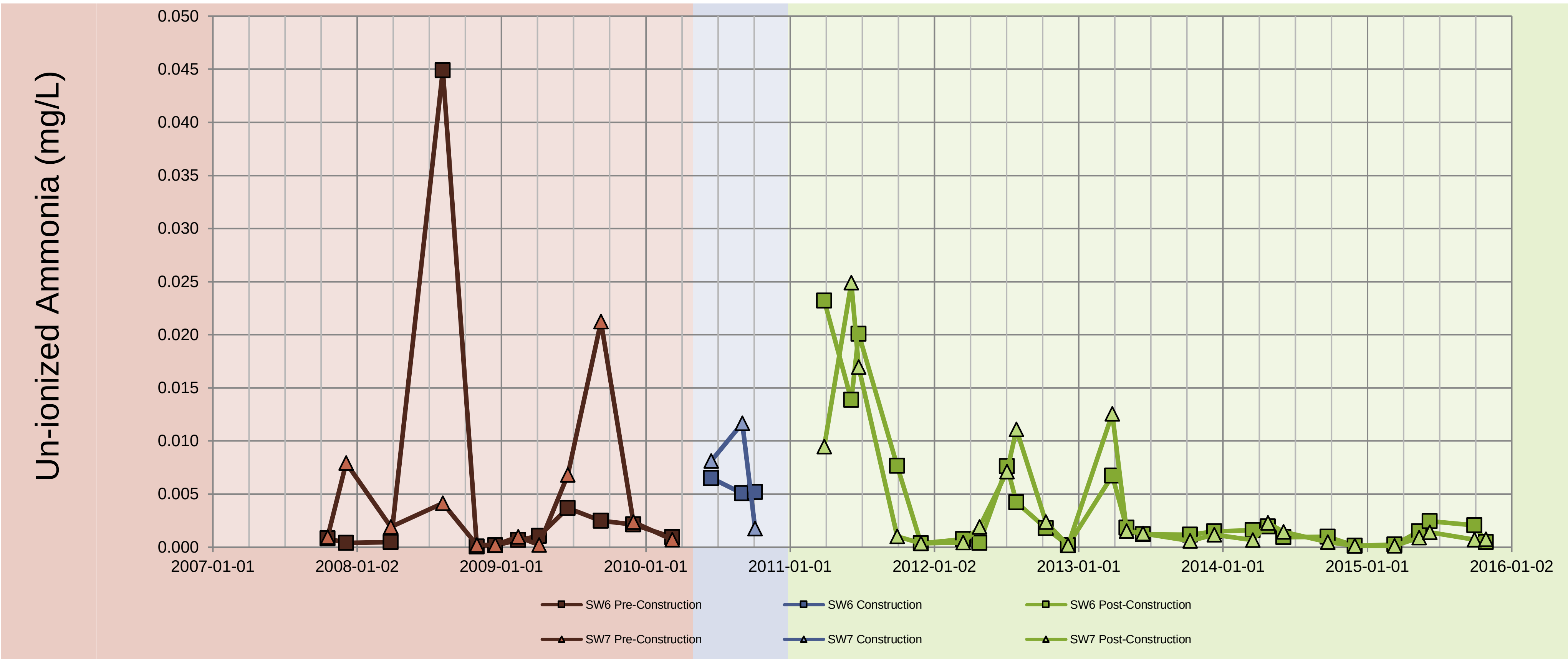
# Figure C-2 Surface Water Quality
# Rice Road Tributary

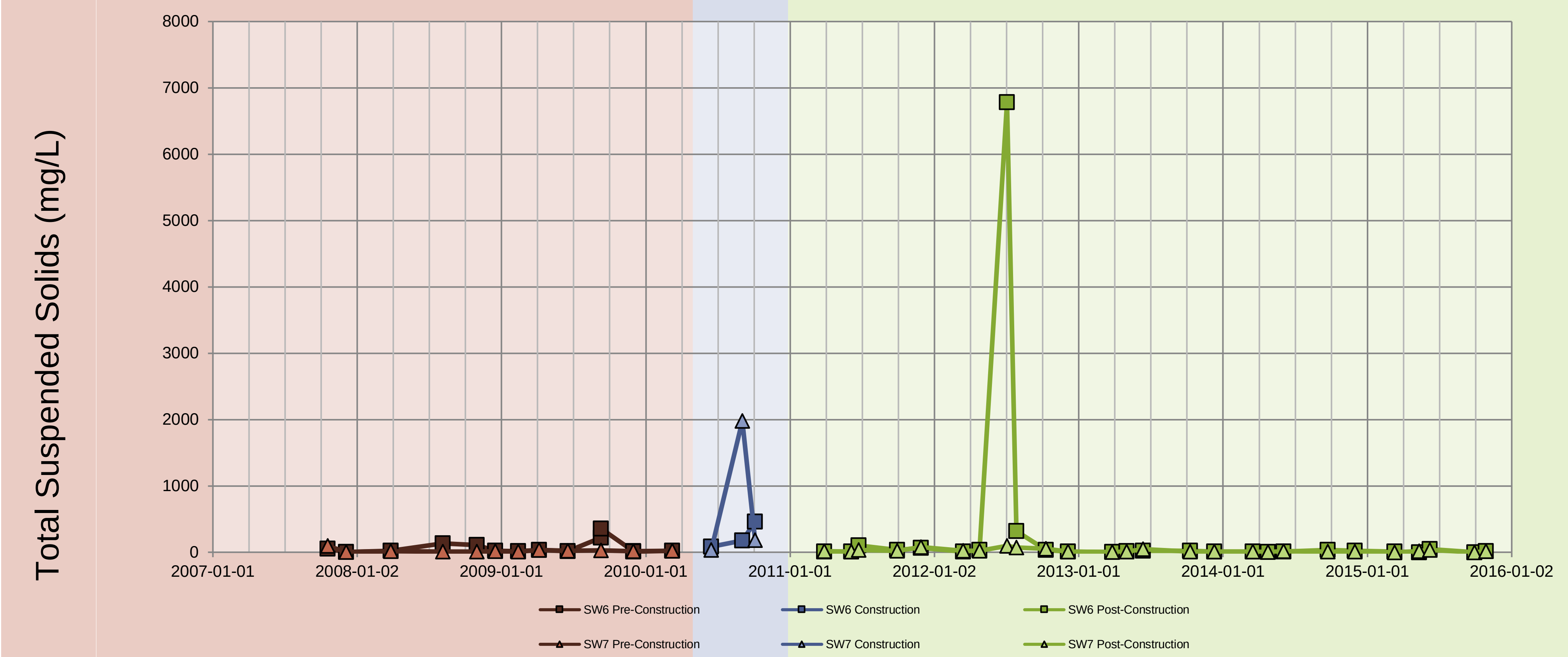


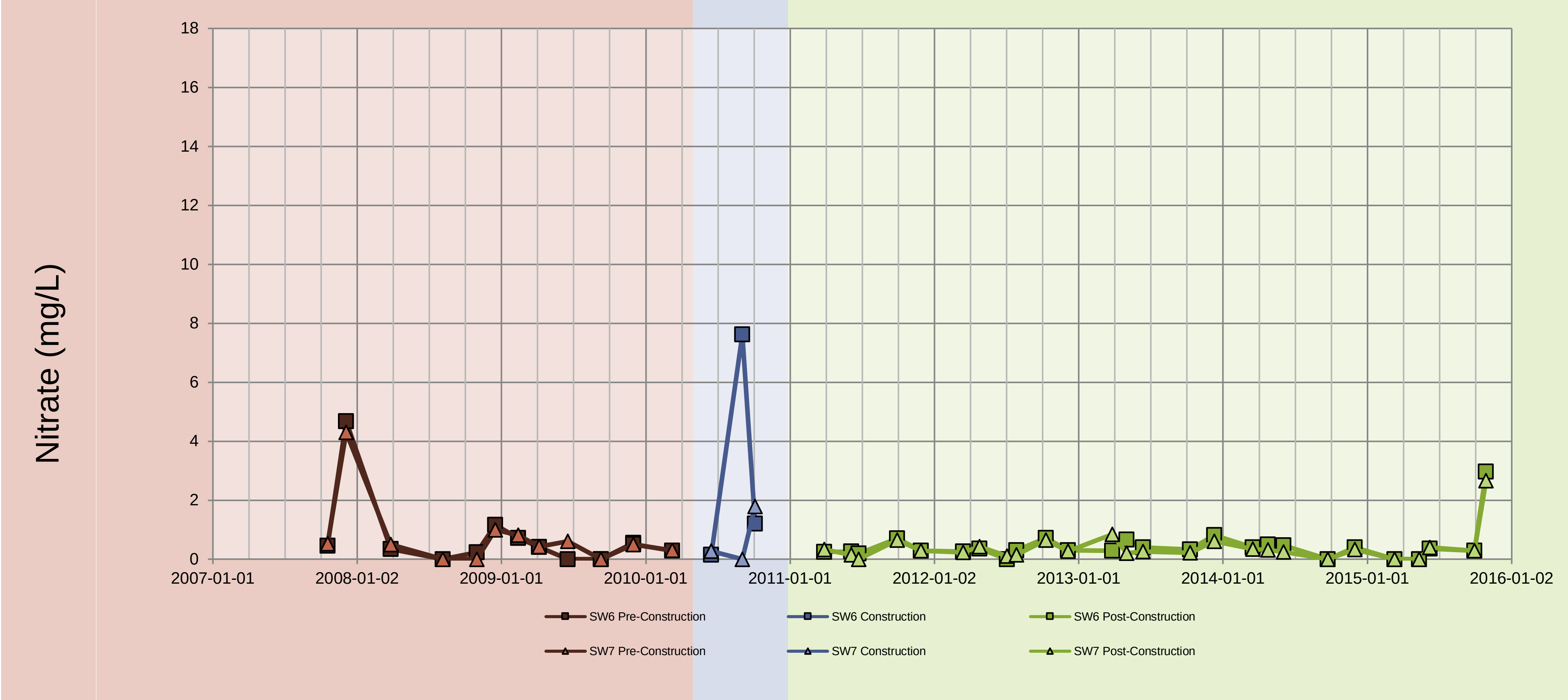
# Figure C-3 Surface Water Quality
# Merrittville Highway Tributary



# Figure C-3 Surface Water Quality
# Merrittville Highway Tributary




2017-06-2614:54
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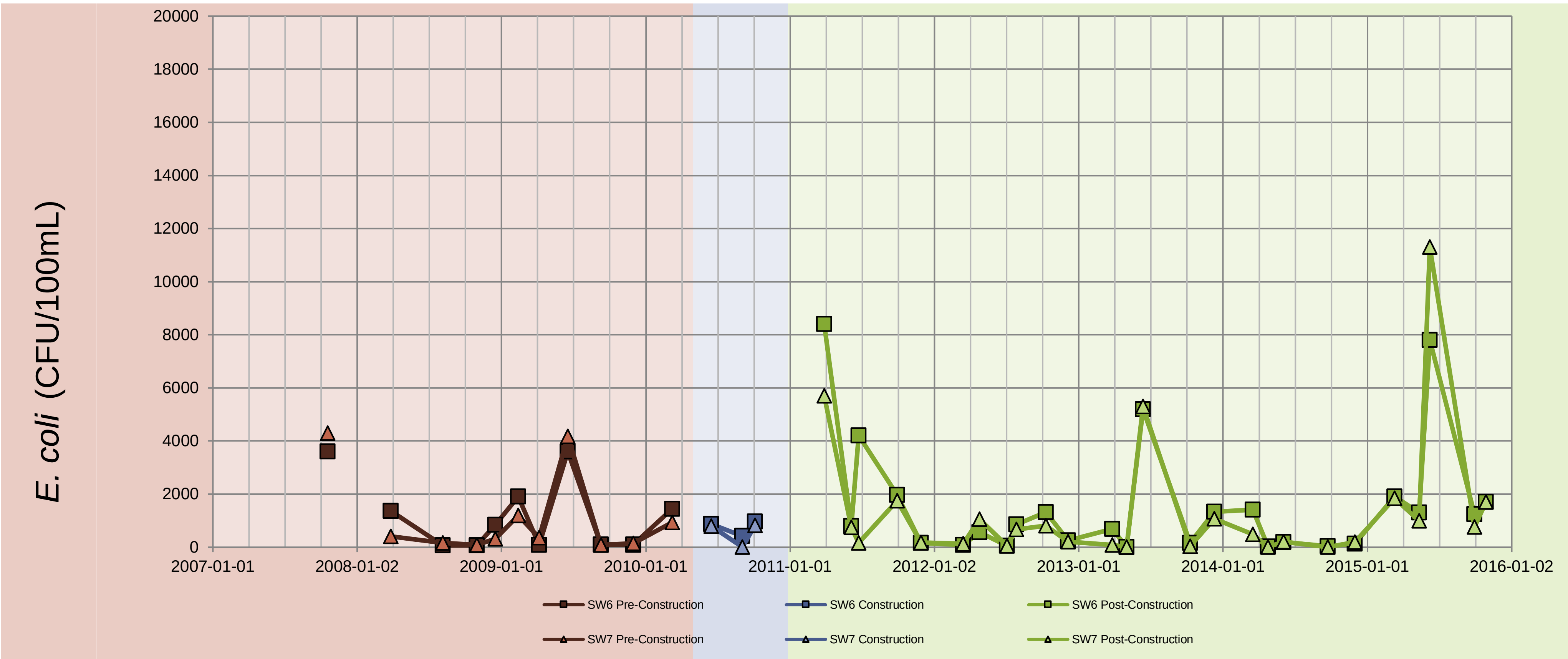
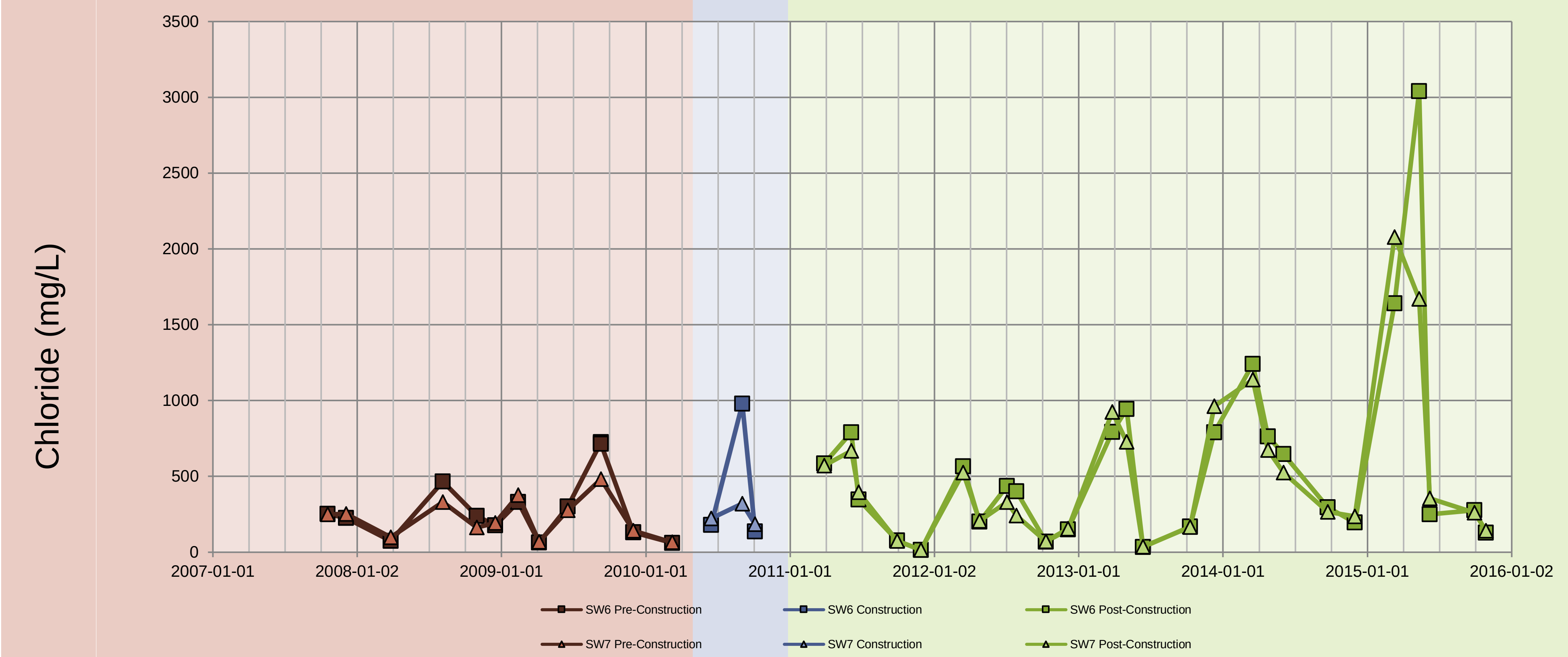
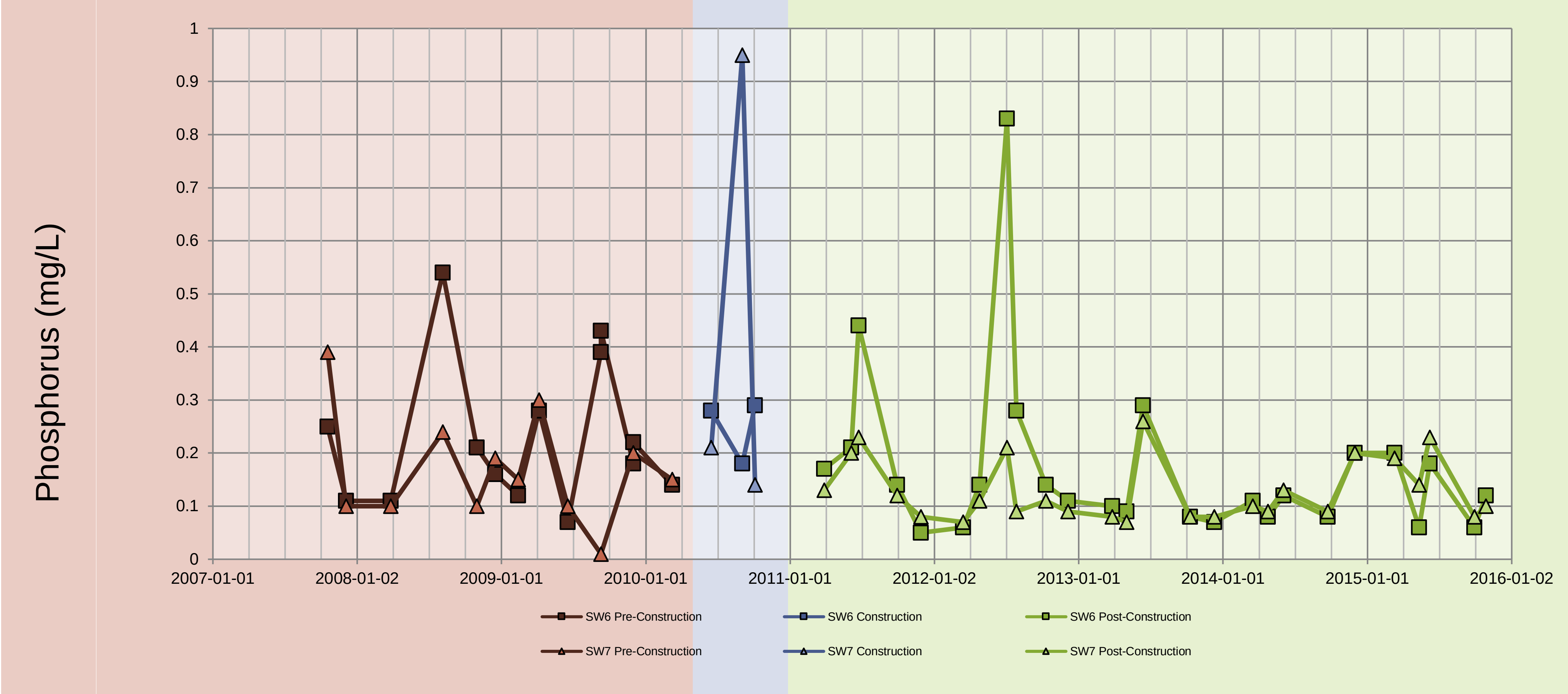
# Figure C-3 Surface Water Quality
# Merrittville Highway Tributary




2017-06-2614:54
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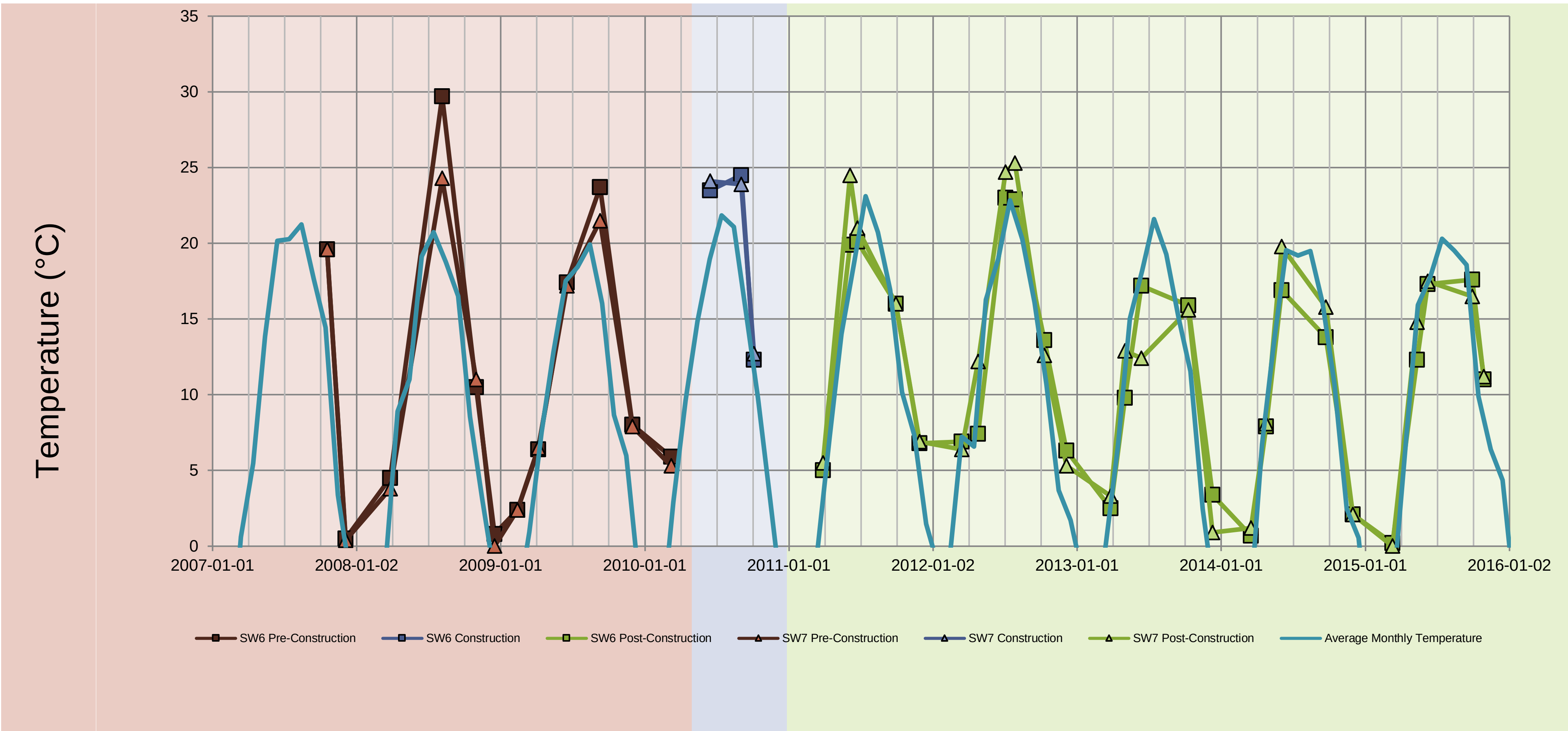
# Figure C-3 Surface Water Quality
# Merrittville Highway Tributary




2017-06-2614:54
Z:\Projects\2011\111-53018-00 - Regional Road 20\100\1634010 - 2016 SW Monitoring\Tech\App C - SW Chem\Table C-1 SW Chem2016.xlsx

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: WSP CANADA INC.
55 KING STREET, 7TH FLOOR
ST CATHARINES, ON L2R3H5
(905) 687-1771

ATTENTION TO: Craig Leger

PROJECT: 111-53018-00

AGAT WORK ORDER: 16T079620

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

WATER ANALYSIS REVIEWED BY: Sofka Pehlyova, Senior Analyst

DATE REPORTED: Mar 31, 2016

PAGES (INCLUDING COVER): 7

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

# Certificate of Analysis

AGAT WORK ORDER: 16T079620

PROJECT: 111-53018-00

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE:Fonthill - Regional Road 20

ATTENTION TO: Craig Leger

SAMPLED BY:Steve Kellerman

## Microbiological Analysis (water)

DATE RECEIVED: 2016-03-23

DATE REPORTED: 2016-03-31

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW100 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 3/22/2016 | 3/22/2016 | 3/22/2016 | 3/22/2016 |
| Parameter | Unit | G / S | RDL | 7457566 | 7457567 | 7457572 | 7457582 |
| Escherichia coli | CFU/100mL | | 2 | ND | ND | ND | ND |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7457566-7457582 RDL >1 indicates dilutions of the sample.
ND - Not Detected.

Certified By:

AGAT Laboratories

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# Certificate of Analysis

AGAT WORK ORDER: 16T079620

PROJECT: 111-53018-00

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Craig Leger

SAMPLING SITE:Fonthill - Regional Road 20

SAMPLED BY:Steve Kellerman

## Inorganic Chemistry (Water)

DATE RECEIVED: 2016-03-23

DATE REPORTED: 2016-03-31

| | | | SAMPLE DESCRIPTION: | SW1 | | SW2 | SW3 | | SW100 |
|---|---|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | | Water | Water | | Water |
| | | | DATE SAMPLED: | 3/22/2016 | | 3/22/2016 | 3/22/2016 | | 3/22/2016 |
| Parameter | Unit | G / S | RDL | 7457566 | RDL | 7457567 | 7457572 | RDL | 7457582 |
| BOD (5) | mg/L | | 5 | 6 | 5 | <5 | <5 | 5 | 6 |
| pH | pH Units | | NA | 8.11 | NA | 8.12 | 8.17 | NA | 8.07 |
| Total Suspended Solids | mg/L | | 10 | 14 | 10 | <10 | <10 | 10 | 15 |
| Chloride | mg/L | | 1.0 | 415 | 2.0 | 625 | 640 | 1.0 | 409 |
| Nitrate as N | mg/L | | 0.5 | 1.2 | 1.0 | 1.3 | 1.3 | 0.5 | 1.1 |
| Nitrite as N | mg/L | | 0.5 | <0.5 | 1.0 | <1.0 | <1.0 | 0.5 | <0.5 |
| Ammonia as N | mg/L | | 0.02 | <0.02 | 0.02 | <0.02 | <0.02 | 0.02 | <0.02 |
| Total Phosphorus | mg/L | | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 |
| Total Kjeldahl Nitrogen | mg/L | | 0.10 | 0.79 | 0.10 | 0.42 | 0.46 | 0.10 | 0.85 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7457566-7457582 Elevated RDLs for Anions indicate the degree of sample dilutions prior to analyses to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instrument.

Certified By: Sofia Pehlyova

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FAX (905)712-5122
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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:Fonthill - Regional Road 20

AGAT WORK ORDER: 16T079620
ATTENTION TO: Craig Leger
SAMPLED BY:Steve Kellerman

## Microbiology Analysis

| RPT Date: Mar 31, 2016 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| Microbiological Analysis (water) | | | | | | | | | | | | | | | |
| Escherichia coli | 7457566 | 7457566 | ND | ND | NA | < 1 | | | | | | | | | |

Comments: ND - Not Detected, NA - % RPD Not Applicable

Certified By:

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:Fonthill - Regional Road 20

AGAT WORK ORDER: 16T079620
ATTENTION TO: Craig Leger
SAMPLED BY:Steve Kellerman

## Water Analysis

| RPT Date: Mar 31, 2016 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Inorganic Chemistry (Water) | | | | | | | | | | | | | | | |
| BOD (5) | 7456577 | | 449 | 470 | 4.6% | < 5 | 103% | 75% | 125% | NA | | | NA | | |
| pH | 7458510 | | 8.05 | 8.11 | 0.7% | NA | 99% | 90% | 110% | NA | | | NA | | |
| Total Suspended Solids | 7457577 | 7457577 | 90 | 95 | 5.4% | < 10 | 102% | 80% | 120% | NA | | | NA | | |
| Chloride | 7457487 | | 71.0 | 67.0 | 5.8% | < 0.10 | 97% | 90% | 110% | 101% | 90% | 110% | 96% | 80% | 120% |
| Nitrate as N | 7457487 | | <0.25 | <0.25 | NA | < 0.05 | 102% | 90% | 110% | 107% | 90% | 110% | 108% | 80% | 120% |
| Nitrite as N | 7457487 | | <0.25 | <0.25 | NA | < 0.05 | NA | 90% | 110% | 95% | 90% | 110% | 93% | 80% | 120% |
| Ammonia as N | 7457572 | 7457572 | <0.02 | <0.02 | NA | < 0.02 | 90% | 90% | 110% | 97% | 90% | 110% | 94% | 80% | 120% |
| Total Phosphorus | 7460336 | | 0.17 | 0.16 | 6.1% | < 0.01 | 106% | 90% | 110% | 102% | 90% | 110% | 104% | 70% | 130% |
| Total Kjeldahl Nitrogen | 7455677 | | 0.64 | 0.67 | 4.6% | < 0.10 | 102% | 80% | 120% | 100% | 80% | 120% | 95% | 70% | 130% |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Sofra Pehlyova

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# Method Summary

CLIENT NAME: WSP CANADA INC.
AGAT WORK ORDER: 16T079620
PROJECT: 111-53018-00
ATTENTION TO: Craig Leger
SAMPLING SITE:Fonthill - Regional Road 20
SAMPLED BY:Steve Kellerman

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Microbiology Analysis | | | |
| Escherichia coli | MIC-93-7010 | EPA 1604 | Membrane Filtration |
| Water Analysis | | | |
| BOD (5) | INOR-93-6006 | SM 5210 B | DO METER |
| pH | INOR-93-6000 | SM 4500-H+ B | PC TITRATE |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |
| Chloride | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrate as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrite as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Ammonia as N | INOR-93-6059 | QuikChem 10-107-06-1-J & SM 4500 NH3-F | LACHAT FIA |
| Total Phosphorus | INOR-93-6022 | SM 4500-P B&E | SPECTROPHOTOMETER |
| Total Kjeldahl Nitrogen | INOR-93-6048 | QuikChem 10-107-06-2-I & SM 4500-Norg D | LACHAT FIA |

**AGAT Laboratories**

Mi-Bi 2 LS coolers #

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

**Laboratory Use Only**

Work Order #: 16T079620

Cooler Quantity:

Arrival Temperatures: 4.7 4.9 4.9 / 4.5 4.7 4.7

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

# Chain of Custody Record

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water intended for human consumption)

**Report Information:**

Company: WSP

Contact: Craig Luger

Address: St. Catharines Office

Phone: 905-687-1771 Fax: 905-687-1773

Reports to be sent to:
1. Email: craig.luger@wspgroup.com
2. Email:

**Regulatory Requirements:** ☐ No Regulatory Requirement
(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ Indicate One
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ Indicate One

☐ Regulation 558
☐ CCME
☒ Prov. Water Quality Objectives (PWQO)
☐ Other ____ Indicate One

**Turnaround Time (TAT) Required:**

**Regular TAT** ☒ 5 to 7 Business Days

**Rush TAT** (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

**OR** Date Required (Rush Surcharges May Apply):

*Please provide prior notification for rush TAT*
**TAT is exclusive of weekends and statutory holidays*

**Project Information:**

Project: Regional Road 20 111-53018-00

Site Location: Foothill

Sampled By: SM

AGAT Quote #: 60876 PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

**Report Guideline on *Certificate of Analysis*** ☐ Yes ☒ No

**Invoice Information:** Bill To Same: Yes ☒ No ☐

Company:

Contact:

Address:

Email:

**Sample Matrix Legend**

- **B** Biota
- **GW** Ground Water
- **O** Oil
- **P** Paint
- **S** Soil
- **SD** Sediment
- **SW** Surface Water

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Metals and Inorganics | Metal Scan | Hydride Forming Metals | Client Custom Metals | ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr⁶⁺ ☐EC ☐FOC ☐NO₃/NO₂ ☐Total N ☐Hg ☐pH ☐SAR | Nutrients: ☐TP ☐NH₃ ☐TKN ☐NO₃ ☐NO₂ ☐NO₃/NO₂ | Volatiles: ☐VOC ☐BTEX ☐THM | CCME Fractions 1 to 4 | ABNs | PAHs | Chlorophenols | PCBs | Organochlorine Pesticides | TCLP Metals/Inorganics | Sewer Use | SW as per quote |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SW1 | 22/Mar/16 | | 5 | SW | | | | | | | | | | | | | | | | | X |
| SW2 | ↓ | | ↓ | ↓ | | | | | | | | | | | | | | | | | X |
| SW3 | ↓ | | ↓ | ↓ | | | | | | | | | | | | | | | | | X |
| SW6 | ↓ | | ↓ | ↓ | | | | | | | | | | | | | | | | | X |
| SW100 | ↓ | | ↓ | ↓ | | | | | | | | | | | | | | | | | X |

(Check Applicable)

| Samples Relinquished By (Print Name and Sign): | Date | Time | Samples Received By (Print Name and Sign): | Date | Time | |
|---|---|---|---|---|---|---|
| Steve Kellerman | 22/Mar/16 | | [signature] | 2016/03/23 | 12:30 | Page 1 of 1 |
| [signature] | 2016/03/23 | 4:10 | | | | Nº: T 021428 |

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| | |
|---|---|
| CLIENT NAME: | WSP CANADA INC.<br>55 KING STREET, 7TH FLOOR<br>ST CATHARINES, ON L2R3H5<br>(905) 687-1771 |
| ATTENTION TO: | Craig Leger |
| PROJECT: | 111-53018-00 |
| AGAT WORK ORDER: | 16T089209 |
| MICROBIOLOGY ANALYSIS REVIEWED BY: | Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor |
| WATER ANALYSIS REVIEWED BY: | Parvathi Malemath, Data Reviewer |
| DATE REPORTED: | May 06, 2016 |
| PAGES (INCLUDING COVER): | 7 |
| VERSION*: | 1 |

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

# Certificate of Analysis

AGAT WORK ORDER: 16T089209

PROJECT: 111-53018-00

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CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Craig Leger

SAMPLING SITE:RR 20

SAMPLED BY:Sean Morris

## Microbiological Analysis (water)

DATE RECEIVED: 2016-04-27

DATE REPORTED: 2016-05-06

| | | | SAMPLE DESCRIPTION: | SW1 | SW100 | SW2 | SW3 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 4/26/2016 | 4/26/2016 | 4/26/2016 | 4/26/2016 |
| Parameter | Unit | G / S | RDL | 7516297 | 7516298 | 7516304 | 7516310 |
| Escherichia coli | CFU/100mL | | 2 | 90 | 100 | 8 | 8 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7516297-7516310 RDL >1 indicates dilutions of the sample.

Certified By: Elizabeth Rolakowska



Results relate only to the items tested and to all the items tested

# Certificate of Analysis

AGAT WORK ORDER: 16T089209

PROJECT: 111-53018-00

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE:RR 20

ATTENTION TO: Craig Leger

SAMPLED BY:Sean Morris

## Fonthill Sites - SW Parameters

DATE RECEIVED: 2016-04-27

DATE REPORTED: 2016-05-06

| Parameter | Unit | G / S | RDL | SW1 | SW100 | RDL | SW2 | RDL | SW3 |
|---|---|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | | Water | | Water |
| | | | DATE SAMPLED: | 4/26/2016 | 4/26/2016 | | 4/26/2016 | | 4/26/2016 |
| | | | | 7516297 | 7516298 | | 7516304 | | 7516310 |
| BOD (5) | mg/L | | 5 | <5 | <5 | 5 | 5 | 5 | <5 |
| pH | pH Units | | NA | 7.99 | 8.05 | NA | 7.97 | NA | 7.99 |
| Total Suspended Solids | mg/L | | 10 | 60 | 24 | 10 | 92 | 10 | 61 |
| Chloride | mg/L | | 0.50 | 253 | 248 | 0.10 | 456 | 1.0 | 461 |
| Nitrate as N | mg/L | | 0.25 | 0.59 | 0.58 | 0.25 | 1.17 | 0.5 | 1.2 |
| Nitrite as N | mg/L | | 0.25 | <0.25 | <0.25 | 0.25 | <0.25 | 0.5 | <0.5 |
| Ammonia as N | mg/L | | 0.02 | 0.11 | 0.10 | 0.02 | 0.03 | 0.02 | 0.03 |
| Total Phosphorus | mg/L | | 0.01 | 0.08 | 0.09 | 0.01 | 0.08 | 0.01 | 0.07 |
| Total Kjeldahl Nitrogen | mg/L | | 0.10 | 0.59 | 0.64 | 0.10 | 0.48 | 0.10 | 0.50 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7516297-7516310 The RDL's were increased for Anions to reflect a dilution of the sample in order to keep the analytes within a valid calibration range of the instruments.

Certified By:

AGAT Laboratories

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CANADA L4Z 1Y2
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FAX (905)712-5122
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# Quality Assurance

CLIENT NAME: WSP CANADA INC. | AGAT WORK ORDER: 16T089209

PROJECT: 111-53018-00 | ATTENTION TO: Craig Leger

SAMPLING SITE:RR 20 | SAMPLED BY:Sean Morris

## Microbiology Analysis

| RPT Date: May 06, 2016 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| Microbiological Analysis (water) | | | | | | | | | | | | | | | |
| Escherichia coli | 7515297 | | ND | ND | NA | < 1 | | | | | | | | | |

Comments: ND - Not Detected, NA - % RPD Not Applicable

Certified By: Elizabeth Polakowska

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CANADA L4Z 1Y2
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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:RR 20

AGAT WORK ORDER: 16T089209
ATTENTION TO: Craig Leger
SAMPLED BY:Sean Morris

## Water Analysis

| RPT Date: May 06, 2016 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Fonthill Sites - SW Parameters | | | | | | | | | | | | | | | |
| BOD (5) | 7516297 | 7516297 | <5 | <5 | NA | < 5 | 101% | 75% | 125% | NA | | | NA | | |
| pH | 7521618 | | 6.80 | 6.84 | 0.6% | NA | 100% | 90% | 110% | NA | | | NA | | |
| Total Suspended Solids | 7516252 | | 69 | 63 | 9.1% | < 10 | 98% | 80% | 120% | NA | | | NA | | |
| Chloride | 7517713 | | 11.3 | 11.4 | 0.9% | < 0.10 | 96% | 90% | 110% | 107% | 90% | 110% | 103% | 80% | 120% |
| Nitrate as N | 7517713 | | <0.25 | <0.25 | NA | < 0.05 | 98% | 90% | 110% | 108% | 90% | 110% | 109% | 80% | 120% |
| Nitrite as N | 7517713 | | <0.25 | <0.25 | NA | < 0.05 | NA | 90% | 110% | 104% | 90% | 110% | 104% | 80% | 120% |
| Ammonia as N | 7526005 | | 12.0 | 12.2 | 1.7% | < 0.02 | 90% | 90% | 110% | 101% | 90% | 110% | 90% | 80% | 120% |
| Total Phosphorus | 7516297 | 7516297 | 0.08 | 0.08 | 0.0% | < 0.01 | 95% | 90% | 110% | 92% | 90% | 110% | 101% | 70% | 130% |
| Total Kjeldahl Nitrogen | 7516297 | 7516297 | 0.59 | 0.64 | 8.1% | < 0.10 | 102% | 80% | 120% | 101% | 80% | 120% | 97% | 70% | 130% |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

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# Method Summary

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:RR 20

AGAT WORK ORDER: 16T089209
ATTENTION TO: Craig Leger
SAMPLED BY:Sean Morris

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Microbiology Analysis | | | |
| Escherichia coli | MIC-93-7010 | EPA 1604 | Membrane Filtration |
| Water Analysis | | | |
| BOD (5) | INOR-93-6006 | SM 5210 B | DO METER |
| pH | INOR-93-6000 | SM 4500-H+ B | PC TITRATE |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |
| Chloride | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrate as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrite as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Ammonia as N | INOR-93-6059 | QuikChem 10-107-06-1-J & SM 4500 NH3-F | LACHAT FIA |
| Total Phosphorus | INOR-93-6022 | SM 4500-P B&E | SPECTROPHOTOMETER |
| Total Kjeldahl Nitrogen | INOR-93-6048 | QuikChem 10-107-06-2-I & SM 4500-Norg D | LACHAT FIA |

Mi - Bi / LS Cooler

# AGAT Laboratories

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## Chain of Custody Record

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water intended for human consumption)

**Laboratory Use Only**

Work Order #: 16T089209

Cooler Quantity:

Arrival Temperatures: 3.6 | 4.0 | 4.0 / 3.0 | 3.4 | 3.4

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

**Report Information:**

Company: WSP Canada Inc.

Contact: Craig Leger

Address: 55 King St, Suite 600, St. Catharines, ON

Phone: 905-687-1771 Fax:

Reports to be sent to:

1. Email: Craig.leger@wspgroup.com
2. Email: bailey.Walters@wspgroup.com

**Regulatory Requirements:** ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04 — Table ___ (Indicate One) ☐Ind/Com ☐Res/Park ☐Agriculture; Soil Texture (Check One) ☐Coarse ☐Fine

☐ Sewer Use — ☐Sanitary ☐Storm; Region ___ (Indicate One)

☐ Regulation 558 ☐ CCME ☒ Prov. Water Quality Objectives (PWQO) ☐ Other ___ (Indicate One)

Is this submission for a Record of Site Condition? ☐ Yes ☒ No

Report Guideline on Certificate of Analysis ☐ Yes ☒ No

**Turnaround Time (TAT) Required:**

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply) ☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

*Please provide prior notification for rush TAT*

**TAT is exclusive of weekends and statutory holidays*

**Project Information:**

Project: 111-53018-00

Site Location: RR 20

Sampled By: SM

AGAT Quote #: 134907 PO:

*Please note: If quotation number is not provided, client will be billed full price for analysis.*

**Invoice Information:** Bill To Same: Yes ☒ No ☐

Company:

Contact:

Address:

Email:

**Sample Matrix Legend**

- **B** Biota
- **GW** Ground Water
- **O** Oil
- **P** Paint
- **S** Soil
- **SD** Sediment
- **SW** Surface Water

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Field Filtered - Metals, Hg, CrVI (Please Circle) Y / N | Metals and Inorganics | Metal Scan | Hydride Forming Metals | Client Custom Metals | ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr6+ ☐EC ☐FOC ☐NO3/NO2 ☐Total N ☐Hg ☐pH ☐SAR | Nutrients: ☐TP ☐NH3 ☐TKN ☐NO3 ☐NO2 ☐NO3/NO2 | Volatiles: ☐VOC ☐BTEX ☐THM | CCME Fractions 1 to 4 | ABNs | PAHs | Chlorophenols | PCBs | Organochlorine Pesticides | TCLP Metals/Inorganics | Sewer Use | SW as per Quote |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SW1 | Apr 26/16 | PM | 5 | SW | | N | | | | | | | | | | | | | | | | X |
| SW100 | | | | | | | | | | | | | | | | | | | | | | X |
| SW2 | | | | | | | | | | | | | | | | | | | | | | X |
| SW3 | | | | | | | | | | | | | | | | | | | | | | X |

| Samples Relinquished By (Print Name and Sign) | Date | Time | Samples Received By (Print Name and Sign) | Date | Time |
|---|---|---|---|---|---|
| Sean Morris | Apr 26/16 | 5pm | [illegible] | 2016/04/27 | 12:35 |
| [illegible] | 2016/04/27 | 3:15 | A. MARTIN | 2016/04/27 | 15:55 |
| | | | | | |

Page 1 of 1

Nº: T 023525

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| | |
|---|---|
| CLIENT NAME: | WSP CANADA INC.<br>4 Hughson Street South, Suite 300<br>Hamilton, ON L8N3Z1<br>(905) 529-4414 |
| ATTENTION TO: | Bailey Walters |
| PROJECT: | 111-53018-00 |
| AGAT WORK ORDER: | 16T111241 |
| MICROBIOLOGY ANALYSIS REVIEWED BY: | Scott Ross, Operations Manager |
| WATER ANALYSIS REVIEWED BY: | Parvathi Malemath, Data Reviewer |
| DATE REPORTED: | Jul 13, 2016 |
| PAGES (INCLUDING COVER): | 8 |
| VERSION*: | 1 |

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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# Certificate of Analysis

AGAT WORK ORDER: 16T111241
PROJECT: 111-53018-00

CLIENT NAME: WSP CANADA INC.
ATTENTION TO: Bailey Walters
SAMPLING SITE:
SAMPLED BY:

## Microbiological Analysis (water)

DATE RECEIVED: 2016-06-30
DATE REPORTED: 2016-07-13

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW100 | SW3 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 6/29/2016 | 6/29/2016 | 6/29/2016 | 6/29/2016 |
| Parameter | Unit | G / S | RDL | 7676589 | 7676595 | 7676600 | 7676605 |
| Escherichia coli | CFU/100mL | | 2 | 16 | 316 | 52 | 340 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7676589-7676605 RDL >1 indicates dilutions of the sample.

Certified By:

AGAT Laboratories

# Certificate of Analysis

AGAT WORK ORDER: 16T111241

PROJECT: 111-53018-00

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CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Bailey Walters

SAMPLING SITE:

SAMPLED BY:

## Inorganic Chemistry (Water)

DATE RECEIVED: 2016-06-30

DATE REPORTED: 2016-07-13

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW100 | SW3 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 6/29/2016 | 6/29/2016 | 6/29/2016 | 6/29/2016 |
| Parameter | Unit | G / S | RDL | 7676589 | 7676595 | 7676600 | 7676605 |
| BOD (5) | mg/L | | 5 | <5 | <5 | <5 | <5 |
| pH | pH Units | 6.5-8.5 | NA | 7.74 | 8.04 | 7.81 | 8.09 |
| Total Suspended Solids | mg/L | | 10 | 36 | 506 | 32 | 92 |
| Chloride | mg/L | | 0.50 | 351 | 305 | 354 | 307 |
| Nitrate as N | mg/L | | 0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Nitrite as N | mg/L | | 0.25 | <0.25 | <0.25 | <0.25 | <0.25 |
| Total Phosphorus | mg/L | 0.03 | 0.01 | 0.06 | 0.23 | 0.06 | 0.08 |
| Total Kjeldahl Nitrogen | mg/L | | 0.10 | 0.59 | 0.84 | 0.53 | 0.42 |
| Ammonia as N | mg/L | | 0.02 | 0.13 | 0.19 | 0.14 | 0.08 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)

7676589-7676605 Samples required dilution prior to analysis for Anions in order to keep the analytes within the calibration range of the instruments and to minimize any matrix interferences; the RDLs were adjusted to reflect the dilution.

Certified By:

CHARTERED CHEMIST

5835 COOPERS AVENUE
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CANADA L4Z 1Y2
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# Guideline Violation

AGAT WORK ORDER: 16T111241

PROJECT: 111-53018-00

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Bailey Walters

| SAMPLEID | SAMPLE TITLE | GUIDELINE | ANALYSIS PACKAGE | PARAMETER | GUIDEVALUE | RESULT |
|---|---|---|---|---|---|---|
| 7676589 | SW1 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.06 |
| 7676595 | SW2 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.23 |
| 7676600 | SW100 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.06 |
| 7676605 | SW3 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.08 |

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# Quality Assurance

CLIENT NAME: WSP CANADA INC. | AGAT WORK ORDER: 16T111241
PROJECT: 111-53018-00 | ATTENTION TO: Bailey Walters
SAMPLING SITE: | SAMPLED BY:

## Microbiology Analysis

| RPT Date: Jul 13, 2016 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| Microbiological Analysis (water) | | | | | | | | | | | | | | | |
| Escherichia coli | 7675333 | | 2 | 2 | NA | < 1 | | | | | | | | | |

Comments: NA - % RPD Not Reportable based on the number of colonies count acceptable for RPD calculation

Certified By:

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:

AGAT WORK ORDER: 16T111241
ATTENTION TO: Bailey Walters
SAMPLED BY:

## Water Analysis

| RPT Date: Jul 13, 2016 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Inorganic Chemistry (Water) | | | | | | | | | | | | | | | |
| BOD (5) | 7675750 | | 582 | 576 | 1.0% | < 5 | 101% | 75% | 125% | NA | | | NA | | |
| pH | 7676605 | 7676605 | 8.09 | 8.07 | 0.2% | NA | 100% | 90% | 110% | NA | | | NA | | |
| Total Suspended Solids | 7677778 | | <10 | <10 | NA | < 10 | 94% | 80% | 120% | NA | | | NA | | |
| Chloride | 7676761 | | 3.32 | 3.13 | 5.9% | < 0.10 | 91% | 90% | 110% | 101% | 90% | 110% | 108% | 80% | 120% |
| Nitrate as N | 7676761 | | 0.33 | 0.28 | 16.4% | < 0.05 | 102% | 90% | 110% | 108% | 90% | 110% | 116% | 80% | 120% |
| Nitrite as N | 7676761 | | <0.25 | <0.25 | NA | < 0.05 | NA | 90% | 110% | 96% | 90% | 110% | 96% | 80% | 120% |
| Total Phosphorus | 7676589 | 7676589 | 0.06 | 0.06 | 0.0% | < 0.01 | 95% | 90% | 110% | 102% | 90% | 110% | 97% | 70% | 130% |
| Total Kjeldahl Nitrogen | 7676595 | 7676595 | 0.84 | 0.89 | 5.8% | < 0.10 | 101% | 80% | 120% | 103% | 80% | 120% | 99% | 70% | 130% |
| Ammonia as N | 7673421 | | <0.02 | <0.02 | NA | < 0.02 | 103% | 90% | 110% | 99% | 90% | 110% | 97% | 80% | 120% |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

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# Method Summary

CLIENT NAME: WSP CANADA INC.
AGAT WORK ORDER: 16T111241
PROJECT: 111-53018-00
ATTENTION TO: Bailey Walters
SAMPLING SITE:
SAMPLED BY:

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Microbiology Analysis | | | |
| Escherichia coli | MIC-93-7010 | EPA 1604 | Membrane Filtration |
| Water Analysis | | | |
| BOD (5) | INOR-93-6006 | SM 5210 B | DO METER |
| pH | INOR-93-6000 | SM 4500-H+ B | PC TITRATE |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |
| Chloride | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrate as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrite as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Total Phosphorus | INOR-93-6022 | SM 4500-P B&E | SPECTROPHOTOMETER |
| Total Kjeldahl Nitrogen | INOR-93-6048 | QuikChem 10-107-06-2-I & SM 4500-Norg D | LACHAT FIA |
| Ammonia as N | INOR-93-6059 | QuikChem 10-107-06-1-J & SM 4500 NH3-F | LACHAT FIA |

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

# Chain of Custody Record

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water intended for human consumption)

**Laboratory Use Only**

Work Order #: 16T 111241

Cooler Quantity:

Arrival Temperatures: 7.9 | 8.1 | 8.1
6.9 | 7.1 | 7.1

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

## Report Information:

Company: WSP Canada Inc.
Contact: Bailey Walters (cc: Craig Leger)
Address: Suite 300, 4 Hughson St. S, Hamilton, ON L8N 3Z1
Phone: 905-529-4414 Fax:
Reports to be sent to:
1. Email: Bailey.Walters@wspgroup.com
2. Email: Craig.Leger@wspgroup.com

## Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ Indicate One
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ Indicate One

☐ Regulation 558
☐ CCME
☑ Prov. Water Quality Objectives (PWQO)
☐ Other
____ Indicate One

Is this submission for a Record of Site Condition? ☐ Yes ☑ No

Report Guideline on Certificate of Analysis ☐ Yes ☑ No

## Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

*Please provide prior notification for rush TAT*
**TAT is exclusive of weekends and statutory holidays*

## Project Information:

Project: 111-53018-00
Site Location: Regional Rd. 20
Sampled By: BC and SM
AGAT Quote #: 60876 PO:
*Please note: If quotation number is not provided, client will be billed full price for analysis.*

## Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

**Sample Matrix Legend**

| | |
|---|---|
| B | Biota |
| GW | Ground Water |
| O | Oil |
| P | Paint |
| S | Soil |
| SD | Sediment |
| SW | Surface Water |

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Field Filtered - Metals, Hg, CrVI (Please Circle) Y / N | Metals and Inorganics | Metal Scan | Hydride Forming Metals | Client Custom Metals | ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ $Cr^{6+}$ ☐ EC ☐ FOC ☐ $NO_3/NO_2$ ☐ Total N ☐ Hg ☐ pH ☐ SAR | Nutrients: ☐ TP ☐ $NH_3$ ☐ TKN ☐ $NO_3$ ☐ $NO_2$ ☐ $NO_3/NO_2$ | Volatiles: ☐ VOC ☐ BTEX ☐ THM | CCME Fractions 1 to 4 | ABNs | PAHs | Chlorophenols | PCBs | Organochlorine Pesticides | TCLP Metals/Inorganics | Sewer Use | SW As per quote |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SW1 | 29/06/2016 | 10:00 | 5 | SW | | N | | | | | | | | | | | | | | | | X |
| SW2 | ↓ | ↓ | 5 | SW | | N | | | | | | | | | | | | | | | | X |
| SW100 | ↓ | ↓ | 5 | SW | | N | | | | | | | | | | | | | | | | X |
| SW3 | ↓ | ↓ | 5 | SW | | N | | | | | | | | | | | | | | | | X |

(Check Applicable)

| | | | | | |
|---|---|---|---|---|---|
| Samples Relinquished By (Print Name and Sign): BRENDAN CRILLY Brendan Crilly | Date 29/06/2016 | Time 15:30 | Samples Received By (Print Name and Sign): [signature] | Date 2016/06/30 | Time 2:10 |
| Samples Relinquished By (Print Name and Sign): [signature] | Date 2016/06/30 | Time 5:26 | Samples Received By (Print Name and Sign): | Date | Time |
| Samples Relinquished By (Print Name and Sign): | Date | Time | Samples Received By (Print Name and Sign): | Date | Time |

Page 1 of 1

Nº: T 029449

AGAT Laboratories
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CLIENT NAME: WSP CANADA INC.
4 Hughson Street South, Suite 300
Hamilton, ON L8N3Z1
(905) 529-4414

ATTENTION TO: Bailey Walters

PROJECT: 111-53018-00

AGAT WORK ORDER: 16T134110

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

WATER ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

DATE REPORTED: Sep 12, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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# Certificate of Analysis

AGAT WORK ORDER: 16T134110

PROJECT: 111-53018-00

CLIENT NAME: WSP CANADA INC.

SAMPLING SITE:

ATTENTION TO: Bailey Walters

SAMPLED BY:Hayden Bellows

## Microbiological Analysis (water)

DATE RECEIVED: 2016-09-02

DATE REPORTED: 2016-09-12

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW100 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 9/1/2016 | 9/1/2016 | 9/1/2016 | 9/1/2016 |
| Parameter | Unit | G / S | RDL | 7823163 | 7823164 | 7823169 | 7823174 |
| Escherichia coli | CFU/100mL | 100 | 2 | 400 | 46 | 46 | 380 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO

7823163-7823174 RDL >1 indicates dilutions of the sample.

Certified By:

# Certificate of Analysis

AGAT WORK ORDER: 16T134110

PROJECT: 111-53018-00

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CLIENT NAME: WSP CANADA INC.

SAMPLING SITE:

ATTENTION TO: Bailey Walters

SAMPLED BY:Hayden Bellows

## Inorganic Chemistry (Water)

DATE RECEIVED: 2016-09-02

DATE REPORTED: 2016-09-12

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | | SW3 | | SW100 |
|---|---|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | | Water | | Water |
| | | | DATE SAMPLED: | 9/1/2016 | 9/1/2016 | | 9/1/2016 | | 9/1/2016 |
| Parameter | Unit | G / S | RDL | 7823163 | 7823164 | RDL | 7823169 | RDL | 7823174 |
| BOD (5) | mg/L | | 5 | <5 | <5 | 5 | <5 | 5 | <5 |
| pH | pH Units | 6.5-8.5 | NA | 8.23 | 8.12 | NA | 7.92 | NA | 7.95 |
| Total Suspended Solids | mg/L | | 10 | 34 | 17 | 10 | 23 | 10 | 50 |
| Chloride | mg/L | | 0.50 | 193 | 193 | 100 | 203 | 0.50 | 192 |
| Nitrate as N | mg/L | | 0.25 | <0.25 | <0.25 | 50 | <50 | 0.25 | <0.25 |
| Nitrite as N | mg/L | | 0.25 | <0.25 | <0.25 | 50 | <50 | 0.25 | <0.25 |
| Ammonia as N | mg/L | | 0.02 | <0.02 | <0.02 | 0.02 | <0.02 | 0.02 | <0.02 |
| Total Phosphorus | mg/L | 0.03 | 0.01 | 0.06 | 0.06 | 0.01 | 0.07 | 0.01 | 0.07 |
| Total Kjeldahl Nitrogen | mg/L | | 0.10 | 0.59 | 0.54 | 0.10 | 0.51 | 0.10 | 0.60 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)

7823163-7823174 Elevated RDLs for Anions indicate the degree of dilution prior to analysis in order to keep analytes within the calibration range of the instruments and to reduce matrix interferences.

Certified By:

# Guideline Violation

AGAT WORK ORDER: 16T134110

PROJECT: 111-53018-00

5835 COOPERS AVENUE
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CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Bailey Walters

| SAMPLEID | SAMPLE TITLE | GUIDELINE | ANALYSIS PACKAGE | PARAMETER | GUIDEVALUE | RESULT |
|---|---|---|---|---|---|---|
| 7823163 | SW1 | PWQO | Microbiological Analysis (water) | Escherichia coli | 100 | 400 |
| 7823163 | SW1 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.06 |
| 7823164 | SW2 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.06 |
| 7823169 | SW3 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.07 |
| 7823174 | SW100 | PWQO | Microbiological Analysis (water) | Escherichia coli | 100 | 380 |
| 7823174 | SW100 | PWQO (mg/L) | Inorganic Chemistry (Water) | Total Phosphorus | 0.03 | 0.07 |

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:

AGAT WORK ORDER: 16T134110
ATTENTION TO: Bailey Walters
SAMPLED BY:Hayden Bellows

## Microbiology Analysis

| RPT Date: Sep 12, 2016 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Microbiological Analysis (water) | | | | | | | | | | | | | | | |
| Escherichia coli | 7823163 | 7823163 | 400 | 360 | 10.5% | < 1 | | | | | | | | | |

Certified By:

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:

AGAT WORK ORDER: 16T134110
ATTENTION TO: Bailey Walters
SAMPLED BY:Hayden Bellows

## Water Analysis

| RPT Date: Sep 12, 2016 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Inorganic Chemistry (Water) | | | | | | | | | | | | | | | |
| BOD (5) | 7822593 | | 124 | 122 | 1.6% | < 5 | 100% | 75% | 125% | NA | | | NA | | |
| pH | 7817858 | | 8.23 | 8.12 | 1.3% | NA | 100% | 90% | 110% | NA | | | NA | | |
| Total Suspended Solids | 7823163 | 7823163 | 34 | 34 | NA | < 10 | 104% | 80% | 120% | NA | | | NA | | |
| Chloride | 7821138 | | 1940 | 1960 | 1.3% | < 0.10 | 92% | 90% | 110% | 108% | 90% | 110% | NA | 80% | 120% |
| Nitrate as N | 7821138 | | <2.5 | <2.5 | NA | < 0.05 | 93% | 90% | 110% | 104% | 90% | 110% | 105% | 80% | 120% |
| Nitrite as N | 7821138 | | <2.5 | <2.5 | NA | < 0.05 | NA | 90% | 110% | 94% | 90% | 110% | 101% | 80% | 120% |
| Ammonia as N | 7823163 | 7823163 | <0.02 | <0.02 | NA | < 0.02 | 98% | 90% | 110% | 99% | 90% | 110% | 104% | 80% | 120% |
| Total Phosphorus | 7823320 | | 0.02 | 0.02 | NA | < 0.01 | 91% | 90% | 110% | 105% | 90% | 110% | 96% | 70% | 130% |
| Total Kjeldahl Nitrogen | 7820711 | | 12.0 | 12.1 | 0.8% | < 0.10 | 106% | 80% | 120% | 97% | 80% | 120% | 99% | 70% | 130% |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

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# Method Summary

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00
SAMPLING SITE:

AGAT WORK ORDER: 16T134110
ATTENTION TO: Bailey Walters
SAMPLED BY:Hayden Bellows

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Microbiology Analysis | | | |
| Escherichia coli | MIC-93-7010 | EPA 1604 | Membrane Filtration |
| Water Analysis | | | |
| BOD (5) | INOR-93-6006 | SM 5210 B | DO METER |
| pH | INOR-93-6000 | SM 4500-H+ B | PC TITRATE |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |
| Chloride | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrate as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrite as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Ammonia as N | INOR-93-6059 | QuikChem 10-107-06-1-J & SM 4500 NH3-F | LACHAT FIA |
| Total Phosphorus | INOR-93-6022 | SM 4500-P B&E | SPECTROPHOTOMETER |
| Total Kjeldahl Nitrogen | INOR-93-6048 | QuikChem 10-107-06-2-I & SM 4500-Norg D | LACHAT FIA |

AGAT Laboratories

1 Lg cooler ml-131

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# Chain of Custody Record

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water intended for human consumption)

**Laboratory Use Only**

Work Order #: 16T134110

Cooler Quantity:

Arrival Temperatures: 4.9 5.1 5.1 / 3.9 4.1 4.1

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

## Report Information:

Company: WSP Canada Inc

Contact: Bailey Walters

Address: 4 Hughson St. S, Suite 300, Hamilton ON

Phone: 226-920-4477 Fax:

Reports to be sent to:

1. Email: bailey.walters@wspgroup.com
2. Email:

## Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04 — Table (Indicate One): ☐ Ind/Com ☐ Res/Park ☐ Agriculture

Soil Texture (Check One): ☐ Coarse ☐ Fine

☐ Sewer Use: ☐ Sanitary ☐ Storm — Region (Indicate One)

☐ Regulation 558

☐ CCME

☑ Prov. Water Quality Objectives (PWQO)

☐ Other (Indicate One)

Is this submission for a Record of Site Condition? ☐ Yes ☐ No

Report Guideline on Certificate of Analysis ☑ Yes ☐ No

## Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

*Please provide prior notification for rush TAT*

**TAT is exclusive of weekends and statutory holidays*

## Project Information:

Project: 111-53018-00

Site Location:

Sampled By: Hayden Bellows

AGAT Quote #: 60876 PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

## Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:

Contact:

Address:

Email:

**Sample Matrix Legend**

| | |
|---|---|
| B | Biota |
| GW | Ground Water |
| O | Oil |
| P | Paint |
| S | Soil |
| SD | Sediment |
| SW | Surface Water |

(Check Applicable): Field Filtered - Metals, Hg, CrVI (Please Circle) Y / N; Metals and Inorganics; Metal Scan; Hydride Forming Metals; Client Custom Metals; ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN ☐ Cr6+ ☐ EC ☐ FOC ☐ $NO_3/NO_2$ ☐ Total N ☐ Hg ☐ pH ☐ SAR; Nutrients: ☐ TP ☐ $NH_3$ ☐ TKN ☐ $NO_3$ ☐ $NO_2$ ☐ $NO_3/NO_2$; Volatiles: ☐ VOC ☐ BTEX ☐ THM; CCME Fractions 1 to 4; ABNs; PAHs; Chlorophenols; PCBs; Organochlorine Pesticides; TCLP Metals/Inorganics; Sewer Use

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Y / N |
|---|---|---|---|---|---|---|
| SW1 | Sept 1, 2016 | FT | 5 | SW | | |
| SW2 | ↓ | ↓ | ↓ | ↓ | | |
| SW3 | ↓ | ↓ | ↓ | ↓ | | |
| SW100 | ↓ | ↓ | ↓ | ↓ | | |

| Samples Relinquished By (Print Name and Sign): | Date | Time | Samples Received By (Print Name and Sign): | Date | Time |
|---|---|---|---|---|---|
| Hayden Bellows | Sept 1, 2016 | 5:00pm | | 2016/09/02 | 3:25 |
| 2016/09/02 | | 5:10 | | | |
| | | | | | |

Page ____ of ____

Nº: T 033845

Document ID: DIV-78-1511.011

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

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CLIENT NAME: WSP CANADA INC.
4 Hughson Street South, Suite 300
Hamilton, ON L8N3Z1
(905) 529-4414

ATTENTION TO: Bailey Walters

PROJECT: 111-53018-00 Regional Road 20

AGAT WORK ORDER: 16T151516

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

WATER ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor

DATE REPORTED: Nov 02, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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# Certificate of Analysis

AGAT WORK ORDER: 16T151516

PROJECT: 111-53018-00 Regional Road 20

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Bailey Walters

SAMPLING SITE:Fonthill Sites

SAMPLED BY:Craig Leger

## Microbiological Analysis (water)

DATE RECEIVED: 2016-10-21

DATE REPORTED: 2016-11-02

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW100 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 2016-10-21 | 2016-10-21 | 2016-10-21 | 2016-10-21 |
| Parameter | Unit | G / S | RDL | 7946308 | 7946313 | 7946318 | 7946323 |
| Escherichia coli | CFU/100mL | 100 | 2 | 186 | 250 | 320 | 360 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO

7946308-7946323 ND - Not Detected.

Certified By:

# Certificate of Analysis

AGAT WORK ORDER: 16T151516

PROJECT: 111-53018-00 Regional Road 20

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CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Bailey Walters

SAMPLING SITE:Fonthill Sites

SAMPLED BY:Craig Leger

## Fonthill Sites - SW Package

DATE RECEIVED: 2016-10-21

DATE REPORTED: 2016-11-02

| Parameter | Unit | G / S | RDL | SW1 | SW2 | SW3 | SW100 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 2016-10-21 | 2016-10-21 | 2016-10-21 | 2016-10-21 |
| | | | | 7946308 | 7946313 | 7946318 | 7946323 |
| BOD (5) | mg/L | | 5 | <5 | <5 | <5 | <5 |
| pH | pH Units | 6.5-8.5 | NA | 7.74 | 7.91 | 7.90 | 7.91 |
| Total Suspended Solids | mg/L | | 10 | 15 | 11 | 20 | 17 |
| Chloride | mg/L | | 0.10 | 49.3 | 49.6 | 49.5 | 49.4 |
| Nitrate as N | mg/L | | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nitrite as N | mg/L | | 0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Ammonia as N | mg/L | | 0.02 | <0.02 | 0.04 | <0.02 | <0.02 |
| Total Phosphorus | mg/L | 0.03 | 0.01 | 0.05 | 0.08 | 0.06 | 0.06 |
| Total Kjeldahl Nitrogen | mg/L | | 0.10 | 0.35 | 0.40 | 0.39 | 0.37 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to PWQO (mg/L)

Certified By: Elizabeth Rolakowska

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AGAT Laboratories

# Guideline Violation

AGAT WORK ORDER: 16T151516

PROJECT: 111-53018-00 Regional Road 20

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Bailey Walters

| SAMPLEID | SAMPLE TITLE | GUIDELINE | ANALYSIS PACKAGE | PARAMETER | GUIDEVALUE | RESULT |
|---|---|---|---|---|---|---|
| 7946308 | SW1 | PWQO | Microbiological Analysis (water) | Escherichia coli | 100 | 186 |
| 7946308 | SW1 | PWQO (mg/L) | Fonthill Sites - SW Package | Total Phosphorus | 0.03 | 0.05 |
| 7946313 | SW2 | PWQO | Microbiological Analysis (water) | Escherichia coli | 100 | 250 |
| 7946313 | SW2 | PWQO (mg/L) | Fonthill Sites - SW Package | Total Phosphorus | 0.03 | 0.08 |
| 7946318 | SW3 | PWQO | Microbiological Analysis (water) | Escherichia coli | 100 | 320 |
| 7946318 | SW3 | PWQO (mg/L) | Fonthill Sites - SW Package | Total Phosphorus | 0.03 | 0.06 |
| 7946323 | SW100 | PWQO | Microbiological Analysis (water) | Escherichia coli | 100 | 360 |
| 7946323 | SW100 | PWQO (mg/L) | Fonthill Sites - SW Package | Total Phosphorus | 0.03 | 0.06 |

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00 Regional Road 20
SAMPLING SITE:Fonthill Sites

AGAT WORK ORDER: 16T151516
ATTENTION TO: Bailey Walters
SAMPLED BY:Craig Leger

## Microbiology Analysis

| RPT Date: Nov 02, 2016 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Microbiological Analysis (water) | | | | | | | | | | | | | | | |
| Escherichia coli | 7945342 | | ND | ND | NA | < 1 | | | | | | | | | |

Comments: ND - Not Detected,  NA - % RPD Not Applicable

Certified By:

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 111-53018-00 Regional Road 20
SAMPLING SITE:Fonthill Sites

AGAT WORK ORDER: 16T151516
ATTENTION TO: Bailey Walters
SAMPLED BY:Craig Leger

## Water Analysis

| RPT Date: Nov 02, 2016 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper | Recovery | Acceptable Limits Lower | Acceptable Limits Upper |
| Fonthill Sites - SW Package | | | | | | | | | | | | | | | |
| BOD (5) | 7946621 | | <5 | <5 | NA | < 5 | 101% | 75% | 125% | NA | | | NA | | |
| pH | 7939755 | | 8.26 | 8.18 | 1.0% | NA | 102% | 90% | 110% | NA | | | NA | | |
| Total Suspended Solids | 7949073 | | 168 | 166 | 1.2% | < 10 | 98% | 80% | 120% | NA | | | NA | | |
| Chloride | 7947145 | | 30.3 | 30.4 | 0.3% | < 0.10 | 94% | 90% | 110% | 108% | 90% | 110% | 101% | 80% | 120% |
| Nitrate as N | 7947145 | | <0.25 | <0.25 | NA | < 0.05 | 102% | 90% | 110% | 110% | 90% | 110% | 107% | 80% | 120% |
| Nitrite as N | 7947145 | | <0.25 | <0.25 | NA | < 0.05 | NA | 90% | 110% | 102% | 90% | 110% | 105% | 80% | 120% |
| Ammonia as N | 7945752 | | 0.18 | 0.17 | 5.7% | < 0.02 | 95% | 90% | 110% | 103% | 90% | 110% | 94% | 80% | 120% |
| Total Phosphorus | 7944419 | | 0.04 | 0.04 | NA | < 0.01 | 102% | 90% | 110% | 105% | 90% | 110% | 90% | 70% | 130% |
| Total Kjeldahl Nitrogen | 7946318 | 7946318 | 0.39 | 0.38 | NA | < 0.10 | 102% | 80% | 120% | 100% | 80% | 120% | 102% | 70% | 130% |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fonthill Sites - SW Package | | | | | | | | | | | | | | | |
| Total Kjeldahl Nitrogen | 7946318 | 7946318 | 0.39 | 0.38 | NA | < 0.10 | 100% | 80% | 120% | 100% | 80% | 120% | NA | 70% | 130% |

Certified By: Elizabeth Polakowska

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# Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 16T151516

PROJECT: 111-53018-00 Regional Road 20

ATTENTION TO: Bailey Walters

SAMPLING SITE:Fonthill Sites

SAMPLED BY:Craig Leger

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Microbiology Analysis | | | |
| Escherichia coli | MIC-93-7010 | EPA 1604 | Membrane Filtration |
| Water Analysis | | | |
| BOD (5) | INOR-93-6006 | SM 5210 B | DO METER |
| pH | INOR-93-6000 | SM 4500-H+ B | PC TITRATE |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |
| Chloride | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrate as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Nitrite as N | INOR-93-6004 | SM 4110 B | ION CHROMATOGRAPH |
| Ammonia as N | INOR-93-6059 | QuikChem 10-107-06-1-J & SM 4500 NH3-F | LACHAT FIA |
| Total Phosphorus | INOR-93-6022 | SM 4500-P B&E | SPECTROPHOTOMETER |
| Total Kjeldahl Nitrogen | INOR-93-6048 | QuikChem 10-107-06-2-I & SM 4500-Norg D | LACHAT FIA |

# AGAT Laboratories

Mibi

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

**Laboratory Use Only**

Work Order #: 16T151516

Cooler Quantity:

Arrival Temperatures: 4.2 | 4.1 | 3.9

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

## Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

### Report Information:

Company: WSP
Contact: Bailey Walters
Address: 4 Hughson St. Hamilton, ON
Phone: Fax:
Reports to be sent to:
1. Email: bailey.walters@wspgroup.com
2. Email:

### Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table ___ Indicate One
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ___ Indicate One

☐ Regulation 558
☐ CCME
☑ Prov. Water Quality Objectives (PWQO)
☐ Other
___ Indicate One

Is this submission for a Record of Site Condition? ☐ Yes ☑ No

Report Guideline on Certificate of Analysis ☑ Yes ☐ No

### Turnaround Time (TAT) Required:

**Regular TAT** ☑ 5 to 7 Business Days

**Rush TAT** (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

**OR** Date Required (Rush Surcharges May Apply):

*Please provide prior notification for rush TAT*
**TAT is exclusive of weekends and statutory holidays*

### Project Information:

Project: Fonthill Sites
Site Location: Reg Rd 20 111-53018-00
Sampled By: SCL
AGAT Quote #: 134907 PO:

Please note: If quotation number is not provided, client will be billed full price for analysis

### Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

**Sample Matrix Legend**

| | |
|---|---|
| B | Biota |
| GW | Ground Water |
| O | Oil |
| P | Paint |
| S | Soil |
| SD | Sediment |
| SW | Surface Water |

| Sample Identification | Date Sampled | Time Sampled | # of Containers | Sample Matrix | Comments/ Special Instructions | Field Filtered - Metals, Hg, CrVI (Please Circle) Y/N | Metals and Inorganics | Metal Scan | Hydride Forming Metals | Client Custom Metals | ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr6+ ☐ EC ☐ FOC ☐ $NO_3/NO_2$ ☐ Total N ☐ Hg ☐ pH ☐ SAR | Nutrients: ☐ TP ☐ $NH_3$ ☐ TKN ☐ $NO_3$ ☐ $NO_2$ ☐ $NO_3/NO_2$ | Volatiles: ☐ VOC ☐ BTEX ☐ THM | CCME Fractions 1 to 4 | ABNs | PAHs | Chlorophenols | PCBs | Organochlorine Pesticides | TCLP Metals/Inorganics | Sewer Use | As Per Quote | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SW1 | 21 Oct 16 | | 5 | SW | | N | | | | | | | | | | | | | | | | ✓ | | | | | | |
| SW2 | ↓ | | ↓ | ↓ | | ↓ | | | | | | | | | | | | | | | | ✓ | | | | | | |
| SW3 | | | | | | | | | | | | | | | | | | | | | | ✓ | | | | | | |
| SW100 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Samples Relinquished By (Print Name and Sign): | Date | Time | Samples Received By (Print Name and Sign): | Date | Time |
|---|---|---|---|---|---|
| C Leyer | 21 Oct | 12:15 | [signature] BAUMEISTER | 2016/10/21 | 5:30 |
| | | | | | |
| | | | | | |

Page 1 of 1

Nº: T 037078



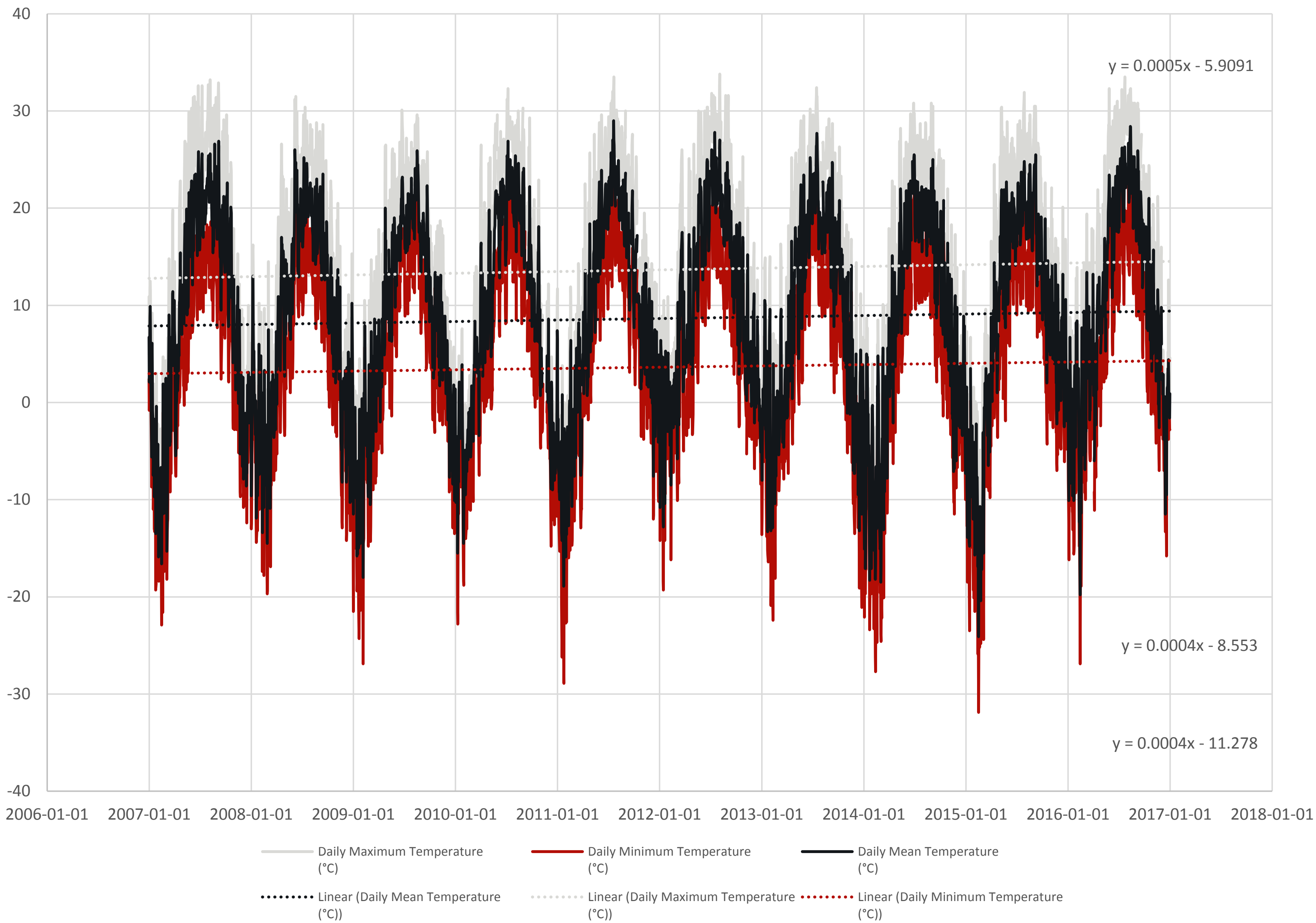
Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

# APPENDIX

# D CLIMATE DATA

Data tables are not included in this report. Data tables can be provided upon request.

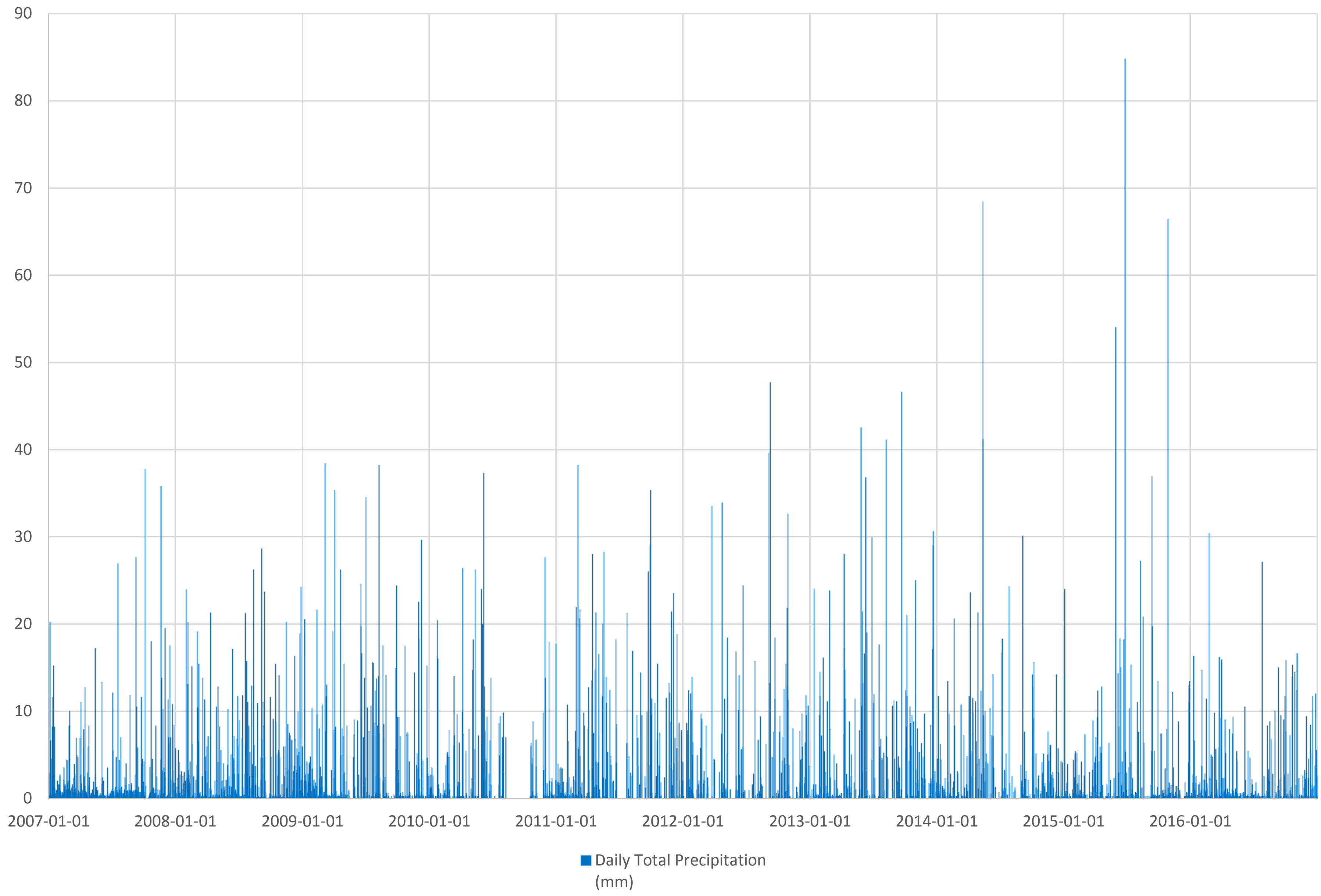
# Figure D-1
## Daily Temperature vs Time
## Environment Canada Climate Data




2017-06-06

Z:\Projects\2011\111-53018-00 - Regional Road 20\100\1634010 - 2016 SW Monitoring\Tech\App D - Climate Data\Env Can Welland-Pelham 2007-2016.xlsx

**Figure D-2**
**Daily Precipitation vs Time**
**Environment Canada Climate Data**




2017-06-06
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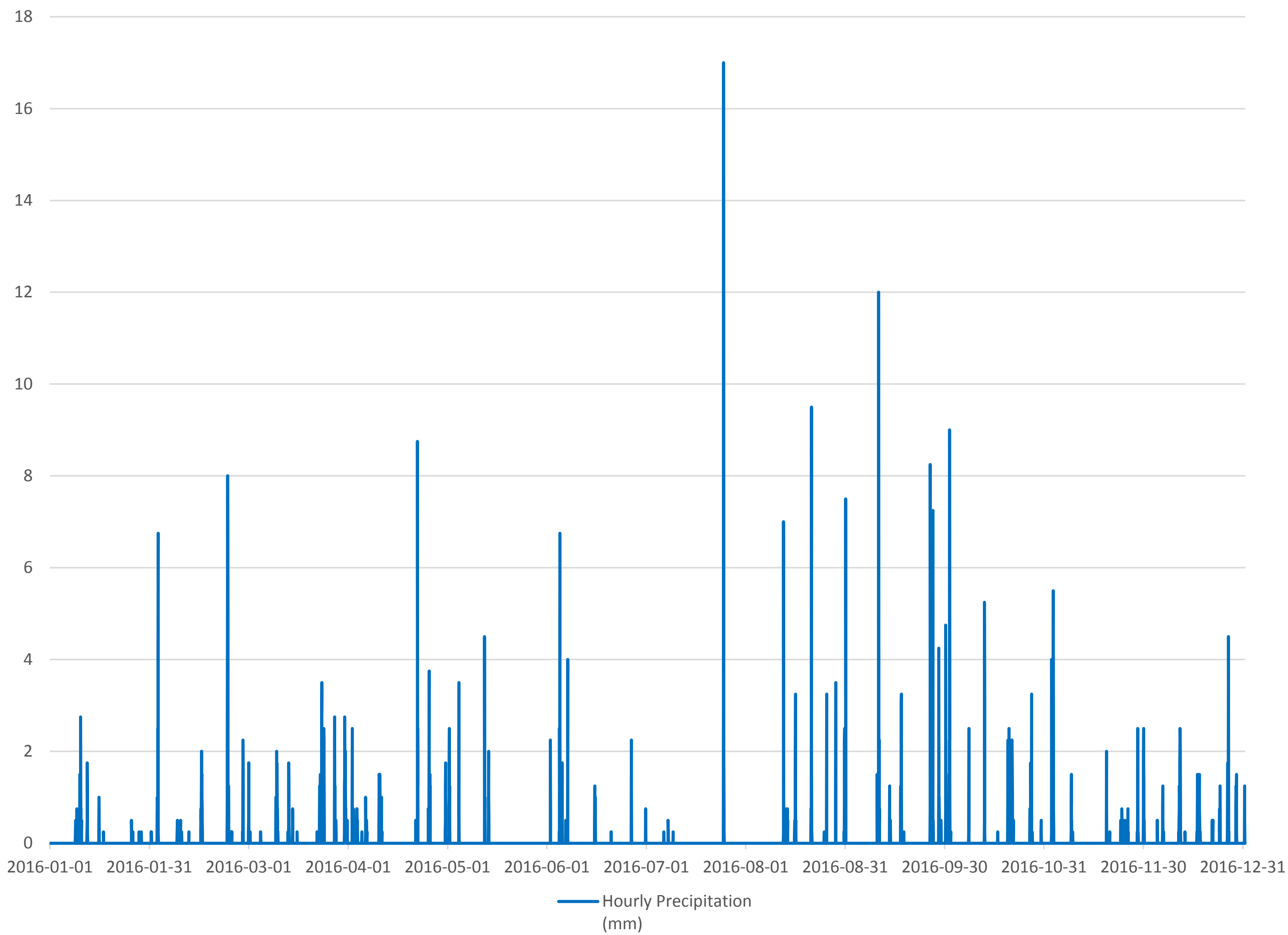
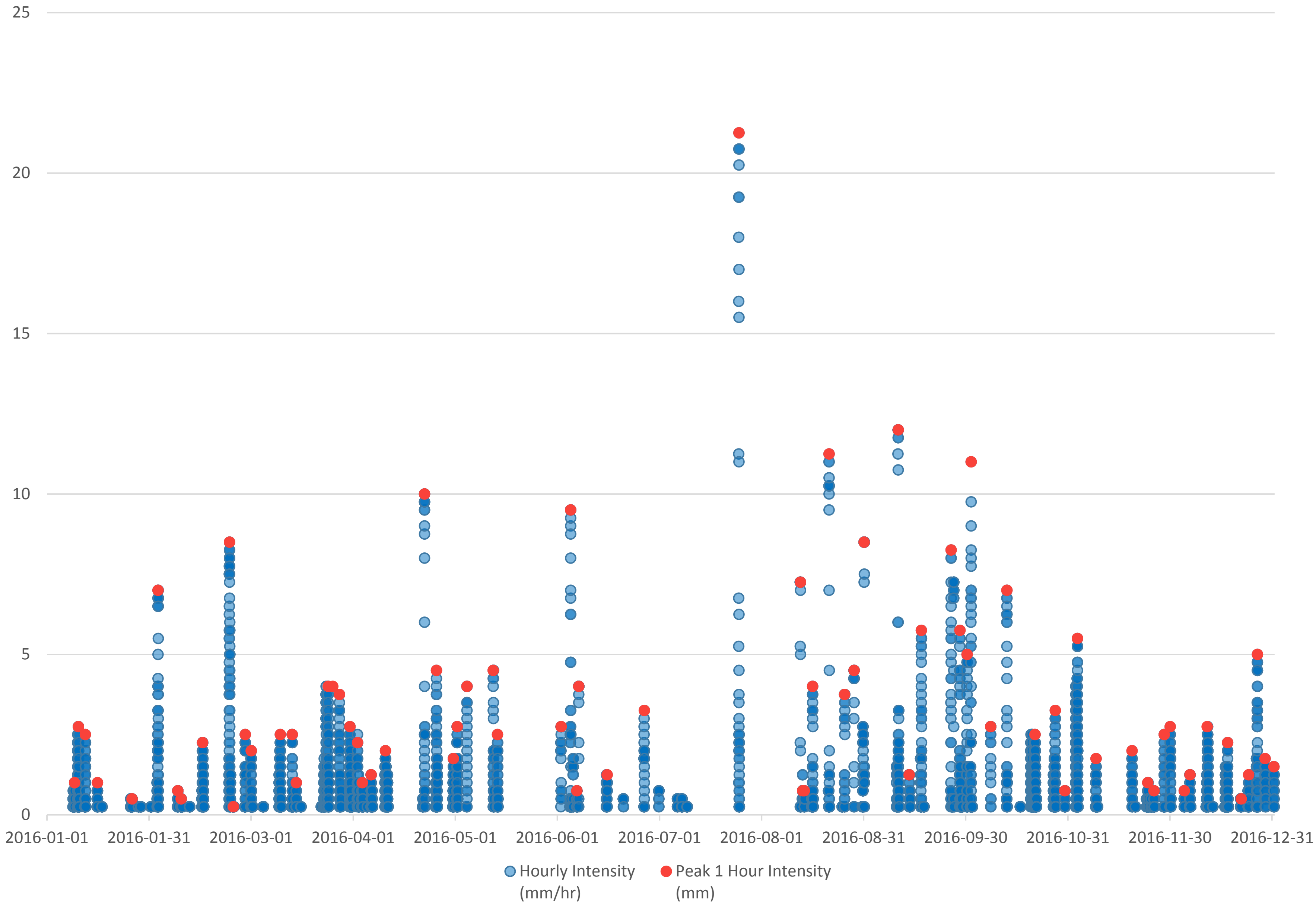
**Figure D-3**
**Hourly Precipitation vs Time**
**Regional Municipality of Niagara Pelham Climate Station**



# Figure D-4
## Hourly Precip Intensity vs Time
## Regional Municipality of Niagara Pelham Climate Station




2017-06-06
Z:\Projects\2011\111-53018-00 - Regional Road 20\100\1634010 - 2016 SW Monitoring\Tech\App D - Climate Data\Pelham Precipitation Station 2016 5 minuteX.xlsx

2018-04-03

Town of Pelham
20 Pelham Town Square
P.O. Box 400
Fonthill, ON L0S 1E0

**c/o Adam Keane, P.Eng., Upper Canada Consultants**

**Subject: 2017 Hydrologic Monitoring Program**

Dear Sir:

We are pleased to provide you the 2017 Hydrologic Monitoring Report for the East Fonthill Development.

The report provides background information on the physical setting, details of the work program completed, and a presentation of the monitoring data. Conclusions and recommendations for future monitoring programs are also included in the report. Relevant technical data is appended.

## BACKGROUND

Development activities are currently being undertaken at the proposed Village of East Fonthill Phase 1 Development. As part of the development, a storm water management pond was constructed at the northeast corner of the development area to manage storm water runoff. Pond construction occurred in 2015 and was fully constructed by October 2015. The pond has three inlets and one outlet, which discharges to the Twelve Mile Creek watershed. The storm water management pond is located on the southwest corner of Regional Road 20 and Rice Road, in the Town of Pelham, in the Regional Municipality of Niagara, as shown on Figure 1.

As part of the development, hydrologic monitoring of the storm water management pond is required. WSP Canada Limited (WSP) was retained to complete the hydrologic monitoring program, including the field investigation and reporting.

## OBJECTIVE AND SCOPE

The objective of the hydrologic monitoring program for the Village of East Fonthill Development is to evaluate if the storm water management pond is functioning as designed to ensure no significant adverse impacts upon the receiving watercourse.

The monitoring program included a data collection component, and an analysis and interpretation component. This report provides the results of the hydrologic monitoring program activities that occurred over the period of the 2017 calendar year.

## PHYSICAL SETTING

### Geology And HydRogeology

The site is located to the northeast of the Fonthill Kame Complex within the Haldimand Clay Plain physiographic region (Chapman and Putnam, 1984). The fine-grained glaciolacustrine overburden in the area, deposited by pro glacial Lake Warren, varies in thickness between 23 and 35 metres.

Local overburden thickness is mapped as approximately 21 m east of the site (near Highway 406) to 38 m west of the site (near Station Road) (Vos, 1969). The bedrock contact is located at approximately 160 mASL east of the site (near Highway 406) to 145 mASL west of the site (near Station Road) (Feenstra, 1981b). The underlying bedrock is a succession of Palaeozoic beds that dip slightly southward, toward Lake Erie.

Typical quaternary geology of the area (Fenco MacLaren, 1995) includes the following units:

**Table 1 Quaternary Geology**

| GEOLOGIC UNIT | DESCRIPTION |
|---|---|
| **QUATERNARY DEPOSITS** | **Upper Glaciolacustrine Unit**<br>The surficial overburden in the area is mapped as an upper glaciolacustrine unit that is composed of a brown, reddish, and grey silty clay to clayey silt that is massive to thinly-stratified. This unit may be present from ground surface to approximately 10 metres below ground surface. |
| | **Halton Till**<br>Underlying the upper glaciolacustrine unit is the Halton Till, a brown to grey, massive to laminated clayey silt with a sand content of less than 20 percent. The till is approximately 10 metres thick. |
| | **Lower Glaciolacustrine Unit**<br>Beneath the Halton Till is a lower glaciolacustrine unit of silty clay that is approximately 10 metres thick. |
| | **Lower Till Unit**<br>The Lower Till unit consists of sandy silt with lenses of silt, sand, and gravel. The Lower Till unit is approximately 5 metres thick. |
| **BEDROCK** | **Salina Formation**<br>The bedrock consists of inter-bedded dolostones and shales of the Salina Formation. |

The upper glaciolacustrine unit, the Halton Till, and the lower glaciolacustrine unit are reportedly fairly uniform and predictable. The sand and gravel lenses within the lower till unit are considered non-uniform and unpredictable since they are laterally variable and discontinuous.

Generally, hydraulic conductivity in overburden soils is low due to the fine-grained nature of the material. Local topography (including existing ditches and swales) and seasonal precipitation strongly influence groundwater flow through fractures in the shallow, weathered overburden.

### STORMWATER MANAGEMENT POND

The pond is located on the Rice Road Tributary within the Twelve Mile Creek watershed. The pond has three inlet structures that collect runoff from roadside ditches along the east and west sides of Rice Road (south of Regional Road 20), and from manholes along the south side of Regional Road 20 (west of Rice Road). The pond discharges north through an existing 1.25 m diameter concrete culvert beneath Regional Road 20 into the Rice Road Tributary. On the north side of Regional Road 20, the Rice Road Tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north side of Regional Road 20. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary. The Rice Road Tributary flows north to Twelve Mile Creek, ultimately to Lake Ontario.

## MONITORING PROGRAM

The hydrologic monitoring program for the Village of East Fonthill Development includes surface water quality monitoring and surface water flow and temperature monitoring.

The monitoring program will consist of two phases:

- Construction Monitoring – monitoring for the duration of the Village of East Fonthill Development construction activities to determine the hydrologic conditions during construction; and,
- Post-Construction Monitoring – monitoring for two full years once the Village of East Fonthill Development construction activities are completed to determine if the proposed storm water management strategy is functioning as designed.

This report presents the results of the construction monitoring phase, completed during 2017.

Five surface water monitoring stations were established for the monitoring program, as shown on Figure 1 and described below. As noted above, the north storm water management pond was fully constructed by October 2015. The locations of the stations included below.

- SW1 – Inlet to pond, northwest corner of pond
- SW2 – Inlet to pond, northeast corner of pond
- SW3 – Inlet to pond, east side of pond
- SW4 – Outlet from pond to box culvert beneath Regional Road 20 to the Rice Road Tributary
- SW5 – Downstream in the Rice Road Tributary, approximately 40 metres north of Regional Road 20

The monitoring program is summarized in Table 2 and discussed in the following sections.

**Table 2 2017 Monitoring Program**

| SURFACE WATER STATION ID | SURFACE WATER QUALITY MONITORING* | SURFACE WATER FLOW MONITORING (INCLUDING TEMPERATURE) | |
|---|---|---|---|
| | | MANUAL** | ELECTRONIC*** |
| SW1 | ✓ | ✓ | Temperature |
| SW2 | ✓ | ✓ | Temperature |
| SW3 | ✓ | ✓ | Temperature |
| SW4 | ✓ | ✓ | Water level, velocity, temperature |
| SW5 | n/a | ✓ | Water level, velocity, temperature |

**Notes:**

* Frequency – five times per year (weather-based): spring freshet, two dry events and two storm events (preferably >25 mm of precipitation)

Parameters – TSS (laboratory); pH/conductivity/temperature/DO (field)

** Frequency – five times per year with sampling events

*** Frequency – continuous electronic measurement at 10-minute intervals during non-freezing conditions (approximately March to November (weather permitting))

Electronic flow and temperature monitoring in the pond was initiated in spring 2015. Pond construction activities, however, were not completed until October 2015. Additionally, in 2016 the pond was not operating at full capacity due to the time required for the pond to fill. Therefore, it is interpreted that the monitoring data in 2015 and 2016 may not capture the pond operating as it is intended.

## SURFACE WATER QUALITY

The surface water quality monitoring program includes five sampling events throughout the year at stations SW1, SW2, SW3 and SW4. The events are undertaken to correspond with specific weather conditions that include the spring freshet (i.e., snow melt runoff) (approximately March/April), twice during dry periods (April/May and September/October), and twice during storm events (preferably >25 mm of precipitation) (May/June and October/November). The surface water monitoring protocols are presented in Table 3.

The surface water samples are analysed for the following water quality parameters:

— Total Suspended Solids (laboratory)
— pH, conductivity, temperature and dissolved oxygen (field measurement only)

**Table 3 Monitoring Protocols and Procedures**

**SURFACE WATER SAMPLING**

| |
|---|
| Attempts are made to schedule surface water monitoring events to correspond with intended freshet, dry, or wet event monitoring. |
| Surface water samples at each location are collected prior to flow measurement. |
| Surface water samples are collected directly into the laboratory provided bottles that do not have preservatives. For bottles with preservatives added, standard grab sampling methods are used and then the water is decanted into laboratory provided bottles with the appropriate preservatives. The sample container is pointed upstream and care is taken to avoid particulate and organic matter in the water. |
| Sample bottles are marked, labelled, and sealed in the field. |
| Samples are stored in ice packed coolers, and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures. |
| Field parameters (pH, conductivity, temperature and dissolved oxygen) are measured from a separate beaker of water using calibrated instruments. |
| When the flows are present, stream flow discharge is calculated based on the cross-sectional area of the stream, and the water velocity. |
| A cross-sectional profile of the stream is determined by measuring the cross sectional width and depth of the wetted stream at incremental sections. The velocity is measured using an electromagnetic velocity meter by measuring the average velocity of each section. |
| Field notes including date, weather, time, sampling data, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book. |

## SURFACE WATER FLOW AND TEMPERATURE

Manual flow measurements are completed at each surface water station during each monitoring event. Manual flow measurements are done generally following the USGS area-velocity method.

Future monitoring events will include submerged electronic temperature loggers at stations SW1, SW2 and SW3 to record water temperature at 10 minute intervals on a seasonal basis (i.e., during non-freezing conditions), and submerged electronic flow monitoring equipment at stations SW4 and SW5 to measure water level, velocity and temperature at 10-minute intervals on a seasonal basis (i.e., during non-freezing conditions).

# MONITORING PROGRAM RESULTS

Collection of surface water quality samples and flow measurements was attempted five times in 2017 to coincide with the following weather events:

— Spring Freshet/Spring Melt event
— Dry events (without precipitation)
— Wet events (with precipitation)

The table below indicates the dates of the monitoring events. It is noted that the outlet station (SW4) was not sampled in September 2017 as the pond was not discharging at the time the sampling event was conducted.

**Table 4 Sampling Event Dates**

| YEAR | SPRING FRESHET | DRY EVENTS (WITHOUT PRECIPITATION) | WET EVENTS (WITH PRECIPITATION) |
|---|---|---|---|
| 2017 | 28 March | 6 June<br>12 December | 3 May<br>22 September |

## SURFACE WATER QUALITY

Surface water samples were submitted to AGAT Laboratories of Mississauga for analysis TSS. Field parameters pH, conductivity, temperature, and DO were measured at the time of sample collection.

Water quality results are presented in Table B 1; Appendix B. Laboratory certificates of analysis for the current reporting period are included in Appendix B. The results were compared to the Provincial Water Quality Objectives (PWQO), where available.

The 2017 water quality results met the PWQOs.

Time-concentration graphs of parameter concentrations at the surface monitoring stations are presented in Figure B-1. During 2017, parameter concentrations generally were similar at the inlet stations (SW1, SW2 and SW3) and the outlet station (SW4).

In 2017, the TSS concentrations ranged from less than 10 mg/L to 78 mg/L. It is noted that the TSS concentration at the outlet (SW4) has decreased overall since completion of the pond construction activities.

## SURFACE WATER FLOW AND TEMPERATURE

Manual flow measurements were obtained from each surface water station at the time of the sampling events listed in Section 3.1.

Manual flow measurements are presented in Table C-1. Electronic flow measurements at SW4 and SW5 are presented on Figure C-1 and Figure C-2 respectively. Flow rates typically were highest at the pond outlet (SW4) during each event. The flow rates typically corresponded to the type of event; that is, higher flows during the freshet and storm events, and lower flows during the dry period sampling events.

As previously mentioned, pond construction activities in 2015 and the pond not operating at full capacity in 2016 have impacted the monitoring data. For example, high flow rates observed early in 2015 are likely attributed to pumping of water directly to the outlet structure to accommodate construction activities. Additionally, low flow rates observed in 2016 are possibly attributed to the pond not operating at full capacity.

Electronic and manual temperature monitoring is presented on Figure C-3. The data indicates that, in the summer months, the outlet structures are effectively cooling the temperature of the pond water prior to reaching the downstream location (SW5).

It is noted that electronic monitoring of temperature within the pond was not initiated in 2015 due to the ongoing construction of the pond. In 2016, the electronic temperature devices were lost and/or stolen from SW1, SW2 and SW3 and, therefore, only manual temperature data is available at these locations.

## CLIMATE DATA

Climate data is included in Appendix D. Table D-1 summarizes the 2017 climate data from the Environment Canada Welland-Pelham climatological station.

Normal annual precipitation for the area is approximately 997.4 mm, based on the 1981-2010 30-Year Normals calculated from Environment Canada climatological station data located in Welland (approximately six kilometres north of the study area).

A total of 823 mm of precipitation was received in 2017 in the area, based on the total precipitation measured at the Environment Canada Welland-Pelham climatological station, indicating that the volume of precipitation received in 2017 was below normal.

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The monitoring program should be continued in 2018. The monitoring program is discussed in detail in Section 2 of this report and summarized below in Table 5. The 2018 program will consist of the construction monitoring phase.

**Table 5 2018 Monitoring Program**

| SURFACE WATER STATION ID | SURFACE WATER QUALITY MONITORING* | SURFACE WATER FLOW MONITORING (INCLUDING TEMPERATURE) | |
|---|---|---|---|
| | | MANUAL** | ELECTRONIC*** |
| SW1 | ✓ | ✓ | Temperature |
| SW2 | ✓ | ✓ | Temperature |
| SW3 | ✓ | ✓ | Temperature |
| SW4 | ✓ | ✓ | Water level, velocity, temperature |
| SW5 | n/a | ✓ | Water level, velocity, temperature |

**Notes:**

* Frequency – five times per year (weather-based): spring freshet, two dry events and two storm events (preferably >25 mm of precipitation)

Parameters – TSS (laboratory); pH/conductivity/temperature/DO (field)

** Frequency – five times per year with sampling events

*** Frequency – continuous electronic measurement at 10-minute intervals during non-freezing conditions (approximately March to November (weather permitting))

## CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the 2017 monitoring program results presented in this report, the following conclusions are provided:

- The 2017 water quality results met the PWQOs.
- TSS concentration at the outlet (SW4) has decreased overall since completion of the pond construction activities.
- Flow rates were typically highest at the pond outlet (SW4) during each event. The flow rates corresponded to the type of event; that is, higher flows during the freshet and storm events, and lower flows during the dry events.
- Electronic and manual temperature monitoring indicates that, in the summer months, the outlet structures are effectively cooling the temperature of the pond water prior to reaching the downstream location (SW5).

Based on the findings of the 2017 monitoring program, the following recommendations are provided for consideration:

- The monitoring program should be continued in 2018 as outlined in Section 4 of this report.

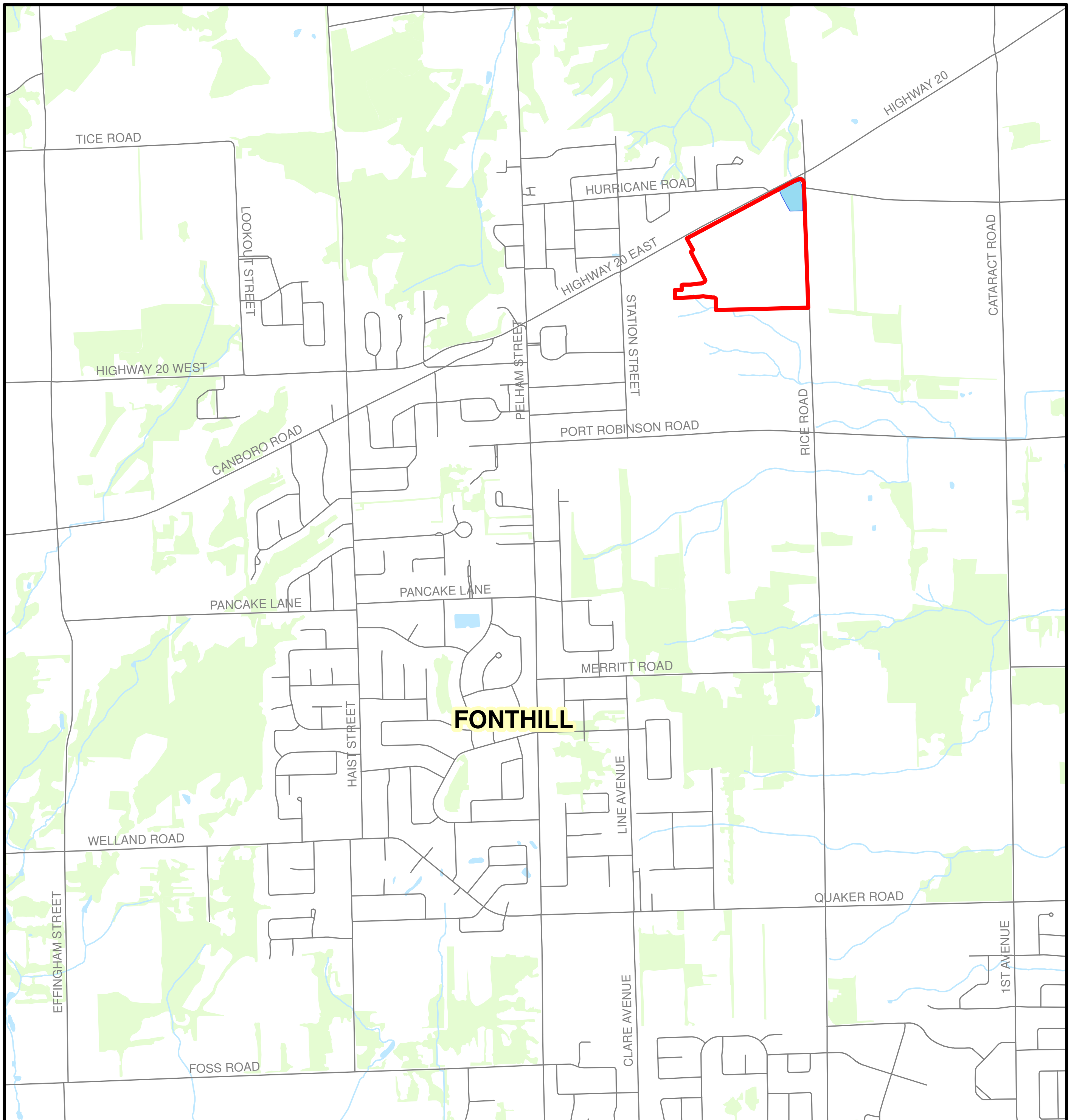
Kind regards,

Craig Leger, M.Sc., C.E.T.
Project Technologist, Environment

Bailey Walters, M.Sc., P.Geo.
Project Geoscientist, Environment

Encl. Appendix A: Work Program, Appendix B: SW Chemistry, Appendix C: SW Flows & Temperatures, Appendix D: Climate

WSP ref.: 151-02261-00 200




**LEGEND**

EAST FONTHILL DEVELOPMENT

STORM WATER MANAGEMENT POND

N W E S

Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.

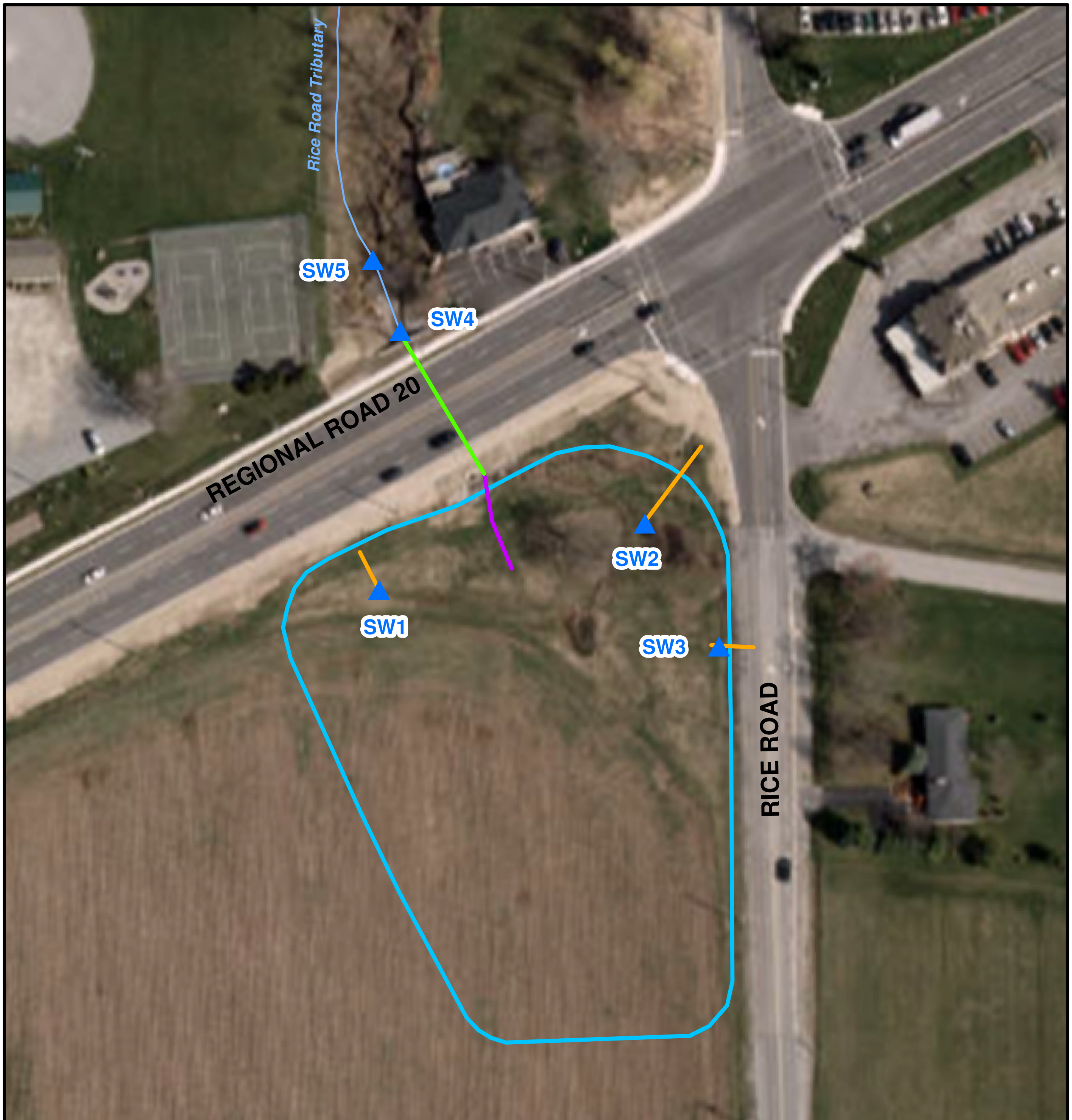
300 150 0 300 Metres

# SITE LOCATION PLAN

HYDROLOGIC MONITORING -
2017 MONITORING REPORT
EAST FONTHILL DEVELOPMENT
For Upper Canada Consultants

| | |
|---|---|
| □A□□□ MARCH 2017 | SCALE: 1:25000 |
| PROJECT: 151-02661-00 | FILE. NO.:151-02661-00 200 F1 |

FIGURE 1




**LEGEND**

- STORMWATER MANAGEMENT POND OUTLINE
- CULVERT
- OUTLET PIPE
- INLET CULVERT
- WATERCOURSE
- SURFACE WATER STATIONS

N
W E
S

10 5 0 10 Metres

Data Source: Ministry of Natural Resources,
Ontario Base Mapping, March 2014.
Imagery, Region of Niagara, 2013.

# SITE PLAN

HYDROLOGIC MONITORING -
2017 MONITORING REPORT
EAST FONTHILL DEVELOPMENT
For Upper Canada Consultants

| | |
|---|---|
| DATE: MARCH 2017 | SCALE: 1:1250 |
| PROJECT: 151-02661-00 | FILE. NO.:151-02661-00 F2 |

wsp

FIGURE
2

# APPENDIX

# A

## □ □R□ □R□ □RAM

June 26, 2017

Town of Pelham
20 Pelham Town Square
P.O. Box 400
Fonthill, ON L0S 1E0

c/o Adam Keane, P.Eng., Upper Canada Consultants

**Subject:** **2017 Monitoring Program**
**Fonthill East**
Our file 151-02661-00

Dear Sir:

We are pleased to provide a work plan and cost estimate to conduct the 2017 monitoring program as part of the long term hydrologic monitoring of the development activities at the Village of Fonthill East Phase 1 development, located on the south side of Regional Road 20, west of Rice Road.

The monitoring program will continue to monitor the storm water management pond that was constructed at the north east corner of the Site to manage storm water runoff. The pond has three points of inlet and a single point of discharge (discharging north across Regional Road 20 through an existing culvert). Storm water discharging from this pond will ultimately drain into the Twelve Mile Creek watershed.

## MONITORING PROGRAM

As discussed, the monitoring program is required to monitor surface water quality and surface water flow relating to the aforementioned storm water management facilities. The monitoring program will be broken down into the following two segments:

- Monitoring during construction: monitoring for the duration of the construction activities
- Post-construction monitoring: two (2) full years of monitoring to be conducted once construction activities are completed to determine if the proposed storm water management strategy is functioning as designed

Pre-construction data that was collected as part of the recent Regional Road 20 upgrades may be available from the Regional Municipality of Niagara.

### SURFACE WATER QUALITY MONITORING

Surface water quality monitoring will be conducted as follows.

Suite 600
55 King Street
St. Catharines, ON, Canada L2R 3H5

Tel.: +1 905 687-1771
Fax: +1 905 687-1773
wsp.com

## MONITORING STATIONS

- SW1 (Inlet)
- SW2 (Inlet)
- SW3 (Inlet)
- SW4 (Outlet (after treatment))

## FREQUENCY OF SAMPLING

It is proposed that sampling be conducted at all monitoring stations during the following events:

- Spring freshet sample with melting snow.
- Two dry period samples – due to the potential for lack of base flow, at least one sample should be taken in early spring.
- Two storm event samples, preferably thunderstorms or after significant rain in a frontal storm (>25 mm precipitation).

## SAMPLING PARAMETERS

Samples will be analyzed for the following water quality parameters:

- Total suspended solids
- Temperature, pH, conductivity, DO (field parameters)

# SURFACE WATER FLOW MONITORING

Surface water flow monitoring will be conducted concurrent with quality monitoring activities.

## MONITORING STATIONS

Manual flow measurements will be conducted at the following stations during the sampling events:

- SW1 (Inlet)
- SW2 (Inlet)
- SW3 (Inlet)
- SW4 (Outlet (after treatment))
- SW5 (Downstream of outlet (north of Regional Road 20))

## FREQUENCY OF FLOW MONITORING

Manual flow measurements will be acquired during sampling events at all water quality sampling locations plus a location downstream of the outlet.

Additionally, we propose to install electronic flow monitoring equipment at the outlet station and the downstream of outlet station and temperature monitoring equipment at the three inlet stations. The flow monitoring equipment will measure water level, velocity, and temperature on a 10-minute interval on a seasonal basis (to avoid freezing conditions).

## REPORTING

The results of the surface water quality and flow monitoring will be summarized in an annual report to be submitted to the Niagara Peninsula Conservation Authority (NPCA).

### MONITORING DURING CONSTRUCTION

Monitoring of surface water flows and surface water quality should begin as soon as the storm water management pond is in place to ensure the receiving watercourse is not negatively impacted during construction.

### POST-DEVELOPMENT MONITORING

The post-construction data will be compared against the baseline (pre-construction data) in order to determine if the proposed storm water management strategy is functioning as designed (i.e., reducing TSS concentrations effluent to less than 80% of that in the influent, and ameliorating storm water temperature).

Annual monitoring reports will be compiled and circulated to the NPCA for review. A final post-construction monitoring report will be prepared after the completion of two full years of monitoring. This report will also be circulated to the NPCA.

A 'draft' report will be made available to the client for comment, prior to submission to the regulatory agencies.

## PROJECT COSTS

Our quotation to complete the proposed monitoring program in 2017, including fieldwork, laboratory testing and reporting is approximately **$5,300** (HST extra). The breakdown of costs is as follows:

| | |
|---|---|
| Field technician, services and expenses | $2,600.00 |
| Laboratory fees | $300.00 |
| Report preparation | $2,400.00 |
| Total | $5,300.00 |

WSP will require a 50% deposit upon project approval.

Kind regards,

Craig Leger, M.Sc., C.E.T.
Project Technologist, Environment

WSP ref.: 151-02661-00

# APPENDIX

# B

## □□R□AC□ □ A□□R CH□M□□□R□

**Table B-1**
**Surface Water Quality Data**
**East Fonthill Development**

| Parameter | PWQO | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 (SW1) | 10/21/2016 | 11/11/2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Field Analyses** | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | [illegible] | 4.5 | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Laboratory Analyses** | | | | | | | | | | | |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| Parameter | PWQO | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 (SW2) | 10/21/2016 | 11/11/2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Field Analyses** | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | 707 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3.2 | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Laboratory Analyses** | | | | | | | | | | | |
| [illegible] | | [illegible] | [illegible] | 10 | 17 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| Parameter | PWQO | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 (SW3) | 10/21/2016 | 11/11/2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Field Analyses** | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | Dry | [illegible] | Dry | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | | [illegible] | | [illegible] | [illegible] | [illegible] | 4.5 | [illegible] | [illegible] |
| [illegible] | | [illegible] | | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Laboratory Analyses** | | | | | | | | | | | |
| [illegible] | | 10 | | [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| Parameter | PWQO | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 (SW4) | 10/21/2016 | 11/11/2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Field Analyses** | | | | | | | | | | | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 3.4 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Laboratory Analyses** | | | | | | | | | | | |
| [illegible] | | 20 | [illegible] | [illegible] | 10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] $^{-0.019x}$, y=DO criteria x=temperature

**Table B-1**
**Surface Water Quality Data**
**East Fonthill Development**

| Parameter / Event Type / Event Phase | PWQO | 3/28/2017 Freshet C□□□r□□□□□ | 5/3/2017 Wet C□□□r□□□□□ | 6/6/2017 Dry C□□□r□□□□□ | 9/22/2017 Wet C□□□r□□□□□ | 12/5/2017 Dry C□□□r□□□□□ |
|---|---|---|---|---|---|---|
| **Field Analyses** | | | | | | |
| □H □□□□□□□ | □□□ □□□□ | □□□ | □□1 | 7□□ | 7□□ | 7□7 |
| C□□d□□□□□ □□□□□ □ | | 1□10 | □□0 | □□0 | □□0 | 2□□ |
| □□□ □□r□□r□ □C□ | | 10□0 | 11□□ | 17□□ | 2□□□ | □□1 |
| □□□□□□d □□□□□ □C□d □ □□r □□□□□ | □□ □□ □□□ | 11□□ | 1□□□ | □□□ | 7□□ | 10□0 |
| □□ □□□ □□r□□r□d□□□□d□□□□r□□r□ □□□□□□□□ | | □□□ | □□2 | □□□ | □□□ | □□□ |
| A□□□□r□□□□ | | □□□□□ □□□d□ | C□□d□ □□□□r□□□ | C□□r | C□□r | C□□d□ □□□□r□□□ |
| **Laboratory Analyses** | | | | | | |
| □□□□□□□□□□d□d □□□d□ | | □0 | □2 | □10 | 1□ | 7□ |

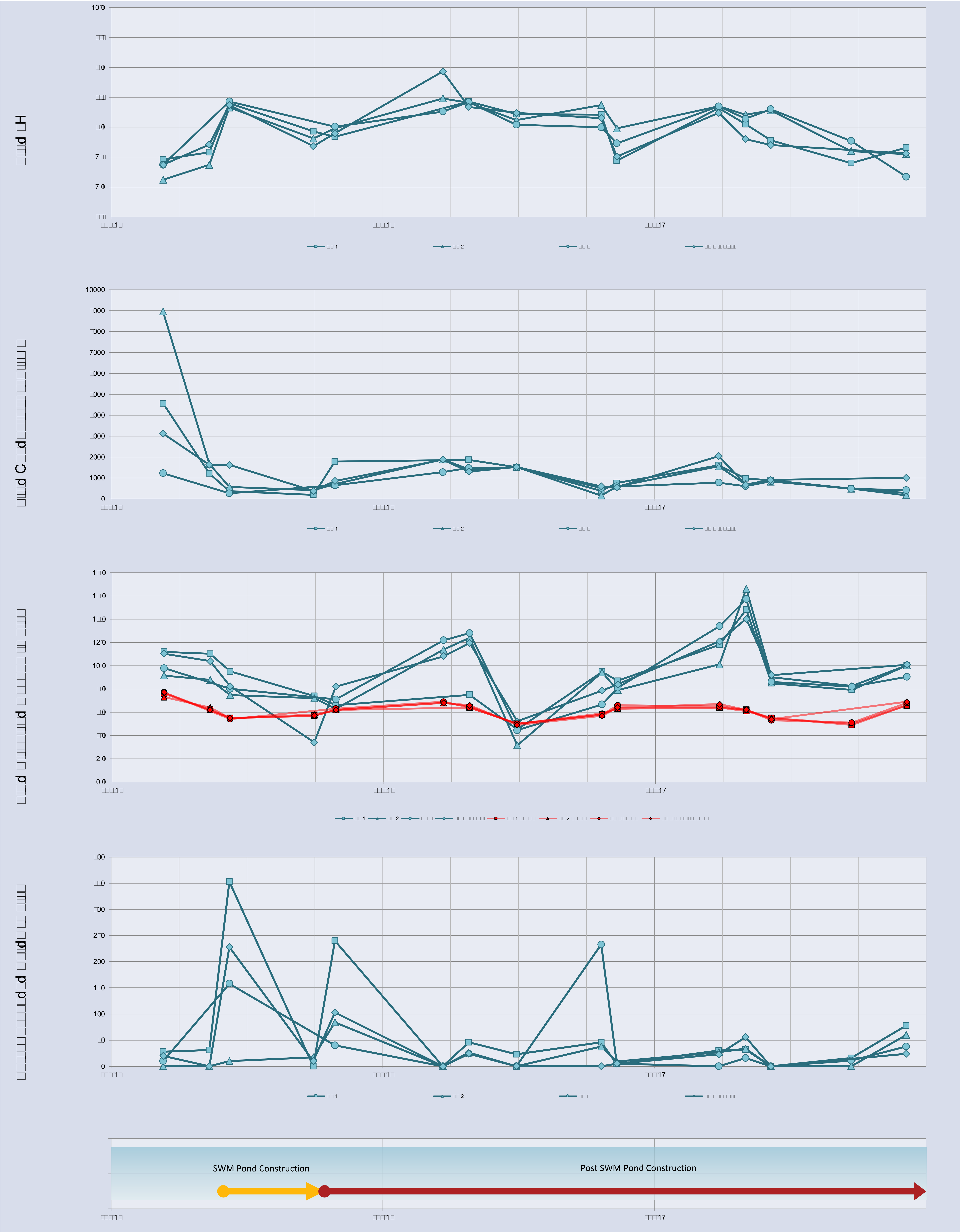
| Parameter / Event Type / Event Phase | PWQO | 3/28/2017 Freshet C□□□r□□□□□ | 5/3/2017 Wet C□□□r□□□□□ | 6/6/2017 Dry C□□□r□□□□□ | 9/22/2017 Wet C□□□r□□□□□ | 12/5/2017 Dry C□□□r□□□□□ |
|---|---|---|---|---|---|---|
| **Field Analyses** | | | | | | |
| □H □□□□□□□ | □□□ □□□□ | □□□ | □2 | □□□ | 7□□ | 7□□ |
| C□□d□□□□□ □□□□□ □ | | 1□□0 | 700 | □□1 | □□0 | 1□□ |
| □□□ □□r□□r□ □C□ | | 10□1 | 12□□ | 17□□ | 22□□ | □0 |
| □□□□□□d □□□□□ □C□d □ □□r □□□□□ | □□ □□ □□□ | 10□1 | 1□□□ | □0 | □□□ | 10□0 |
| □□ □□□ □□r□□r□d□□□□d□□□□r□□r□ □□□□□□□□ | | □□□ | □1 | □□□ | □0 | □□□ |
| A□□□□r□□□□ | | C□□r | C□□d□ □□□□r□□□ | C□□r | C□□r | C□□d□ □□□□r□□□ |
| **Laboratory Analyses** | | | | | | |
| □□□□□□□□□□d□d □□□d□ | | 27 | □□ | □10 | □10 | □0 |

| Parameter / Event Type / Event Phase | PWQO | 3/28/2017 Freshet C□□□r□□□□□ | 5/3/2017 Wet C□□□r□□□□□ | 6/6/2017 Dry C□□□r□□□□□ | 9/22/2017 Wet C□□□r□□□□□ | 12/5/2017 Dry C□□□r□□□□□ |
|---|---|---|---|---|---|---|
| **Field Analyses** | | | | | | |
| □H □□□□□□□ | □□□ □□□□ | □□□ | □1 | □□□ | 7□□ | 7□2 |
| C□□d□□□□□ □□□□□ □ | | 7□0 | □10 | □□□ | □□0 | □1□ |
| □□□ □□r□□r□ □C□ | | □1 | 11□2 | 1□□□ | 21□□ | 7□0 |
| □□□□□□d □□□□□ □C□d □ □□r □□□□□ | □□ □□ □□□ | 1□□□ | 1□7 | □□□ | □2 | □0 |
| □□ □□□ □□r□□r□d□□□□d□□□□r□□r□ □□□□□□□□ | | □□□ | □2 | □□□ | □1 | □□□ |
| A□□□□r□□□□ | | C□□r | □□□□□ □□□d□ | C□□r | C□□r | C□□d□ □□□□r□□□ |
| **Laboratory Analyses** | | | | | | |
| □□□□□□□□□□d□d □□□d□ | | □10 | 1□ | □10 | 11 | □□ |

| Parameter / Event Type / Event Phase | PWQO | 3/28/2017 Freshet C□□□r□□□□□ | 5/3/2017 Wet C□□□r□□□□□ | 6/6/2017 Dry C□□□r□□□□□ | 9/22/2017 Wet C□□□r□□□□□ | 12/5/2017 Dry C□□□r□□□□□ |
|---|---|---|---|---|---|---|
| **Field Analyses** | | | | | | |
| □H □□□□□□□ | □□□ □□□□ | □2 | 7□□ | 7□7 | Dry | 7□□ |
| C□□d□□□□□ □□□□□ □ | | 20□0 | □□0 | □0□ | | 100□ |
| □□□ □□r□□r□ □C□ | | 7□□ | 11□□ | 1□□□ | | □□□ |
| □□□□□□d □□□□□ □C□d □ □□r □□□□□ | □□ □□ □□□ | 12□1 | 1□0 | □2 | | 10□1 |
| □□ □□□ □□r□□r□d□□□□d□□□□r□□r□ □□□□□□□□ | | □7 | □2 | □□□ | | □□□ |
| A□□□□r□□□□ | | C□□d□ | □□□□□ □□□d□ □r□□□ | C□□r | | C□□d□ □□□□r□□□ |
| **Laboratory Analyses** | | | | | | |
| □□□□□□□□□□d□d □□□d□ | | 2□ | □□ | □10 | | 2□ |

□□□□□
□A□□□r□□ □□r□ □r□ □ □□ □□□□□ □□□r□ □□ □d□□□d□
□□□ □□ □□r□□□□□□ □□r □ □□□□ □ □□□□□□ □1□□□
□□□□d□□ □d□□□□ □□r□□ □□r □□□□d□ □□ □□
□□C□d □ □□r □□□□Cr□□r□□□□□ □□ □□ □□r□□r□□
□□7.72□□□ $^{-0.019x}$, y=DO criteria x=temperature

# Figure B-1 Surface Water Quality
# East Fonthill Development



# APPENDIX

# C

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## □□□□ □ □ A□□
## □□M□□RA□□R□

## Table C-1
## Surface Water Manual Flow Measurements
## East Fonthill Development

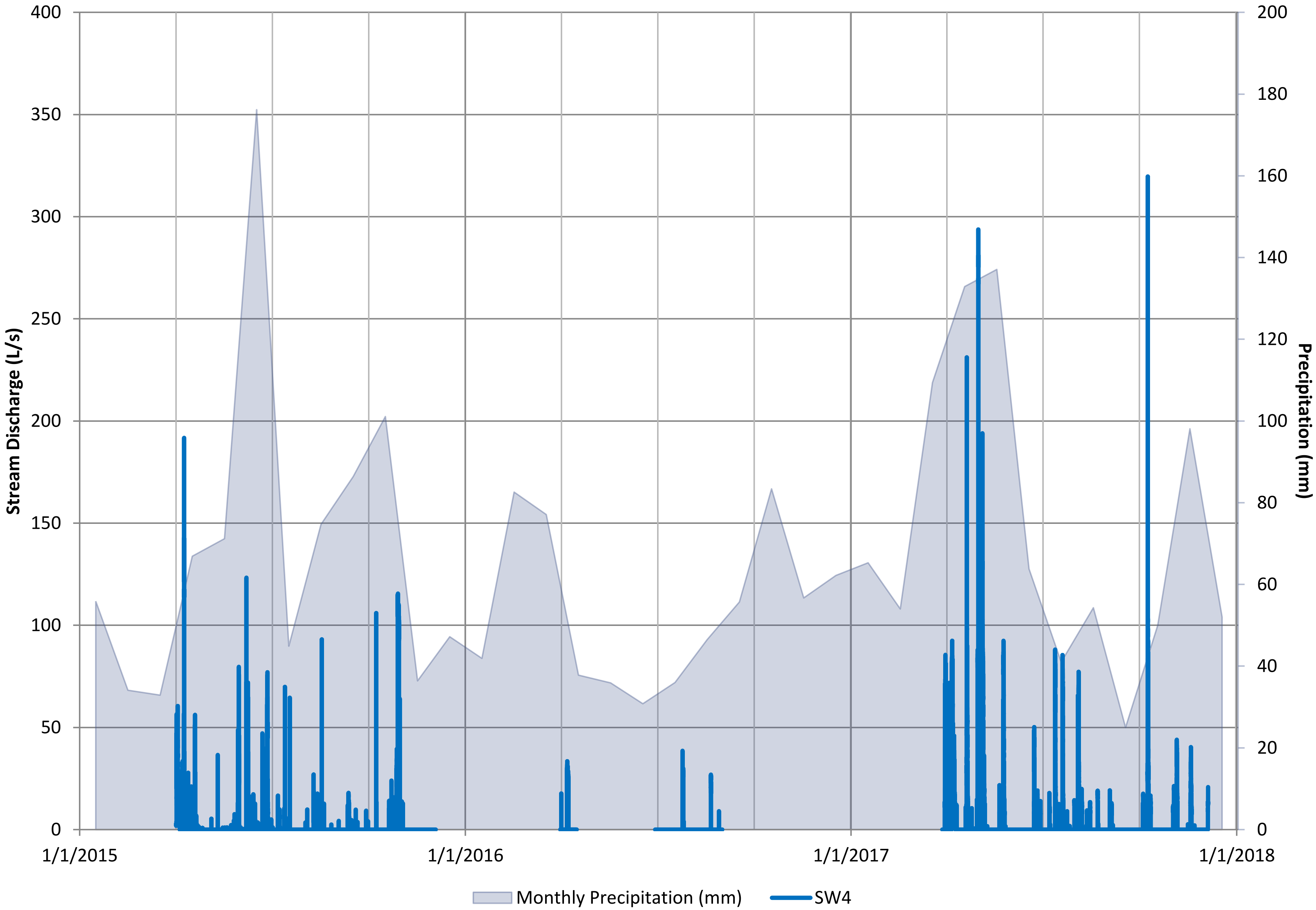
| Date (dd/mm/yyyy) | Event Type | SW1 Discharge Rate (L/sec) | SW2 Discharge Rate (L/sec) | SW3 Discharge Rate (L/sec) | SW4 Discharge Rate (L/sec) | SW5 Discharge Rate (L/sec) |
|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

[illegible]

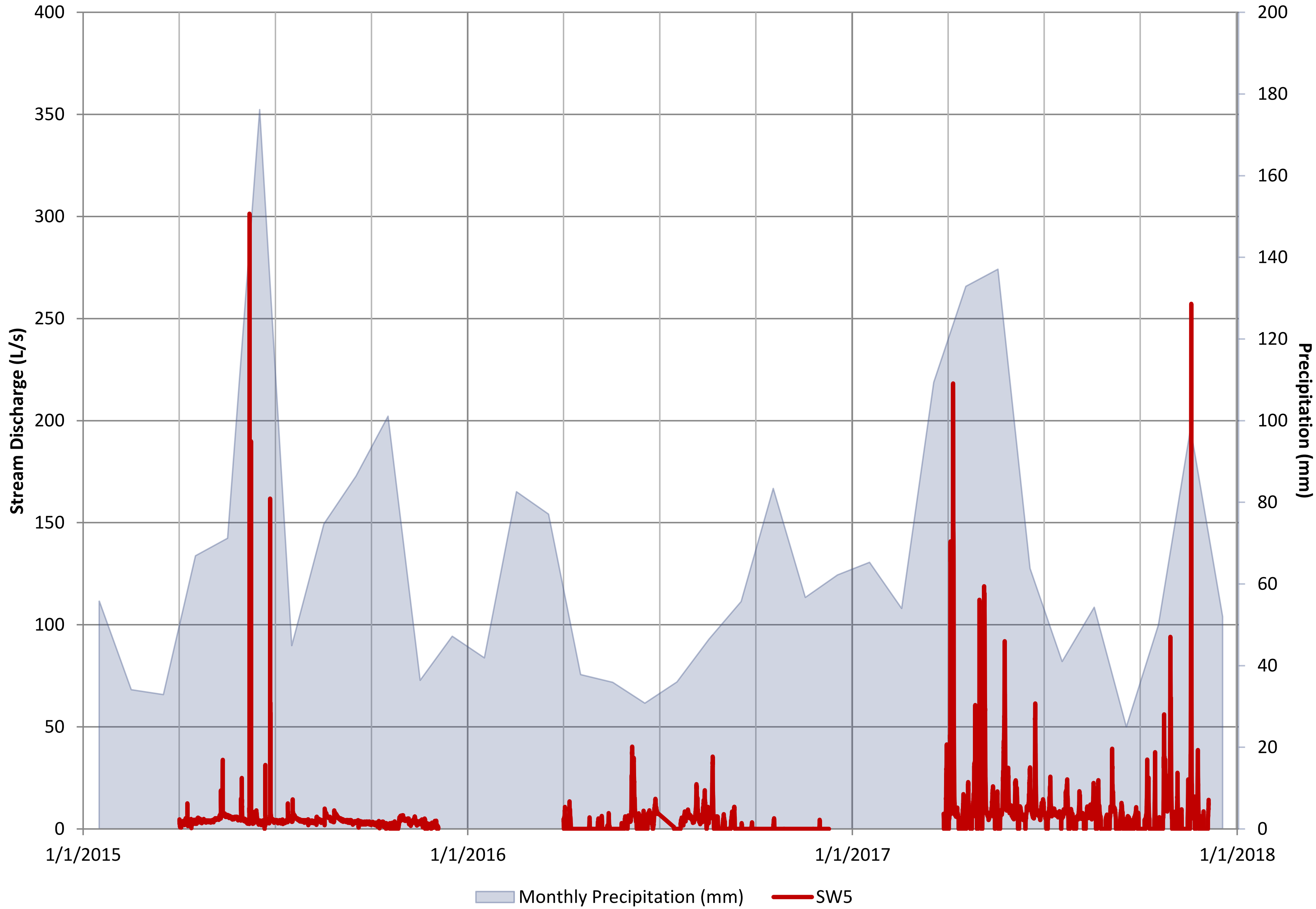
[illegible]

[illegible]

# Figure C-1 - SW4 Flow Monitoring and Precipitation



# Figure C-2 - SW5 Flow Monitoring and Precipitation



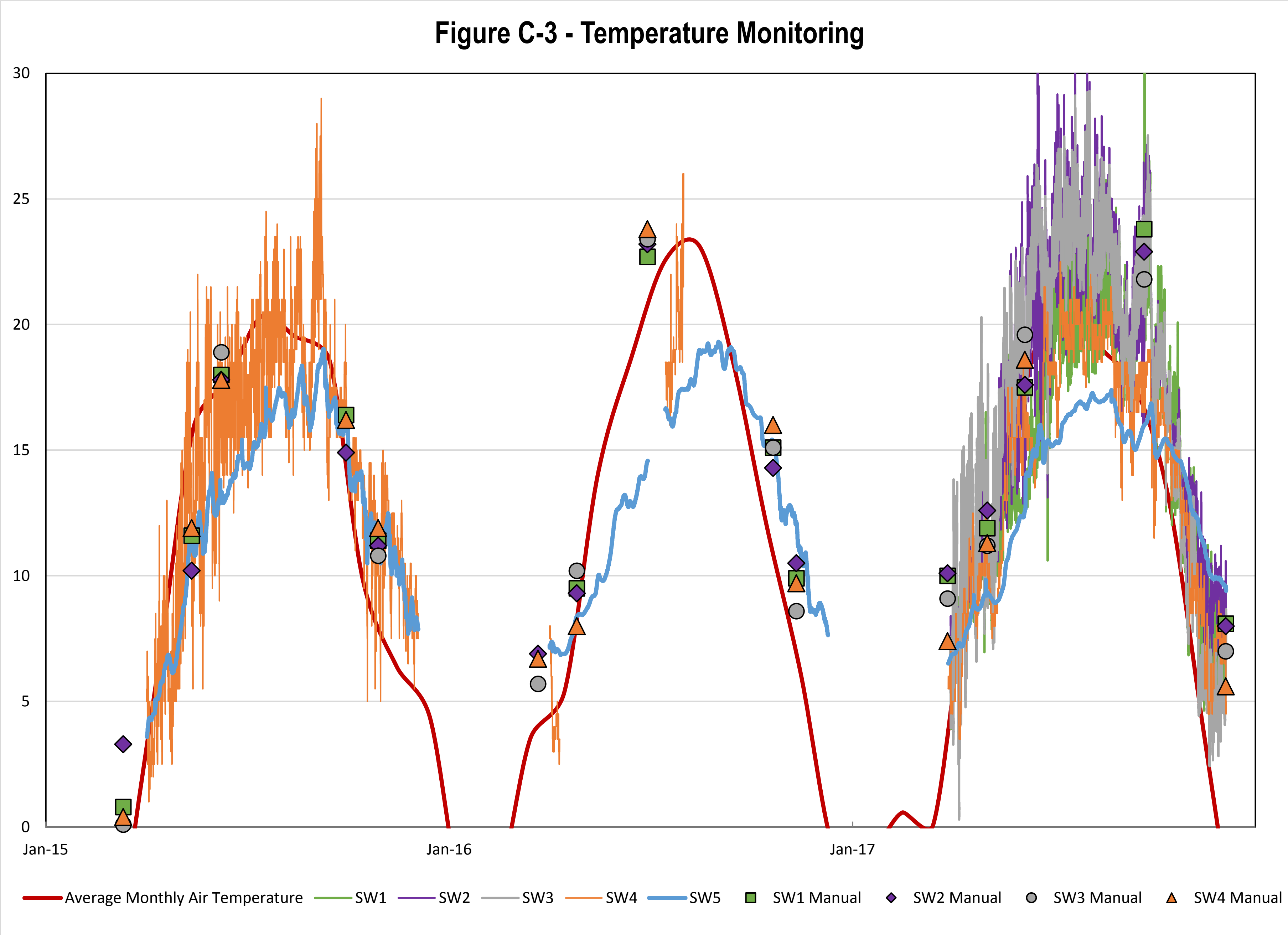


Figure C-3 - Temperature Monitoring
30
25
20
15
10
5
0
Jan-15
Jan-16
Jan-17
Average Monthly Air Temperature
SW1
SW2
SW3
SW4
SW5
SW1 Manual
SW2 Manual
SW3 Manual
SW4 Manual

# APPENDIX

# D

## C□□MA□□

## Table D-1
## Environment Canada Climate Data - Temperature and Precipitation
## East Fonthill Development

□□□□ □□□r□□□ □□□□r□□□ □□□C□□□d□ □□□□□□□C□□ □□□ □□□□ □□d □□□r□ □□□□ Ar□□□□□
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□□□□□□□ 17□
C□□ □□□ □d□□□1□□□□□
□ M□ □d□□□□ 717□2
□C □d□□□□□r □□ □

**Legend**

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| M | M□□□□□ |
| □ | □□□□ □□□d |
| A | A□□□□ □□□□d |
| C | □r□□□□□□□□ □ □□□rr□d□A□ □□□□□ □□□r□□□ |
| □ | □r□□□□□□□□ M□□ □r M□□ □□□H□□□ □ □□□rr□d |
| □ | A□□□□ □□□□d □□d □□□□ □□□d |
| □ | □□□ □□r□□□r□ M□□□□□ □□□□□□□ □ □□ □□ □ 0 |
| □ | □□□ □□r□□□r□ M□□□□□ □□□□□□□ □ □□ □□ □ 0 |
| □ | M□r□ □□□□□ □ □□ □ □□□rr□□□□ |
| □ | □r□□□ |
| □ | □□□□ □□r □□□□d□□ □□□ □□d□r□□□□ □□□□ □r□□□ □□□r□ □□□□□□ □□□□□□□□ |
| □□ | □□r□□r d□□□ □□□□□ □□□□□□□□□□□□ r□□□□□ □□ □□□ □ □□□□□□□C□□ □□□ Ar□□□□□□ |

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1□1□201□ | □0□□ | □□□7 | □□□□ | 21□□ | 0 | | | 0 | | | □□1 |
| 1□2□201□ | 0□□ | □□□□ | □□ | 22 | 0 | | | 0 | | | □□1 |
| 1□□□201□ | □□□ | □□□□ | □0□1 | 1□□1 | 0 | | | 1□ | | | □□1 |
| 1□□□201□ | 7□□ | □□□2 | 1□□ | 1□□□ | 0 | | | 2□ | | | □□1 |
| 1□□□201□ | □□□2 | □12□7 | □□□□ | 2□□□ | 0 | | | 0□2 | | | □□1 |
| 1□□□201□ | □□□1 | □12□2 | □10□2 | 2□□2 | 0 | | | 0□□ | | | □□1 |
| 1□7□201□ | □□□□ | □1□□□ | □1□□□ | □1□□ | 0 | | | 0□□ | | | □□1 |
| 1□□□201□ | □7□□ | □1□□□ | □11□□ | 2□□□ | 0 | | | 0□□ | | | □□1 |
| 1□□□201□ | □7□□ | □1□□□ | □10□7 | 2□□7 | 0 | | | 1□7 | | | □□1 |
| 1□10□201□ | □□□2 | □1□□□ | □10□□ | 2□□□ | 0 | | | 0□2 | | | □□1 |
| 1□11□201□ | 0□□ | □□□□ | □2□□ | 20□□ | 0 | | | 2 | | | □□1 |
| 1□12□201□ | □0□□ | □11□□ | □□ | 2□ | 0 | | | □□□ | | | □□1 |
| 1□1□□201□ | □11□□ | □17 | □1□□□ | □2□□ | 0 | | | 0□2 | | | □□1 |
| 1□1□□201□ | □□ | □2□□□ | □1□□□ | □2□□ | 0 | | | 0□2 | | | □□1 |
| 1□1□□201□ | □1□□ | □17□2 | □□□□ | 27□□ | 0 | | | 0 | | | □□1 |
| 1□1□□201□ | □2□□ | □□□□ | □□□□ | 22□□ | 0 | | | 0 | | | |
| 1□17□201□ | □□□ | | | | | | | | | | □□1 |
| 1□1□□201□ | □□7 | 0□2 | □□□ | 1□□□ | 0 | | | 0□□ | | | □□1 |
| 1□1□□201□ | 0□□ | □□□□ | □2□□ | 20□□ | 0 | | | 0□2 | | | □□1 |
| 1□20□201□ | □□□□ | □1□□7 | □□□7 | 27□7 | 0 | | | 0□2 | | | □□1 |
| 1□21□201□ | □2□□ | □1□□□ | □□□□ | 2□□□ | 0 | | | 0□2 | | | □□1 |
| 1□22□201□ | □0□□ | □□□□ | □□ | 21 | 0 | | | 0 | | | □□1 |
| 1□2□□201□ | □2□2 | □□□7 | □□□□ | 21□□ | 0 | | | 0 | | | □□1 |
| 1□2□□201□ | 0□□ | □□□1 | □2□□ | 20□□ | 0 | | | 0 | | | □□1 |
| 1□2□□201□ | 0□□ | □□□□ | □□□□ | 22□□ | 0 | | | 0 | | | □□1 |
| 1□2□□201□ | □□□2 | □10 | □□□1 | 2□□1 | 0 | | | 0□2 | | | □□1 |
| 1□27□201□ | □7□1 | □1□□□ | □12 | □0 | 0 | | | 1 | | | □□1 |
| 1□2□□201□ | □□□7 | □1□□□ | □12 | □0 | 0 | | | 0 | | | □□1 |
| 1□2□□201□ | 1□□ | □□□7 | □□□1 | 22□1 | 0 | | | □□□ | | | □□1 |
| 1□□0□201□ | □1□□ | □20□1 | □10□□ | 2□□□ | 0 | | | 0□□ | | | □□1 |
| 1□□1□201□ | □2□7 | □20□1 | □11□□ | 2□□□ | 0 | | | 0 | | | □□1 |

# Table D-1
## Environment Canada Climate Data - Temperature and Precipitation
## East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2□1□201□ | □2□□ | □10□□ | □□□□ | 2□□□ | 0 | | | 2□□ | | | □□1 |
| 2□2□201□ | □□□□ | □21□□ | □1□7 | □□□7 | 0 | | | □□1 | | | □□1 |
| 2□□□201□ | □□□□ | □20□□ | □12□□ | □0□□ | 0 | | | 0 | | | □□1 |
| 2□□□201□ | 0□1 | □□□□ | □□□1 | 22□1 | 0 | | | □□□ | | | □□1 |
| 2□□□201□ | □□□2 | □17□7 | □1□ | □1 | 0 | | | 0□2 | | | □□1 |
| 2□□□201□ | □□□2 | □12□□ | □□□□ | 2□□□ | 0 | | | 0□□ | | | □□1 |
| 2□7□201□ | □0□1 | □□□2 | □2□2 | 20□2 | 0 | | | 0□2 | | | □□1 |
| 2□□□201□ | □□ | □10□1 | □□□□ | 2□□□ | 0 | | | □□2 | | | □□1 |
| 2□□□201□ | □□□1 | □10□□ | □□□2 | 27□2 | 0 | | | 1□□ | | | □□1 |
| 2□10□201□ | □□□7 | □11□2 | □□□□ | 2□□□ | 0 | | | 0□2 | | | □□1 |
| 2□11□201□ | □0□□ | □1□□□ | □7□7 | 2□□7 | 0 | | | 1□7 | | | □□1 |
| 2□12□201□ | □2□1 | □22□□ | □12□□ | □0□□ | 0 | | | 0□□ | | | □□1 |
| 2□1□□201□ | □7□□ | □2□□□ | □1□□□ | □□□□ | 0 | | | 0□2 | | | □□1 |
| 2□1□□201□ | □□□□ | □1□□□ | □11□□ | 2□□□ | 0 | | | 2□7 | | | □□1 |
| 2□1□□201□ | □1□□□ | □2□□7 | □22 | □0 | 0 | | | 0□□ | | | □□1 |
| 2□1□□201□ | □1□□□ | □□1□□ | □2□□1 | □2□1 | 0 | | | 0□□ | | | □□1 |
| 2□17□201□ | □10□1 | □2□□□ | □17□□ | □□□□ | 0 | | | 0 | | | □□1 |
| 2□1□□201□ | □□□1 | □1□ | □11□□ | 2□□□ | 0 | | | 0□□ | | | □□1 |
| 2□1□□201□ | □1□□7 | □2□□2 | □20 | □□ | 0 | | | 0□2 | | | □□1 |
| 2□20□201□ | □1□□2 | □2□□□ | □20□□ | □□□□ | 0 | | | 0 | | | □□1 |
| 2□21□201□ | □□□2 | □1□□2 | □10□7 | 2□□7 | 0 | | | □□2 | | | □□1 |
| 2□22□201□ | □□□□ | □1□ | □12 | □0 | 0 | | | 0□2 | | | □□1 |
| 2□2□□201□ | □1□ | □2□□□ | □20□□ | □□□□ | 0 | | | 0□2 | | | □□1 |
| 2□2□□201□ | □□□□ | □2□□□ | □1□□□ | □□□□ | 0 | | | 0 | | | □□1 |
| 2□2□□201□ | □□ | □17□□ | □11□□ | 2□□□ | 0 | | | 0□□ | | | □□1 |
| 2□2□□201□ | □□□1 | □1□□□ | □1□□7 | □1□7 | 0 | | | 0□7 | | | □□1 |
| 2□27□201□ | □10□□ | □2□□□ | □17□2 | □□□2 | 0 | | | 0□2 | | | □□1 |
| 2□2□□201□ | □7□□ | □2□□□ | □1□□□ | □□□□ | 0 | | | 0 | | | □□1 |
| □□1□201□ | □□□□ | □1□□2 | □10□□ | 2□□□ | 0 | | | 2□□ | | | □□1 |
| □□2□201□ | □2□□ | □21 | □11□□ | 2□□□ | 0 | | | 0□□ | | | □□1 |
| □□□□201□ | □□7 | □22□1 | □□□2 | 27□2 | 0 | | | 7□□ | | | □□1 |
| □□□□201□ | 1□7 | □7□□ | □□□1 | 21□1 | 0 | | | 0 | | | □□1 |
| □□□□201□ | □7□□ | □1□□□ | □1□□□ | □1□□ | 0 | | | 0□□ | | | □□1 |
| □□□□201□ | □□□□ | □2□□□ | □1□□□ | □□□□ | 0 | | | 0 | | | □□1 |
| □□7□201□ | 0□□ | □□□7 | □□□1 | 21□1 | 0 | | | 0 | | | □□1 |
| □□□□201□ | 1□7 | □2□□ | □0□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| □□□□201□ | □□2 | □□□□ | □1□1 | 1□□1 | 0 | | | 0□□ | | | □□1 |
| □□10□201□ | 7□1 | □□□7 | □0□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| □□11□201□ | □ | □1□1 | 2 | 1□ | 0 | | | 0 | | | □□1 |
| □□12□201□ | □□□ | □□□□ | □1 | 1□ | 0 | | | 0 | | | □□1 |
| □□1□□201□ | □□□ | □□□2 | 1□7 | 1□□□ | 0 | | | 0 | | | □□1 |
| □□1□□201□ | □□2 | 1□7 | □□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| □□1□□201□ | □□□ | □1 | 1□□ | 1□□7 | 0 | | | 0 | | | □□1 |
| □□1□□201□ | □□□ | □0□7 | 2□□ | 1□□2 | 0 | | | □ | | | □□1 |
| □□17□201□ | □ | □□□□ | 0□□ | 17□7 | 0 | | | 0□2 | | | □□1 |
| □□1□□201□ | 1□□ | □□□□ | □2□1 | 20□1 | 0 | | | 0 | | | □□1 |
| □□1□□201□ | 1□□ | □□□7 | □□□□ | 21□□ | 0 | | | 0□2 | | | □□1 |
| □□20□201□ | □□□ | □1□7 | 2□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| □□21□201□ | □ | □□□□ | 0□7 | 17□□ | 0 | | | 0□7 | | | □□1 |
| □□22□201□ | □1□□ | □7□□ | □□□7 | 22□7 | 0 | | | 0□2 | | | □□1 |
| □□2□□201□ | □□□7 | □□□2 | □□□□ | 2□□□ | 0 | | | 0 | | | □□1 |
| □□2□□201□ | □□□ | □□□1 | □2□7 | 20□7 | 0 | | | 0 | | | □□1 |
| □□2□□201□ | □□□ | □□□□ | 0□□ | 17□1 | 0 | | | □□2 | | | □□1 |
| □□2□□201□ | □□□ | 0□□ | 2□□ | 1□□1 | 0 | | | □□□ | | | □□1 |
| □□27□201□ | 1□1 | □□□□ | □□□7 | 21□7 | 0 | | | 1□□ | | | □□1 |
| □□2□□201□ | □1□□ | □□□7 | □□□1 | 2□□1 | 0 | | | 0 | | | □□1 |
| □□2□□201□ | □□□ | □□□□ | □2□□ | 20□□ | 0 | | | 0 | | | □□1 |
| □□□0□201□ | □□□ | □1 | 2□7 | 1□□□ | 0 | | | □□1 | | | □□1 |
| □□□1□201□ | □□□ | □□□□ | 1□1 | 1□□□ | 0 | | | 0 | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| □1□201□ | □2 | □□□□ | 0□□ | 17□1 | 0 | | | 0 | | | □□1 |
| □2□201□ | 1□□□ | 0□□ | □□□ | □2 | 0 | | | □□□ | | | □□1 |
| □□□201□ | 10□□ | 1□□ | □□□ | 11□7 | 0 | | | 7 | | | □□1 |
| □□□201□ | □1 | □2□□ | 0□□ | 17□1 | 0 | | | 0□□ | | | □□1 |
| □□□201□ | 2□□ | □2□□ | 0□1 | 17□□ | 0 | | | 0□7 | | | □□1 |
| □□□201□ | 11□2 | 0□7 | □ | 12 | 0 | | | 0 | | | □□1 |
| □7□201□ | □□□ | 1□□ | □1 | 12□□ | 0 | | | 1□□ | | | □□1 |
| □□□201□ | □□□ | 0□□ | □2 | 1□□□ | 0 | | | □□□ | | | □□1 |
| □□□201□ | 1□1 | 1□□ | □ | 10 | 0 | | | 12□□ | | | □□1 |
| □10□201□ | 1□□□ | □□□ | □□□ | □□□ | 0 | | | 0 | | | □□1 |
| □11□201□ | □2 | 1□□ | □□□ | 12□7 | 0 | | | 0□2 | | | □□1 |
| □12□201□ | 1□7 | □1□□ | 7□□ | 10□□ | 0 | | | 0 | | | □□1 |
| □1□□201□ | 2□□□ | □□□ | 1□□□ | □□□ | 0 | | | □2 | | | □□1 |
| □1□□201□ | 1□□□ | 2□□ | □2 | □□□ | 0 | | | 0 | | | □□1 |
| □1□□201□ | 1□2 | □0□□ | 7□□ | 10□□ | 0 | | | 0□2 | | | □□1 |
| □1□□201□ | 20□□ | 1□2 | 10□□ | 7□1 | 0 | | | □□□ | | | □□1 |
| □17□201□ | 1□□□ | □2 | 10□□ | 7□□ | 0 | | | 0□7 | | | □□1 |
| □1□□201□ | 21□□ | □ | 12□2 | □□□ | 0 | | | 0 | | | □□1 |
| □1□□201□ | 17□□ | □□□ | 11□2 | □□□ | 0 | | | □2 | | | □□1 |
| □20□201□ | 1□7 | □1 | 12□□ | □□□ | 0 | | | 12□□ | | | □□1 |
| □21□201□ | 11□□ | □□□ | 7□7 | 10□□ | 0 | | | 0 | | | □□1 |
| □22□201□ | □□□ | 0□□ | □□□ | 1□□□ | 0 | | | 1□□ | | | □□1 |
| □2□□201□ | □2 | □1□2 | 1 | 17 | 0 | | | 0 | | | □□1 |
| □2□□201□ | 7□2 | □1□□ | 2□7 | 1□□□ | 0 | | | 0□2 | | | □□1 |
| □2□□201□ | 10□1 | □□□□ | □□□ | 1□7 | 0 | | | 0 | | | □□1 |
| □2□□201□ | 12□7 | 1□2 | 7 | 11 | 0 | | | 0 | | | □□1 |
| □27□201□ | □7 | □□□ | □□□ | 11□2 | 0 | | | 0 | | | □□1 |
| □2□□201□ | | 1□□ | | | | | | | | | □□1 |
| □2□□201□ | 1□□□ | 1□□ | □□□ | □□□ | 0 | | | 0 | | | □□1 |
| □□0□201□ | 1□□□ | □7 | 11□1 | □□□ | 0 | | | 0 | | | □□1 |
| □1□201□ | 20 | □□□ | 11□□ | □1 | 0 | | | 0 | | | □□1 |
| □2□201□ | 1□□□ | 2□□ | 11□1 | □□□ | 0 | | | 0□2 | | | □□1 |
| □□□201□ | 22□□ | □1 | 1□□□ | □2 | 0 | | | 0 | | | □□1 |
| □□□201□ | 2□□□ | □□□ | 17□1 | 0□□ | 0 | | | 0□2 | | | □□1 |
| □□□201□ | 1□□□ | □□□ | 11□7 | □□□ | 0 | | | 1□□ | | | □□1 |
| □□□201□ | 22□□ | □□□ | 1□1 | 1□□ | 0 | | | 0 | | | □□1 |
| □7□201□ | 2□□□ | 7□□ | 1□□□ | 1□□ | 0 | | | 0□2 | | | □□1 |
| □□□201□ | □0□□ | 10□□ | 20□□ | 0 | 2□□ | | | 0 | | | □□1 |
| □□□201□ | □0□□ | 1□□□ | 21□□ | 0 | □□□ | | | 0□□ | | | □□1 |
| □10□201□ | 27□2 | 1□□□ | 20□□ | 0 | 2□□ | | | 0 | | | □□1 |
| □11□201□ | 27□□ | 1□□□ | 20□7 | 0 | 2□7 | | | □□□ | | | □□1 |
| □12□201□ | 17□□ | 10□□ | 1□1 | □□□ | 0 | | | 0 | | | □□1 |
| □1□□201□ | | | | | | | | | | | □□1 |
| □1□□201□ | 1□□□ | 0□□ | □□□ | □□□ | 0 | | | 0□2 | | | □□1 |
| □1□□201□ | 1□□□ | □□□ | 1□1 | □□□ | 0 | | | 2□1 | | | □□1 |
| □1□□201□ | 2□□□ | 11□□ | 17□□ | 0□□ | 0 | | | 0 | | | □□1 |
| □17□201□ | 27□□ | 1□ | 21□2 | 0 | □2 | | | 0□2 | | | □□1 |
| □1□□201□ | 2□□□ | 1□□□ | 21□□ | 0 | □□□ | | | 0 | | | □□1 |
| □1□□201□ | 1□1 | □□□ | 1□ | □ | 0 | | | 0 | | | □□1 |
| □20□201□ | 12□□ | □□□ | □□□ | □□□ | 0 | | | 0 | | | □□1 |
| □21□201□ | 1□1 | □□□ | 11□□ | □□□ | 0 | | | 0 | | | □□1 |
| □22□201□ | 17□7 | 0□2 | □ | □ | 0 | | | 0□2 | | | □□1 |
| □2□□201□ | 17□2 | □1□□ | 7□7 | 10□□ | 0 | | | 0 | | | □□1 |
| □2□□201□ | 2□□□ | □□□ | 1□2 | □□□ | 0 | | | 0 | | | □□1 |
| □2□□201□ | 27 | 1□□□ | 20□□ | 0 | 2□□ | | | 0 | | | □□1 |
| □2□□201□ | 27□1 | 1□□□ | 22□7 | 0 | □7 | | | 2□□ | | | □□1 |
| □27□201□ | 27 | 1□□□ | 21□□ | 0 | □□□ | | | 0□□ | | | □□1 |
| □2□□201□ | 2□1 | 1□1 | 1□1 | 0 | 0□1 | | | 0 | | | □□1 |
| □2□□201□ | 2□□□ | 10□□ | 1□□□ | 0 | 1□□ | | | 0 | | | □□1 |
| □□0□201□ | 27□7 | 1□□□ | 20□□ | 0 | 2□□ | | | 2□□ | | | □□1 |
| □□1□201□ | 1□□□ | □□□ | 10□1 | 7□□ | 0 | | | □□ | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| □1□201□ | 1□□ | □7 | 10□□ | 7□7 | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 1□□ | □□ | 1□1 | □□ | 0 | | | 0 | | | □□1 |
| □□201□ | 22 | □1 | 1□1 | □□ | 0 | | | 0□2 | | | □□1 |
| □□201□ | 2□□ | □□ | 1□1 | 1□ | 0 | | | 0 | | | □□1 |
| □□201□ | 2□□ | 1□□ | 20□ | 0 | 2□ | | | 0□2 | | | □□1 |
| □□201□ | 1□ | □□ | 12□7 | □□ | 0 | | | 0□2 | | | □□1 |
| □7□201□ | 2□□ | □□ | 1□7 | 2□ | 0 | | | 1□□ | | | □□1 |
| □□201□ | 21□ | 1□□ | 1□1 | 0 | 0□1 | | | 2□ | | | □□1 |
| □□201□ | 20□ | 12□ | 1□□ | 1□ | 0 | | | □2 | | | □□1 |
| □10□201□ | 2□□ | 12□ | 1□1 | 0 | 1□1 | | | 0□2 | | | □□1 |
| □11□201□ | 22□2 | 1□7 | 1□ | 0 | 0 | | | 0 | | | □□1 |
| □12□201□ | 2□7 | 1□□ | 20□ | 0 | 2□ | | | 1□□ | | | □□1 |
| □1□201□ | 22□ | 1□ | 1□□ | 0 | 0□ | | | 0 | | | □□1 |
| □1□201□ | 2□□ | 1□□ | 1□□ | 0 | 1□ | | | 1□ | | | □□1 |
| □1□201□ | 2□1 | 17□ | 21 | 0 | □ | | | 0 | | | □□1 |
| □1□201□ | 27□2 | 1□ | 21□ | 0 | □□ | | | 1□ | | | □□1 |
| □17□201□ | 2□□ | 1□□ | 1□1 | 0 | 1□1 | | | 0 | | | □□1 |
| □1□201□ | 2□□ | 1□□ | 1□2 | 0 | 1□2 | | | □2 | | | □□1 |
| □1□201□ | 20□ | 11□1 | 1□□ | 2□1 | 0 | | | 0□2 | | | □□1 |
| □20□201□ | 2□□ | 10□1 | 17□ | 0□7 | 0 | | | 0 | | | □□1 |
| □21□201□ | 2□2 | 1□7 | 21 | 0 | □ | | | 0□ | | | □□1 |
| □22□201□ | 2□□ | 1□2 | 20□ | 0 | 2□ | | | 0□7 | | | □□1 |
| □2□201□ | 2□□ | 1□1 | 1□□ | 0 | 1□ | | | 1□2 | | | □□1 |
| □2□201□ | 22□ | 12□7 | 17□ | 0□ | 0 | | | 0 | | | □□1 |
| □2□201□ | 2□□ | 1□□ | 1□□ | 0 | 1□ | | | 0 | | | □□1 |
| □2□201□ | 2□□ | 1□□ | 1□□ | 0 | 0□ | | | 0□2 | | | □□1 |
| □27□201□ | 1□ | 1□□ | 1□7 | 2□ | 0 | | | □□□ | | | □□1 |
| □2□201□ | 1□□ | 12□ | 1□1 | □□ | 0 | | | □□ | | | □□1 |
| □2□201□ | 22□7 | 1□□ | 1□1 | 0 | 0□1 | | | 0 | | | □□1 |
| □□0□201□ | 22□ | 1□□ | 1□2 | 0 | 1□2 | | | 1 | | | □□1 |
| 7□1□201□ | 22□2 | 1□ | 1□□ | 0 | 0□ | | | 2□ | | | □□1 |
| 7□2□201□ | 21□ | 10□ | 1□2 | 1□ | 0 | | | 0□2 | | | □□1 |
| 7□□201□ | 2□2 | □ | 1□1 | 1□ | 0 | | | 0 | | | □□1 |
| 7□□201□ | 2□7 | 1□□ | 1□2 | 0 | 1□2 | | | 0□2 | | | □□1 |
| 7□□201□ | 2□□ | 1□□ | 1□□ | 0 | 1□ | | | 0□2 | | | □□1 |
| 7□□201□ | 2□□ | 1□□ | 21□ | 0 | □□ | | | 0□2 | | | □□1 |
| 7□7□201□ | 2□□ | 1□□ | 22□ | 0 | □□ | | | □□ | | | □□1 |
| 7□□201□ | 21 | 1□□ | 17□ | 0□ | 0 | | | 0 | | | □□1 |
| 7□□201□ | 21 | 1□□ | 17□ | 0□ | 0 | | | 10□ | | | □□1 |
| 7□10□201□ | 2□1 | 12□ | 1□□ | 0 | 0□ | | | 0 | | | □□1 |
| 7□11□201□ | 2□1 | 12□7 | 1□□ | 0 | 1□ | | | 0□ | | | □□1 |
| 7□12□201□ | 2□7 | 1□□ | 21□2 | 0 | □2 | | | 0 | | | □□1 |
| 7□1□201□ | 2□ | 1□□ | 22□2 | 0 | □2 | | | □1 | | | □□1 |
| 7□1□201□ | 2□1 | 1□□ | 20□7 | 0 | 2□7 | | | 1□□ | | | □□1 |
| 7□1□201□ | 21□1 | 11□ | 1□2 | 1□ | 0 | | | 0□ | | | □□1 |
| 7□1□201□ | 2□1 | 10□1 | 17□1 | 0□ | 0 | | | 0 | | | □□1 |
| 7□17□201□ | 2□□ | 1□7 | 1□□ | 0 | 1□ | | | 1 | | | □□1 |
| 7□1□201□ | 2□ | 1□□ | 2□7 | 0 | □7 | | | 2□ | | | □□1 |
| 7□1□201□ | 27□ | 1□□ | 2□7 | 0 | □7 | | | 0□ | | | □□1 |
| 7□20□201□ | 2□1 | 1□□ | 21□2 | 0 | □2 | | | 0 | | | □□1 |
| 7□21□201□ | 2□7 | 1□□ | 20□ | 0 | 2□ | | | 0□ | | | □□1 |
| 7□22□201□ | 2□ | 12□ | 1□2 | 0 | 0□2 | | | 0 | | | □□1 |
| 7□2□201□ | 2□1 | 11□2 | 1□7 | 0 | 0□7 | | | 0 | | | □□1 |
| 7□2□201□ | 2□ | 10□7 | 1□□ | 0 | 0□ | | | 0□2 | | | □□1 |
| 7□2□201□ | 2□ | 17□ | 22□7 | 0 | □7 | | | 0 | | | □□1 |
| 7□2□201□ | 2□1 | 1□□ | 22 | 0 | □ | | | 0□ | | | □□1 |
| 7□27□201□ | 2□□ | 1□□ | 22□ | 0 | □□ | | | 0□7 | | | □□1 |
| 7□2□201□ | □1□1 | 17 | 2□1 | 0 | □1 | | | 0□ | | | □□1 |
| 7□2□201□ | □1□ | 17□ | 2□□ | 0 | □□ | | | 0□ | | | □□1 |
| 7□□0□201□ | 2□□ | 1□□ | 2□1 | 0 | □1 | | | 0 | | | □□1 |
| 7□□1□201□ | 27□ | 1□□ | 21□2 | 0 | □2 | | | 0□ | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| □1□201□ | 2□2 | 1□□ | 1□□ | 0 | 1□ | | | 11 | | | □□1 |
| □2□201□ | 2□7 | 1□7 | 20□2 | 0 | 2□2 | | | 0 | | | □□1 |
| □□□201□ | 2□□ | 1□2 | 20□ | 0 | 2□ | | | 0 | | | □□1 |
| □□□201□ | 2□□ | 1□□ | 20□2 | 0 | 2□2 | | | 7□ | | | □□1 |
| □□□201□ | 2□□ | 11□ | 17□7 | 0□ | 0 | | | | | | □□1 |
| □□□201□ | 2□7 | □□ | 1□□ | 1□2 | 0 | | | 0 | | | □□1 |
| □7□201□ | 2□7 | 11□ | 1□□ | 0 | 0□ | | | 0 | | | □□1 |
| □□□201□ | 2□□ | 1□□ | 1□ | 0 | 1 | | | 0 | | | □□1 |
| □□□201□ | 2□ | 11□1 | 1□□ | 0 | 0□ | | | 0□2 | | | □□1 |
| □10□201□ | 27□7 | 12□7 | 20□2 | 0 | 2□2 | | | 27□2 | | | □□1 |
| □11□201□ | 2□7 | 1□7 | 20□7 | 0 | 2□7 | | | 0 | | | □□1 |
| □12□201□ | 2□□ | 11 | 17□ | 0□7 | 0 | | | 0 | | | □□1 |
| □1□201□ | 2□□ | □□ | 1□□ | 1□1 | 0 | | | 0 | | | □□1 |
| □1□201□ | 2□□ | 20□ | 22□ | 0 | □□ | | | 1□2 | | | □□1 |
| □1□201□ | 27□ | 1□□ | 2□□ | 0 | □□ | | | 0 | | | □□1 |
| □1□201□ | 2□1 | 17 | 22□ | 0 | □□ | | | 0 | | | □□1 |
| □17□201□ | 2□□ | 1□□ | 2□□ | 0 | □□ | | | 0 | | | □□1 |
| □1□201□ | 2□1 | 1□□ | 22 | 0 | □ | | | 20□ | | | □□1 |
| □1□201□ | 2□□ | 1□□ | 2□□ | 0 | □□ | | | 0 | | | □□1 |
| □20□201□ | 2□□ | 17□ | 21□ | 0 | □□ | | | □□ | | | □□1 |
| □21□201□ | 22□ | 12□ | 17□ | 0□2 | 0 | | | 0 | | | □□1 |
| □22□201□ | 2□7 | 10□2 | 17 | 1 | 0 | | | 0 | | | □□1 |
| □2□201□ | 2□ | □□ | 17□ | 0□2 | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 22□ | 1□2 | 1□□ | 0 | 1□ | | | 0 | | | □□1 |
| □2□201□ | 1□□ | 1□□ | 17□1 | 0□ | 0 | | | 0 | | | □□1 |
| □2□201□ | 1□□ | 11□7 | 1□7 | 2□ | 0 | | | 0 | | | □□1 |
| □27□201□ | 1□□ | 11□2 | 1□□ | 2□ | 0 | | | 0 | | | □□1 |
| □2□201□ | 22□7 | □□ | 1□□ | 1□7 | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 2□1 | 11□1 | 1□1 | 0 | 0□1 | | | 0 | | | □□1 |
| □□0□201□ | 2□7 | 17□ | 21□ | 0 | □□ | | | 0 | | | □□1 |
| □□1□201□ | 27□1 | 1□□ | 21□ | 0 | □□ | | | 0 | | | □□1 |
| □1□201□ | 2□□ | 1□7 | 21□2 | 0 | □2 | | | 0□2 | | | □□1 |
| □2□201□ | 2□1 | 17 | 2□1 | 0 | □1 | | | 0 | | | □□1 |
| □□□201□ | 2□□ | 1□1 | 2□2 | 0 | □2 | | | 0 | | | □□1 |
| □□□201□ | □0□ | 1□□ | 2□□ | 0 | □□ | | | 0 | | | □□1 |
| □□□201□ | 2□7 | 17 | 2□□ | 0 | □□ | | | | | | □□1 |
| □□□201□ | 2□□ | 1□□ | 2□□ | 0 | □□ | | | 0□2 | | | □□1 |
| □7□201□ | □0□ | 1□2 | 2□□ | 0 | □□ | | | 0 | | | □□1 |
| □□□201□ | 2□□ | 21 | 2□□ | 0 | 7□ | | | 0 | | | □□1 |
| □□□201□ | 2□□ | 1□1 | 20□ | 0 | 2□ | | | 1□ | | | □□1 |
| □10□201□ | 2□7 | 10□1 | 17□ | 0□ | 0 | | | 0□2 | | | □□1 |
| □11□201□ | 2□□ | □1 | 17□2 | 0□ | 0 | | | □□ | | | □□1 |
| □12□201□ | 1□□ | 11□ | 1□2 | □□ | 0 | | | □□□ | | | □□1 |
| □1□201□ | 1□□ | □□ | 12 | □ | 0 | | | 1□7 | | | □□1 |
| □1□201□ | 21□ | □7 | 1□2 | □□ | 0 | | | 0 | | | □□1 |
| □1□201□ | 2□□ | □□ | 17 | 1 | 0 | | | 0□2 | | | □□1 |
| □1□201□ | 2□7 | 11□7 | 1□2 | 0 | 1□2 | | | 0□2 | | | □□1 |
| □17□201□ | 2□□ | 12□ | 1□□ | 0 | 1□ | | | 0□ | | | □□1 |
| □1□201□ | 2□2 | 11□ | 1□1 | 0 | 1□1 | | | 0 | | | □□1 |
| □1□201□ | 2□□ | 10□ | 17□ | 0□ | 0 | | | □□ | | | □□1 |
| □20□201□ | 1□ | 7□ | 1□2 | □□ | 0 | | | 0□2 | | | □□1 |
| □21□201□ | 20□ | 7□ | 1□□ | □2 | 0 | | | 0 | | | □□1 |
| □22□201□ | 22□1 | □□ | 1□□ | 2□ | 0 | | | 0□ | | | □□1 |
| □2□201□ | 2□2 | □7 | 1□□ | 1□ | 0 | | | 0 | | | □□1 |
| □2□201□ | 2□□ | □□ | 17□ | 0□ | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 2□□ | 1□□ | 1□□ | 0 | 0□ | | | 0□2 | | | □□1 |
| □2□201□ | 2□1 | 12□ | 17□ | 0□1 | 0 | | | 0 | | | □□1 |
| □27□201□ | 2□1 | 11□ | 17□ | 0□ | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 20□ | 17□ | 1□1 | 0 | 1□1 | | | 1□ | | | □□1 |
| □2□201□ | 20□ | 1□1 | 1□□ | 1□2 | 0 | | | 1□□ | | | □□1 |
| □□0□201□ | 1□ | □□ | 12□7 | □□ | 0 | | | 0□2 | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10□1□201□ | 1□□□ | 7□□ | 10□□ | 7□□ | 0 | | | 0 | | | □□1 |
| 10□2□201□ | 11□□ | 7□□ | □□□ | □□□ | 0 | | | 0 | | | □□1 |
| 10□□□201□ | □□□ | 7□□ | □□□ | □□□ | 0 | | | 0□□ | | | □□1 |
| 10□□□201□ | 1□□□ | □□□ | 12□□ | □□□ | 0 | | | 0 | | | □□1 |
| 10□□□201□ | 1□□7 | □□□ | 11□□ | □□2 | 0 | | | 0 | | | □□1 |
| 10□□□201□ | 1□□□ | 12 | 1□□□ | □□□ | 0 | | | 0 | | | □□1 |
| 10□7□201□ | 20 | 7□□ | 1□□□ | □□1 | 0 | | | 0□□ | | | □□1 |
| 10□□□201□ | 1□□□ | □□□ | 11□□ | □□□ | 0 | | | 7□□ | | | □□1 |
| 10□□□201□ | 17□□ | □□□ | 11□□ | □□□ | 0 | | | 7□□ | | | □□1 |
| 10□10□201□ | 1□□7 | □□□ | □□□ | □□7 | 0 | | | 0 | | | □□1 |
| 10□11□201□ | 1□□7 | 12□□ | 1□□□ | 2□2 | 0 | | | 0 | | | □□1 |
| 10□12□201□ | 22□□ | 1□□1 | 1□□□ | 0 | 0□□ | | | 0□□ | | | □□1 |
| 10□1□□201□ | 17□□ | 11□2 | 1□□□ | □□□ | 0 | | | 0 | | | □□1 |
| 10□1□□201□ | 1□□□ | 2□2 | 7□□ | 10□1 | 0 | | | 0□□ | | | □□1 |
| 10□1□□201□ | 1□□7 | 1 | □□□ | □□1 | 0 | | | 0□□ | | | □□1 |
| 10□1□□201□ | 1□□□ | 1□□ | 7□□ | 10□□ | 0 | | | 0□□ | | | □□1 |
| 10□17□201□ | 7□1 | □1□1 | □ | 1□ | 0 | | | 0□2 | | | □□1 |
| 10□1□□201□ | 7□1 | □□□1 | 2 | 1□ | 0 | | | 0 | | | □□1 |
| 10□1□□201□ | 1□□□ | □□□□ | □□2 | 12□□ | 0 | | | 0□2 | | | □□1 |
| 10□20□201□ | 1□□□ | 11□□ | 1□ | □ | 0 | | | □□□ | | | □□1 |
| 10□21□201□ | 17□□ | 11□□ | 1□□□ | □□□ | 0 | | | 0□□ | | | □□1 |
| 10□22□201□ | 17□□ | □□□ | 11□1 | □□□ | 0 | | | 0□2 | | | □□1 |
| 10□2□□201□ | 11□1 | □0□1 | □□□ | 12□□ | 0 | | | 0□□ | | | □□1 |
| 10□2□□201□ | 1□□□ | □□□ | 11 | 7 | 0 | | | 7□□ | | | □□1 |
| 10□2□□201□ | 1□□1 | 1□□ | □□2 | □□□ | 0 | | | 0□□ | | | □□1 |
| 10□2□□201□ | 11□□ | □1 | □□□ | 12□7 | 0 | | | 0□2 | | | □□1 |
| 10□27□201□ | 1□□1 | 2 | 7□□ | 10□□ | 0 | | | 0 | | | □□1 |
| 10□2□□201□ | 1□□□ | □□□ | 12□□ | □□□ | 0 | | | □□□□ | | | □□1 |
| 10□2□□201□ | 1□□□ | □ | □□□ | □□2 | 0 | | | 1□2 | | | □□1 |
| 10□□0□201□ | 10□□ | □0□□ | □□□ | 1□□1 | 0 | | | 0□□ | | | □□1 |
| 10□□1□201□ | 11□7 | □1□□ | □ | 1□ | 0 | | | 0□□ | | | □□1 |
| 11□1□201□ | 1□□□ | □□□ | □□7 | □□□ | 0 | | | 1□□ | | | □□1 |
| 11□2□201□ | 1□□□ | 1□7 | □□2 | □□□ | 0 | | | 0□2 | | | □□1 |
| 11□□□201□ | 1□□7 | □□□ | 11□□ | □□2 | 0 | | | 0□□ | | | □□1 |
| 11□□□201□ | 22□1 | □□□ | 1□ | □ | 0 | | | 0□□ | | | □□1 |
| 11□□□201□ | | □□□ | | | | | | | | | □□1 |
| 11□□□201□ | 1□□□ | □□7 | 1□□□ | □□7 | 0 | | | 1□□ | | | □□1 |
| 11□7□201□ | 11□7 | 2□□ | 7□1 | 10□□ | 0 | | | 0 | | | □□1 |
| 11□□□201□ | 10□□ | □1□□ | □□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| 11□□□201□ | 1□□□ | □2□□ | □□□ | 12□□ | 0 | | | 0□7 | | | □□1 |
| 11□10□201□ | 11□□ | 0□□ | □□□ | 12□1 | 0 | | | 12□2 | | | □□1 |
| 11□11□201□ | 11□□ | □□1 | 7□□ | 10□□ | 0 | | | 0□□ | | | □□1 |
| 11□12□201□ | 1□□□ | □□□ | 10□2 | 7□□ | 0 | | | □□□ | | | □□1 |
| 11□1□□201□ | □□7 | 2□□ | □□1 | 11□□ | 0 | | | 0□2 | | | □□1 |
| 11□1□□201□ | 7□7 | 0□2 | □ | 1□ | 0 | | | 0□□ | | | □□1 |
| 11□1□□201□ | 1□□□ | 2□7 | □□2 | □□□ | 0 | | | 0 | | | □□1 |
| 11□1□□201□ | 1□□□ | 1 | □□2 | □□□ | 0 | | | 0□2 | | | □□1 |
| 11□17□201□ | 1□□□ | 2□1 | □ | 10 | 0 | | | 0□2 | | | □□1 |
| 11□1□□201□ | 1□□□ | 11□□ | 1□□2 | □□□ | 0 | | | 0 | | | □□1 |
| 11□1□□201□ | 1□□7 | □□7 | 10□7 | 7□□ | 0 | | | 0□7 | | | □□1 |
| 11□20□201□ | 7 | □□□1 | 2 | 1□ | 0 | | | 0□2 | | | □□1 |
| 11□21□201□ | □□7 | □0□□ | □□2 | 1□□□ | 0 | | | 1□□ | | | □□1 |
| 11□22□201□ | □□□ | □□□□ | □0□7 | 1□□7 | 0 | | | 0□□ | | | □□1 |
| 11□2□□201□ | 2□□ | □7 | □2□2 | 20□2 | 0 | | | 1□□ | | | □□1 |
| 11□2□□201□ | □□□ | □□ | 0□□ | 17□1 | 0 | | | 0□2 | | | □□1 |
| 11□2□□201□ | 10□□ | □□□□ | 2□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| 11□2□□201□ | 1□□□ | □□□ | 12□1 | □□□ | 0 | | | 0 | | | □□1 |
| 11□27□201□ | 1□□□ | 1□□ | □□2 | □□□ | 0 | | | □□□ | | | □□1 |
| 11□2□□201□ | 2□1 | □□□□ | □0□□ | 1□□□ | 0 | | | 0□□ | | | □□1 |
| 11□2□□201□ | □□7 | □□□□ | □0□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| 11□□0□201□ | □□□ | □1□□ | 2□□ | 1□□7 | 0 | | | 0 | | | □□1 |

# Table D-1
## Environment Canada Climate Data - Temperature and Precipitation
## East Fonthill Development

| Date/Time | Maximum Temperature | Minimum Temperature | Mean Temperature | Heat Degree Days | Cool Degree Days | Total Rain | Total Snow | Total Precipitation | Snow on Ground | Direction of Maximum Gust | Speed of Maximum Gust |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (°C) | (°C) | (°C) | (°C) | (°C) | (mm) | (cm) | (mm) | (cm) | (10's deg) | (km/h) |
| 12□1□201□ | 10□□ | □□□ | 7□2 | 10□□ | 0 | | | 0□□ | | | □□1 |
| 12□2□201□ | □□□ | □2□2 | □□□ | 1□□7 | 0 | | | 0□□ | | | □□1 |
| 12□□□201□ | 7□□ | □2□2 | 2□7 | 1□□□ | 0 | | | 0 | | | □□1 |
| 12□□□201□ | □□□ | □0□□ | 2□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| 12□□□201□ | □□□ | □□□□ | 1□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| 12□□□201□ | 7□□ | □□□2 | 1□7 | 1□□□ | 0 | | | 0 | | | □□1 |
| 12□7□201□ | □□2 | □□□□ | 0□2 | 17□□ | 0 | | | 0 | | | □□1 |
| 12□□□201□ | □□□ | □0□□ | 2□□ | 1□□□ | 0 | | | 0 | | | □□1 |
| 12□□□201□ | 12□□ | □□□ | □□□ | □□□ | 0 | | | 0 | | | □□1 |
| 12□10□201□ | 12□□ | □□2 | □□□ | □□7 | 0 | | | 0 | | | □□1 |
| 12□11□201□ | 1□□□ | □□1 | □□□ | □□2 | 0 | | | 0 | | | □□1 |
| 12□12□201□ | 10□2 | □0□2 | □ | 1□ | 0 | | | 0 | | | □□1 |
| 12□1□□201□ | 10□2 | □□□ | 7□□ | 10□1 | 0 | | | 0 | | | □□1 |
| 12□1□□201□ | 20□1 | □□□ | 1□□2 | □□□ | 0 | | | | | | □□1 |
| 12□1□□201□ | □□□ | 2□7 | □ | 12 | 0 | | | 0□2 | | | □□1 |
| 12□1□□201□ | □□□ | 2□□ | □ | 12 | 0 | | | 0 | 0 | | □□1 |
| 12□17□201□ | 10□2 | 1□□ | □□1 | 11□□ | 0 | | | 1□□ | 0 | | □□1 |
| 12□1□□201□ | □□2 | □2□□ | 0□2 | 17□□ | 0 | | | 0□2 | | | □□1 |
| 12□1□□201□ | □0□□ | □□□□ | □2□□ | 20□□ | 0 | | | 0 | | | □□1 |
| 12□20□201□ | 7□□ | □□□1 | 0□□ | 17□2 | 0 | | | 0 | | | □□1 |
| 12□21□201□ | 10□□ | □□2 | □□□ | □□7 | 0 | | | 0□7 | | | □□1 |
| 12□22□201□ | 12□1 | 2□□ | 7□□ | 10□□ | 0 | | | 0□2 | | | □□1 |
| 12□2□□201□ | 1□□□ | | | | | | | | | | □□1 |
| 12□2□□201□ | 1□□2 | □ | 10□□ | 7□□ | 0 | | | 0□2 | | | □□1 |
| 12□2□□201□ | □□□ | 0□□ | □□7 | 1□□□ | 0 | | | 0□□ | | | □□1 |
| 12□2□□201□ | □ | □0□□ | 2□□ | 1□□□ | 0 | | | □□1 | 1 | | □□1 |
| 12□27□201□ | □□□ | 0□□ | □□□ | 1□□□ | 0 | | | 12□□ | 0 | | □□1 |
| 12□2□□201□ | 1 | □□□□ | □1□□ | 1□□□ | 0 | | | 11□1 | | | □□1 |
| 12□2□□201□ | 7 | □0□□ | □□□ | 1□□7 | 0 | | | 1□□□ | 1 | | □□1 |
| 12□□0□201□ | □□□ | 0□□ | 2□1 | 1□□□ | 0 | | | 0□□ | | | □□1 |
| 12□□1□201□ | 1□2 | □0□□ | 0□□ | 17□□ | 0 | | | 0□2 | | | □□1 |
| 1□1□201□ | 0□0 | □□□2 | □1□□ | 1□□□ | 0 | | | 0□0 | | | □□1 |
| 1□2□201□ | □□0 | □2□□ | 0□1 | 17□□ | 0 | | | 0□0 | 0 | | □□1 |
| 1□□□201□ | □□2 | □□□0 | □2□□ | 20□□ | 0 | | | 0□2 | | | □□1 |
| 1□□□201□ | □□□0 | □12□2 | □10□1 | 2□□1 | 0 | | | 0□□ | 0 | | □□1 |
| 1□□□201□ | □1□□ | □1□□2 | □□□□ | 2□□□ | 0 | | | 0□2 | | | □□1 |
| 1□□□201□ | 2□□ | □□□□ | □2□0 | 20□0 | 0 | | | 0□□ | 0 | | □□1 |
| 1□7□201□ | □□□ | □□□0 | □1□□ | 1□□□ | 0 | | | 0□0 | | | □□1 |
| 1□□□201□ | □□1 | □□□□ | □0□□ | 1□□□ | 0 | | | 2□7 | | | □□1 |
| 1□□□201□ | □□□ | □□□ | □□7 | 11□□ | 0 | | | 1□□ | | | □□1 |
| 1□10□201□ | □□□ | □□□1 | 1□2 | 1□□□ | 0 | | | 1□□□ | | | □□1 |
| 1□11□201□ | □□□1 | □□□□ | □□□0 | 2□□0 | 0 | | | 0□7 | 1 | | □□1 |
| 1□12□201□ | □0□□ | □□□1 | □□□□ | 22□□ | 0 | | | □□□ | □ | | □□1 |
| 1□1□□201□ | □□□□ | □10□□ | □□□□ | 2□□□ | 0 | | | 1□0 | 10 | | □□1 |
| 1□1□□201□ | □2□□ | □7□□ | □□□2 | 2□□2 | 0 | | | 0□□ | 1□ | | □□1 |
| 1□1□□201□ | 7□□ | □□□□ | 1□□ | 1□□□ | 0 | | | 0□□ | 11 | | □□1 |
| 1□1□□201□ | □□2 | □2□□ | 0□□ | 17□1 | 0 | | | 1□7 | □ | | □□1 |
| 1□17□201□ | 0□1 | □11□2 | □□□□ | 2□□□ | 0 | | | 2□□ | □ | | □□1 |
| 1□1□□201□ | □7□□ | □11□□ | □□□□ | 27□□ | 0 | | | 0□0 | □ | | □□1 |
| 1□1□□201□ | □□□□ | □1□1 | □□□□ | 27□□ | 0 | | | 0□0 | □ | | □□1 |
| 1□20□201□ | □□□1 | □10□2 | □7□2 | 2□□2 | 0 | | | 0□0 | □ | | □□1 |
| 1□21□201□ | □2□□ | □10□2 | □□□□ | 2□□□ | 0 | | | 0□0 | □ | | □□1 |
| 1□22□201□ | □□□□ | □1□□□ | □10□1 | 2□□1 | 0 | | | 0□□ | □ | | □□1 |
| 1□2□□201□ | □□□7 | □1□□□ | □10□0 | 2□□0 | 0 | | | 0□0 | □ | | □□1 |
| 1□2□□201□ | 0□1 | □1□□7 | □7□□ | 2□□□ | 0 | | | 0□0 | □ | | □□1 |
| 1□2□□201□ | □□7 | □0□□ | 2□1 | 1□□□ | 0 | | | 1□□ | □ | | □□1 |
| 1□2□□201□ | □□□ | 0□□ | □□□ | 1□□2 | 0 | | | 1□□ | 2 | | □□1 |
| 1□27□201□ | 0□7 | □0□□ | □0□1 | 1□□1 | 0 | | | 0□0 | 1 | | □□1 |
| 1□2□□201□ | □□□ | □2□2 | 0□7 | 17□□ | 0 | | | 1□□ | 1 | | □□1 |
| 1□2□□201□ | 0□1 | □□□□ | □□□□ | 22□□ | 0 | | | 0□□ | 1 | | □□1 |
| 1□□0□201□ | 7□□ | □□□0 | □0□□ | 1□□□ | 0 | | | 0□0 | 1 | | □□1 |
| 1□□1□201□ | 12□□ | □□□ | □□2 | □□□ | 0 | | | 0□2 | 1 | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2□1□201□ | □□ | □□□ | 2□7 | 1□□ | 0 | | | 0□ | | | □□1 |
| 2□2□201□ | □□ | □□2 | 0□2 | 17□ | 0 | | | □7 | | | □□1 |
| 2□□201□ | 1□□ | 2□ | □□ | □□ | 0 | | | 1□7 | 0 | | □□1 |
| 2□□201□ | □□ | □1□0 | 1□ | 1□□ | 0 | | | 0□ | | | □□1 |
| 2□□201□ | 0□ | □2□0 | □0□ | 1□□ | 0 | | | 0□2 | 0 | | □□1 |
| 2□□201□ | 2□1 | □0□7 | 0□7 | 17□ | 0 | | | 0□0 | | | □□1 |
| 2□7□201□ | 7□ | □0□ | □□ | 1□□ | 0 | | | 0□0 | 0 | | □□1 |
| 2□□201□ | □0 | □1□0 | □□ | 1□□ | 0 | | | 1□0 | | | □□1 |
| 2□□201□ | 2□ | □2□1 | 0□2 | 17□ | 0 | | | 2□1 | | | □□1 |
| 2□10□201□ | □2□1 | □10□ | □□□ | 2□□ | 0 | | | 2□1 | □ | | □□1 |
| 2□11□201□ | □□7 | □1□□ | □12□ | □0□ | 0 | | | 0□2 | 1 | | □□1 |
| 2□12□201□ | □□□ | □1□7 | □□2 | 27□2 | 0 | | | 2□ | 1 | | □□1 |
| 2□1□201□ | □11□7 | □20□0 | □1□□ | □□□ | 0 | | | 0□7 | □ | | □□1 |
| 2□1□201□ | □12□7 | □2□□ | □1□□ | □7□ | 0 | | | 0□ | 1 | | □□1 |
| 2□1□201□ | □1□ | □17□7 | □□□ | 27□ | 0 | | | 0□0 | 2 | | □□1 |
| 2□1□201□ | □0□1 | □2□ | □1□ | 1□□ | 0 | | | 11□ | □ | | □□1 |
| 2□17□201□ | □1□2 | □1□□ | □7□ | 2□□ | 0 | | | 1□7 | 1□ | | □□1 |
| 2□1□201□ | □□□ | □1□□ | □11□ | 2□□ | 0 | | | 1□1 | 1□ | | □□1 |
| 2□1□201□ | □□ | □12□7 | □2□2 | 20□2 | 0 | | | 0□0 | 1□ | | □□1 |
| 2□20□201□ | 1□□ | 1□ | 7□7 | 10□ | 0 | | | 0□0 | 0 | | □□1 |
| 2□21□201□ | □7 | □1□ | 2□ | 1□□ | 0 | | | 0□2 | 0 | | □□1 |
| 2□22□201□ | 1□0 | □□2 | □2□1 | 20□1 | 0 | | | 0□2 | | | □□1 |
| 2□2□201□ | 2□0 | □□1 | □2□1 | 20□1 | 0 | | | 0□0 | | | □□1 |
| 2□2□201□ | 2□ | □0□7 | 1□0 | 17□0 | 0 | | | □0□ | | | □□1 |
| 2□2□201□ | 2□ | □□□ | □1□0 | 1□0 | 0 | | | 2□ | | | □□1 |
| 2□2□201□ | □2□ | □□2 | □□□ | 2□□ | 0 | | | 0□2 | 1 | | □□1 |
| 2□27□201□ | □1 | □□□ | □0□ | 1□□ | 0 | | | 0□0 | 1 | | □□1 |
| 2□2□201□ | 1□□ | □□ | □□ | □□ | 0 | | | 0□ | | | □□1 |
| 2□2□201□ | □7 | □□1 | 1□ | 1□2 | 0 | | | □0 | 0 | | □□1 |
| □1□201□ | □1□7 | □7□ | □□□ | 22□ | 0 | | | 2□2 | 0 | | □□1 |
| □2□201□ | □□□ | □□□ | □□□ | 2□□ | 0 | | | 0□7 | 1 | | □□1 |
| □□201□ | □□1 | □7□ | □□2 | 2□2 | 0 | | | 0□ | 2 | | □□1 |
| □□201□ | □0□1 | □10□0 | □□1 | 2□1 | 0 | | | □□ | 2 | | □□1 |
| □□201□ | 0□ | □□□ | □2□ | 20□ | 0 | | | 0□0 | 1 | | □□1 |
| □□201□ | 2□1 | □□1 | □□0 | 21□0 | 0 | | | 0□0 | 0 | | □□1 |
| □7□201□ | 12□ | 1□ | 7□0 | 11□0 | 0 | | | 0□0 | 0 | | □□1 |
| □□201□ | 1□7 | □□ | 11□1 | □□ | 0 | | | 0□0 | | | □□1 |
| □□201□ | 1□□ | 7□ | 1□□ | □□ | 0 | | | 0□0 | | | □□1 |
| □10□201□ | 12□2 | □2 | □7 | □□ | 0 | | | □□ | | | □□1 |
| □11□201□ | 7□1 | □2□1 | 2□ | 1□□ | 0 | | | 0□ | | | □□1 |
| □12□201□ | 12□ | □2□ | □□ | 1□1 | 0 | | | 0□0 | | | □□1 |
| □1□201□ | □7 | □0□ | □□ | 1□□ | 0 | | | 0□ | | | □□1 |
| □1□201□ | 11□ | □2 | □□ | □□ | 0 | | | □□ | | | □□1 |
| □1□201□ | □□ | □0 | 7□2 | 10□ | 0 | | | 2□1 | | | □□1 |
| □1□201□ | 1□□ | □□ | □□ | □1 | 0 | | | 1□2 | | | □□1 |
| □17□201□ | 10□7 | □□ | 7□ | 10□2 | 0 | | | 1□0 | | | □□1 |
| □1□201□ | □2 | □2□1 | 2□1 | 1□□ | 0 | | | 0□ | | | □□1 |
| □1□201□ | 1□ | □□2 | □1□ | 1□□ | 0 | | | 0□2 | | | □□1 |
| □20□201□ | □□ | □□□ | □0□7 | 1□7 | 0 | | | 0□0 | | | □□1 |
| □21□201□ | □□ | □□0 | □0□ | 1□□ | 0 | | | 0□0 | 0 | | □□1 |
| □22□201□ | 10□ | □□□ | 2□ | 1□7 | 0 | | | 0□0 | 0 | | □□1 |
| □2□201□ | □1 | 0□1 | 2□ | 1□□ | 0 | | | □□ | | | □□1 |
| □2□201□ | □7 | 0□1 | □□ | 1□□ | 0 | | | 1□2 | | | □□1 |
| □2□201□ | □2 | □2□ | 2□ | 1□2 | 0 | | | 0□ | | | □□1 |
| □2□201□ | 7□ | □□□ | 1□ | 1□1 | 0 | | | 0□0 | 0 | | □□1 |
| □27□201□ | 17□ | □□0 | 7□ | 10□ | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 1□0 | 1□ | 7□ | 10□7 | 0 | | | □2 | | | □□1 |
| □2□201□ | 7□ | □0□ | □□ | 1□□ | 0 | | | 0□2 | | | □□1 |
| □□0□201□ | 1□□ | □1□7 | 7□ | 10□ | 0 | | | 0□0 | | | □□1 |
| □□1□201□ | 17□7 | □□ | 1□2 | □□ | 0 | | | 1□□ | | | □□1 |

# Table D-1
## Environment Canada Climate Data - Temperature and Precipitation
## East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| □1□201□ | 12□□ | 2□□ | 7□□ | 10□□ | 0 | | | 0□□ | | | □□1 |
| □2□201□ | □□1 | □□7 | 0□7 | 17□□ | 0 | | | 2□□ | | | □□1 |
| □□□201□ | □0□□ | | | | | | | | | | □□1 |
| □□□201□ | □2□7 | □□2 | □□□0 | 2□□0 | 0 | | | 0□□ | | | □□1 |
| □□□201□ | 0□1 | □11□1 | □□□□ | 2□□□ | 0 | | | 0□7 | | | □□1 |
| □□□201□ | □□1 | □□□□ | 2□□ | 1□□7 | 0 | | | 2□□ | | | □□1 |
| □7□201□ | □□□ | □0□□ | □□7 | 1□□□ | 0 | | | 0□□ | | | □□1 |
| □□□201□ | □□□ | □□□□ | 0□□ | 17□□ | 0 | | | 0□7 | | | □□1 |
| □□□201□ | 0□□ | □□□□ | □2□□ | 20□□ | 0 | | | 0□0 | | | □□1 |
| □10□201□ | □□1 | □7□7 | □2□□ | 20□□ | 0 | | | □□0 | | | □□1 |
| □11□201□ | □□7 | 2□□ | □□1 | 11□□ | 0 | | | □□2 | | | □□1 |
| □12□201□ | □□0 | □2□□ | 2□□ | 1□□□ | 0 | | | 0□2 | | | □□1 |
| □1□□201□ | 7□0 | □□□□ | 1□□ | 1□□7 | 0 | | | 0□0 | | | □□1 |
| □1□□201□ | 12□1 | □1□□ | □□□ | 12□□ | 0 | | | 0□□ | | | □□1 |
| □1□□201□ | 1□□□ | 0□□ | □□□ | □□□ | 0 | | | 0□□ | | | □□1 |
| □1□□201□ | 1□□□ | □□□ | 11□1 | □□□ | 0 | | | 1□1 | | | □□1 |
| □17□201□ | 21□□ | 2□□ | 12□1 | □□□ | 0 | | | 0□□ | | | □□1 |
| □1□□201□ | 20□□ | □□□ | 12□0 | □□0 | 0 | | | 0□7 | | | □□1 |
| □1□□201□ | 1□□1 | □□□ | □□7 | □□□ | 0 | | | 0□□ | | | □□1 |
| □20□201□ | 17□□ | 0□2 | □□□ | □□2 | 0 | | | 0□7 | | | □□1 |
| □21□201□ | 1□□0 | 2□□ | 10□□ | 7□7 | 0 | | | 0□2 | | | □□1 |
| □22□201□ | 1□□□ | □□□ | 12□□ | □□1 | 0 | | | 7□□ | | | □□1 |
| □2□□201□ | 12□0 | □□0 | 7□□ | 10□□ | 0 | | | 0□0 | | | □□1 |
| □2□□201□ | 1□□□ | □0□□ | 7□1 | 10□□ | 0 | | | 0□□ | | | □□1 |
| □2□□201□ | 12□□ | □□7 | □□□ | □□□ | 0 | | | 0□□ | | | |
| □2□□201□ | □□1 | | | | | | | | | | □□1 |
| □27□201□ | 12□□ | □2□□ | □□1 | 12□□ | 0 | | | 0□□ | | | □□1 |
| □2□□201□ | □□□ | 2□2 | □□□ | 12□1 | 0 | | | 0□2 | | | □□1 |
| □2□□201□ | 11□1 | 1□□ | □□□ | 11□□ | 0 | | | 0□2 | | | □□1 |
| □□□0□201□ | 1□□1 | 1□□ | □□□ | □□2 | 0 | | | 1□1 | | | □□1 |
| □□1□201□ | 12□7 | 7□0 | □□□ | □□1 | 0 | | | 7□□ | | | □□1 |
| □2□201□ | 10□□ | □□□ | 7□1 | 10□□ | 0 | | | □□□ | | | □□1 |
| □□□201□ | 1□□□ | 2□□ | □□2 | □□□ | 0 | | | 0□□ | | | □□1 |
| □□□201□ | 17□0 | 2□□ | □□□ | □□2 | 0 | | | 0□□ | | | □□1 |
| □□□201□ | 1□□□ | □□7 | 11□□ | □□□ | 0 | | | 0□2 | | | □□1 |
| □□□201□ | 20□□ | □□2 | 12□□ | □□2 | 0 | | | 0□□ | | | □□1 |
| □7□201□ | 1□□□ | 7□□ | 1□□□ | □□□ | 0 | | | 0□2 | | | □□1 |
| □□□201□ | 1□□□ | □□□ | □□0 | □□0 | 0 | | | 0□2 | | | □□1 |
| □□□201□ | 1□□□ | 2□1 | □□□ | □□1 | 0 | | | 1□1 | | | □□1 |
| □10□201□ | 17□0 | □□7 | 10□□ | 7□□ | 0 | | | 0□7 | | | □□1 |
| □11□201□ | 22□□ | □□□ | 1□□□ | □□□ | 0 | | | 0□□ | | | □□1 |
| □12□201□ | 2□□□ | □□□ | 1□□□ | 1□1 | 0 | | | 0□7 | | | □□1 |
| □1□□201□ | 17□□ | □□□ | 1□□□ | □□□ | 0 | | | □□□ | | | □□1 |
| □1□□201□ | 1□□□ | □□0 | □□□ | □□2 | 0 | | | □□□ | | | □□1 |
| □1□□201□ | □□1 | 2□□ | □□□ | 12□7 | 0 | | | 0□2 | | | □□1 |
| □1□□201□ | 1□□□ | 2□□ | □□□ | □□□ | 0 | | | 0□□ | | | □□1 |
| □17□201□ | | 7□7 | | | | | | | | | □□1 |
| □1□□201□ | 1□□□ | □□7 | 10□□ | 7□□ | 0 | | | 0□0 | | | □□1 |
| □1□□201□ | 1□□7 | 2□□ | 10□□ | 7□2 | 0 | | | 0□2 | | | □□1 |
| □20□201□ | 22□7 | □□□ | 1□□7 | □□□ | 0 | | | 0□2 | | | □□1 |
| □21□201□ | 1□□7 | 11□□ | 1□□□ | 2□□ | 0 | | | 0□2 | | | □□1 |
| □22□201□ | 22□1 | □□□ | 1□□0 | 2□0 | 0 | | | 0□2 | | | □□1 |
| □2□□201□ | 2□□□ | 7□7 | 1□□□ | 1□□ | 0 | | | 0□□ | | | □□1 |
| □2□□201□ | 2□□7 | □□0 | 1□□□ | 1□□ | 0 | | | 0□□ | | | □□1 |
| □2□□201□ | 27□□ | 11□□ | 1□□□ | 0□0 | 1□□ | | | 0□□ | | | □□1 |
| □2□□201□ | 2□□□ | 1□□1 | 20□□ | 0□0 | 2□□ | | | 0□0 | | | □□1 |
| □27□201□ | 2□□□ | 1□□□ | 21□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □2□□201□ | □2□□ | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □2□□201□ | 27□□ | 1□□2 | 22□□ | 0□0 | □□□ | | | 0□□ | | | □□1 |
| □□□0□201□ | 27□□ | 1□□0 | 20□□ | 0□0 | 2□□ | | | 0□0 | | | □□1 |
| □□□1□201□ | 2□□□ | 1□□□ | 21□0 | 0□0 | □ | | | 0□□ | | | □□1 |

# Table D-1
## Environment Canada Climate Data - Temperature and Precipitation
## East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| □1□201□ | 2□1 | 12□□ | 1□2 | 0□0 | 0□2 | | | 0□0 | | | □□1 |
| □2□201□ | 2□2 | 1□0 | 1□□□ | 0□0 | 1□□ | | | 0□7 | | | □□1 |
| □□□201□ | 2□□□ | 12□7 | 1□□□ | 0□0 | 1□□ | | | 0□2 | | | □□1 |
| □□□201□ | 2□□□ | 11□□ | 1□□□ | 0□0 | 1□□ | | | 0□0 | | | □□1 |
| □□□201□ | 22□□ | 1□□□ | 1□□□ | 0□0 | 1□□ | | | 10□□ | | | □□1 |
| □□□201□ | 2□1 | 1□□□ | 1□□□ | 0□0 | 0□□ | | | 0□□ | | | □□1 |
| □7□201□ | 21□0 | 11□2 | 1□1 | 1□□ | 0 | | | 2□1 | | | □□1 |
| □□□201□ | 1□□□ | □2 | 10□□ | 7□2 | 0 | | | 0□0 | | | □□1 |
| □□□201□ | 21□0 | □□□ | 1□0 | □0 | 0 | | | 0□0 | | | □□1 |
| □10□201□ | 21□□ | □1 | 1□□□ | □□□ | 0 | | | 0□2 | | | □□1 |
| □11□201□ | 2□0 | 1□1 | 22□1 | 0□0 | □1 | | | 0□2 | | | □□1 |
| □12□201□ | 22□1 | 10□□ | 1□2 | 1□□ | 0 | | | 0□2 | | | □□1 |
| □1□201□ | 1□0 | □1 | 1□□□ | □□□ | 0 | | | 0□0 | | | □□1 |
| □1□201□ | 22□□ | 7□□ | 1□1 | 2□□ | 0 | | | 0□□ | | | □□1 |
| □1□201□ | 27□0 | □1 | 17□□ | 0□□ | 0 | | | □□□ | | | □□1 |
| □1□201□ | 27□2 | 1□7 | 21□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □17□201□ | □0□1 | 1□7 | 21□□ | 0□0 | □□□ | | | 0□2 | | | □□1 |
| □1□201□ | □0□□ | 12□□ | 21□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □1□201□ | □0□0 | 1□7 | 21□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □20□201□ | 2□□□ | 17□7 | 2□□□ | 0□0 | □□□ | | | □□□ | | | □□1 |
| □21□201□ | 2□7 | 10□□ | 17□□ | 0□2 | 0 | | | 0□2 | | | □□1 |
| □22□201□ | 2□□□ | 1□2 | 1□□□ | 0□0 | 1□□ | | | 0□0 | | | □□1 |
| □2□201□ | 2□□□ | 11□□ | 17□□ | 0□□ | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 27□7 | 10□1 | 1□□□ | 0□0 | 0□□ | | | 0□□ | | | □□1 |
| □2□201□ | □0□□ | 12□□ | 21□□ | 0□0 | □□□ | | | 0□□ | | | □□1 |
| □2□201□ | □1□0 | 1□□□ | 2□7 | 0□0 | □7 | | | 2□2 | | | □□1 |
| □27□201□ | 2□□□ | 1□7 | 2□□□ | 0□0 | □□□ | | | 1□□ | | | □□1 |
| □2□201□ | 2□0 | 1□1 | 1□1 | 0□0 | 1□1 | | | 0□0 | | | □□1 |
| □2□201□ | 2□□□ | 1□□□ | 1□□□ | 0□0 | 0□□ | | | 0□□ | | | □□1 |
| □□0□201□ | 2□□□ | □□□ | 17□□ | 0□□ | 0 | | | 0□0 | | | □□1 |
| 7□1□201□ | 2□2 | 12□□ | 1□□□ | 0□0 | 0□□ | | | 0□□ | | | □□1 |
| 7□2□201□ | 2□□□ | 10□□ | 1□2 | 0□0 | 0□2 | | | 0□0 | | | □□1 |
| 7□□201□ | 2□7 | 10□□ | 1□0 | 0□0 | 0 | | | 0□□ | | | □□1 |
| 7□□201□ | 2□□□ | 11□1 | 20□□ | 0□0 | 2□□ | | | 0□0 | | | □□1 |
| 7□□201□ | 27□□ | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| 7□□201□ | □0□1 | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□□ | | | □□1 |
| 7□7□201□ | 2□7 | 20□□ | 2□1 | 0□0 | 7□1 | | | 0□2 | | | □□1 |
| 7□□201□ | 2□□□ | 20□□ | 2□□□ | 0□0 | □□□ | | | 1□□ | | | □□1 |
| 7□□201□ | 2□□□ | 1□□□ | 2□0 | 0□0 | □ | | | 0□0 | | | □□1 |
| 7□10□201□ | 27□□ | 1□7 | 21□□ | 0□0 | □□□ | | | 0□□ | | | □□1 |
| 7□11□201□ | 2□7 | 1□2 | 22□0 | 0□0 | □ | | | 0□0 | | | □□1 |
| 7□12□201□ | □2□2 | 1□1 | 2□2 | 0□0 | 7□2 | | | 0□2 | | | □□1 |
| 7□1□201□ | □0□□ | 22□0 | 2□2 | 0□0 | □2 | | | 0□0 | | | □□1 |
| 7□1□201□ | 27□□ | 20□1 | 2□□□ | 0□0 | □□□ | | | 0□□ | | | □□1 |
| 7□1□201□ | 27□□ | 1□2 | 21□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| 7□1□201□ | 2□□□ | 1□□□ | 1□□□ | 0□0 | 0□□ | | | 0□□ | | | □□1 |
| 7□17□201□ | 27□□ | 1□2 | 20□□ | 0□0 | 2□□ | | | 0□0 | | | □□1 |
| 7□1□201□ | □1□□ | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□2 | | | □□1 |
| 7□1□201□ | 27□□ | 11□□ | 1□□□ | 0□0 | 1□□ | | | 0□2 | | | □□1 |
| 7□20□201□ | 27□0 | 10□1 | 1□□□ | 0□0 | 0□□ | | | 0□2 | | | □□1 |
| 7□21□201□ | 2□□□ | 1□2 | 22□0 | 0□0 | □ | | | 0□0 | | | □□1 |
| 7□22□201□ | □2□7 | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| 7□2□201□ | □□□□ | 1□□□ | 2□0 | 0□0 | 7 | | | 0□2 | | | □□1 |
| 7□2□201□ | □0□2 | 17□2 | 2□7 | 0□0 | □7 | | | 0□0 | | | □□1 |
| 7□2□201□ | □0□2 | 1□0 | 2□□□ | 0□0 | □□□ | | | 27□1 | | | □□1 |
| 7□2□201□ | 27□□ | 1□□□ | 22□1 | 0□0 | □1 | | | 0□0 | | | □□1 |
| 7□27□201□ | 2□□□ | 1□7 | 2□0 | 0□0 | □ | | | 0□2 | | | □□1 |
| 7□2□201□ | 2□□□ | 1□□□ | 2□7 | 0□0 | □7 | | | 0□2 | | | □□1 |
| 7□2□201□ | 2□0 | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| 7□□0□201□ | 2□□□ | 1□7 | 2□1 | 0□0 | □1 | | | 0□0 | | | □□1 |
| 7□□1□201□ | 27□□ | 1□□□ | 2□□□ | 0□0 | □□□ | | | 2□□ | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| □1□201□ | 2□2 | 17□1 | 22□7 | 0□0 | □7 | | | 0□0 | | | □□1 |
| □2□201□ | □0□□ | 1□□□ | 22□□ | 0□0 | □□□ | | | 0□□ | | | □□1 |
| □□□201□ | □0□□ | 1□□1 | 22□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □□□201□ | □1□□ | 1□□□ | 2□□□ | 0□0 | □□□ | | | 0□2 | | | □□1 |
| □□□201□ | □0□□ | 22□□ | 2□□7 | 0□0 | □7 | | | 0□0 | | | □□1 |
| □□□201□ | 2□2 | 1□□□ | 2□□1 | 0□0 | □1 | | | 0□0 | | | □□1 |
| □7□201□ | 27□□ | 1□□7 | 20□□ | 0□0 | 2□□ | | | 0□2 | | | □□1 |
| □□□201□ | 2□0 | 1□□1 | 21□1 | 0□0 | □1 | | | 0□□ | | | □□1 |
| □□□201□ | □1□□ | 1□□0 | 22□□ | 0□0 | □□□ | | | □□□ | | | □□1 |
| □10□201□ | □1□□ | 22□□ | 27□1 | 0□0 | □1 | | | 0□□ | | | □□1 |
| □11□201□ | □2□2 | 22□□ | 27□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □12□201□ | □1□□ | 2□□□ | 2□□□ | 0□0 | 10□□ | | | 2□1 | | | □□1 |
| □1□201□ | □2□□ | 2□□1 | 2□□2 | 0□0 | 10□2 | | | □□□ | | | □□1 |
| □1□201□ | 2□1 | 1□□2 | 2□□2 | 0□0 | □2 | | | 0□0 | | | □□1 |
| □1□201□ | 27□7 | 17□2 | 22□□ | 0□0 | □□□ | | | 1□□ | | | □□1 |
| □1□201□ | 2□□□ | 1□□7 | 22□□ | 0□0 | □□□ | | | □□□ | | | □□1 |
| □17□201□ | 27□□ | 1□□□ | 21□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □1□201□ | 2□2 | 17□□ | 2□□1 | 0□0 | □1 | | | 0□0 | | | □□1 |
| □1□201□ | 2□□□ | 17□□ | 2□□□ | 0□0 | □□□ | | | 0□2 | | | □□1 |
| □20□201□ | □0□□ | 1□□7 | 2□□□ | 0□0 | 7□□ | | | 0□0 | | | □□1 |
| □21□201□ | 2□□□ | 1□□0 | 21□2 | 0□0 | □2 | | | □□□ | | | □□1 |
| □22□201□ | 2□□□ | 12□□ | 17□□ | 0□1 | 0 | | | 0□0 | | | □□1 |
| □2□201□ | 2□1 | 11□2 | 1□□7 | 0□0 | 0□7 | | | 0□0 | | | □□1 |
| □2□201□ | 2□□□ | 1□□□ | 21□7 | 0□0 | □7 | | | 0□0 | | | □□1 |
| □2□201□ | 2□1 | 21□□ | 2□□□ | 0□0 | 7□□ | | | 2□□ | | | □□1 |
| □2□201□ | 2□0 | 17□1 | 22□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □27□201□ | □0□□ | 1□□□ | 22□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □2□201□ | 2□□□ | 1□□1 | 2□□0 | 0□0 | □ | | | 0□0 | | | □□1 |
| □2□201□ | 27□7 | 1□□2 | 21□0 | 0□0 | □ | | | 0□0 | | | □□1 |
| □□0□201□ | 27□□ | 1□□□ | 20□□ | 0□0 | 2□□ | | | 0□0 | | | □□1 |
| □□1□201□ | 2□□□ | 17□□ | 22□0 | 0□0 | □ | | | 10□0 | | | □□1 |
| □1□201□ | 2□1 | 1□□□ | 1□□□ | 0□0 | 0□□ | | | 0□2 | | | □□1 |
| □2□201□ | 22□□ | 10□□ | 1□□□ | 1□□ | 0 | | | 0□0 | | | □□1 |
| □□□201□ | 2□□□ | □□□ | 1□□7 | 1□□ | 0 | | | 0□7 | | | □□1 |
| □□□201□ | 27□0 | □7 | 1□□□ | 0□0 | 0□□ | | | 0□0 | | | □□1 |
| □□□201□ | 2□□□ | 12□1 | 20□□ | 0□0 | 2□□ | | | 0□□ | | | □□1 |
| □□□201□ | 2□□□ | 1□□0 | 22□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □7□201□ | □0□□ | 21□0 | 2□□□ | 0□0 | 7□□ | | | 0□0 | | | □□1 |
| □□□201□ | 2□□□ | 21□2 | 2□□0 | 0□0 | 7 | | | 1□□ | | | □□1 |
| □□□201□ | 2□□□ | 1□□0 | 2□□□ | 0□0 | □□□ | | | 0□0 | | | □□1 |
| □10□201□ | □0□2 | 17□□ | 2□□□ | 0□0 | □□□ | | | 1□□0 | | | □□1 |
| □11□201□ | 22□□ | 11□□ | 1□□□ | 1□1 | 0 | | | 0□0 | | | □□1 |
| □12□201□ | 2□□□ | □□□ | 1□□2 | 1□□ | 0 | | | 0□□ | | | □□1 |
| □1□201□ | 2□□□ | 11□2 | 1□□□ | 0□0 | 0□□ | | | 0□0 | | | □□1 |
| □1□201□ | 22□□ | □□□ | 1□□2 | 1□□ | 0 | | | 2□1 | | | □□1 |
| □1□201□ | 21□7 | □1 | 1□□□ | 2□□ | 0 | | | 0□0 | | | □□1 |
| □1□201□ | 2□□7 | □□□ | 17□1 | 0□□ | 0 | | | 0□2 | | | □□1 |
| □17□201□ | 2□2 | 1□□2 | 21□7 | 0□0 | □7 | | | □□□ | | | □□1 |
| □1□201□ | 2□0 | 1□□□ | 21□□ | 0□0 | □□□ | | | 0□2 | | | □□1 |
| □1□201□ | 2□□□ | 1□□□ | 20□□ | 0□0 | 2□□ | | | 0□0 | | | □□1 |
| □20□201□ | 27□2 | 12□2 | 1□□7 | 0□0 | 1□7 | | | 0□0 | | | □□1 |
| □21□201□ | 27□□ | □□□ | 1□□7 | 0□0 | 0□7 | | | 0□0 | | | □□1 |
| □22□201□ | | 12□□ | | | | | | | | | □□1 |
| □2□201□ | 22□7 | 1□□□ | 1□□□ | 0□0 | 0□□ | | | 0□0 | | | □□1 |
| □2□201□ | 1□□1 | □□□ | 11□□ | □2 | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 1□□□ | □□□ | 12□□ | □7 | 0 | | | 0□2 | | | □□1 |
| □2□201□ | 1□□□ | □□□ | 1□□□ | □1 | 0 | | | □0 | | | □□1 |
| □27□201□ | 21□□ | □0 | 1□□2 | 2□□ | 0 | | | 2□7 | | | □□1 |
| □2□201□ | 2□□□ | 12□□ | 1□□□ | 0□0 | 0□□ | | | 0□0 | | | □□1 |
| □2□201□ | 1□□□ | 1□□□ | 1□□7 | □□□ | 0 | | | 11□7 | | | □□1 |
| □□0□201□ | 1□□□ | 12□7 | 1□□7 | 2□□ | 0 | | | 1□2 | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10□1□201□ | 1□□□ | 12□2 | 1□□□ | 2□1 | 0 | | | 7□□ | | | □□1 |
| 10□2□201□ | 1□□□ | 12□2 | 1□□□ | 2□□ | 0 | | | 1□□□ | | | □□1 |
| 10□□□201□ | 20□1 | 12□0 | 1□□1 | 1□□ | 0 | | | 0□□ | | | □□1 |
| 10□□□201□ | 22□□ | □□□ | 1□□2 | 1□□ | 0 | | | 0□2 | | | □□1 |
| 10□□□201□ | 22□2 | 12□□ | 17□□ | 0□□ | 0 | | | 0□0 | | | □□1 |
| 10□□□201□ | 2□□1 | 1□□1 | 1□□1 | 0□0 | 0□1 | | | 0□0 | | | □□1 |
| 10□7□201□ | 2□□□ | 10□□ | 17□2 | 0□□ | 0 | | | 0□□ | | | □□1 |
| 10□□□201□ | 1□□□ | □□□ | 12□□ | □□1 | 0 | | | 2□□ | | | □□1 |
| 10□□□201□ | 1□□□ | □□□ | 10□0 | □□0 | 0 | | | 0□0 | | | □□1 |
| 10□10□201□ | 1□□□ | 1□7 | 7□□ | 10□□ | 0 | | | 0□2 | | | □□1 |
| 10□11□201□ | 1□□□ | 1□1 | □□□ | □□1 | 0 | | | 0□0 | | | □□1 |
| 10□12□201□ | 22□□ | 11□1 | 17□0 | 1□0 | 0 | | | 0□0 | | | □□1 |
| 10□1□□201□ | 20□2 | 2□7 | 11□□ | □□□ | 0 | | | 7□2 | | | □□1 |
| 10□1□□201□ | 1□□7 | 0□0 | 7□□ | 10□□ | 0 | | | 0□□ | | | □□1 |
| 10□1□□201□ | 20□□ | □□□ | 12□0 | □□0 | 0 | | | 0□0 | | | □□1 |
| 10□1□□201□ | 22□□ | 1□□□ | 1□□□ | 0□0 | 1□□ | | | 0□□ | | | □□1 |
| 10□17□201□ | 2□□□ | 17□□ | 21□0 | 0□0 | □ | | | 1□□ | | | □□1 |
| 10□1□□201□ | 2□□0 | 12□□ | 1□□□ | 0□0 | 0□□ | | | 0□□ | | | □□1 |
| 10□1□□201□ | 20□0 | □□2 | 1□□□ | □□□ | 0 | | | 0□2 | | | □□1 |
| 10□20□201□ | 1□□□ | 10□□ | 12□□ | □□7 | 0 | | | 1□□□ | | | □□1 |
| 10□21□201□ | 11□□ | □□□ | □□0 | □□0 | 0 | | | 1□□□ | | | □□1 |
| 10□22□201□ | □□2 | □□□ | □□□ | 11□□ | 0 | | | 0□2 | | | □□1 |
| 10□2□□201□ | 1□□□ | □□□ | □□1 | □□□ | 0 | | | 0□0 | | | □□1 |
| 10□2□□201□ | 10□7 | □□□ | □□0 | 10□0 | 0 | | | 0□0 | | | □□1 |
| 10□2□□201□ | □□□ | □1□2 | □□□ | 1□□□ | 0 | | | 0□0 | | | □□1 |
| 10□2□□201□ | | □1□2 | | | | | | | | | □□1 |
| 10□27□201□ | □□□ | 0□□ | □□2 | 1□□□ | 0 | | | 1□□□ | | | □□1 |
| 10□2□□201□ | 12□0 | □1□0 | □□□ | 12□□ | 0 | | | 0□0 | | | □□1 |
| 10□2□□201□ | 1□□0 | 10□□ | 1□□2 | □□□ | 0 | | | 0□0 | | | □□1 |
| 10□□0□201□ | 10□□ | 1□7 | □□□ | 11□7 | 0 | | | 1□□ | | | □□1 |
| 10□□1□201□ | □□□ | 0□0 | □□0 | 1□□0 | 0 | | | 0□0 | | | □□1 |
| 11□1□201□ | 20□□ | 0□□ | 10□□ | 7□□ | 0 | | | 0□0 | | | □□1 |
| 11□2□201□ | 1□□0 | 12□□ | 1□□7 | 2□□ | 0 | | | 12□□ | | | □□1 |
| 11□□□201□ | 1□□7 | □□□ | 10□□ | 7□7 | 0 | | | 1□□□ | | | □□1 |
| 11□□□201□ | 11□□ | □□2 | 7□□ | 10□□ | 0 | | | 0□0 | | | □□1 |
| 11□□□201□ | 1□□□ | □□0 | 10□0 | □□0 | 0 | | | 0□0 | | | □□1 |
| 11□□□201□ | 1□□0 | 0□□ | 7□□ | 10□7 | 0 | | | 0□0 | | | □□1 |
| 11□7□201□ | 1□□□ | □1□2 | 7□7 | 10□□ | 0 | | | 0□0 | | | □□1 |
| 11□□□201□ | 1□□□ | 1□□ | □□□ | □□2 | 0 | | | 2□□ | | | □□1 |
| 11□□□201□ | 10□7 | □0□□ | □□2 | 12□□ | 0 | | | 0□2 | | | □□1 |
| 11□10□201□ | 1□□□ | □0□□ | □□□ | 11□□ | 0 | | | 0□□ | | | □□1 |
| 11□11□201□ | 12□1 | □2□□ | □□□ | 1□□1 | 0 | | | 0□0 | | | □□1 |
| 11□12□201□ | □□□ | □□□2 | 2□2 | 1□□□ | 0 | | | 0□0 | | | □□1 |
| 11□1□□201□ | 11□□ | □□□ | □□2 | □□□ | 0 | | | 0□0 | | | □□1 |
| 11□1□□201□ | 11□□ | 0□1 | □□0 | 12□0 | 0 | | | 0□0 | | | □□1 |
| 11□1□□201□ | 1□□□ | □1□□ | □□0 | 12□0 | 0 | | | 0□□ | | | □□1 |
| 11□1□□201□ | 11□□ | □0□2 | □□□ | 12□□ | 0 | | | 0□2 | | | □□1 |
| 11□17□201□ | 12□2 | □2□0 | □□1 | 12□□ | 0 | | | 0□2 | | | □□1 |
| 11□1□□201□ | 21□2 | 1□□ | 11□□ | □□□ | 0 | | | 0□0 | | | □□1 |
| 11□1□□201□ | 17□1 | 0□0 | □□□ | □□□ | 0 | | | 2□□ | | | □□1 |
| 11□20□201□ | 1□□ | □1□□ | □0□2 | 1□□2 | 0 | | | 0□□ | | | □□1 |
| 11□21□201□ | □□1 | □2□7 | 0□2 | 17□□ | 0 | | | 0□0 | | | □□1 |
| 11□22□201□ | □□□ | □□□□ | □1□1 | 1□□1 | 0 | | | 0□0 | 0 | | □□1 |
| 11□2□□201□ | 1□□ | □7□0 | □2□□ | 20□□ | 0 | | | 1□2 | 0 | | □□1 |
| 11□2□□201□ | 7□1 | 0□□ | □□□ | 1□□2 | 0 | | | □□2 | | | □□1 |
| 11□2□□201□ | 7□2 | □□□ | □□□ | 12□□ | 0 | | | 1□□ | | | □□1 |
| 11□2□□201□ | □□0 | 2□□ | □□2 | 1□□□ | 0 | | | 2□2 | | | □□1 |
| 11□27□201□ | 7□□ | □1□0 | □□□ | 1□□7 | 0 | | | 0□0 | | | □□1 |
| 11□2□□201□ | 10□1 | □□□□ | □□□ | 1□□□ | 0 | | | 0□□ | | | □□1 |
| 11□2□□201□ | 1□□7 | □□1 | □□□ | □□□ | 0 | | | □□0 | | | □□1 |
| 11□□0□201□ | 1□□0 | □□□ | □□□ | □□2 | 0 | | | □□□ | | | □□1 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12□1□201□ | □□□ | □□□ | □0 | 12□0 | 0 | | | 0□0 | | | □□1 |
| 12□2□201□ | | □7 | | | | | | | | | □□1 |
| 12□□201□ | □1 | 0□□ | □0 | 1□□0 | 0 | | | 0□2 | | | □□1 |
| 12□□201□ | □2 | 0□□ | 2□□ | 1□7 | 0 | | | 0□0 | 0 | | □□1 |
| 12□□201□ | □1 | 0□□ | 2□7 | 1□□□ | 0 | | | 2□□ | 0 | | □□1 |
| 12□□201□ | □□□ | □□□□ | 0□□ | 17□2 | 0 | | | □□□ | 0 | | □□1 |
| 12□7□201□ | □□□ | 0□□ | 2□□ | 1□□1 | 0 | | | 0□0 | | | □□1 |
| 12□□201□ | 0□□ | □2□□ | □1□2 | 1□□2 | 0 | | | 0□0 | 0 | | □□1 |
| 12□□201□ | □0□2 | □□□□ | □2□□ | 20□□ | 0 | | | 0□2 | 0 | | □□1 |
| 12□10□201□ | □0□□ | □7□0 | □□□□ | 21□□ | 0 | | | 0□0 | | | □□1 |
| 12□11□201□ | 0□□ | □□□□ | □2□2 | 20□2 | 0 | | | □□□ | | | □□1 |
| 12□12□201□ | 2□□ | □1□7 | 0□□ | 17□□ | 0 | | | □□2 | □ | | □□1 |
| 12□1□□201□ | 0□□ | □□□7 | □□□0 | 21□0 | 0 | | | 0□□ | □ | | □□1 |
| 12□1□□201□ | □□□□ | □11□2 | □7□□ | 2□□□ | 0 | | | 1□0 | □ | | □□1 |
| 12□1□□201□ | □□□7 | □1□□□ | □11□□ | 2□□□ | 0 | | | 0□0 | □ | | □□1 |
| 12□1□□201□ | □□□□ | □12□□ | □□□0 | 27□0 | 0 | | | 1□□ | □ | | □□1 |
| 12□17□201□ | 2□□ | □□□0 | □1□□ | 1□□□ | 0 | | | 11□7 | 1□ | | □□1 |
| 12□1□□201□ | 0□0 | □12□□ | □□□2 | 2□□2 | 0 | | | 1□2 | 11 | | □□1 |
| 12□1□□201□ | □□□2 | □1□□□ | □□□□ | 27□□ | 0 | | | 0□0 | 11 | | □□1 |
| 12□20□201□ | □0 | □□□□ | □0□□ | 1□□□ | 0 | | | 0□0 | 11 | | □□1 |
| 12□21□201□ | 2□1 | □2□□ | □0□2 | 1□□2 | 0 | | | 0□□ | 11 | | □□1 |
| 12□22□201□ | 2□7 | 0□2 | 1□□ | 1□□□ | 0 | | | 1□□ | 12 | | □□1 |
| 12□2□□201□ | □0 | 0□□ | 1□7 | 1□□□ | 0 | | | 0□0 | 11 | | □□1 |
| 12□2□□201□ | □2 | 1□7 | □□□ | 1□□□ | 0 | | | □□7 | 10 | | □□1 |
| 12□2□□201□ | 2□□ | □□□□ | □0□□ | 1□□□ | 0 | | | 0□0 | □ | | □□1 |
| 12□2□□201□ | 12□□ | □□□□ | □□□ | 1□□□ | 0 | | | 12□0 | □ | | □□1 |
| 12□27□201□ | 7□0 | □1□7 | 2□7 | 1□□□ | 0 | | | 0□0 | 1 | | □□1 |
| 12□2□□201□ | 0□□ | □2□□ | □1□2 | 1□□2 | 0 | | | 0□0 | 1 | | □□1 |
| 12□2□□201□ | 2□2 | □1□1 | 0□□ | 17□□ | 0 | | | □□□ | □ | | □□1 |
| 12□□0□201□ | □0□□ | □2□□ | □1□□ | 1□□□ | 0 | | | 0□2 | □ | | □□1 |
| 12□□1□201□ | □□□ | □2□□ | 0□□ | 17□1 | 0 | | | 2□□ | □ | | □□1 |

2019-05-01

Town of Pelham
20 Pelham Town Square
P.O. Box 400
Fonthill, ON L0S 1E0

**c/o Adam Keane, P.Eng., Upper Canada Consultants**

**Subject: 2018 Hydrologic Monitoring Program**

Dear Sir:

We are pleased to provide you the 2018 Hydrologic Monitoring Report for the East Fonthill Development.

The report provides background information on the physical setting, details of the work program completed, and a presentation of the monitoring data. Conclusions and recommendations for future monitoring programs are also included in the report. Relevant technical data is appended.

# INTRODUCTION

## BACKGROUND

Development activities are currently being undertaken at the proposed Village of East Fonthill Phase 1 Development. As part of the development, a storm water management pond was constructed at the northeast corner of the development area to manage storm water runoff. Pond construction occurred in 2015 and was fully constructed by October 2015. The pond has three inlets and one outlet, which discharges to the Twelve Mile Creek watershed. The storm water management pond is located on the southwest corner of Regional Road 20 and Rice Road, in the Town of Pelham, in the Regional Municipality of Niagara, as shown on Figure 1.

As part of the development, hydrologic monitoring of the storm water management pond is required. WSP Canada Limited (WSP) was retained to complete the hydrologic monitoring program, including the field investigation and reporting.

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## OBJECTIVE AND SCOPE

The objective of the hydrologic monitoring program for the Village of East Fonthill Development is to evaluate if the storm water management pond is functioning as designed to ensure no significant adverse impacts upon the receiving watercourse.

The monitoring program included a data collection component, and an analysis and interpretation component. This report provides the results of the hydrologic monitoring program activities that occurred over the period of the 2018 calendar year.

## PHYSICAL SETTING

### GEOLOGY AND HYDROGEOLOGY

The site is located to the northeast of the Fonthill Kame Complex within the Haldimand Clay Plain physiographic region (Chapman and Putnam, 1984). The fine-grained glaciolacustrine overburden in the area, deposited by pro glacial Lake Warren, varies in thickness between 23 and 35 metres.

Local overburden thickness is mapped as approximately 21 m east of the site (near Highway 406) to 38 m west of the site (near Station Road) (Vos, 1969). The bedrock contact is located at approximately 160 mASL east of the site (near Highway 406) to 145 mASL west of the site (near Station Road) (Feenstra, 1981b). The underlying bedrock is a succession of Palaeozoic beds that dip slightly southward, toward Lake Erie.

Typical quaternary geology of the area (Fenco MacLaren, 1995) includes the following units:

**Table 1 Quaternary Geology**

| GEOLOGIC UNIT | DESCRIPTION |
|---|---|
| **QUATERNARY DEPOSITS** | **Upper Glaciolacustrine Unit**<br>The surficial overburden in the area is mapped as an upper glaciolacustrine unit that is composed of a brown, reddish, and grey silty clay to clayey silt that is massive to thinly-stratified. This unit may be present from ground surface to approximately 10 metres below ground surface. |
| | **Halton Till**<br>Underlying the upper glaciolacustrine unit is the Halton Till, a brown to grey, massive to laminated clayey silt with a sand content of less than 20 percent. The till is approximately 10 metres thick. |
| | **Lower Glaciolacustrine Unit**<br>Beneath the Halton Till is a lower glaciolacustrine unit of silty clay that is approximately 10 metres thick. |
| | **Lower Till Unit**<br>The Lower Till unit consists of sandy silt with lenses of silt, sand, and gravel. The Lower Till unit is approximately 5 metres thick. |
| **BEDROCK** | **Salina Formation**<br>The bedrock consists of inter-bedded dolostones and shales of the Salina Formation. |

The upper glaciolacustrine unit, the Halton Till, and the lower glaciolacustrine unit are reportedly fairly uniform and predictable. The sand and gravel lenses within the lower till unit are considered non-uniform and unpredictable since they are laterally variable and discontinuous.

Generally, hydraulic conductivity in overburden soils is low due to the fine-grained nature of the material. Local topography (including existing ditches and swales) and seasonal precipitation strongly influence groundwater flow through fractures in the shallow, weathered overburden.

### STORMWATER MANAGEMENT POND

The pond is located on the Rice Road Tributary within the Twelve Mile Creek watershed. The pond has three inlet structures that collect runoff from roadside ditches along the east and west sides of Rice Road (south of Regional Road 20), and from manholes along the south side of Regional Road 20 (west of Rice Road). The pond discharges north through an existing 1.25 m diameter concrete culvert beneath Regional Road 20 into the Rice Road Tributary. On the north side of Regional Road 20, the Rice Road Tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north side of Regional Road 20. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary. The Rice Road Tributary flows north to Twelve Mile Creek, ultimately to Lake Ontario.

## MONITORING PROGRAM

The hydrologic monitoring program for the Village of East Fonthill Development includes surface water quality monitoring and surface water flow and temperature monitoring.

The monitoring program will consist of two phases:

- Construction Monitoring – monitoring for the duration of the Village of East Fonthill Development construction activities to determine the hydrologic conditions during construction; and,
- Post-Construction Monitoring – monitoring for two full years once the Village of East Fonthill Development construction activities are completed to determine if the proposed storm water management strategy is functioning as designed.

This report presents the results of the construction monitoring phase, completed during 2018.

Five surface water monitoring stations were established for the monitoring program, as shown on Figure 1 and described below. As noted above, the north storm water management pond was fully constructed by October 2015. The locations of the stations included below.

- SW1 – Inlet to pond, northwest corner of pond
- SW2 – Inlet to pond, northeast corner of pond
- SW3 – Inlet to pond, east side of pond
- SW4 – Outlet from pond to box culvert beneath Regional Road 20 to the Rice Road Tributary
- SW5 – Downstream in the Rice Road Tributary, approximately 40 metres north of Regional Road 20

The monitoring program is summarized in Appendix A and discussed in the following sections.

Electronic flow and temperature monitoring in the pond was initiated in spring 2015. Pond construction activities, however, were not completed until October 2015. Additionally, in 2016 the pond was not operating at full capacity due to the time required for the pond to fill. Therefore, it is interpreted that the monitoring data in 2015 and 2016 may not capture the pond operating as it is intended.

## SURFACE WATER QUALITY

The surface water quality monitoring program includes five sampling events throughout the year at stations SW1, SW2, SW3 and SW4. The events are undertaken to correspond with specific weather conditions that include the spring freshet (i.e., snow melt runoff) (approximately March/April), twice during dry periods (April/May and September/October), and twice during storm events (preferably >25 mm of precipitation) (May/June and October/November). The surface water monitoring protocols are presented in Table 3.

The surface water samples are analysed for the following water quality parameters:

- Total Suspended Solids (laboratory)
- pH, conductivity, temperature and dissolved oxygen (field measurement only)

**Table 2 Monitoring Protocols and Procedures**

| SURFACE WATER SAMPLING |
| --- |
| Attempts are made to schedule surface water monitoring events to correspond with intended freshet, dry, or wet event monitoring. |
| Surface water samples at each location are collected prior to flow measurement. |
| Surface water samples are collected directly into the laboratory provided bottles that do not have preservatives. For bottles with preservatives added, standard grab sampling methods are used and then the water is decanted into laboratory provided bottles with the appropriate preservatives. The sample container is pointed upstream and care is taken to avoid particulate and organic matter in the water. |
| Sample bottles are marked, labelled, and sealed in the field. |
| Samples are stored in ice packed coolers, and delivered or couriered to the laboratory at the end of each day, under Chain of Custody procedures. |
| Field parameters (pH, conductivity, temperature and dissolved oxygen) are measured from a separate beaker of water using calibrated instruments. |
| When the flows are present, stream flow discharge is calculated based on the cross-sectional area of the stream, and the water velocity. |
| A cross-sectional profile of the stream is determined by measuring the cross sectional width and depth of the wetted stream at incremental sections. The velocity is measured using an electromagnetic velocity meter by measuring the average velocity of each section. |
| Field notes including date, weather, time, sampling data, staff, field parameters, visual observations, and number of bottles are marked on the Water Sampling Field Data sheets in the Project Field Book. |

## SURFACE WATER FLOW AND TEMPERATURE

Manual flow measurements are completed at each surface water station during each monitoring event. Manual flow measurements are done generally following the USGS area-velocity method.

Future monitoring events will include submerged electronic temperature loggers at stations SW1, SW2 and SW3 to record water temperature at 10-minute intervals on a seasonal basis (i.e., during non-freezing conditions), and submerged electronic flow monitoring equipment at stations SW4 and SW5 to measure water level, velocity and temperature at 10-minute intervals on a seasonal basis (i.e., during non-freezing conditions).

## MONITORING PROGRAM RESULTS

Collection of surface water quality samples and flow measurements was attempted five times in 2018 to coincide with the following weather events:

— Spring Freshet/Spring Melt event
— Dry events (without precipitation)
— Wet events (with precipitation)

The table below indicates the dates of the monitoring events.

**Table 3 Sampling Event Dates**

| YEAR | SPRING FRESHET | DRY EVENTS (WITHOUT PRECIPITATION) | WET EVENTS (WITH PRECIPITATION) |
|---|---|---|---|
| 2018 | 4 April | 8 May<br>18 September | 4 June<br>1 November |

### SURFACE WATER QUALITY

Surface water samples were submitted to AGAT Laboratories of Mississauga for analysis TSS. Field parameters pH, conductivity, temperature, and DO were measured at the time of sample collection.

Water quality results are presented in Table B-1. Laboratory certificates of analysis for the current reporting period are included in Appendix B. The results were compared to the Provincial Water Quality Objectives (PWQO), where available.

The 2018 water quality results met the PWQOs with the exception of dissolved oxygen at SW2 and SW4 in June.

Time-concentration graphs of parameter concentrations at the surface monitoring stations are presented in Figure B-1. During 2018, parameter concentrations generally were similar at the inlet stations (SW1, SW2 and SW3) and the outlet station (SW4).

In 2018, the TSS concentrations ranged from less than 10 mg/L to 89 mg/L. It is noted that the TSS concentration at the outlet (SW4) has decreased overall since completion of the pond construction activities.

The following table compares the average TSS concentrations at the inlets and the TSS concentrations at the outlet (SW4).

TSS at the outlet (SW4) was generally lower than at the inlets throughout 2018. With the exception of the spring freshet sampling event, the TSS concentrations at the outlet were less than 80% of that in the inlet.

**Table 4 Total Suspended Solids Concentrations**

| SAMPLING EVENT | AVERAGE CONCENTRATIONS AT INLETS (SW1, SW2, SW3) | TSS CONCENTRATION AT OUTLET (SW4) | TSS AT OUTLET VS INLETS |
|---|---|---|---|
| Freshet | 38 mg/L | 45 mg/L | 120 % |
| May | 13 mg/L | <10 mg/L | 77 % |
| June | 41 mg/L | 25 mg/L | 61 % |
| September | 15 mg/L | <10 mg/L | 67 % |
| November | 55 mg/L | 12 mg/L | 22 % |

## SURFACE WATER FLOW AND TEMPERATURE

Manual flow measurements were obtained from each surface water station at the time of the sampling events listed in Section 3.1.

Manual flow measurements are presented in Table C-1. Electronic flow measurements at SW4 and SW5 are presented on Figure C-1 and Figure C-2 respectively. Flow rates typically were highest at the pond outlet (SW4) during each event. The flow rates typically corresponded to the type of event; that is, higher flows during the freshet and storm events, and lower flows during the dry period sampling events.

As previously mentioned, pond construction activities in 2015 and the pond not operating at full capacity in 2016 have impacted the monitoring data. For example, high flow rates observed early in 2015 are likely attributed to pumping of water directly to the outlet structure to accommodate construction activities. Additionally, low flow rates observed in 2016 are possibly attributed to the pond not operating at full capacity.

Electronic and manual temperature monitoring is presented on Figure C-3. The data indicates that, in the summer months, the outlet structures are effectively cooling the temperature of the pond water prior to reaching the downstream location (SW5).

It is noted that electronic monitoring of temperature within the pond was not initiated in 2015 due to the ongoing construction of the pond. In 2016, the electronic temperature devices were lost and/or stolen from SW1, SW2 and SW3 and, therefore, only manual temperature data is available at these locations.

## CLIMATE DATA

Climate data is included in Appendix D. Table D-1 summarizes the 2018 climate data from the Environment Canada Welland-Pelham climatological station.

Normal annual precipitation for the area is approximately 997.4 mm, based on the 1981-2010 30-Year Normals calculated from Environment Canada climatological station data located in Welland (approximately six kilometres north of the study area).

A total of 894 mm of precipitation was received in 2018 in the area, based on the total precipitation measured at the Environment Canada Welland-Pelham climatological station, indicating that the volume of precipitation received in 2018 was below normal.

## 2019 MONITORING PROGRAM

The monitoring program should be continued in 2019. The monitoring program is discussed in detail in Section 2 of this report and summarized below in Table 5. The 2019 program will consist of the construction monitoring phase.

**Table 6 2019 Monitoring Program**

| SURFACE WATER STATION ID | SURFACE WATER QUALITY MONITORING* | SURFACE WATER FLOW MONITORING (INCLUDING TEMPERATURE) | |
|---|---|---|---|
| | | MANUAL** | ELECTRONIC*** |
| SW1 | ✓ | ✓ | Temperature |
| SW2 | ✓ | ✓ | Temperature |
| SW3 | ✓ | ✓ | Temperature |
| SW4 | ✓ | ✓ | Water level, velocity, temperature |
| SW5 | n/a | ✓ | Water level, velocity, temperature |

**Notes:**

* Frequency – five times per year (weather-based): spring freshet, two dry events and two storm events (preferably >25 mm of precipitation)**;** Parameters – TSS (laboratory), pH/conductivity/temperature/DO (field)

** Frequency – five times per year with sampling events

******* Frequency – continuous electronic measurement at 10-minute intervals during non-freezing conditions (approximately March to November (weather permitting))

## CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the 2018 monitoring program results presented in this report, the following conclusions are provided:

— The 2018 water quality results met the PWQOs with the exception of dissolved oxygen on one occasion.

— TSS concentration at the outlet (SW4) has decreased overall since completion of the pond construction activities and, with the exception of the spring freshet sampling event, the TSS concentrations at the outlet were less than 80% of that in the inlet.

— Flow rates were typically highest at the pond outlet (SW4) during each event. The flow rates corresponded to the type of event; that is, higher flows during the freshet and storm events, and lower flows during the dry events.

— Electronic and manual temperature monitoring indicates that, in the summer months, the outlet structures are effectively cooling the temperature of the pond water prior to reaching the downstream location (SW5).

Based on the findings of the 2018 monitoring program, the following recommendations are provided for consideration:

— The monitoring program should be continued in 2019 as outlined in Section 4 of this report.

Kind regards,

Craig Leger, M.Sc., C.E.T.
Environment Consultant

Encl. Appendix A: Work Program, Appendix B: SW Chemistry, Appendix C: SW Flows & Temperatures, Appendix D: Climate

WSP ref.: 151-02261-01 200

# APPENDIX

# A WORK PROGRAM

## 2018 MONITORING PROGRAM

| SURFACE WATER STATION ID | SURFACE WATER QUALITY MONITORING* | SURFACE WATER FLOW MONITORING (INCLUDING TEMPERATURE) | |
|---|---|---|---|
| | | MANUAL** | ELECTRONIC*** |
| SW1 | ✓ | ✓ | Temperature |
| SW2 | ✓ | ✓ | Temperature |
| SW3 | ✓ | ✓ | Temperature |
| SW4 | ✓ | ✓ | Water level, velocity, temperature |
| SW5 | n/a | ✓ | Water level, velocity, temperature |

**Notes:**

* Frequency – five times per year (weather-based): spring freshet, two dry events and two storm events (preferably >25 mm of precipitation)

Parameters – TSS (laboratory); pH/conductivity/temperature/DO (field)

** Frequency – five times per year with sampling events

******* Frequency – continuous electronic measurement at 10-minute intervals during non-freezing conditions (approximately March to November (weather permitting))

# APPENDIX

# B SURFACE WATER CHEMISTRY

**Table B-1**
**Surface Water Quality Data**
**East Fonthill Development**

| Parameter | PWQO | SW1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 | 10/21/2016 | 11/11/2016 |
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.5 | 7.6 | 8.4 | 7.9 | 7.8 | | 8.4 | 8.2 | 8.2 | 7.4 |
| Conductivity (µS/cm) | | 4570 | 1215 | 370 | 195 | 1781 | | 1869 | 1514 | 380 | 760 |
| Temperature ($^{o}$C) | | 0.8 | 11.6 | 18.0 | 16.4 | 11.4 | | 9.5 | 22.7 | 15.1 | 9.9 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 11.2 | 11.0 | 9.5 | 7.4 | 6.6 | | 7.5 | **4.5** | 9.5 | 8.7 |
| DO temperature-dependent criteria calculation* | | 7.6 | 6.2 | 5.5 | 5.7 | 6.2 | | 6.4 | 5.0 | 5.8 | 6.4 |
| Appearance | | Clear | Clear | Brown, cloudy | Clear | Brown, cloudy | Cloudy | Brown, cloudy | Clear, colourless | Slightly cloudy | Clear |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | 28 | 31 | 353 | <10 | 240 | <10 | 46 | 23 | 46 | 4 |

| Parameter | PWQO | SW2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 | 10/21/2016 | 11/11/2016 |
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.1 | 7.4 | 8.3 | 7.8 | 8.0 | 8.5 | 8.4 | 8.1 | 8.4 | 8.0 |
| Conductivity (µS/cm) | | 8960 | 1675 | 571 | 410 | 707 | 1884 | 1421 | 1526 | 160 | 600 |
| Temperature ($^{o}$C) | | 3.3 | 10.2 | 17.8 | 14.9 | 11.2 | 6.9 | 9.3 | 23.2 | 14.3 | 10.5 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 9.2 | 8.8 | 7.5 | 7.2 | 6.3 | 11.4 | 12.4 | **3.2** | 9.4 | 7.9 |
| DO temperature-dependent criteria calculation* | | 7.3 | 6.4 | 5.5 | 5.8 | 6.2 | 6.8 | 6.5 | 5.0 | 5.9 | 6.3 |
| Appearance | | Clear | Clear | slight brown, cloudy | yellowish, clear | slight cloudy | Cloudy | Light brown, cloudy | Clear, colourless | Slightly cloudy | Clear |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | <10 | <10 | 10 | 17 | 84 | <10 | 26 | <10 | 38 | 9 |

| Parameter | PWQO | SW3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 | 10/21/2016 | 11/11/2016 |
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.4 | Dry | 8.4 | Dry | 8.0 | 8.3 | 8.4 | 8.0 | 8.0 | 7.7 |
| Conductivity (µS/cm) | | 1226 | | 269 | | 649 | 1280 | 1479 | 1500 | 520 | 600 |
| Temperature ($^{o}$C) | | 0.1 | | 18.9 | | 10.8 | 5.7 | 10.2 | 23.4 | 15.1 | 8.6 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 9.8 | | 8.0 | | 7.1 | 12.2 | 12.8 | **4.5** | 6.7 | 8.1 |
| DO temperature-dependent criteria calculation* | | 7.7 | | 5.4 | | 6.3 | 6.9 | 6.4 | 5.0 | 5.8 | 6.6 |
| Appearance | | Clear | | slight brown, cloudy | | slight cloudy | Cloudy | Light brown, cloudy | Clear, colourless | Cloudy brown | Clear |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | 10 | | 158 | | 40 | <10 | 24 | <10 | 233 | 5 |

| Parameter | PWQO | SW4 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/12/2015 | 5/13/2015 | 6/9/2015 | 9/30/2015 | 10/29/2015 | 3/22/2016 | 4/26/2016 | 6/29/2016 | 10/21/2016 | 11/11/2016 |
| *Event Type* | | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 7.4 | 7.7 | 8.4 | 7.7 | 7.9 | 8.9 | 8.3 | 8.2 | 8.2 | 7.5 |
| Conductivity (µS/cm) | | 3120 | 1631 | 1626 | 376 | 859 | 1880 | 1308 | 1530 | 600 | 560 |
| Temperature ($^{o}$C) | | 0.4 | 11.9 | 17.8 | 16.2 | 11.9 | 6.7 | 8.0 | 23.8 | 16.0 | 9.7 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 11.0 | 10.4 | 8.2 | **3.4** | 8.2 | 10.8 | 12.0 | 5.2 | 7.9 | 8.4 |
| DO temperature-dependent criteria calculation* | | 7.7 | 6.2 | 5.5 | 5.7 | 6.2 | 6.8 | 6.6 | 4.9 | 5.7 | 6.4 |
| Appearance | | Clear | Clear | Cloudy brown | Clear | slightly cloudy | Cloudy | Light brown, cloudy | Clear, colourless | Slightly cloudy | Clear |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | 20 | <10 | 228 | 10 | 103 | <10 | 25 | <10 | <10 | 5 |

Notes:
- All parameters are mg/L unless otherwise indicated.
- PWQO - Provincial Water Quality Objectives (1999)
- Shading indicates parameter exceeds PWQO
* - Cold Water Biota Criteria relative to temperature:
$y = 7.7259e^{-0.019x}$, y=DO criteria x=temperature

**Table B-1**
**Surface Water Quality Data**
**East Fonthill Development**

| Parameter | PWQO | SW1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/28/2017 | 5/3/2017 | 6/6/2017 | 9/22/2017 | 12/5/2017 | 4/4/2018 | 5/8/2018 | 6/4/2018 | 9/18/2018 | 11/1/2018 |
| *Event Type* | | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.3 | 8.1 | 7.8 | 7.4 | 7.7 | 7.7 | 7.7 | 7.9 | 7.8 | 7.9 |
| Conductivity (µS/cm) | | 1610 | 980 | 890 | 490 | 283 | 1529 | 1694 | 1544 | 765 | 459 |
| Temperature ($^{o}$C) | | 10.0 | 11.9 | 17.5 | 23.8 | 8.1 | 5.1 | 15.0 | 19.4 | 24.1 | 8.1 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 11.8 | 14.8 | 8.5 | 7.9 | 10.0 | 11.1 | 9.0 | 6.8 | 7.4 | 8.9 |
| DO temperature-dependent criteria calculation* | | 6.4 | 6.2 | 5.5 | 4.9 | 6.6 | 7.0 | 5.8 | 5.3 | 4.9 | 6.6 |
| Appearance | | Slightly cloudy | Cloudy light brown | Clear | Clear | Cloudy light brown | Clear, slightly yellow | Clear | Clear, yellowish | Clear | Cloudy |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | 30 | 32 | <10 | 16 | 78 | 57 | <10 | 18 | <10 | 61 |

| Parameter | PWQO | SW2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/28/2017 | 5/3/2017 | 6/6/2017 | 9/22/2017 | 12/5/2017 | 4/4/2018 | 5/8/2018 | 6/4/2018 | 9/18/2018 | 11/1/2018 |
| *Event Type* | | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.4 | 8.2 | 8.3 | 7.6 | 7.6 | 7.4 | 7.5 | 7.7 | 7.6 | 7.9 |
| Conductivity (µS/cm) | | 1560 | 700 | 831 | 490 | 168 | 1036 | 1478 | 1618 | 983 | 618 |
| Temperature ($^{o}$C) | | 10.1 | 12.6 | 17.6 | 22.9 | 8.0 | 4.9 | 16.3 | 20.4 | 24.3 | 8.2 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 10.1 | 16.6 | 9.0 | 8.3 | 10.0 | 10.8 | 6.2 | **4.2** | 5.9 | 8.8 |
| DO temperature-dependent criteria calculation* | | 6.4 | 6.1 | 5.5 | 5.0 | 6.6 | 7.0 | 5.7 | 5.2 | 4.9 | 6.6 |
| Appearance | | Clear | Cloudy light brown | Clear | Clear | Cloudy light brown | Clear, slightly yellow | Clear | Clear, slightly yellow | Clear | Cloudy |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | 27 | 34 | <10 | <10 | 60 | 30 | 19 | 38 | <10 | 89 |

| Parameter | PWQO | SW3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/28/2017 | 5/3/2017 | 6/6/2017 | 9/22/2017 | 12/5/2017 | 4/4/2018 | 5/8/2018 | 6/4/2018 | 9/18/2018 | 11/1/2018 |
| *Event Type* | | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.4 | 8.1 | 8.3 | 7.8 | 7.2 | 7.3 | 7.6 | 7.5 | 7.6 | 7.8 |
| Conductivity (µS/cm) | | 780 | 610 | 839 | 480 | 418 | 722 | 1485 | 1612 | 1081 | 529 |
| Temperature ($^{o}$C) | | 9.1 | 11.2 | 19.6 | 21.8 | 7.0 | 4.6 | 16.2 | 20.0 | 23.8 | 8.1 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 13.4 | 15.7 | 8.6 | 8.2 | 9.0 | 11.9 | 7.6 | 5.0 | 6.1 | 8.2 |
| DO temperature-dependent criteria calculation* | | 6.5 | 6.2 | 5.3 | 5.1 | 6.8 | 7.1 | 5.7 | 5.3 | 4.9 | 6.6 |
| Appearance | | Clear | Slightly cloudy | Clear | Clear | Cloudy light brown | Clear, slightly yellow | Clear | Clear, slightly yellow | Clear | Slightly cloudy |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | <10 | 16 | <10 | 11 | 38 | 26 | <10 | 68 | 25 | 14 |

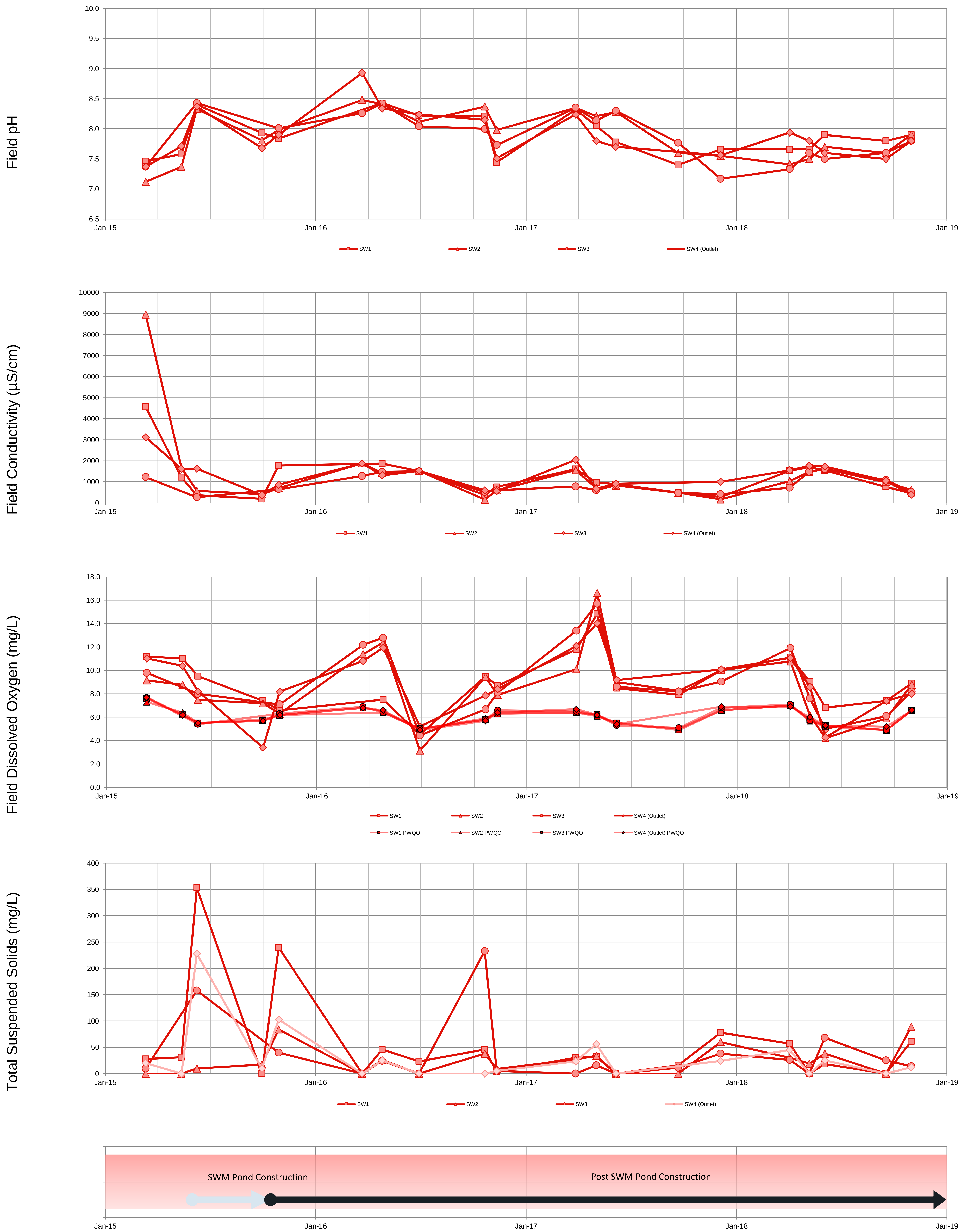
| Parameter | PWQO | SW4 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/28/2017 | 5/3/2017 | 6/6/2017 | 9/22/2017 | 12/5/2017 | 4/4/2018 | 5/8/2018 | 6/4/2018 | 9/18/2018 | 11/1/2018 |
| *Event Type* | | *Freshet* | *Wet* | *Dry* | *Wet* | *Dry* | *Freshet* | *Dry* | *Wet* | *Dry* | *Wet* |
| *Event Phase* | | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction | Construction |
| **Field Analyses** | | | | | | | | | | | |
| pH (unitless) | 6.5 - 8.5 | 8.2 | 7.8 | 7.7 | | 7.6 | 7.9 | 7.8 | 7.6 | 7.5 | 7.8 |
| Conductivity (µS/cm) | | 2050 | 680 | 908 | | 1009 | 1551 | 1770 | 1728 | 1045 | 396 |
| Temperature ($^{o}$C) | | 7.4 | 11.3 | 18.6 | | 5.6 | 5.7 | 13.5 | 19.7 | 20.7 | 8.0 |
| Dissolved Oxygen (Cold Water Biota) | >5 to >8* | 12.1 | 14.0 | 9.2 | Dry | 10.1 | 11.1 | 8.6 | **4.3** | 7.4 | 8.0 |
| DO temperature-dependent criteria calculation* | | 6.7 | 6.2 | 5.4 | | 6.9 | 6.9 | 6.0 | 5.3 | 5.2 | 6.6 |
| Appearance | | Cloudy | Slightly cloudy brown | Clear | | Cloudy light brown | Clear, slightly yellow | Clear | Clear, slightly yellow | Clear | Clear |
| **Laboratory Analyses** | | | | | | | | | | | |
| Total Suspended Solids | | 23 | 56 | <10 | | 24 | 45 | <10 | 25 | <10 | 12 |

Notes:
- All parameters are mg/L unless otherwise indicated.
- PWQO - Provincial Water Quality Objectives (1999)
- Shading indicates parameter exceeds PWQO

* - Cold Water Biota Criteria relative to temperature:

$y = 7.7259e^{-0.019x}$, y=DO criteria x=temperature

# Figure B-1 Surface Water Quality
# East Fonthill Development



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FAX (905)712-5122
http://www.agatlabs.com

**CLIENT NAME:** **WSP CANADA INC.**
**55 KING STREET, 7TH FLOOR**
**ST CATHARINES, ON L2R3H5**
**(905) 687-1771**

**ATTENTION TO:** **Craig Leger**

**PROJECT:** **151-02661-00**

**AGAT WORK ORDER:** **18T326648**

**WATER ANALYSIS REVIEWED BY:** **Parvathi Malemath, Data Reviewer**

**DATE REPORTED:** **Apr 13, 2018**

**PAGES (INCLUDING COVER):** **5**

**VERSION*:** **1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

**All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.**

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# Certificate of Analysis

**AGAT WORK ORDER: 18T326648**

**PROJECT: 151-02661-00**

**CLIENT NAME: WSP CANADA INC.**

**ATTENTION TO: Craig Leger**

**SAMPLING SITE:Fonthill East (Fonthill Sites)**

**SAMPLED BY:BC**

## TSS (Water)

**DATE RECEIVED: 2018-04-05**

**DATE REPORTED: 2018-04-13**

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 2018-04-04 | 2018-04-04 | 2018-04-04 | 2018-04-04 |
| **Parameter** | **Unit** | **G / S** | **RDL** | **9166604** | **9166605** | **9166606** | **9166607** |
| Total Suspended Solids | mg/L | | 10 | 57 | 30 | 26 | 45 |

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:




*Results relate only to the items tested and to all the items tested*

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# Quality Assurance

**CLIENT NAME: WSP CANADA INC.**

**PROJECT: 151-02661-00**

**SAMPLING SITE:Fonthill East (Fonthill Sites)**

**AGAT WORK ORDER: 18T326648**

**ATTENTION TO: Craig Leger**

**SAMPLED BY:BC**

## Water Analysis

| RPT Date: Apr 13, 2018 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| **TSS (Water)** | | | | | | | | | | | | | | | |
| Total Suspended Solids | 9167950 | | <10 | <10 | NA | < 10 | 98% | 80% | 120% | | | | | | |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the Reporting Limit (RL), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

CHARTERED Parvathi Malemath CHEMIST

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# Method Summary

**CLIENT NAME: WSP CANADA INC.**
**PROJECT: 151-02661-00**
**SAMPLING SITE:Fonthill East (Fonthill Sites)**
**AGAT WORK ORDER: 18T326648**
**ATTENTION TO: Craig Leger**
**SAMPLED BY:BC**

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| **Water Analysis** | | | |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |

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CLIENT NAME: WSP CANADA INC.
55 KING STREET, 7TH FLOOR
ST CATHARINES, ON L2R3H5
(905) 687-1771

ATTENTION TO: Craig Leger

PROJECT: 151-02661-00

AGAT WORK ORDER: 18T337487

WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: May 18, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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# Certificate of Analysis

AGAT WORK ORDER: 18T337487

PROJECT: 151-02661-00

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Craig Leger

SAMPLING SITE:Fonthill East (Fonthill Sites)

SAMPLED BY:CS/DBM

## TSS (Water)

DATE RECEIVED: 2018-05-09

DATE REPORTED: 2018-05-18

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 2018-05-08 | 2018-05-08 | 2018-05-08 | 2018-05-08 |
| Parameter | Unit | G / S | RDL | 9231640 | 9231641 | 9231642 | 9231643 |
| Total Suspended Solids | mg/L | | 10 | <10 | 19 | <10 | <10 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Iris Verástegui

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 151-02661-00
SAMPLING SITE:Fonthill East (Fonthill Sites)

AGAT WORK ORDER: 18T337487
ATTENTION TO: Craig Leger
SAMPLED BY:CS/DBM

## Water Analysis

| RPT Date: May 18, 2018 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| TSS (Water) | | | | | | | | | | | | | | | |
| Total Suspended Solids | 9234875 | | <10 | <10 | NA | < 10 | 102% | 80% | 120% | NA | | | NA | | |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Iris Verástegui

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# Method Summary

CLIENT NAME: WSP CANADA INC.
PROJECT: 151-02661-00
SAMPLING SITE:Fonthill East (Fonthill Sites)

AGAT WORK ORDER: 18T337487
ATTENTION TO: Craig Leger
SAMPLED BY:CS/DBM

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Water Analysis | | | |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |

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CLIENT NAME: WSP CANADA INC.
55 KING STREET, 7TH FLOOR
ST CATHARINES, ON L2R3H5
(905) 687-1771

ATTENTION TO: Craig Leger

PROJECT: 151-02661-00

AGAT WORK ORDER: 18T347030

WATER ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Jun 13, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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# Certificate of Analysis

AGAT WORK ORDER: 18T347030

PROJECT: 151-02661-00

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Craig Leger

SAMPLING SITE:Fonthill, ON

SAMPLED BY:CS

## TSS (Water)

DATE RECEIVED: 2018-06-05

DATE REPORTED: 2018-06-13

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 2018-06-04 | 2018-06-04 | 2018-06-04 | 2018-06-04 |
| Parameter | Unit | G / S | RDL | 9300724 | 9300725 | 9300726 | 9300727 |
| Total Suspended Solids | mg/L | | 10 | 18 | 38 | 68 | 25 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Nivine Basily

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
PROJECT: 151-02661-00
SAMPLING SITE:Fonthill, ON

AGAT WORK ORDER: 18T347030
ATTENTION TO: Craig Leger
SAMPLED BY:CS

## Water Analysis

| RPT Date: Jun 13, 2018 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| TSS (Water) | | | | | | | | | | | | | | | |
| Total Suspended Solids | 9298666 | | <10 | <10 | NA | < 10 | 98% | 80% | 120% | | | | | | |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Nivine Basily

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# Method Summary

CLIENT NAME: WSP CANADA INC.
AGAT WORK ORDER: 18T347030
PROJECT: 151-02661-00
ATTENTION TO: Craig Leger
SAMPLING SITE:Fonthill, ON
SAMPLED BY:CS

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Water Analysis | | | |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |

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CLIENT NAME: WSP CANADA INC.
55 KING STREET, 7TH FLOOR
ST CATHARINES, ON L2R3H5
(905) 687-1771

ATTENTION TO: Craig Leger

PROJECT: Fonthill East 151-02661-02

AGAT WORK ORDER: 18H387561

WATER ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Sep 26, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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# Certificate of Analysis

AGAT WORK ORDER: 18H387561

PROJECT: Fonthill East 151-02661-02

CLIENT NAME: WSP CANADA INC.

SAMPLING SITE:

ATTENTION TO: Craig Leger

SAMPLED BY:

## TSS

DATE RECEIVED: 2018-09-20

DATE REPORTED: 2018-09-26

| Parameter | Unit | G / S | RDL | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|---|---|---|
| SAMPLE DESCRIPTION: | | | | SW1 | SW2 | SW3 | SW4 |
| SAMPLE TYPE: | | | | Water | Water | Water | Water |
| DATE SAMPLED: | | | | 2018-09-18 | 2018-09-18 | 2018-09-18 | 2018-09-18 |
| | | | | 9561412 | 9561415 | 9561418 | 9561419 |
| Total Suspended Solids | mg/L | | 10 | <10 | <10 | 25 | <10 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Iris Verástegui



Results relate only to the items tested and to all the items tested

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# Quality Assurance

CLIENT NAME: WSP CANADA INC.
AGAT WORK ORDER: 18H387561
PROJECT: Fonthill East 151-02661-02
ATTENTION TO: Craig Leger
SAMPLING SITE:
SAMPLED BY:

## Water Analysis

| RPT Date: Sep 26, 2018 | | | DUPLICATE | | | Method Blank | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| TSS | | | | | | | | | | | | | | | |
| Total Suspended Solids | 9566684 | | <10 | <10 | NA | < 10 | 98% | 80% | 120% | NA | | | NA | | |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Iris Verástegui

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# Method Summary

CLIENT NAME: WSP CANADA INC.
PROJECT: Fonthill East 151-02661-02
SAMPLING SITE:
AGAT WORK ORDER: 18H387561
ATTENTION TO: Craig Leger
SAMPLED BY:

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Water Analysis | | | |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |

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CLIENT NAME: WSP CANADA INC.
55 KING STREET, 7TH FLOOR
ST CATHARINES, ON   L2R3H5
(905) 687-1771

ATTENTION TO: Leigh Davis

PROJECT: East Fonthill 151-02661-01

AGAT WORK ORDER: 18H404503

WATER ANALYSIS REVIEWED BY: Rocio Morales, Inorganics Lab Supervisor

DATE REPORTED: Nov 09, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

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*NOTES

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# Certificate of Analysis

AGAT WORK ORDER: 18H404503

PROJECT: East Fonthill 151-02661-01

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Leigh Davis

SAMPLING SITE:

SAMPLED BY:

## TSS

DATE RECEIVED: 2018-11-01

DATE REPORTED: 2018-11-09

| | | | SAMPLE DESCRIPTION: | SW1 | SW2 | SW3 | SW4 |
|---|---|---|---|---|---|---|---|
| | | | SAMPLE TYPE: | Water | Water | Water | Water |
| | | | DATE SAMPLED: | 2018-11-01 | 2018-11-01 | 2018-11-01 | 2018-11-01 |
| Parameter | Unit | G / S | RDL | 9668441 | 9668442 | 9668443 | 9668444 |
| Total Suspended Solids | mg/L | | 10 | 61 | 89 | 14 | 12 |

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

# Quality Assurance

CLIENT NAME: WSP CANADA INC.
AGAT WORK ORDER: 18H404503
PROJECT: East Fonthill 151-02661-01
ATTENTION TO: Leigh Davis
SAMPLING SITE:
SAMPLED BY:

## Water Analysis

| RPT Date: Nov 09, 2018 | | | DUPLICATE | | | | REFERENCE MATERIAL | | | METHOD BLANK SPIKE | | | MATRIX SPIKE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | Batch | Sample Id | Dup #1 | Dup #2 | RPD | Method Blank | Measured Value | Acceptable Limits | | Recovery | Acceptable Limits | | Recovery | Acceptable Limits | |
| | | | | | | | | Lower | Upper | | Lower | Upper | | Lower | Upper |
| TSS | | | | | | | | | | | | | | | |
| Total Suspended Solids | 9668441 | 9668441 | 61 | 64 | 4.8% | < 10 | 98% | 80% | 120% | NA | | | NA | | |

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

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# Method Summary

CLIENT NAME: WSP CANADA INC.
PROJECT: East Fonthill 151-02661-01
SAMPLING SITE:

AGAT WORK ORDER: 18H404503
ATTENTION TO: Leigh Davis
SAMPLED BY:

| PARAMETER | AGAT S.O.P | LITERATURE REFERENCE | ANALYTICAL TECHNIQUE |
|---|---|---|---|
| Water Analysis | | | |
| Total Suspended Solids | INOR-93-6028 | SM 2540 D | BALANCE |

# APPENDIX

# C

## SURFACE WATER FLOWS AND TEMPERATURE

# Table C-1
# Surface Water Manual Flow Measurements
# East Fonthill Development

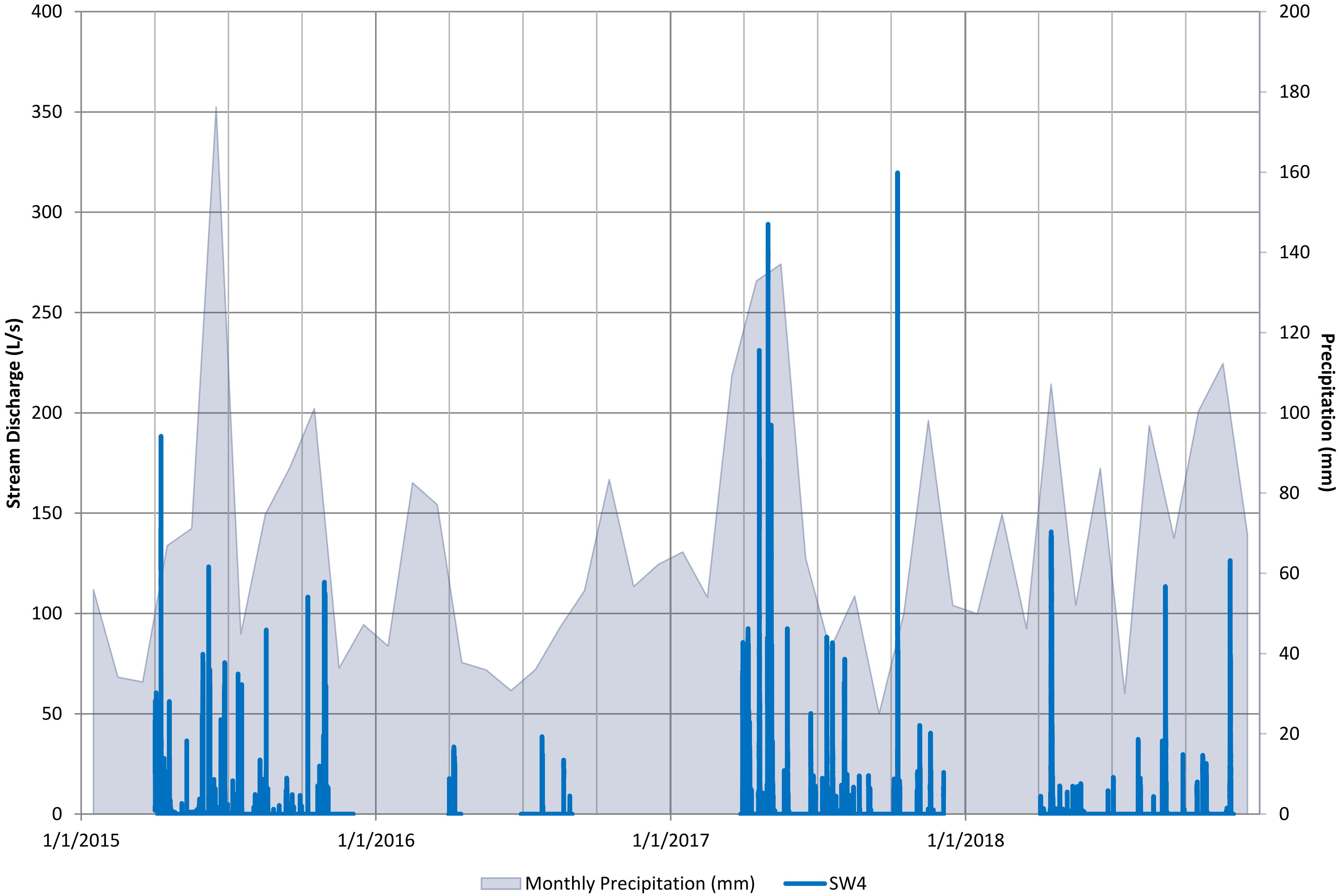
| Date (dd/mm/yyyy) | Event Type | SW1 Discharge Rate (L/sec) | SW2 Discharge Rate (L/sec) | SW3 Discharge Rate (L/sec) | SW4 Discharge Rate (L/sec) | SW5 Discharge Rate (L/sec) |
|---|---|---|---|---|---|---|
| 3/12/2015 | Freshet | 2.0 | 1.0 | 2.6 | 14.5 | 3.5 |
| 5/13/2015 | Dry | 0.02 | 0.1 | Dry | 0.2 | 0.4 |
| 6/9/2015 | Wet | 10.4 | 5.6 | 13.8 | 43.9 | 5.3 |
| 9/30/2015 | Dry | No Flow | No Flow | Dry | & | 1.5 |
| 10/29/2015 | Wet | Flooded | Flooded | 0.05 | 27.5 | 19.4 |
| 3/22/2016 | Freshet | No Flow | No Flow | No Flow | 8.9 | 4.6 |
| 4/26/2016 | Wet | No Flow | No Flow | No Flow | No Flow | 7.4 |
| 6/29/2016 | Dry | No Flow | No Flow | No Flow | No Flow | 0.2 |
| 9/1/2016 | Dry | No Flow | No Flow | No Flow | No Flow | No Flow |
| 10/21/2016 | Wet | Flooded | Flooded | Flooded | 12.8 | 19.9 |
| 3/28/2017 | Freshet | 14.3 | 1.5 | 0.7 | 24.2 | |
| 5/3/2017 | Dry | 1.9 | 0.6 | 2.8 | 5.4 | 5.7 |
| 6/6/2017 | Wet | 3.4 | 0.3 | 0.3 | 1.9 | 0.8 |
| 9/22/2017 | Dry | 0.0 | 0.0 | 0.0 | Dry | Dry |
| 12/5/2017 | Wet | 5.4 | 2.7 | 2.8 | 21.2 | 22.2 |
| 4/4/2018 | Freshet | 3.2 | 4.8 | 3.5 | 24.9 | 23.4 |
| 5/8/2018 | Dry | 0.8 | 0.8 | 0.3 | 2.9 | 0.5 |
| 6/4/2018 | Wet | 3.6 | 0.2 | 0.2 | 2.5 | 2.3 |
| 9/18/2018 | Dry | 0.2 | Dry | 0.1 | 0.2 | 0.4 |
| 11/1/2018 | Wet | 4.1 | 0.3 | 0.3 | 9.0 | 5.0 |

Notes:

Event type indicates weather conditions. Dry indicates no precipitation. Wet indicates precipitation.

& - Construction around station prevented flow measurement

# Figure C-1 - SW4 Flow Monitoring and Precipitation
# East Fonthill Development



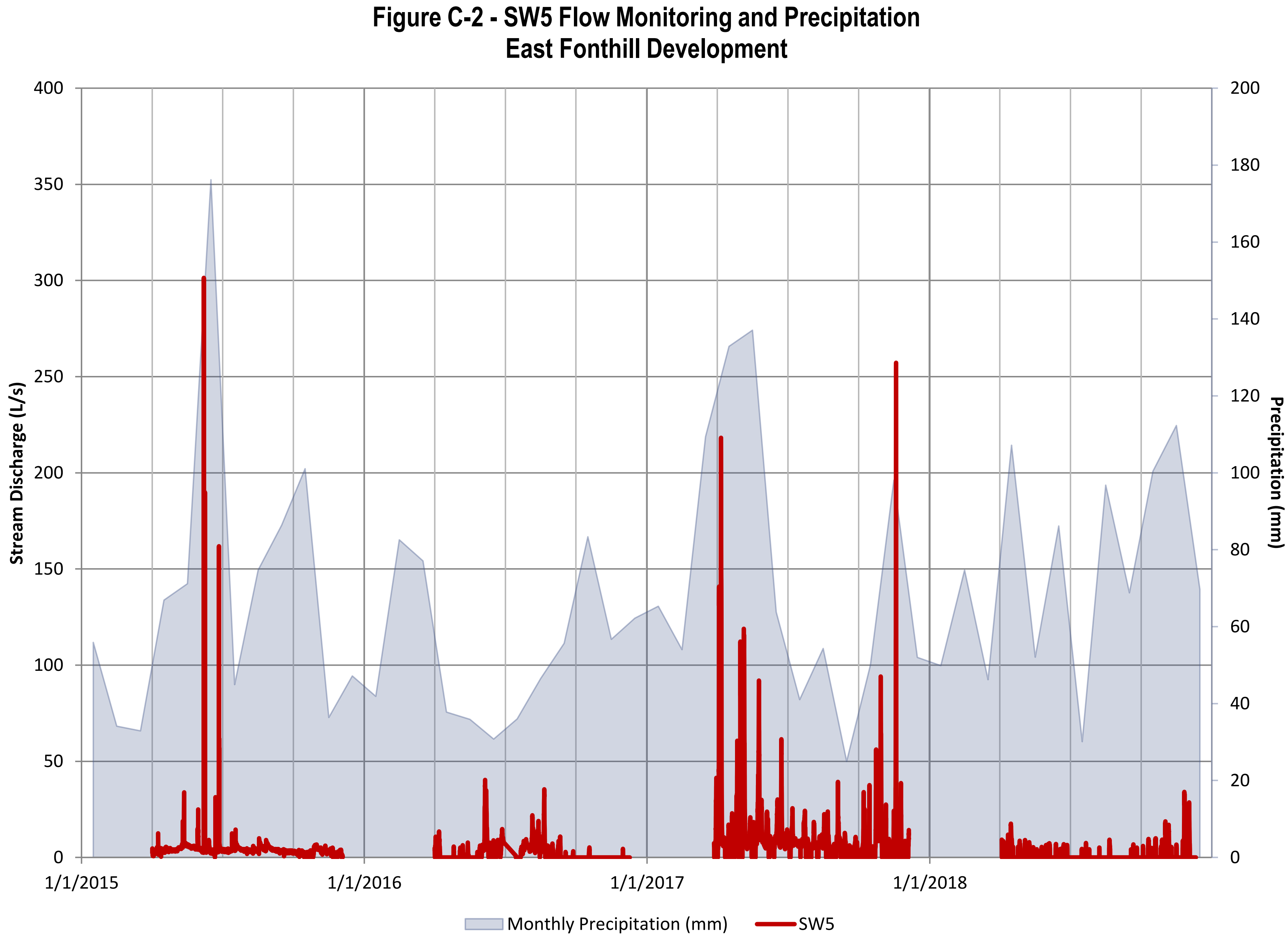


Figure C-2 - SW5 Flow Monitoring and Precipitation
East Fonthill Development
Stream Discharge (L/s)
Precipitation (mm)
400
350
300
250
200
150
100
50
0
200
180
160
140
120
100
80
60
40
20
0
1/1/2015
1/1/2016
1/1/2017
1/1/2018
Monthly Precipitation (mm)
SW5

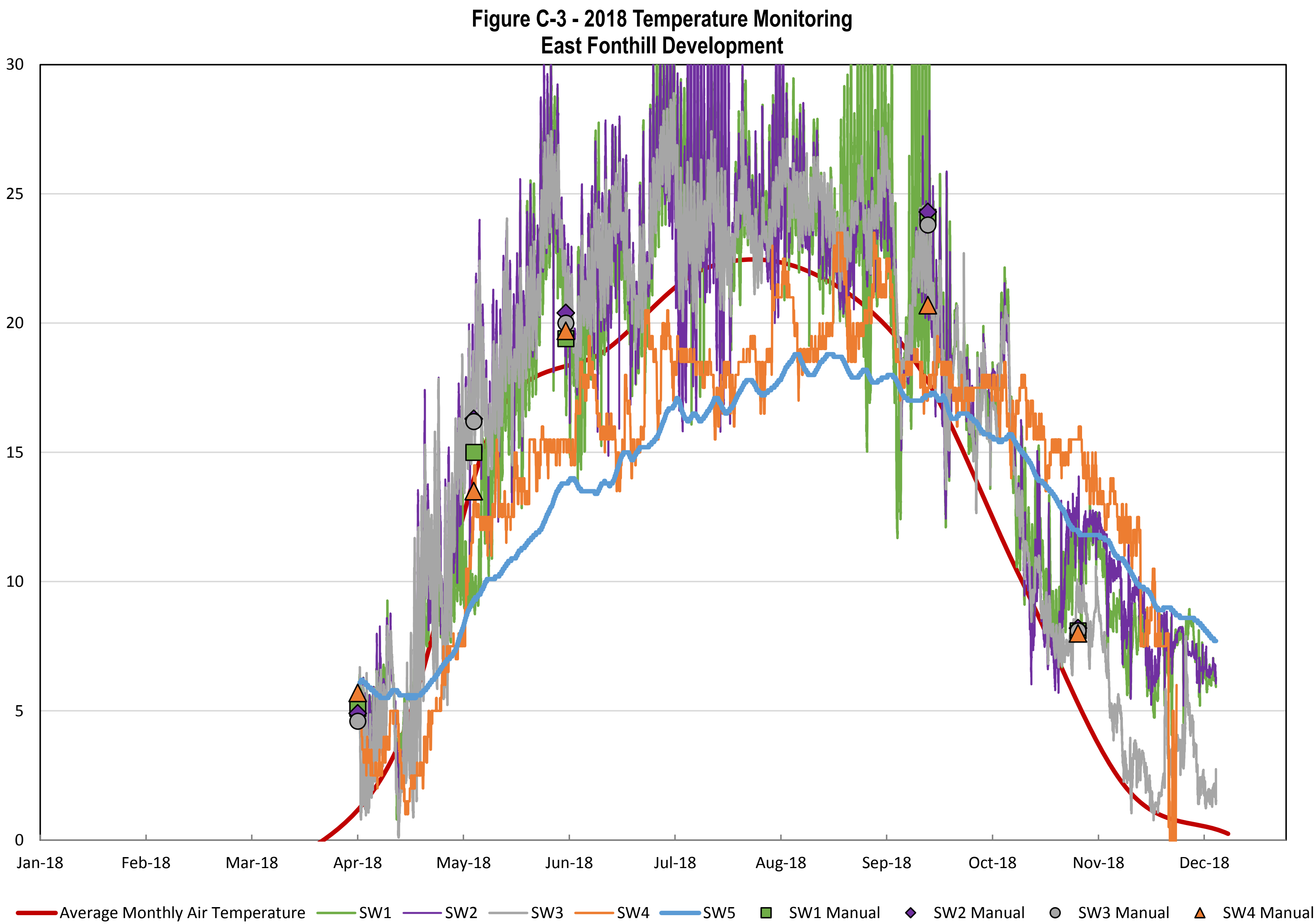


Figure C-3 - 2018 Temperature Monitoring
East Fonthill Development
30
25
20
15
10
5
0
Jan-18
Feb-18
Mar-18
Apr-18
May-18
Jun-18
Jul-18
Aug-18
Sep-18
Oct-18
Nov-18
Dec-18
Average Monthly Air Temperature
SW1
SW2
SW3
SW4
SW5
SW1 Manual
SW2 Manual
SW3 Manual
SW4 Manual

# APPENDIX

# D CLIMATE

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| | |
|---|---|
| Data Source: | Environment Canada National Climate Data and Information Archive |
| Station Name | Welland-Pelham |
| Province | Ontario |
| Latitude | 42.97 |
| Longitude | -79.33 |
| Elevation | 178 |
| Climate Identi | 139449 |
| WMO Identifie | 71752 |
| TC Identifier | TWL |

**Legend**

| | |
|---|---|
| [Empty] | No Data Available |
| M | Missing |
| E | Estimated |
| A | Accumulated |
| C | Precipitation Occurred; Amount Uncertain |
| L | Precipitation May or May Not Have Occurred |
| F | Accumulated and Estimated |
| N | Temperature Missing but Known to be > 0 |
| Y | Temperature Missing but Known to be < 0 |
| S | More Than One Occurrence |
| T | Trace |
| * | Data for this day has undergone only preliminary quality checking |
| ** | Partner data that is not subject to review by the National Climate Archives. |

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/1/2018 | -10.6 | -26.1 | -18.4 | 36.4 | 0 | | | 0 | 7 | | <31 |
| 1/2/2018 | -6.3 | -12.7 | -9.5 | 27.5 | 0 | | | 0 | 7 | | <31 |
| 1/3/2018 | -5.6 | -9.7 | -7.7 | 25.7 | 0 | | | 0.7 | 5 | | <31 |
| 1/4/2018 | -9.5 | -17.3 | -13.4 | 31.4 | 0 | | | 0.2 | 4 | | <31 |
| 1/5/2018 | -15.7 | -20.8 | -18.3 | 36.3 | 0 | | | 0 | 5 | | <31 |
| 1/6/2018 | -15.7 | -24 | -19.9 | 37.9 | 0 | | | 0 | 5 | | <31 |
| 1/7/2018 | 0.6 | -25.2 | -12.3 | 30.3 | 0 | | | 0 | 5 | | <31 |
| 1/8/2018 | 1.4 | -1 | 0.2 | 17.8 | 0 | | | 5.1 | 5 | | <31 |
| 1/9/2018 | 1 | -10.6 | -4.8 | 22.8 | 0 | | | 0 | 5 | | <31 |
| 1/10/2018 | 7.4 | -12 | -2.3 | 20.3 | 0 | | | 0.8 | 5 | | <31 |
| 1/11/2018 | 14 | 6.8 | 10.4 | 7.6 | 0 | | | 7.9 | 1 | | <31 |
| 1/12/2018 | 12.5 | -10 | 1.3 | 16.7 | 0 | | | 13.8 | 2 | | <31 |
| 1/13/2018 | -10 | -16.8 | -13.4 | 31.4 | 0 | | | 0 | 8 | | <31 |
| 1/14/2018 | -7.6 | -19.6 | -13.6 | 31.6 | 0 | | | 0 | 5 | | <31 |
| 1/15/2018 | -5.8 | -13.2 | -9.5 | 27.5 | 0 | | | 0.9 | 6 | | <31 |
| 1/16/2018 | -3.6 | -9.8 | -6.7 | 24.7 | 0 | | | 0.7 | 8 | | <31 |
| 1/17/2018 | -6.2 | -10.1 | -8.2 | 26.2 | 0 | | | 0.4 | 10 | | <31 |
| 1/18/2018 | -2.4 | -7.7 | -5.1 | 23.1 | 0 | | | 0 | 6 | | <31 |
| 1/19/2018 | 3 | -2.6 | 0.2 | 17.8 | 0 | | | 0 | 5 | | <31 |
| 1/20/2018 | 3.2 | -1.4 | 0.9 | 17.1 | 0 | | | 0 | 5 | | <31 |
| 1/21/2018 | 3.5 | -3.1 | 0.2 | 17.8 | 0 | | | 0 | 3 | | <31 |
| 1/22/2018 | 7.3 | 1.7 | 4.5 | 13.5 | 0 | | | 6.5 | 1 | | <31 |
| 1/23/2018 | 10.1 | -3.2 | 3.5 | 14.5 | 0 | | | 3.8 | 0 | | <31 |
| 1/24/2018 | -3.1 | -7.7 | -5.4 | 23.4 | 0 | | | 0 | | | <31 |
| 1/25/2018 | -2.5 | -11.1 | -6.8 | 24.8 | 0 | | | 0 | 2 | | <31 |
| 1/26/2018 | 7.2 | -5.8 | 0.7 | 17.3 | 0 | | | 0 | 2 | | <31 |
| 1/27/2018 | 8.3 | -0.7 | 3.8 | 14.2 | 0 | | | 1.4 | 1 | | <31 |
| 1/28/2018 | 6.5 | -2.8 | 1.9 | 16.1 | 0 | | | 0.2 | 1 | | <31 |
| 1/29/2018 | 0.8 | -5.3 | -2.3 | 20.3 | 0 | | | 6.1 | 2 | | <31 |
| 1/30/2018 | -5.3 | -21.6 | -13.5 | 31.5 | 0 | | | 1.4 | 15 | | <31 |
| 1/31/2018 | 2.4 | -21.3 | -9.5 | 27.5 | 0 | | | 0 | 12 | | <31 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/1/2018 | 4 | -9.3 | -2.7 | 20.7 | 0 | | | 0 | 10 | | <31 |
| 2/2/2018 | -8.4 | -12 | -10.2 | 28.2 | 0 | | | 0 | 7 | | <31 |
| 2/3/2018 | 0 | -10.2 | -5.1 | 23.1 | 0 | | | 0 | 7 | | <31 |
| 2/4/2018 | 2.5 | -8.3 | -2.9 | 20.9 | 0 | | | 8.5 | 7 | | <31 |
| 2/5/2018 | -6.4 | -12.7 | -9.6 | 27.6 | 0 | | | 0.2 | 9 | | <31 |
| 2/6/2018 | -5 | -14.6 | -9.8 | 27.8 | 0 | | | 1.5 | 10 | | <31 |
| 2/7/2018 | -4.4 | -15.4 | -9.9 | 27.9 | 0 | | | 4.9 | 10 | | <31 |
| 2/8/2018 | -7.1 | -19.1 | -13.1 | 31.1 | 0 | | | 0 | 14 | | <31 |
| 2/9/2018 | -4.8 | -9.9 | -7.4 | 25.4 | 0 | | | 6.2 | 13 | | <31 |
| 2/10/2018 | -1.6 | -5 | -3.3 | 21.3 | 0 | | | 8 | 20 | | <31 |
| 2/11/2018 | 2.4 | -3.6 | -0.6 | 18.6 | 0 | | | 3.5 | 23 | | <31 |
| 2/12/2018 | -2.4 | -14 | -8.2 | 26.2 | 0 | | | 0.2 | 18 | | <31 |
| 2/13/2018 | -1.8 | -18.4 | -10.1 | 28.1 | 0 | | | 0 | 18 | | <31 |
| 2/14/2018 | 4.5 | -4 | 0.3 | 17.7 | 0 | | | 0 | 18 | | <31 |
| 2/15/2018 | 8.1 | 1.8 | 5 | 13 | 0 | | | 1.1 | 11 | | <31 |
| 2/16/2018 | 3.7 | -7.5 | -1.9 | 19.9 | 0 | | | 0.2 | 3 | | <31 |
| 2/17/2018 | -1.5 | -7.9 | -4.7 | 22.7 | 0 | | | 0 | 3 | | <31 |
| 2/18/2018 | 1.6 | -3.3 | -0.9 | 18.9 | 0 | | | 0 | 2 | | <31 |
| 2/19/2018 | 13.8 | -0.8 | 6.5 | 11.5 | 0 | | | 16.7 | 2 | | <31 |
| 2/20/2018 | 17.9 | 8.4 | 13.2 | 4.8 | 0 | | | 7.6 | 2 | | <31 |
| 2/21/2018 | 17.9 | 0.1 | 9 | 9 | 0 | | | 4.6 | 1 | | <31 |
| 2/22/2018 | 3.7 | -1.6 | 1.1 | 16.9 | 0 | | | 0.2 | 1 | | <31 |
| 2/23/2018 | 8.7 | 0.4 | 4.6 | 13.4 | 0 | | | 5.7 | 0 | | <31 |
| 2/24/2018 | 5.4 | 1.5 | 3.5 | 14.5 | 0 | | | 0 | 0 | | <31 |
| 2/25/2018 | 11.7 | 1.5 | 6.6 | 11.4 | 0 | | | 5.4 | 1 | | <31 |
| 2/26/2018 | 6.7 | -1.3 | 2.7 | 15.3 | 0 | | | 0.2 | 0 | | <31 |
| 2/27/2018 | 10.4 | -0.4 | 5 | 13 | 0 | | | 0 | 0 | | <31 |
| 2/28/2018 | 12.6 | 0.5 | 6.6 | 11.4 | 0 | | | 0 | | | <31 |
| 3/1/2018 | 3 | -0.6 | 1.2 | 16.8 | 0 | | | 4.8 | | | <31 |
| 3/2/2018 | 0.1 | -3.1 | -1.5 | 19.5 | 0 | | | 9 | 9 | | <31 |
| 3/3/2018 | 1.9 | -7.7 | -2.9 | 20.9 | 0 | | | 0 | 6 | | <31 |
| 3/4/2018 | 1.2 | -4.2 | -1.5 | 19.5 | 0 | | | 0 | 5 | | <31 |
| 3/5/2018 | 1.4 | -9.4 | -4 | 22 | 0 | | | 0 | 4 | | <31 |
| 3/6/2018 | 1.4 | -5.4 | -2 | 20 | 0 | | | 0 | 2 | | <31 |
| 3/7/2018 | 3.4 | -4.3 | -0.5 | 18.5 | 0 | | | 0.4 | 1 | | <31 |
| 3/8/2018 | -1 | -5.9 | -3.5 | 21.5 | 0 | | | 0.2 | 0 | | <31 |
| 3/9/2018 | 1.9 | -4.1 | -1.1 | 19.1 | 0 | | | 0.2 | 0 | | <31 |
| 3/10/2018 | 1.3 | -5.6 | -2.2 | 20.2 | 0 | | | 0 | 0 | | <31 |
| 3/11/2018 | 0.8 | -7.8 | -3.5 | 21.5 | 0 | | | 0.2 | 0 | | <31 |
| 3/12/2018 | 0.3 | -3.8 | -1.8 | 19.8 | 0 | | | 0 | 0 | | <31 |
| 3/13/2018 | 1.2 | -6.5 | -2.7 | 20.7 | 0 | | | 1.6 | 0 | | <31 |
| 3/14/2018 | -0.7 | -4.7 | -2.7 | 20.7 | 0 | | | 1.3 | 6 | | <31 |
| 3/15/2018 | 2.6 | -7.2 | -2.3 | 20.3 | 0 | | | 0 | 4 | | <31 |
| 3/16/2018 | -1.2 | -6.3 | -3.8 | 21.8 | 0 | | | 0 | 1 | | <31 |
| 3/17/2018 | 4 | -5.4 | -0.7 | 18.7 | 0 | | | 0 | 1 | | <31 |
| 3/18/2018 | 6.6 | -7.3 | -0.4 | 18.4 | 0 | | | 0 | 0 | | <31 |
| 3/19/2018 | 0.3 | -5.6 | -2.7 | 20.7 | 0 | | | 0 | 0 | | <31 |
| 3/20/2018 | 2.7 | -6.2 | -1.8 | 19.8 | 0 | | | 0 | 0 | | <31 |
| 3/21/2018 | 2.5 | -3.1 | -0.3 | 18.3 | 0 | | | 0 | 1 | | <31 |
| 3/22/2018 | 5.2 | -3.5 | 0.9 | 17.1 | 0 | | | 0 | | | <31 |
| 3/23/2018 | 4.7 | -5.2 | -0.3 | 18.3 | 0 | | | 0 | 0 | | <31 |
| 3/24/2018 | 1.7 | -4.6 | -1.5 | 19.5 | 0 | | | 0 | 0 | | <31 |
| 3/25/2018 | 4.8 | -6.4 | -0.8 | 18.8 | 0 | | | 0 | 0 | | <31 |
| 3/26/2018 | 10.6 | -5.1 | 2.8 | 15.2 | 0 | | | 0 | 0 | | <31 |
| 3/27/2018 | 5.9 | 2.6 | 4.3 | 13.7 | 0 | | | 3.2 | | | <31 |
| 3/28/2018 | | 3.7 | | | | | | | 0 | | <31 |
| 3/29/2018 | 6.9 | 3.8 | 5.4 | 12.6 | 0 | | | 20.4 | | | <31 |
| 3/30/2018 | 6.4 | -2.5 | 2 | 16 | 0 | | | 0 | 0 | | <31 |
| 3/31/2018 | 9.3 | -2.5 | 3.4 | 14.6 | 0 | | | 4.9 | 0 | | <31 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/1/2018 | 2.6 | -2.1 | 0.3 | 17.7 | 0 | | | 0 | | | <31 |
| 4/2/2018 | 4.7 | -4.6 | 0.1 | 17.9 | 0 | | | 0 | | | <31 |
| 4/3/2018 | 5.6 | -2.1 | 1.8 | 16.2 | 0 | | | 9.3 | | | <31 |
| 4/4/2018 | 12.6 | -3.2 | 4.7 | 13.3 | 0 | | | 3.9 | | | <31 |
| 4/5/2018 | 1.2 | -4.6 | -1.7 | 19.7 | 0 | | | 0.3 | | | <31 |
| 4/6/2018 | 4.9 | -2.5 | 1.2 | 16.8 | 0 | | | 4.4 | 0 | | <31 |
| 4/7/2018 | 0.3 | -5 | -2.4 | 20.4 | 0 | | | 0 | 0 | | <31 |
| 4/8/2018 | 1.3 | -4.9 | -1.8 | 19.8 | 0 | | | 0 | 0 | | <31 |
| 4/9/2018 | 3.8 | -5.4 | -0.8 | 18.8 | 0 | | | 0 | 1 | | <31 |
| 4/10/2018 | 4.6 | -4 | 0.3 | 17.7 | 0 | | | 0 | | | <31 |
| 4/11/2018 | 6.7 | -2.3 | 2.2 | 15.8 | 0 | | | 0 | | | <31 |
| 4/12/2018 | 16.3 | -2.7 | 6.8 | 11.2 | 0 | | | 3.2 | | | <31 |
| 4/13/2018 | 9.1 | 3.4 | 6.3 | 11.7 | 0 | | | 0 | | | <31 |
| 4/14/2018 | 3.8 | -2.7 | 0.6 | 17.4 | 0 | | | 13.6 | | | <31 |
| 4/15/2018 | 3.1 | -2.2 | 0.5 | 17.5 | 0 | | | 29.4 | 3 | | <31 |
| 4/16/2018 | 4.1 | 0.5 | 2.3 | 15.7 | 0 | | | 26.2 | 0 | | <31 |
| 4/17/2018 | 1.2 | -1.4 | -0.1 | 18.1 | 0 | | | 0.4 | 1 | | <31 |
| 4/18/2018 | 4 | 0.5 | 2.3 | 15.7 | 0 | | | 0.2 | | | <31 |
| 4/19/2018 | 4.5 | -0.8 | 1.9 | 16.1 | 0 | | | 0 | | | <31 |
| 4/20/2018 | 7.6 | -2.5 | 2.6 | 15.4 | 0 | | | 0 | | | <31 |
| 4/21/2018 | 11.8 | -3.3 | 4.3 | 13.7 | 0 | | | 0 | | | <31 |
| 4/22/2018 | 16.6 | -3.1 | 6.8 | 11.2 | 0 | | | 0 | | | <31 |
| 4/23/2018 | 22.1 | -0.6 | 10.8 | 7.2 | 0 | | | 0 | | | <31 |
| 4/24/2018 | 17.1 | 6.3 | 11.7 | 6.3 | 0 | | | 3.8 | | | <31 |
| 4/25/2018 | 12.5 | 4 | 8.3 | 9.7 | 0 | | | 8.1 | | | <31 |
| 4/26/2018 | 10.8 | 1.5 | 6.2 | 11.8 | 0 | | | 0 | | | <31 |
| 4/27/2018 | 17.3 | 0.1 | 8.7 | 9.3 | 0 | | | 0 | | | <31 |
| 4/28/2018 | 7.8 | 1.3 | 4.6 | 13.4 | 0 | | | 4.2 | | | <31 |
| 4/29/2018 | 11.8 | 0.7 | 6.3 | 11.7 | 0 | | | 0.2 | | | <31 |
| 4/30/2018 | 14.7 | -0.9 | 6.9 | 11.1 | 0 | | | 0 | | | <31 |
| 5/1/2018 | 23.8 | 3 | 13.4 | 4.6 | 0 | | | 0 | | | <31 |
| 5/2/2018 | 24.9 | 13.1 | 19 | 0 | 1 | | | 0 | | | <31 |
| 5/3/2018 | 19.7 | 10.7 | 15.2 | 2.8 | 0 | | | 3.1 | | | <31 |
| 5/4/2018 | 23.7 | 6.6 | 15.2 | 2.8 | 0 | | | 4.5 | | | <31 |
| 5/5/2018 | 22.2 | 6.4 | 14.3 | 3.7 | 0 | | | 0 | | | <31 |
| 5/6/2018 | | 9.2 | | | | | | | | | <31 |
| 5/7/2018 | | 9.9 | | | | | | | | | <31 |
| 5/8/2018 | 23.5 | 4.8 | 14.2 | 3.8 | 0 | | | 0 | | | <31 |
| 5/9/2018 | 26.9 | 7.6 | 17.3 | 0.7 | 0 | | | 0 | | | <31 |
| 5/10/2018 | 21.1 | 6 | 13.6 | 4.4 | 0 | | | 7.8 | | 36 | 41 |
| 5/11/2018 | 11 | 2.5 | 6.8 | 11.2 | 0 | | | 0 | | | <31 |
| 5/12/2018 | 15.4 | 5.3 | 10.4 | 7.6 | 0 | | | 1.6 | | | <31 |
| 5/13/2018 | 19.4 | 4.5 | 12 | 6 | 0 | | | 0 | | | <31 |
| 5/14/2018 | 19.3 | 7.5 | 13.4 | 4.6 | 0 | | | 0 | | | <31 |
| 5/15/2018 | 19.6 | 11.2 | 15.4 | 2.6 | 0 | | | 8.4 | | 3 | 33 |
| 5/16/2018 | 23.5 | 7.7 | 15.6 | 2.4 | 0 | | | 0 | | | <31 |
| 5/17/2018 | 24.5 | 9.8 | 17.2 | 0.8 | 0 | | | 0 | | 7 | 32 |
| 5/18/2018 | 18.9 | 10 | 14.5 | 3.5 | 0 | | | 0 | | 5 | 44 |
| 5/19/2018 | 21.8 | 13 | 17.4 | 0.6 | 0 | | | 18.6 | | | <31 |
| 5/20/2018 | 20.1 | 8.7 | 14.4 | 3.6 | 0 | | | 0 | | 30 | 35 |
| 5/21/2018 | 23.2 | 5.7 | 14.4 | 3.6 | 0 | | | 0.2 | | | |
| 5/22/2018 | 20.8 | 13.8 | 17.3 | 0.7 | 0 | | | 7.7 | | | <31 |
| 5/23/2018 | 19.1 | 8.9 | 14 | 4 | 0 | | | 0 | | | <31 |
| 5/24/2018 | 25.2 | 8.2 | 16.7 | 1.3 | 0 | | | 0 | | | <31 |
| 5/25/2018 | 26.6 | 11.1 | 18.9 | 0 | 0.9 | | | 0 | | 23 | 39 |
| 5/26/2018 | 24.8 | 14 | 19.4 | 0 | 1.4 | | | 0 | | | <31 |
| 5/27/2018 | 27.1 | 15.2 | 21.2 | 0 | 3.2 | | | 0 | | | <31 |
| 5/28/2018 | 28.8 | 17.3 | 23.1 | 0 | 5.1 | | | 0 | | | <31 |
| 5/29/2018 | 29.6 | 17.1 | 23.4 | 0 | 5.4 | | | 0 | | | <31 |
| 5/30/2018 | 31.2 | 17.7 | 24.5 | 0 | 6.5 | | | 0.2 | | 14 | 32 |
| 5/31/2018 | 28.6 | 20.3 | 24.5 | 0 | 6.5 | | | 0 | | 19 | 43 |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/1/2018 | 26.8 | 17.6 | 22.2 | 0 | 4.2 | | | 0 | | | <31 |
| 6/2/2018 | 20.5 | 13.4 | 17 | 1 | 0 | | | 0 | | 4 | 32 |
| 6/3/2018 | 23.3 | 13.1 | 18.2 | 0 | 0.2 | | | 8.6 | | 16 | 35 |
| 6/4/2018 | 19.8 | 12.4 | 16.1 | 1.9 | 0 | | | 0 | | 28 | 52 |
| 6/5/2018 | 17.8 | 10.6 | 14.2 | 3.8 | 0 | | | 1.7 | | 29 | 39 |
| 6/6/2018 | 14.4 | 8.7 | 11.6 | 6.4 | 0 | | | 0 | | | <31 |
| 6/7/2018 | 22.9 | 9 | 16 | 2 | 0 | | | 0 | | | <31 |
| 6/8/2018 | 24.9 | 11 | 18 | 0 | 0 | | | 0 | | | <31 |
| 6/9/2018 | 23.2 | 11.4 | 17.3 | 0.7 | 0 | | | 0 | | | <31 |
| 6/10/2018 | 23.8 | 15.2 | 19.5 | 0 | 1.5 | | | 0 | | 8 | 35 |
| 6/11/2018 | 25 | 12.6 | 18.8 | 0 | 0.8 | | | 0 | | 1 | 37 |
| 6/12/2018 | 27.4 | 11.8 | 19.6 | 0 | 1.6 | | | 0 | | | <31 |
| 6/13/2018 | 25 | 15.6 | 20.3 | 0 | 2.3 | | | 2.4 | | 31 | 54 |
| 6/14/2018 | 26.6 | 11.3 | 19 | 0 | 1 | | | 0 | | 30 | 54 |
| 6/15/2018 | 24.4 | 9.6 | 17 | 1 | 0 | | | 0 | | | <31 |
| 6/16/2018 | 27.6 | 11.3 | 19.5 | 0 | 1.5 | | | 0 | | | <31 |
| 6/17/2018 | 29.7 | 13.8 | 21.8 | 0 | 3.8 | | | 0 | | | <31 |
| 6/18/2018 | 29.7 | 20 | 24.9 | 0 | 6.9 | | | 28 | | 23 | 33 |
| 6/19/2018 | 23.5 | 16.4 | 20 | 0 | 2 | | | 0 | | 6 | 32 |
| 6/20/2018 | 23.7 | 14.1 | 18.9 | 0 | 0.9 | | | 0 | | | <31 |
| 6/21/2018 | 23 | 12.3 | 17.7 | 0.3 | 0 | | | 0 | | | <31 |
| 6/22/2018 | 23.3 | 10.8 | 17.1 | 0.9 | 0 | | | 1.8 | | | <31 |
| 6/23/2018 | 24.2 | 16.4 | 20.3 | 0 | 2.3 | | | 7.8 | | | <31 |
| 6/24/2018 | 18.9 | 15.1 | 17 | 1 | 0 | | | 25 | | | <31 |
| 6/25/2018 | 22 | 10.6 | 16.3 | 1.7 | 0 | | | 0 | | | <31 |
| 6/26/2018 | 26.3 | 8.7 | 17.5 | 0.5 | 0 | | | 0 | | | <31 |
| 6/27/2018 | 22.4 | 18.6 | 20.5 | 0 | 2.5 | | | 8.9 | | | <31 |
| 6/28/2018 | 27.6 | 18.8 | 23.2 | 0 | 5.2 | | | 2 | | | <31 |
| 6/29/2018 | 28 | 16.4 | 22.2 | 0 | 4.2 | | | 0 | | | <31 |
| 6/30/2018 | 29.9 | 19.9 | 24.9 | 0 | 6.9 | | | 0 | | 22 | 35 |
| 7/1/2018 | 32.3 | 20.3 | 26.3 | 0 | 8.3 | | | 0.2 | | | <31 |
| 7/2/2018 | 29.9 | 22.6 | 26.3 | 0 | 8.3 | | | 0 | | 25 | 33 |
| 7/3/2018 | 31.4 | 20.2 | 25.8 | 0 | 7.8 | | | 0 | | | |
| 7/4/2018 | | | | | | | | | | | |
| 7/5/2018 | | | | | | | | | | | <31 |
| 7/6/2018 | 23.9 | 14.5 | 19.2 | 0 | 1.2 | | | 0 | | 33 | 37 |
| 7/7/2018 | 25.5 | 12 | 18.8 | 0 | 0.8 | | | 0.5 | | | <31 |
| 7/8/2018 | 27.5 | 12.1 | 19.8 | 0 | 1.8 | | | 0 | | | <31 |
| 7/9/2018 | 28.7 | 13.6 | 21.2 | 0 | 3.2 | | | 0 | | 21 | 35 |
| 7/10/2018 | 30.8 | 18.2 | 24.5 | 0 | 6.5 | | | 0.2 | | 2 | 35 |
| 7/11/2018 | 26.9 | 14.6 | 20.8 | 0 | 2.8 | | | 0 | | | <31 |
| 7/12/2018 | 28.3 | 12.8 | 20.6 | 0 | 2.6 | | | 0.2 | | | <31 |
| 7/13/2018 | 29.7 | 19.7 | 24.7 | 0 | 6.7 | | | 0 | | | <31 |
| 7/14/2018 | 28.1 | 20.5 | 24.3 | 0 | 6.3 | | | 0.3 | | | <31 |
| 7/15/2018 | 30.2 | 19.9 | 25.1 | 0 | 7.1 | | | 0 | | | <31 |
| 7/16/2018 | 31.8 | 19.1 | 25.5 | 0 | 7.5 | | | 0 | | | |
| 7/17/2018 | 28.8 | 15.6 | 22.2 | 0 | 4.2 | | | 0 | | 31 | 39 |
| 7/18/2018 | 24.9 | 15.9 | 20.4 | 0 | 2.4 | | | 0.2 | | | |
| 7/19/2018 | 27.1 | 12.6 | 19.8 | 0 | 1.8 | | | 0 | | | |
| 7/20/2018 | 31.6 | 15.1 | 23.3 | 0 | 5.3 | | | 0 | | 14 | 42 |
| 7/21/2018 | 28.9 | 15.7 | 22.3 | 0 | 4.3 | | | 2.4 | | 14 | 35 |
| 7/22/2018 | 23.2 | 15.4 | 19.3 | 0 | 1.3 | | | 24.3 | | 2 | 35 |
| 7/23/2018 | 27.7 | 19.8 | 23.7 | 0 | 5.7 | | | 0 | | | |
| 7/24/2018 | | | | | | | | | | | |
| 7/25/2018 | | | | | | | | | | | |
| 7/26/2018 | 27.4 | 16.2 | 21.8 | 0 | 3.8 | | | 0 | | 29 | 47 |
| 7/27/2018 | 25.3 | 18.4 | 21.8 | 0 | 3.8 | | | 0.3 | | 20 | 32 |
| 7/28/2018 | 23 | 13.5 | 18.3 | 0 | 0.3 | | | 0.4 | | 28 | 32 |
| 7/29/2018 | 25.4 | 12.4 | 18.9 | 0 | 0.9 | | | 1.1 | | | |
| 7/30/2018 | 25.6 | 14.9 | 20.3 | 0 | 2.3 | | | 0 | | | |
| 7/31/2018 | 27.4 | 17.3 | 22.3 | 0 | 4.3 | | | 0 | | | |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/1/2018 | 25.9 | 20.1 | 23 | 0 | 5 | | | 0 | | 20 | 43 |
| 8/2/2018 | 26.7 | 18.4 | 22.6 | 0 | 4.6 | | | 0 | | | |
| 8/3/2018 | 27.5 | 17.1 | 22.3 | 0 | 4.3 | | | 0 | | | |
| 8/4/2018 | 28.6 | 17 | 22.8 | 0 | 4.8 | | | 0 | | | |
| 8/5/2018 | 30.7 | 15.7 | 23.2 | 0 | 5.2 | | | 0 | | | |
| 8/6/2018 | 31.2 | 22.2 | 26.7 | 0 | 8.7 | | | 3.5 | | 34 | 41 |
| 8/7/2018 | 27.3 | 21 | 24.1 | 0 | 6.1 | | | 1.3 | | | |
| 8/8/2018 | 25.4 | 19.2 | 22.3 | 0 | 4.3 | | | 18.3 | | 25 | 34 |
| 8/9/2018 | 26.9 | 16 | 21.5 | 0 | 3.5 | | | 0 | | | |
| 8/10/2018 | 26.4 | 12.9 | 19.6 | 0 | 1.6 | | | 0 | | | |
| 8/11/2018 | 27.4 | 10.7 | 19.1 | 0 | 1.1 | | | 0 | | | |
| 8/12/2018 | 28.5 | 14.2 | 21.3 | 0 | 3.3 | | | 0 | | | |
| 8/13/2018 | 26.4 | 16.9 | 21.7 | 0 | 3.7 | | | 0 | | | |
| 8/14/2018 | 29.4 | 17.7 | 23.6 | 0 | 5.6 | | | 0.2 | | | |
| 8/15/2018 | 29.2 | 17.3 | 23.2 | 0 | 5.2 | | | 0 | | 24 | 31 |
| 8/16/2018 | 29 | 17.7 | 23.4 | 0 | 5.4 | | | 0.9 | | 18 | 38 |
| 8/17/2018 | 27.8 | 21.7 | 24.7 | 0 | 6.7 | | | 17 | | | |
| 8/18/2018 | 24 | 15.1 | 19.6 | 0 | 1.6 | | | 21.7 | | 4 | 33 |
| 8/19/2018 | 25.1 | 14.3 | 19.7 | 0 | 1.7 | | | 0 | | | |
| 8/20/2018 | 26.1 | 15.2 | 20.6 | 0 | 2.6 | | | 0 | | | |
| 8/21/2018 | 27.3 | 18.5 | 22.9 | 0 | 4.9 | | | 28 | | 18 | 41 |
| 8/22/2018 | 23.1 | 11.8 | 17.4 | 0.6 | 0 | | | 0 | | 34 | 38 |
| 8/23/2018 | 24.9 | 12.4 | 18.7 | 0 | 0.7 | | | 0 | | | |
| 8/24/2018 | 25.8 | 13.7 | 19.8 | 0 | 1.8 | | | 0 | | | |
| 8/25/2018 | 26.5 | 20.2 | 23.4 | 0 | 5.4 | | | 2.1 | | 20 | 36 |
| 8/26/2018 | 26.5 | 20.3 | 23.4 | 0 | 5.4 | | | 0 | | 25 | 31 |
| 8/27/2018 | 28.7 | 20.1 | 24.4 | 0 | 6.4 | | | 3.8 | | 25 | 38 |
| 8/28/2018 | 28.9 | 23.4 | 26.1 | 0 | 8.1 | | | 0 | | 22 | 48 |
| 8/29/2018 | 28.6 | 19.6 | 24.1 | 0 | 6.1 | | | 0 | | 27 | 53 |
| 8/30/2018 | 20.9 | 13.2 | 17 | 1 | 0 | | | 0 | | | |
| 8/31/2018 | 24.1 | 12.4 | 18.2 | 0 | 0.2 | | | 0 | | | |
| 9/1/2018 | 28.9 | 13.7 | 21.3 | 0 | 3.3 | | | 0 | | | |
| 9/2/2018 | 27.3 | 22.5 | 24.9 | 0 | 6.9 | | | 1.1 | | | |
| 9/3/2018 | 29.7 | 19.9 | 24.8 | 0 | 6.8 | | | 7 | | 32 | 51 |
| 9/4/2018 | 30.3 | 19.1 | 24.7 | 0 | 6.7 | | | 0 | | | |
| 9/5/2018 | 30.8 | 19.9 | 25.3 | 0 | 7.3 | | | 0 | | | |
| 9/6/2018 | 24.5 | 18.3 | 21.4 | 0 | 3.4 | | | 0 | | | |
| 9/7/2018 | 24.9 | 16.8 | 20.8 | 0 | 2.8 | | | 0 | | | |
| 9/8/2018 | 17.6 | 9.7 | 13.6 | 4.4 | 0 | | | 0 | | 4 | 37 |
| 9/9/2018 | 15.1 | 10 | 12.6 | 5.4 | 0 | | | 1.9 | | 6 | 38 |
| 9/10/2018 | 17.7 | 11.9 | 14.8 | 3.2 | 0 | | | 22.3 | | 10 | 38 |
| 9/11/2018 | 19.3 | 12.3 | 15.8 | 2.2 | 0 | | | 4.4 | | | |
| 9/12/2018 | 24.6 | 12.6 | 18.6 | 0 | 0.6 | | | 0 | | | |
| 9/13/2018 | 27.8 | 15.8 | 21.8 | 0 | 3.8 | | | 0 | | | |
| 9/14/2018 | 29.1 | 17.7 | 23.4 | 0 | 5.4 | | | 0 | | | |
| 9/15/2018 | 29.1 | 17.5 | 23.3 | 0 | 5.3 | | | 0 | | | |
| 9/16/2018 | 29.9 | 16.2 | 23 | 0 | 5 | | | 0 | | | |
| 9/17/2018 | 25.7 | 16.6 | 21.1 | 0 | 3.1 | | | 0 | | | |
| 9/18/2018 | 27.8 | 16.4 | 22.1 | 0 | 4.1 | | | 0 | | | |
| 9/19/2018 | 21.1 | 13.2 | 17.2 | 0.8 | 0 | | | 0 | | | |
| 9/20/2018 | 22.2 | 11.4 | 16.8 | 1.2 | 0 | | | 0.3 | | | |
| 9/21/2018 | 30.2 | 13.6 | 21.9 | 0 | 3.9 | | | 0.8 | | 29 | 53 |
| 9/22/2018 | 15.5 | 5.6 | 10.5 | 7.5 | 0 | | | 0.2 | | 32 | 39 |
| 9/23/2018 | 20.5 | 3.9 | 12.2 | 5.8 | 0 | | | 0 | | | |
| 9/24/2018 | 20.4 | 10.7 | 15.6 | 2.4 | 0 | | | 8.1 | | 16 | 38 |
| 9/25/2018 | 22.3 | 15.4 | 18.9 | 0 | 0.9 | | | 13.2 | | 16 | 39 |
| 9/26/2018 | 22.9 | 7.8 | 15.3 | 2.7 | 0 | | | 6.5 | | 30 | 43 |
| 9/27/2018 | 17.9 | 6.3 | 12.1 | 5.9 | 0 | | | 0 | | | |
| 9/28/2018 | 19.8 | 8.8 | 14.3 | 3.7 | 0 | | | 1 | | 31 | 41 |
| 9/29/2018 | 16.9 | 6.8 | 11.9 | 6.1 | 0 | | | 0.2 | | 27 | 35 |
| 9/30/2018 | 14.3 | 8.5 | 11.4 | 6.6 | 0 | | | 1.8 | | | |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/1/2018 | 12.6 | 10.3 | 11.5 | 6.5 | 0 | | | 3.8 | | 7 | 32 |
| 10/2/2018 | 21.4 | 10.6 | 16 | 2 | 0 | | | 19.6 | | | |
| 10/3/2018 | 22 | 11.7 | 16.8 | 1.2 | 0 | | | 0 | | 20 | 33 |
| 10/4/2018 | 23.3 | 5.5 | 14.4 | 3.6 | 0 | | | 8.5 | | 25 | 45 |
| 10/5/2018 | 14 | 6.6 | 10.3 | 7.7 | 0 | | | 0 | | | |
| 10/6/2018 | 21.9 | 10.9 | 16.4 | 1.6 | 0 | | | 22.7 | | | |
| 10/7/2018 | 17.5 | 12.2 | 14.9 | 3.1 | 0 | | | 0 | | | |
| 10/8/2018 | 25.4 | 11.9 | 18.7 | 0 | 0.7 | | | 2.7 | | | |
| 10/9/2018 | 27.8 | 18.7 | 23.2 | 0 | 5.2 | | | 0 | | 21 | 34 |
| 10/10/2018 | 27.4 | 19 | 23.2 | 0 | 5.2 | | | 0 | | 20 | 32 |
| 10/11/2018 | 22.8 | 9.4 | 16.1 | 1.9 | 0 | | | 0.2 | | 29 | 41 |
| 10/12/2018 | 10.4 | 4.9 | 7.7 | 10.3 | 0 | | | 0.8 | | 30 | 39 |
| 10/13/2018 | 10.9 | 2 | 6.4 | 11.6 | 0 | | | 0.9 | | 27 | 35 |
| 10/14/2018 | 14.9 | 2.6 | 8.7 | 9.3 | 0 | | | 0 | | | |
| 10/15/2018 | 14.4 | 3 | 8.7 | 9.3 | 0 | | | 2.5 | | 29 | 56 |
| 10/16/2018 | 12.3 | 1.2 | 6.7 | 11.3 | 0 | | | 0.2 | | 26 | 51 |
| 10/17/2018 | 11.5 | 2.4 | 7 | 11 | 0 | | | 0 | | 30 | 52 |
| 10/18/2018 | 9.6 | -1.6 | 4 | 14 | 0 | | | 0 | | 26 | 33 |
| 10/19/2018 | 13.6 | 9.1 | 11.4 | 6.6 | 0 | | | 0 | | 24 | 55 |
| 10/20/2018 | 14.1 | 4.5 | 9.3 | 8.7 | 0 | | | 5.3 | | 25 | 48 |
| 10/21/2018 | 6.2 | 1.8 | 4 | 14 | 0 | | | 0.2 | | 32 | 43 |
| 10/22/2018 | 10.7 | 0 | 5.4 | 12.6 | 0 | | | 0 | | 21 | 39 |
| 10/23/2018 | 12.1 | -1 | 5.5 | 12.5 | 0 | | | 0 | | 28 | 54 |
| 10/24/2018 | | | | | | | | | | | |
| 10/25/2018 | 7.6 | 2.5 | 5.1 | 12.9 | 0 | | | 0 | | | |
| 10/26/2018 | 9.2 | 1.1 | 5.2 | 12.8 | 0 | | | 0.5 | | 8 | 33 |
| 10/27/2018 | 6.7 | 2.5 | 4.6 | 13.4 | 0 | | | 15.6 | | 7 | 38 |
| 10/28/2018 | 6.2 | 2 | 4.1 | 13.9 | 0 | | | 3.2 | | | |
| 10/29/2018 | 8.9 | -0.1 | 4.4 | 13.6 | 0 | | | 2.4 | | 28 | 41 |
| 10/30/2018 | 11.6 | -1.5 | 5.1 | 12.9 | 0 | | | 1.4 | | | |
| 10/31/2018 | 14.2 | 7.3 | 10.8 | 7.2 | 0 | | | 9.9 | | 22 | 43 |
| 11/1/2018 | 7.9 | 6.5 | 7.2 | 10.8 | 0 | | | 46.4 | | 5 | 45 |
| 11/2/2018 | 6.9 | 3.7 | 5.3 | 12.7 | 0 | | | 3.4 | | 5 | 45 |
| 11/3/2018 | 6.8 | 3 | 4.9 | 13.1 | 0 | | | 1.3 | | 29 | 40 |
| 11/4/2018 | 10.1 | -1.3 | 4.4 | 13.6 | 0 | | | 0.4 | | | |
| 11/5/2018 | 12.6 | 7 | 9.8 | 8.2 | 0 | | | 1.3 | | 19 | 34 |
| 11/6/2018 | 14.7 | 9.2 | 12 | 6 | 0 | | | 6.6 | | 27 | 65 |
| 11/7/2018 | 9.6 | 3.9 | 6.7 | 11.3 | 0 | | | 0 | | 24 | 51 |
| 11/8/2018 | 6.9 | -0.8 | 3 | 15 | 0 | | | 0.2 | | 31 | 33 |
| 11/9/2018 | 6.1 | -1.3 | 2.4 | 15.6 | 0 | | | 7.9 | | 28 | 48 |
| 11/10/2018 | 1.6 | -2.7 | -0.5 | 18.5 | 0 | | | 0 | | 27 | 57 |
| 11/11/2018 | 4.2 | -3.6 | 0.3 | 17.7 | 0 | | | 0 | | | |
| 11/12/2018 | 6.3 | -0.1 | 3.1 | 14.9 | 0 | | | 0 | | | |
| 11/13/2018 | | | | | | | | | | | |
| 11/14/2018 | 1.4 | -4.3 | -1.5 | 19.5 | 0 | | | 0 | | 28 | 36 |
| 11/15/2018 | 0.4 | -3.5 | -1.5 | 19.5 | 0 | | | 7.5 | | | |
| 11/16/2018 | 2.8 | 0.1 | 1.4 | 16.6 | 0 | | | 3 | 4 | 29 | 44 |
| 11/17/2018 | 3.2 | -0.9 | 1.1 | 16.9 | 0 | | | 0 | 0 | 29 | 36 |
| 11/18/2018 | 2.8 | -1 | 0.9 | 17.1 | 0 | | | 1 | 1 | | |
| 11/19/2018 | 4.5 | -3.9 | 0.3 | 17.7 | 0 | | | 0.2 | 0 | | |
| 11/20/2018 | 1.3 | -3 | -0.9 | 18.9 | 0 | | | 0.9 | 0 | 28 | 41 |
| 11/21/2018 | 2.1 | -9.3 | -3.6 | 21.6 | 0 | | | 1.5 | 1 | 30 | 51 |
| 11/22/2018 | -5.8 | -11.1 | -8.4 | 26.4 | 0 | | | 0 | 0 | 2 | 34 |
| 11/23/2018 | 3.8 | -5.8 | -1 | 19 | 0 | | | 0 | 1 | | |
| 11/24/2018 | 7.9 | 0.1 | 4 | 14 | 0 | | | 3.4 | 0 | 19 | 44 |
| 11/25/2018 | 8 | 2.4 | 5.2 | 12.8 | 0 | | | 0 | 0 | | |
| 11/26/2018 | 7.5 | 1.6 | 4.6 | 13.4 | 0 | | | 18.3 | | 20 | 36 |
| 11/27/2018 | 1.7 | -1.3 | 0.2 | 17.8 | 0 | | | 5.1 | 0 | 28 | 49 |
| 11/28/2018 | 2 | -1.6 | 0.2 | 17.8 | 0 | | | 3.9 | 17 | 30 | 42 |
| 11/29/2018 | 0.8 | -1.8 | -0.5 | 18.5 | 0 | | | 0 | 11 | 28 | 34 |
| 11/30/2018 | 1.1 | -0.5 | 0.3 | 17.7 | 0 | | | 0 | 9 | | |

# Table D-1
# Environment Canada Climate Data - Temperature and Precipitation
# East Fonthill Development

| Date/Time | Maximum Temperature (°C) | Minimum Temperature (°C) | Mean Temperature (°C) | Heat Degree Days (°C) | Cool Degree Days (°C) | Total Rain (mm) | Total Snow (cm) | Total Precipitation (mm) | Snow on Ground (cm) | Direction of Maximum Gust (10's deg) | Speed of Maximum Gust (km/h) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/1/2018 | 2.4 | -0.1 | 1.2 | 16.8 | 0 | | | 3.8 | 5 | | |
| 12/2/2018 | 14.1 | 2.4 | 8.2 | 9.8 | 0 | | | 4.8 | 0 | 26 | 56 |
| 12/3/2018 | 6 | -0.5 | 2.8 | 15.2 | 0 | | | 0.7 | 0 | 27 | 55 |
| 12/4/2018 | 0.3 | -6.8 | -3.3 | 21.3 | 0 | | | 0 | 0 | | |
| 12/5/2018 | 0.5 | -7.5 | -3.5 | 21.5 | 0 | | | 0 | 0 | | |
| 12/6/2018 | 1.2 | -7.2 | -3 | 21 | 0 | | | 5.7 | | 21 | 38 |
| 12/7/2018 | -3.1 | -8.9 | -6 | 24 | 0 | | | 0.4 | 5 | | |
| 12/8/2018 | -1.8 | -7 | -4.4 | 22.4 | 0 | | | 1.5 | 10 | 29 | 31 |
| 12/9/2018 | -0.3 | -10 | -5.1 | 23.1 | 0 | | | 0 | 9 | | |
| 12/10/2018 | 1.4 | -4.2 | -1.4 | 19.4 | 0 | | | 0 | 8 | | |
| 12/11/2018 | -0.1 | -2.2 | -1.1 | 19.1 | 0 | | | 0 | 7 | 24 | 33 |
| 12/12/2018 | 1.6 | -8.6 | -3.5 | 21.5 | 0 | | | 0 | 6 | | |
| 12/13/2018 | 5.3 | -0.6 | 2.4 | 15.6 | 0 | | | 1.2 | 6 | | |
| 12/14/2018 | 6.5 | 0 | 3.3 | 14.7 | 0 | | | 0 | 2 | | |
| 12/15/2018 | 3.7 | -0.2 | 1.8 | 16.2 | 0 | | | 0 | 1 | | |
| 12/16/2018 | 4.7 | 1.1 | 2.9 | 15.1 | 0 | | | 0 | 1 | 25 | 38 |
| 12/17/2018 | 3.3 | -0.6 | 1.3 | 16.7 | 0 | | | 0 | 0 | 31 | 46 |
| 12/18/2018 | -0.3 | -6.1 | -3.2 | 21.2 | 0 | | | 0.2 | | 31 | 38 |
| 12/19/2018 | 5.1 | -5.3 | -0.1 | 18.1 | 0 | | | 0 | | 18 | 31 |
| 12/20/2018 | 6.8 | -2.1 | 2.3 | 15.7 | 0 | | | 13.1 | | 5 | 36 |
| 12/21/2018 | 5.3 | 0.2 | 2.8 | 15.2 | 0 | | | 10.8 | 0 | 31 | 41 |
| 12/22/2018 | 0.3 | -1.2 | -0.5 | 18.5 | 0 | | | 0 | | 29 | 44 |
| 12/23/2018 | 2.3 | -1.3 | 0.5 | 17.5 | 0 | | | 0 | | | |
| 12/24/2018 | 2.2 | -0.7 | 0.8 | 17.2 | 0 | | | 0 | | 28 | 40 |
| 12/25/2018 | 1.4 | -1.5 | -0.1 | 18.1 | 0 | | | 0 | | | |
| 12/26/2018 | 2.9 | -1.7 | 0.6 | 17.4 | 0 | | | 0 | | | |
| 12/27/2018 | 7 | -4.3 | 1.3 | 16.7 | 0 | | | 5.7 | | 19 | 43 |
| 12/28/2018 | 11.9 | 3.1 | 7.5 | 10.5 | 0 | | | 4.2 | | 25 | 48 |
| 12/29/2018 | 3.1 | -3 | 0.1 | 17.9 | 0 | | | 0.4 | | 27 | 39 |
| 12/30/2018 | 1.1 | -4.1 | -1.5 | 19.5 | 0 | | | 1 | | | |
| 12/31/2018 | 13.1 | -4.1 | 4.5 | 13.5 | 0 | | | 16.2 | 2 | 27 | 77 |

2021-03-17

For internal use

Jason Marr, P.Eng.

Town of Pelham
290 Pelham Town Square
PO Box 400
Fonthill, ON L0S 1E0

**Subject: East Fonthill Development Stormwater Management Pond Data Review**

Dear Sir:

We are pleased to provide you with a review of monitoring data collected from an outfall located near the intersection of Regional Road 20 and Rice Road in Fonthill, ON. The data was collected under two separate monitoring programs completed by WSP, Regional Road 20 Redevelopment Monitoring and East Fonthill Hydrologic Monitoring. We understand that there are concerns related to the functionality of the East Fonthill Development stormwater management pond located at the southwest corner of the Rice Road and Regional Road 20 intersection that drains from the aforementioned outfall and ultimately flows to Twelve Mile Creek.

This assessment provides background information on the work programs completed, and a presentation of the monitoring data. Detailed objectives and methodologies of the past monitoring activities are provided in Regional Road 20 Redevelopment Monitoring and East Fonthill Hydrologic Monitoring Reports which were provided under separate cover.

# INTRODUCTION

## REGIONAL ROAD 20 REDEVELOPMENT

Jagger Hims Limited (now WSP Canada Limited) was retained by the Niagara Region to complete surface water monitoring associated with the redevelopment of Regional Road 20 between Highway 406 and west of Station Street in the Town of Pelham, Ontario. The surface water monitoring activities included flow monitoring, water quality monitoring/sampling, and erosion monitoring. The program was approved by the Niagara Peninsula Conservation Authority (NPCA).

Phase 3 of the redevelopment program involved construction activities from west of Station Street to east of Rice Road and included the Rice Road Tributary. The southwestern corner of the Rice Road and Regional Road 20 intersection drains to Twelve Mile Creek through the Rice Road

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Tributary of Twelve Mile Creek. A square, closed-bottom concrete culvert (approximately 1.22 m wide) beneath Regional Road 20 drains away water from the area surrounding the intersection with Rice Road.

There were three surface water stations established on the Rice Road Tributary. From 2009 to 2015, SW1 was located at the culvert invert on the south side of Regional Road 20. Runoff collected from the properties northeast, southeast and southwest of the Rice Road intersection flows into the culvert. During construction of the aforementioned storm-water management pond in 2015, the invert at the south side was reconfigured making it inaccessible for monitoring and surface water flow that formerly joined into the box culvert beneath RR20 was redirected into the SWM Pond; as a consequence, SW1 was relocated to near the evert (north end) of the box culvert. The result is that roadside drainage that previous discharged directly to the Rice Road Tributary (by-passing SW1) was now directed to the SWM Pond and the resultant (attenuated) discharge was now captured by SW1 monitoring.

SW2 is located approximately 3 m north of the box culvert evert.

Between SW1 and SW2, the tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north side of Regional Road 20. The storm drains collect road runoff from Regional Road 20, west of the Rice Road Tributary. The roadside ditch collects water from Regional Road 20 and Hurricane Road, west of the Rice Road Tributary and east as far as Rice Road. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary.

SW3 is located approximately 40 metres north of the confluence of these inputs, in the natural channel.

Pre-construction monitoring was initiated in 2007. Phase 3 construction was completed from April to October 2012. Phase 3 post-construction monitoring began in October 2012 and was completed October 2016.

## EAST FONTHILL DEVELOPMENT

As part of the Village of East Fonthill Phase 1 Development activities, a storm water management pond was constructed at the northeast corner of the development area to manage storm water runoff. Pond construction occurred in 2015 and was fully constructed by October 2015.

WSP Canada Limited (WSP) was retained by Upper Canada Consultants and the Town of Pelham to complete the hydrologic monitoring of the storm water management pond, which included surface water flow monitoring and surface water quality monitoring.

The storm water management pond is located on the southwest corner of Regional Road 20 and Rice Road, in the Town of Pelham.

The SWM pond has three inlet structures that collect runoff from roadside ditches along the east and west sides of Rice Road (south of Regional Road 20), and from manholes along the south side of Regional Road 20 (west of Rice Road). The bottom draining SWM pond discharges north through an existing 1.22-m diameter concrete culvert beneath Regional Road 20 into the Rice Road Tributary. On the north side of Regional Road 20, the Rice Road Tributary receives surface water runoff from Regional Road 20 storm drains and from the roadside ditch located on the north side of Regional Road 20. The collected runoff then flows north into the narrowly confined, densely wooded channel of the Rice Road Tributary. The Rice Road Tributary flows north to Twelve Mile Creek, ultimately to Lake Ontario.

Five surface water monitoring stations were established for the monitoring program. As noted above, the storm water management pond was fully constructed by October 2015. The locations of the stations are described below.

- SW1 – Inlet to pond, northwest corner of pond
- SW2 – Inlet to pond, northeast corner of pond
- SW3 – Inlet to pond, east side of pond
- SW4 – Outlet from pond to box culvert beneath Regional Road 20 to the Rice Road Tributary
- SW5 – Downstream in the Rice Road Tributary, approximately 40 metres north of Regional Road 20

Stations SW1, SW2 and SW3 (not shown on the attached Figure 1) were monitored for surface water quality and surface water temperature while stations SW4 and SW5 were monitored for surface water flow, surface water quality and surface water temperature.

Pre-construction monitoring was conducted from March to May 2015. Construction of the stormwater management pond occurred from June 2015 until late September 2015. Post-construction monitoring began in October 2016 and was conducted until December 2018.

## MONITORING LOCATIONS

The following table summarizes the monitoring locations and associated data that were collated for this assessment. The monitoring locations are shown on Figure 1.

| Station ID (this assessment) | Regional Road 20 Redevelopment Station ID | East Fonthill Development Station ID | Location Description |
|---|---|---|---|
| SW1 (Effluent) | SW1 | SW4 | Outlet/effluent from south of Regional Road 20 / stormwater management pond |
| SW2 | SW2 | | 3 metres north of the box culvert |
| SW3 | SW3 | SW5 | 40 metres north (downstream) of the box culvert in the natural channel |

The SW1 location was relocated from the south end of the box culvert to the north end of the box culvert in September 2015 to accommodate the pond construction activities.

Manual and electronic flow temperature measurements were collected as part of the both monitoring programs. Submerged electronic monitoring equipment at station SW1 measured and recorded water level, velocity, and temperature at 10-minute intervals on a seasonal basis (i.e., during non-freezing conditions). The water level and temperature at the SW3 monitoring station were recorded at hourly intervals by a Levelogger located in a stilling well in the watercourse. Manual flow measurements were made during each site inspection of the monitoring stations. Flows were measured manually generally following the USGS area-velocity method.

During the manual flow measurement event, surface water samples were obtained from the stations noted above and submitted to an accredited lab for water quality analyses.

## MONITORING PROGRAM RESULTS

The following section provides a summary of the results of the surface water monitoring programs. The significant dates of construction and development phases that occurred in the vicinity of the Rice Road and Regional Road 20 intersection are as follows.

— Regional Road 20 Phase 3 Construction Activities; April 2012 to October 2012
— East Fonthill Development Stormwater Management Pond Construction; June 2015 to September 2015

For the purpose of this assessment, the monitoring results are assembled according to the aforementioned significant dates of construction and development. The data sets are organized as follows.

| Monitoring Phase | Date Range |
|---|---|
| Pre-development monitoring | Prior to April 2012 |
| Development / construction monitoring | April 2012 to September 2015 |
| Post pond-construction monitoring | October 2015 to December 2018 |

### SURFACE WATER QUALITY

Concentrations of total suspended solids (TSS) were assessed in the pond effluent (SW1) to determine if the stormwater management pond was effectively removing sediment prior to discharging. TSS concentrations from the monitoring locations are presented on Figure 2 and summarized in the table, below.

| Effluent (SW1) | Average | Maximum |
|---|---|---|
| Pre-development monitoring | 61.1 mg/L | 281 mg/L |
| Development / construction monitoring | 36.3 mg/L | 228 mg/L |
| Post pond-construction monitoring | 23.2 mg/L | 103 mg/L |

As indicated in the table above, both the average and the maximum concentrations of TSS observed in the pond effluent after pond construction were less than the respective pre-development concentrations suggesting that the pond was effectively attenuating TSS to pre-development concentrations  or better.

A TSS concentration of 506 mg/L was observed at SW2 in June 2016.  On that date, the TSS concentration in the SWM pond effluent (SW1) was <10 mg/L suggesting that the TSS concentrations observed at SW2 were the results of surface water inputs between SW1 and SW2.

### SURFACE WATER TEMPERATURE

Electronic and manual temperature measurements from the monitoring locations are presented on Figure 3. The electronic temperature measurements from the pond effluent and downstream monitoring locations are summarized on the following tables. It is noted that electronic data is not available from SW1 during 2012 due to the culvert reconstruction and from SW4 during 2016 due to equipment failures.

**Electronic Measurements**

| Effluent (SW1) | Average | Maximum |
|---|---|---|
| Pre-development monitoring | 15.4 °C | 30.9 °C |
| Development / construction monitoring | 14.2 °C | 29.0 °C |
| Post pond-construction monitoring | 14.1 °C | 24.0 °C |

**Electronic Measurements**

| Downstream (SW3) | Average | Maximum |
|---|---|---|
| Pre-development monitoring | 13.9 °C | 29.2 °C |
| Development / construction monitoring | 12.4 °C | 19.0 °C |
| Post pond-construction monitoring | 13.2 °C | 19.3 °C |

In general, the measured temperatures reflect seasonal variations as depicted on Figure 3. Due to the intermittent nature of the discharge, the electronic temperatures at SW1 often reflect ambient temperatures in the culvert. Surface water temperatures at SW3 are moderated, as the logger is located within the sump of the stilling well, below the creek bed; thus, recorded temperatures at SW3 reflect seasonal surface water temperatures moderated by the temperature in the shallow sub-surface.

As indicated in the tables above, the average and maximum electronic temperatures measured in the pond effluent and at the downstream location after the pond was constructed were lower than the pre-development monitoring temperatures suggesting that the pond is attenuating surface water temperatures to pre-development levels or better.

Additionally, the daily maximum ambient air temperatures recorded at the Environment Canada Welland-Pelham Climatological Station are presented on Figure 3.  As indicated on the figure, water temperatures in the effluent relative to the daily maximum ambient air temperature are reduced post pond-construction.

The manual temperature measurements from the pond effluent and downstream monitoring locations are presented on the following tables. It is noted that manual temperature measurements were not obtained from East Fonthill station SW5.

**Manual Measurements**

| Effluent (SW1) | Average | Maximum |
|---|---|---|
| Pre-development monitoring | 12.7 °C | 27.6 °C |
| Development / construction monitoring | 11.2 °C | 23.7 °C |
| Post pond-construction monitoring | 12.4 °C | 23.8 °C |

Consistent with the electronic measurements, the average and maximum manual temperatures measured in the pond effluent after the pond was constructed were lower than the pre-development monitoring temperatures.

**Manual Measurements**

| Downstream (SW3) | Average | Maximum |
|---|---|---|
| Pre-development monitoring | 12.4 °C | 22.9 °C |
| Development / construction monitoring | 11.5 °C | 22.4 °C |
| Post pond-construction monitoring | 14.0 °C | 23.0 °C |

While the average manual temperatures at the downstream location were greater in the post pond-construction monitoring than the pre-development monitoring, the maximum manual temperatures were similar. It is noted, however, that the database is limited for manual measurements at SW3 during the development/construction and post pond-construction monitoring periods

## SURFACE WATER DISCHARGE RATE

Flow monitoring was conducted to determine pre- and post development flow rates and to ensure that the stormwater management pond is attenuating post-development peak flows to pre-development levels. Pond effluent and downstream flow rates are provided on Figure 4 and summarized in the table below. As previously mentioned, electronic data is not available from SW1 during 2012 due to the culvert reconstruction and from SW4 during 2016 due to equipment failures.

| | Maximum | |
|---|---|---|
| Effluent (SW1) | Electronic | Manual |
| Pre-development monitoring | 553.8 L/s | 72.8 L/s |
| Development / construction monitoring | 627.8 L/s | 43.9 L/s |
| Post pond-construction monitoring | 319.5 L/s | 43.9 L/s |

As indicated in the table above, the maximum electronic flow rates measured in the pond discharge location (SW1) after the pond was constructed were lower than the pre-development monitoring flow rates suggesting that the pond is effectively attenuating post-development peak flows to pre-development levels. Similar results were measured at the downstream location (SW3), presented in the table below.

| | Maximum | |
|---|---|---|
| Downstream (SW3) | Electronic | Manual |
| Pre-development monitoring | 683.3 L/s | 83.0 L/s |
| Development / construction monitoring | 2804.2 L/s | 28.6 L/s |
| Post pond-construction monitoring | 257.2 L/s | 23.4 L/s |

# EROSION MONITORING

Licensed Ontario Land Surveyors (William A. Mascoe Surveying Limited) surveyed the creek reach annually in April from 2007 to 2016 following the snow melt/spring freshet, using Total Station survey equipment. The creek profile was surveyed at approximately one-metre intervals, including breaks in grade, lowest point, edge of creek, and top of bank. Field benchmarks were established, and the work was completed relative to the Regional Niagara UTM system for future monitoring purposes.

Figures 5.1 through 5.9, from past Regional Road 20 Redevelopment Annual Monitoring Reports, presents the year-to-year erosion/accretion from 2008 until 2016. Figure 6, from the Regional Road 20 Redevelopment 2016 Annual Monitoring Report, presents the erosion/accretion difference between 2016 and 2007 surveys, identifying areas of either erosion or accretion relative to the original 2007 survey. The differences were interpolated using the ESRI's ArcGIS using the "Topo to Raster" tool which is a technique used to create a hydrologically correct surface. The algorithm used is based on that of ANUDEM (developed by Hutchinson et al at the Australian National University). Between April 2007 and April 2016, the year-to-year erosion/accretion in the surveyed reach is generally less than 0.5 m, with small areas of greater erosion/accretion which shifted each year; year-to-year erosion/accretion as shown in Figure 5.1 to Figure 5.8. Overall erosion/accretion is shown in Figure 6, and there did not appear to be a significant change in erosion/accretion rates over the monitoring period.

## CONCLUSIONS

Based on the data presented in this assessment, the following conclusions are provided:

- For the purpose of this assessment, the monitoring results were assembled according to significant dates of construction and development in the vicinity of the Twelve Mile Creek tributary / East Fonthill Development stormwater management pond located near the intersection of Regional Road 20 and Rice Road in the Town of Pelham. The data sets are organized as follows:
  - Pre-development monitoring – Prior to April 2012
  - Development / construction monitoring – April 2012 to September 2015
  - Post pond-construction monitoring – October 2015 to December 2018
- Average and maximum total suspended solids concentrations in the effluent are lower in the post pond-construction monitoring than the pre-development monitoring.
- Average and maximum electronically and manually measured temperatures in the effluent and downstream locations are lower in the post pond-construction monitoring than the pre-development monitoring, with the exception of the average manual temperatures at the downstream location which are greater in the post pond-construction period. It was noted that the database is limited for manual measurements at the downstream location during the development/construction and post pond-construction monitoring periods
- Peak flow rates in the effluent and downstream location are lower in the post pond-construction monitoring than the pre-development monitoring.
- Erosion monitoring has indicated the erosion/accretion in the surveyed reach is generally less than 0.5 m between April 2007 and April 2016.
- The stormwater management pond located at the northeast corner of the East Fonthill Development is effectively attenuating peak TSS concentrations, temperatures, and flow rates to pre-development levels or better.

We trust that this information is sufficient for your needs. Please contact us if there are any questions or comments.

Yours sincerely,

***DRAFT*** ***DRAFT***

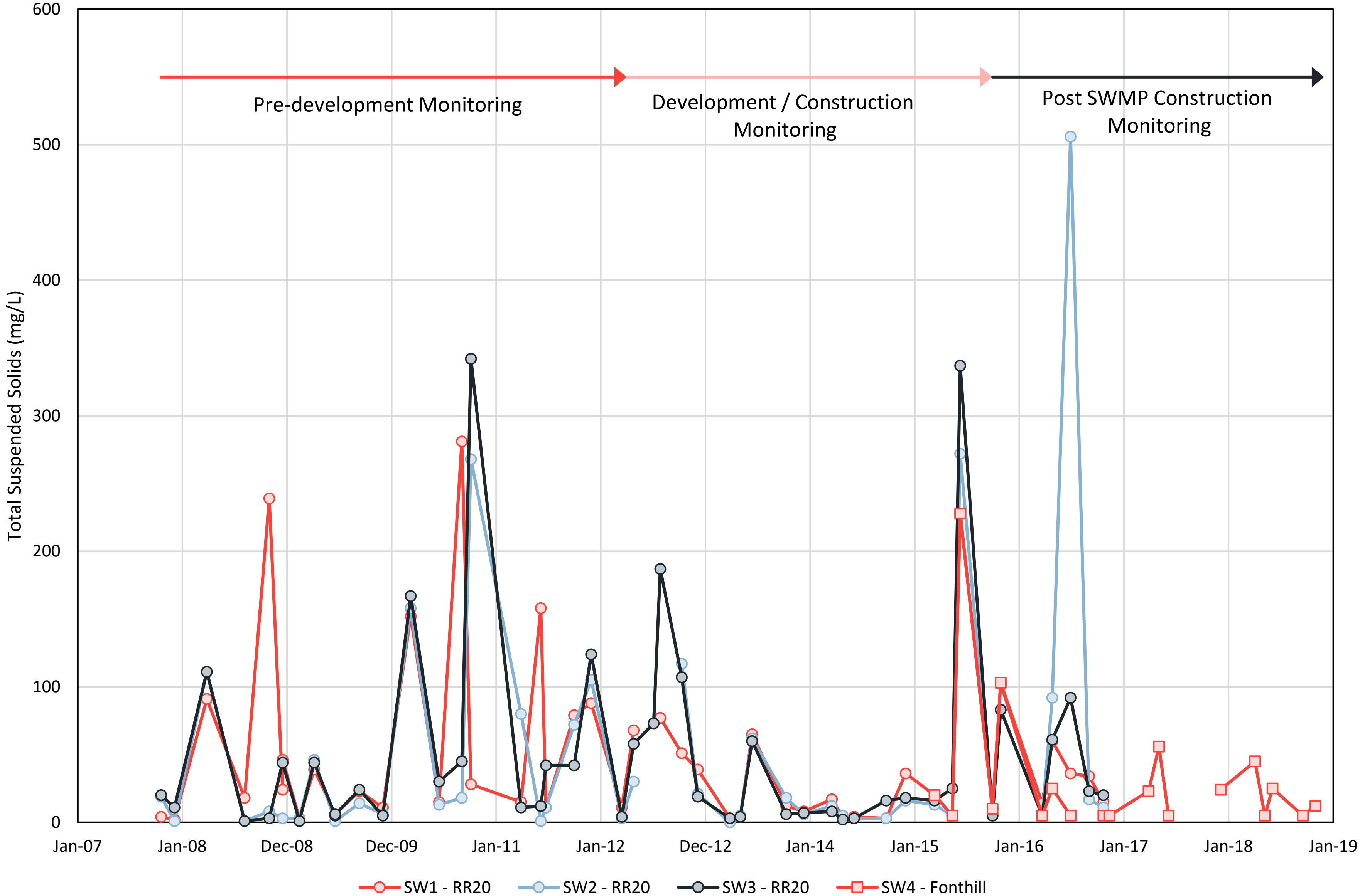
Craig Leger, M.Sc., C.E.T.
Environmental Consultant

Bailey Walters, MSc, PGeo
Senior Geoscientist | Environment

Encl. Figures 1 through 6

WSP ref.: 151-02661-03

Figure 2
Surface Water Quality - Total Suspended Solids
East Fonthill



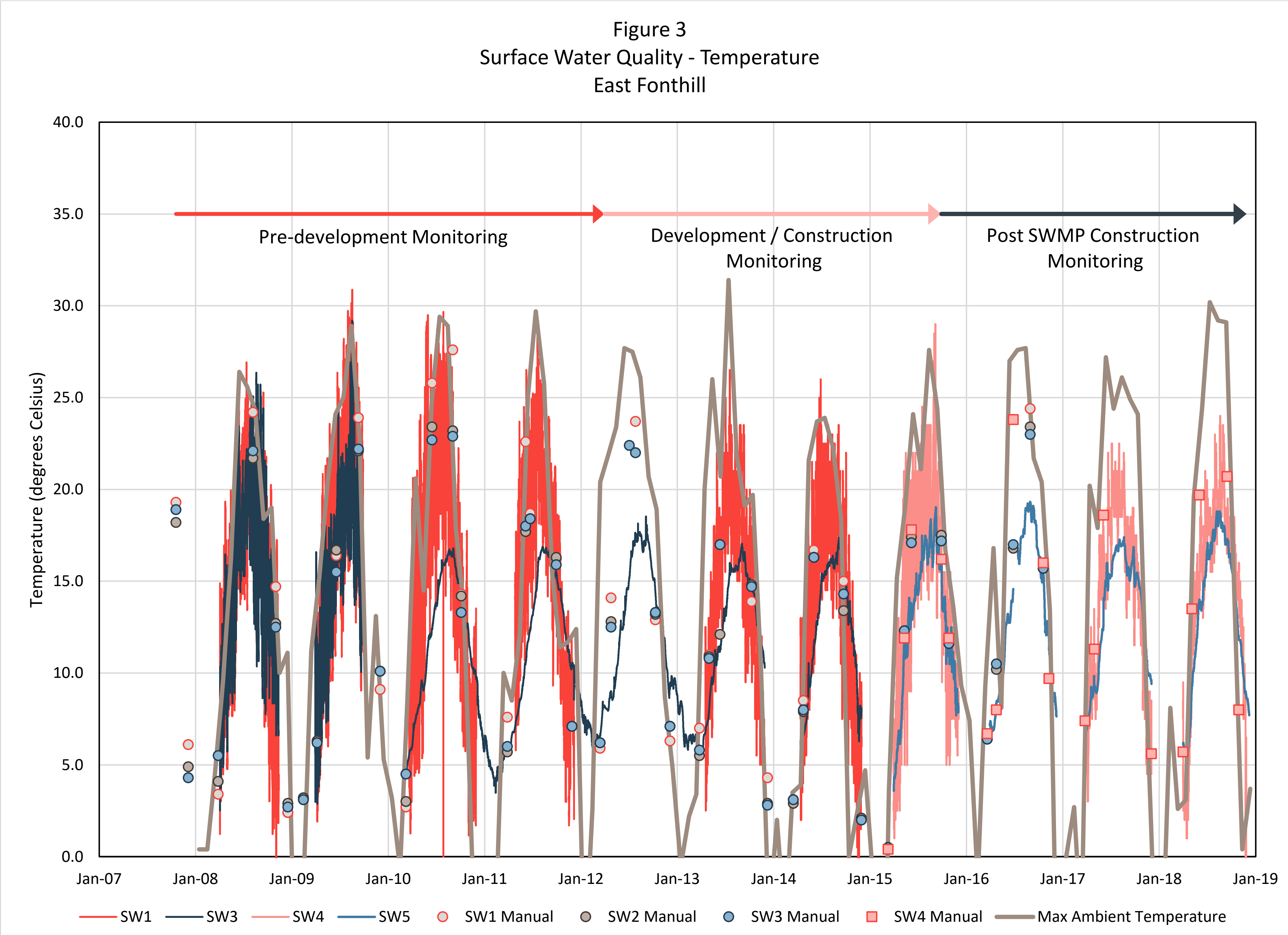


Figure 3
Surface Water Quality - Temperature
East Fonthill
Pre-development Monitoring
Development / Construction Monitoring
Post SWMP Construction Monitoring
Temperature (degrees Celsius)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
SW1
SW3
SW4
SW5
SW1 Manual
SW2 Manual
SW3 Manual
SW4 Manual
Max Ambient Temperature

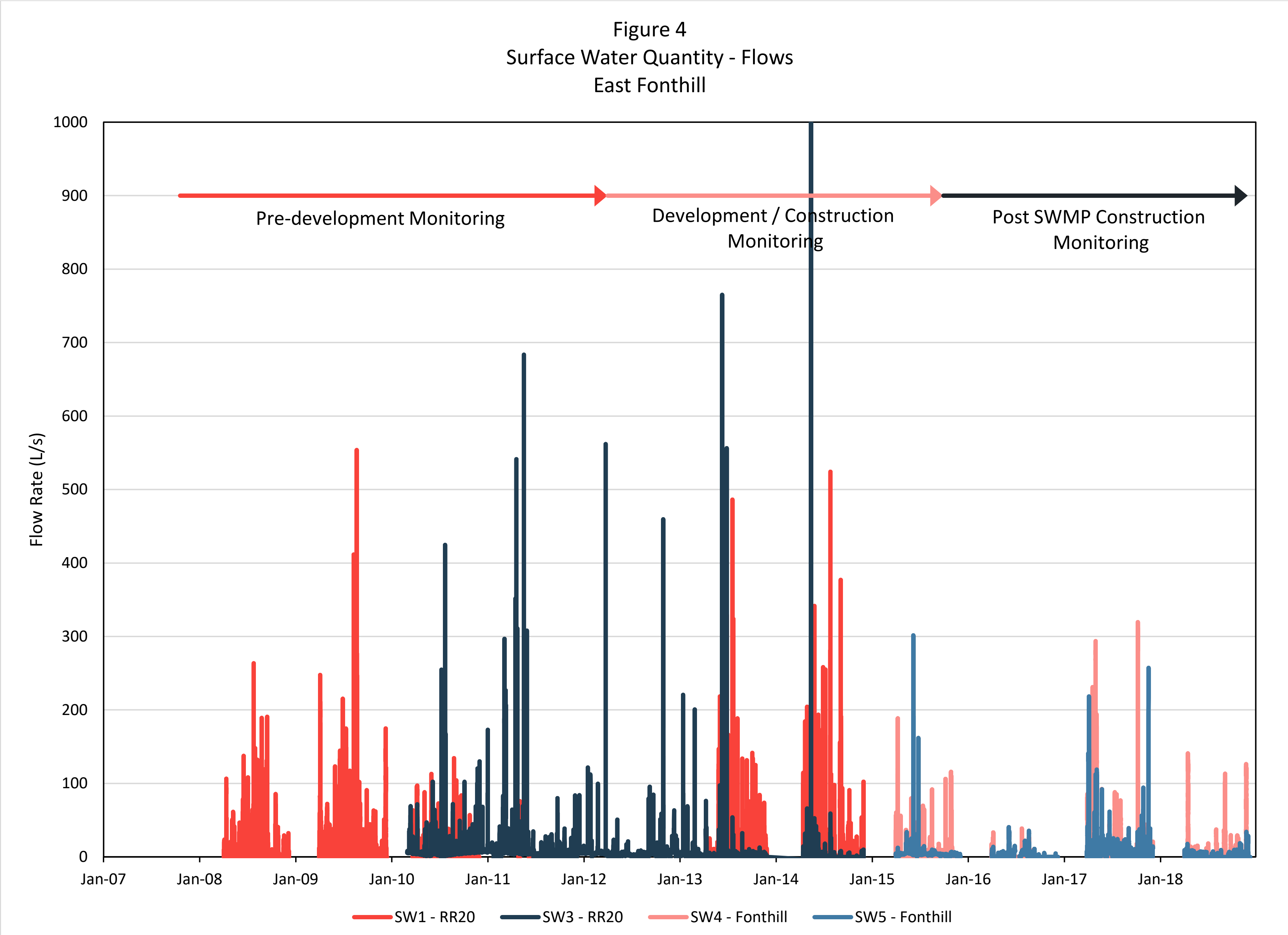
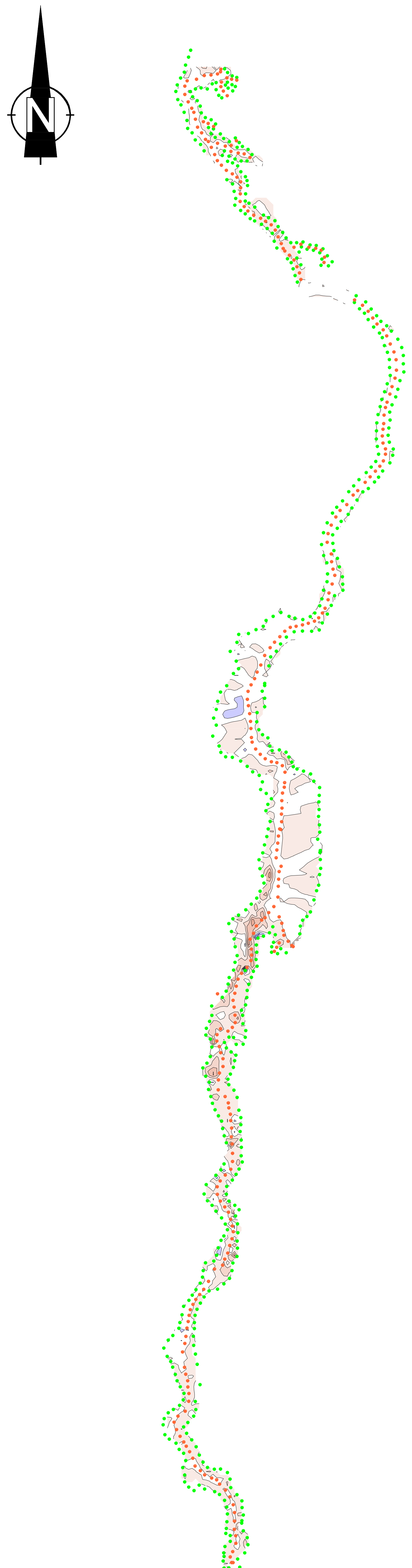


Figure 4
Surface Water Quantity - Flows
East Fonthill
Pre-development Monitoring
Development / Construction Monitoring
Post SWMP Construction Monitoring
Flow Rate (L/s)
1000
900
800
700
600
500
400
300
200
100
0
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
SW1 - RR20
SW3 - RR20
SW4 - Fonthill
SW5 - Fonthill



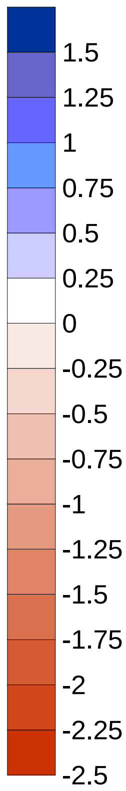
**LEGEND:**

TOP OF BANK WITH SURVEY POINTS (2008)

CENTRE LINE WITH SURVEY POINTS (2008)

—218— EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE




# RICE ROAD TRIBUTARY EROSION SURVEY 2008 MINUS 2007

PREDEVELOPMENT MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| **DATE:** MARCH 2009 | **SCALE:** 1:590 |
| **PROJECT:** 1070359.00 | **REF.:** H:\PROJECTS\2007\1070359\00\GRAPHICS\SURFER\2008MINUS2007_SURVEY_RR20.SRF |
| JAGGER HIMS LIMITED Environmental Consulting Engineers | **FIGURE:** 5.1 |

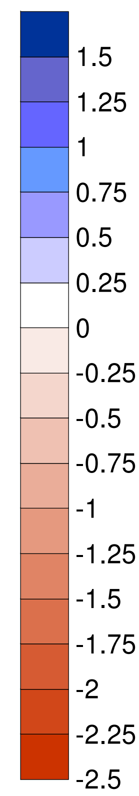

LEGEND:

TOP OF BANK WITH SURVEY POINTS (2009)

CENTRE LINE WITH SURVEY POINTS (2009)

—218— EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE



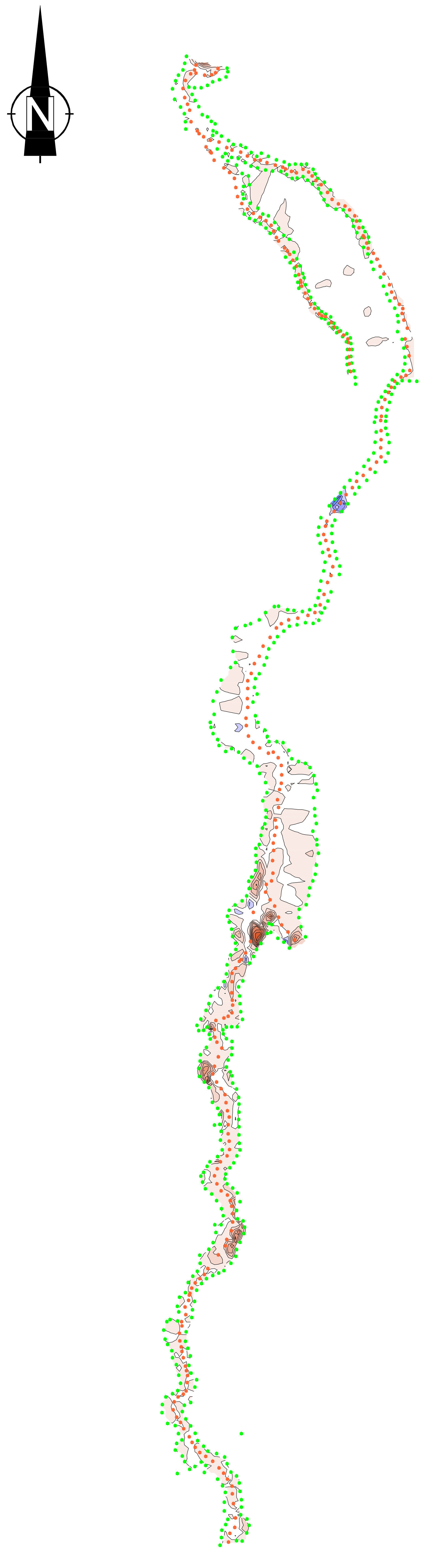

# RICE ROAD TRIBUTARY EROSION SURVEY 2009 MINUS 2008

SURFACE WATER AND EROSION MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| **DATE:** MAY 2009 | **SCALE:** 1:590 |
| **PROJECT:** 1070359.00 | **REF.:** H:\PROJECTS\2007\1070359\00\GRAPHICS\SURFER\2009 REPORT SURFER FIGURES\2009MINUS2008_SURVEY_RR20.SRF |

GENIVAR

**FIGURE:** 5.2



LEGEND:

TOP OF BANK WITH SURVEY POINTS (2010)

CENTRE LINE WITH SURVEY POINTS (2010)

218 EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE

1.5
1.25
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
-1.25
-1.5
-1.75
-2
-2.25
-2.5

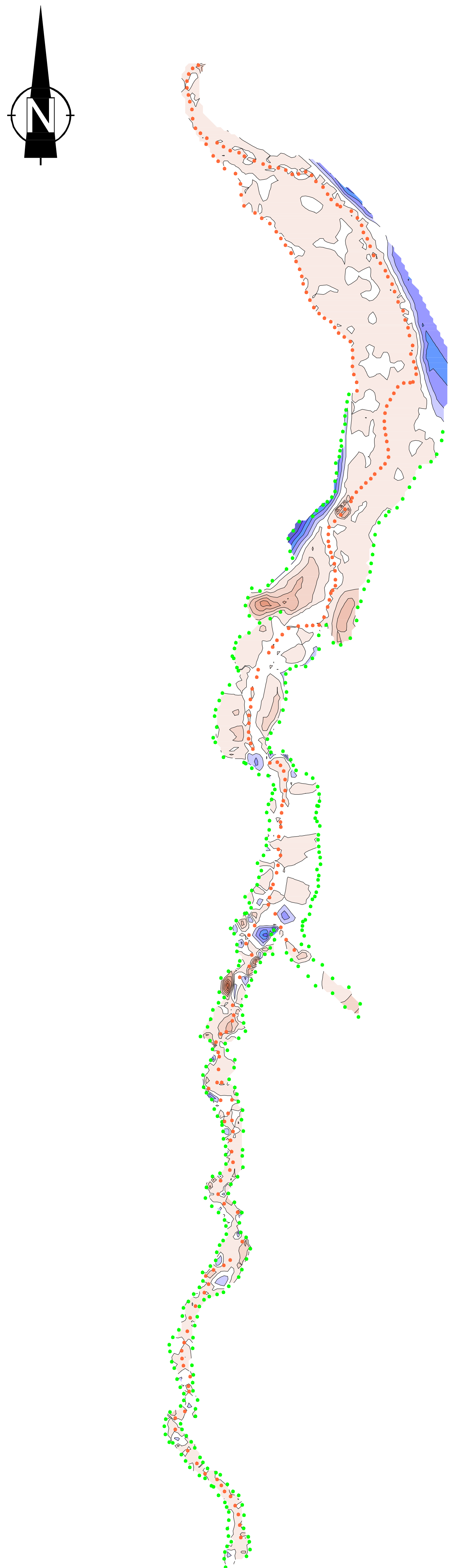
# RICE ROAD TRIBUTARY EROSION SURVEY 2010 MINUS 2009

PRE-CONSTRUCTION MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: APRIL 2011 | SCALE: 1:590 |
| PROJECT: 111-53018-00 A02 | REF.: |

GENIVAR

FIGURE: 5.3



**LEGEND:**

- TOP OF BANK WITH SURVEY POINTS (2011)
- CENTRE LINE WITH SURVEY POINTS (2011)
- —218— EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE

1.5
1.25
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
-1.25
-1.5
-1.75
-2
-2.25
-2.5

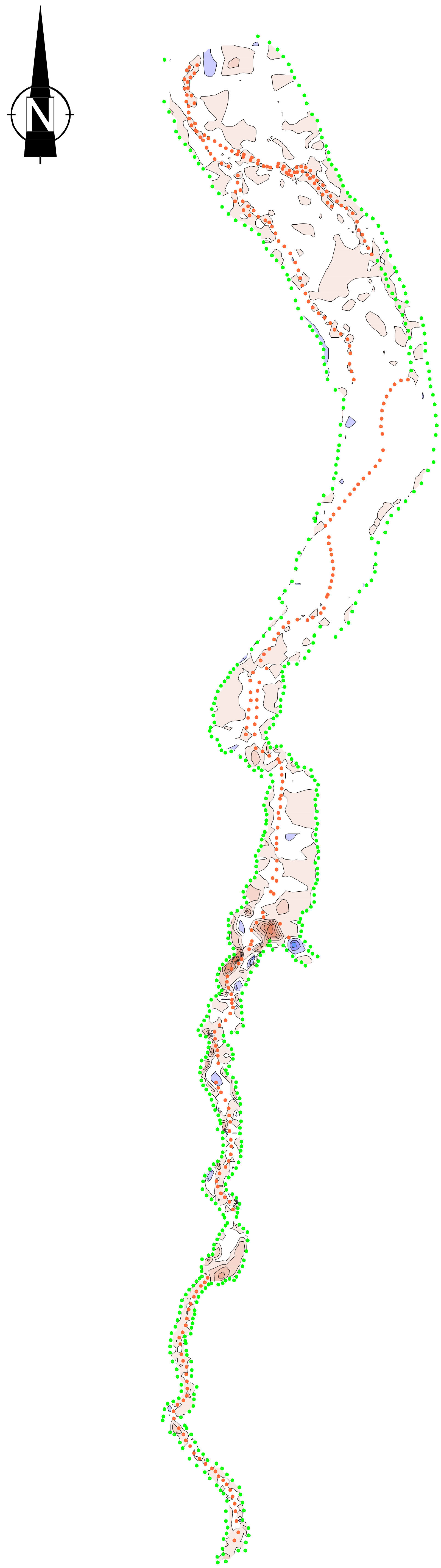
# RICE ROAD TRIBUTARY EROSION SURVEY 2011 MINUS 2010

PRE-CONSTRUCTION MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| **DATE:** APRIL 2011 | **SCALE:** 1:590 |
| **PROJECT:** 111-53018-00 A02 | **REF.:** |

GENIVAR

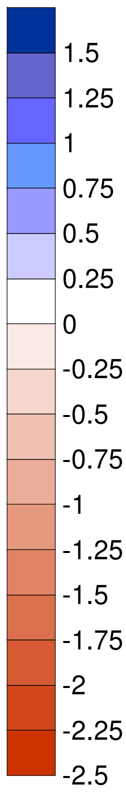
**FIGURE:** 5.4




**LEGEND:**

- TOP OF BANK WITH SURVEY POINTS (2012)
- CENTRE LINE WITH SURVEY POINTS (2012)
- —218— EROSION/ACCRETION CONTOUR (METRES)

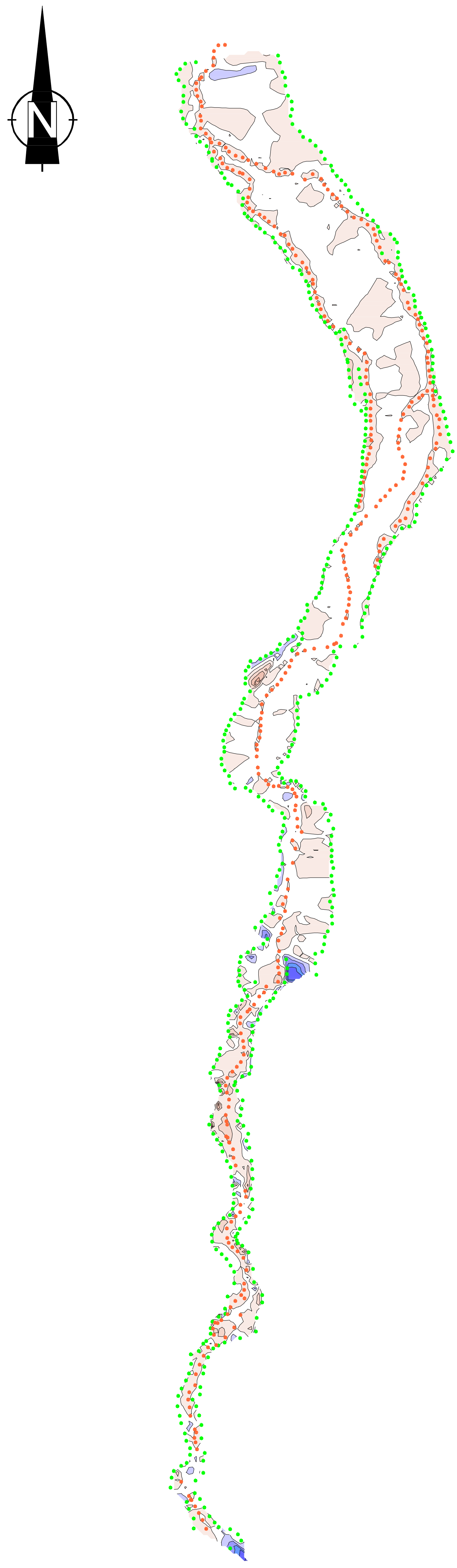
EROSION/ACCRETION COLOUR SCALE




# RICE ROAD TRIBUTARY EROSION SURVEY 2012 MINUS 2011

SURFACE WATER AND EROSION
2012 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| **DATE:** APRIL 2012 | **SCALE:** 1:590 |
| **PROJECT:** 111-53018-00 | **REF.:** |
| GENIVAR | **FIGURE:** 5.5 |



**LEGEND:**

- TOP OF BANK WITH SURVEY POINTS (2013)
- CENTRE LINE WITH SURVEY POINTS (2013)
- —218— EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE

1.5
1.25
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
-1.25
-1.5
-1.75
-2
-2.25
-2.5

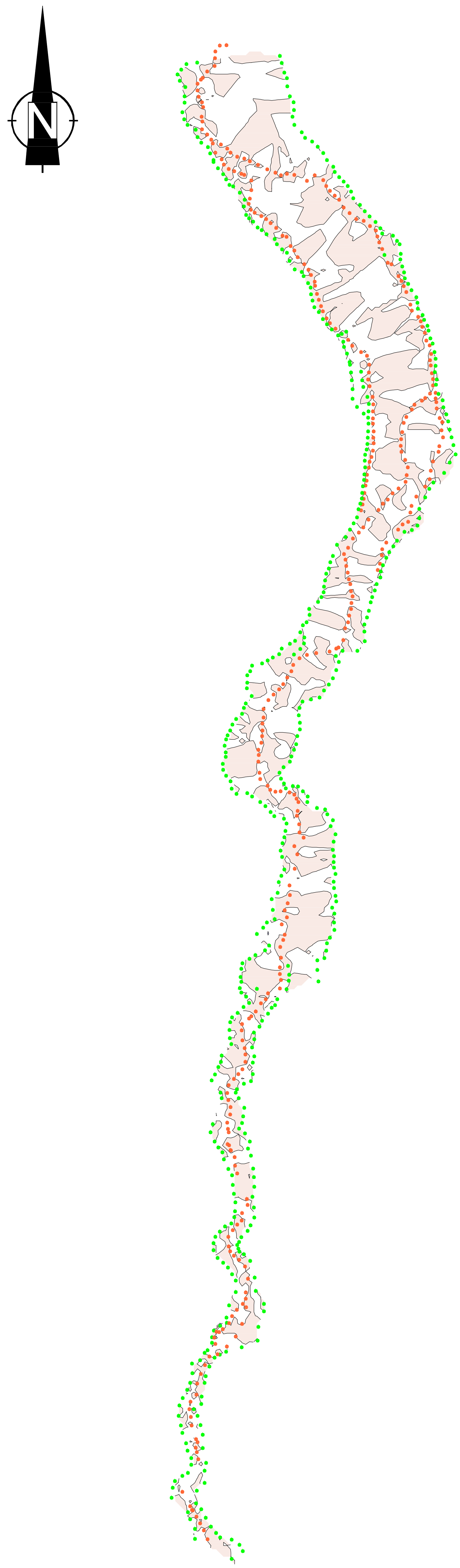
# RICE ROAD TRIBUTARY EROSION SURVEY 2013 MINUS 2012

SURFACE WATER AND EROSION
2013 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| **DATE:** MAY 2013 | **SCALE:** 1:590 |
| **PROJECT:** 111-53018-00 | **REF.:** |

WSP

**FIGURE:** 5.6



**LEGEND:**

TOP OF BANK WITH SURVEY POINTS (2014)

CENTRE LINE WITH SURVEY POINTS (2014)

—218— EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE

1.5
1.25
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
-1.25
-1.5
-1.75
-2
-2.25
-2.5

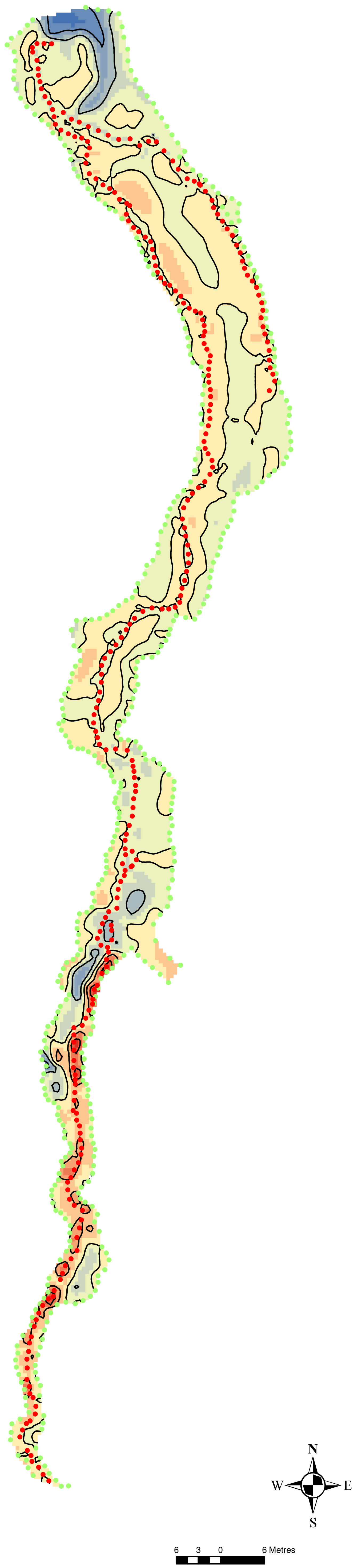
# RICE ROAD TRIBUTARY EROSION SURVEY 2014 MINUS 2013

SURFACE WATER AND EROSION
2014 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| **DATE:** MAY 2014 | **SCALE:** 1:590 |
| **PROJECT:** 111-53018-00 | **REF.:** |

WSP

**FIGURE:** 5.7




**LEGEND**

- CENTRE LINE WITH SURVEY POINTS (2015)
- TOP OF BANK WITH SURVEY POINTS (2015)
- EROSION/ACCRETION CONTOUR (METRES)

EROSION/ACCRETION COLOUR SCALE

- 1.25 to 1.5
- 1 to 1.25
- 0.75 to 1
- 0.5 to 0.75
- 0.25 to 0.5
- 0 to 0.25
- -0.25 to 0
- -0.5 to -0.25
- -0.75 to -0.5
- -1 to -0.75
- -1.25 to -1
- -1.5 to -1.25

NEGATIVE NUMBERS REPRESENT EROSION, POSITIVE NUMBERS REPRESENT ACCRETION.

# RICE ROAD TRIBUTARY EROSION SURVEY 2015 MINUS 2014

SURFACE WATER AND EROSION
2015 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: APRIL 2016 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100-5 | FILE. NO.:111-53018-00 100-5 F5 |
| WSP | FIGURE 5.8 |


**LEGEND**

- CENTRE LINE WITH SURVEY POINTS (2016)
- TOP OF BANK WITH SURVEY POINTS (2016)

EROSION/ACCRETION COLOUR SCALE

- 0.75 to 1
- 0.5 to 0.75
- 0.25 to 0.5
- 0 to 0.25
- -0.25 to 0
- -0.5 to -0.25
- -0.75 to -0.5
- -1 to -0.75
- -1.25 to -1
- -1.5 to -1.25

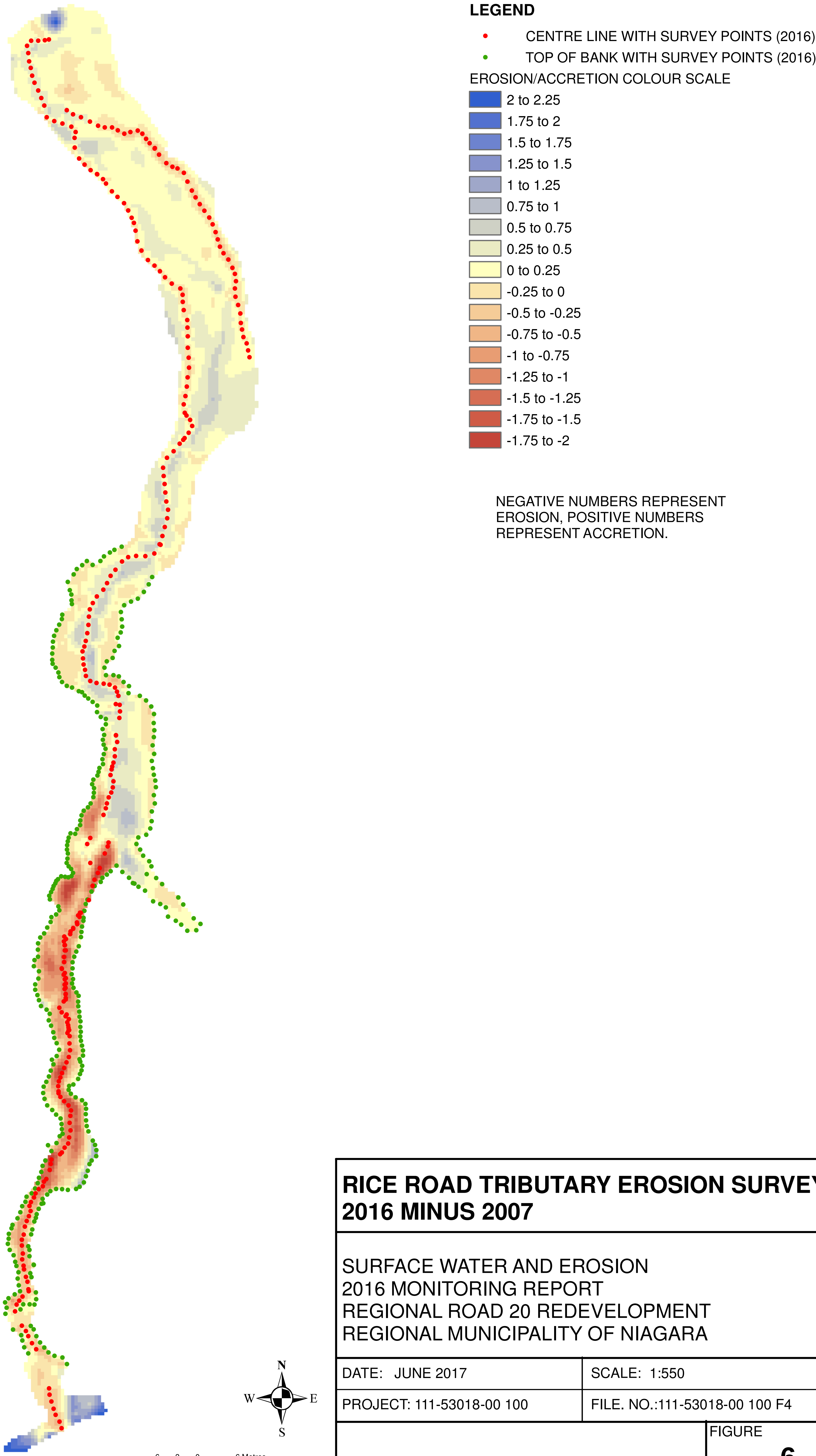
NEGATIVE NUMBERS REPRESENT EROSION, POSITIVE NUMBERS REPRESENT ACCRETION.

# RICE ROAD TRIBUTARY EROSION SURVEY 2016 MINUS 2015

SURFACE WATER AND EROSION
2016 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: JUNE 2017 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100 | FILE. NO.:111-53018-00 100 F5 |

FIGURE
**5.9**




**RICE ROAD TRIBUTARY EROSION SURVEY 2016 MINUS 2007**

SURFACE WATER AND EROSION
2016 MONITORING REPORT
REGIONAL ROAD 20 REDEVELOPMENT
REGIONAL MUNICIPALITY OF NIAGARA

| | |
|---|---|
| DATE: JUNE 2017 | SCALE: 1:550 |
| PROJECT: 111-53018-00 100 | FILE. NO.:111-53018-00 100 F4 |
| | FIGURE 6 |

**PUBLIC WORKS DEPARTMENT**
Monday, April 19, 2021

# **Subject:** Options for Recognizing Pride Week Celebrations in the Town of Pelham

**Recommendation:**

> **BE IT RESOLVED THAT Council receive Report #2021-0071, Options for Recognizing Pride Week Celebrations in the Town of Pelham, for information;**
>
> **AND THAT Council direct Staff to proceed with the implementation of Council's preferred alternative for the Pride celebrations scheduled for June of 2021.**

**Background:**

The Town of Pelham recently committed to adhering to the standards set out by the Coalition of Inclusive Municipalities of Niagara. While many of the initiatives that will coincide with this commitment will occur within the workplace, outside of the public eye, there are opportunities for the Town to provide visual cues that the Town is firm in its commitment to creating diverse and inclusive spaces and hint at further initiatives to come.

In 2020, The Town of Pelham participated in a pride flag raising ceremony at Town Hall, which was completed virtually, and using Covid 19 safety precautions.

Other municipalities in Niagara Region are looking at different ways to show support and provide inclusiveness for the LBGTQ2S+ community during the Pride celebrations. A good example is the Town of Lincoln, which has chosen to install rainbow coloured benches at select locations within the municipality, in conjunction with an advertising slogan featuring the phrase "A community where everyone has a seat."

Other municipalities have chosen to install features such as painted crosswalks displaying pride colours to show support. Alternative projects such as these could serve as proof that Pelham follows through on its commitment and dedication to diversity and inclusivity outside of the workplace environment.

The purpose of this report is to provide alternatives for Council's consideration in regards to the upcoming Pride celebrations scheduled in June 2021.

**Analysis:**

Staff have consulted with other municipalities to see what options are available for showing support and inclusiveness for the Pride celebrations and to show the Town's commitment to promoting an inclusive community. Some options for Council's consideration are as follows:

1) Perform a Pride Flag Raising in support of Pride week;
2) Purchase and place Pride benches at select locations in the Town;
3) Place Painted Pride crosswalks in the downtown business areas of Fonthill and Fenwick; and
4) Purchase and place Pride banners in the downtown

The attached table in Appendix A provides a summary of these options and gives points of consideration included estimated costs of each.

Appendix B provides visual details of the proposed alternatives.

**Financial Considerations:**

There will be a range of financial resources required based on the preferred alternative as chosen by Council and the number of items selected.

The cost associated with the features to be included as part of the Pride celebrations were not included as items in the 2021 capital budget and additional funding will need to be provided as part of the 2021 Beautification Operating budget.

**Alternatives Reviewed:**

See Appendix A and Appendix B for alternatives reviewed in the preparation of this report.

**Strategic Plan Relationship: Strong Organization**

The Town of Pelham strives to hire a workforce that is both diverse and tolerant. Bringing employees in from different backgrounds, experiences, genders, ages, and abilities provides the opportunity for any organization to be more innovative and enhance its overall customer service, both internally and externally.

In addition, it is important that existing staff feel that their workplace is safe, welcoming, and accepting. The more the Town can do to demonstrate this focus outside of the workplace, the more inviting these positions will appear to minority community members who may be considering a career with the Town.

Beyond diversity in the workplace, the possible additions to the Town's public spaces will confirm that this level of dedication is not just lip service, but rather a real and demonstrable commitment to creating spaces that are welcoming and inviting to all. The features will serve as a reminder to all who use these common spaces that Pelham is a tolerant community.

**Consultation:**

Consultation was undertaken with the Public Works Beautification staff and the Town of Pelham Human Resources Department.

**Other Pertinent Reports/Attachments:**

Appendix A – Summary of Pride Celebration Alternatives
Appendix B – Photographs of Alternatives for Consideration

**Prepared and Recommended by:**

Jason Marr, P. Eng.
Director of Public Works

**Prepared and Submitted by**:

David Cribbs, BA, MA, JD, MPA
Chief Administrative Officer

APPENDIX A – Pride Celebration Alternatives

| Alternative | Description | Pros | Cons | Estimated Cost |
|---|---|---|---|---|
| Flag Raising Event | Conduct Flag Raising Ceremony at Town Hall | • Similar ceremony and recognition as in 2020<br>• Easy installation and Removal<br>• Low capital and maintenance related cost. | • Low exposure and awareness | • Cost of flag $150 ea.<br>• Currently have in stock. |
| Pride Benches | Supply and Install Pride Benches | • Similar to the approach taken by the Town of Lincoln<br>• Low Maintenance<br>• Higher initial capital cost<br>• Permanent (year round ) recognition and commemoration<br>• Supports active transportation initiatives | • Higher replacement costs | • $2000 per bench for supply and install. |
| Pride Crosswalks at Intersections | Supply and placement of coloured sidewalks at select locations in the downtown areas of Fonthill and Fenwick. | • High recognition and visibility.<br>• Contributes to Public Art. | • High capital cost initially.<br>• High Maintenance costs.<br>• Paint will wear with traffic and weather events. | • $2000 per crosswalk for regular road paint.<br>• $5000 per crosswalk for thermoplastic paint. |
| Pride Banners | Supply and place banners to be installed on street light | • High recognition and visibility<br>• Low maintenance costs<br>• | • Moderate capital cost initially<br>• Requires specialized equipment and | • Banner costs are $150 - $200 ea. The Town has 13 poles on Pelham St and 15 |

| | | | | |
|---|---|---|---|---|
| | banner arms | | contractors for installation and removal | locations around MCC.<br>• Installation and Removal costs would be $3000 per set-up and takedown using a third party contractor with a boom truck. |

APPENDIX B – Photographs of Alternatives

THE CORPORATION OF THE

T O W N  O F  P E L H A M

BY-LAW #4338 (2021)

**Being a by-law to appoint an Emergency Management Control Group for the Town of Pelham, and to Repeal and Replace By-law #3874(2017).**

WHEREAS Ontario Regulation 380/04, s.11, pursuant to the Emergency Management and Civil Protection Act, requires that every municipality have an Emergency Management Control Group appointed by the council, comprised of such members who are involved in emergency management; and

WHEREAS the roles and responsibilities of the emergency management control group are set out in the O.Reg. 380/04 and through the Town's Emergency Response Plan:

NOW THEREFORE COUNCIL OF THE CORPORATION OF THE TOWN OF PELHAM ENACTS AS FOLLOWS:

THAT the individuals serving in the capacity of the following Members of the Senior Leadership Team or as it pertains to roles and responsibilities for the Emergency Operations Centre, or their designates, for the Town of Pelham be and are hereby appointed as the Town of Pelham Emergency Management Control Group:

Fire Chief
Chief Administrative Officer
Emergency Information Officer
Director of Community Planning and Development
Director of Public Works

AND THAT By-law #3874(2017) appointing an Emergency Management Control Group be and is hereby repealed and replaced with this By-law.

ENACTED, SIGNED & SEALED THIS
19th DAY OF APRIL, 2021 A.D.

MAYOR M. JUNKIN

HOLLY WILLFORD,
ACTING TOWN CLERK

THE CORPORATION OF THE
T O W N O F P E L H A M
BY-LAW 4339(2021)

**Being a by-law to amend By-law No. 4299(2020) to establish 2021 Fees and Charges to be collected by the Corporation of the Town of Pelham;**

**And to amend Schedule "1", Recreation & Culture Services.**

WHEREAS the *Municipal Act, 2001*, *S.O 2001, c.25*, provides that a municipality may pass by-laws imposing fees or charges on any class of persons; and,

AND WHEREAS By-law No. 4299(2020) establishes the 2021 Fees and Charges to be collected by the Corporation of the Town of Pelham;

WHEREAS the Corporation of the Town of Pelham deems it expedient to amend the Fees and Charges as they relate to the proposed 2021 Tennis Operation Rates for the Corporation of the Town of Pelham;

NOW THEREFORE COUNCIL OF THE CORPORATION OF THE TOWN OF PELHAM ENACTS AS FOLLOWS:

(1) THAT Schedule '1' to By-law #4299(2020) be amended as follows, detailed in the attached schedule, as it relates to Tennis Operation Rates, as below listed:

Add – Family Membership - $150.00
Add – Single Adult Membership - $100.00
Add – Single Student Membership - $50.00
Add – Single Senior Membership - $50.00
Add – Children (12 years and under) – Free
Add – Lesson Fees will be determined based on competitive rates;

ENACTED, SIGNED AND SEALED THIS
19th DAY OF April, 2021 A.D.

____________________________
MAYOR MARVIN JUNKIN

____________________________
ACTING CLERK, HOLLY WILLFORD

# Recreation & Cultural Services

| | 2021 |
|---|---|
| **Park Pavilions: Centennial Park & Harold Black Park** | |
| Park Pavilion | $35.00 |
| **Passive Areas: Centennial Park, Harold Black Park** | |
| Permit Fee | $29.00 |
| **Peace Park including Bandshell** | |
| Pavilion Rate + Passive Area Rate (under 100 people) | $67.00 |
| Pavilion Rate + Passive Area Rate (over 100 people) | $135.00 |
| Per Hour Rate | $14.00 |
| SOCAN fee | Full Cost Recovery |
| Town Staff fee (per hour) | $37.00 |
| **Centennial Park Tennis Courts** | |
| Tennis lights per season | Full Cost Recovery |
| Family Membership | $150.00 |
| Single Adult Membership | $100.00 |
| Single Student/Senior Membership | $50.00 |
| Children (12 years and under) | Free |
| Lesson Fees will be determined based on competitive rates | |
| Storage Space Per Year | |
| Youth Organization Storage | $500.00 |
| Centennial/ H.B. Park | $50.00 |
| Supply Rentals (Daily Fee with Facility Rental) | |
| Picnic Table/Folding Table | $20.00 |
| Folding Cruiser Table | $10.00 |
| 10 x 10 Tents with Weights | $25.00 |
| Kids Folding Table | $10.00 |
| Refundable Equipment Deposit (taxes not applicable) | $100.00 |

THE CORPORATION OF THE

T O W N  O F  P E L H A M

**BY-LAW # 4340(2021)**

**Being a by-law to Authorize the Execution of Grant Funding Agreements between the Town of Pelham and Her Majesty the Queen in Right of Ontario, as represented by the Minister of Transportation Relating to Funding Provided as follows:**

**i. $58,854 Dedicated Gas Tax Funds for Public Transportation Program 2020-2021**

WHEREAS the Council of the Corporation of the Town of Pelham deems it desirable to enter into Ontario Transfer Payment Agreements with Her Majesty the Queen in Right of Ontario, as represented by the Minister of Transportation relating to funding provided to the Municipality for the initiative above-referenced;

NOW THEREFORE COUNCIL OF THE CORPORATION OF THE TOWN OF PELHAM ENACTS AS FOLLOWS:

(1) THAT the Mayor and Clerk be and are hereby authorized and instructed on behalf of the Corporation of the Town of Pelham to execute the said Agreement between the Town of Pelham and the Minister of Transportation relating to the Dedicated Gas Tax Funds for Public Transportation Program 2020/2021;

(2) AND THAT the Clerk is hereby authorized to affix the Corporate Seal thereto;

(3) AND THAT this by-law shall come into force forthwith upon enactment.

ENACTED, SIGNED & SEALED THIS 19th DAY OF APRIL, 2021 A.D.

MARVIN JUNKIN, MAYOR

HOLLY WILLFORD, ACTING TOWN CLERK

**THE CORPORATION OF THE TOWN OF PELHAM**

**BY-LAW NO. 4341(2021)**
**BEING A BY-LAW TO ADOPT THE ESTIMATES FOR THE TOWN OF PELHAM FOR ITS OWN OPERATIONS FOR THE YEAR 2021**

**WHEREAS** Section 290(1) of the *Municipal Act, 2001*, as amended, provides that a council shall in each year prepare and adopt a budget including estimates of all sums required during the year for the purposes of the municipality;

**AND WHEREAS** it is necessary for the Council of The Corporation of the Town of Pelham (Council) to raise for the year 2021 certain sums;

**AND WHEREAS** Council deems it necessary to comply with *Ontario Regulation 284/09*, regarding budgeting using the cash basis and excluding accrued amortization and post-employment benefits expenses;

**AND WHEREAS** Council, during its budget deliberations, considered and accepted the budget estimates and requirements of the municipality for the year 2021;

**AND WHEREAS** at its meeting of January 11, 2021, Council approved the recommendation, as amended, of the Council Reports Subjects: 2021 Draft Operating Budget Update and 2021 Draft Capital Budget Update.

**NOW THEREFORE THE COUNCIL OF THE CORPORATION OF THE TOWN OF PELHAM ENACTS AS FOLLOWS:**

1. (a) (i) That the 2021 budget was developed using the cash basis and has excluded the following accrual expenses: a portion of the amortization expense which amounts to approximately $6,300,000 and a portion of post-employment benefits expense which amounts to approximately $40,000.

   (ii) That the budget estimates, as set out in the Council Reports “2021 Draft Capital Update and 2021 Draft Operating Budget Update”, and attached hereto and forming part of this By-law, be and are hereby adopted.

   (iii) That the summary of 2021 budget estimates as set out in Schedule "A", attached hereto, be and are hereby adopted.

   (b) That the budget estimates to be raised by tax levy as set out in Schedule "A", attached hereto, be and are hereby adopted.

2. That this by-law shall come into force and take effect on the date of passing.

**ENACTED AND PASSED THIS 19th DAY OF APRIL, 2021**

____________________________
Mayor M. Junkin

____________________________
Acting Town Clerk, Holly Willford

**Schedule "A" to By-law No. 4341(2021)**

**2021 Budget**

| | Revenue/ Funding | Expenditures |
|---|---|---|
| General Operations | $ 3,397,183 | $ 19,376,524 |
| Capital Projects | 9,275,526 | 9,275,526 |
| | $12,672,709 | $ 28,652,050 |
| | ========= | ========= |

**Tax Levy**

| | |
|---|---|
| General | $ 12,266,391 |
| Capital | 3,712,950 |
| Total Tax Levy | $ 15,979,341 |
| | ========= |

THE CORPORATION OF THE
T O W N O F P E L H A M
BY-LAW #4343(2021)

**Being a by-law to adopt, ratify and confirm the actions of the Council at its regular meeting held on the 19th day of April 2021.**

WHEREAS Section 5 (3) of the Municipal Act, S.O. 2001, Chapter M.25, as amended, provides that, except if otherwise authorized, the powers of Council shall be exercised by by-law;

AND WHEREAS it is deemed desirable and expedient that the actions of the Council as herein set forth be adopted, ratified and confirmed by by-law;

NOW THEREFORE COUNCIL OF THE CORPORATION OF THE TOWN OF PELHAM ENACTS AS FOLLOWS:

(1) (a) The actions of the Council at its meeting held on the 19th day of April, 2021, including all resolutions or motions approved, are hereby adopted, ratified and confirmed as if they were expressly embodied in this by-law.

(b) The above-mentioned actions shall not include:

(I) any actions required by law to be taken by resolution, or

(II) any actions for which prior Ontario Municipal Board approval is required, until such approval is obtained.

(2) The Mayor and proper officials of the Corporation of the Town of Pelham are hereby authorized and directed to do all things necessary to give effect to the above-mentioned actions and to obtain approvals where required.

(3) Unless otherwise provided, the Mayor and Clerk are hereby authorized and directed to execute and the Clerk to affix the seal of the Corporation of the Town of Pelham to all documents necessary to give effect to the above-mentioned actions.

(4) THAT this by-law shall come into force on the day upon which it is passed.

READ, ENACTED, SIGNED AND SEALED
THIS 19th DAY OF APRIL 2021 A.D.

MAYOR MARVIN JUNKIN

ACTING TOWN CLERK, HOLLY WILLFORD