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Revision: 0

March 28, 2024

Prepared for:

TOWNSHIP OF ALFRED AND PLANTAGENET
205 Old Highway 17, P.O. Box 350
Plantagenet, ON
K0B 1L0

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
343 Preston Street, Tower II, Suite 1000
Ottawa, ON K1S 1N4
TEL: 613-728-3571

Environmental Study Report

Plantagenet Wastewater Municipal Class Environmental Assessment

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Table of Contents

List of Appendices

1.0 Introduction

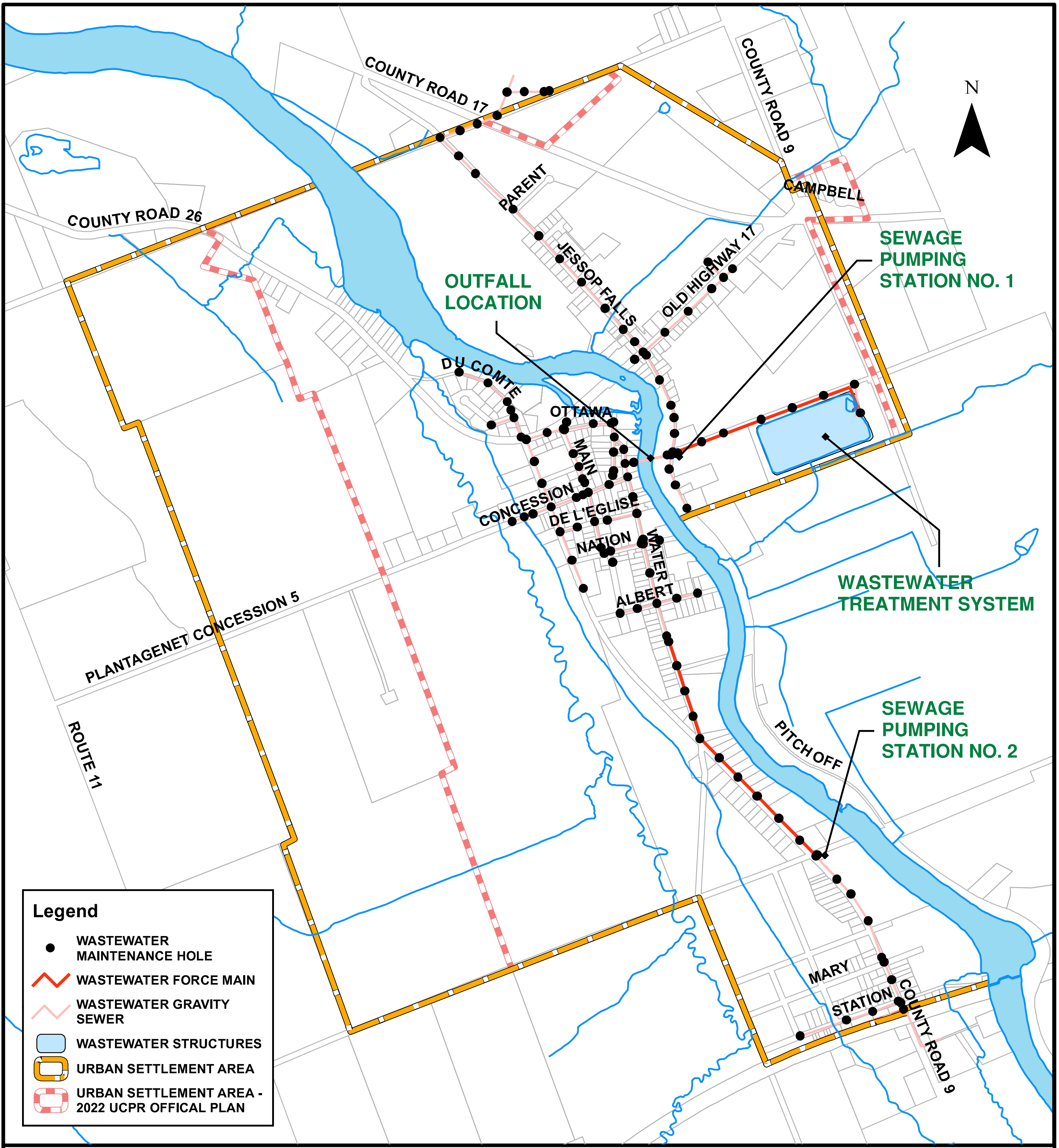
1.1 Background

The Village of Plantagenet (Village) is located approximately 60 km east of the City of Ottawa and 7 km south of the Ottawa River, in the Township of Alfred and Plantagenet (Township) and United Counties of Prescott and Russell. The Village is situated along the South Nation River, in the Lower South Nation River watershed, at the intersection of County Road 9 and Old Highway 17. According to the Township's Official Plan, the Plantagenet urban area covers an area of approximately 600 ha, a large portion of which is currently farmland. Village residents are serviced by a communal potable water supply/distribution system, and a communal wastewater collection/treatment system. Refer to Figure 1 for an overview of the study area and wastewater collection system.

The existing wastewater collection and treatment system is owned by the Township and operated by the Ontario Clean Water Agency (OCWA). It consists of several kilometers of gravity sewers, two (2) sewage pumping stations (SPSs) (one main SPS and one sub-area SPS), a lagoon-based wastewater treatment system and a gravity outfall to the South Nation River. The lagoon-based wastewater treatment system operates under Amended Certificate of Approval (C of A) No. 4631-5WXQE9 (refer to Appendix A1). The treatment system, constructed in the early 1970s, consists of a single cell 6.9 ha facultative waste stabilization pond that is batched dose with alum prior to seasonal discharge (Spring and Fall). Refer to Figure 2 for an overview of the Plantagenet wastewater treatment system (WWTS).

Since 1988, the treatment system has operated at or above its rated capacity of 561 m^3/day, and the lagoon itself has been required to operate at its storage limit to avoid discharging during non-allowable discharge windows. The system has also regularly exceeded its seasonal total suspended solids (TSS) and 5-day biological oxygen demand (BOD5) objectives and limits. These factors have resulted in non-compliance issues with the Ministry of the Environment, Conservation and Parks (MECP). The Township has implemented SPSs upgrades, completed minor repairs to the collection system maintenance holes and de-sludged the existing lagoon; however, no upgrades have been completed to address capacity and/or quality limitations associated with the WWTS.

Although there has been minimal population growth within the Village in the last 20 years, the Township has noted that there has been recent interest in new development that would result in an increased serviced population for the wastewater system. To accommodate this development and resolve previous non-compliance issues, the Township is undertaking a Municipal Class Environmental Assessment (Class EA) to evaluate alternatives to expand and/or upgrade their wastewater system. The study will aim to establish reliable, robust and cost-effective solutions with low to medium operational complexity and flexibility to meet both current and anticipated future servicing requirements. The Township has retained J.L. Richards & Associates Limited (JLR) to assist them in completing the Class EA.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

STUDY AREA

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FIGURE 1

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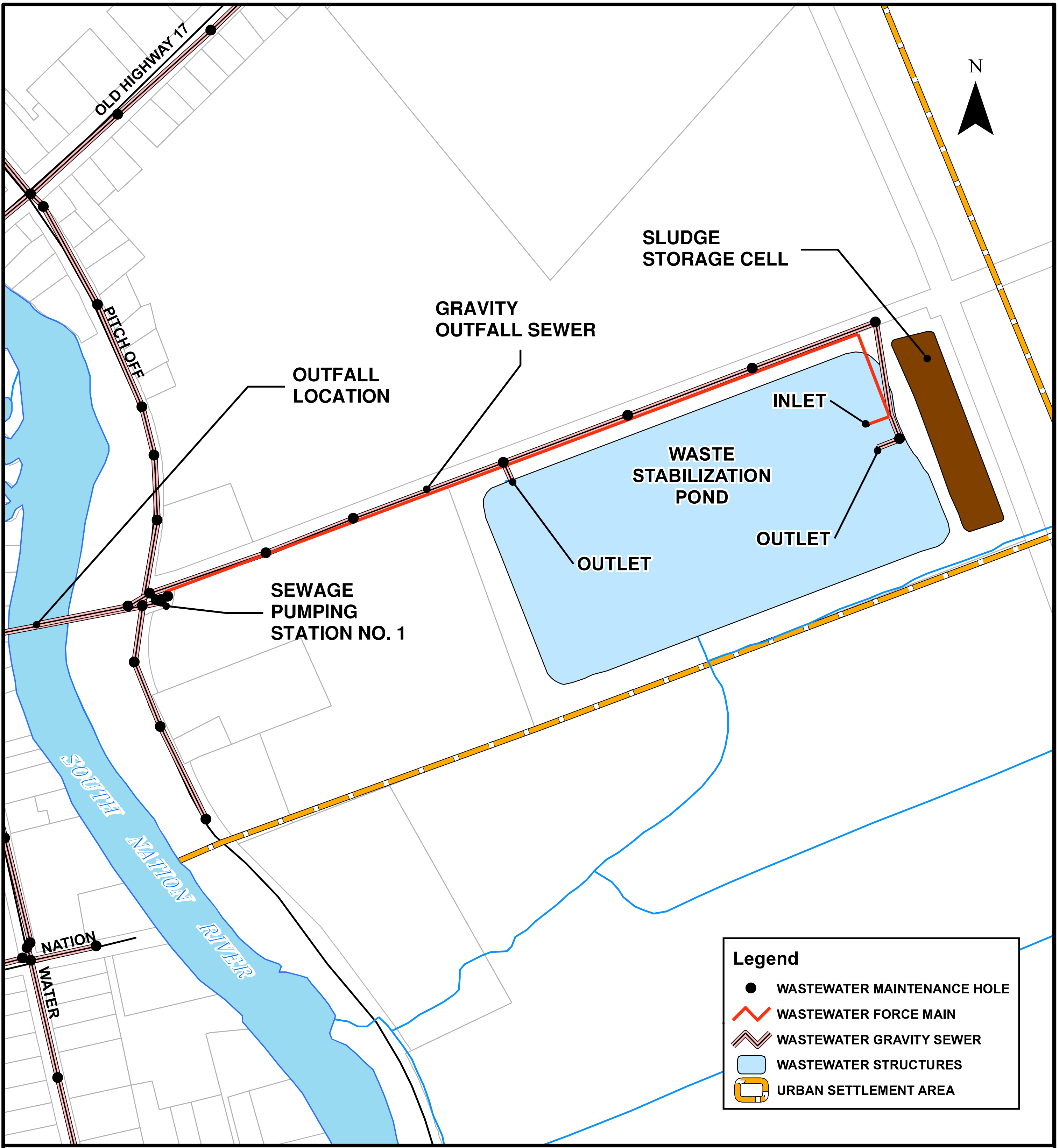

PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

PLANTAGENET WASTEWATER TREATMENT SYSTEM

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1.2 Municipal Class Environmental Assessment Process

The Ontario Environmental Assessment Act (Act) sets out a planning and decision-making process so that potential environmental effects are considered before a project begins. The purpose of the Act is to provide for the protection and conservation of the natural environment (R.S.O. 1990, c.E.18, s.2).

The Municipal Class EA process is followed for common types of projects to streamline the review process while ensuring that the project meets the requirements of the Act. It involves detailed site-specific information gathering and studies, as well as consultation with the public and stakeholder agencies. Different Class EA Schedules are followed depending on the type of project to be completed and their impact on the environment. These include Schedule A, Schedule A+, Schedule B and Schedule C, each more involved than the last. In 1987, the first Class EA document, prepared by the Municipal Engineers Association on behalf of Ontario Municipalities, was approved under the Act. Updates and amendments were subsequently made in 1993, 2000, 2007, 2011, 2015 and 2023.

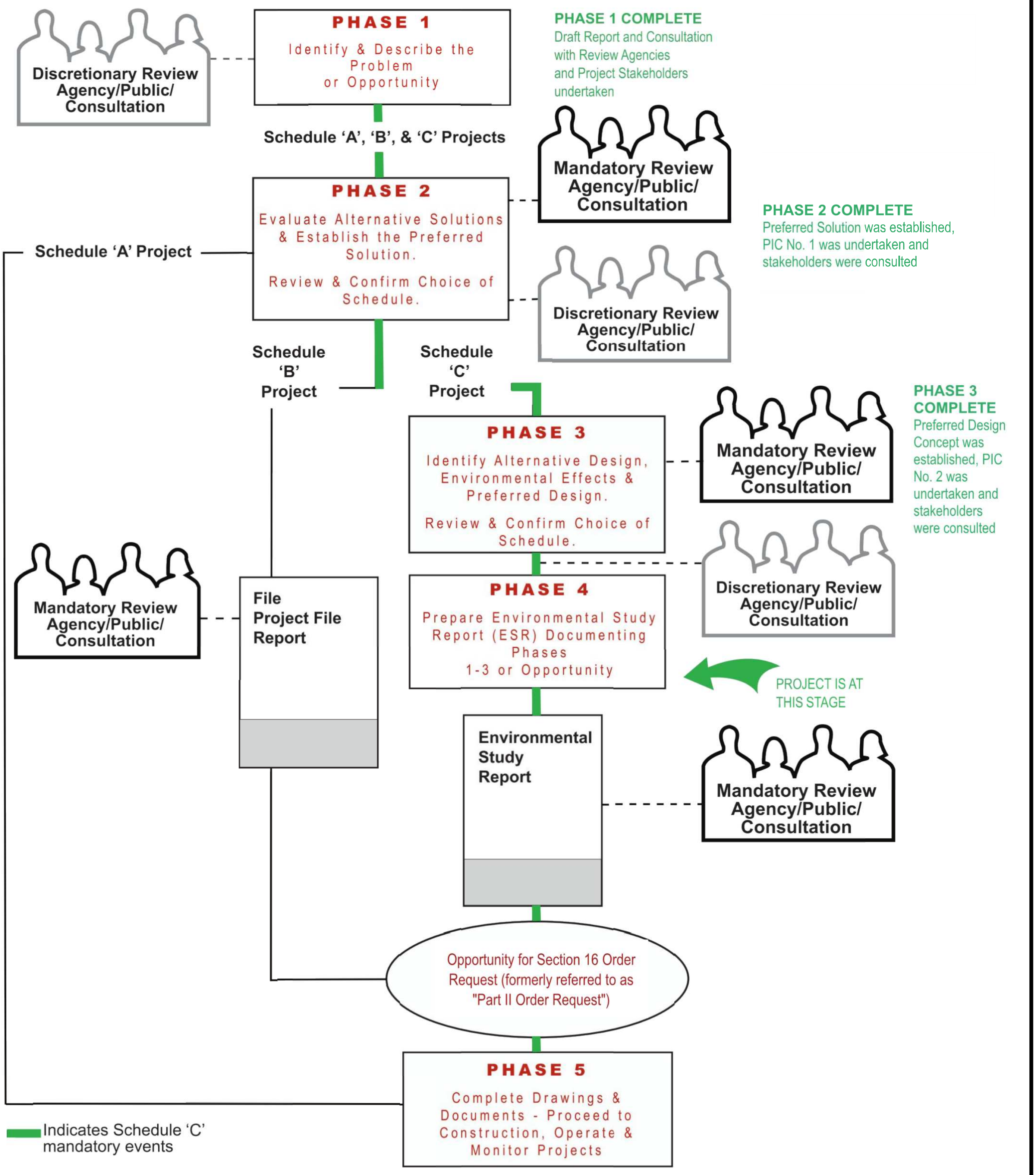
This Class EA was initiated as a Schedule C project under the Class EA process because it was expected that the capacity of the Plantagenet WWTS would need to be increased beyond its existing rated capacity and expanded beyond its existing site boundary. Projects categorized as Schedule C undertakings have the potential for significant environmental effects, and are required to follow the full planning and design process specified under the Municipal Class EA. This includes consultation with all parties that may potentially be affected by the project, and the preparation of an Environmental Study Report (ESR) that documents the Class EA process that was followed for the project.

The Class EA framework (refer to Figure 3) defines the process for each type of project. For Schedule C projects, the completion of Phase 1 to Phase 4 of the Class EA process is required:

- Phase 1 – Identify and Describe the Problem and/or Opportunity
- Phase 2 – Identify Alternative Solutions and Establish the Preferred Solution
- Phase 3 – Identify Alternative Design Concepts and Establish a Preferred Design Concept for the Preferred Solution
- Phase 4 – Prepare Environmental Study Report
- Phase 5 – Implementation

The ESR shall be made available for review by indigenous communities, the public and review agencies at the completion of Phase 4 for a period of 30 calendar days. This period is followed by a waiting period lasting 30 days to allow the MECP to request or notify proponents of a ‘Section 16 Order’ (formerly known as a ‘Part II Order’). Following the 30-day waiting period, if there are no requests received from the MECP for a ‘Section 16 Order’, then the project may proceed to implementation (Phase 5).

The Class EA is proceeding in accordance with the Schedule C requirements of the Ontario Municipal Class EA. This Schedule was confirmed as part of Phase 2 of the Class EA.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

SCHEDULE 'C' CLASS EA PROCESS

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1.3 Objectives of the Class Environmental Assessment and ESR

The objective of this Class EA is to identify the preferred servicing option(s) for the Plantagenet Wastewater System for the 20-year planning horizon (to 2042). All components of the wastewater system will be reviewed, including the wastewater treatment system, gravity collection system, sewage pumping stations and gravity outfall to the South Nation River. Note that the data/documentation available to JLR for the study is listed in Appendix A2.

This report provides a summary of Phases 1 to 3 of the Class EA process.

In addition to the Phase 1 and Phase 2 reports, the following three (3) technical memoranda were developed throughout the course of the Class EA:

- TM-1: Design Basis (Phase 1, included as Appendix A3 to this report)
- TM-2: Climate Change Impacts (Phase 2, included as Appendix B1 to this report)
- TM-3: Alternatives Design Memorandum (Phase 3, included as Appendix C to this report)

2.0 Phase 1: Problem and/or Opportunity

Phase 1 of the Class EA aimed to describe existing conditions of the Plantagenet wastewater system and establish the problem and/or opportunity statement. For a full description of activities undertaken during Phase 1, refer to the Phase 1 Report (Appendix A). Below is a summary of key information from the Phase 1 Report:

- Detailed physical description of the Plantagenet wastewater system, including the gravity sewer collection system, both SPSs, the sewage treatment lagoon, and the gravity outfall to the South Nation River. It is noted that the gravity sewer collection system consists of approximately 8.5 km of gravity sewers ranging in size from 200 mm to 375 mm, most of which were built in the early 1970s. Refer to Appendix A4 for the original 1974 as-built drawings of the Plantagenet wastewater system.

- Land uses and zoning for the SPSs, WWTS and adjacent lands. Refer to Figure 4 and Figure 5 for existing Village land uses and zoning. The land immediately adjacent to the SPSs and the WWTS are not owned by the Township. Acquisition of a portion of the agricultural lands adjacent to the existing lagoon is required for any WWTS expansion. A factor to consider in determining the direction of expansion is maintaining a separation distance of at least 150 m to sensitive receivers. It is noted that there are no sensitive receivers within the 150 m buffer area of the existing lagoon, as shown in Figure 6.

- Summary of the natural environment assessment undertaken by Bowfin Environmental Consulting (Bowfin) in and around the existing WWTS lagoon to identify existing natural environment features. Refer to Appendix A6 for the full study report. Key findings from this study included the potential presence or potential to impact certain endangered species (Eastern Whip-poor-will, Bobolink, Eastern Meadowlark, little brown myotis bat and Butternut), the presence of a fish habitat within an unnamed tributary to the south of the site (refer to Figure 7 for location of tributary), and the identification of a Wildlife Travel Corridor 105 m southwest of the lagoon site.

- Summary of the Stage 1 Archaeological Study and a Cultural Heritage Study undertaken by Archaeological Research Associates Ltd. (ARA) to identify known and potential archaeological and heritage resources. Refer to Appendix A7 and A8 for the full study reports. Key findings from these reports include archaeological potential in the farmland to the south of the existing WWTS lagoon and a potential built heritage resource in the vicinity of the existing WWTS lagoon and SPS #1.

- Assessment of nearby contaminated sites, abandoned mines, and vulnerable areas. Refer to Figure 7 for the location of these natural and particular elements.

Key findings from this assessment included that the WWTS and SPS #1 are within the 1km buffer area for the Plantagenet Springs abandoned mine, and that most of the wastewater system is located within a highly vulnerable aquifer. It is noted that Plantagenet is serviced via a watermain distribution system from treated water supplied by the Lefaivre Water Treatment Plant.

- MECP compliance requirements for the operation of the existing WWTS. Refer to Appendix A1 for the existing compliance document (amended Certificate of Approval No. 4631-5WXQE9).

- Analysis of historical (2016-2020) WWTS data. Key findings included:

    - The WWTS regularly exceeded compliance limits for total suspended solids (TSS), regularly exceeded compliance objectives for 5-day biochemical oxygen demand (BOD_5), and occasionally exceeded TP compliance objectives.

    - The raw wastewater received at the WWTS can be categorized as a medium strength wastewater.

    - Although the system operates beyond its rated capacity, there were no reported overflows. A key discrepancy observed in the data that may provide an explanation is that the measured annual influent flow was approximately 90,000 m^3 greater than the measured annual effluent flow (40% difference).

- Identification of operational challenges and existing system constraints based on discussions with OCWA and the Township. Key operational challenges identified related to the WWTS; they included lack of system capacity, presence of high levels of algae in the lagoon and the difficulty in repairing or maintaining a WWTS with a single lagoon cell.

- Summary of the evaluation of potential growth in the servicing area over the next 20 years. Phasing of growth (10-year (2032) and 20-year (2042)) was requested by the Township due to the large magnitude and timing uncertainty of projected development. Refer to TM1 – Design Basis (Appendix A3) for the full growth evaluation. Key findings from the evaluation include the establishment of an existing residential serviced population of 1,336 and existing institutional, commercial, and industrial (ICI) serviced area of approximately 6 ha, a projected 2032 residential population of 2,636 and ICI area of 8.23 ha, and a projected 2042 residential population of 3,935 and ICI area of 10.46 ha.

- Summary of the projected average daily, peak daily and maximum monthly raw wastewater flows and raw wastewater quality for the 10-year (2032) and 20-year

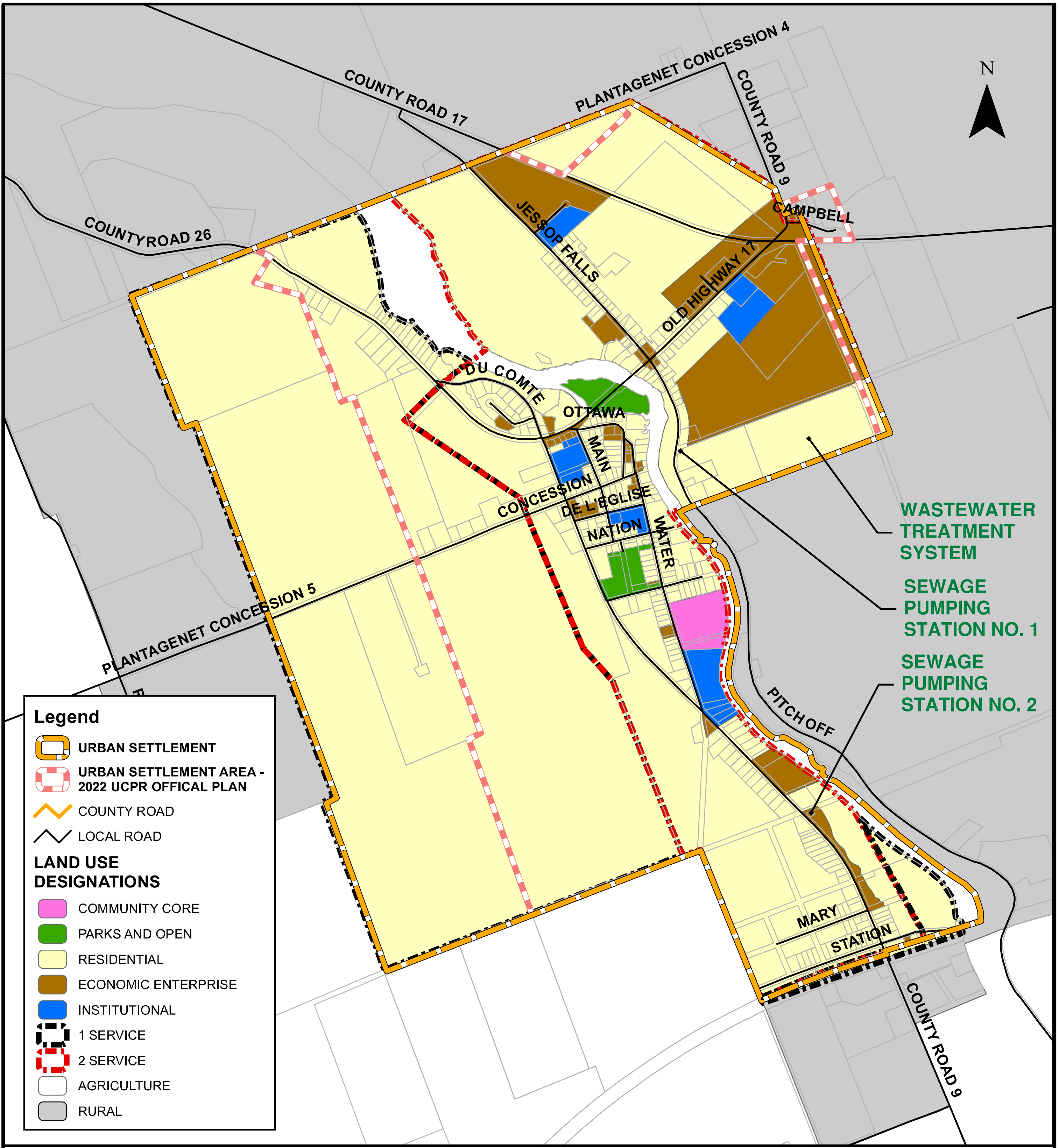
(2042) design horizons. Refer to TM1 – Design Basis (Appendix A3) for the projection tables. For the 20-year design horizon, an average daily flow of 2,020 m^3/day is projected. This represents the projected required rated capacity of the upgraded WWTS.

- Summary of the Receiver Assimilative Capacity Study undertaken by Blue Sky Energy Engineering & Consulting Inc. (Blue Sky) to assess existing conditions of the South Nation River and discharge constraints associated with an expanded WWTS (e.g., discharge concentrations and flows), as well as to establish proposed effluent criteria. Refer to Appendix A5 for the full study report. It is noted that all water quality parameters, except for TP, were identified as having Policy 1 status. TP was identified as having Policy 2 status, meaning that the annual loading of TP could not be increased as part of the preferred upgrade solution. Refer to Section 5.0 for proposed effluent criteria.

- Preliminary assessment of WWTS storage volume and discharge regime, which found that the outfall sewers downstream of MH-E appear to be sufficiently sized to accommodate 20-year discharge flows, although hydraulic modelling is required to determine the actual outfall flow capacity, which is impacted by water levels in the South Nation River.

Based on the information developed and analyzed during Phase 1, the following problem and opportunity statement was developed for the project:

A review of the Plantagenet Wastewater System suggests that the Plantagenet Wastewater Treatment System is operating above its rated capacity and has treatment performance issues that have resulted in effluent wastewater concentrations above the current Environmental Compliance Approval objectives and limits. As a result, the system cannot accommodate any growth of the serviced area or population. The Township of Alfred and Plantagenet is undertaking a Municipal Class Environmental Assessment to evaluate options to upgrade the Plantagenet Wastewater System to address issues related to achieving effluent quality criteria and ensure that the 20-year growth of Plantagenet is adequately planned for and accommodated. The Class EA will consider the level of adequacy of wastewater treatment at the lagoon and will recommend a solution to address the findings in accordance with the 2023 Municipal Class Environmental Assessment process.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

VILLAGE OF PLANTAGENET LAND USE DESIGNATIONS AND TRANSPORTATION

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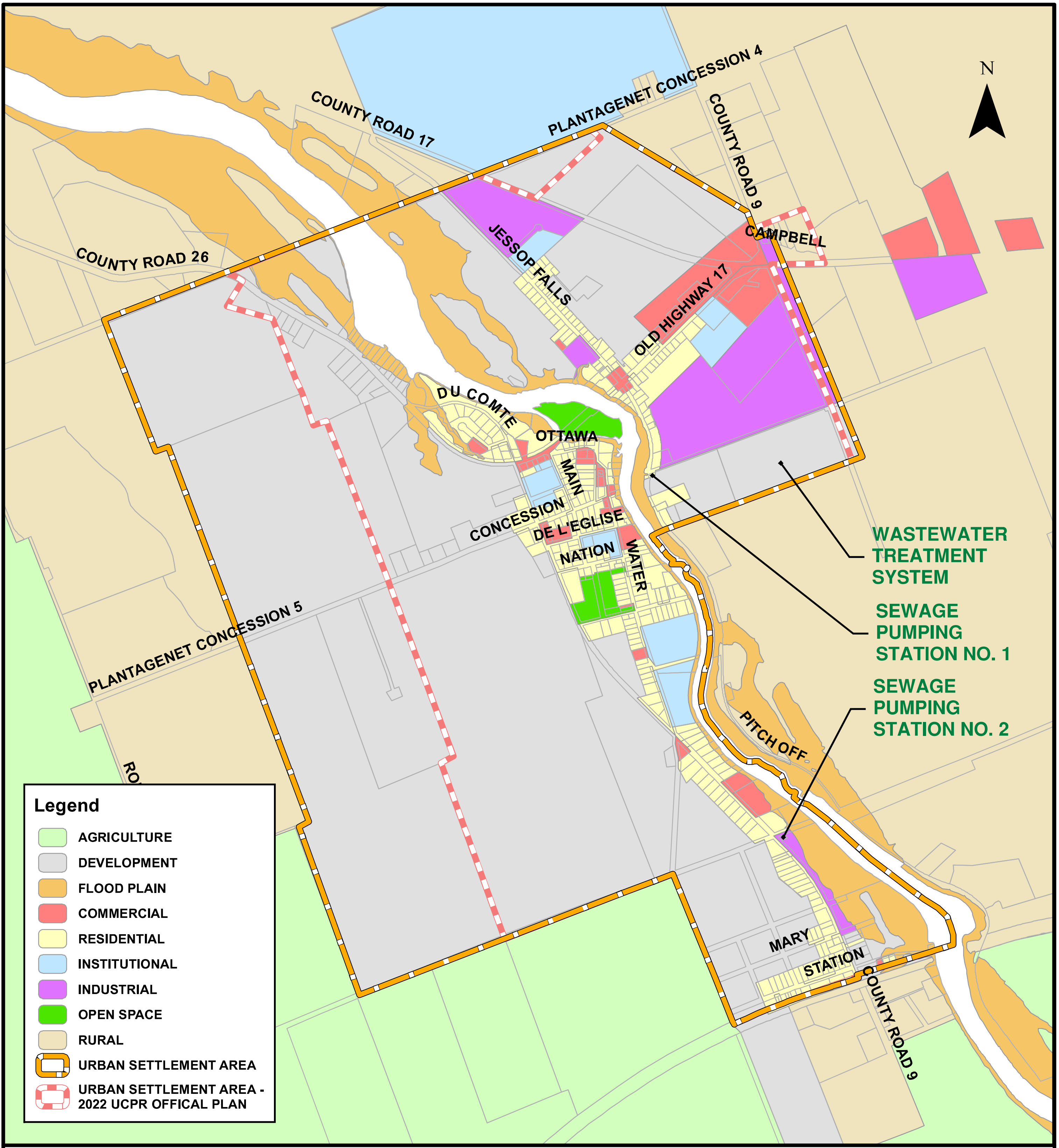

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PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

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VILLAGE OF PLANTAGENET ZONING

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FIGURE 5

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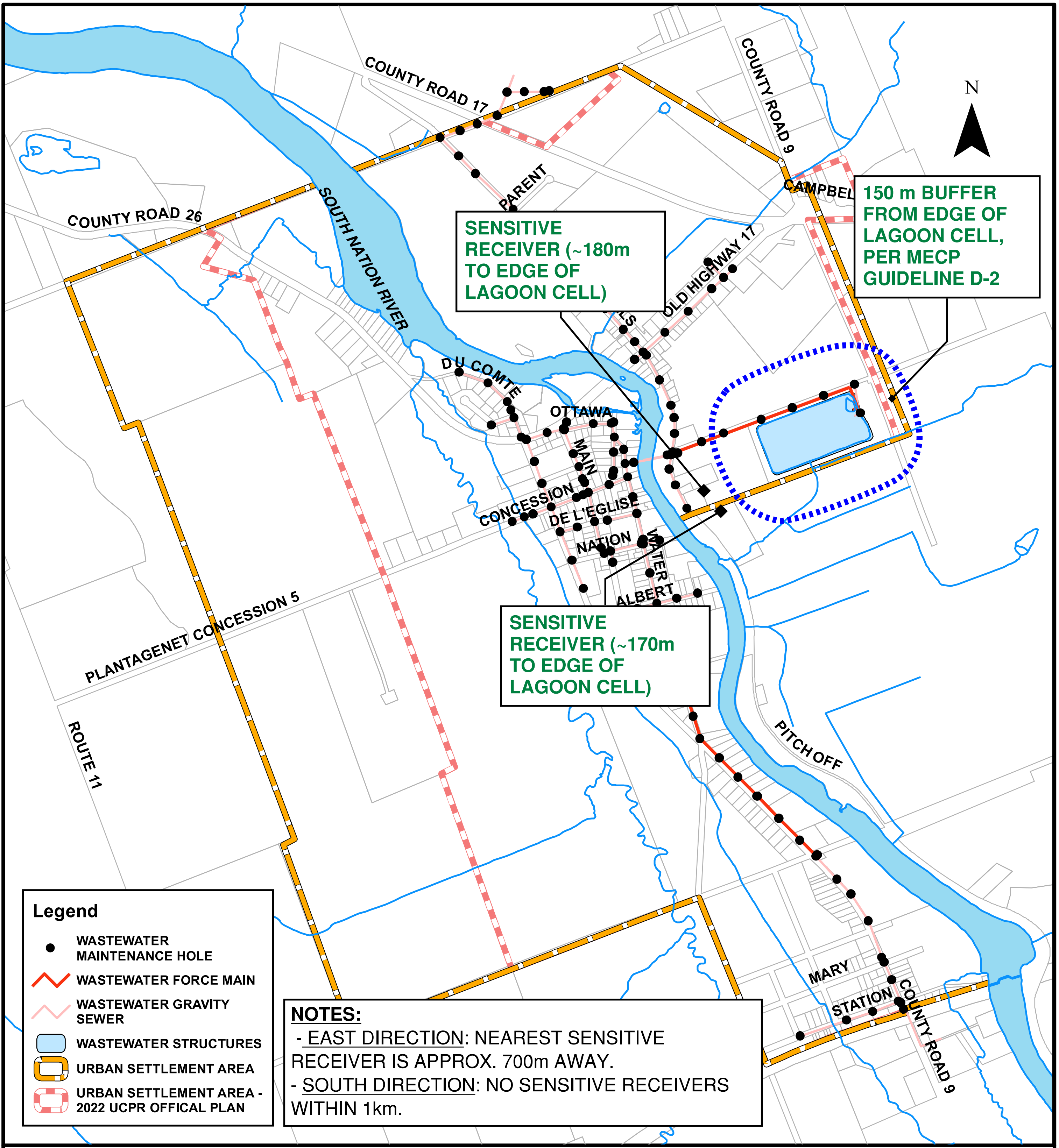

SENSITIVE RECEIVER (~180m TO EDGE OF LAGOON CELL)

150 m BUFFER FROM EDGE OF LAGOON CELL, PER MECP GUIDELINE D-2

SENSITIVE RECEIVER (~170m TO EDGE OF LAGOON CELL)

Legend

- ● WASTEWATER MAINTENANCE HOLE
- WASTEWATER FORCE MAIN
- WASTEWATER GRAVITY SEWER
- WASTEWATER STRUCTURES
- URBAN SETTLEMENT AREA
- URBAN SETTLEMENT AREA - 2022 UCPR OFFICAL PLAN

NOTES:

- EAST DIRECTION: NEAREST SENSITIVE RECEIVER IS APPROX. 700m AWAY.
- SOUTH DIRECTION: NO SENSITIVE RECEIVERS WITHIN 1km.

PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

PLANTAGENET LAGOON BUFFER AREA TO SENSITIVE RECEIVERS

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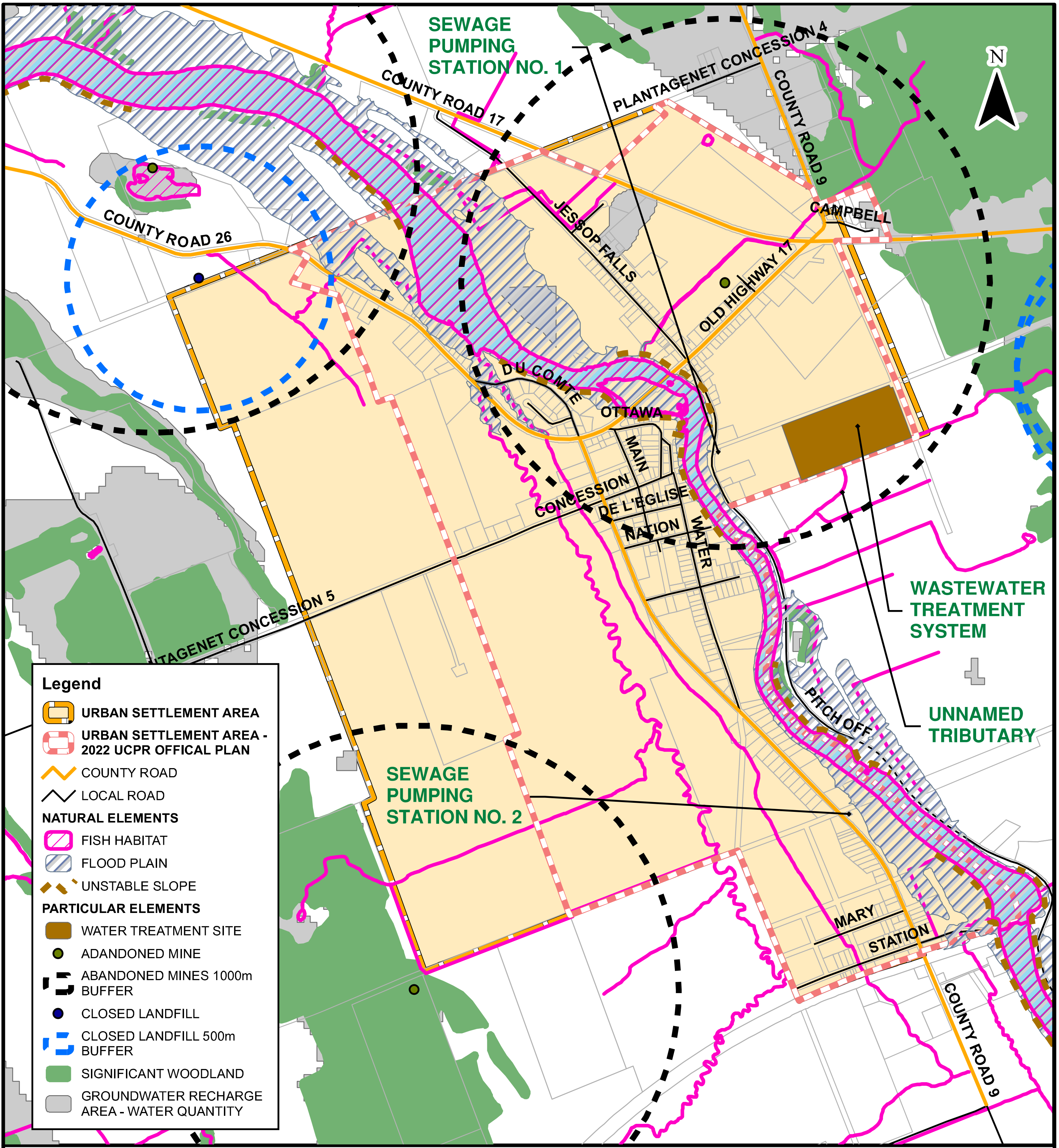

PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

VILLAGE OF PLANTAGENET NATURAL AND PARTICULAR ELEMENTS

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FIGURE 7

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3.0 Phase 2: Development of a Preferred Solution

Phase 2 of the Class EA aimed to further describe existing conditions of the Plantagenet wastewater system, evaluate alternative upgrade solutions, and establish a preferred upgrade solution for the Plantagenet wastewater system. For a full description of additional studies undertaken during Phase 2, as well as findings from Phase 2, refer to the Phase 2 Report (Appendix B). Below is a summary of key information from the Phase 2 Report:

- Summary of TM2 – Climate Change Impacts (refer to Appendix B1), which outlined the potential impacts of climate change on the Plantagenet wastewater system and potential areas of concerns to be addressed in future upgrade designs.

- Summary of the preliminary hydrogeological investigation undertaken by Thurber Engineering Limited (Thurber) in the area surrounding the existing lagoon site to establish baseline hydrogeological conditions. Refer to Appendix B2 for the full investigation report. Key findings from this investigation and study include an interpreted southwest groundwater flow direction (towards the South Nation River and away from recorded water supply wells), relatively high normal groundwater level (base of existing lagoon is expected to be below interpreted normal groundwater level) and an interpreted dominant downward vertical hydraulic gradient.

- Summary of the geotechnical desktop study undertaken by Thurber for the area surrounding the existing lagoon site to establish baseline geotechnical conditions. Refer to Appendix B3 for the full study report. Key findings from this study include the establishment of a likely design seismic site class (Class D with Class C possible), preliminary conservative maximum recommended grade raise and permanent design sloping of 3.0 m and 3H:1V, respectively, and no identification of significant concerns with the site geotechnical conditions.

- Review of the historical influent and effluent flow discrepancy at the WWTS. A key finding from this review was that seepage through the bottom of the lagoon is likely the main contributor to the discrepancy, and that upgrades to the lagoon liner to minimize seepage be carried forward as part of the preferred upgrade solution if the existing lagoon is to continue to be used for treatment/storage.

- Summary of the 2-month flow monitoring study undertaken by Civica Infrastructure Inc. (Civica) and subsequent analysis by JLR to provide a preliminary assessment of the inflow and infiltration (I&I) in the existing wastewater collection system. Refer to Appendix B4 for the flow monitoring study report and the Phase 1 Report (Appendix B) for the analysis. Refer to Figure 8 for flow monitor locations and delineated servicing areas for the study. Key findings include that MH-4 frequently experienced submerged flow conditions during rainfall events, that dry weather groundwater infiltration is estimated to account for 20 to 40% of the total annual influent volume (areas A2 and A4 were most susceptible), that the system is susceptible to high wet weather I&I (areas A2, A3 and A4 were most susceptible) and that the calculated per capita sewage flow rate for the existing servicing area is approximately 270 L/cap/day. It was recommended that the Township undertake a CCTV inspection of key problem areas and develop and implement a I&I Reduction Program.

- Development of peak raw wastewater flow projections. For the 20-year (2042) design horizon, the rated capacities of SPS No. 1 (main SPS) and SPS No. 2 (sub-area SPS) are projected to be increased from 29.2 L/s to 99.7 L/s and from 10.6 L/s to 42.1 L/s, respectively.

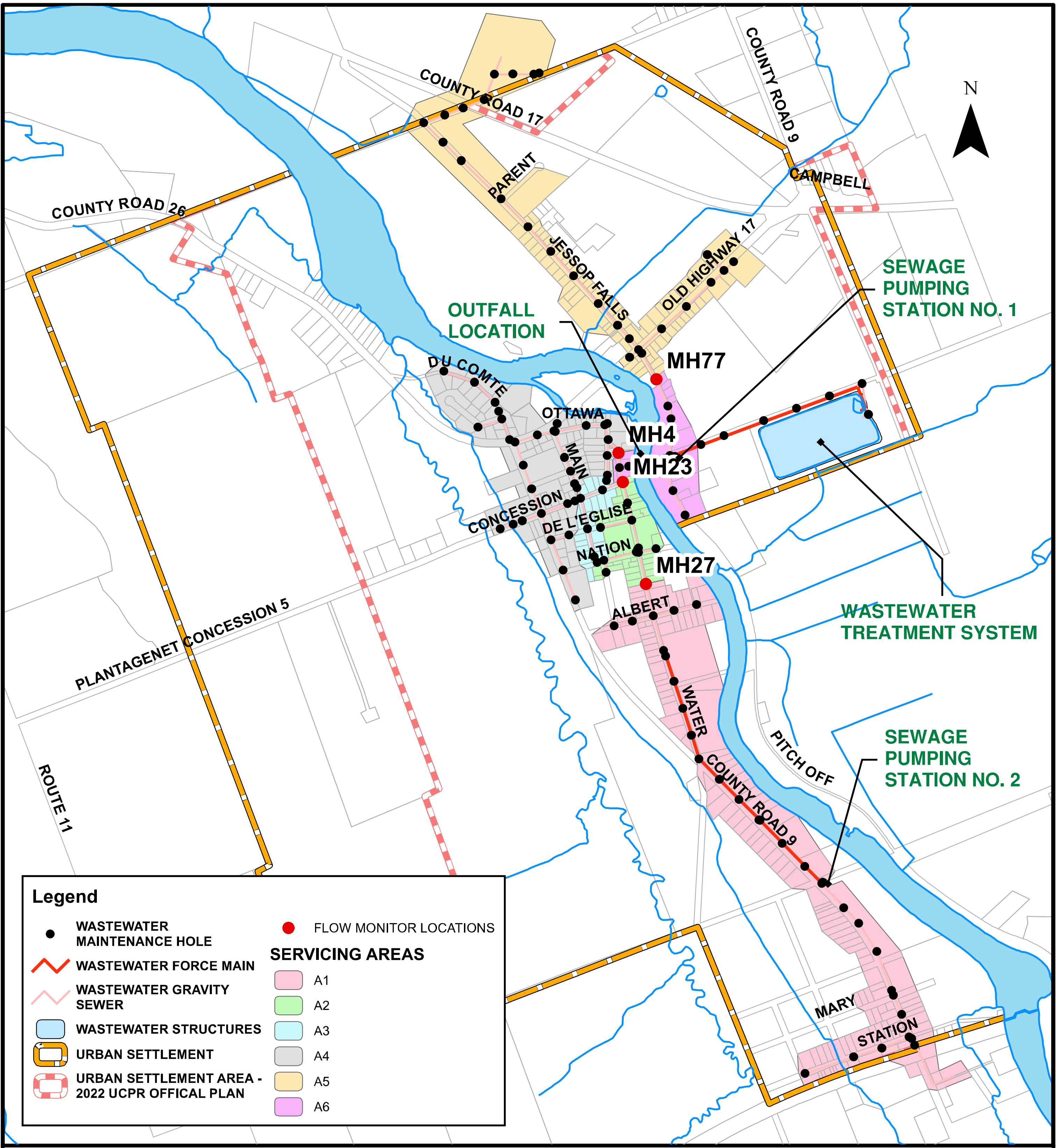
- Development of alternative solutions to meet the problem and opportunity statement identified in Phase 1. The preferred solution was established through an evaluation that consisted of an initial screening and detailed evaluation of the screened alternatives. An evaluation matrix was developed based on natural environment & archaeological, engineering & technical, social & community well being, and financial criteria, each weighted based on their relative level of importance. Refer to the Phase 2 Report (Appendix B) for details of the evaluation. The following preferred solution was developed for the Plantagenet Wastewater System:

    - Wastewater Treatment System: Expansion to a rated capacity of 2,020 m^3/day with additional lagoon storage and specialized treatment system(s) using an expanded discharge window (October 1 to May 31). Refer to Figure 9 for a conceptual site plan of this expansion. Refer to Section 4.0 for a summary of Phase 3 of the Class EA, which developed the preferred design concept for this upgrade.

    - Outfall from Wastewater Treatment System: Undertake hydraulic modelling of the existing WWTS outfall to determine the actual maximum flow capacity. It is noted that the outfall capacity is impacted by water levels in the South Nation River.

    - Sewage Pumping Stations & Forcemains: Upgrade SPS No. 1 and its associated forcemain to increase the rated capacity to 99.7 L/s, and upgrade SPS No. 2 and its associated forcemain to increase the rated capacity to 42.1 L/s.

    - Wastewater Collection System: Develop an Infrastructure Master Plan (including I&I Reduction Program) to identify upgrades to the wastewater collection system.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

PHASE 2 FLOW MONITORING STUDY - MONITOR LOCATIONS AND DELINEATED SERVICING AREAS

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FIGURE 8

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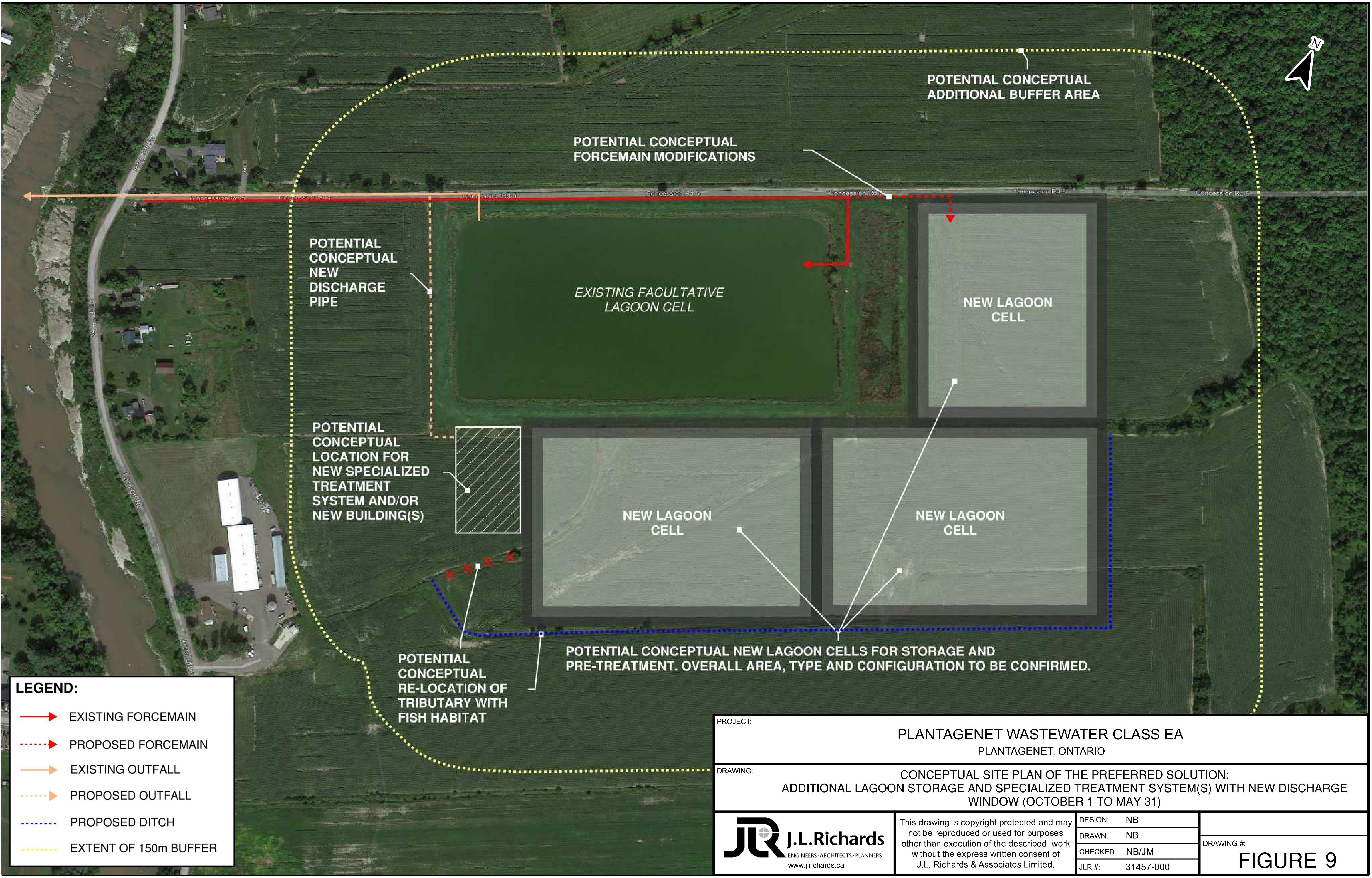

LEGEND:

- EXISTING FORCEMAIN
- PROPOSED FORCEMAIN
- EXISTING OUTFALL
- PROPOSED OUTFALL
- PROPOSED DITCH
- EXTENT OF 150m BUFFER

PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF THE PREFERRED SOLUTION:
ADDITIONAL LAGOON STORAGE AND SPECIALIZED TREATMENT SYSTEM(S) WITH NEW DISCHARGE WINDOW (OCTOBER 1 TO MAY 31)

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4.0 Phase 3: Development of a Preferred Design Concept

Phase 3 of the Class EA aimed to evaluate alternative design concepts for the preferred WWTS upgrade solution and establish a preferred design concept for the WWTS. For a full description of Phase 3, refer to Technical Memorandum No. 3 – Alternatives Design (Appendix C).

During Phase 3, a design basis summary (see Appendix C1) was provided to various suppliers of specialized treatment systems to obtain information and identify technologies currently available on the market that could meet the future requirements of the Plantagenet WWTS. The South Nation Conservation (SNC) TP Management (TPM) program was also reviewed as an alternative to a specialized treatment system for TP removal. The TPM program relies on the improvement of water quality by reduction of non-point sources of TP. Participation in the TPM program consists of a one-time payment to the SNC that is invested in capital projects that will contribute to reduce the overall TP loading to the South Nation River. Payment is calculated based on a per kg unit rate, the projected additional TP loading discharged to the South Nation River and a 4:1 offsetting ratio (e.g., 4 kg offset for every 1 kg discharged to the river).

Four (4) alternative design concepts were developed, each of which included technologies that could provide a process guarantee to meet the design effluent criteria. The preferred design concept was established through a detailed evaluation of the four (4) concepts based on financial and engineering & technical criteria, each weighted based on their relative level of importance. The following preferred solution was developed for the Plantagenet WWTS:

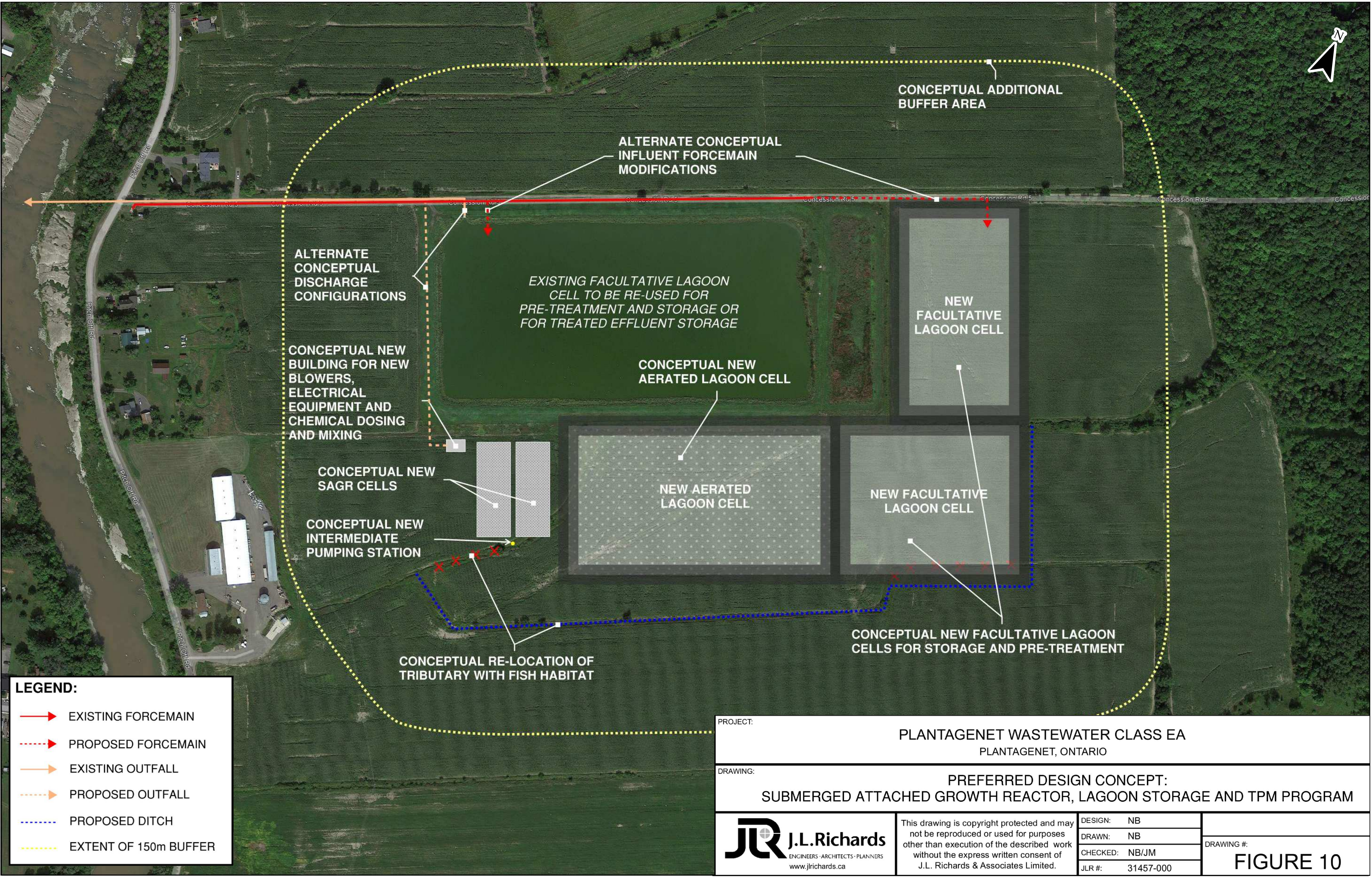
- Participation in the TPM program to eliminate the need for TP removal beyond an effluent concentration of 1.0 mg/L.
- Addition of lagoon cells for additional storage and pre-treatment, at least one of which is an aerated lagoon cell.
- Addition of two (2) parallel horizontal flow Submerged Attached Growth Reactors (SAGRs) for TAN removal and BOD_5 and TSS polishing.
- Addition of new blowers to meet aeration requirements.
- Addition of a chemical storage, dosing & mixing system for the removal of TSS and TP.
- Addition of a new electrical service, emergency backup generator, panels, and instrumentation.

- Addition of a new building to house the blowers, chemical storage, dosing & mixing system, and electrical equipment.

- Addition of an intermediate pumping station and other miscellaneous piping, chambers, and valves.

- Other miscellaneous upgrades and/or requirements to accommodate the above items (e.g., purchase of adjacent farmland, modifications to the existing lagoon, relocation of tributary intercepting the proposed expansion location, etc.).

Refer to Figure 10 for a conceptual site plan of the preferred design concept of the Plantagenet WWTS. A Class ‘D’ opinion of probable construction cost of $24M was developed for the above upgrade. It is estimated that once this system is fully commissioned, annual energy consumption and chemical consumption costs will be approximately $140,000.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

PREFERRED DESIGN CONCEPT:
SUBMERGED ATTACHED GROWTH REACTOR, LAGOON STORAGE AND TPM PROGRAM

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FIGURE 10

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5.0 Proposed Effluent Discharge Criteria

The effluent criteria for the expanded WWTS were approved by the MECP on February 29, 2024. Refer to Section 8.0 and the appendices for all consultation activities undertaken as part of the study. Refer to Table 1, Table 2, Table 3 and Table 4 below for the approved effluent criteria.

Table 1: Maximum Daily Effluent Discharge Rates – Phase 1 – 10-Year (2032).

Date Range	Maximum Daily Discharge Rate (m^3/d) (1)
October 1 to 31	Lower of 2,200 or outfall capacity
November 1 to 30	Lower of 6,100 or outfall capacity
December 1 to March 31	Lower of 4,500 or outfall capacity
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 8,500 or outfall capacity

Notes:

1. It is recommended that hydraulic modelling be completed to confirm the actual outfall flow capacity. It is expected that the outfall capacity is lowest in April due to high tailwater elevations (high water levels in the South Nation River).
2. Phase 1 – 10-Year (2032) Rated Capacity = 1,390 m^3/day

Table 2: Effluent Objectives and Limits – Phase 1 – 10-Year (2032).

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.4	5.0
Nov 1 – 30		6.0	7.5
Dec 1 – 31		9.6	12.0
Jan 1 – Feb 28		11.2	14.0
Mar 1 – 31		9.6	12.0
Apr 1 – 30		4.4	5.5
May 1 – 31		2.1	2.6
TP (1)	Monthly	0.75	1.0
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

Notes:

1. Loading that exceeds the total allowable loading of 204.8 kg will be offset through participation in the SNC TPM program.
2. Phase 1 – 10-Year (2032) Rated Capacity = 1,390 m^3/day

Table 3: Maximum Daily Effluent Discharge Rates – Phase 2 – 20-Year (2042).

Date Range	Maximum Daily Discharge Rate (m^3/d) (1)
October 1 to 31	Lower of 4,500 or outfall capacity
November 1 to 30	Lower of 10,800 or outfall capacity
December 1 to March 31	Lower of 7,600 or outfall capacity
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 15,100 or outfall capacity

Notes:

1. It is recommended that hydraulic modelling be completed to confirm the actual outfall flow capacity. It is expected that the outfall capacity is lowest in April due to high tailwater elevations (high water levels in the South Nation River).
2. Phase 2 – 20-Year (2042) Rated Capacity = 2,020 m^3/day

Table 4: Effluent Objectives and Limits – Phase 2 – 20-Year (2042).

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.4	5.0
Nov 1 – 30		6.0	7.5
Dec 1 – 31		9.6	12.0
Jan 1 – Feb 28		11.2	14.0
Mar 1 – 31		9.6	12.0
Apr 1 – 30		4.4	5.5
May 1 – 31		2.1	2.6
TP (1)	Monthly	0.75	1.0
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

Notes:

1. Loading that exceeds the total allowable loading of 204.8 kg will be offset through participation in the SNC TPM program.
2. Phase 2 – 20-Year (2042) Rated Capacity = 2,020 m^3/day

6.0 Potential Phasing of Upgrades

As previously noted, potential phasing of upgrades was requested by the Township to be reviewed due to the large magnitude and timing uncertainty of projected development. The ability to phase construction was a key consideration in the development of the preferred solution and design concept. This section will review a conceptual two-phase construction of the preferred design concept using the 10-year (2032) and 20-year (2042) growth projections previously developed. Note that, to an extent, phasing of the SPS upgrades is possible (e.g., pump sizes, etc.), however, it is unlikely to significantly reduce the capital cost of the upgrades due to limited amount of components that can be phased (e.g., wet well and building should be constructed to accommodate the 20-year pumping and electrical equipment).

Note that a Class D opinion of probable construction cost (OPCC) was prepared for the 10-year (2032) WWTS design concept based on available information, experience on similar projects and professional judgement. Note that a 30% contingency was added to the cost estimates based on the below definition of a Class D cost estimate:

- Definition of Work: A description of the option with such supporting documentation as is available (definition of project typically in the order of 1 to 5 percent).
- Intended Purpose: To aid in the screening of alternative potential design concepts prior to recommending a preferred design concept (not intended to establish or confirm budgets).
- Level of Effort: Is limited and expected accuracy could range from -30% to +30%.
- Dollar Value: 2023.

This OPC has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final project cost will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors. As a result, the final project cost will vary from the OPC presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

It was assumed that the Phase 1 WWTS design concept would include the below-noted components. Refer to Figure 11 for a potential conceptual site plan of the Phase 1 WWTS upgrades, and Figure 12 for a potential conceptual site plan of the Phase 2 WWTS upgrades.

- Estimated payment of $0.67M for participation in the TPM program, based on a system rated capacity of 1,390 m^3/day.

- Aerated lagoon sized for Phase 2, equipped with enough aerators to accommodate Phase 1 pre-tertiary treatment requirements. No additional storage or new facultative lagoons needed for Phase 1.

- Addition of two (2) smaller parallel horizontal flow SAGR cells for TAN removal and BOD_5 and TSS polishing with provisions to add two (2) additional cells in the future.

- Addition of new blowers to meet Phase 1 aeration requirements, considering provisions to accommodate additional blower(s) during Phase 2.

- Addition of a chemical storage, dosing & mixing system for the removal of TSS and TP.

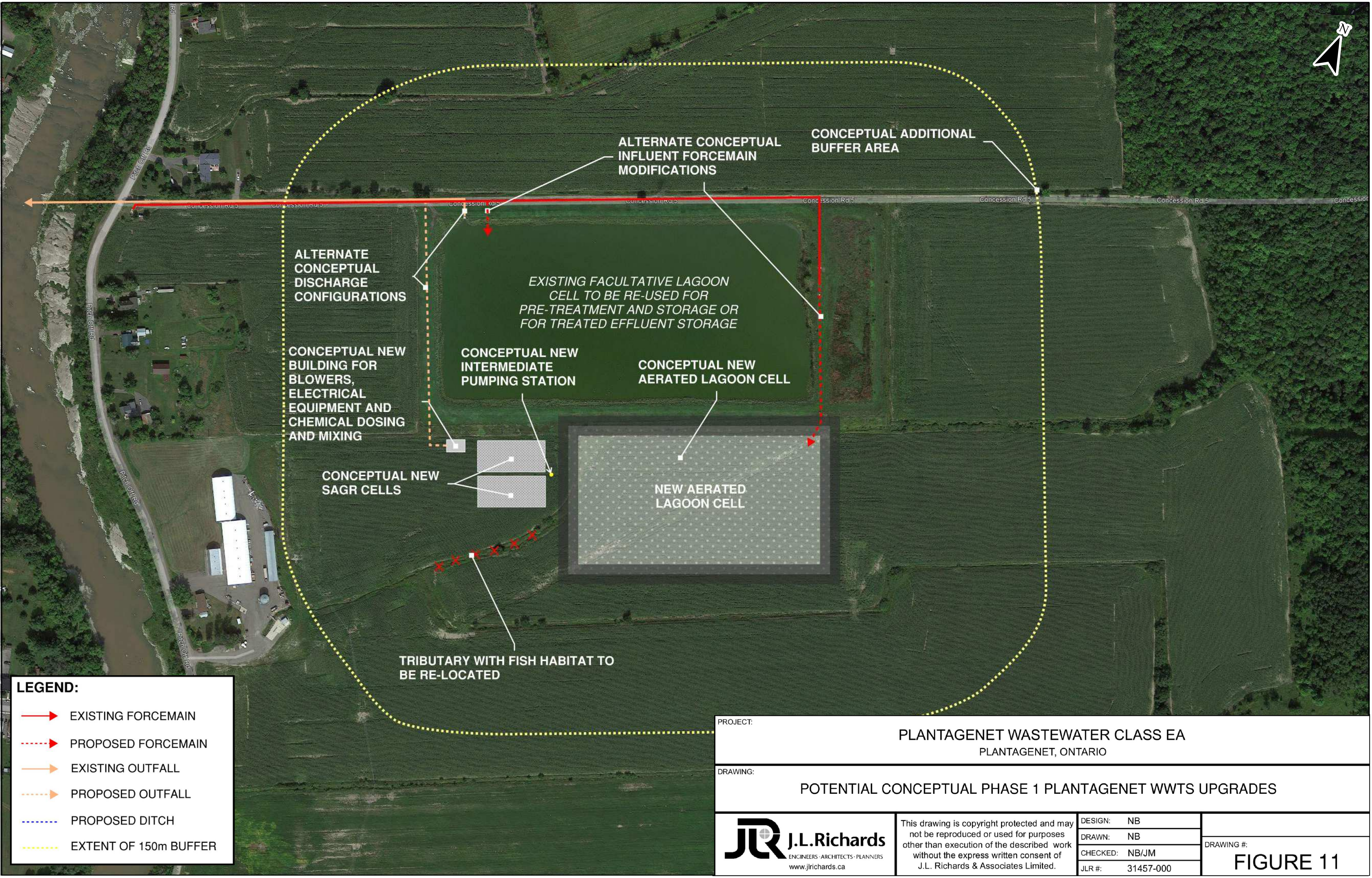
- Addition of a new electrical service and backup generator sized for Phase 2.

- Addition of a new building sized for Phase 2 to house the blowers, chemical storage, dosing & mixing system, and electrical equipment.

- Addition of an intermediate pumping station and other miscellaneous piping, chambers, and valves sized for Phase 2.

- Other miscellaneous upgrades and/or requirements to accommodate the above items (e.g., purchase of adjacent farmland, modifications to the existing lagoon, relocation of tributary intercepting the proposed expansion location, etc.). It is assumed that only land required for Phase 1 will be purchased and that the tributary will only be relocated as required for the Phase 1 upgrades.

Based on the above, a Class 'D' capital cost estimate of $17M was developed for the Phase 1 WWTS upgrades. It is also estimated that once the Phase 1 WWTS Upgrades are fully commissioned, annual energy consumption and chemical consumption costs will be approximately $95,000.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

POTENTIAL CONCEPTUAL PHASE 1 PLANTAGENET WWTS UPGRADES

J.L.Richards
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JLR #: 31457-000

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FIGURE 11

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LEGEND:

- → EXISTING / PHASE 1 FORCEMAIN
- ⇢ PROPOSED FORCEMAIN
- → EXISTING / PHASE 1 OUTFALL
- ⇢ PROPOSED OUTFALL
- ⋯ EXTENT OF 150m BUFFER

<u>NOTE</u>: SHADED INFRASTRUCTURE IS PROPOSED TO BE CONSTRUCTED AS PART OF THE PHASE 1 UPGRADES.

PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

POTENTIAL CONCEPTUAL PHASE 2 PLANTAGENET WWTS UPGRADES

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DRAWING #:
FIGURE 12

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 Figure6_opt4b.mxd

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7.0 Impact Mitigation Measures and Monitoring

This section describes mitigation measures to be undertaken to minimize potential effects from the construction of the upgrades to the Plantagenet WWTS. Refer for Table 5 for a summary of suggested mitigation measures.

Table 5: Suggested Mitigation Measures to Minimize Potential Effects.

Considerations	Suggested Mitigation Measure
Fish, Aquatic Wildlife and Vegetation	• Refer to the Natural Environment Study Report (Appendix A6) for more information on potential impacts and mitigation measures. • No work below the high-water level can take place on the South Nation River tributary (with fish habitat) without a review by the federal Department of Fisheries and Oceans (DFO). Furthermore, no work can occur within 120 m of fish habitat without a review of potential impacts, and the minimum setback from the tributary (provided there are no impacts) is 15m. Prior to the start of design of the upgrades, a study should be completed to review the relocation of the South Nation River tributary and the constraints on the design and construction of the upgrades (e.g., setbacks, working windows, etc.). • Dewatering flows to receive proper filtering and treated water to be directed away from watercourses. Rock check dams with filter cloth and/or straw bale carriers to be placed, as required, in swales and silt fencing properly installed and maintained during construction. • Avoid tree removal near surface waterbodies to prevent sunlight from reaching the waters. Restoration planting to take place in the case that tree removal is required. In disturbed areas, watercourse beds and banks are to be stabilized with clean shot rock.
Terrestrial Vegetation and Wildlife	• Refer to the Natural Environment Study Report (Appendix A6) for more information on potential impacts and mitigation measures. • A butternut survey is to be completed prior to clearing vegetation from any area. Survey to be completed between May 15 and August 31 (green-leaf period). Should butternuts be identified, they will need to be assessed and the appropriate actions taken. Note that butternut surveys are valid for 2 years. • Potential impacts to Whip-poor-wills (Category 3) to be mitigated by clearing vegetation outside of their breading period

	(May 1 – July 31) and restricting work activities to daytime during this period. • Potential impacts to grassland-breeding birds (Bobolink and Eastern Meadowlark) to be mitigated by ensuring adjacent agricultural fields (currently planted in corn or soy) are not left fallow or planted in hay or cereal at the time of land clearing or other adjacent work activities. • Potential impacts to the little brown myotis bat to be mitigated by educating Contractors that most bats in Ontario are protected, and by removing all trees with a diameter of 10cm or larger (fencerows and forests) outside of the active season (April 1 – September 30) or by conducting exit surveys prior to cutting down any trees within the active bat season. • Active bird nests, eggs, or nestlings (in trees or in the ground) are not to be destroyed or disturbed. The standard nesting period in this region of Ontario is approximately April 5 to August 28. • When possible, work to be completed during daytime hours to prevent light disturbances. Heavy equipment to have mufflers to reduce noise disturbances. • Suspected turtle nests within the construction site to be identified and given a 10m buffer to protect the nest. The MECP (for Species at Risk) or the MNRF (for other species) to be contacted. • Removal of woody vegetation to be minimized as much as possible. • If vegetation/trees are disturbed/removed, re-vegetation or compensating restoration to be provided. Sedimentation and erosion control measures to be in place and maintained until re-vegetation or disturbed areas is complete. Re-vegetation with native trees is recommended. • Trees adjacent to the construction area to be protected by buffer fencing placed at a recommended distance. Construction equipment or materials will not be permitted within the protective fencing.
Heritage Resources	• Refer to the Stage 1 Archaeological Assessment Study Report (Appendix A7) and Desktop Cultural Heritage Assessment Report (Appendix A8) for more information on potential features and mitigation measures. • A Stage 2 archaeological assessment is to be undertaken in areas of archaeological potential that could be impacted by the upgrades. It is noted that a pedestrian survey at an interval of 5m was identified for the agricultural area surrounding the existing lagoon site.

	• Identified or potential heritage resources are not to be impacted by construction of the upgrades. If there is potential that a heritage feature is impacted by the upgrades, an impact assessment is to be undertaken during detailed design to evaluate any impact from the upgrades and identify avoidance/mitigation measures. It is noted that there are no potential heritage features within the proposed expansion area. • If any burial features are encountered, work is to stop immediately, and appropriate next steps, as identified in Appendix A7, are to be followed.
Agricultural	• Continued notification and liaison with landowner of adjacent agricultural lands. • Locate and design facilities to minimize land purchase requirements and disturbance of adjacent non-purchased agricultural lands.
Residential, Institutional, Commercial, and Industrial	• Notify public agencies and adjacent owners of construction scheduling. • Advise/distribute contact number to adjacent owners and develop protocol to document and address inquiries and/or complaints. • Stage construction activities to minimize impacts. Incorporate odour control measures identified during the design phase. • Preparation of emergency programs to ensure quick resolution of possible servicing problems. • Design upgrades to maintain a minimum 150 m buffer from sensitive receivers.
Outdoor Recreation	• Construction to be staged to minimize disruption to open space activities. • Upgrades to be designed to avoid overflows and direct discharges to the river during non-discharge periods. • Protect or temporarily relocate existing public areas adjacent to expansion area.
Soils Geology and Groundwater	• Additional sub-surface information will be required at the site to address specific design features, as well as characterize the geotechnical and hydrogeological conditions of the site. Design of upgrades to be based on geotechnical and hydrogeological recommendations. • Erosion and sedimentation control measures to protect stockpiled material. • Prevent soil contamination by employing measures to avoid spills and leaks. Ensure Contractor has a contingency plan prepared, and appropriate spill containment measures on-hand in the case of spills or other accidents.

	• Seepage from lagoons into groundwater to be mitigated with liners. This should be reviewed in more detail during the design of the upgrades. • Where possible, construction activities to be located away from groundwater users and water bearing formations. Refueling and storage areas to be in areas with lower potential for environmental effects. • Required permits to be identified based on anticipated dewatering volume. Proper dewatering techniques to be used. Seasonal dewatering constraints, if any, are to be identified to the Contractor.
Climatic Features	• Vegetation to be retained as much as possible, and if necessary, restored promptly to prevent the reduction of windscreen effect on adjacent activities. • Use of pervious pavement or reduction in impervious surfaces to be reviewed to manage or reduce stormwater runoff and on-site flow control. • Treatment system to be designed to account for potentially higher influent flows as a result of climate change (e.g., storage requirements and influent quality). • Design of upgrades should review anticipated greenhouse gas emissions and implement strategies to reduce emissions.
Public Health	• For any spill or emergency condition, provide notice and make appropriate contact with emergency services and potentially affected public and agencies. • Good practice measures for noise, dust, odour and emission control and minimization to be employed during construction and operation. Municipal by-laws and provincial regulations for working hours and noise to be followed. Air & Noise study, if required, to be undertaken during design for the implementation of a new backup generator.

8.0 Consultation

This EA study has met the consultation requirements for a Schedule ‘C’ Municipal Class EA, as shown in Figure 3. Refer to the Consultation Summary in Appendix D for a full summary of consultation activities undertaken during the Class EA, including notices, public information centers (PICs) and correspondences between the project team and the public, Indigenous Communities, agencies, and other interested stakeholders.

9.0 Next Steps and Study Milestones

As described in Section 1.2, upon issuance of the Study Notice of Completion, the public, Indigenous Communities, agencies, and other interested stakeholders will have 30 calendar days to review the Environmental Study Report. This period is followed by a 30-day waiting period to allow the MECP to request or notify proponents of a ‘Section 16 Order’. Following the 30-day waiting period, if there are no requests received from the MECP, the project may then proceed to implementation (Phase 5).

The study has identified the following recommended next steps for the Township in proceeding towards implementation of the preferred solution and design concept:

Prior to Design:

- Confirm design concept to be carried forward to design (WWTS and SPSs).
- Procure land required for the expansion of the WWTS.
- Undertake a study to review the relocation of the South Nation River tributary. As part of the study, stakeholders are to be consulted (including DFO, SNC and MECP) and a proposed path forward is to be developed.

During Preliminary Design:

- Undertake hydraulic modelling of the WWTS outfall to determine the actual maximum discharge flow capacity for each proposed discharge month (October to May).
- Undertake a butternut survey between May 15 and August 31 (green-leaf period) at each site to be impacted by construction activities (SPSs and WWTS).
- Undertake a Stage 2 archaeological assessment of areas with archaeological potential that could be impacted by the upgrades (e.g., lands surrounding the WWTS site).
- Undertake consultation with the MECP to finalize WWTS effluent criteria.
- Undertake consultation with the SNC and MECP for the TPM program.
- Undertake detailed geotechnical and hydrogeological investigations at the WWTS and SPS sites. The investigations at the WWTS site are to include a review of potential seepage from the existing facultative lagoon.
- Identify or apply for all necessary permits and approvals for the construction of the upgrades (e.g., amended Environmental Compliance Approval, Permit to Take Water / Environmental Activity and Sector Registration, electricity, DFO, etc.).

Other Recommended Next Steps:

- Undertake CCTV inspection of preliminarily identified key areas within the sanitary collection system (e.g., Areas A2 and A4, and MH-3 to MH-10) to potentially implement solutions to minimize extraneous flows.

- Develop and implement a I&I Reduction Program to plan and implement strategies and improvements to the collection system to minimize the volume of extraneous flows. It is recommended that the planning portion of this program be completed through an Infrastructure Master Plan (IMP), which would allow for the assessment of the condition and capacity of the existing sanitary sewer collection system (through modelling), and identify the scope, cost, and timeline of any proposed improvements to the system.

10.0 References

1. Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers and Managers, United States Environmental Protection Agency, August 2011.
2. Stanley Consulting Group Ltd., Environmental Study Report – Sewage System – Village of Plantagenet OCWA Project No. 3-0946-01, July 1998.
3. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 4th Edition, 2003.
4. Stantec Consulting Ltd., Township of Alfred and Plantagenet, Plantagenet Sewage Treatment System, Final Report, October 5, 2015.
5. Ontario Clean Water Agency, Performance Assessment Report Data (2016-2020).
6. Ministry of the Environment, Design Guidelines for Sewage Works, 2008.
7. City of Ottawa, Ottawa Design Guidelines – Sewer, Second Edition, October 2012.
8. City of Ottawa, Technical Bulletin ISTB-2018-1 – Revisions to Ottawa Design Guidelines – Sewer dated 2012, March 2018.
9. United Counties of Prescott and Russell, Adopted Official Plan, 2022.
10. Hemson Consulting Inc., Growth Management Strategy Final Report, March 30, 2022.
11. Municipal Engineers Association, Municipal Class Environmental Assessment document, March 2023.

This report has been prepared by J.L. Richards & Associates Limited for the Township of Alfred and Plantagenet's exclusive use. Its discussions and conclusions are summary in nature and cannot properly be used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report is based on information, drawings, data, or reports provided by the named client, its agents, and certain other suppliers or third parties, as applicable, and relies upon the accuracy and completeness of such information. Any inaccuracy or omissions in information provided, or changes to applications, designs, or materials may have a significant impact on the accuracy, reliability, findings, or conclusions of this report.

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J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

LICENSED PROFESSIONAL ENGINEER
N. R. BIALIK
100530276
2024-03-26
PROVINCE OF ONTARIO

Nicolas Bialik, P.Eng.
Environmental Engineer

Prepared by:

Camila Valcarcel, EIT
Environmental Engineering Intern

Reviewed by:

LICENSED PROFESSIONAL ENGINEER
2024-03-27
J.M.C. MORRISSETTE
100151410
PROVINCE OF ONTARIO

Jordan Morrissette, M.Eng., P.Eng.
Associate, Manager, Ottawa Civil and Environmental Department

Appendix A

Phase 1 Report

JLR No.: 31457-000
Revision: 0

April 26, 2023

Prepared for:

TOWNSHIP OF ALFRED AND PLANTAGENET
205 Old Highway 17, P.O. Box 350
Plantagenet, ON
K0B 1L0

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
343 Preston Street, Tower II, Suite 1000
Ottawa, ON
K1S 1N4
TEL: 613-728-3571

Phase 1 Report

Plantagenet Wastewater Municipal Class Environmental Assessment

Value through **service** and **commitment**

Table of Contents

List of Appendices

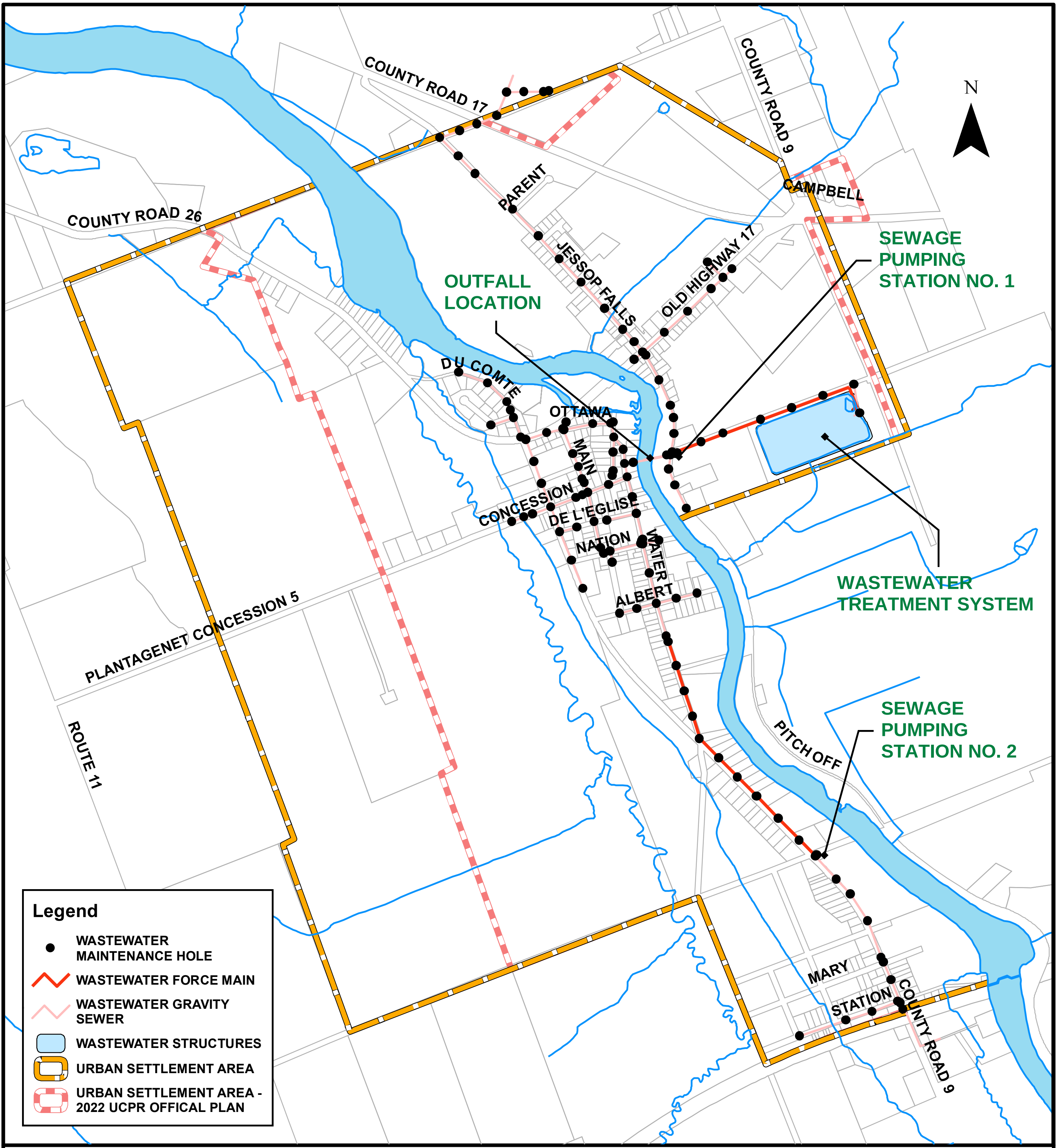
1.0 Introduction

1.1 Background

The Village of Plantagenet (Village) is located approximately 60 km east of the City of Ottawa and 7 km south of the Ottawa River, in the Township of Alfred and Plantagenet (Township) and United Counties of Prescott and Russell (UCPR). The Village is situated along the South Nation River, in the Lower South Nation River watershed, at the intersection of County Road 9 and Old Highway 17. According to the Township's Official Plan, the Plantagenet urban area covers an area of approximately 600 ha, a large portion of which is currently farmland. Village residents are serviced by a communal potable water supply/distribution system, and a communal wastewater collection/treatment system. Refer to Figure 1 for an overview of the study area and wastewater collection system.

The existing wastewater collection and treatment system is owned by the Township and operated by the Ontario Clean Water Agency (OCWA). It consists of several kilometers of gravity sewers, two (2) sewage pumping stations (SPSs) (one main SPS and one sub-area SPS), a lagoon-based wastewater treatment system and a gravity outfall to the South Nation River. The lagoon-based wastewater treatment system operates under Amended Certificate of Approval (C of A) No. 4631-5WXQE9 (refer to Appendix A). The system, constructed in the early 1970s, consists of a single cell 6.9 ha facultative waste stabilization pond that is batched dose with alum prior to seasonal discharge (spring and fall). Refer to Figure 2 for an overview of the Plantagenet wastewater treatment system (WWTS).

Since 1988, the treatment system has operated at or above its rated capacity of 561 m^3/day, and the lagoon itself has been required to operate at its storage limit to avoid discharging during non-allowable discharge windows. The system has also regularly exceeded its seasonal total suspended solids (TSS) and 5-day biological oxygen demand (BOD_5) objectives and limits. These factors have resulted in non-compliance issues with the MECP. The Township has implemented some upgrades to the SPSs, minor repairs to the collection system manholes and de-sludging of the lagoons; however, no upgrades have been completed to date to address capacity and/or quality limitations associated with the WWTS. Although there has been minimal population growth within the Village in the last 20 years, the Township has noted that there has been recent interest in new development that would result in an increased serviced population for the wastewater system. To accommodate this development and resolve previous non-compliance issues, the Township is undertaking a Municipal Class Environmental Assessment (Class EA) study to evaluate alternatives to expand and/or upgrade their wastewater system. The study will aim to establish reliable, robust and cost-effective solutions with low to medium operational complexity and flexibility to meet both current and anticipated future servicing requirements. The Township has retained J.L. Richards & Associates Limited (JLR) to assist them in completing the Class EA.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

STUDY AREA

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FIGURE 1

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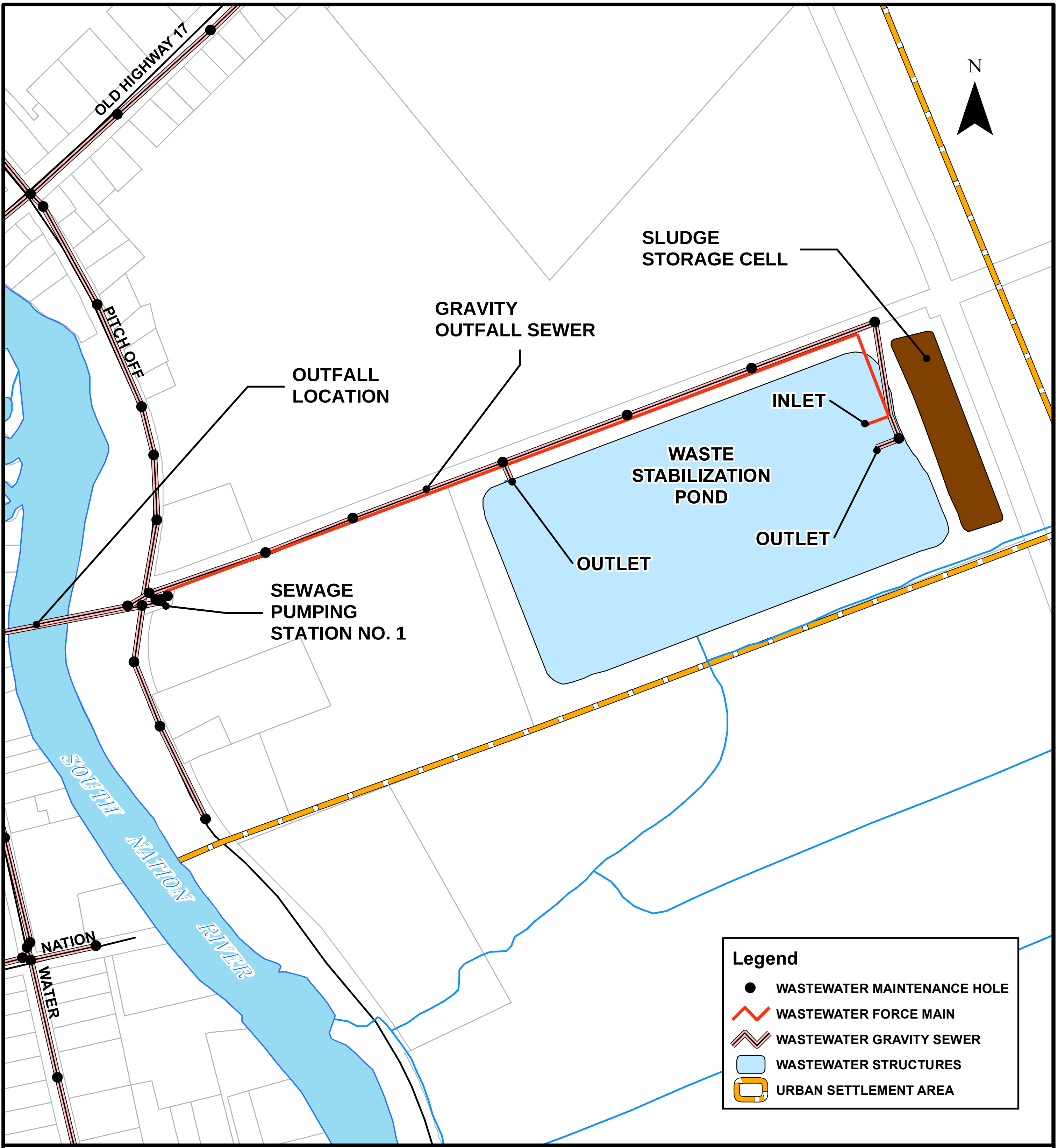

PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

PLANTAGENET WASTEWATER TREATMENT SYSTEM

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JLR #:	31457-000

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FIGURE 2

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1.2 Municipal Class Environmental Assessment Process

The Ontario Environmental Assessment Act (Act) sets out a planning and decision-making process so that potential environmental effects are considered before a project begins. The purpose of the Act is to provide for the protection and conservation of the natural environment (R.S.O. 1990, c.E.18, s.2).

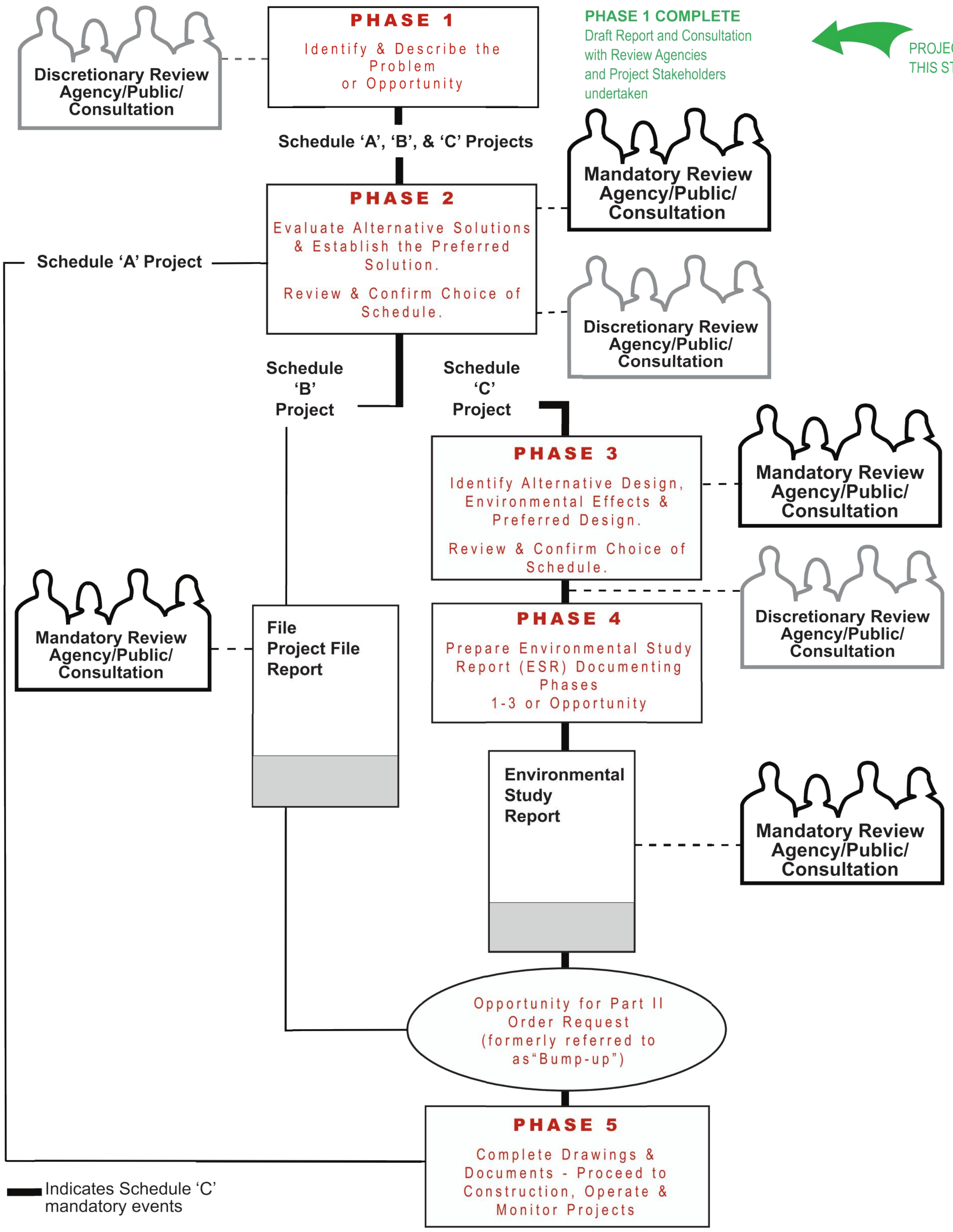
The Municipal Class EA process is followed for common types of projects to streamline the review process while ensuring that the project meets the requirements of the Act. It involves detailed site-specific information gathering and studies, as well as consultation with the public and stakeholder agencies. Different schedules are followed depending on the type of project to be completed and their impact on the environment. These include Schedule A, Schedule A+, Schedule B and Schedule C, each more involved than the last. In 1987, the first Class EA document, prepared by the Municipal Engineers Association (MEA) on behalf of Ontario Municipalities, was approved under the Act. Updates and amendments were subsequently made in 1993, 2000, 2007, 2011, 2015 and 2023.

This Class EA was initiated as a Schedule C project under the Class EA process because it was expected that the Plantagenet WWTS would need to be increased beyond its existing rated capacity. Projects categorized as Schedule C undertakings have the potential for significant environmental effects, and are required to follow the full planning and design process specified under the Municipal Class EA. This includes consultation with all parties that may potentially be affected by the project, and the preparation of an Environmental Study Report (ESR) that documents the Class EA process that was followed for the project.

The Class EA framework (refer to Figure 3) defines the process for each type of project. For Schedule C projects, the completion of the following Phases of the Class EA process is required:

- Phase 1 – Identify the Problem and/or Opportunity
- Phase 2 – Identify Alternative Solutions to the Problem and/or Opportunity
- Phase 3 – Identify Alternative Design Concepts for the Preferred Solution
- Phase 4 – Preparation of Environmental Study Report
- Phase 5 – Implementation

The Environmental Study Report shall be made available for public and agency review at the completion of Phase 4 of the Class EA process for a mandatory 30-day period. If there are no requests to the Minister of the Environment, Conservation and Parks (MECP) for a ‘Part II Order’ within this 30-day review period, then the project may proceed to implementation (Phase 5). The Class EA is proceeding in accordance with the Schedule C requirements of the Ontario Municipal Class EA, but the Schedule will be reconfirmed at the end of Phase 1 or 2 when the project types and scopes of each project are further established.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

CLASS EA PROCESS

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CHECKED: SG
JLR NO:
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FIGURE 3

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1.3 Objectives of the Class Environmental Assessment

The objective of this Class EA is to identify the preferred servicing option(s) for the Plantagenet Wastewater System for the 20-year planning horizon (to 2042). All components of the wastewater system will be reviewed, including the wastewater treatment system, gravity collection system, sewage pumping stations and gravity outfall to the South Nation River.

This Phase 1 Report provides a summary of existing background information and identifies the problems/opportunities associated with the existing wastewater system. This Report serves as the basis for moving forward into Phase 2 of the Class EA, which will involve identifying and evaluating solutions to the identified problems/opportunities.

It is planned that two (2) technical memoranda will be developed throughout the course of the Class EA at various milestones which will be used to identify specific issues or existing conditions that will allow decisions to be made to advance the project forward. The technical memoranda will cover the following topics:

- TM-1: Design Basis (included as Appendix C)
- TM-2: Climate Change Impacts (to be developed during Phase 2)

2.0 Phase 1 Methodology

2.1 Compilation of Documentation

A documentation request was prepared by JLR and provided to the Township in November 2021. Available documentation from the Township and JLR's files was subsequently compiled and reviewed in detail. General sources of information are listed below and documented further in the list of available documentation (refer to Appendix B).

The main sources of information for the Phase 1 background review included:

- Existing Drawings
- Sewage Quality and Quantity Data (excel format)
- Amended Certificate of Approval
- MECP Annual Reports and Inspection Reports
- Operation Manuals
- Previous Studies and Reports
- Planning Documents

2.2 Stakeholder Consultation

The Class EA process requires consultation with parties that may potentially be affected by the project. As part of Phase 1, a consultation plan was prepared to facilitate communication with the public, indigenous communities, agencies, and other interested stakeholders. Refer to Appendix D for the Phase 1 Stakeholder Consultation Summary, which includes the Consultation Plan and other supporting documentation.

Key components of consultation completed during Phase 1 include:

- Development of a Stakeholder Consultation Plan
- Notice of Study Commencement
- Maintaining Stakeholder Mailing List and Contacts
- Responding to Stakeholder Comments
- Project Committee and Other Consultation Meetings

2.3 Preparation of Base Maps / GIS

A digital base map was updated for the project area based on available information supplied by the Township and the UCPR. It should be noted that this base map was based on available maps from other reports and sources and, therefore, it should be considered a schematic representation of the project area. The base map has been used to develop key figures to assist in providing an overview of the Plantagenet WWTS, the pumping and collection system and the projected developments within the urban area.

2.4 Development of a Problem/Opportunity Statement

Based on a review of available documentation and initial stakeholder consultation, a problem/opportunity statement was developed. This statement is presented within Section 10.0 of this report.

2.5 Phase 1 Summary Report

This Phase 1 Report is the culmination of the first phase of the Class EA process. The Report was provided in Draft form to Township/OCWA staff for comment prior to proceeding to Phase 2. It will be used as a background document for subsequent phases.

3.0 System History

1974 - The Plantagenet Wastewater System was designed during the early 1970s and fully constructed and operational by 1974. It included a single-cell facultative sewage lagoon with gravity outfall to the South Nation River, two (2) sewage pumping stations and underground gravity sewers.

1991 - The Village passed a resolution to ensure that the Provincial Water Quality Objectives (PWQO's) are met for discharges from their lagoon to the South Nation River.

1998 - In July 1998, Stanley Consulting Group Ltd. completed an Environmental Study Report for the Village Wastewater System as part of a Schedule C Class EA process. A Schedule C Class EA was undertaken due to routine exceedances of the operational capacities of the sewage lagoon and sewage pumping stations, which were restricting development within the Village. High extraneous flows from structural deficiencies in the collection system and cross-connections from storm drainage facilities, as well as insufficient controls at the pumping stations, were also identified in the ESR as significant issues.

The Class EA projected a 20-year (2018) equivalent population of 1,444 and average daily flow of 823 m^3/day. Preferred design concepts were identified for the sewage lagoon and outfall, sewage pumping stations and collection system. The selected design concept for the sewage lagoon included raising the berms of the existing lagoons by 0.2 m to increase the operating depth to 1.7 m (resulting in total capacity of approx. 105,000 m^3) and adding a 1.8 ha aerated lagoon east of the existing lagoon with an operating depth of 2.0 m (for an additional 30,500 m^3 capacity). This option was noted as being the most economical while meeting the environmental constraints of the receiving stream. A new higher-capacity outfall was also recommended to replace the existing outfall along the same alignment, and it was noted that the final outlet structure was to be studied during detailed design to avoid a spawning shoal identified during the study. The preferred solution for the sewage pumping stations included increasing the rated capacity of each pumping station by replacing the stations and rehabilitating or replacing each forcemain. The preferred solution for the collection system included no work to the main sewers, the continuation of work on the rehabilitation of service laterals and the correction of extraneous flows to reduce operating costs and free up capacity in the future.

2004 - The MECP issued amended C of A No. 4631-5WXQE9, dated April 23, 2004, with updated effluent criteria for the Plantagenet wastewater system (C of A includes wording for sewage treatment plant, two (2) sewage pumping stations and the effluent discharge). Effluent criteria were established for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), total phosphorous (TP) and pH. Monitoring of these parameters as well as total ammonia nitrogen (TAN) was also established.

2008 - Drinking water plant process wastewater (clarifier sludge and filter backwash) stopped being released into the Plantagenet sewage lagoon, reducing the overall influent wastewater volume by an estimated 15%.

2015 - Stantec Consulting Ltd. submitted a study report of the Plantagenet WWTS on May 15, 2015. The study report included "*the assessment of hydraulic flows, effluent quality, compliance with effluent criteria, and recommendations for improvements to the Plantagenet Lagoon, including Environmental Assessment implications and costs.*" It did not recommend an increase in the capacity of the lagoon, but instead recommended separating the existing lagoon into two (2) equal-sized lagoon cells and adding a process building to provide aeration to Cell 2 for the purpose of reducing organic loading and improving the overall effluent quality.

1998 to 2021 - Since the 1998 Class EA, the following upgrades were completed to address some of the problems identified at the time:

- Upgrades to both pumping stations, including replacement of pumps and valves, installation of an ultrasonic level control system, and stand-by power;
- Minor repairs to manhole covers in the collection system to prevent stormwater infiltration;
- Installation of check valves and manual isolation valves on both the pumping station overflow pipes and the overflow pipe from the lagoon to prevent backflow; and
- De-sludging of the lagoon (completed between 2010-2013).

2021 - A Class EA was initiated to expand and/or upgrade the Plantagenet wastewater system. The study aims to establish reliable, robust and cost-effective solutions with low to medium operational complexity and flexibility to meet both current and anticipated future servicing requirements.

4.0 Description of Existing Conditions

4.1 Physical Description of Existing Infrastructure

The Village of Plantagenet Wastewater System generally consists of:

- A gravity sewer collection system, including a gravity crossing of the South Nation River;
- One sub-area sewage pumping station and associated forcemain;
- One main sewage pumping station and associated forcemain;
- A lagoon wastewater treatment system; and
- A gravity outfall to the South Nation River.

The system operates under MECP Amended C of A No. 4631-5WXQE9 (see Appendix A).

4.1.1 Gravity Collection System

The majority of the Village gravity sewer collection system was built in the early 1970s through MECP Project No. 1-0078-67, "*Sanitary Sewer Collection and Disposal System – Village of Plantagenet*". Refer to Appendix E for the project's as-built drawings. As part of this project, approximately 7.9 km of asbestos cement gravity sewer mains, two (2) sewage pumping stations with associated forcemains and a gravity crossing of the South Nation River were installed. Immediately following this project, the collection system was extended an additional 0.4 km to service a French catholic high school located on County Road 17. Since the 1970s, the collection system has only been extended another 0.25 km. The collection system currently includes approximately 8.5 km of gravity sewer mains varying in size from 200 mm to 375 mm. Refer to Table 1 for a summary of sewer main sizing within the system. The system also includes over 100 precast concrete maintenance holes and hundreds of sewer laterals connecting to the sewer mains.

Table 1: Size Classification for Plantagenet Wastewater Collection System Gravity Sewer Mains.

Nominal Pipe Size	Approx. Length of Pipe	Percentage
200 mm	6,769 m	80.0%
250 mm	910 m	10.8%
300 mm	634 m	7.5%
375 mm	145 m	1.7%
	8,458 m	**100%**

As noted in Section 3.0, the collection system has had issues historically with high flow contributions from extraneous sources. Previous studies have noted that these flows were caused mainly by illegal cross-connections from stormwater drainage facilities (direct connections from sump pumps, tile drains, etc.), but also by structural deficiencies in the sewer service laterals (inflow and infiltration (I&I)). The Township and OCWA have noted that some improvements have been made to the system to minimize these flows (e.g., new maintenance hole covers, rehabilitation of service laterals and removal of illegal connections), but that they may still have a significant impact on the total generated wastewater volume, especially in the older parts of the Village that do not have storm sewers. A flow monitoring study will be completed in Phase 2 of the Class EA to further analyze this issue.

4.1.2 Sewage Pumping Stations

There are two (2) sewage pumping stations in the Plantagenet Wastewater System; one sub-area sewage pumping station and one main sewage pumping station. The sub-area sewage pumping station pumps sewage from a low-lying area to a gravity sewer located downstream at a higher elevation, and the main sewage pumping station pumps sewage collected from the entire wastewater servicing area to the sewage treatment lagoon. Refer to Figure 1 for an overview of the location of each sewage pumping station and Appendix E for the original as-built drawings of these pumping stations. A general description of each sewage pumping station is provided below. The Township noted that both pumping stations have been upgraded in recent years (including the installation of new higher-capacity pumps at both stations), however they also noted that other upgrades may be required, including repairs to the landings in both pumping stations and the replacement of the emergency generator at the sub-area pumping station.

Sewage Pumping Station No. 1 (Main Pumping Station):

Sewage Pumping Station No. 1 (SPS #1) is the main sewage pumping station. It is located east of the South Nation River on Pitch-Off Road at the intersection with Concession Road 5. SPS #1 receives raw wastewater from the entire collection system and pumps it via an 890 m long, 200 mm diameter forcemain to the lagoon inlet distribution box. SPS #1 consists of one 2.4 m diameter, 10.2 m deep precast concrete wet well equipped with two (2) submersible pumps, one duty and one standby, rated to pump sewage at a rate of 29.2 L/s. The SPS site has a footprint of approximately 345 m^2, an outdoor emergency generator, various uncovered electrical and control panels and is separated from adjacent farmland with short wire fencing. Refer to Table 2 for a summary of pumping station components and operation.

Table 2: Sewage Pumping Station No. 1 (SPS #1) Components and Operation.

Component	Description	Operation / Capacity
Pumps	Two (2) three-phase, 18 HP (575 V) submersible pumps	One duty, one standby; lead/lag configuration Rated capacity of each pump of 29.2 L/s
Controls & Alarms	Ultrasonic level control system and floats; high-level alarm	Level system can be pre-set and adjustable; control power to pumps (alternating duty / standby)
Flow Measurement	Toshiba electromagnetic flow meter	100 mm diameter, housed in concrete chamber
Influent Screening	Static bar screen	1 m x 0.3 m metal screen with approx. 21 mm spacing
Emergency Power	SDMO Outdoor Diesel Generator	125 kVA, 100 kW
Emergency Overflow	Overflow pipe	300 mm diameter emergency overflow to South Nation River
Maintenance Equipment	Permanent davit arm and by-pass chamber	1 ton davit arm

Sewage Pumping Station No. 2 (Sub-Area Pumping Station):

Sewage Pumping Station No. 2 (SPS #2) is a sub-area pumping station located west of the South Nation River on County Road 9, just south of Prescott-Russel Emergency Services Station No. 7. The pumping station receives raw wastewater from gravity sewers further south than 135 m south of Albert Street and pumps it via a 970 m long, 125 mm diameter forcemain to a downstream maintenance hole located 115m south of Albert Street. SPS #2 consists of one 2.4 m diameter, 3.6 m deep precast concrete wet well equipped with two (2) submersible pumps, one duty and one standby, rated to pump sewage at a rate of 10.6 L/s. The SPS site has a footprint of approximately 410 m^2, gravel access road, small brick generator building and is separated from adjacent farmland with short wire fencing. Refer to Table 3 for a summary of pumping station components and operation.

Table 3: Sewage Pumping Station No. 2 (SPS #2) Components and Operation.

Component	Description	Operation / Capacity
Pumps	Two (2) three-phase, 18 HP (575 V) submersible pumps	One duty, one standby; lead/lag configuration Rated capacity of each pump of 10.6 L/s
Controls & Alarms	Ultrasonic level control system and floats	Pre-set and adjustable; control power to pumps (alternating duty / standby)
Influent Screening	Static bar screen	1 m x 0.3 m metal screen with approx. 21 mm spacing
Emergency Power	Dorman diesel-powered generator	15 kW
Emergency Overflow	Overflow pipe	Unknown size; equipped with check valve and manual isolation valve
Maintenance Equipment	Permanent davit arm and by-pass pipe	1 ton davit arm

4.1.3 Sewage Treatment Lagoon

The sewage treatment lagoon is located on the south side of Concession Road 5 and consists of a single seasonally discharged facultative lagoon. Refer to Figure 2 for an overview and Appendix E for original as-built drawings of the lagoon treatment system. The lagoon has an area of approximately 6.9 ha, design operating depth of 1.5 m and operating capacity of 92,577 m^3. The system's rated capacity of 561 m^3/day was established based on a 165-day retention period. Raw wastewater is pumped from SPS #1 to an inlet distribution box on the east side of the lagoon. It then flows by gravity via a 250 mm diameter pipe to the lagoon inlet located 30 m west of the inlet distribution box. Wastewater is then retained in the lagoon until it is discharged semi-annually in the spring and the fall. Refer to Section 4.7 for the allowable discharge windows under amended C of A No. 4631-5WXQE9. Five to seven days prior to discharge, alum (coagulant) is batched-dosed in the lagoon for TP removal. On average, 20,000 L of Alum is added prior to each seasonal discharge. The lagoon system also includes an overflow with direct connection to the South Nation River to mitigate the potential for wastewater overtopping the lagoon berms. There is a smaller cell located east of the lagoon that is currently used for the storage of sludge removed from the lagoon. The sludge storage cell allows for drainage of water back to the lagoon through perforated tiles installed at the bottom of the drying bed. Refer to Table 4 for a summary of lagoon properties and process capabilities based on as-built drawings provided in Appendix E.

Table 4: Sewage Treatment Lagoon Properties and Process Capabilities.

Component:	Item:	Size / Capacity:
Lagoon Cell A	Cell Dimensions	~ 370 m x ~ 185 m
	Area at Top of Lagoon	~ 6.9 ha
	Area at Base of Lagoon	~ 5.8 ha
	Elevation – Top of Berm	53.71 m
	Elevation – Bottom of Lagoon	51.36 m
	Elevation – High Water Level	52.96 m
	Elevation – Overflow	53.34 m
	Depth – MECP C of A Operating	1.50 m
	Depth – Operating Freeboard	0.38 m
	MECP C of A Operational Volume	92,577 m^3
	MECP C of A Rated Capacity	561 m^3/day (based on 165-day retention)

4.1.4 Lagoon Outlets and Gravity Outfall to South Nation River

The sewage treatment lagoon has two (2) available outlet locations that tie together downstream at the gravity outfall to the South Nation River. Refer to Figure 2 for an overview of the discharge piping and outfall, and Appendix E for original as-built drawings of the lagoon treatment system and outfall. Refer to Table 6 for elevations at each outlet. Note that neither outlet is currently equipped with flow measurement devices.

Table 5: Sewage Treatment Lagoon Outlet Elevations.

Item:	Value (m):
Outlet A – Maintenance Hole J	
Shear Gate Invert Elevation	51.39
Sludge Depth at Min. Elevation	0.03
Outlet B – Outlet Chamber No. 1	
Overflow Elevation	53.34
Upper Shear Gate Invert Elevation	52.27
Lower Shear Gate Invert Elevation	51.44
Sludge Depth at Min. Elevation	0.08

Lagoon Outlet A, which was originally designed as an inlet to the facultative lagoon, is located approx. 21m south of the raw wastewater inlet location. It is connected to Maintenance Hole 'J' (MH-J) via a 30 m long, 300 mm diameter pipe. MH-J was originally designed to receive flow from an aerated lagoon, and using shear gates, either re-circulate the aerated effluent to the facultative lagoon using the 30 m long pipe or convey the effluent downstream around the lagoon to MH-E via a 430 m long, 300 mm diameter section of concrete sewer pipe. Given that the aerated lagoon cell was never constructed (footprint is currently used for sludge storage), MH-J is not currently used in regular operation.

Lagoon Outlet B is located at the northwest of the lagoon at Outlet Chamber No. 1 (OC-1) and currently functions as both the overflow and discharge chamber. OC-1 connects to MH-E via a 15 m long, 450 mm diameter concrete sewer. The remaining length of sewers connecting MH-E to the South Nation River is considered the outfall according to the MECP C of A. Treated wastewater from the lagoon is conveyed from MH-E to the South Nation River by gravity via a 425 m long, 450 mm diameter concrete pipe. OC-1 includes openings at three separate elevations, as shown in Table 5. The top opening is for the lagoon overflow and the bottom two openings are used to discharge effluent. Both discharge openings have shear gates that allows for a controlled discharge of effluent.

The capacities of the sewers from each lagoon outlet to the outfall in the South Nation River is summarized in Table 6 based on as-built elevations provided in Appendix E. Note that, assuming gravity flow and using as-built invert elevations, the limiting sewer capacity within the effluent discharge section of sewers (i.e., the final 425 m) is approximately 190 L/s, and within the upstream discharge piping (i.e., Outlet A to MH-E) is approximately 68 L/s. Note also that the high-water level in the South Nation River was noted as 45.11 m, which means that when the river reaches a high water elevation, water may backup within the discharge pipe up to approximately 125 m upstream.

Table 6: Capacity of Lagoon Effluent and Outfall Sewers.

Upstream Maintenance Hole		Downstream Maintenance Hole		Sewer Properties			
ID	**Invert Elevation (m)**	**ID**	**Invert Elevation (m)**	**Length (m)**	**Slope**	**Diameter (mm)**	**Capacity (L/s) (1)**
Outlet A – MH-J to MH-E							
MH-J	51.39	MH-H	50.87	91.4	0.57%	300	72.9
MH-H	50.87	MH-G	50.30	112.2	0.51%	300	68.8
MH-G	50.30	MH-F	49.74	113.7	0.50%	300	68.1
MH-F	49.74	MH-E	48.95	113.4	0.70%	300	80.7
Outlet B (Main Outlet / Overflow Outlet) – OC-1 to MH-E							
OC-1	51.36	MH-E	50.60	15.2	5.00%	450	216.2
Effluent Discharge / Outfall – MH-E to South Nation River							
MH-E	48.95	MH-D	48.48	105.2	0.45%	450	190.6
MH-D	48.48	MH-C	47.94	111.6	0.48%	450	198.4
MH-C	46.86	MH-B	44.70	105.2	2.05%	450	408.6
MH-B	43.77	MH-A	43.31	21.9	2.10%	450	413.2
MH-A	43.02	SNR	Unknown	80.8	N/A	450	N/A
(1) A Manning’s roughness coefficient of 0.013 was assumed for all piping.							

4.2 Land Use and Property Constraints

Existing land use and zoning for the Village are shown in Figure 4 and Figure 5, respectively. These figures were produced using amended GIS data from the Township’s Official Plan (2010), obtained from the UCPR as part of this study. It is noted that the UCPR has recently adopted its 2022 Official Plan, which shows a revised urban or settlement area boundary. It is expected that the Township will update its urban boundary once the UCPR Official Plan is approved. Refer to Section 5.2 for more information on the 2022 UCPR Official Plan.

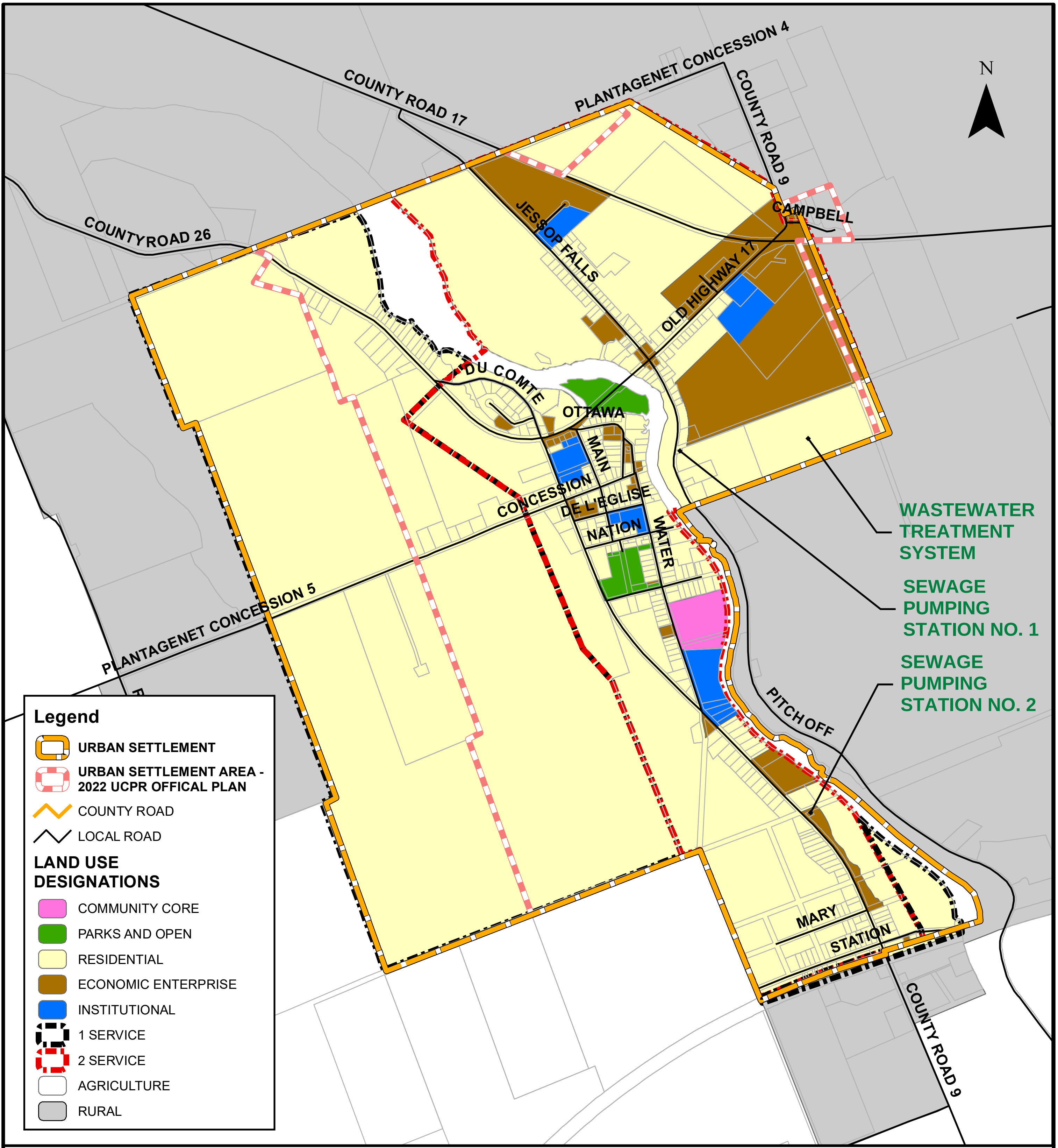
The Plantagenet Lagoon is located on roughly 9.5 ha on part of Lots 9 and 10 in Concession 4. The lagoon site is within a Residential Policy Area and is zoned as “D – Development Zone” with a current use of “water treatment, filtration/water towers/pumping station”. The existing lagoon and sludge storage cell take up most of the available property on the site, with a small vacant area located at the easternmost section. To the North, the site is bordered by Concession Road 5 and an Economic Enterprise Policy Area with land zoned as “ML – Light Industrial”. On all other sides, the site is bordered by privately held agricultural land. To the west, the agricultural land is within a Residential Policy Area and is zoned as “D1 – Development Zone – Exception 1 (Only agricultural and forestry uses (no building or structure) are permitted on the land)”, per Township By-Law 2019-67. To the east and south, the agricultural land is within a Rural Policy Area and is zoned as “Rural”. Note that there is an unopened municipal road allowance to the west of the lagoon that are shown on both figures. The lagoon outfall is conveyed through the existing site, the Concession Road 5 and Pitch Off Road allowances and through land zoned as “FP – Flood Plain”.

SPS #1 is located at 403 Pitch Off Road. The site is within a Residential Policy Area and is zoned as “R1 – Low Density Residential”. The site has a current use of “water treatment, filtration/water towers/pumping station”. The existing site appears to have sufficient space to accommodate an expansion to the pumping station. All adjacent sites are also within a Residential Policy Area. To the west, the site is bordered by Pitch Off Road and land zoned as “FP – Flood Plain. To the north, the site is bordered by Concession Road 5 and land zoned as “R1 – Low Density Residential”. To the south and east, the site is bordered by agricultural land zoned as “Development Zone – Exception 1 (Only agricultural and forestry uses (no building or structure) are permitted on the land)”, per Township By-Law 2019-67.

SPS #2 is located at 600 County Road 9. The site is within an Economic Enterprise Policy Area and is zoned as “ML – Light Industrial”. The site has a current use of “water treatment, filtration/water towers/pumping station”. The existing site appears to have sufficient space to accommodate an expansion to the pumping station. To the east and south, the site is bordered by land with the same land use and zoning. Further east, the land is zoned as “FP – Flood Plain”. To the west and north, the site is bordered by County Road 9 and land that is within a Residential Policy Area and is zoned “R1 – Low Density Residential”.

4.3 Air Quality, Dust and Noise, and Sensitive Receivers

MECP Guideline D-2 “*Compatibility between Sewage Treatment and Sensitive land Use*” states that the recommended separation distances between property/lot line of sensitive land uses (e.g., residences) and wastewater lagoons vary between 100 m to 400 m depending on the type of pond and characteristics of the waste. Guideline D-2 states that a separation distance of 150 m is recommended for wastewater treatment plants of capacity between 500 m^3/day and 25,000 m^3/day. Figure 6 illustrates the 150 m separation distance from the edge of the existing lagoon cell (or odour/noise-producing source structure. As shown in Figure 6, the nearest sensitive receiver is over 150 m from the edge of the existing lagoon cell.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

VILLAGE OF PLANTAGENET LAND USE DESIGNATIONS AND TRANSPORTATION

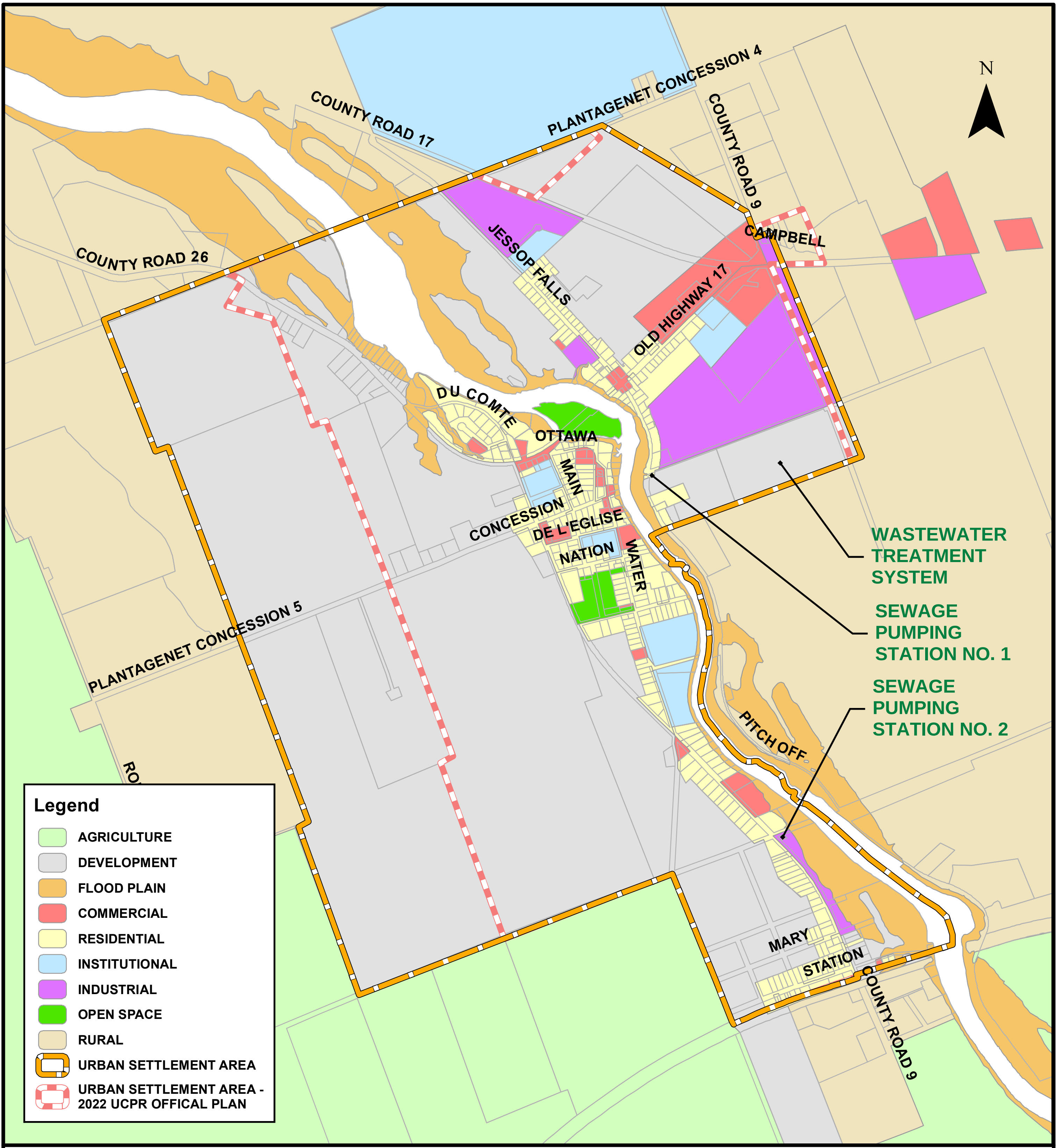
J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN: NB/TB
DRAWN: TB
CHECKED: NB/JM
JLR #: 31457-000

DRAWING #: FIGURE 4

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 Figure 4.mxd

Plot Date: March 29, 2023 9:35:25 AM



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

VILLAGE OF PLANTAGENET ZONING

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
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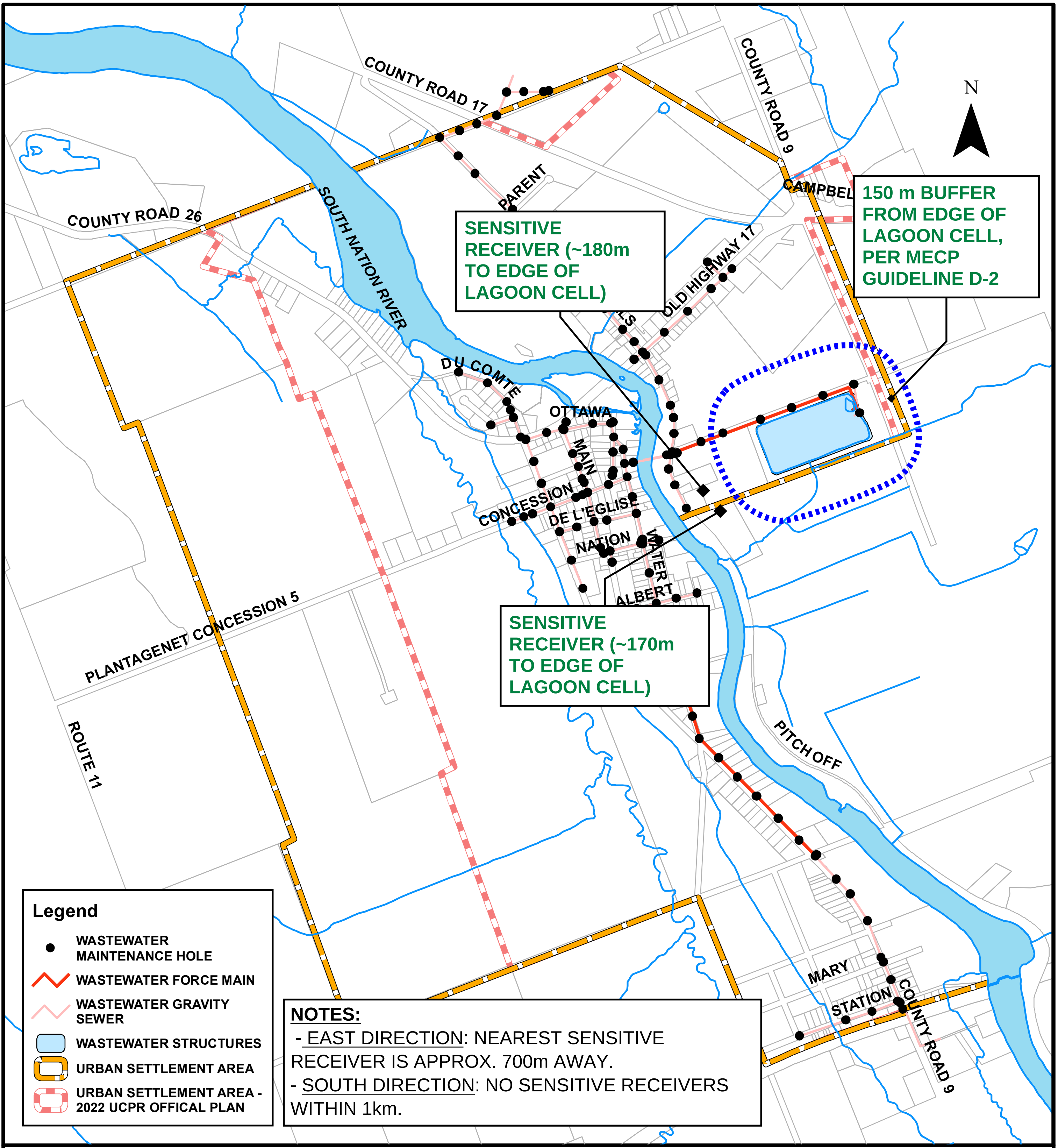
DESIGN: NB/TB
DRAWN: TB
CHECKED: NB/JM
JLR #: 31457-000

DRAWING #:
FIGURE 5

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 Figure 5 Zoning.mxd

Plot Date: March 29, 2023 9:45:03 AM



SENSITIVE RECEIVER (~180m TO EDGE OF LAGOON CELL)

150 m BUFFER FROM EDGE OF LAGOON CELL, PER MECP GUIDELINE D-2

SENSITIVE RECEIVER (~170m TO EDGE OF LAGOON CELL)

Legend

●	WASTEWATER MAINTENANCE HOLE
🟥	WASTEWATER FORCE MAIN
▨	WASTEWATER GRAVITY SEWER
🟦	WASTEWATER STRUCTURES
🟧	URBAN SETTLEMENT AREA
▨	URBAN SETTLEMENT AREA - 2022 UCPR OFFICAL PLAN

NOTES:

- EAST DIRECTION: NEAREST SENSITIVE RECEIVER IS APPROX. 700m AWAY.

- SOUTH DIRECTION: NO SENSITIVE RECEIVERS WITHIN 1km.

PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

PLANTAGENET LAGOON BUFFER AREA TO SENSITIVE RECEIVERS

J.L.Richards
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DESIGN:	NB/TB
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JLR #:	31457-000

DRAWING #:

FIGURE 6

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 FIGURE 1.mxd

Plot Date: March 29, 2023 9:30:12 AM

4.4 Natural Environment

An overview of existing natural elements for the Village of Plantagenet is provided in Figure 7. These figures were produced using amended GIS data from the Township's Official Plan (2010) and GIS data from the adopted 2022 UCPR Official Plan, obtained from the UCPR as part of this study. As previously noted, the UCPR's adopted Official Plan shows a revised urban boundary for the Village and it is expected that the Township will update its urban boundary once the UCPR Official Plan is approved. Refer to Section 5.2 for more information on the 2022 UCPR Official Plan. Note that there is a sand-gravel mineral resource located approximately 300 m northeast of the lagoon site, within the significant woodland.

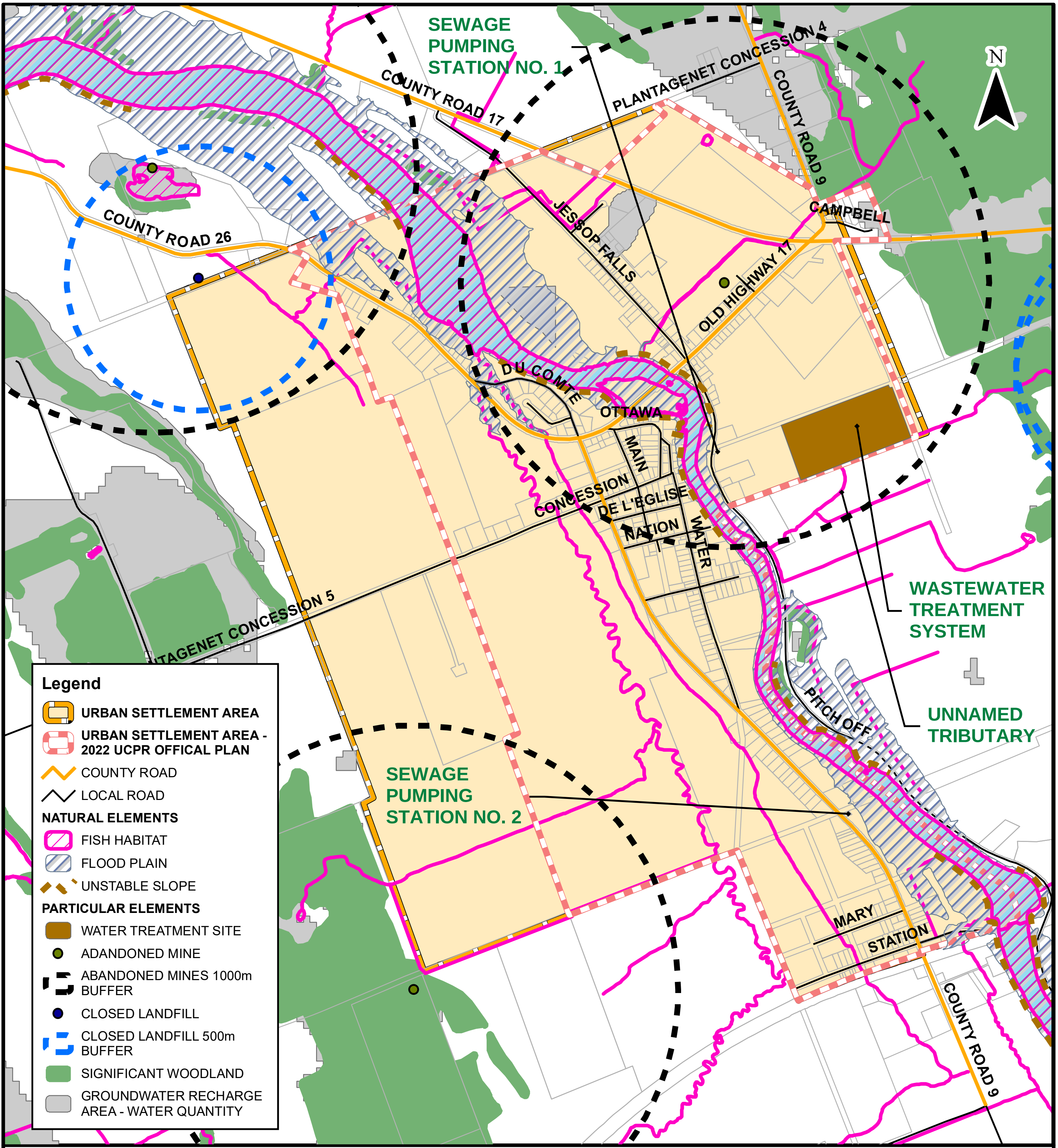
As part of the 1998 ESR, a natural environment study was completed for the area within a 3km radius of the existing lagoon. The study identified the following main items for consideration:

- Sensitive fish habitat (walleye spawning shoal) upstream of the Plantagenet bridge in the vicinity the lagoon effluent discharge. The study recommended that: "*Any changes to the outflow structure or water quality should have regard for this sensitive feature. Any in-water work near the spawning area will have to be conducted between July 1 and September 31 and meet the requirements of the Federal Fisheries Act. This will protect the young stages of fish species. Further characterization of the spawning shoal will need to be undertaken prior to any in-water work. This will be necessary to avoid destruction of the fish habitat.*"
- No environmentally significant vegetation (only agriculture and forest identified).
- No wetlands or Areas of Natural and Scientific Interest (ANSIs).
- No important deer or moose habitat or waterfowl concentrations.

As part of the current study, a natural environment assessment was undertaken by Bowfin Environmental Consulting (Bowfin) around the Plantagenet Lagoon to review and confirm previous findings, as well as undertake fish habitat surveys, butternut inventories, review endangered and/or threatened habitat or species, and review the presence of significant woodlands or valleylands. A summary of natural environment features identified in the study area is provided below. Refer to the study report provided in Appendix G for additional details. Note that Phase 2 of the Class EA will assess the impact of these features on the different alternatives and will identify appropriate next steps and mitigation measures.

- No provincially significant wetlands (PSWs), significant valleylands, ANSIs or woodlands were present in or within 120 m of the site.
- Endangered and Threatened Species:
    - The forested area to the east of the existing Plantagenet Lagoon was identified as a Category 3 potential habitat for the Eastern Whip-poor-will.
    - If the agricultural lands surrounding the Plantagenet Lagoon are abandoned or planted in hay or cereal crops, these lands could represent habitat for the Bobolink and Eastern Meadowlark, both grassland-breeding birds.
    - Trees with a diameter of 10 cm or larger have the potential to be used for day-roosting by the little brown myotis bat.
    - A butternut inventory, conducted during the leaf-off period, did not identify butternut species in or within 50 m of the site.

- Fish habitat was identified within an unnamed tributary (Figure 7 identifies this tributary) crossing the farm fields and running along the south of the existing Lagoon.
- No significant wildlife habitat within 2 km of the site. Wildlife Travel Corridor identified 105m southwest of the site.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

VILLAGE OF PLANTAGENET NATURAL AND PARTICULAR ELEMENTS

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN: NB/TB
DRAWN: TB
CHECKED: NB/JM
JLR #: 31457-000

DRAWING #: FIGURE 7

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 Figure 7.mxd

Plot Date: March 29, 2023 9:29:55 AM

4.5 Cultural Environment

As part of the 1998 ESR, a Stage 1 Archaeological Study was completed inside a 3-km radius area around the Village of Plantagenet. This study identified the following main items for consideration. The study also made recommendations on eliminating or minimizing impacts to any of the identified potential heritage or archaeological sites or areas.

- No registered archaeological sites and no designated heritage properties.
- Areas or sites of potential heritage, historical or archaeological interest were identified:
  - Chesser House and outbuildings located on Lot 10, Concession 3 just off Highway 17. There are a few wooden buildings associated with this house.
  - houses, church, presbytery, hotel, etc., in the Village of Plantagenet dating to the 19th century.
  - Protestant cemetery located along the east bank of the South Nation River at Lot 7, Concession 4.
  - James Charles burial site: a marked burial site located at Lot 6, Concession 6.
- Locations of historic archaeological potential were identified:
  - Site of mills: a sawmill, gristmill and fulling (or carding) mill were once located at Plantagenet.
  - a dam was constructed just upstream of the sawmill and gristmill.
  - Plantagenet Springs: ruins which are visible along the south side of the Station Road.
  - Possible site of Albert (and Abner?) Hagar house at Lot 7, Concession 4.
  - Carratraca (or Carratarac?) Mineral Springs: a few buildings were located at an area identified as Carratraca Mineral Springs in the nineteenth century. The structures were located in the south part of Lot 9, Concession 6.
  - potential farmstead sites: in the nineteenth century, settlers came to the Plantagenet area and cleared the land in preparation for farming. In the study area, most of the settlers were French-Canadian. A large influx of French-Canadian pioneers left the St Lawrence Lowlands m the mid-1800's and settled in the lowlands along the Ottawa River (Brault 1965) There is therefore the potential for archaeological remains of pioneer farmsteads in the study area.

As part of the current study, both a Stage 1 Archaeological Study and a Cultural Heritage Study were undertaken by Archeological Research Associates Ltd. (ARA). A summary of cultural heritage and archaeological features identified in these studies is provided below. Refer to the study reports provided in Appendix H and Appendix I for additional details. Note that Phase 2 of the Class EA will assess the impact of these features on the different alternatives and will identify appropriate next steps and mitigation measures.

- No registered or known archaeological resources were identified within a 1km radius of the study area.
- The sites for the lagoon, SPS #1 and SPS #2 were all noted as disturbed sites, with no archaeological potential. The farmland surrounding the existing treatment system was noted as having archaeological potential.

- Potential for deeply buried human remains and/or burial features was identified in front of the utilized portion of the St. Paul Roman Catholic Cemetery.
- 64 built heritage resources (BHRs) were identified within the study area as having potential cultural heritage value or interest, along with 9 potential BHRs that could not be sufficiently evaluated through a desktop survey.
  - One potential BHR is located approximately 130 m west of the lagoon site and 200 m south of the SPS #1 site.
- 10 cultural heritage landscapes (CHLs) within the study area were identified within the study area as having potential cultural heritage value or interest, along with 1 potential CHL that could not be sufficiently evaluated through a desktop survey.

4.6 Contaminated Sites and Mines

Other particular elements within the study area are shown in Figure 7. The majority of these elements were identified as part of GIS data received from the UCPR from the adopted 2022 UCPR Official Plan. There is the closed landfill located just southwest of the intersection of County Road 26 and Concession Road 4, the abandoned Centerfield Quarry located just northwest of this closed landfill, the abandoned Whitney Quarry located just southwest of the urban boundary (2010), and the abandoned Plantagenet Springs mine located near the intersection of Old Highway 17 and Champlain Street. According to the adopted 2022 UCPR Official Plan, "*Where development is proposed within 1000 metres of a mine hazard, as identified by the [Ministry of Mines'] Abandoned Mine Inventory System (AMIS) mapping and as identified on Schedule C1 […], the Regional Land Use Geologist responsible for the area or the Mine Rehabilitation Section of the [Ministry of Mines] shall be contacted to determine the scope and terms of reference of any technical studies that may be required to address the potential mine hazard.*". The Plantagenet wastewater system is situated outside the Centerfield Quarry and Whitney Quarry buffer areas, but a large portion of the Village is within the Plantagenet Springs buffer area, including the lagoon site (575 m south of the abandoned mine) and SPS #1 (630 m south of the abandoned mine). The Ministry of Mines will therefore be provided this Phase I Report for review and consultation. Not shown in the figure is a waste disposal site closed in 1969 located approximately 900 m east of the lagoon site. The 500 m buffer area for this closed disposal site does not extend beyond the forested area to the east of the lagoon site. The 500 m buffer area for the closed landfill northwest of the Village also does not extent into the Village's wastewater system.

In addition to the above, it is noted that there are no known active waste disposal sites/landfills (except for a waste truck parking area located in the southwest part of the Village approximately 500 m west of the intersection County Road 9 and Water Street), no known underground storage tanks, no known septage disposal facilities, no known active pits or quarries, and no known contaminated sites in the study area.

4.7 Socio-Economic Environment

The Village is serviced by communal water and wastewater systems and has a range of businesses and municipal facilities and programming to serve residents. Population growth within the Village has been minimal for the last 20+ years, but the Township has noted that there has been significant increase in interest for new development within the Village and high growth is anticipated for the 20-year planning period. Refer to Section 5.0 for more information.

4.8 Climate Change

Climate change has the potential to alter weather patterns that can affect both the wastewater collection and treatment system in the Village. As part of Phase 2, a Climate Change Impacts technical memorandum will be completed to review potential effects of climate change, as well as climate change adaptation and mitigation strategies. In the evaluation of alternatives, consideration will be given to greenhouse gas (GHG) emissions and impacts of carbon sinks, as well as resiliency or vulnerability of the alternatives.

4.9 Source Water Protection

The Clean Water Act (2006) ensures communities protect their municipal drinking water supplies by developing collaborative, watershed-based source protection plans, and delineating vulnerable areas such as Wellhead Protection Areas (WHPAs), surface water Intake Protection Zones (IPZs), Highly Vulnerable Aquifers (HVAs), Significant Groundwater Recharge Areas (SGRAs), Event-based modelling areas (EBAs) and Issues Contributing Areas (ICAs). The Village of Plantagenet is located within the Raison-South Source Protection Region and South Nation Source Protection Area. Municipal drinking water for Plantagenet is provided through a pipeline from the Lefaivre treated water distribution system. The Plantagenet wastewater system is located within the following vulnerable areas, as defined by the Clean Water Act (2006):

- Most of the wastewater system (including SPS No. 1 and the treatment lagoon) is within an HVA with a vulnerability score of 6 out of 10. An HVA has a relatively fast path for water to travel from the ground's surface down to the aquifer.

No other vulnerable areas were identified.

4.10 Receiving Waterbody

The Plantagenet lagoon discharges to the South Nation River. Previous studies have demonstrated that based on the Provincial Water Quality Objectives (PWQOs) established by the MECP (1994), the South Nation River is a Policy 2 receiver with respect to phosphorous. Refer to Section 7.0 for a summary of the assimilative capacity assessment completed for the South Nation River.

4.11 Hydrogeological and Geotechnical Conditions

A preliminary hydrogeological investigation is being undertaken as part of this Class EA to establish baseline hydrogeological conditions in the area surrounding the lagoon through subsurface investigation, including characterization of the soil and groundwater conditions. Additionally, potential impacts on groundwater quality and quantity from an expansion of the lagoon will be assessed, and associated mitigation measures will be discussed. The results of the investigation will be included in the Phase 2 Report and will inform the evaluation of alternatives.

A desktop geotechnical assessment is also being undertaken as part of this Class EA to assess geotechnical conditions in the area surrounding the lagoon through a review of historical borehole records and a review of boreholes drilled as part of the preliminary hydrogeological investigation.

From GIS data received from UCPR from the adopted 2022 UCPR Official Plan, and as shown in Figure 7, the Village of Plantagenet is situated within a stable bedrock area (not shown), has unstable slopes along some banks of the South Nation River and has groundwater recharge areas in various areas throughout and outside the Village. It is noted that there are no groundwater recharge areas in the vicinity of the lagoon, SPS #1 and SPS #2.

4.12 Amended Certificate of Approval Requirements

The Plantagenet Wastewater System is operated under Amended Certificate of Approval No. 4631-5WXQE9 (see Appendix A). The C of A sets limits on the rated capacity of the treatment system, discharge periods and seasonal average effluent concentrations. The rated capacity of the system is 561 m^3/day average daily flow, below which the system is to be operated. Effluent discharge is only allowed each year in the spring from April 01 to May 31 and in the fall from November 01 to December 20. Key seasonal average effluent concentrations for the treatment system are outlined in Table 7 and Table 8.

Table 7: Effluent Objectives (C of A No. 4631-5WXQE9).

Effluent Parameter	Seasonal Average Concentration (mg/L)
BOD_5	15
Total Suspended Solids (TSS)	20
Total Phosphorous (TP)	0.75

Notes:

1. Effluent pH should be maintained within the range of 6.5 to 9.0, at all times.
2. Effluent should essentially be free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film or sheen or foam or discolouration on the receiving waters.

Table 8: Effluent Compliance Limits (C of A No. 4631-5WXQE9).

Effluent Parameter	Seasonal Average Concentration (mg/L)
BOD_5	25
Total Suspended Solids (TSS)	25
Total Phosphorous (TP)	1.0
pH, at all times	6.0 – 9.5 (unitless)

4.13 Lagoon Influent and Effluent Flows

Raw influent flow into the lagoon is measured at SPS #1 using a magnetic flow meter. The lagoon treatment system is not equipped with effluent flow meter. Instead, effluent discharge flows are estimated based on lagoon water elevations, known lagoon storage volumes and influent flow rates. Table 9 provides a summary of historical raw wastewater and effluent flows for the period encompassing January 2016 to December 2020. A more detailed summary of the raw sewage flows is provided in TM-1 – Design Basis (refer to Appendix C, Section 2.1). This memorandum estimated a residential per capita flow rate of 365 L/cap/day based on assumed I&I, and industrial, commercial and institutional (ICI) flow contributions. It also demonstrated that the highest average and peak flows are occurring during the spring and calculated peak daily and maximum month average daily flow factors of 2.47 and 1.48, respectively. The below table shows that the lagoon treatment system is regularly operating beyond its rated capacity of 561 m^3/day, averaging 747 m^3/day, which is 33% above the rated capacity.

Table 9: Summary of Lagoon Influent and Effluent Flow (2016 – 2020).

	Raw Influent Flow		Effluent Flow (m^3)			Influent/Effluent Difference	
	ADF (m^3/d)	Annual Flow (m^3)	Spring Period (1)	Fall Period (2)	Total	Volume (m^3)	% Difference
2016	619	226,649	98,851	48,360	147,211	+79,438	42.5%
2017	801	292,381	104,140	97,801	201,941	+90,440	36.6%
2018	791	288,656	81,474	74,074	155,548	+133,108	59.9%
2019	773	282,161	107,532	72,150	179,682	+102,479	44.4%
2020	752	275,409	160,770	69,552	230,322	+45,087	17.8%
Average	**747**	**273,051**	**110,553**	**72,387**	**182,941**	**+90,110**	**39.5%**
C of A	**561**	**204,765**	**-**	**-**	**-**	**-**	**-**

Notes:
1. Spring discharge period is from April 01 to May 31.
2. Fall discharge period is from November 01 to December 20.
3. A raw sewage spill occurred on October 24th when it was observed that the SPS #1 forcemain was leaking. An estimated volume of 500 m^3 was reported.

Note that the existing C of A does not provide a maximum daily or monthly volume of treated effluent that can be discharged. OCWA noted that spring discharges typically begin when the water level in the lagoon reaches the overflow elevation in chamber OC-1. Oftentimes, this occurs when the lagoon still has partial ice cover. During the fall, OCWA noted that they typically begin the discharge as soon as possible. Based on data received, discharge periods and flow rates have varied significantly over the study period. On average, the spring discharge periods have started on April 23 and ended on May 26, for a duration of 34 days and with discharge flow rates ranging between 1,854 m^3/day and 4,446 m^3/day, while the fall discharge periods have started on November 21 and ended on December 14, for a duration of 24 days and discharge flow rates ranging between 1,727 m^3/day and 5,230 m^3/day.

Although the system regularly operates beyond capacity, it is noted that no overflows were reported during the study period. This is likely due to the freeboard capacity of the lagoon (storage between high water and overflow elevations) and the large discrepancy between the influent and effluent flows, as shown in Table 9. Based on previous experience with lagoon treatment systems in Eastern Ontario, the flow discrepancy is typically less than 10% and may be due to a variety of factors such as net precipitation, variations in annual storage utilization, leakage, seepage, and flow measurement error. Given that the lagoon operates at peak capacity and that operators regularly discharge the full lagoon contents during each discharge, the large discrepancy observed is likely due to a combination of net precipitation, leakage, seepage, and/or flow measurement error. This will be further reviewed during Phase 2 of the Class EA.

4.13.1 Net Precipitation

Net precipitation may have a significant impact on monthly influent and effluent flow volumes. Net precipitation is the difference between the average precipitation (rain or snow) and the average evaporation that is estimated to occur within an open waterbody (lagoon) in proximity to Plantagenet, Ontario. Precipitation values were taken from the nearest Environment and Climate Change Canada (ECCC) weather station and evaporation values were estimated based on ECCC lake evaporation normals. Table 10 provides an estimate for average monthly net precipitation based on actual data from 2016 to 2020, and also shows its impact on the average monthly raw influent wastewater volume. The table shows that on an annual basis, net precipitation increases the volume of wastewater with the lagoon.

Table 10: Average Monthly Net Precipitation and Raw Wastewater Volume (2016 – 2020).

Month	Average Monthly Raw Wastewater Volume (m^3)	Estimated Average Net Precipitation [(1)] (m^3)	Adjusted Average Monthly Raw Wastewater Volume (m^3)
January	21,819	6,276	28,095
February	19,843	6,169	26,012
March	28,468	6,665	35,133
April	32,257	7,322	39,579
May	23,703	-1,565	22,138
June	19,339	-3,320	16,019
July	19,870	-1,783	18,087
August	19,820	-796	19,024
September	19,162	55	19,217
October	22,303	6,072	28,375
November	22,946	6,452	29,398
December	23,522	6,124	29,646
Annual	**273,051**	**37,671**	**310,722**

Notes:

1. Based on ECCC historical weather station data from St. Albert, Ontario (approx. 28 km from lagoon) for the period between January 2016 to December 2020, and ECCC lake evaporation normals based on data from 1981 to 2010. An area of 6.9 ha was used for the lagoon.

4.14 Raw Wastewater Quality

As required by the C of A, 24-hour composite samples are taken monthly at the inlet of the lagoon from the SPS #1 forcemain and analyzed for 5-Day Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Total Kjeldahl Nitrogen (TKN), Total Ammonia Nitrogen (TAN) and Total

Phosphorous (TP). During the study period, OCWA also analyzed the samples for Carbonaceous Biochemical Oxygen Demand (cBOD). Testing results, on an annual basis, are provided in Table 11. For more detailed summaries of the raw wastewater quality, refer to TM-1 – Design Basis, (refer to Appendix C, Section 2.3). The table below shows that, compared to typical wastewater strength (Metcalf and Eddy, 2003), the raw wastewater received at the lagoon has an above-medium concentration of BOD_5, a medium concentration of TSS, a below-medium concentration of TP and medium concentration of TKN. Overall, the raw wastewater received at the lagoon can be categorized as a medium or average strength wastewater.

Table 11: Summary of Raw Wastewater Quality (2016 – 2020).

	cBOD		BOD_5		TSS		TP		TKN	
	mg/L	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*
2016	229	141	-	-	218	149	5.84	3.67	48.6	30.6
2017	169	138	297	211	176	139	4.27	3.34	36.3	28.5
2018	221	182	360	282	194	153	6.03	4.71	40.8	31.2
2019	-	-	195	140	170	125	5.48	3.97	44.7	32.4
2020	-	-	265	216	202	161	6.55	5.06	56.1	42.4
AVG:	**206**	**154**	**279**	**213**	**192**	**145**	**5.63**	**4.15**	**45.3**	**33.0**
75th Percential	225	162	312	233	202	153	6.03	4.71	48.6	32.4
MAX:	229	182	360	282	218	161	6.55	5.06	56.1	42.4
MIN:	169	138	195	140	170	125	4.27	3.34	36.3	28.5
Low (see Note 4)	-	-	110	-	120	-	4	-	20	-
Medium (see Note 4)	-	-	190	-	210	-	7	-	40	-
High (see Note 4)	-	-	350	-	400	-	12	-	70	-
Characterization:	-	-	Medium-High		Medium		Low-Medium		Medium	

Notes:
1 - The following outliers were removed from the data: **BOD5**: February 2018 (1,300 mg/L); **TSS**: January 2016 (1,360 mg/L), February 2016 (1,670 mg/L), July 2016 (2,420 mg/L), January 2017 (8,920 mg/L), January 2018 (6,910 mg/L), and February 2018 (1,700 mg/L); **TKN**: November 2018 (162 mg/L).
2 - CBOD5 data from 2019 and 2020 was excluded from the analysis due to CBOD5 sampling stopping after March 2019.
3 - BOD5 data from 2016 was excluded from the analysis, as data was only available for 4/12 months.
4 - Typical wastewater strength is from Metcalf and Eddy, 2003.

4.15 Treated Effluent Quality

As required by the C of A, during seasonal discharge of the lagoon, at least five (5) grab/probe samples are to be collected at the outlet of the lagoon and analyzed for BOD_5, TSS, TP, TAN, pH and temperature. These samples are taken, at a minimum, at the beginning of the discharge, at 25%, 50% and 75% of the drawdown and at the end of the discharge. To meet C of A requirements, the resulting average seasonal concentration of each effluent parameter cannot exceed the limits summarized in Table 8. A summary of the average seasonal effluent concentrations from 2016 to 2020 are provided in Table 12. This table shows that:

- BOD_5 limits were met in 10/10 discharges; objectives were met in 4/10 discharges;
- TSS limits were met in 3/10 discharges; objectives were met in 2/10 discharges;

- TP limits were met in 9/10 discharges; objectives were met in 8/10 discharges; and
- pH limits were met in 10/10 discharges; objectives were met in 9/10 discharges.

The treated effluent quality has therefore regularly been out of compliance with C of A requirements. Section 4.16 summarizes operational challenges of the treatment system, and describes likely causes of the compliance issues.

Table 12: Summary of Treated Effluent Quality (2016 – 2020).

	BOD$_5$		TSS		TP		pH	CBOD$_5$		TAN	
	# samples*	mg/L	# samples	mg/L	# samples	mg/L	-	# samples	mg/L	# samples	mg/L
ECA Objective		***15***		***20***		***0.8***	***6.5 - 9.0***				
ECA Limit		***25***		***25***		***1.0***	***6.0 - 9.5***				
Spring 2016	10	17.2	10	19.4	10	0.67	6.3 - 7.8	6	10.7	10	7.5
Fall 2016	6	18.0	6	26.2	6	0.53	7.0 - 7.5	2	14.5	6	5.4
Spring 2017	8	12.0	8	26.0	8	0.35	6.8 - 8.1	3	9.3	8	6.5
Fall 2017	8	23.0	8	40.1	8	0.59	7.2 - 8.3	3	8.3	8	10.8
Spring 2018	8	10.0	8	29.0	8	0.57	7.2 - 8.4	7	8.9	8	6.6
Fall 2018	7	19.6	7	36.9	7	2.96	7.1 - 8.0	7	12.7	7	10.3
Spring 2019	8	15.2	8	30.1	8	0.63	7.1 - 8.5	8	12.4	8	6.9
Fall 2019	5	19.2	5	32.4	5	0.85	7.5 - 8.2	5	10.8	5	10.1
Spring 2020	7	12.6	7	19.7	7	0.26	7.0 - 8.7	7	9.7	7	10.4
Fall 2020	8	9.4	8	23.7	8	0.58	7.4 - 8.1	8	6.6	8	10.7
# of Objective Exceedances (/10):	-	6	-	8	-	2	1	-	-	-	-
# of Limit Exceedances(/10):	-	0	-	7	-	1	0	-	-	-	-
Average Spring Discharge:	8.2	13.4	8.2	24.8	8.2	0.49	N/A	6.2	10.2	8.2	7.6
Average Fall Discharge:	6.8	17.8	6.8	31.9	6.8	1.10	N/A	5.0	10.6	6.8	9.4

Notes:

1 - Number of effluent samples taken for BOD$_5$ was not provided. It was assumed to be equal to the number of TSS and TP effluent samples collected.

2 - Only 1 data point for E.Coli was provided - this was not included in the analysis.

3 - Data for pH was collected from OCWA's annual wastewater reports.

4 - Effluent NO3 and NO2 were collected, but were present in negligeable quantities.

4.16 Operational Challenges and Existing Constraints

The main operational challenges and constraints identified by OCWA and the Township relate to the lagoon treatment system and its lack of capacity, high levels of algae affecting treated effluent quality and the difficulty in maintaining a system that includes only a single cell. These operational challenges are further described below. In consideration of these challenges and constraints, no overflows nor complaints were noted over the study period.

- Lack of System Capacity – With the lagoon operating regularly above capacity (on average 33% above rated capacity), there is limited operational flexibility during the discharge windows to improve treatment of the wastewater before it is discharged.
- Algae Affecting Treated Effluent Quality – High levels of algae are reported in the lagoon during both the spring and fall discharges. Algae growth stems from exposure to light, stable conditions, high levels of nutrients and warmer temperatures, all of which are present in a facultative lagoon. Facultative lagoons rely on the presence of algae for dissolved oxygen, but the long-term presence of algae in large quantities (with growth and decomposition) can increase levels of TSS and BOD_5 and reduce wastewater treatment effectiveness. Algae also has the potential to cause false high BOD_5 and TSS levels, create surface scum and produce odours. It is therefore likely that the presence of algae at the lagoon has had an impact on the treated effluent quality.
- Difficulty Maintaining Single-Cell Lagoon – With the system only having a single cell, there is no opportunity for OCWA to isolate the lagoon and take it offline for diagnostic testing, repairs and/or regular maintenance.

No operational challenges nor constraints were noted for the pumping stations. TM-1 – Design Basis (refer to Appendix C) shows that the rated capacity of SPS #1 was only exceeded once during the study period during April 2017, when significant flooding was occurring in Eastern Ontario. No flow data was available for SPS #2.

No operational challenges nor constraints were noted for the collection system. However, as described in Section 4.1.1, OCWA and the Township have noted that I&I flows likely have a significant impact on the total generated wastewater volume, especially in the older parts of the Village that do not have storm sewers.

5.0 Growth Evaluation

5.1 Provincial Policy Statement

The 2020 Provincial Policy Statement (PPS) provides guidance on matters of provincial interest related to land use planning and development. The PPS states that settlement areas, such as the Village, shall be the focus of growth and development (section 1.1.3.1). It further contemplates that land use patterns within settlement areas shall be based on efficient use of land, resources, and infrastructure (section 1.1.3.2). Municipal sewage and water services are the preferred form of servicing for settlement areas to support protection of the environment and minimize potential risks to human health and safety (section 1.6.6.2). As such, planning for sewage, water, and stormwater services shall accommodate forecasted growth in a manner that promotes the efficient use and optimization of existing services, ensure that the systems can be sustained by the water resources upon which such the services rely, and promote water conservation and water use efficiency (section 1.6.6.1).

5.2 United Counties of Prescott and Russel Official Plan and Growth Forecast

The United Counties of Prescott and Russell are the upper-tier municipality for the Village. The UCPR Official Plan provides guidance and sets out policies for development related to land use planning within its lower-tier municipalities, including within the Township of Alfred and Plantagenet. The most recent Official Plan was adopted by Council in 2022 but is pending Ministry approval. The most recent approved Official Plan dates to 2015. The 2022 UCPR Official Plan designates the Village as a settlement area within the Urban Policy Area. The Urban Policy Area designation applies to City, Towns and Villages with populations of 1000 or more and which have been developed primarily on the basis of municipal water and sewer systems (section 2.3.1). The Urban Policy Area shall be the predominant focus for new growth in UCPR (section 2.2.1).

The UCPR Official Plan growth forecasts are based on the report ‘Growth Management Strategy Update’, dated March 30, 2022, prepared by Hemson Consulting Ltd. This report is an update of the report ‘Growth Forecast and Land Needs Analysis – United Counties of Prescott and Russel’, dated December 2012, prepared by Hemson Consulting Ltd, referenced in the 2015 Official Plan. According to the 2022 UCPR Official Plan, the UCPR is anticipating rapid growth between 2021 and 2046, with an annual growth rate of 1% (section 2.1.1.1). The major driver of growth will be in-migration from the City of Ottawa and its environs by young families seeking affordable singled detached homes (section 2.1.1.1). Growth within the Township of Alfred and Plantagenet is expected to be slightly slower in comparison, with the population forecasted to increase by 1,210 over this planning horizon, from 10,190 in 2021 to 11,400 in 2046. This represents a compounded annual growth rate of 0.4%.

In consultation with the Township, it was determined that higher growth projections for the Village of Plantagenet should be considered in the review of the wastewater treatment system. The Township noted that growth within the Village has historically been limited by the Village’s wastewater treatment system, and that once the system is upgraded, growth greater than identified in the Official Plan is possible for the Village. As such, in consultation with planners, the Township provided information on potential development areas, which were used as the basis of the study’s growth projections. Refer to Section 5.3 for more information.

5.3 Growth Projections and Phasing

The current and future population within Plantagenet that will be serviced by the wastewater system is an important factor in establishing influent flow projections and projected influent characterization of raw sewage. The 20-year population projections (2042) will serve as the basis for establishing the wastewater collection, conveyance, and treatment requirements for the Plantagenet Wastewater Class EA.

An evaluation of potential growth in the servicing area was undertaken as part of TM-1 – ‘Design Basis’ (refer to Appendix C, Section 1). This memorandum estimated an existing serviced residential population of 1,336 and an existing ICI serviced area of ~ 6 ha. Growth was projected based on a list of potential development areas (high and low potential) and their associated types and land uses provided by the Township. Using a target residential development unit density of 20.2 units/ha, as well as a household density of 2.57 people/unit, serviced residential population and ICI land projections were developed. Due to the magnitude and timing uncertainty of projected development, the Township requested the opportunity to review a phased implementation approach for the Class EA. A two-phase implementation strategy was therefore reviewed for the 20-year horizon, whereby half the “high potential” lands are assumed to be developed within a 10-year horizon (2022 – 2032) and the other half within the next 10-year horizon (2032 – 2042). Refer to Table 13 and Table 14 for serviced population and ICI land projections to 2042 and refer to Appendix C for any additional information. The below tables show that there is the potential for significant growth within the Village in the 20-year design horizon.

Table 13: Serviced Population Projections to 2042 (including Phasing).

Description:	Population	Growth (# People)	Growth (%)
Existing (2022)	1,336	-	-
Phase 1 – 10-Year (2032)	2,636	1,300	97%
Phase 2 – 20-Year (2042)	3,935	1,299	49%
20-Year Growth:	**-**	**2,599**	**195%**
Phase 3 – Build-Out (Post-2042)	11,034	7,099	180%
Build-Out Growth:	**-**	**9,698**	**726%**

Table 14: Serviced ICI Land Projections to 2042 (including Phasing).

Description:	ICI Area (ha)	Growth (ha)	Growth (%)
Existing (2022)	~ 6	-	-
Phase 1 – 10-Year (2032)	8.23	2.23	37%
Phase 2 – 20-Year (2042)	10.46	2.23	27%
20-Year Growth:	**-**	**4.46**	**75%**
Phase 3 – Build-Out (Post-2042)	37.18	26.72	255%
Build-Out Growth:	**-**	**31.18**	**520%**

6.0 Influent Characterization

6.1 Projected Raw Wastewater Flow

Raw wastewater flow projections were undertaken as part of TM1 – ‘Design Basis’. The total average daily raw sewage flow projected to be received at the Plantagenet WWTS was a combination of projected flows from residential, ICI and I&I from development and infill. Refer to Table 15 and Table 16 for average daily, peak daily and maximum monthly average flows projected to be conveyed to the Plantagenet WWTS in the 10-year, 20-year and build-out horizons. These tables show a 10-year projected rated capacity increase of 86% and a 20-year rated capacity increase of 170%.

Table 15: Projected Average Raw Wastewater Flows.

	Population	Wastewater Flow Contributions (m3/day)				Total Projected Design Flow (m3/day)
		Existing Residential & ICI Connections	Residential Development	Commercial Development	Dry Weather I/I from Development	
Existing (2022)	1,336	747	-	-	-	**747**
Phase 1 - 10-Year (2032)	2,636	747	455	62	118	**1,390**
Phase 2 - 20-Year (2042)	3,935	747	910	125	235	**2,020**
Phase 3 - Build-Out (Post-2042)	11,034	747	3,394	873	941	**5,960**

Table 16: Projected Peak Daily and Maximum Monthly Average Flows.

	Projected Average Daily Flow (m3/day)	Peak Daily Flow Factor	Projected Peak Daily Flow (m3/day)	Maximum Monthly Average Flow Factor	Projected Maximum Monthly Average Flow (m3/day)
Existing (2022)	747	2.47	1,847	1.48	1,107
Phase 1 - 10-Year (2032)	1,390	2.47	3,435	1.48	2,059
Phase 2 - 20-Year (2042)	2,020	2.47	4,992	1.48	2,992
Phase 3 - Build-Out (Post-2042)	5,960	2.47	14,728	1.48	8,828

6.2 Projected Raw Wastewater Quality

Raw wastewater quality projections were undertaken for the 20-year horizon as part of TM1 – ‘Design Basis’. The projections are based on existing raw wastewater quality and projected raw wastewater flows. Refer to Table 17 a summary of projected raw wastewater parameter concentrations and loadings for the 10-year and 20-year horizons.

Table 17: Projected Raw Wastewater Quality

EXISTING RAW WASTEWATER QUALITY (2016 TO 2020)					
Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Average Raw Wastewater Concentration (mg/L):	206	279	192	5.63	45.3
Maximum Monthly Raw Wastewater Concentration (mg/L):	412	659	430	9.76	70.9
PHASE 1 - 10-YEAR (2032)					
Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Projected Average Daily Flow (m3/day):	1,390				
Average Raw Wastewater Concentration (mg/L):	210	280	200	5.7	46
Average Raw Wastewater Loading (kg/day):	300	390	280	8.0	64
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	577	917	598	13.6	99
PHASE 2 - 20-YEAR (2042)					
Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Projected Average Daily Flow (m3/day):	2,020				
Average Raw Wastewater Concentration (mg/L):	210	280	200	5.7	46
Average Raw Wastewater Loading (kg/day):	430	570	410	11.6	93
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	838	1,333	869	19.8	143

7.0 Assimilative Capacity Study and Effluent Quality Requirements

7.1 Receiver Assimilative Capacity Study – Ambient Conditions and Approach

As part of Phase 1 of the Class EA, Blue Sky Energy Engineering & Consulting Inc. (Blue Sky), in coordination with JLR and the MECP, undertook a desktop assimilative capacity study (ACS) of the South Nation River to determine the conditions and constraints for discharge associated with an expansion of the Plantagenet WWTS. The full study report is provided in Appendix F. For the ACS, JLR provided Blue Sky with projected 10-year and 20-year equivalent annual discharge average daily flows of 1,660 m^3/day and 2,411 m^3/day, respectively. These values were conservatively calculated based on average monthly net precipitation and assuming lateral lagoon expansions (i.e., new or expanded lagoons with identical operating depths, resulting in larger area for net precipitation).

Using available data from a nearby Provincial Water Quality Monitoring Network (PWQMN) station and nearby Water Survey of Canada (WSC) flow gauge, Blue Sky established ambient water quality and low flow conditions in the South Nation River. A summary of the main findings from the review is presented below. Refer to Appendix F for more details.

- BOD_5 – Low ambient concentrations and Policy 1 status for Dissolved Oxygen (DO).
- TSS – No PWQO / policy status.
- TP – Policy 2 status for all months with data available (April – December).
- Unionized Ammonia (UIA) – Policy 1 status from October to May, and Policy 2 status from June to September (higher temperatures).
- Nitrate-N – No PWQO / policy status.
- E. coli – Policy 1 status based on limited data available.
- pH – High ambient pH year-round (>8.0) and Policy 1 status.
- 7Q20 flows range from 0.52 m^3/s in July to 14.5 m^3/s in June.

Note that a receiving waterbody with **Policy 1** status for a certain water quality parameter means that the ambient surface water quality is better than the PWQO, and a receiving waterbody with **Policy 2** status for a certain water quality parameter means that the ambient surface water quality does not meet the PWQO and therefore, water quality of the receiver is not to be degraded any further. For wastewater treatment systems, if a parameter has Policy 1 status, the effluent concentration of that parameter must be sufficiently low to maintain a fully mixed downstream parameter concentration at or below the PWQO. If a wastewater treatment system parameter has Policy 2 status, the effluent concentration of that parameter must be chosen such that the water quality of the receiver is not further degraded.

Once existing conditions were established, Blue Sky developed a proposed approach to complete the ACS. This approach was provided to the MECP for review and a meeting was held on May 5, 2022, to discuss the approach with the project team. Minutes from the meeting with the MECP are provided in Appendix D. Following the meeting, the MECP approved the proposed approach. The approved ACS approach is provided below.

- Review an effluent discharge over some or all of the period spanning October 1 to May 31. Monthly discharge volumes to consider maintaining adequate dilution ratios, ensuring reasonable downstream fully mixed water quality, and providing allowances for WWTS operational flexibility. Continuous discharge was not an option for the South Nation River due to low flows and effluent quality requirements during summer months.
- Utilize a mass-balance approach to ensure downstream, fully mixed seasonal UIA concentrations remain at or below the PWQO at ambient (75th percentile) concentrations and low (7Q20) flows. Proposed effluent TAN targets will also ensure non-toxicity at end-of-pipe.
- Limit future effluent TP loadings to 204.8 kg/yr. Consideration will be given to seasonal TP loadings, as well as the impact on downstream, fully mixed TP concentrations.
- An assessment of in-stream DO will be achieved using a one-dimensional application of EPA's Water Quality Analysis Simulation Program (WASP8) to develop appropriate cBOD5 effluent targets. Consistency with the CCME target for suspended material will be used along with the cBOD5 targets to develop effluent TSS requirements.
- Nitrate is not currently a parameter of concern for the South Nation River. As a result, no effluent nitrate targets will be proposed.
- Effluent pH and E. coli targets will be consistent with targets for other municipal WWTSs in Ontario.
- To address the limited availability of ambient water quality for the months of March and December, and lack of data for January and February, ambient conditions over the period February to April will be assumed to be equivalent to the consolidated data from March and April. Similarly, ambient conditions over the period November to January will be based on consolidated data from November and December.

7.2 Proposed Effluent Discharge Criteria

7.2.1 Discharge Windows and Maximum Allowable Daily Discharge Rate

Two different scenarios were reviewed in developing the effluent objectives and limits for an upgraded Plantagenet WWTS: Scenario A – Existing Discharge Period (Apr 1 to May 31 and Nov 1 to Dec 20) and Scenario B – Extended Discharge Period (Oct 1 to May 31). For each scenario, to provide operational flexibility, daily maximum effluent flows were defined based on ensuring that downstream, fully mixed UIA concentration would not exceed the PWQO, ensuring that downstream, fully mixed TP concentration would increase ambient concentrations by no more than 5%, and recognizing the hydraulic capacity of the existing outfall downstream of MH-E is approximately 16,000 m^3/day (190 L/s, per Section 4.1.4). Refer to Table 18 and Table 19 for the maximum daily effluent discharge rates in the 10-year (2032) and 20-year (2042) horizons, respectively.

Table 18: Proposed Maximum Daily Effluent Discharge Rates – Phase 1 – 10-Year (2032).

Date Range	Maximum Daily Discharge Rate (m^3/d)
Scenario A – Existing Discharge Periods	
April 1 to 30	16,000
May 1 to 31	8,500
November 1 to 30	6,100
December 1 to 20	9,500
Scenario B – Semi-Continuous Discharge	
October 1 to 31	2,200
November 1 to 30	6,100
December 1 to March 31	4,500
April 1 to 30	16,000
May 1 to 31	8,500

Table 19: Proposed Maximum Daily Effluent Discharge Rates – Phase 2 – 20-Year (2042).

Date Range	Maximum Daily Discharge Rate (m^3/d)
Scenario A – Existing Discharge Periods	
April 1 to 30	16,000
May 1 to 31	15,100
November 1 to 30	10,800
December 1 to 20	16,000
Scenario B – Semi-Continuous Discharge	
October 1 to 31	4,500
November 1 to 30	10,800
December 1 to March 31	7,600
April 1 to 30	16,000
May 1 to 31	15,100

7.2.2 Effluent Limits and Objectives

Using the MECP-approved approach to the ACS, effluent objectives and limits were developed for each water quality parameter. Refer to Appendix F for more information. Table 20 and Table 21 provide summaries of proposed effluent objectives and limits for the 10-year (2032) and 20-year (2042) horizons, respectively.

Table 20: Proposed Effluent Objectives and Limits – Phase 1 – 10-Year (2032).

Parameter	**Averaging Period**	**Objective** (mg/L unless noted otherwise)	**Limit** (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.3	0.33
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

Table 21: Proposed Effluent Objectives and Limits – Phase 2 – 20-Year (2042).

Parameter	**Averaging Period**	**Objective** (mg/L unless noted otherwise)	**Limit** (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.2	0.23
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

7.2.3 Total Phosphorous Offsetting

The Total Phosphorous Management (TPM) credit trading program was implemented in 2000, through a partnership between the South Nation Conservation (SNC), the MECP and other local partners. This program permits increased phosphorous loading from any new or expanding wastewater treatment plants through a purchase of credits towards phosphorous-reducing best management practices completed through the Clean Water

Program (CWP). The CWP was implemented by the SNC in 1993 and aims to reduce non-point sources of nutrients through cost-share agri-environmental projects. As part of the evaluation process of different upgrade options, total phosphorous offsetting will be considered.

7.2.4 Ice-Free Cover Constraint

The C of A or ECA of lagoon-based systems in Eastern Ontario have historically had an “ice-free cover” requirement when discharging treated wastewater directly from a lagoon. This requirement typically prevents the discharge of wastewater from approximately mid-December to mid-April, negating any benefits from expanding the discharge windows through the Winter, as proposed in Scenario B. To avoid potential issues relating to the ice-free cover requirement, the MECP recommended that lagoon aeration or tertiary treatment technologies downstream of the lagoon prior to discharge be considered in Phase 2 of the Class EA.

8.0 Lagoon Storage Volume and Discharge Assessment

8.1 Existing Storage Volume and Seasonal Discharge Periods

As noted previously, the total effective storage volume of the Plantagenet lagoon is 92,577 m^3. This storage volume represents the volume between the minimum level to which the operators can discharge treated effluent (maintaining sludge depth) and the maximum level based on the top of lagoon berm minus the freeboard. It was also previously noted that there currently exists a large discrepancy between the influent and effluent flows. Refer to Section 4.13 for more information on this discrepancy. The existing discharge periods allow for discharge of treated effluent between April 01 and May 31, and November 01 and December 20 with no maximum daily or monthly flow rate.

8.2 Preliminary 10-Year and 20-Year Storage Volume and Discharge Assessment

Based on projected Phase 1 (2032) and Phase 2 (2042) influent flow and net precipitation volumes (see Section 6.0), as well as proposed effluent discharge regimes and maximum daily discharge flows (See Section 7.0), a preliminary storage volume and discharge assessment was completed to assess if treated wastewater can be emptied from the lagoon. Assumptions used, as well as findings from this preliminary assessment are summarized below. Note that more detailed assessments will be completed and documented as part of Phase 2 of the Class EA when evaluating different upgrade options.

Assumptions for Preliminary Storage and Discharge Assessment:

- Monthly effluent flow volumes are equal to the total of the flow received from SPS #1 (raw wastewater) and net precipitation of the lagoon.

- Immediate discharge at the start of the discharge periods, and at the end of the discharge periods, there is no remaining volume in the lagoon. Storage contingencies for operational flexibility to be reviewed as part of Phase 2 of the Class EA.
- No "ice-free cover" requirements. To be reviewed as part of Phase 2 of the Class EA. Will be dependent on the preferred upgrade solution and discussions with the MECP.
- A total lagoon area of 141,000 m^2 (with same operating depth) was assumed for Phase 1 (2032) and a total lagoon area of 205,000 m^3 (with same operating depth) was assumed for Phase 2 (2042). These lagoon sizes were selected based on the minimum lagoon storage volume required for discharge Scenario A for both phases (Phase 1 requires a minimum of 189,000 m^3 and Phase 2 requires a minimum of 275,000 m^3). To be reviewed as part of Phase 2 of the Class EA.

<u>Findings Preliminary Storage and Discharge Assessment</u>:

- If the preferred solution is to include an expansion of the existing WWTS, an increase in the effective storage capacity of the lagoon will be required.
- Capacity upgrades to the discharge piping from MH-J to MH-E may be required depending on the results of Phase 2. The outfall sewers downstream of MH-E are sufficiently sized to accommodate the 20-year flows from the upgraded Plantagenet WWTS.
- The maximum allowable monthly discharge rates allow for significant operational flexibility in both Phase 1 (2032) and Phase 2 (2042), particularly with the new discharge windows.

9.0 Summary of Existing Conditions and Constraints

Based on a review of the available background information undertaken as part of Phase 1 of the Class EA process, the following is a summary of the key findings and constraints for the Plantagenet Wastewater System:

- The Plantagenet wastewater collection system consists of approximately 8.46 km of gravity sewer mains varying in size from 200 mm to 375 mm, most of which was built in the early 1970s. The collection system has historically had issues with extraneous flows. Previous studies have noted that these flows were caused mainly by illegal cross-connections from stormwater drainage facilities (direct connections from sump pumps, tile drains, etc.), but also by structural deficiencies in the sewer service laterals (inflow and infiltration (I&I)). A flow monitoring study is being completed for this Class EA, at which point extraneous flows will be further reviewed.

- The Plantagenet Lagoon is located on roughly 9.5 ha on part of Lots 9 and 10 in Concession 4. The existing lagoon and sludge storage cell take up most of the available property on the site, with a small vacant area located at the easternmost section. Immediately adjacent lands are not owned by the Township, and therefore acquisition of adjacent land would be required if an expansion of the lagoon treatment system is part of the preferred solution. A factor to be considered in determining in which direction to expand the site is maintaining a separation distance of at least 150 m to sensitive receivers. It is noted that there are no sensitive receivers within the 150 m buffer area of the existing lagoon.

- No provincially significant wetlands (PSWs), significant valleylands, ANSIs or woodlands were present in or within 120 m of the study site (refer to Appendix for study area). Endangered species were identified that may be impacted by the project; these include the Eastern Whip-poor-will, Bobolink, Eastern Meadowlark, little brown myotis bat and Butternut. Fish habitat was identified within an unnamed tributary crossing the farm fields and running along the south of the existing lagoon. No significant wildlife habitat within 2 km of the site was identified. Wildlife Travel Corridor identified 105m southwest of the lagoon site.

- No registered or known archaeological resources were identified within a 1km radius of the study area. The sites for the lagoon, SPS #1 and SPS #2 were all noted as disturbed sites, with no archaeological potential. The farmland surrounding the existing treatment system was noted as having archaeological potential. Potential for deeply buried human remains and/or burial features was identified in front of the utilized portion of the St. Paul Roman Catholic Cemetery.

- 64 built heritage resources (BHRs) were identified within the study area as having potential cultural heritage value or interest, along with 9 potential BHRs that could not be sufficiently evaluated through a desktop survey. One potential BHR is located approximately 130 m west of the lagoon site and 200 m south of the SPS #1 site. 10 cultural heritage landscapes (CHLs) within the study area were identified within the study area as having potential cultural heritage value or interest, along with 1 potential CHL that could not be sufficiently evaluated through a desktop survey.

- The lagoon site and SPS #1 are within the buffer area for the Plantagenet Springs abandoned mine, requiring consultation with the Ministry of Mines during Phase 2.

- Climate change has the potential to alter weather patterns that can affect both the wastewater collection and treatment system in the Village. Potential climate change impacts will be assessed in Phase 2 of the Class EA.

- Most of the wastewater system (including SPS No. 1 and the treatment lagoon) is within a highly vulnerable aquifer, as identified in the Clean Water Act (2006), with a vulnerability score of 6 out of 10.

- The existing C of A for the Plantagenet Wastewater System sets the rated capacity of the lagoon treatment system at 561 m^3/day average daily flow and allows for the discharge of effluent during the spring (April 01 – May 31) and the fall (November 01 – December 20). It also sets limits on the allowable BOD_5, TSS, TP and pH concentrations in the effluent discharge, and sets forth a sampling and monitoring program that must be followed by operators of the system.

- Compared to typical wastewater strength, the raw wastewater received at the lagoon has an above-medium concentration of BOD_5, a medium concentration of TSS, a below-medium concentration of TP and medium concentration of TKN. Overall, the raw wastewater received at the lagoon can be categorized as a medium strength wastewater.

- The existing lagoon treatment system was shown to regularly operate well beyond the system's rated capacity, averaging an influent flow of 747 m^3/day (33% above the rated capacity). The existing lagoon was also shown to regularly exceed effluent water quality criteria for TSS and BOD_5.

- The main operational challenges identified by the Township and OCWA for the lagoon treatment system related to the lack of capacity of the lagoon, regular presence of algae and difficulties in maintaining a single-cell system. No operational challenges were identified for the sewage pumping stations, or the collection system.

- An evaluation of potential growth in the servicing area was undertaken. Phasing of growth was requested by the Township due to the large magnitude and timing uncertainty of projected development. A two-phase (10-year (2032) and 20-year (2042)) strategy was developed. An existing residential population of 1,336 and existing ICI serviced area of approximately 6 ha was established. A 2032 residential population of 2,636 and ICI area of 8.23 ha, as well as a 2042 residential population of 3,935 and ICI area of 10.46 ha were projected. These projections were used to develop raw wastewater flow projections.

- Capacity upgrades of the sewage pumping stations and associated forcemains should be reviewed in Phase 2 of the Class EA and considered as part of the preferred solution.

- A desktop assimilative capacity study of the South Nation River was undertaken. All water quality parameters, except for TP, were identified as having Policy 1 status. TP was identified as having Policy 2 status, meaning that the annual loading of TP must be kept below 204.8 kg/year as part of the preferred upgrade solution. Maximum daily discharge rates were established for both phases (10-year and 20-year) and for two discharge scenarios: Scenario A – Existing Discharge Period (Apr 1 to May 31 and Nov 1 to Dec 20) and Scenario B – Extended Discharge Period (Oct 1 to May 31), both of which will be carried forward to Phase 2 of the Class EA.

- Effluent objectives and limits were also established as part of the ACS. In addition to providing criteria for $cBOD_5$, TSS, TP and pH, effluent criteria were also provided for TAN (varying monthly) and E. coli, for which treatment will need to be considered in the evaluation of alternative solutions. Participation in the Total Phosphorous Management program was identified as a potential option to potentially increase the allowable amount of TP that can be discharged. The lagoon “ice-free cover” requirement was also identified as a constraint to be considered in the evaluation of alternative upgrade solutions.

- A preliminary storage volume and discharge assessment was completed, which identified that additional storage will be required for a lagoon-based treatment solution, capacity upgrades to the discharge piping from MH-J to MH-E may be required depending on the results of Phase 2, the outfall sewers downstream of MH-E are sufficiently sized to accommodate the 20-year flows from the upgraded Plantagenet WWTS, and the proposed maximum allowable monthly discharge rates allow for significant operational flexibility in both Phase 1 (2032) and Phase 2 (2042), particularly with the new discharge windows.

10.0 Problem/Opportunity Statement (Phase 1)

Based on the foregoing, a Problem Statement has been generated from this Class EA Phase 1 review and will serve as the basis of the next Phases of the project.

> *A review of the Plantagenet Wastewater System suggests that the Plantagenet Wastewater Treatment System is operating above its rated capacity and has treatment performance issues that have resulted in effluent wastewater concentrations above the current Environmental Compliance Approval objectives and limits. As a result, the system cannot accommodate any growth of the serviced area or population. The Township of Alfred and Plantagenet is undertaking a Municipal Class Environmental Assessment (Class EA) to evaluate options to upgrade the Plantagenet Wastewater System to address issues related to achieving effluent quality criteria and ensure that the 20-year growth of Plantagenet is adequately planned for and accommodated. The Class EA will consider the level of adequacy of wastewater treatment at the lagoon and will recommend a solution to address the findings in accordance with the 2023 Municipal Class EA process.*

11.0 Study Milestones

Throughout the remainder of the study, several key milestones must be reached. A list of key milestones and their anticipated timing is provided in Table 22.

Table 22: Key Study Milestones.

PHASE 1	**Timing**
Project Initiation	November 2021
Project Review Meeting	November 2021
Issue Notice of Commencement	December 2, 2021
Draft Phase 1 Report	March 2023
Progress Review Meeting	April 18, 2023
Finalize Phase 1 Report	April 2023

PHASE 2	**Timing**
Criteria Matrix and Draft Alternatives Report	April 2023
Progress Review Meeting	April 2023
Public Information Centre No. 1	May 10, 2023
Draft Phase 2 Report	May 2023
Progress Review Meeting	May/June 2023
Finalize Phase 2 Report and Confirm Project Schedule	June 2023

PHASE 3	**Timing**
Draft Alternative Designs Report	June 2023
Progress Review Meeting	July 2023
Public Information Centre No. 2	July 2023
Final Alternative Designs Report and Recommendation	July/August 2023
Progress Review Meeting	August 2023

PHASE 4	Timing
Confirm Project Schedule	August 2023
Draft Environmental Study Report	August 2023
Progress Review Meeting	September 2023
Final Environmental Study Report	September 2023
Issue Notice of Completion	September 2023
Project Close-Out Meeting	October 2023

12.0 References

1. Stanley Consulting Group Ltd., Environmental Study Report – Sewage System – Village of Plantagenet OCWA Project No. 3-0946-01, July 1998.
2. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 4th Edition, 2003.
3. Stantec Consulting Ltd., Township of Alfred and Plantagenet, Plantagenet Sewage Treatment System, Final Report, October 5, 2015.
4. Ontario Clean Water Agency, Performance Assessment Report Data (2016-2020).
5. Ministry of the Environment, Design Guidelines for Sewage Works, 2008.
6. City of Ottawa, Ottawa Design Guidelines – Sewer, Second Edition, October 2012.
7. City of Ottawa, Technical Bulletin ISTB-2018-1 – Revisions to Ottawa Design Guidelines – Sewer dated 2012, March 2018.
8. United Counties of Prescott and Russell, Adopted Official Plan, 2022.
9. Hemson Consulting Inc., Growth Management Strategy Final Report, March 30, 2022.

This report has been prepared by J.L. Richards & Associates Limited for the Township of Alfred and Plantagenet's exclusive use. Its discussions and conclusions are summary in nature and cannot properly be used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report is based on information, drawings, data, or reports provided by the named client, its agents, and certain other suppliers or third parties, as applicable, and relies upon the accuracy and completeness of such information. Any inaccuracy or omissions in information provided, or changes to applications, designs, or materials may have a significant impact on the accuracy, reliability, findings, or conclusions of this report.

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J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

LICENSED PROFESSIONAL ENGINEER
N. R. BIALIK
100530276
2023-04-26
PROVINCE OF ONTARIO

Nicolas Bialik, P.Eng.
Environmental Engineer

Reviewed by:

LICENSED PROFESSIONAL ENGINEER
April 26, 2023
J.M.C. MORRISSETTE
100151410
Jordan Morrissette
PROVINCE OF ONTARIO

Jordan Morrissette, M.Eng., P.Eng
Associate, Senior Environmental Engineer

Appendix A1

Existing Amended Certificate of Approval (No. 4631-5WXQE9)

Ontario
Ministry of the Environment
Ministère de l'Environnement

AMENDED CERTIFICATE OF APPROVAL
MUNICIPAL AND PRIVATE SEWAGE WORKS
NUMBER 4631-5WXQE9

The Corporation of the Township of Alfred and Plantagenet
PO Box 350
Plantagenet, Ontario
K0B 1L0

Site Location: Part of Lot 6, Concession V
Alfred and Plantagenet Township, United Counties of Prescott and Russell
Ontario K0B 1L0

You have applied in accordance with Section 53 of the Ontario Water Resources Act for approval of:

An existing municipal sewage treatment plant located at the above site location for the treatment and disposal of domestic sewage from the village of Plantagenet, rated at a capacity of 561 cubic meters per day *Average Daily Flow* and consisting of the following *Works* ;

PREVIOUS WORKS

Pumping Station No. 1

The Pumping Station No. 1 consists of the following components:

- one (1) 2.4 m diameter, 10.2 m deep wet well;
- one (1) 100 mm diameter magnetic flowmeter;
- approximately 890 m of 200 mm diameter forcemain discharging at the lagoon inlet box; and
- two (2) submersible pumps, one duty one standby, rated to deliver 29.2 L/s.

Pumping Station No. 2

The Pumping Station No. 1 consists of the following components:

- one (1) 2.4 m diameter, 3.6 m deep wet well;
- approximately 970 m of 125 m diameter forcemain; and

- two (2) submersible pumps, one duty one standby, rated to deliver 10.6 L/s.

Inlet works

One (1) inlet distribution box providing an air gap between the forcemain and the lagoon to prevent backflow from the lagoon.

Facultative Lagoon

One (1) 6.9 hectare single cell facultative lagoon, having a working volume of approximately 92,580 m^3 at an average depth of 1.5 m.

Effluent Discharge

Effluent discharge facilities consist of the following components:

- one (1) outlet chamber with an overflow structure; and
- approximately 425 m of 450 mm diameter gravity outfall sewer discharging to South Nation River.

Miscellaneous

All controls, sensors, electrical equipment, instrumentation, piping, pumps, valves and appurtenances essential for the proper operation of the aforementioned *Works* .

all in accordance with the original application for approval, including design calculations, engineering drawings, reports and any other document prepared in support of the existing Certificate of Approval.

For the purpose of this Certificate of Approval and the terms and conditions specified below, the following definitions apply:

"*Act* " means the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended;

"*Average Daily Flow* " means the cumulative total sewage flow to the sewage works during a calendar year divided by the number of days during which sewage was flowing to the sewage works that year;

"*BOD_5* " means five day biochemical oxygen demand measured in an unfiltered sample;

"*Certificate* " means this entire certificate of approval document, issued in accordance with Section 53 of the *Act* , and includes any schedules;

"*Daily Concentration* " means the concentration of a contaminant in the effluent discharged over any single day, as measured by a composite or grab sample, whichever is required;

"*Director* " means any *Ministry* employee appointed by the Minister pursuant to section 5 of the *Act* ;

"*District Manager* " means the District Manager of the Kingston District Office of the *Ministry* ;

"*E. Coli* " refers to the thermally tolerant forms of Escherichia that can survive at 44.5 degrees Celsius;

"*Ministry* " means the Ontario Ministry of the Environment;

"*Owner* " means The Corporation of the Township of Alfred and Plantagenet and includes its successors and assignees;

"Previous Works " means those portions of the sewage works previously constructed and approved under a certificate of approval;

"*Rated Capacity* " means the *Average Daily Flow* for which the *Works* are approved to handle;

"*Seasonal Average Concentration* " means the arithmetic mean of all *Daily Concentrations* of a contaminant measured during a seasonal discharge period; and

"*Works* " means the sewage works described in the *Owner* 's application, this *Certificate* and in the supporting documentation referred to herein, to the extent approved by this *Certificate* and includes *Previous Works* .

You are hereby notified that this approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) The *Owner* shall ensure that any person authorized to carry out work on or operate any aspect of the *Works* is notified of this *Certificate* and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

(2) Except as otherwise provided by these Conditions, the *Owner* shall design, build, install, operate and maintain the *Works* in accordance with the description given in this *Certificate* , the application for approval of the works and the submitted supporting documents and plans and specifications as listed in this *Certificate* .

(3) Where there is a conflict between a provision of any submitted document referred to in this *Certificate* and the Conditions of this *Certificate* , the Conditions in this *Certificate* shall take precedence, and where there is a conflict between the listed submitted documents, the document bearing the most recent date shall prevail.

(4) Where there is a conflict between the listed submitted documents, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(5) The requirements of this *Certificate* are severable. If any requirement of this *Certificate* , or the application of any requirement of this *Certificate* to any circumstance, is held invalid or unenforceable, the application of such requirement to other circumstances and the remainder of this *Certificate* shall not be affected thereby.

2. CHANGE OF OWNER

(1) The *Owner* shall notify the *District Manager* and the *Director* , in writing, of any of the following changes within 30 days of the change occurring:

(a) change of *Owner* ;

(b) change of address of the *Owner* ;

(c) change of partners where the *Owner* is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c.B17 shall be included in the notification to the *District Manager* ; and

(d) change of name of the corporation where the *Owner* is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Informations Act, R.S.O. 1990, c. C39 shall be included in the notification to the *District Manager* .

(2) In the event of any change in ownership of the *Works* , other than a change to a successor municipality, the *Owner* shall notify in writing the succeeding owner of the existence of this *Certificate* , and a copy of such notice shall be forwarded to the *District Manager* and the *Director* .

3. AS-CONSTRUCTED DRAWINGS

Within one year of the date of issuance of the *Certificate* , a set of as-built drawings showing the *Works* "as constructed" shall be prepared, if not already prepared. These drawings shall be kept up to date through revisions undertaken from time to time and a copy shall be retained at the *Works* for the operational life of the *Works* .

4. EFFLUENT OBJECTIVES

(1) The *Owner* shall use best efforts to operate and maintain the *Works* with the objective that the concentrations of the materials named below as effluent parameters are not exceeded in the effluent from the *Works* .

Table 1 - Effluent Objectives

Effluent Parameter	**Concentration Objective** (milligrams per litre)
BOD_5	15
Suspended Solids	20
Total Phosphorus	0.75

Effluent discharge is seasonal with spring discharge from April 01 to May 31 and Autumn discharge from November 01 to December 20, each year.

(2) The *Owner* shall use best efforts to:

(a) maintain the pH of the effluent from the *Works* within the range of 6.5 to 9.0 inclusive, at all times;

(b) operate the *Works* within the *Rated Capacity* of the *Works* ; and

(c) ensure that the effluent from the *Works* is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film or sheen or foam or discolouration on the receiving waters.

(3) The *Owner* shall include in all reports submitted in accordance with Condition 8 a summary of the efforts made and results achieved under this Condition.

(4) The objective concentrations set out in Table 1 of subsection (1) are interim concentrations and may be modified by the *Director* upon completion of South Nation River assimilative capacity assessment.

5. EFFLUENT LIMITS

(1) The *Owner* shall design and construct the *Proposed Works* and operate and maintain the *Works* such that the concentrations of the materials named below as effluent parameters are not exceeded in the effluent from the *Work* s.

Table 2 - Effluent Limits	
Effluent Parameter	**Seasonal Average Concentration** (milligrams per litre unless otherwise indicated)
Column 1	Column 2
BOD_5	25
Suspended Solids	25
Total Phosphorus	1.0
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times.	

Effluent discharge is seasonal with spring discharge from April 01 to May 31 and Autumn discharge from November 01 to December 20, each year.

(2) For the purposes of determining compliance with and enforcing subsection (1):

(a) The *Seasonal Average Concentration* of a parameter named in Column 1 of Table 2 of subsection (1) shall not exceed the corresponding maximum concentration set out in Column 2 of Table 2 of subsection (1); and

(b) The pH of the effluent shall be maintained within the limits outlined in subsection (1), at all times.

(3) Paragraphs (a) and (b) of subsection (2) shall apply upon the issuance of this *Certificate* .

(4) Only those monitoring results collected during the corresponding time period shall be used in calculating the *Seasonal Average Concentration* for this *Certificate.*

(5) The effluent limits set out in Table 2 of subsection (1) are interim concentrations and may be modified by the *Director* upon completion of South Nation River assimilative capacity assessment.

6. OPERATION AND MAINTENANCE

(1) Effluent from the *Works* shall be discharged seasonally with spring discharge between April 01 - May 31 and Autumn discharge between November 01 - December 20, each year, however, the discharge period(s) may be modified by the *Director* upon completion of South Nation River assimilative capacity assessment.

(2) The *Owner* shall exercise due diligence in ensuring that, at all times, the *Works* and the related equipment and appurtenances used to achieve compliance with this *Certificate* are properly operated and maintained. Proper operation and maintenance shall include effective performance, adequate funding, adequate operator staffing and training, including training in all procedures and other requirements of this *Certificate* and the *Act* and regulations, adequate laboratory facilities, process controls and alarms and the use of process chemicals and other substances used in the *Works* .

(3) The *Owner* shall prepare, or update if already prepared, an operations manual within six (6) months of *Substantial Completion* of the *Proposed Works* , that includes, but not necessarily limited to, the following information:

(a) operating procedures for routine operation of the *Works* ;

(b) inspection programs, including frequency of inspection, for the *Works* and the methods or tests employed to detect when maintenance is necessary;

(c) repair and maintenance programs, including the frequency of repair and maintenance for the *Works* ;

(d) procedures for the inspection and calibration of monitoring equipment;

(e) a spill prevention control and countermeasures plan, consisting of contingency plans and procedures for dealing with equipment breakdowns, potential spills and any other abnormal situations, including notification of the *District Manager* ; and

(f) procedures for receiving, responding and recording public complaints, including recording any follow-up actions taken.

(4) The *Owner* shall maintain the operations manual current and retain a copy at the location of the *Works* for the operational life of the *Works* . Upon request, the *Owner* shall make the manual available to *Ministry* staff.

(5) The *Owner* shall provide for the overall operation of the *Works* with an operator who holds a licence that is applicable to that type of facility and that is of the same class as or higher than the class of the facility in accordance with Ontario Regulation 435/93.

7. EFFLUENT MONITORING AND RECORDING

The *Owner* shall, upon commencement of operation of the *Works* , carry out the following monitoring program:

(1) All samples and measurements taken for the purposes of this *Certificate* are to be taken at a time and a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

(2) For the purposes of this condition, monthly means once every month.

(3) Samples shall be collected at the following sampling points, at the frequency specified, by means of the specified sample type and analyzed for each parameter listed and all results recorded:

Table 3 - Raw Sewage Monitoring
(Samples to be collected at the inlet of the Lagoon from Pumping Station No. 1 forcemain)

Parameters	Sample Type	Frequency
BOD_5	24-hr composite	Monthly
Total Suspended Solids	24-hr composite	Monthly
Total Kjeldahl Nitrogen	24-hr composite	Monthly
Total Ammonia Nitrogen	24-hr composite	Monthly
Total Phosphorus	24-hr composite	Monthly

Table 4 - Effluent Monitoring*
(Samples to be collected at the outlet of the lagoon or at the outfall sewer as close as possible to the lagoon)

Parameters	Sample Type	Frequency
BOD_5	Grab	See Note 1 below
Total Suspended Solids	Grab	See Note 1 below
Total Phosphorus	Grab	See Note 1 below
Total Ammonia Nitrogen	Grab	See Note 1 below
pH	Grab/Probe	See Note 1 below
Temperature	Grab/Probe	See Note 1 below

* Effluent discharge is seasonal with spring discharge from April 01 to May 31 and Autumn discharge from November 01 to December 20, each year.

Note 1: Samples of the effluent from the lagoon shall be collected at least five (5) times during each seasonal discharge, namely at the beginning of the discharge, at 25 %, at 50 % and at 75 % of the drawdown, and at the end of the discharge.

Table 5 - Lagoon Overflow Monitoring
(Samples to be collected at the outlet of the lagoon's overflow structure)

Parameters	Sample Type	Frequency*
BOD_5	Grab	Weekly
Total Suspended Solids	Grab	Weekly
Total Phosphorus	Grab	Weekly
Total Ammonia Nitrogen	Grab	Weekly
Nitrate Nitrogen	Grab	Weekly
E-Coli	Grab	Weekly
pH	Grab/Probe	Weekly
Temperature	Grab/Probe	Weekly

* During the period of overflow.

(Note: Definitions for grab and composite samples are included in one or more documents below. 24-hour composite sample means a time-composite sample and constitutes of an integrated sample made up of blending 24 hourly aliquots taken by refrigerated autosampler, which are obtained at an hourly frequency having same sample volume).

(4) The methods and protocols for sampling, analysis and recording shall conform, in order of precedence, to the methods and protocols specified in the following:

(a) the Ministry's Procedure F-10-1, “Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only), as amended from time to time by more recently published editions;

(b) the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (January 1999), ISBN 0-7778-1880-9, as amended from time to time by more recently published editions; and

(c) the publication "Standard Methods for the Examination of Water and Wastewater" (20th edition), as amended from time to time by more recently published editions.

8. REPORTING

(1) The *Owner* shall report to the *District Manager* or designate, any exceedance of any parameter specified in Condition 5 orally, as soon as reasonably possible, and in writing within seven (7) days after receiving analytic results of the exceedance.

(2) The *Owner* shall report to the *District Manager* or designate orally, as soon as possible, and in writing within seven (7) days of the end of overflow from lagoon's overflow structure, the start and the end of each sewage overflow event through the lagoon's

overflow structure and the volume of sewage that overflowed during each event.

(3) In addition to the obligations under Part X of the Environmental Protection Act, the *Owner* shall, within 10 working days of the occurrence of any reportable spill as defined in Ontario Regulation 675/98, bypass or loss of any product, by-product, intermediate product, oil, solvent, waste material or any other polluting substance into the environment, submit a full written report of the occurrence to the *District Manager* describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation.

(4) The *Owner* shall, upon request, make all manuals, plans, records, data, procedures and supporting documentation available to *Ministry* staff.

(5) The *Owner* shall prepare, and submit to the *District Manager* , a performance report, on an annual basis, within ninety (90) days following the end of the period being reported upon. The first such report shall cover the first annual period following the commencement of operation of the *Works* and subsequent reports shall be submitted to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the following information:

   (a) a summary and interpretation of all monitoring data and a comparison to the effluent limits outlined in Condition 5, including an overview of the success and adequacy of the *Works* ;

   (b) a description of any operating problems encountered and corrective actions taken;

   (c) a summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the *Works* ;

   (d) a summary of any effluent quality assurance or control measures undertaken in the reporting period;

   (e) a summary of the calibration and maintenance carried out on all effluent monitoring equipment; and

   (f) a description of efforts made and results achieved in meeting the Effluent Objectives of Condition 4.

   (g) a tabulation of the volume of sludge generated in the reporting period, an outline of anticipated volumes to be generated in the next reporting period and a summary of the locations to where the sludge was disposed;

   (h) a summary of any complaints received during the reporting period and any steps taken to address the complaints;

(i) a summary of all by-pass, spill or abnormal discharge events such as overflows outlining the number of events, the duration of each event, the quantity of flow during each event, and the measures that were taken to address the events/occurrences; and

(j) any other information the *District Manager* requires from time to time.

9. REVOCATION OF EXISTING APPROVALS

(1) The descriptions of the approved works and conditions of approval in this *Certificate* apply in place of all the existing descriptions and conditions in the Certificates of Approval under the Ontario Water Resources Act for sewage works which are part of the *Works* approved by this *Certificate* .

(2) Notwithstanding Condition 9(1) above, the original applications for approval, including design calculations, engineering drawings, and reports prepared in support of the existing Certificate(s) of Approval whose descriptions of the approved works and conditions are now replaced pursuant to Condition 9(1) above, shall form part of this *Certificate* .

(3) Where an existing Certificate of Approval referred to in Condition 9(1) above applies to *Works* in addition to the *Works* approved by this *Certificate* , it shall continue to apply to those additional *Works* .

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the *Works* are built and operated in the manner in which they were described for review and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the *Certificate* and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review. The condition also advises the Owners their responsibility to notify any person they authorized to carry out work pursuant to this *Certificate* the existence of this *Certificate* .

2. Condition 2 is included to ensure that the *Ministry* records are kept accurate and current with respect to the approved works and to ensure that subsequent owners of the *Works* are made aware of the *Certificate* and continue to operate the *Works* in compliance with it.

3. Condition 3 is included to ensure that record drawings of the *Works* "as constructed" are maintained for future references.

4. Condition 4 is imposed to establish non-enforceable effluent quality objectives which the *Owner* is obligated to use best efforts to strive towards on an ongoing basis. These objectives are to be used as a mechanism to trigger corrective action proactively and voluntarily before environmental impairment occurs and before the compliance limits of Condition 5 are exceeded.

5. Condition 5 is imposed to ensure that the effluent discharged from the *Works* to South Nation River meets the *Ministry* 's effluent quality requirements thus minimizing environmental impact on the receiver and to protect water quality, fish and other aquatic life in the receiving water body.

6. Condition 6 is included to require that the *Works* be properly operated, maintained, funded, staffed and equipped such that the environment is protected and deterioration, loss, injury or damage to any person or property is prevented. As well, the inclusion of a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the owner and made available to the *Ministry* . Such a manual is an integral part of the operation of the *Works* . Its compilation and use should assist the *Owner* in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for *Ministry* staff when reviewing the *Owner'* s operation of the *Works* .

7. Condition 7 is included to enable the *Owner* to evaluate and demonstrate the performance of the *Works* , on a continual basis, so that the *Works* are properly operated and maintained at a level which is consistent with the design objectives and effluent limits specified in the *Certificate* and that the *Works* does not cause any impairment to the receiving water body.

8. Condition 8 is included to provide a performance record for future references, to ensure that the *Ministry* is made aware of problems as they arise, and to provide a compliance record for all the terms and conditions outlined in this *Certificate,* so that the *Ministry* can work with the *Owner* in resolving any problems in a timely manner.

9. Condition 9 is included to stipulate that this *Certificate* replaces all previous approvals for the *Works* being the subject of this *Certificate* , and that the existing approvals remain in force for the purpose of any works which are not subject to this *Certificate* .

This Certificate of Approval revokes and replaces Certificate(s) of Approval No. 82/5/221 issued on August 4, 1972

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, Chapter 0.40, as amended, you may by written notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 101 of the Ontario Water Resources

Act, R.S.O. 1990, Chapter 0.40, provides that the Notice requiring the hearing shall state:

1. The portions of the approval or each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Certificate of Approval number;
6. The date of the Certificate of Approval;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
2300 Yonge St., 12th Floor
P.O. Box 2382
Toronto, Ontario
M4P 1E4

AND

The Director
Section 53, *Ontario Water Resources Act*
Ministry of the Environment
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario
M4V 1L5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 314-4600, Fax: (416) 314-4506 or www.ert.gov.on.ca**

The above noted sewage works are approved under Section 53 of the Ontario Water Resources Act.

DATED AT TORONTO this 23rd day of April, 2004

Mohamed Dhalla, P.Eng.
Director
Section 53, *Ontario Water Resources Act*

ZB/

c: District Manager, MOE Kingston - District
Diane Thauvette, The Corporation of the Township of Alfred and Plantagenet
Standards Development Branch, Drinking Water, Wastewater and Watershed Section

Appendix A2

List of Available Documentation

TOWNSHIP OF ALFRED AND PLANTAGENET
PLANTAGENET WASTEWATER CLASS EA

LIST OF AVAILABLE DOCUMENTATION

No.	Description	Information Available
1	United Counties of Prescott and Russel (UCPR) GIS Data	Zoning, land use, urban boundary, and other GIS information.
2	AECOM Water and Wastewater System Site Plans (2013)	Wastewater sewer main and maintenance hole locations, sizes, and flow direction.
3	OCWA Performance Assessment Reports for the Lagoon, complete with flow and quality data (2016 to 2020)	Data for influent & effluent flows and concentrations, and annual reports with interpretations of data, operating and maintenance summaries and records, review of compliance with MECP C of A, etc.
4	MECP Plantagenet Sewage Amended Certificate of Authorization No. 4631-5WXQE9 (April 2004)	Rated capacity of system, effluent criteria, monitoring program requirements, and other system compliance requirements.
5	MECP Inspection Report for Plantagenet Lagoon (2015)	Existing system infrastructure, and flow and concentration data from 2010 to 2015.
6	Plantagenet Sewage Works Operation Manual (2004)	Information on operation of system.
7	Stanley Environmental Study Report for Village of Plantagenet Sewage System (July 1998).	Record of previous class environmental assessment completed for the system. Existing conditions and selected design.
8	Stantec Plantagenet Sewage Treatment System Final Report (2015)	Report describing existing system infrastructure, data and issues, and identifying proposed upgrades with cost estimates.
9	Hemson UCPR Growth Forecast Final Report (2012)	Growth outlook, land supply and capacity analysis and settlement area boundary assessments for the Township of Alfred and Plantagenet.
10	UCPR Official Plan (Adopted 2022)	Growth outlook of Township, maps, etc.
11	Map of development potential (2021), growth projections email (2021) and spreadsheet with sanitary connections since 2011 (2021)	Information and data for servicing area and population projections.
12	J.L. Richards Sanitary Sewage Collection & Disposal System As-Built Drawings (1974)	Original collection system (incl. pumping stations) and lagoon as-built drawings used to understand the design of the existing infrastructure.

Appendix A3

Technical Memorandum No. 1 – Design Basis

MEMORANDUM

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

J.L. Richards
& Associates Limited
343 Preston Street
Tower II, Suite 1000
Ottawa Ontario K1S 1N4
Tel: 613 728 3571
Fax: 613 728 6012

To: Jonathan Gendron, P.Eng.
Director of Building, Planning, Engineering, and Environment
Township of Alfred and Plantagenet

From: Nicolas Bialik, P.Eng.

Date: February 21, 2023

JLR No.: 31457-000

CC: Dawn Crump, OCWA
Sarah Gore, P.Eng., JLR
Jordan Morrissette, P.Eng., JLR

Re: Plantagenet Wastewater Class Environmental Assessment
Technical Memorandum No. 1 – Design Basis

INTRODUCTION

This memorandum forms part of Phase 1 of the Plantagenet Wastewater Class Environmental Assessment (Plantagenet WW Class EA). The purpose of this technical memorandum (TM) is to summarize the development of the design basis for upgrades/expansion of the Village of Plantagenet (Village) wastewater system, which includes sanitary sewers, two (2) sewage pumping stations with forcemains, and a lagoon treatment system with a gravity outfall to the South Nation River. The wastewater system currently operates under Environmental Compliance Approval (ECA) No. 4631-5WXQE9, dated April 23, 2004.

The memorandum is divided into three (3) main sections, representing different components of the design basis:

1. Growth Evaluation
2. Influent Characterization
3. Effluent Requirements (Assimilative Capacity Assessment of Receiver)

Note that Section 3 information is summarized from the Assimilative Capacity Study Report (November 11, 2022), completed by Blue Sky Energy Engineering and Consulting Inc. This study report is attached to the memorandum.

SECTION 1 – GROWTH EVALUATION

1.1 - EXISTING SERVICED POPULATION AND HOUSEHOLD OCCUPANCY

The population serviced by the Plantagenet wastewater system was determined based on a review of existing studies and insight from the Township of Alfred and Plantagenet (Township) on recent residential development. The most recent estimate for the Village population was from the 2016 Census, which calculated a population of 1,027 (down from 1,055 from 2011). Census populations provide a good understanding of populations within a geographical area; however, the actual serviced population is typically undercounted, and additional work is generally required to count the serviced population missed by the Census. The actual population serviced by the Plantagenet wastewater system was most recently estimated in December 2014, as part of the Plantagenet Sewage System – Final Report (Stantec, 2015). This report identified a serviced population of 1,284, confirmed by the Village at the time. Due to the discrepancy between the Census populations and the measured service population, the population used as the basis for estimating the 2022 population was the 2014 population of 1,284.

Since 2014, the Village has approved only 20 connections to the wastewater system. These have come from servicing existing buildings and connecting newly built semi-detached housing and apartments. Using an average household occupancy of 2.57 people/unit, which was derived from unit and population calculations for the Township from the December 2012 United Counties of Prescott and Russel (UCPR) Growth Forecast and Land Needs Analysis (Hemson, 2012), it is estimated that the serviced population has increased by 52 people since 2014. The current population as of January 2022 was therefore calculated as 1,336.

It is also noted that the existing system services a few institutional and commercial users. These include a high school, primary school, catering company, community pool, community library, community center, municipal office and other small commercial spaces. It is estimated that these users occupy a servicing area of approximately 6 ha. This represents approximately 6.6% of the total approximate servicing area of 91 ha.

Section 1.1 Summary:

- Existing Serviced Population (2022) = 1,336
- Average Household Occupancy = 2.57 people per unit
- Existing ICI Servicing Area = ~ 6 ha
- Existing Servicing Area = 91 ha

1.2 - POTENTIAL DEVELOPMENT STRATEGY

The projected growth within the Village was determined from a list of potential development areas and their associated types and land uses provided by the Township. It is noted that projected developments were estimated and that specifics regarding the projected developments are subject to change. It is also noted that projected development outside of the future wastewater servicing area was not considered as part of this study. Refer to Figure TM1-1 for a site plan of the development areas within the future wastewater servicing area. Referencing Figure TM1-1, “high potential” lands are lands that the Township has noted are likely to be developed within the next 20 years (2042), once wastewater infrastructure capacity is available and “low potential” lands are lands that the Township has noted have the potential to be developed in the future (Build-Out – Post 2042). Table 1 provides a description of the areas that the Township has specified as “high potential” lands for residential development, Table 2 provides a description of the areas that the Township has specified as “high potential” lands for industrial, commercial and institutional (ICI) development, Table 3 provides a description of areas within the Village that the Township has specified as “low potential” lands for residential development, and Table 4 provides a description of areas within the Village that the Township has specified as “low potential” lands for ICI development.

Table 1: Village Lands with “High Potential” for Residential Development

Lot ID	Area (m^2)	Area (ha)	Description:
10	21,407	2.14	Vacant residential land not on water.
16	1,239	0.12	Vacant residential land not on water.
17	12,583	1.26	Vacant residential land not on water.
18	6,138	0.61	Vacant residential land not on water.
19	12,036	1.20	Vacant residential land not on water.
26	175,551	17.56	Managed forest property, vacant land not on water.
47	47,608	4.76	Farm property without any buildings/structures.
55	5,675	0.57	Vacant residential land not on water.
56	11,474	1.15	Vacant residential land not on water.
57	12,693	1.27	Vacant residential land not on water.
58	74,184	7.42	Vacant residential land not on water.
59	30,707	3.07	Vacant residential land not on water.
Total:	**411,295**	**41.13**	**See note in Section 1.3.**

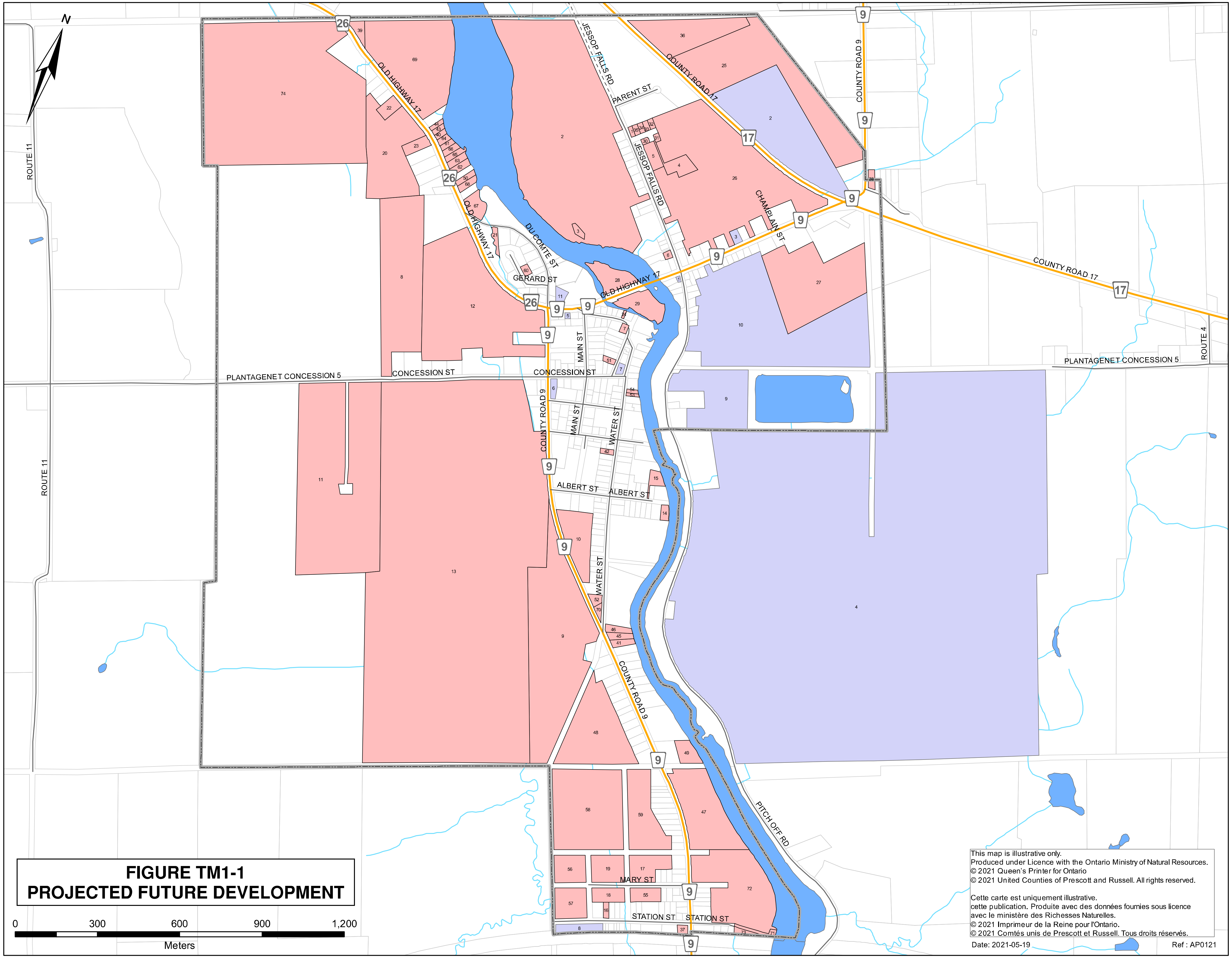

FIGURE TM1-1
PROJECTED FUTURE DEVELOPMENT

This map is illustrative only.
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Date: 2021-05-19

Ref : AP0121

Canton d'Alfred et Plantagenet
Township of Alfred and Plantagenet
Plantagenet

🟦 "Low potential" development lands
🟩 "High potential" development lands

Vacant Residential Land

ID	ROLL	Area	Location	Prop_Code	Prop_Def
3	023104000103301	1313	JESSUP'S FALLS RD	100	Vacant residential land not on water *
6	023104000104100	800	196 JESSOP'S FALLS R	100	Vacant residential land not on water *
7	023104000107500	896	OTTAWA ST	100	Vacant residential land not on water *
10	023104000113000	21407	COUNTY RD 9	100	Vacant residential land not on water *
16	023104000113708	1239	STATION ST	100	Vacant residential land not on water *
17	023104000113750	12583	STATION ST	100	Vacant residential land not on water *
18	023104000113750	6138	STATION ST	100	Vacant residential land not on water *
19	023104000113750	12036	STATION ST	100	Vacant residential land not on water *
21	023104000105200	1685	COMTE RD	100	Vacant residential land not on water *
22	023104000106110	4196	OLD HIGHWAY 17 W/S	100	Vacant residential land not on water *
23	023104000106115	4497	OLD HIGHWAY 17 W/S	100	Vacant residential land not on water *
24	023104000106800	351	OTTAWA ST	100	Vacant residential land not on water *
27	023104000101100	80089	COUNTY ROAD 26	100	Vacant residential land not on water *
31	023104000102015	604	JESSUP'S FALLS RD	100	Vacant residential land not on water *
36	023104000100110	35964	HIGHWAY 17	100	Vacant residential land not on water *
37	023102000601906	1148	COUNTY RD 9	100	Vacant residential land not on water *
38	023102000402372	1721	CAMPBELL RD	100	Vacant residential land not on water *
39	023102000402810	3211	OLD HIGHWAY 17	100	Vacant residential land not on water *
42	023104000119800	944	WATER ST	100	Vacant residential land not on water *
51	023104000123200	946	280 ALFRED ST	100	Vacant residential land not on water *
52	023104000121900	1673	WATER ST	100	Vacant residential land not on water *
55	023104000113750	5675	STATION ST	100	Vacant residential land not on water *
56	023104000113750	11474	STATION ST	100	Vacant residential land not on water *
57	023104000113750	12693	STATION ST	100	Vacant residential land not on water *
58	023104000113750	74184	STATION ST	100	Vacant residential land not on water *
59	023104000113750	30707	STATION ST	100	Vacant residential land not on water *
60	023104000127640	1079	GERARD ST	100	Vacant residential land not on water *
70	023104000121910	1077	WATER ST	100	Vacant residential land not on water *
14	023104000113500	1627	ALBERT ST	110	Vacant residential/recreational land on water *
15	023104000112700	2936	460 ALBERT ST	110	Vacant residential/recreational land on water *
28	023104000101050	11319	574 OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
29	023104000101075	12242	COUNTY RD 26	110	Vacant residential/recreational land on water *
40	023104000105310	1281	850 OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
41	023104000117140	2109	COUNTY RD 9	110	Vacant residential/recreational land on water *
43	023104000105311	1462	860 OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
44	023104000105312	1462	870 OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
45	023104000117142	2177	COUNTY RD 9	110	Vacant residential/recreational land on water *
46	023104000117143	2244	WATER ST	110	Vacant residential/recreational land on water *
50	023104000105302	3030	OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
53	023104000115200	1074	325-331 WATER ST	110	Vacant residential/recreational land on water *
54	023104000115202	1074	WATER ST	110	Vacant residential/recreational land on water *
61	023104000105308	1508	OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
62	023104000105304	2190	COUNTY RD 26	110	Vacant residential/recreational land on water *
63	023104000105305	2246	COUNTY RD 26	110	Vacant residential/recreational land on water *
64	023104000105306	1244	COUNTY RD 26	110	Vacant residential/recreational land on water *
65	023104000105306	1857	COUNTY RD 26	110	Vacant residential/recreational land on water *
66	023104000105307	1857	OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
67	023104000105300	7815	OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
68	023104000105301	3030	OLD HIGHWAY 17	110	Vacant residential/recreational land on water *
71	023104000118400	1941	STATION ST	110	Vacant residential/recreational land on water *
1	023104000102020	584	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
2	023104000103300	289012	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
4	023104000102022	6563	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
5	023104000102023	4210	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
8	023104000107900	88803	CONCESSION RD 5	200	Farm property without any buildings/structures
9	023104000112900	136326	COUNTY RD 9	200	Farm property without any buildings/structures
25	023104000100160	103020	HIGHWAY 17	200	Farm property without any buildings/structures
30	023104000102014	603	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
32	023104000102016	778	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
33	023104000102017	745	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
34	023104000102018	754	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
35	023104000102019	757	JESSUP'S FALLS RD	200	Farm property without any buildings/structures
47	023104000117100	47608	STATION ST	200	Farm property without any buildings/structures
48	023104000117100	54883	STATION ST	200	Farm property without any buildings/structures
49	023104000117100	5767	STATION ST	200	Farm property without any buildings/structures
69	023104000100150	64157	OLD HIGHWAY 17	200	Farm property without any buildings/structures
72	023104000118401	65111	COUNTY RD 9	200	Farm property without any buildings/structures
73	023104000118402	1582	STATION ST	200	Farm property without any buildings/structures
74	023102000402800	298304	OLD HIGHWAY 17	200	Farm property without any buildings/structures
11	023102000502600	205553	CON 5 PT LOT 9	210	Farm without residence - with secondary structures; with farm outbuildings
13	023104000108100	827544	CONCESSION 5 RD	210	Farm without residence - with secondary structures; with farm outbuildings
20	023104000106100	37114	OLD HIGHWAY 17 W/S	210	Farm without residence - with secondary structures; with farm outbuildings
12	023104000105900	147664	COUNTY RD 9	240	Managed forest property, vacant land not on water
26	023104000100300	175551	OLD HIGHWAY 17	240	Managed forest property, vacant land not on water

Vacant Commertial / Industrial Land

ID	ROLL	AREA	Location	Prop_Code	Prop_Def
1	023104000101900	282	COUNTY ROAD 26	105	Vacant commercial land *
3	023104000100380	1537	COUNTY RD 9 N S	105	Vacant commercial land *
5	023104000105710	434	OLD HIGHWAY 17	105	Vacant commercial land *
6	023104000109600	1581	COUNTY RD 9	105	Vacant commercial land *
7	023104000118900	983	WATER ST	105	Vacant commercial land *
11	023104000104700	2151	CON 4 OS PT LOT 11	105	Vacant commercial land *
2	023104000100310	94862	OLD HIGHWAY 17	260	Vacant residential/commercial/industrial land, owned by a non-farmer with a portion
4	023102000502200	1648456	PITCH OFF RD	260	Vacant residential/commercial/industrial land, owned by a non-farmer with a portion
8	023104000114306	5621	STATION ST	260	Vacant residential/commercial/industrial land, owned by a non-farmer with a portion
9	023104000103200	53731	PITCH OFF RD	260	Vacant residential/commercial/industrial land, owned by a non-farmer with a portion
10	023104000103200	172314	PITCH OFF RD	260	Vacant residential/commercial/industrial land, owned by a non-farmer with a portion

Legend

🟥 Vacant Residential Land
🟪 Vacant Commercial / Industrial Land

Table 2: Village Lands with "High Potential" for ICI Development

Lot ID	Area (m^2)	Area (ha)	Description:
3	1,537	0.15	Vacant commercial land.
5	434	0.04	Vacant commercial land.
8	5,621	0.56	Vacant commercial land.
11	2,151	0.22	Vacant commercial land.
-	40,469	4.05	10 acres – existing residential lot that could be severed.
Total:	**50,212**	**5.02**	**See note in Section 1.3.**

Table 3: Village Lands with "Low Potential" for Residential Development

Lot ID	Area (m^2)	Area (ha)	Description:
2	289,012	28.90	Farm property without any buildings/structures.
12	147,664	14.77	Managed forest property, vacant land not on water.
13	827,544	82.75	Farm without residence - with secondary structures; with farm outbuildings.
25	103,020	10.30	Farm property without any buildings/structures.
Total:	**1,367,270**	**136.72**	

Table 4: Village Lands with "Low Potential" for ICI Development

Lot ID	Area (m^2)	Area (ha)	Description:
2	94,862	9.49	Vacant residential/commercial/industrial land, owned by a non-farmer.
10	172,314	17.23	Vacant residential/commercial/industrial land, owned by a non-farmer.
Total:	**267,176**	**26.72**	

The Township has noted that their target metric for residential development is 70% low density (16 units/ha), 20% medium density (25 units/ha) and 10% high density (40 units/ha). This equates to a weighted average unit density of 20.2 units/ha. Therefore, based on Table 1, approximately 831 residential units are projected to be developed in the next 20 years ("high potential" lands), and based on Table 3, approximately 2,762 additional residential units are projected to be developed post-2042 ("low potential" lands) **(see note in Section 1.3)**.

Section 1.2 Summary:

- Target Residential Development Unit Density = 20.2 units/ha
- Projected Number of "High Potential" Residential Units to be Developed = 831 units
- ICI Land with "High Potential" to be Developed = 5.02 ha
- Projected Number of "Low Potential" Residential Units to be Developed = 2,762 units
- ICI Land with "Low Potential" to be Developed = 26.72 ha

1.3 – SERVICED POPULATION AND ICI PROJECTIONS

Important Note: This technical memorandum was developed using a "high potential" residential development area of 50.01 ha (equivalent to 1,011 units), and "high potential" ICI development area of 4.46 ha instead of the "high potential" development areas shown in Table 1 and Table 2. The changes to the areas described in Section 1.2 were made following the development of the design basis. It is noted that the values used in the projections are conservative.

Using the residential development projections described in Section 1.2 and as noted above, as well as a household density of 2.57 people/unit, serviced population projections were developed, as summarized in Table 5. A summary of ICI land development projections is provided in Table 6.

Table 5: Serviced Population Projections

Description:	Population	Growth (# People)	Growth (%)
Existing (2022)[1]	1,336	-	-
20-Year (2042)	3,935	2,599	195%
Build-Out (Post-2042)	11,034	7,099	180%
Overall Growth:	**-**	**9,698**	**726%**

Notes:
1. Existing population is estimated based on Plantagenet Sewage System – Final Report (Stantec, 2015) and additional 20 connections to the wastewater system.

Table 6: Serviced ICI Land Projections

Description:	ICI Area (ha)	Growth (ha)	Growth (%)
Existing (2022)	~ 6	-	-
20-Year (2042)	10.46	4.46	75%
Build-Out (Post-2042)	37.18	26.72	255%
Overall Growth:	**-**	**31.18**	**520%**

Section 1.3 Summary:

- 20-Year (2042) Projections – Serviced population of 3,935 and 10.46 ha of serviced ICI (growth of 2,599 people and 4.46 ha)
- Build-Out (Post-2042) Projections – Serviced population of 11,034 and 37.18 ha of serviced ICI (growth of additional 7,099 people and 26.72 ha)

1.4 – POTENTIAL PHASING OF UPGRADES

Table 5 and Table 6 show that over the next 20 years, there is potential for significant residential and ICI growth based on land availability. However, the actual timing for development to occur depends on several factors (e.g., employment market, economic outlook, land quality, geographical location, etc.), and therefore, it can be difficult to accurately predict timing and growth within a municipality. Since implementing all the upgrades at once can present a significant financial risk to the owner of the system, as they may be relying on service connections to fund the system upgrades, the Township has requested that the opportunity to phase implementation of the upgrades be reviewed as part of the Class EA. As such, a two-phase strategy is being reviewed for the 20-year horizon, whereby half the “high potential” lands are assumed to be developed within a 10-year horizon (2022 – 2032) and the other half within the next 10-year horizon (2032 – 2042). Table 7 and Table 8 summarize the serviced population projections and ICI servicing projections based on these phases.

It is important to note that although a phased approach is being reviewed, the overall requirements of the Class EA to identify solutions that meet the 20-year horizon will be considered. The overall intent of reviewing the above phasing strategy is to provide flexibility to the Township in implementing the overall preferred solution identified. Phasing of the upgrades should be further reviewed during preliminary and detailed design.

Table 7: Serviced Population Projections (including Phasing)

Description:	Population	Growth (# People)	Growth (%)
Existing (2022)	1,336	-	-
Phase 1 – 10-Year (2032)	2,636	1,300	97%
Phase 2 – 20-Year (2042)	3,935	1,299	49%
Phase 3 – Build-Out (Post-2042)	11,034	7,099	180%
Overall Growth:	**-**	**9,698**	**726%**

Table 8: Serviced ICI Land Projections (including Phasing)

Description:	ICI Area (ha)	Growth (ha)	Growth (%)
Existing (2022)	~ 6	-	-
Phase 1 – 10-Year (2032)	8.23	2.23	37%
Phase 2 – 20-Year (2042)	10.46	2.23	27%
Phase 3 – Build-Out (Post-2042)	37.18	26.72	255%
Overall Growth:	**-**	**31.18**	**520%**

Section 1.4 Summary:

- Phase 1 (2032) Projections – Serviced population of 2,636 and 8.23 ha of serviced ICI (growth of 1,300 people and 2.23 ha)
- Phase 2 (2042) Projections – Serviced population of 3,935 and 10.46 ha of serviced ICI (growth of 1,299 people and 2.23 ha)

SECTION 2 – INFLUENT CHARACTERIZATION

2.1 – EXISTING INFLUENT FLOWS

Influent flow data was obtained from the Township for the period between January 2016 and December 2020. Summaries of the average and maximum daily influent flows during this period are provided in Table 9 and Table 10.

Table 9 below shows that the average influent flow rate at the lagoon between 2016 and 2020 was 747 m^3/day, which is above the rated capacity of the system of 561 m^3/day. Given that no specific annual trend was observed in the data, and that only four (4) sanitary connections were added to the system between 2020 and January 2022, it was assumed that the average influent flow rate of 747 m^3/day represents the average influent flow rate in 2022. Given that there is no historical ICI flow data available, a typical annual ICI flow rate of 17 m^3/day/ha was used together with the estimated existing ICI servicing area (6 ha) to calculate an average ICI flow contribution of 102 m^3/day, which represents approximately 13.7% of the total average influent flow. Additionally, since there is no historical I/I flow data available, a typical annual dry weather inflow and infiltration (I&I) rate of 0.02 L/s/ha was used together with the estimated existing total servicing area (91 ha) to calculate an average dry weather I&I flow contribution of 157 m^3/day, which represents approximately 21% of the total average influent flow. Using the remaining 488 m^3/day and a population of 1,336 in 2022, a per capita flow rate of 365 L/cap/day is estimated, which is slightly above the average, but well within the Ministry of the Environment, Conservation and Parks (MECP) range typically used to project average residential flow rates (225 L/s to 450 L/s).

Table 9: Average Daily Influent Flows to the Wastewater Treatment System (2016 to 2020)

		AVERAGE DAILY INFLUENT FLOWS (2016 TO 2020)						
		Rated Capacity	**2016**	**2017**	**2018**	**2019**	**2020**	**AVG:**
Date	**# Days**	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
January	31	561	632	722	779	659	727	704
February	28	561	624	827	830	599	619	700
March	31	561	823	919	940	813	1,096	918
April	30	561	842	1,199	1,048	1,367	921	1,075
May	31	561	466	979	774	901	703	765
June	30	561	463	782	659	701	619	645
July	31	561	478	803	645	637	641	641
August	31	561	570	677	685	601	664	639
September	30	561	492	633	748	661	660	639
October	31	561	615	711	704	756	812	719
November	30	561	747	648	868	817	744	765
December	31	561	681	718	819	764	812	759
AVG:	-	-	619	801	791	773	752	**747**
MAX:	-	-	842	1,199	1,048	1,367	1,096	**1,367**
MIN:	-	-	463	633	645	599	619	**463**

Table 10 shows that the average of monthly maximum daily flows from 2016 to 2020 was 1,047 m^3/day and the maximum day flow over the period was 2,951 m^3/day. In general, other than the April 2017 maximum daily flow, the maximum daily flows recorded were below the maximum Pumping Station No. 1 (PS1) rated capacity. This table also shows that, as expected, the highest peak flows are occurring during the spring, with lowest peak flows occurring during winter and summer.

Table 10: Maximum Daily Influent Flows to the Wastewater Treatment System (2016 to 2020)

		MAXIMUM DAILY INFLUENT FLOWS (2016 TO 2020)								
		Rated Capacity	2016	2017	2018	2019	2020	AVG:	MAX:	99.5%:
Date	# Days	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*	*m3/day*
January	31	-	847	895	1,008	709	906	873	1,008	1,006
February	28	-	757	1,640	1,092	692	654	967	1,640	1,629
March	31	-	1,409	1,640	1,417	1,057	1,448	1,394	1,640	1,636
April	30	-	1,409	2,951	1,445	2,004	1,217	1,805	2,951	2,932
May	31	-	619	1,823	870	1,650	775	1,147	1,823	1,820
June	30	-	564	1,066	774	770	675	770	1,066	1,060
July	31	-	554	1,360	1,368	679	733	939	1,368	1,368
August	31	-	832	946	821	655	806	812	946	944
September	30	-	562	825	1,082	712	737	784	1,082	1,077
October	31	-	1,015	1,078	807	2,045	894	1,168	2,045	2,026
November	30	-	802	1,143	1,194	1,036	948	1,025	1,194	1,193
December	31	-	949	941	987	935	1,196	1,002	1,196	1,192
AVG:	-	-	859	1,355	1,071	1,081	916	1,055	-	-
MAX:	-	-	1,409	2,951	1,445	2,045	1,448	-	2,951	-
99.5%:	-	-	1,409	2,889	1,443	2,043	1,435	-	-	2,684

Notes:
1 - Sanitary Pumping Station (SPS) No. 1 is rated to deliver 29.2 L/s (2523 m3/day) to the Lagoon. It is noted that significant flooding occured in Eastern Ontario in April 2017, and the data suggests that pumping more than the capacity of the SPS was required at that time.

Using the average and maximum daily influent wastewater flows from 2016 to 2020, peaking factors were calculated, as shown in Table 11. The average peak daily flow (PDF) factor of 2.47 and the average maximum monthly average flow factor of 1.48 were obtained by calculating factors for each year and averaging these values. Note that the average PDF factor is in line with MECP guidelines for populations between 1,000 and 2,000 (maximum day peaking factor of 2.5).

Table 11: Wastewater Influent Flow Peaking Factors (2016 to 2020)

Year:	2016	2017	2018	2019	2020	AVG:	Max:
Average Daily Flow (m^3/day):	619	801	791	773	752	747	801
Maximum Average Monthly Flow (m^3/day):	842	1,199	1,048	1,367	1,096	1,110	1,367
Peak Daily Flow (m^3/day):	1,409	2,951	1,445	2,045	1,448	1,860	2,951
PDF Factor:	2.28	3.68	1.83	2.65	1.92	**2.47**	-
Maximum Monthly Average Flow Factor:	1.36	1.50	1.33	1.77	1.46	**1.48**	-

Section 2.1 Summary:

- Average Daily Influent Flow (2016 to 2020) = 747 m^3/day
- Maximum Daily Influent Flow (2016 to 2020) = 2,951 m^3/day
- Maximum Average Monthly Flow (2016 to 2020) = 1,367 m^3/day
- PDF Factor = 2.47
- Maximum Monthly Average Flow Factor = 1.48

2.2 – PROJECTED RAW WASTEWATER FLOWS

The average daily influent flow from 2016 to 2020 of 747 m^3/day was used as the projected average raw wastewater flow contribution from the existing wastewater servicing system, as it is assumed that any future increase in inflow and infiltration (I&I) would be offset by lifecycle repairs of aging infrastructure.

To project the average raw wastewater flow contributions from future development, design criteria from the City of Ottawa (COO) Sewer Design Guidelines (SDGs), as amended by various technical bulletins, and the MECP SDGs, were used. Three (3) components were considered in projecting the wastewater flow from new development: residential wastewater, ICI wastewater and dry weather I&I flow. For projecting residential wastewater flow, the COO SDGs uses a per capita flow rate of 280 L/cap/day, while the MECP SDGs uses a range from 225 to 450 L/cap/day. A value of 350 L/cap/day was conservatively used. For projecting ICI wastewater flow, a value of 28 m^3/day/ha was used, which is the design value specified in both the COO SDGs and the MECP SDGs. Finally, for projecting dry weather I&I flow, a design value of 0.05 L/s/ha (4.32 m^3/day/ha), per the COO SDGs was used and applied to both future residential and ICI lands.

Based on the above, total projected average raw wastewater flows of 1,390 m^3/day, 2,020 m^3/day and 5,960 m^3/day were calculated for Phase 1 (2032), Phase 2 (2042), and Phase 3 (Build-out), respectively. Table 12 provides a summary of these projected flows.

Table 12: Projected Average Raw Wastewater Flows

	Population	Wastewater Flow Contributions (m3/day)				Total Projected Design Flow (m3/day)
		Existing Residential & ICI Connections	Residential Development	Commercial Development	Dry Weather I/I from Development	
Existing (2022)	1,336	747	-	-	-	**747**
Phase 1 - 10-Year (2032)	2,636	747	455	62	118	**1,390**
Phase 2 - 20-Year (2042)	3,935	747	910	125	235	**2,020**
Phase 3 - Build-Out (Post-2042)	11,034	747	3,394	873	941	**5,960**

To project future peak daily flows and maximum monthly average flows for each phase, the average peaking factors from Section 2.1 were used. The projected flows are provided in Table 13.

Table 13: Projected Peak Daily and Maximum Monthly Average Flows

	Projected Average Daily Flow (m3/day)	Peak Daily Flow Factor	Projected Peak Daily Flow (m3/day)	Maximum Monthly Average Flow Factor	Projected Maximum Monthly Average Flow (m3/day)
Existing (2022)	747	2.47	1,847	1.48	1,107
Phase 1 - 10-Year (2032)	1,390	2.47	3,435	1.48	2,059
Phase 2 - 20-Year (2042)	2,020	2.47	4,992	1.48	2,992
Phase 3 - Build-Out (Post-2042)	5,960	2.47	14,728	1.48	8,828

Section 2.2 Summary:

- Phase 1 (2032) Projected Influent Wastewater Flows:
  - ADF = 1,390 m^3/day
  - PDF = 3,435 m^3/day
  - Maximum Monthly Average Flow = 2,059 m^3/day
- Phase 2 (2042) Project Influent Wastewater Flows:
  - ADF = 2,020 m^3/day
  - PDF = 4,992 m^3/day
  - Maximum Monthly Average Flow = 2,992 m^3/day

2.3 – EXISTING INFLUENT QUALITY

Influent quality data was obtained from the Township for the period between January 2016 and December 2020. In accordance with the wastewater system ECA, the Township/Ontario Clean Water Agency (OCWA) has historically, on a monthly basis, collected 24-hour composite samples, and analyzed these samples for the following parameters of interest: carbonaceous biochemical oxygen demand (cBOD), 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), total phosphorous (TP) and total kjeldahl nitrogen (TKN). Table 14 and Table 15 summarize the average concentrations of these parameters during this period. Table 14 summarizes the data on an annual basis, while Table 15 summarizes the data on a monthly basis. These tables show that, on average and compared to typical wastewater strength (Metcalf and Eddy, 2003), the wastewater received at the treatment system is medium strength wastewater.

Table 14: Raw Influent Wastewater Quality (2016 to 2020) – Annual Basis

	cBOD		BOD_5		TSS		TP		TKN	
	mg/L	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*
2016	229	141	-	-	218	149	5.84	3.67	48.6	30.6
2017	169	138	297	211	176	139	4.27	3.34	36.3	28.5
2018	221	182	360	282	194	153	6.03	4.71	40.8	31.2
2019	-	-	195	140	170	125	5.48	3.97	44.7	32.4
2020	-	-	265	216	202	161	6.55	5.06	56.1	42.4
AVG:	**206**	**154**	**279**	**213**	**192**	**145**	**5.63**	**4.15**	**45.3**	**33.0**
75th Percential	225	162	312	233	202	153	6.03	4.71	48.6	32.4
MAX:	229	182	360	282	218	161	6.55	5.06	56.1	42.4
MIN:	169	138	195	140	170	125	4.27	3.34	36.3	28.5
Low (see Note 4)	-	-	110	-	120	-	4	-	20	-
Medium (see Note 4)	-	-	190	-	210	-	7	-	40	-
High (see Note 4)	-	-	350	-	400	-	12	-	70	-
Characterization:	-	-	Medium-High		Medium		Low-Medium		Medium	

Notes:

1 - The following outliers were removed from the data: **BOD5**: February 2018 (1,300 mg/L); **TSS**: January 2016 (1,360 mg/L), February 2016 (1,670 mg/L), July 2016 (2,420 mg/L), January 2017 (8,920 mg/L), January 2018 (6,910 mg/L), and February 2018 (1,700 mg/L); **TKN**: November 2018 (162 mg/L).

2 - CBOD5 data from 2019 and 2020 was excluded from the analysis due to CBOD5 sampling stopping after March 2019.

3 - BOD5 data from 2016 was excluded from the analysis, as data was only available for 4/12 months.

4 - Typical wastewater strength is from Metcalf and Eddy, 2003.

Table 15: Average Raw Influent Wastewater Quality (2016 to 2020) – Monthly Basis

	cBOD		BOD_5		TSS		TP		TKN	
	mg/L	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*
January	294	206	541	393	310	213	6.98	5.0	53.9	38.3
February	157	112	189	116	191	132	6.52	4.6	52.0	36.5
March	174	150	311	318	225	218	4.80	4.6	43.5	41.6
April	252	239	76	83	196	188	4.10	4.1	31.3	31.2
May	212	164	102	86	181	141	3.39	2.7	30.6	24.5
June	149	88	210	141	178	112	5.04	3.1	44.6	27.8
July	207	122	176	113	147	100	6.63	4.2	55.2	35.1
August	207	118	152	98	130	79	5.51	3.4	46.5	28.9
September	169	83	368	254	195	126	7.12	4.6	53.4	34.5
October	175	112	333	254	197	142	6.35	4.6	53.4	38.4
November	438	380	277	223	181	144	6.00	4.8	34.7	26.2
December	74	61	164	126	208	157	4.95	3.8	41.4	31.5

Notes:
1 - The following outliers were removed from the data: BOD5: February 2018 (1,300 mg/L); TSS: January 2016 (1,360 mg/L), February 2016 (1,670 mg/L), July 2016 (2,420 mg/L), January 2017 (8,920 mg/L), January 2018 (6,910 mg/L), and February 2018 (1,700 mg/L); TKN: November 2018 (162 mg/L).

2.4 - PROJECTED RAW WASTEWATER QUALITY

To project future raw wastewater quality, it was assumed that the historical raw wastewater concentrations will remain similar to existing in future years. This assumption was made in the absence of separate residential, ICI and I&I quality data. Refer to Table 16 for a summary of the raw wastewater quality projections. Note that the maximum monthly concentration was calculated by averaging the maximum monthly concentration from each year from 2016 to 2020.

Table 16: Projected Raw Wastewater Quality

EXISTING RAW WASTEWATER QUALITY (2016 TO 2020)					
Parameter:	**cBOD**	**BOD_5**	**TSS**	**TP**	**TKN**
Average Raw Wastewater Concentration (mg/L):	206	279	192	5.63	45.3
Maximum Monthly Raw Wastewater Concentration (mg/L):	412	659	430	9.76	70.9
PHASE 1 - 10-YEAR (2032)					
Parameter:	**cBOD**	**BOD_5**	**TSS**	**TP**	**TKN**
Projected Average Daily Flow (m3/day):	1,390				
Average Raw Wastewater Concentration (mg/L):	210	280	200	5.7	46
Average Raw Wastewater Loading (kg/day):	300	390	280	8.0	64
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	577	917	598	13.6	99
PHASE 2 - 20-YEAR (2042)					
Parameter:	**cBOD**	**BOD_5**	**TSS**	**TP**	**TKN**
Projected Average Daily Flow (m3/day):	2,020				
Average Raw Wastewater Concentration (mg/L):	210	280	200	5.7	46
Average Raw Wastewater Loading (kg/day):	430	570	410	11.6	93
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	838	1,333	869	19.8	143

SECTION 3 – EFFLUENT REQUIREMENTS (ASSIMILATIVE CAPACITY ASSESSMENT OF RECEIVER)

3.1 - RECEIVER ASSIMILATIVE CAPACITY STUDY

An assimilative capacity study (ACS) of the South Nation River was undertaken by Blue Sky Energy Engineering & Consulting Inc. (Blue Sky) in association with JLR to develop reasonable effluent targets and discharge rates for an upgraded Plantagenet WWTS. A meeting was held with the MECP on May 5, 2022 to review the proposed approach to the ACS. The approach was subsequently accepted by the MECP.

Two different scenarios were reviewed in developing the effluent objectives and limits for an upgraded Plantagenet WWTS; Scenario A – Existing Discharge Period (Apr 1 to May 31 and Nov 1 to Dec 20) and Scenario B – Extended Discharge Period (Oct 1 to May 31). These scenarios were also considered for different implementation phases (i.e., Phase 1: 10-Year (2032) and Phase 2: 20-Year (2042)).

A report to summarize the results of the ACS was prepared and summaries of the proposed effluent discharge rates and proposed effluent objectives and limits are provided in subsequent sections. For further details regarding the ACS, refer to Appendix 'A' of this memorandum.

3.2 – PROPOSED EFFLUENT OBJECTIVES AND LIMITS AND MAXIMUM DAILY EFFLUENT DISCHARGE RATES

The approach to the ACS for determining proposed maximum daily effluent discharge rates was developed to consider maintaining adequate dilution ratios, ensuring reasonable downstream fully-mixed water quality, and providing allowances for WWTS operational flexibility. The proposed maximum daily effluent discharge rates for each scenario and phase are presented in Table 17 and Table 19. Similarly, proposed effluent objectives and limits were determined for each phase and are presented in Table 18 and Table 20. It is noted that the only difference between the proposed effluent objectives and limits for Phase 1 and Phase 2 is the TP concentrations, as the MECP confirmed that upgrades should limit future effluent TP loadings to 204.8 kg/yr. Additional discussions with the Township to determine their participation in the South Nation River Total Phosphorous Management Program will be undertaken during Phase 2 of the Class EA.

Table 17: Proposed Maximum Daily Effluent Discharge Rates – Phase 1 – 10-Year (2032)

Date Range	Maximum Daily Discharge Rate (m^3/d)
Scenario A – Existing Discharge Periods	
April 1 to 30	16,000
May 1 to 31	8,500
November 1 to 30	6,100
December 1 to 20	9,500
Scenario B – Semi-Continuous Discharge	
October 1 to 31	2,200
November 1 to 30	6,100
December 1 to March 31	4,500
April 1 to 30	16,000
May 1 to 31	8,500

Table 18: Proposed Effluent Objectives and Limits – Phase 1 – 10-Year (2032)

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.3	0.33
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

Table 19: Proposed Maximum Daily Effluent Discharge Rates – Phase 2 – 20-Year (2042)

Date Range	Maximum Daily Discharge Rate (m^3/d)
Scenario A – Existing Discharge Periods	
April 1 to 30	16,000
May 1 to 31	15,100
November 1 to 30	10,800
December 1 to 20	16,000
Scenario B – Semi-Continuous Discharge	
October 1 to 31	4,500
November 1 to 30	10,800
December 1 to March 31	7,600
April 1 to 30	16,000
May 1 to 31	15,100

Table 20: Proposed Effluent Objectives and Limits – Phase 2 – 20-Year (2042)

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.2	0.23
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

SUMMARY

The information presented in the above sections will be used as the design basis moving forward with the Class EA. Following acceptance of the design basis by the Township, the Phase 1 Report will be prepared and issued for review prior to proceeding with Phase 2.

REFERENCES

1. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 4th Edition, 2003.
2. Stantec Consulting Ltd., Township of Alfred and Plantagenet, Plantagenet Sewage Treatment System, Final Report, October 5, 2015.
3. Ontario Clean Water Agency, Performance Assessment Report Data (2016-2020).
4. Blue Sky Energy Engineering & Consulting Inc., Final Report – Assimilative Capacity Study to Support the Expansion of the Plantagenet WWTS, November 11, 2022.
5. Ministry of the Environment, Design Guidelines for Sewage Works, 2008
6. Ministry of the Environment, Design Guidelines for Drinking-Water Systems, 2008
7. City of Ottawa, Ottawa Design Guidelines – Sewer, Second Edition, October 2012
8. City of Ottawa, Technical Bulletin ISTB-2018-1 – Revisions to Ottawa Design Guidelines – Sewer dated 2012, March 2018

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

NBialik

Nicolas Bialik, P.Eng.
Environmental Engineer

Reviewed by:

Jordan Morrissette

Jordan Morrissette, M.Eng., P.Eng.
Associate
Senior Environmental Engineer

NB/JM/SG:nb

Appendix A4

As-Built Drawings of MOE Project No. 1-0078-67 “*Sanitary Sewage Collection and Disposal System – Village of Plantagenet*”, 1974

(PROVIDED UNDER SEPERATE COVER)

Appendix A5

Assimilative Capacity Study (Bowfin, 2022)

Final Report
Assimilative Capacity Study to Support the Expansion of the Plantagenet WWTS

November 11, 2022

Prepared for:
J.L. Richards & Associates Limited
343 Preston Street
Tower II, Suite 1000
Ottawa, Ontario K1S 1N4

Attention: Jordan Morrissette, M.Eng., P.Eng.

Submitted by:

BLUE SKY Energy Engineering & Consulting Inc.
4826 Derrydown Drive, Mississauga, ON, L5J 7J7
647.721.7644
melody@bskyeng.com
www.bskyeng.com

Table of Contents

List of Figures

List of Tables

Appendices

1. Introduction

1.1 Overview

A Class Environmental Assessment (Class EA) study is underway to determine the most cost effective and environmentally sustainable approach to increasing wastewater servicing capacity to meet future growth needs in Plantagenet. An assimilative capacity assessment of the South Nation River is required to develop reasonable effluent targets and discharge rates for an upgraded Plantagenet WWTS.

Blue Sky Energy Engineering & Consulting Inc. (Blue Sky), in association with J.L. Richards & Associates Limited (JLR), has been retained to conduct a desk-top assimilative capacity study (ACS) of the South Nation River to support the Plantagenet WWTS Class EA study. This report summarizes the results of the ACS.

1.2 Objectives

The specific objectives of the ACS are to:

- Document data sources and assumptions used;
- Define ambient water quality and verify low flow conditions in the South Nation River;
- Develop recommendations for future effluent requirements for an upgraded Plantagenet WWTS at two future equivalent annual discharge average daily flow (ADF) values of 1,660 m^3/d (Phase 1) and 2,441 m^3/d (Phase 2).

2. Background

2.1 Current Effluent Requirements

The existing Plantagenet WWTS operates under Amended Certificate of Approval (CofA) No. 4631-5WXQE9, dated April 23, 2004, which stipulates effluent requirements for final effluent quality and effluent discharge limitations. Table 2.1 presents the CofA effluent discharge concentration objectives / limits.

Effluent is discharged to the South Nation River approximately 10 km upstream of its confluence with the Ottawa River. The current CofA permits seasonal discharge in the Spring (April 1 – May 31) and Fall (November 1 – December 20). The location of the outfall is shown in Figure 2.1.

Table 2.1 – Existing CofA Effluent Objectives and Limits – Plantagenet WWTS

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Seasonal	15	25
TSS	Seasonal	20	25
TP	Seasonal	0.75	1.0
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

2.2 Available Data

In establishing ambient water quality and flow for a receiver, recent data available in the upstream vicinity of the effluent discharge location is reviewed to establish ambient conditions. In the case of the Plantagenet WWTS assimilative capacity assessment, a nearby Provincial Water Quality Monitoring Network (PWQMN) station is located approximately 7 km downstream of the outfall, while a Water Survey of Canada (WSC) gauge is located approximately 2 km upstream of the outfall. Information regarding the PWQMN and WSC stations is presented in Table 2.2, while their locations are presented in Figure 2.1.

Table 2.2 – Summary of Key Data Sources to Assess Ambient Conditions

Key Location Along South Nation River	Distance Relative to Plantagenet WWTS Outfall	Parameters of Interest	Period of Record Used in this Study
PWQMN Station 18207002002	7 km downstream	BOD_5, DO, ammonia, temperature, pH, TP, TSS, nitrate, E. coli	2000 – 2020
WSC Gauge 02LB005	2 km upstream	Flow	2000 – 2020

Figure 2.1 Locations of the Outfall, WSC Gauge and PWQMN Station

3. Ambient Conditions

3.1 Water Quality

A detailed analysis of ambient water quality was documented in a memorandum dated May 2022 (see Appendix A). Water quality data were only available for the months of March to December. The key findings are summarized in Table 3.1, while details can be found in Appendix A.

Table 3.1 – Summary of Ambient Water Quality in the South Nation River

Parameter	Policy Status	Comments
BOD_5 / DO	Policy 1 (DO)	• Low ambient BOD5 (75th percentile of 2.1 mg/L) • Available DO results suggest Policy 1 status for a warm water fishery
TSS	n/a	• No PWQO for TSS • Average monthly TSS concentrations range from 12 to 48 mg/L, with concentrations highest in April
TP	Policy 2	• Policy 2 for all months for which data are available (Apr-Dec) • No seasonal concentration trends observed
UIA	Policy 1 (Oct-May) Policy 2 (Jun-Sep)	• No seasonal concentration trends in TAN observed • Elevated temperature and pH result in Policy 2 conditions during the warm weather months
Nitrate-N	n/a	• No PWQO for nitrate-N • 75th percentile concentration < CWQG long-term exposure limit during warmer months (Jul-Oct)
E. coli	Policy 1	• Limited number of sample results available (15) • Overall geometric mean of 18 CFU/100 mL
pH	Policy 1	• pH in the South Nation River is elevated year-round (monthly averages >8.0)

3.2 Flow

A statistical analysis of recorded flows in the South Nation River was used to determine monthly low (7Q20) flows in the receiver. The results of the low flow analysis are presented in Table 3.2, while details can be found in Appendix A.

Table 3.2 – Results of Low Flow Analysis – South Nation River in the Vicinity of the Plantagenet WWTS Outfall (2000 to 2020)

Month	WSC Station 02LB005 Mean Flow (m^3/s)	WSC Station 02LB005 7Q20 Flow (m^3/s)
January	43.7	2.78
February	29.3	2.58
March	121.4	3.79
April	185.0	14.5
May	50.6	5.29
June	32.2	1.52
July	19.4	0.520
August	9.3	0.563
September	9.7	0.578
October	27.2	0.861
November	45.2	3.74
December	50.4	5.78

Notes:

WSC data over the period 2000 to 2020.

4. Determination of Effluent Limits

4.1 Methodology

A memorandum outlining the proposed ACS approach was submitted to MECP for review and comment in May 2022 (see Appendix A). A meeting was held with MECP on May 5, 2022 to present the proposed approach and discuss preliminary comments. In subsequent correspondence, MECP confirmed that the proposed approach was acceptable and confirmed the allowable annual TP loading limit associated with an upgraded Plantagenet WWTS (see Appendix B).

The approved ACS approach consists of the following:

- Allow effluent discharge over some or all of the period spanning October 1 to May 31. Monthly discharge volumes to consider maintaining adequate dilution ratios, ensuring reasonable downstream fully-mixed water quality, and providing allowances for WWTS operational flexibility.
- Utilize a mass-balance approach to ensure downstream, fully-mixed seasonal UIA concentrations remain at or below the PWQO at ambient (75th percentile) concentrations and low (7Q20) flows. Proposed effluent TAN targets will also ensure non-toxicity at end-of-pipe.
- Limit future effluent TP loadings to 204.8 kg/yr. Consideration will be given to seasonal TP loadings, as well as the impact on downstream, fully-mixed TP concentrations.
- An assessment of in-stream DO will be achieved using a one-dimensional application of EPA's Water Quality Analysis Simulation Program (WASP8) to develop appropriate $cBOD_5$ effluent targets. Consistency with the CCME target for suspended material will be used along with the $cBOD_5$ targets to develop effluent TSS requirements.
- Nitrate is not currently a parameter of concern for the South Nation River. As a result, no effluent nitrate targets will be proposed.
- Effluent pH and E. coli targets will be consistent with targets for other municipal WWTSs in Ontario.
- To address the limited availability of ambient water quality for the months of March and December, and lack of data for January and February, ambient conditions over the period February to April will be assumed to be equivalent to the consolidated data from March and April. Similarly, ambient conditions over the period November to January will be based on consolidated data from November and December.

In addition to the above, effluent objectives and limits were developed for two discharge scenarios, namely: Scenario A – Existing Discharge Period (Apr 1 to May 31 and Nov 1 to Dec 20); Scenario B – Extended Discharge Period (Oct 1 to May 31). Finally, consideration was given to both Phase 1 (606,085 m^3/year) and Phase 2 (879,922 m^3/year) overall discharge volumes. To improve operational flexibility, daily maximum effluent flows were also defined, as shown in Table 4.1. These daily maximum values were developed to ensure that the downstream, fully mixed UIA concentration would not exceed the PWQO (see Section 4.5), to ensure the downstream, fully mixed TP concentration would increase ambient concentrations by no more than 5% (see Section 4.4), and recognizing the hydraulic capacity of the existing outfall is approximately 16,000 m^3/d.

Table 4.1 – Seasonal Effluent Discharge Volumes for an Upgraded Plantagenet WWTS

Parameter	Phase 1 (2032)	Phase 2 (2042)
Total Annual Discharge Volume	606,085 m^3/yr	879,922 m^3/yr
Equivalent Annual Discharge ADF	1,660 m^3/d	2,411 m^3/d
Scenario A – Existing Discharge Periods		
Spring Discharge (Apr 1 – May 31)		
Discharge Period Duration	61 days	61 days
Maximum Daily Discharge Rate		
April 1 to 30	16,000 m^3/d	16,000 m^3/d
May 1 to 31	8,500 m^3/d	15,100 m^3/d
Fall Discharge (Nov 1 – Dec 20)		
Discharge Period Duration	50 days	50 days
Maximum Daily Discharge Rate		
November 1 to 30	6,100 m^3/d	10,800 m^3/d
December 1 to 20	9,500 m^3/d	16,000 m^3/d
Scenario B – Semi-Continuous Discharge		
Discharge Period (Oct 1 – May 31)		
Discharge Period Duration	243 days	243 days
Maximum Daily Discharge Rate		
October 1 to 31	2,200 m^3/d	4,500 m^3/d
November 1 to 30	6,100 m^3/d	10,800 m^3/d
December 1 to March 31	4,500 m^3/d	7,600 m^3/d
April 1 to 30	16,000 m^3/d	16,000 m^3/d
May 1 to 31	8,500 m^3/d	15,100 m^3/d

The following sub-sections present details associated with the development of effluent targets associated with key parameters.

4.2 Effluent $cBOD_5$

There are no PWQO or CWQG targets specified for $cBOD_5$. However, the presence of carbonaceous and nitrogenous biochemical oxygen demand (cBOD and nBOD, respectively) can affect downstream DO concentrations.

An assessment of ambient water quality (see Appendix A) concluded that the South Nation River is Policy 1 for DO, with historic 25th percentile concentrations at least 2.1 mg/L greater than the PWQO between October and May. Furthermore, the available ambient BOD_5 concentration (ambient (75th percentile of 2.1 mg/L) suggest low background concentrations of oxygen depleting constituents.

Proposed $cBOD_5$ requirements of 15 mg/L (design objective) and 20 mg/L (design limit) are being proposed in conjunction with year-round nitrification (see Section 4.5). At the design limit and low flow conditions, the $cBOD_5$ concentration would increase by up to 0.65 mg/L (discharge Scenario A) or 1.14 mg/L (discharge Scenario B), which would have minimal impact on the downstream DO concentrations.

Results of modelling using EPA's WASP8 predict negligible impacts on downstream DO associated with the combined cBOD and nBOD loadings at the proposed $cBOD_5$ and TAN limits. Using the critical low 7Q20 flow Fall and Spring months of October and May, maximum reductions in ambient DO were estimated to be 0.16 mg/L at 2.7 km downstream of the outfall for October, and 0.05 mg/L at 2.7 km downstream of the outfall for May. Details regarding the modelling a provided in Appendix C.

4.3 Effluent Total Suspended Solids

There is no PWQO target specified for TSS. The CWQG recommends a maximum short-term (< 24 h period) increase of 25 mg/L above background, and a maximum increase of 5 mg/L over long-term exposures (up to 30 days).

Effluent TSS requirements of 20mg/L (design objective) and 25 mg/L (design limit) are proposed. These are consistent with the proposed cBOD5 limits (see Section 4.2), and would result in a maximum downstream TSS increase of 0.81 mg/L (discharge Scenario A) or 1.43 mg/L (discharge Scenario B), which meets the CWQG recommendation.

4.4 Effluent Total Phosphorus

The South Nation River was determined to be Policy 2 for TP (see Appendix A) and, therefore, ambient (75th percentile) concentrations exceed the PWQO of 0.030 mg/L. A future effluent TP loading limit of 204.84 kg/yr was proposed (see Appendix A), and MECP confirmed that this loading limit could be used to develop future effluent requirements for the upgraded Plantagenet WWTS (see Appendix B).

Using the approved loading limit (204.84 kg/yr) and the equivalent annual ADFs for both Phase 1 and Phase 2 (see Table 4.1), future effluent TP limits of 0.33 mg/L (Phase 1) and 0.23 mg/L (Phase 2) are proposed. To minimize the environmental impact associated with seasonal effluent discharge, the daily maximum effluent discharge rate has been limited to ensure the downstream, fully-mixed TP concentration would increase by no more than 5% above ambient conditions. The ambient TP concentrations and resulting downstream fully-mixed TP concentrations are shown in Table 4.2.

Table 4.2 – Fully Mixed TP Concentration Under Proposed Effluent TP Limits and Effluent Discharge Rates

Discharge Period	Ambient TP (mg/L)	Phase 1 (ADF 1,660 m³/d) TP limit of 0.33 mg/L		Phase 2 (ADF 2,441 m³/d) TP limit of 0.23 mg/L	
		Downstream TP (mg/L)	% Increase above Ambient	Downstream TP (mg/L)	% Increase above Ambient
Discharge Scenario A – Existing Discharge Periods					
April 1 to 30	0.138	0.141	1.8	0.139	0.9
May 1 to 31	0.091	0.096	5.0	0.096	5.0
Nov 1 to 30	0.092	0.097	5.0	0.097	5.0
Dec 1 to 20	0.092	0.097	5.0	0.096	4.8
Discharge Scenario B – Semi-Continuous Discharge					
Jan 1 to 31	0.092	0.097	4.9	0.096	4.7
Feb 1 to 28	0.138	0.142	2.9	0.141	2.3
Mar 1 to 31	0.138	0.141	2.0	0.140	1.6
April 1 to 30	0.138	0.141	1.8	0.139	0.9
May 1 to 31	0.091	0.096	5.0	0.096	5.0
Oct 1 to 31	0.125	0.131	4.9	0.131	4.9
Nov 1 to 30	0.092	0.097	5.0	0.097	5.0
Dec 1 to 31	0.092	0.094	2.4	0.094	2.3

4.5 Effluent Total Ammonia Nitrogen

In developing TAN limits, two factors were considered: ensuring non-toxic effluent at end-of-pipe, and ensuring downstream conditions within the South Nation River meet the PWQO un-ionized ammonia (UIA) limit of 20 µg/L as NH_3 (16 µg/L as N).

Extensive research by the US EPA and others has demonstrated that a non-toxic limit for UIA ranges between 0.1 mg/L and 0.5 mg/L as NH_3, depending on the aquatic species present in the receiver. The federal Wastewater Systems Effluent Regulations (WSER) under the Fisheries Act set effluent UIA toxicity to 1.25 mg/L (at 15°C). Therefore, selecting a value of 0.2 mg/L as NH_3 at end-of-pipe, which is near the low end of the US EPA range, is more conservative than, and consistent with, the requirements of WSER.

The percentage of UIA in aqueous solution varies depending on the temperature and pH of the water. In order to determine the in-stream UIA concentration, it is necessary to specify anticipated ambient temperature and pH values that can be used to estimate the ammonia dissociation ratio. To account for the seasonal variability in stream temperatures, four periods were defined: October; November to January; February to April; and May. For each period, ambient conditions were taken to be the 75th percentile UIA concentration, and 75th percentile dissociation ratio (see Appendix A).

To confirm non-toxicity at end-of-pipe, it was necessary to define effluent temperature and pH values. Due to the nature of the Plantagenet WWTS, effluent is expected to continue to be stored in the lagoon prior to discharge. As a result, effluent temperatures were estimated to be consistent with the ambient (75th percentile) monthly temperatures in the South Nation River (see Appendix A). Limited temperature data were available over the period December to March for both the receiver and lagoons; however, other lagoon systems in the area report lagoon temperatures of as low as 1.9°C during the winter months. As a conservative estimate, and to account for potential future impacts of climate change, assumed effluent / receiver temperatures of 4°C (January and February) and 6°C (December and March) were used for this assessment. As a conservative measure, effluent pH was assumed to be 8.0 for all months.

For the proposed effluent TAN limits to be acceptable, the resultant downstream UIA concentration must be less than or equal to the PWQO of 20 µg/L (as NH_3), while also meeting the non-toxicity threshold of 0.2 mg/L (as NH_3) at end of pipe. Using the proposed effluent flows (see Table 5.1), it was determined that the effluent TAN limit was limited by meeting the end-of-pipe toxicity requirement. As a result, the downstream fully-mixed UIA concentrations would remain below the PWQO for all months under both discharge scenarios and both future phases.

For both the Phase 1 and Phase 2 design flows, the recommended compliance limits for TAN are: 5.0 mg/L from October 1 to 31; 7.5 mg/L from November 1 to 30; 12.0 mg/L for December 1 to 31; 14.0 mg/L for January 1 to February 28; 12.0 mg/L from March 1 to 31; 5.5 mg/L from April 1 to 30; and, 3.5 from May 1 to 31. The proposed effluent ammonia limits and resulting downstream UIA concentrations are shown in Table 4.3.

Table 4.3 – Fully Mixed Un-ionized Ammonia Under Proposed Effluent TAN Limits and Effluent Discharge Rates

Discharge Period	Effluent TAN Limit (mg/L as N)	Ambient UIA (µg/L as NH_3)	Dissociation Ratio (%)	Fully-Mixed UIA (µg/L as NH_3)	
				Phase 1 ADF 1,660 m^3/d	Phase 2 ADF 2,411 m^3/d
Discharge Scenario A – Existing Discharge Periods					
April 1 to 30	5.5	3.1	2.6	5.2	5.2
May 1 to 31	3.5	5.7	7.8	11.7	16.2
Nov 1 to 30	7.5	2.3	3.2	7.6	11.6
Dec 1 to 20	12.0	2.3	3.2	10.9	16.6
Discharge Scenario B – Semi-Continuous Discharge					
Jan 1 to 31	14.0	2.3	3.2	12.2	18.8
Feb 1 to 28	14.0	3.1	2.6	11.7	17.3
Mar 1 to 31	12.0	3.1	2.6	8.1	11.5
April 1 to 30	5.5	3.1	2.6	5.2	5.2
May 1 to 31	3.5	5.7	7.8	11.7	16.2
Oct 1 to 31	5.0	1.9	4.0	8.8	15.5
Nov 1 to 30	7.5	2.3	3.2	7.6	11.6
Dec 1 to 31	12.0	2.3	3.2	6.4	9.2

4.6 Effluent E. coli

An E. coli compliance limit of 200 CFU/100 mL and a design objective of 150 CFU/100 mL (based on geometric mean) are proposed as reasonable future effluent requirements for an upgraded Plantagenet WWTS. This is consistent with requirements for similarly-sized municipal wastewater treatment facilities across Ontario.

4.7 Effluent pH

A compliance limit pH range of 6.0 to 9.5 is proposed as a single-sample limit, with a corresponding design objective of 6.5 to 9.0. This is consistent with the pH requirements stipulated in the current CofA.

5. Summary

Proposed seasonal effluent discharge rates and associated effluent objectives and limits were developed for an upgraded Plantagenet WWTS. These are summarized in Tables 5.1 and 5.2 for the Phase 1 equivalent annual discharge ADF of 1,660 m^3/d, and Tables 5.3 and 5.4 for the Phase 2 equivalent annual ADF of 2,441 m^3/d.

Table 5.1 – Proposed Maximum Daily Effluent Discharge Rates – Phase 1 Equivalent Annual Discharge ADF of 1,660 m^3/d

Date Range	Maximum Daily Discharge Rate (m^3/d)
Scenario A – Existing Discharge Periods	
April 1 to 30	16,000
May 1 to 31	8,500
November 1 to 30	6,100
December 1 to 20	9,500
Scenario B – Semi-Continuous Discharge	
October 1 to 31	2,200
November 1 to 30	6,100
December 1 to March 31	4,500
April 1 to 30	16,000
May 1 to 31	8,500

Table 5.2 – Proposed Effluent Objectives and Limits – Phase 1 Equivalent Annual Discharge ADF of 1,660 m^3/d

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 to 31		4.5	5.0
Nov 1 to 30		7.0	7.5
Dec 1 to 31		10.0	12.0
Jan 1 to Feb 28		12.0	14.0
Mar 1 to 31		10.0	12.0
Apr 1 to 30		5.0	5.5
May 1 to 31		3.0	3.5
TP	Monthly	0.30	0.33
E. coli	Monthly	150 CFU/100 mL	200 CFU/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

Table 5.3 – Proposed Maximum Daily Effluent Discharge Rates – Phase 2 Equivalent Annual Discharge ADF of 2,441 m^3/d

Date Range	Maximum Daily Discharge Rate (m^3/d)
Scenario A – Existing Discharge Periods	
April 1 to 30	16,000
May 1 to 31	15,100
November 1 to 30	10,800
December 1 to 20	16,000
Scenario B – Semi-Continuous Discharge	
October 1 to 31	4,500
November 1 to 30	10,800
December 1 to March 31	7,600
April 1 to 30	16,000
May 1 to 31	15,100

Table 5.4 – Proposed Effluent Objectives and Limits – Phase 2 Equivalent Annual ADF of 2,441 m^3/d

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 to 31		4.5	5.0
Nov 1 to 30		7.0	7.5
Dec 1 to 31		10.0	12.0
Jan 1 to Feb 28		12.0	14.0
Mar 1 to 31		10.0	12.0
Apr 1 to 30		5.0	5.5
May 1 to 31		3.0	3.5
TP	Monthly	0.20	0.23
E. coli	Monthly	150 CFU/100 mL	200 CFU/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

6. References

MOEE (1994). Policy B-1-5 – Deriving Receiving Water Based Point Source Effluent Requirements for Ontario Waters.

Appendix A

Ambient Conditions and Proposed Approach

Memorandum

To:	Jordan Morrissette, M.Eng., P.Eng., J.L. Richards & Associates Limited (JLR)
CC:	Nicolas Bialik, EIT (JLR)
From:	Melody Johnson, M.A.Sc., PhD, P.Eng.
Date:	May 2, 2022
Subject	Plantagenet WWTP Assimilative Capacity Study – Ambient Conditions and Proposed Approach

1. Introduction

1.1 Background

A Class Environmental Assessment (Class EA) study is underway to determine the most cost effective and environmentally sustainable approach to increasing wastewater servicing capacity to meet future growth needs in Plantagenet. An assimilative capacity assessment of the South Nation River will be used to develop reasonable effluent targets and discharge rates for an upgraded and expanded Plantagenet WWTP.

Blue Sky Energy Engineering & Consulting Inc. (Blue Sky), in association with J.L. Richards & Associates Limited (JLR), has been retained to conduct a desk-top assimilative capacity assessment of the South Nation River to support the Plantagenet WWTP Class EA study. This memorandum presents the results of an assessment of ambient conditions in the receiver, as well as the proposed approach to developing suitable effluent objectives and limits for an upgraded and expanded Plantagenet WWTP.

1.2 Objectives

The specific objectives of this memorandum are to:

- Document data sources used to determine ambient conditions in the South Nation River;
- Specify ambient concentrations and Policy status related to parameters of concern;
- Document the results of a low flow analysis; and,
- Present the proposed approach to developing effluent objectives and limits for an upgraded and expanded Plantagenet WWTP.

2. Overview

2.1 Background Information

The existing Plantagenet WWTP operates under Amended Certificate of Approval (CofA) No. 4631-5WXQE9, dated April 23, 2004, which stipulates effluent requirements for final effluent quality and effluent discharge limitations. Table 2.1 presents the ECA effluent discharge concentration objectives / limits.

Effluent is discharged via to the South Nation River approximately 10 km upstream of its confluence with the Ottawa River. The current CofA permits seasonal discharge in the Spring (April 1 – May 31) and Fall (November 1 – December 20). The location of the outfall is shown in Figure 2.1.

Table 2.1 – Existing ECA Effluent Objectives and Limits – Plantagenet WWTP

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Seasonal	15	25
TSS	Seasonal	20	25
TP	Seasonal	0.75	1.0
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

2.2 Data Sources

In establishing ambient water quality and flow for a receiver, recent data available in the upstream vicinity of the effluent discharge location is reviewed to establish ambient conditions. In the case of the Plantagenet WWTP assimilative capacity assessment, a nearby Provincial Water Quality Monitoring Network (PWQMN) station is located approximately 7 km downstream of the outfall, while a Water Survey of Canada (WSC) gauge is located approximately 2 km upstream of the outfall. Information regarding the PWQMN and WSC stations is presented in Table 2.2, while their locations are presented in Figure 2.1.

Table 2.2 – Summary of Key Data Sources to Assess Ambient Conditions

Key Location Along South Nation River	Distance Relative to Plantagenet WWTP Outfall	Parameters of Interest	Period of Record Used in this Study
PWQMN Station 18207002002	7 km downstream	BOD_5, DO, ammonia, temperature, pH, TP, TSS, nitrate, E. coli	2000 – 2020
WSC Gauge 02LB005	2 km upstream	Flow	2000 – 2020

Figure 2.1 Locations of the Outfall, WSC Gauge and PWQMN Station

3. Ambient Conditions

3.1 Water Quality

Representative background water quality can be defined by examining South Nation River water quality in the vicinity of the Plantagenet WWTP outfall. For analysis purposes, the 75th percentile threshold is applied to characterize ambient conditions, as recommended by the Ministry of the Environment (MOE), now Ministry of the Environment, Conservation and Parks (MOECP). The MOE states, "Normally the 75th percentile is used to determine background quality…".[1] The receiving water quality is assigned Policy 1 if the ambient concentration is less than the Provincial Water Quality Objective (PWQO) and Policy 2 if the ambient concentration exceeds the PWQO. The implication of being a Policy 1 or Policy 2 receiver is described briefly below.

- **Policy 1:** In areas which have water quality better than the Provincial Water Quality Objectives, water quality shall be maintained at or above the Objectives.

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[1] Ministry of Environment and Energy, *Water Management: Policies, Guidelines, Provincial Water Quality Objectives.* July 1994 (MOE Blue Book).

- **Policy 2:** Water quality which presently does not meet the Provincial Water Quality Objectives shall not be degraded further and all practical measures shall be taken to upgrade the water quality to the Objectives.

For the purposes of this analysis, PWQMN data collected over the period 2000 to 2020 were used. The findings for each parameter of interest are summarized in the sections below.

3.1.1 Total Phosphorus

The MOE PWQO state that, as an interim guideline for streams and rivers, total phosphorus (TP) should not exceed 0.03 mg/L, to prevent excessive plant growth. The statistical summary for total phosphorus concentration is shown in Table 3.1. The monthly and annual 75th percentile concentrations exceed the PWQO. Therefore, the receiver is MOE Policy 2 in the vicinity of the Plantagenet WWTP with respect to TP.

Table 3.1 – Total Phosphorous Concentrations in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	0.147 (1)	–	–	1
April	0.111	0.084	0.129	11
May	0.083	0.050	0.091	20
June	0.076	0.067	0.082	28
July	0.077	0.072	0.094	21
August	0.100	0.101	0.121	21
September	0.115	0.113	0.149	19
October	0.115	0.105	0.125	15
November	0.079	0.069	0.083	17
December	0.089	0.093	0.102	4
Overall	**0.092**	**0.074**	**0.115**	**157**
PWQO	–	–	0.030	–

Notes:

PWQMN data over the period 2000 to 2020.

1. Only one sample result was available for the month of March (sample collected March 20, 2012). Therefore, it was not possible to calculate a median or 75th percentile value. The value shown represents the value of the single sample result.

3.1.2 Unionized Ammonia

The percentage of unionized ammonia in aqueous solution varies depending on the temperature and pH of the water. Ambient total ammonia, pH, and temperature are summarized in Table 3.2, Table 3.3, and Table 3.4, respectively. Synoptic pH and temperature data were used to determine daily dissociation ratios; using the daily dissociation ratios and associated daily total ammonia concentrations, it was possible to calculate daily unionized ammonia (UIA) concentrations in the South Nation River. The average, median and mean unionized ammonia concentrations are presented in Table 3.5.

Ambient total ammonia concentrations showed limited seasonal variation. While also showing no seasonal trends, pH in the South Nation River is elevated, which increases the ammonia dissociation ratio for this receiver. As expected, temperature varies seasonally and is quite high (>25°C) over the Summer period (June to September), also increasing the dissociation ratios for those months. Ambient UIA concentrations were, therefore, elevated over the Summer months, with little to no assimilative capacity over that period; conversely, ambient (75th) percentile UIA concentrations were well below the PWQO during all other months for which data were available. While it was not possible to assess the ambient (75th percentile) UIA over the period December to March, given the lack of seasonal variation in total ammonia and pH combined with cold water temperatures over those Winter months, it can be concluded that the ambient (75th percentile) UIA was below the PWQO during those months. Therefore, the receiver can be characterized as Policy 2 for UIA during the Summer (June to September) and Policy 1 at all other times.

Table 3.2 – Total Ammonia Concentrations in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	0.12	–	–	1
April	0.11	0.12	0.13	11
May	0.07	0.06	0.08	17
June	0.06	0.06	0.08	24
July	0.08	0.06	0.11	18
August	0.11	0.08	0.11	21
September	0.10	0.09	0.12	17
October	0.06	0.06	0.08	16
November	0.06	0.05	0.07	14
December	0.07	–	–	2
Overall	**0.08**	**0.07**	**0.10**	**141**

Notes:

Ammonia concentrations as reported as mg/L as NH_3.

Table 3.3 – pH in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	7.68	–	–	1
April	8.05	8.10	8.15	9
May	8.30	8.30	8.40	13
June	7.88	8.19	8.61	19
July	8.51	8.42	8.69	15
August	8.44	8.36	8.45	19
September	8.38	8.29	8.73	13
October	8.06	8.04	8.36	14
November	8.39	8.15	8.47	13
December	8.13	8.13	8.16	2
Overall	**8.24**	**8.24**	**8.46**	**118**

Table 3.4 – Temperature in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	5.5	–	–	1
April	9.3	9.1	11.6	11
May	15.8	16.8	18.1	17
June	22.2	22.4	23.7	21
July	24.7	25.1	26.7	17
August	23.9	24.0	25.4	21
September	19.5	19.7	21.2	16
October	10.9	10.5	13.5	16
November	5.6	6.0	7.6	15
December	2.2	2.2	2.3	2
Overall	**17.1**	**18.7**	**23.3**	**137**

Table 3.5 – Unionized Ammonia Concentrations in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (µg/L)	Median (µg/L)	75th Percentile (µg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	0.7	–	–	1
April	2.3	2.2	3.1	9
May	3.9	3.4	5.7	13
June	6.8	3.6	13.6	19
July	14.5	7.8	26.6	15
August	12.3	7.1	13.8	18
September	12.4	4.3	19.5	13
October	1.8	1.2	1.9	14
November	1.9	1.4	2.6	11
December	0.9	0.9	1.2	2
Overall	**7.4**	**3.5**	**7.6**	**117**
PWQO	–	–	20	–

Notes:

Unionized ammonia concentrations as reported as mg/L as NH_3. Dataset excludes data from two sampling events (August 20, 2019 and November 11, 2019) with reported field pH values >10.4. The reported lab pH values on those days were 8.5 and 8.2, respectively.

3.1.3 Dissolved Oxygen and BOD_5

For dissolved oxygen (DO), low concentrations are indications of degraded water quality; therefore 25th percentiles are typically used, rather than 75th percentiles, to characterize ambient conditions. Assuming the South Nation River is a warm water fishery, the PWQO for DO ranges from 4 to 7 mg/L from month-to-month based on temperature: cooler temperatures have a higher PWQO than warmer temperatures.

Average and 25th percentile DO concentrations are presented in Table 3.6 along with the monthly PWQO (based on ambient temperature data shown in Table 3.4). In addition to DO data, a limited number of 29 samples were analyzed over the review period for BOD_5, with an average concentration of 1.7 mg/L and 75th percentile value of 2.1 mg/L, suggesting low background concentrations of oxygen depleting constituents.

Based on the available data, the South Nation River is Policy 1 with respect to DO in the vicinity of the Plantagenet WWTP. This demonstrates that there is adequate assimilative capacity available for future BOD_5 loads from an upgraded and expanded WWTP.

Table 3.6 – Dissolved Oxygen Concentrations in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	25th Percentile (mg/L)	PWQO (1)	Number of Observations
January	–	–	7	–
February	–	–	7	–
March	13.0	–	6	1
April	10.5	10.1	5	10
May	9.0	8.9	5	15
June	8.5	7.1	4	19
July	8.1	6.4	4	17
August	8.1	6.6	4	18
September	8.1	6.1	4	16
October	9.2	8.2	5	15
November	12.5	11.2	6	14
December	11.6	–	7	2

Notes:

1. The PWQO values applied were based on the 75th percentile monthly temperatures shown in Table 3.7 assuming a warm water fishery.

3.1.4 Total Suspended Solids

There are no PWQO values for total suspended solids (TSS), however the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) recommend a maximum average increase of 5 mg/L from background levels for long-term exposures. Reported PWQMN TSS concentrations are elevated throughout all months for which data are available. A statistical summary of TSS concentrations is provided in Table 3.7.

Since there is no PWQO, it is not possible to define a Policy status for the South Nation River in relation to TSS. However, to be consistent with the objectives of the CWQG, the discharge of effluent from the WWTP should not increase downstream fully-mixed concentrations by more than 5 mg/L.

Table 3.7 – Total Suspended Solids Concentrations in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	68	–	–	1
April	48	30	67	11
May	37	13	18	16
June	21	12	19	23
July	12	10	14	17
August	14	13	19	21
September	18	13	17	16
October	19	17	25	15
November	19	13	16	15
December	27	–	–	2
Overall	**23**	**13**	**22**	**137**

3.1.5 Nitrate

There is no PWQO for nitrate, however the CWQG recommends a long-term exposure limit of 3.0 mg/L as N, and a short-term (acute) exposure limit of 124 mg/L as N. A statistical summary of reported PWQMN nitrate concentrations is provided in Table 3.8.

During the warmer months (July to October), the ambient (75th percentile) nitrate concentration is below the CWQG long-term exposure limit. During the cooler periods, monthly ambient (75th percentile) nitrate concentrations occasionally exceeded the long-term exposure limit, but were significantly below the short-term exposure limit. In addition, monthly median nitrate concentrations were below the short-term exposure limit with the exception of November. Such seasonal variability in ambient concentrations, with higher values during colder periods, is typical of surface waters such as the South Nation River.

Table 3.8 – Nitrate Concentrations in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	Average (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Number of Observations
January	–	–	–	–
February	–	–	–	–
March	3.1	–	–	1
April	2.3	2.3	2.7	11
May	2.0	1.9	2.6	16
June	3.0	2.9	4.6	24
July	1.7	1.4	2.3	18
August	0.9	0.9	1.5	21
September	0.6	0.4	0.9	17
October	2.1	1.7	2.9	16
November	3.2	3.3	4.3	14
December	4.8	–	–	2
Overall	**2.0**	**1.8**	**2.8**	**140**

3.1.6 E. coli

A total of 15 samples were analyzed for E. coli over the review period. Individual sample results ranged from 4 to 3,100 CFU/100 mL with an overall geometric mean of 18 CFU/100 mL, which is below the PWQO of 100 CFU/100 mL. As a result, the South Nation River can be characterized as Policy 1 with respect to E. coli.

3.2 Low Flow Analysis

Typically for assimilative capacity analyses, the 7Q20 river flow (minimum average 7-day low flow with a return period of 20 years) represents an appropriate design condition. As described in Section 2.2, the closest stream flow gauge with relevant data is Water Survey of Canada (WSC) hydrometric station 02LB005 which is located on South Nation River approximately 2 km upstream of the Plantagenet WWTP outfall.

Monthly low flow frequency analyses were completed using the Log-Pearson Type III distribution. The resulting 7Q20 flow values, along with mean stream flows, are presented in Table 3.9.

Table 3.9 – Flows in the South Nation River in the Vicinity of the Plantagenet WWTP Outfall (2000 to 2020)

Month	WSC Station 02LB005 Mean Flow (m^3/s)	WSC Station 02LB005 7Q20 Flow (m^3/s)
January	43.7	2.78
February	29.3	2.58
March	121.4	3.79
April	185.0	14.5
May	50.6	5.29
June	32.2	1.52
July	19.4	0.520
August	9.3	0.563
September	9.7	0.578
October	27.2	0.861
November	45.2	3.74
December	50.4	5.78

Notes:

WSC data over the period 2000 to 2020.

Average flows in the South Nation River vary seasonally, with the lowest flows through the Summer into early Fall (June to October), and highest flows during late Winter into early Spring (March to April). Low (7Q20) flows followed a similar pattern, with the exception of April which has a 7Q20 flow significantly higher than all other months.

4. Proposed Assimilative Capacity Study Approach

Growth projections were used by JLR to develop future design wastewater volumes for a two-stage expansion of the Plantagenet WWTP, namely:

- Phase 1 (2032): 606,085 m^3/year
- Phase 2 (2042): 879,922 m^3/year

Currently, effluent from the Plantagenet WWTP is discharged seasonally (April 1 – May 31 and Nov 1 – Dec 20). From an assessment of the ambient water quality and flows (Section 2), it can be concluded that the South Nation River has little to no assimilative capacity for UIA over the Summer months (June to September); however, there is the potential to expand the discharge period through the Fall, Winter and Spring seasons.

Therefore, the following approach is proposed to develop effluent discharge requirements for an upgraded and expanded Plantagenet WWTP:

- Consider potential effluent discharge over some or all of the period spanning October 1 to May 31. Monthly discharge volumes will consider maintaining adequate dilution ratios, ensuring reasonable downstream fully-mixed water quality, and providing allowances WWTP operational flexibility.
- Utilize a mass-balance approach to ensure downstream, fully-mixed UIA concentrations remain at or below the PWQO at ambient (75th percentile) concentrations and low (7Q20) flows. Seasonal effluent TAN objectives and limits will be developed as appropriate. Proposed effluent TAN targets will also be evaluated to ensure non-toxicity at end-of-pipe.
- Limit future effluent TP loadings to 208.4 kg/yr, representing the loading limit previously approved as part of the 1998 Class EA study (see Attachment 1 for an excerpt from the 1998 ESR). This would be equivalent to design TP concentration limits of 0.34 mg/L (Phase 1) and 0.23 mg/L (Phase 2). Consideration will be given to seasonal TP loadings, as well as the impact on downstream, fully-mixed TP concentrations.
- An assessment of in-stream DO will be achieved using a one-dimensional application of EPA's Water Quality Analysis Simulation Program (WASP v8). The WASP model addresses all important factors influencing ambient dissolved oxygen and will be used to develop appropriate $cBOD_5$ effluent targets, while consistency with the CCME target for suspended material will be used along with the $cBOD_5$ targets to develop effluent TSS requirements.
- Based on available ambient concentration data, nitrate is not currently a parameter of concern for the South Nation River. As a result, no effluent nitrate targets will be proposed.
- Effluent pH and E. coli targets will be consistent with targets for other municipal WWTPs in Ontario.
- As shown and discussed in Section 3, there are limited ambient water quality data available for the months of March and December, and no data available for January and February. Therefore, for the purposes of assessing assimilative capacity, ambient conditions over the period February to April will be assumed to be equivalent to the consolidated data from March and April. Similarly, ambient conditions over the period November to January will be based on consolidated data from November and December.

An assimilative capacity study (ACS) report will be prepared summarizing the development of the proposed effluent discharge and concentration targets for both phases of the Plantagenet WWTP expansion, and circulated to MECP for review and comment.

5. Closure

We trust that the above provides you with the information you require at this time. Should you have any questions or concerns, please do not hesitate to contact Melody Johnson at melody@bskyeng.com or 647-721-7644.

Attachment A

Excerpt from 1998 ESR

5.2 Assimilation Capacity of the South Nation River

Following a study by Gore & Storrie Ltd. (1993), the Ontario Ministry of the Environment and Energy adopted a position that discharging of new and expanded sewage lagoons to the South Nation River could only be done annually during the spring season. As well, the effluent quality must not exceed surface water quality guidelines.

As part of this ESR study, an effluent discharge assimilation was carried out and is included in Appendix M. Based on historical flows examined, it was determined that a dilution ratio of at least 120:1 could be achieved in the spring and 24:1 in the fall. These dilution ratios are sufficient to justify semi-annual discharge. The principal restriction to a fall discharge is related to the low flows and the impact of the effluent on the dissolved oxygen levels. The assessment was carried out using the Streeter-Phelps equation and results show that the critical D.O. level is above the recommended level for the temperature of the river in the fall (MOE guidelines). The critical D.O. does not actually occur since the effluent would have reached the Ottawa River before the critical time occurs. Table 5.1 summarizes the results of the assimilation capacity evaluation.

Table 5.1 Assimilation Capacity Results

CHARACTERISTIC	OBJECTIVE	APR	MAY	OCT	NOV	DEC
CRITICAL DO	4-7 mg/L	10.78	9.97	8.86	10.72	11.74
pH	6.5-8.5	7.62	8.05	7.91	8.12	8.02
AMMONIA	0.02 mg/L	0.004	0.019	0.010	0.010	0.006
PHOSPHORUS	0.03 mg/L	0.15	0.13	0.16	0.15	0.12
ΔT	> 10°C	0.02	0.04	0.20	0.20	0.20
H_2S(AFTER AERATION)	0.002 mg/L	0.000	0.000	0.000	0.000	0.000

In all cases, the dissolved oxygen concentrations are within the guidelines. In fact the critical D.O. is higher than indicated since the South Nation River flows have reached the Ottawa River by the time the critical D.O. is theoretically supposed to occur.

The pH is within the PWQO's in all cases.

The ammonia is within the PWQO's in all cases.

The change in temperature is within the PWQO's in all cases.

The H_2S concentration is minimal since aeration is to be practiced.

Because of improved phosphorus removals in the fall, it is expected that the total annual loading on the receiving stream will be less than the current allowable loading. The following loadings are expected to occur:

existing allowable annual P, kg	215.4
design annual P, kg	208.4

The MOE has confirmed in a letter dated June 25, 1998 (see Appendix C) that a deviation from the Ministry's Water Management Policy 2 is **not** required for the proposed sewage works.

6.0 SELECTED DESIGN

6.1 Selected Design Concept

6.1.1 Sewage Lagoon

The configuration of the recommended lagoon expansion is shown in Figure 5.2. The berms for the existing lagoon cell are to be raised by 0.2 m to allow the active operating zone to be increased to 1.7 m. The new 1.8 ha cell is to operate at the same depth.

The operating volumes for the recommended lagoon are presented in Appendix M.

6.1.2 Sewage Pumping Stations

New pumping stations are recommended to replace existing Sewage Pumping Station Nos. 1 and 2. The preliminary design for each pumping station is presented in Appendix M. Each forcemain is capable of accommodating the increased flows for the growth projections. The condition of each forcemain would be evaluated during detailed design for the project and a decision made then on the need for rehabilitation or replacement.

6.1.3 Collection System

No work is recommended on the main sanitary collection system. As noted in Section 2.5.2, the main sewers are tight and appear to be in satisfactory condition. There do, however, appear to be problems with the condition of service laterals. Further work on the laterals has been recommended in other studies (4) and this work should proceed.

6.1.4 Outfall

A new outfall is recommended to replace the existing outfall along the same alignment. The location of the final outlet structure is to be studied during detailed design to ensure that the spawning shoal identified earlier is avoided.

Appendix B

Correspondence with MECP

From:	Baxter, Sarah (MECP) <Sarah.Baxter@ontario.ca>
Sent:	June 10, 2022 10:01 AM
To:	Nicolas Bialik
Cc:	Castro, Victor (MECP); Orpana, Jon (MECP); Durocher, Jean-Francois (MECP); Jordan Morrissette; Melody Johnson; JGendron@alfred-plantagenet.com
Subject:	RE: JLR No. 27623-013 - Twp. Alfred & Plantagenet - Plantagenet Wastewater Schedule C MEA

Good morning Nicolas,

Thanks again for providing the 2008 study for my review. I also appreciate your patience on this matter.

This morning I sat down with Victor and discussed the allowable annual TP loading for future upgrades to the Plantagenet Lagoon. The current rated capacity of the lagoon is 561 m^3/d and the TP limit is 1.0 mg/L – this equates to 204.8 kg/yr:

- *561 m^3/d @ 1.0 mg/L TP = 561,000 L/d * 1.0 mg/L = 561,000 mg/d * 365 d/yr = 204,765,000 mg/yr = 204.765 kg/yr*

I hope this math makes sense. Please use 204.8 kg/yr as the allowable TP loading from the system. Also keep in mind that it is possible to increase this loading if the client is willing to pay into the South Nation River TPM Program.

As an aside question – why was the lagoon never expanded as proposed in the 2008 study?

Sarah Baxter
Surface Water Specialist
Technical Support Section – Eastern Region
Ministry of the Environment, Conservation and Parks
1259 Gardiners Road, Unit 3, Kingston ON, K7P 3J6
E: sarah.baxter@ontario.ca

From: Nicolas Bialik <nbialik@jlrichards.ca>
Sent: June 8, 2022 9:17 AM
To: Baxter, Sarah (MECP) <Sarah.Baxter@ontario.ca>
Cc: Castro, Victor (MECP) <Victor.Castro@ontario.ca>; Orpana, Jon (MECP) <Jon.Orpana@ontario.ca>; Durocher, Jean-Francois (MECP) <Jean-Francois.Durocher@ontario.ca>; Jordan Morrissette <jmorrissette@jlrichards.ca>; Melody Johnson <melody@bskyeng.com>; JGendron@alfred-plantagenet.com
Subject: RE: JLR No. 27623-013 - Twp. Alfred & Plantagenet - Plantagenet Wastewater Schedule C MEA

Hi Sarah,

Thanks for the response. I will provide you with the 1998 Class EA through a separate large file transfer email. As for the second item, your confirmation that the presented study approach is acceptable is sufficient. We will therefore proceed the presented approach and wait on confirmation from you for the TP loading.

Thanks,

Nicolas Bialik
Environmental Engineering Intern

J.L. Richards & Associates Limited
700 - 1565 Carling Avenue, Ottawa, ON K1Z 8R1
Direct: 343-804-5346

From: Baxter, Sarah (MECP) <Sarah.Baxter@ontario.ca>
Sent: Tuesday, June 7, 2022 1:13 PM
To: Nicolas Bialik <nbialik@jlrichards.ca>
Cc: Castro, Victor (MECP) <Victor.Castro@ontario.ca>; Orpana, Jon (MECP) <Jon.Orpana@ontario.ca>; Durocher, Jean-Francois (MECP) <Jean-Francois.Durocher@ontario.ca>
Subject: RE: JLR No. 27623-013 - Twp. Alfred & Plantagenet - Plantagenet Wastewater Schedule C MEA

Good afternoon Nicholas,

I apologize for the delay in responding, but I have been trying to track down a copy of the 1998 Class EA study without luck. Could you please provide an electronic copy for my review, and then I can respond regarding the TP loading question. I would just like to read through the study to see how that value was initially developed/decided upon.

For question two, I'm not sure what is being asked. It is my understanding that JLR and their subconsultant were going to carry out the assimilative capacity study described to the Ministry on May 5th and new discharge criteria would be developed based on the results. Victor nor I have any objections to the presented study approach.

Sarah Baxter

Surface Water Specialist
Technical Support Section – Eastern Region
Ministry of the Environment, Conservation and Parks
1259 Gardiners Road, Unit 3, Kingston ON, K7P 3J6
E: sarah.baxter@ontario.ca

From: Nicolas Bialik <nbialik@jlrichards.ca>
Sent: May 25, 2022 3:10 PM
To: Orpana, Jon (MECP) <Jon.Orpana@ontario.ca>; JGendron@alfred-plantagenet.com; Melody Johnson <melody@bskyeng.com>; Baxter, Sarah (MECP) <Sarah.Baxter@ontario.ca>; Jordan Morrissette <jmorrissette@jlrichards.ca>; Castro, Victor (MECP) <Victor.Castro@ontario.ca>
Cc: Sarah Gore <sgore@jlrichards.ca>; Durocher, Jean-Francois (MECP) <Jean-Francois.Durocher@ontario.ca>
Subject: JLR No. 27623-013 - Twp. Alfred & Plantagenet - Plantagenet Wastewater Schedule C MEA

Hi Everyone,

Please find attached minutes from the meeting held on May 5, 2022, relating to assimilative capacity assessment for the above-noted project. I have extracted below MECP action items from the minutes:

- Total Phosphorous loadings are proposed to be limited to 208.4 kg/year, representing the loading approved as part of the 1998 Class EA study. MECP to confirm that this loading can still be applied to the current upgrades. **Action MECP.**
- M. Johnson noted that input from the MECP will be used to guide the development of discharge targets for the system. MECP to review information presented during this meeting and provide feedback on the proposed approach. **Action MECP.**

Should you have any questions, comments or corrections, please let us know.

Thanks,

Nicolas Bialik

J.L. Richards & Associates Limited
700 - 1565 Carling Avenue, Ottawa, ON K1Z 8R1
Direct: 343-804-5346

J.L. Richards
& Associates Limited
ENGINEERS • ARCHITECTS • PLANNERS

BEST MANAGED COMPANIES Platinum member

From: Nicolas Bialik
Sent: Wednesday, May 4, 2022 10:27 AM
To: Orpana, Jon (MECP) <Jon.Orpana@ontario.ca>; JGendron@alfred-plantagenet.com; Melody Johnson <melody@bskyeng.com>; Baxter, Sarah (MECP) <Sarah.Baxter@ontario.ca>; Jordan Morrissette <jmorrissette@jlrichards.ca>
Cc: Castro, Victor (MECP) <Victor.Castro@ontario.ca>
Subject: RE: Twp. Alfred - Plantagenet Wastewater Treatment Plant Schedule C MEA

Hi Everyone,

Please find attached PowerPoint slides that will be followed during our meeting to facilitate discussion.

Thanks,

-----Original Appointment-----
From: Orpana, Jon (MECP) <Jon.Orpana@ontario.ca>
Sent: Wednesday, April 20, 2022 4:24 PM
To: Orpana, Jon (MECP); JGendron@alfred-plantagenet.com; Nicolas Bialik; Melody Johnson; Baxter, Sarah (MECP); Jordan Morrissette
Cc: Castro, Victor (MECP)
Subject: Twp. Alfred - Plantagenet Wastewater Treatment Plant Schedule C MEA
When: Thursday, May 5, 2022 1:30 PM-2:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

-----Original Appointment-----
From: Orpana, Jon (MECP) <Jon.Orpana@ontario.ca>

Sent: Wednesday, April 20, 2022 3:33 PM
To: Orpana, Jon (MECP); Baxter, Sarah (MECP); Jordan Morrissette
Cc: Castro, Victor (MECP)
Subject: Twp. Alfred - Plantagenet Wastewater Treatment Plant Schedule C MEA
When: Thursday, May 5, 2022 1:30 PM-2:30 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Microsoft Teams Meeting

Hello Folks,

Please find attached a meeting invite for the above mentioned project to discuss assimilative capacity for the South Nation River with respect to the Plantagenet WWTP.

April 27 did not work for pertinent MECP staff. Please forward to whoever you deem necessary.

Regards,

Jon

Jon K. Orpana
Regional Environmental Planner
Environmental Assessment Branch
Ministry of the Environment, Conservation and Parks
Kingston Regional Office
PO Box 22032, 1259 Gardiners Road
Kingston, Ontario
K7M 8S5

Phone: (613) 548-6918
Fax: (613) 548-6908
Email: jon.orpana@ontario.ca

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teams@msteams.ontario.ca
Video Conference ID: 113 115 233 7
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Appendix C

WASP Modelling of Downstream DO Impacts

C.1. WASP Model Development

The South Nation River HEC-RAS model was obtained from South Nation Conservation. HEC-Ras model runs were completed for summer and fall low-flow conditions to establish surface water levels, water depths, velocities, and reach geometries.

Cross-sections defined in the HEC-RAS model were applied to develop a dynamic river water quality model based on EPA's Water Quality Analysis Simulation Program (WASP), version 8.3. Dynamic flow routing was applied in WASP and the results of the HEC-RAS model were used to develop suitable Leopold Maddock coefficients for depth and velocity relationships for each WASP river segment.

The WASP model extends from River Kilometer 11.30, just downstream of the Prescott Russell Recreational Trail crossing, to the confluence of the South Nation and Ottawa Rivers.

Literature rate constants and coefficients were assigned for all in-stream process related to nutrients, algae, sediment, and dissolved oxygen. Available solar radiation was defined based on the Latitude and Longitude of Plantagenet. Importantly, rigorous calibration of the WASP model would require additional water quality monitoring information including diurnal dissolved oxygen measurements, algae and attached macrophyte surveys. As well time of travel dye studies.

Ambient water quality for the WASP model was estimated based on PWQMN Station 18207002002, while 7Q20 low flows were generated using WSC Gauge 02LB005.

C.2. Modelling Results

Two critical months were modelled under 7Q20 flow conditions, namely:

- October: Assuming Scenario B, Phase 2 daily maximum effluent flow rate of 4,500 m^3/d at a BOD limit of 20 mg/L and TAN limit of 5.0 mg/L; and,
- May: Assuming Scenario B, Phase 2 daily maximum effluent flow rate of 15,000 m^3/d at a BOD limit of 20 mg/L and TAN limit of 3.5 mg/L.

Preliminary model runs indicated that October and May discharge periods provided the greatest potential water quality impacts. The lowest monthly 7Q20 fall and spring flows occur in October and May, respectively. Lower flows correspond to lower velocity and a reduced re-aeration rate. Also, seasonal dilution ratios for the proposed effluent flow occurs during these months. Therefore, for assessment of dissolved oxygen impacts associated with wastewater discharge, WASP model runs were completed for October and May design conditions.

Baseline model WASP model runs were completed to generate average dissolved oxygen concentrations, by river reach, that were consistent with the limited available dissolved oxygen monitoring information. Subsequently, wastewater effluent was introduced to the WASP model in order to determine the approximate reduction in dissolved oxygen levels associated with the additional load. For both October and May, model runs were continued until steady-state conditions were achieved.

Based on the modelling results, the estimated maximum reduction in ambient dissolved oxygen is 0.16 mg/L at 2.7 km downstream of the outfall for October, and 0.05 mg/L at 2.7 km downstream of the outfall for May, representing negligible impacts from the combined cBOD and nBOD loadings from the proposed effluent. These results are presented graphically in Figures C.1 and C.2.

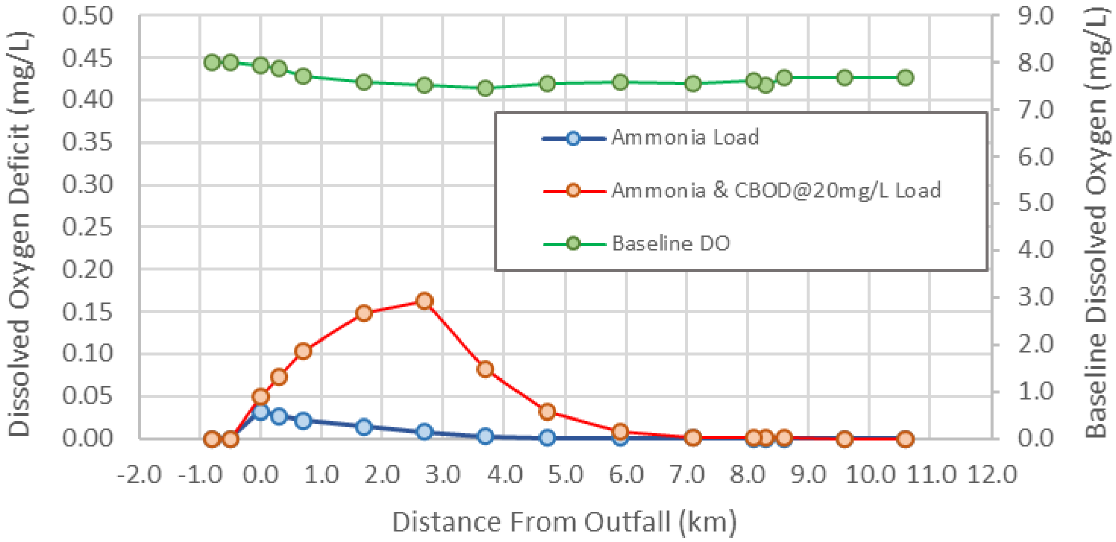


Figure C.1 WASP Modelling Results – October Effluent Flows – Scenario B, Phase 2

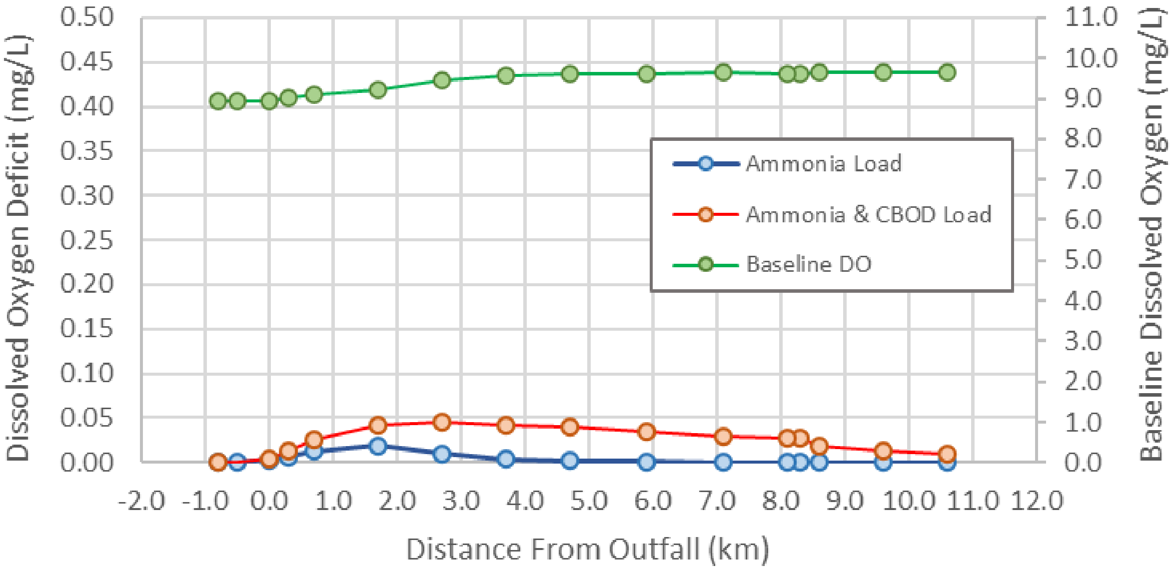


Figure C.2 WASP Modelling Results – May Effluent Flows – Scenario B, Phase 2

Appendix A6

Natural Environment Study Report (Bowfin, 2022)

PLANTAGENET WASTEWATER TREATMENT PLANT EXPANSION

Natural Environment Study

Prepared For:
J.L. Richards & Associates Limited
700 - 1565 Carling Avenue
Ottawa, Ontario K1Z 8R1

Prepared By:
Bowfin Environmental Consulting/CIMA+
168 Montreal Road
Cornwall, Ontario K6H 1B3

Date:
April 2022
(updated June 2022)

List of Acronyms and Definitions

ABBO - Atlas of Breeding Birds of Ontario
ANSI – Area of Natural and Scientific Interest
BHA - Butternut Health Assessments/Butternut Health Assessor
CC - Co-Efficient of Conservation
COSEWIC - Committee on the Status of Endangered Wildlife in Canada
DBH – Diameter-at-breast height
ELC - Ecological Land Classification
ERA – Ecological Risk Assessment
ESA - Endangered Species Act (Provincial)
GPS – Global Positioning System
NAD 83: North American Datum 1983
UTM: Universal Transverse Mercator
LIO - Land Information Ontario
NHIC – Natural Heritage Information Centre
NHRM - Natural Heritage Reference Manual
MBCA - Migratory Bird Convention Act (Federal)
MECP - Ministry of Environment, Conservation and Parks
NHIC – Natural Heritage Information Centre
NHRM - Natural Heritage Reference Manual
OMNR/MNRF/MNDMNRF
    - Ontario Ministry of Natural Resources (old)
    -Ministry of Natural Resources and Forestry (old)
    -Ministry of Northern Development, Mines, Natural Resources, and Forestry (new)
OP – Official Plan
OWES - Ontario Wetland Evaluation System
PSW - Provincially Significant Wetlands
RFP – Request for proposal
SAR - Species at Risk (in this report they refer to species that are provincially or federally listed as endangered or threatened and receive protection under ESA or SARA)
SARA - Species at Risk Act (Federal)
SARO - Species at Risk in Ontario
SWHCS - Significant Wildlife Habitat Criteria Schedules
SWHTG - Significant Wildlife Habitat Technical Guide
SWH - Significant Wildlife Habitat
ToR – Terms of Reference

SRANK DEFINITIONS

S1 Critically Imperiled in the nation or state/province because of extreme rarity (often 5 or

fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
S2 Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S3 Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4 Apparently Secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5 Secure; Common, widespread, and abundant in the nation or state/province.
? Inexact Numeric Rank—Denotes inexact numeric rank
SNA Not Applicable, A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#B Breeding
S#N Non-Breeding

SARA STATUS DEFINITIONS
END Endangered: a wildlife species facing imminent extirpation or extinction.
THR Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
SC Special Concern, a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

SARO STATUS DEFINITIONS
END Endangered: A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's ESA.
THR Threatened: A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed.
SC Special concern: A species with characteristics that make it sensitive to human activities or natural events.

Coefficient of Conservatism Ranking Criteria
0 Obligate to ruderal areas.
1 Occurs more frequently in ruderal areas than natural areas.
2 Facultative to ruderal and natural areas.
3 Occurs less frequent in ruderal areas than natural areas.
4 Occurs much more frequently in natural areas than ruderal areas.
5 Obligate to natural areas (quality of area is low).
6 Weak affinity to high-quality natural areas.

7	Moderate affinity to high-quality natural areas.
8	High affinity to high-quality natural areas.
9	Very high affinity to high-quality natural areas.
10	Obligate to high-quality natural areas.

Table of Contents

List of Figures

List of Tables

List of Photographs

1.0 INTRODUCTION

The Township of Alfred-Plantagenet (the Township) is proposing to upgrade the Plantagenet Wastewater Collection and Treatment System (the facility). Situated in the Village of Plantagenet, this existing facility often operates beyond its capacity, and the Environmental Study Report of 2015 identified expansion as the preferred solution. The existing facility sits on roughly 9.8 ha in part of Lots 9 and 10 in Concession 4, Old Survey in the Geographic Township of Plantagenet. It is accessed from Concession Road 5, about 300 m east of Pitch Off Road. J.L. Richards & Associates and their team were retained by the Township to complete a Class Environmental Assessment as per the Municipal Class Environmental Assessment (MCEA). Bowfin Environmental Consulting Inc. (Bowfin) was brought on board to update a previously completed Natural Area Overview completed in 1998 by Niblett Environmental Associates Inc. Note that Bowfin's professional services now form part of CIMA+. The Niblett report has been updated to this Ecological Risk Assessment (ERA) report. The goal of this ERA is to review the site and identify natural heritage features that are or may be present and provide information on how best to avoid or minimize impacts. The Terms of Reference (ToR) identified in the Request for Proposal (RFP) were:

- Update the 1998 Niblett Report
- Complete field work

As the timing of the award was fall 2021, and since the alternatives were unknown, Bowfin's proposal included the following limited field work:

- Fall vegetation description on the existing site
- Search for larger Butternuts
- Identification of larger trees that may support Chimney Swift (i.e., >50 cm in diameter at breast height, dbh)
- Information on the drain south of the existing lands.

Following that work, a spring visit was recommended to capture additional information on potential fish habitat near the site. This was completed in April 2022.

The following report provides a summary of all findings and an assessment of the functions and values any natural features identified. It also identifies any additional data gaps. Since the alternatives are unknown, the potential impacts to significant natural features and avoidance and mitigation measures provided are preliminary.

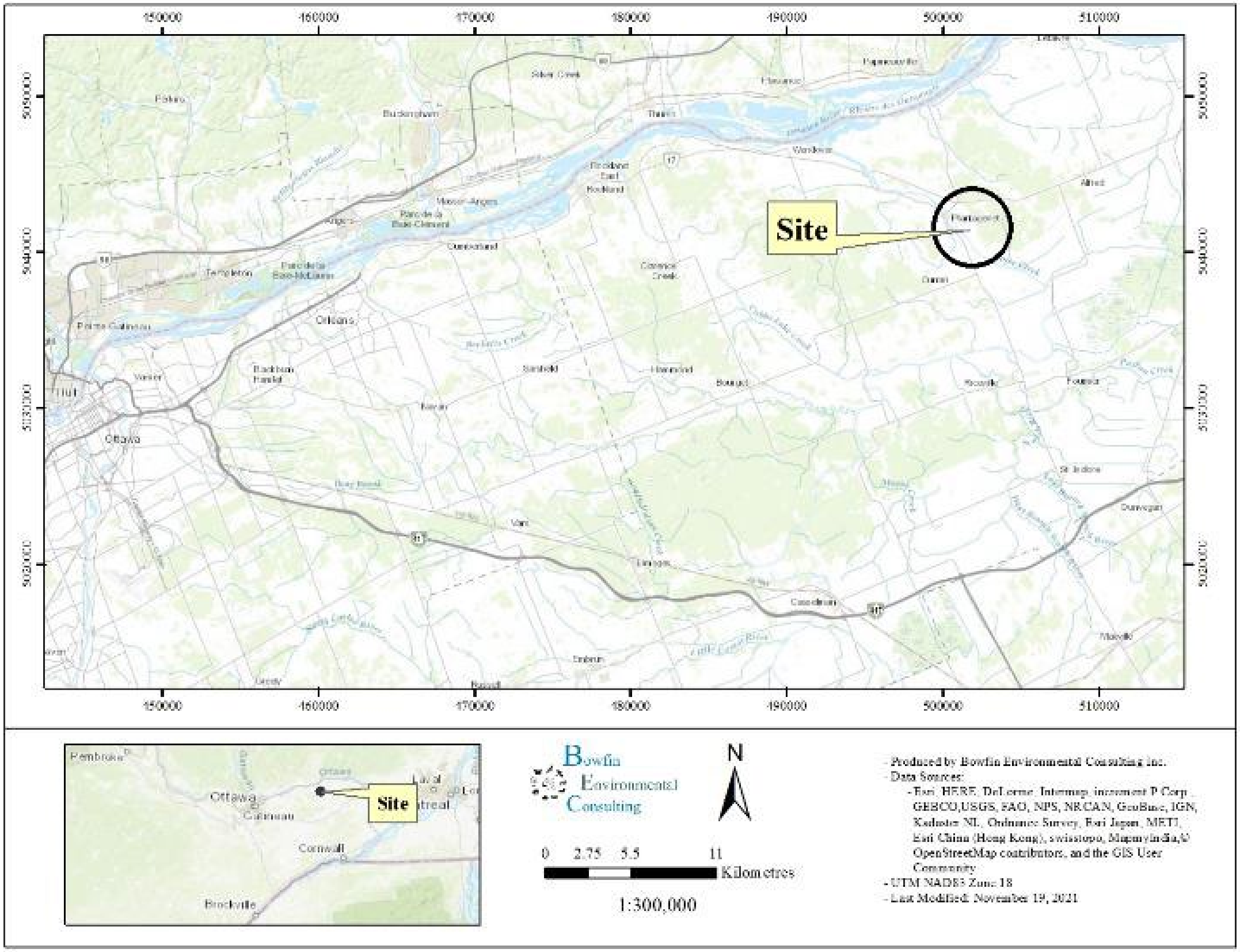
2.0 METHODOLOGY

2.1 Study Area

As per the ToR, the background review was completed for the surrounding 3 km. The study area for the fall 2021 and spring 2022 site investigations was limited to a review of the existing property and the roadside along Concession Road 5. Other features that were within 120 m and could be seen over-the-fence or in the background information were noted. The definition of adjacent lands was based on those of the *Natural Heritage Reference Manual* (OMNR, 2010).

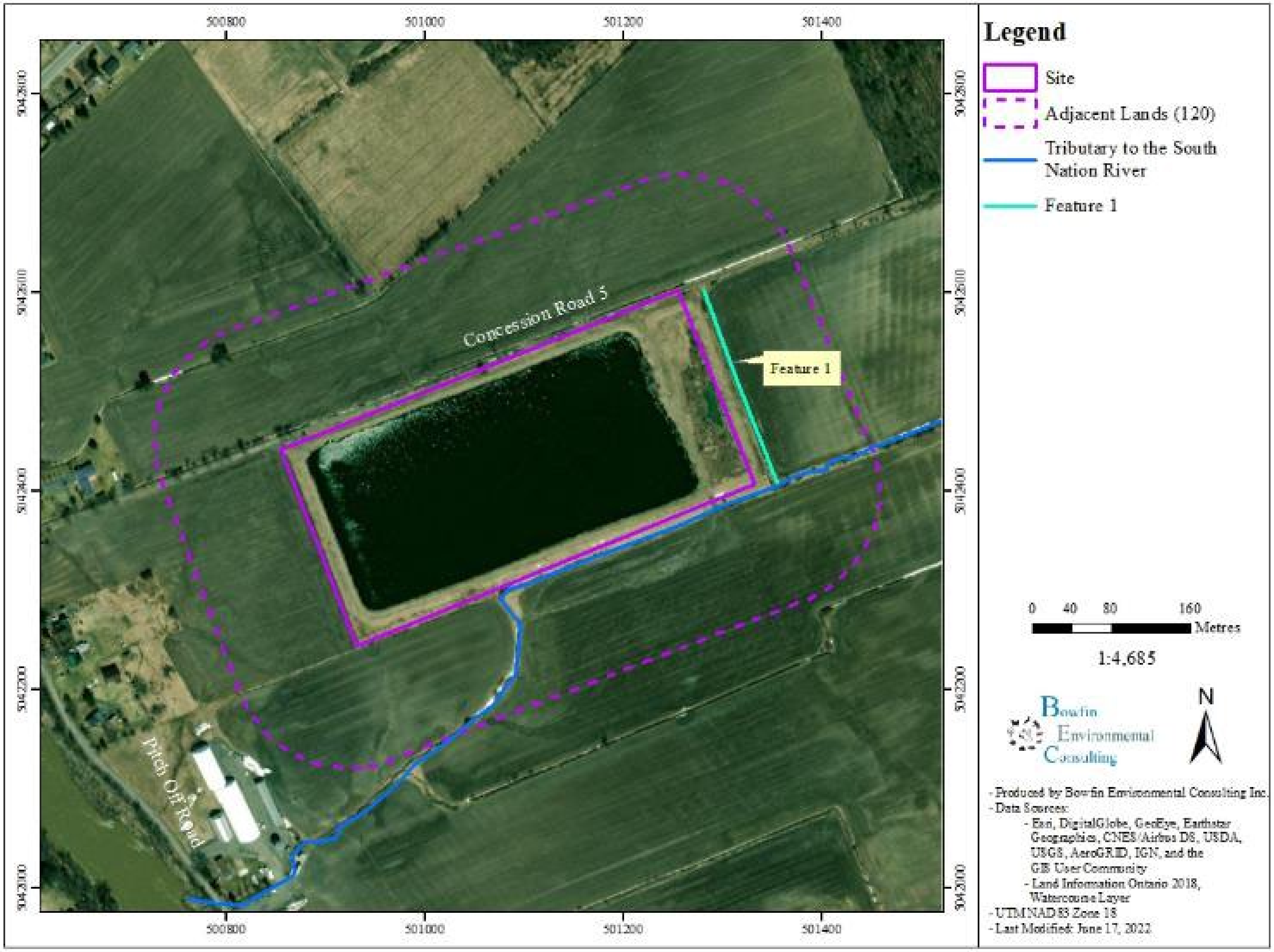
The work was awarded mid-November 2021, outside of the accepted window for many biological surveys, preventing these from occurring. As mentioned, additional fish information was collected in spring 2022. The need for further surveys will be dependent on the alternatives and the ability to apply the recommended avoidance and mitigation measures.

Figure 1: General Location of Site



- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
- UTM NAD83 Zone 18
- Last Modified: November 19, 2021

Figure 2: Location of Existing Wastewater Treatment Plan and Adjacent Lands



2.2 Background Review

Information collected from the official plan along with other sources was used to help identify natural features. Other sources included: Natural Heritage Information Centre (NHIC) database, iNaturalist, Atlas of Breeding Birds of Ontario (ABBO), Make-a-Map Land Information Ontario (LIO) databases, and the Fisheries and Oceans Canada (DFO) National Aquatic Species at Risk (NASAR) map. The desktop review included a larger area (~3 km).

2.3 Field Studies

2.3.1 Vegetation Descriptions and Flora Observations

The descriptions of the vegetation communities were limited to interpretation of satellite imaging and verified from the road or within the property. Habitat descriptions were based on the appropriate methodologies such as: *Ontario Wetland Evaluation System, Southern Manual* (OWES) for wetland habitats and the *Ecological Land Classification for Southern Ontario* (ELC) for terrestrial habitats. The Ministry of Northern Development, Mines and Natural Resources and Forestry (NDMNRF) ELC and OWES definition of wetlands do not match one another. Since wetlands are to be evaluated following OWES, the determination of the presence/absence of wetland habitat was based on the OWES definition of wetland habitat:

> *"Lands that are seasonally or permanently flooded by shallow water as well as lands where the water table is close to the surface; in either case the presence of abundant water has caused the formation of hydric soils and has favored the dominance of either hydrophytic or water tolerant plants".*

Given the timing of the award, and early stage of the project (alternatives not available at time of work), and the nature of the site's characteristics (mostly agricultural), the vegetation communities were only described to the community class level. This is sufficient to predict the potential for species at risk (SAR) and natural heritage features.

Specific attention was paid to locating SAR or species of conservation value listed as potentially occurring within the study area. If these species were observed, they would be photographed, and their coordinates recorded on a hand-held GPS using NAD83. Nomenclature used in this report follows the Southern Ontario Plant List (Bradley, 2007) for both common and scientific names which are based on Newmaster *et al.* (1998). Authorities for scientific names are given in Newmaster *et al.* (1998).

2.3.2 Butternut Inventory

As noted above, the project was not awarded until after the Butternut Health Assessment period. As such, the butternut inventory was limited to searching for larger individuals on the property and in the adjacent 50 m along the road. Any individuals noted would be flagged and labelled, and their coordinates recorded (UTMs, NAD83, using a GPS unit set). The individual would then be assessed according to the Ministry of Environment, Conservation and Parks (MECP) guidelines. It is noted that the shelf-life for butternut assessments is 2-years and that MECP has recently begun updating the protocol. Any individuals should be assessed as per the new guidelines (not all information on the guidelines was available at the time of this report but the process described is very similar to the previous iteration).

2.3.3 Aquatic Habitat Descriptions

To determine the potential impacts to fish habitat, fish communities or fish species at risk (SAR) the aquatic habitats within the study area were assessed based on the Fisheries and Oceans Canada (DFO) definition of fish habitat. As described on the website under "Waterbodies where our review isn't required" (accessed on January 11, 2022), habitat that does not need a review are in essence artificial waterbodies that are not connected to another waterbody and do not contain fish at any time of the year[1].

For this project, the potential fish habitat would include an unnamed tributary to the South Nation River (and the branch labelled as Feature 1) (Figure 2) and any roadside ditches along Concession Road 5. The potential for roadside ditches to provide fish habitat was assessed based on their habitat and connection to the nearest watercourse. Rapid assessments were undertaken which gathered qualitative information on the channel morphology. The data collected included: channel, wetted width, bankfull depth, water depth, substrate size, morphological units, and in-stream cover. Further, the connection to the South Nation River was investigated from Pitch Off Road.

2.3.4 Fish Community Sampling

Fish community sampling was performed to document the use of the site by fish during the spring. The communities were sampled using dip netting, and backpack electrofishing. The fish were identified, counted, measured [fork length (FL)/total length (TL) as appropriate], and released. The transect length, approximate width, volts, current and effort were also recorded.

2.3.5 Incidental Fauna Observations

During the visit, any wildlife observations were recorded. Incidental observations included observations of an individual, its tracks, burrows, feces and/or kill sights.

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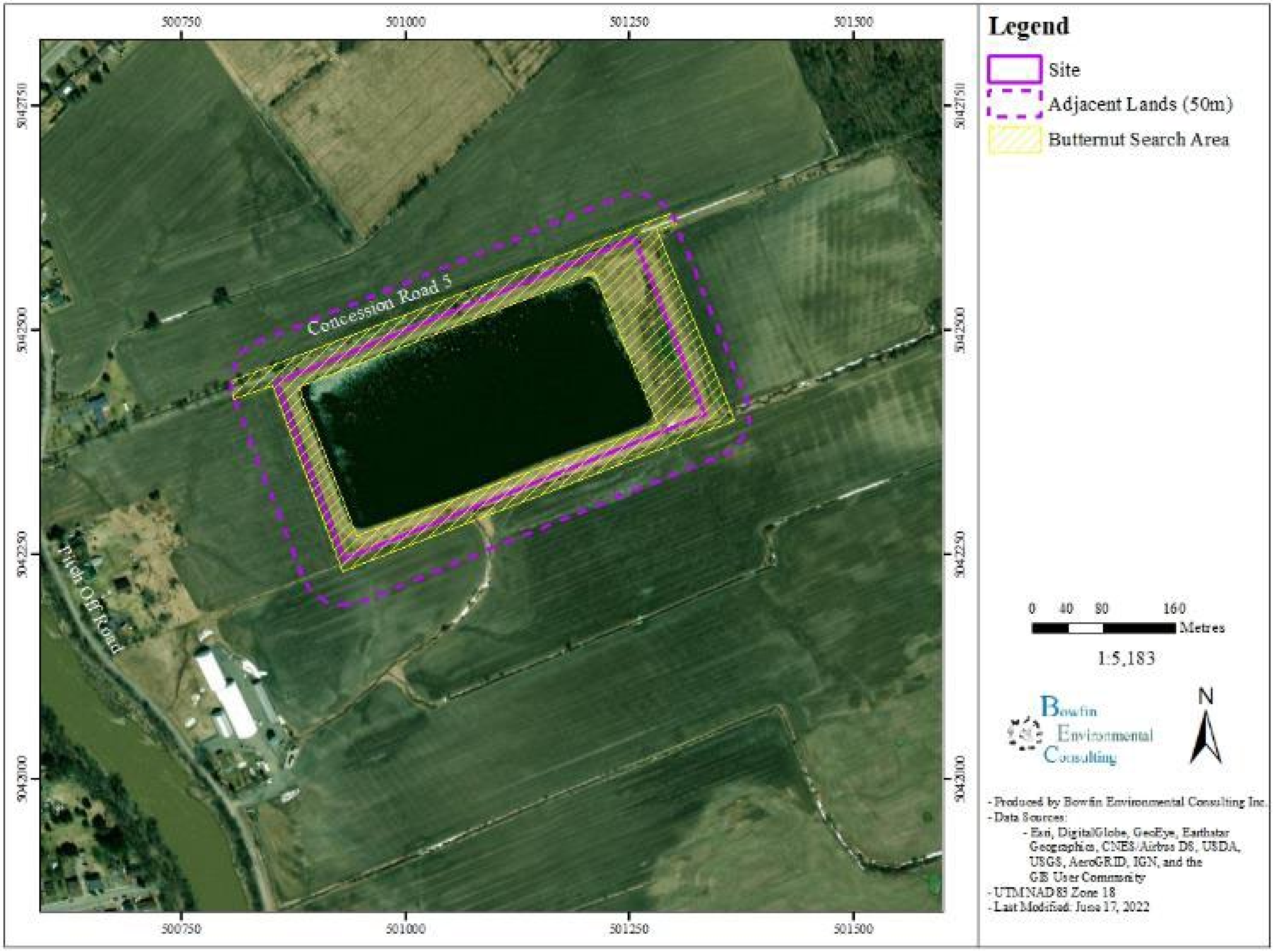
[1] There are a few other waterbodies that do not need a review, but these exceptions do not apply here.

Figure 3: Butternut Survey Area



- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- UTM NAD 83 Zone 18
- Last Modified: June 17, 2022

3.0 BACKGROUND INFORMATION

3.1 Location

The existing facility sits on roughly 9.8 ha in part of Lots 9 and 10 in Concession 4, Old Survey in the Geographic Township of Plantagenet, United Counties of Prescott, and Russell (UCPR) (UTM 18T 501089 m E, 5042413 m N, or Latitude 45.535252 Longitude -74.986052). It is bordered by Concession Road 5 on the north, and agricultural lands on all sides (crops).

3.2 Natural Heritage Features

The existing facility is in the Village of Plantagenet settlement area in the UCPR. This area's natural elements are on Schedule B of the Township of Alfred and Plantagenet's (Township) Official Plan, as opposed to that of UCPR. The adjacent lands to the south, and the wider 3 km search area (defined in the ToR) include areas outside of the Village. There, the schedules of UCPR are in force.

Schedule E of the Township's OP lists the land use of the existing facility on the property, and residential policy area (to the west) and economic enterprise to the north. The only natural feature identified is Fish Habitat running along the south edge of the site and continuing into the adjacent lands towards the south. This is the tributary to the South Nation River referenced above.

UCPR's OP schedules identify the land uses to the south and west as rural (Schedule A). Schedule B also identifies the Wildlife Corridor associated with the South Nation River as touching the southwest corner of the adjacent lands. Further afield, in the 3 km search area, it notes:

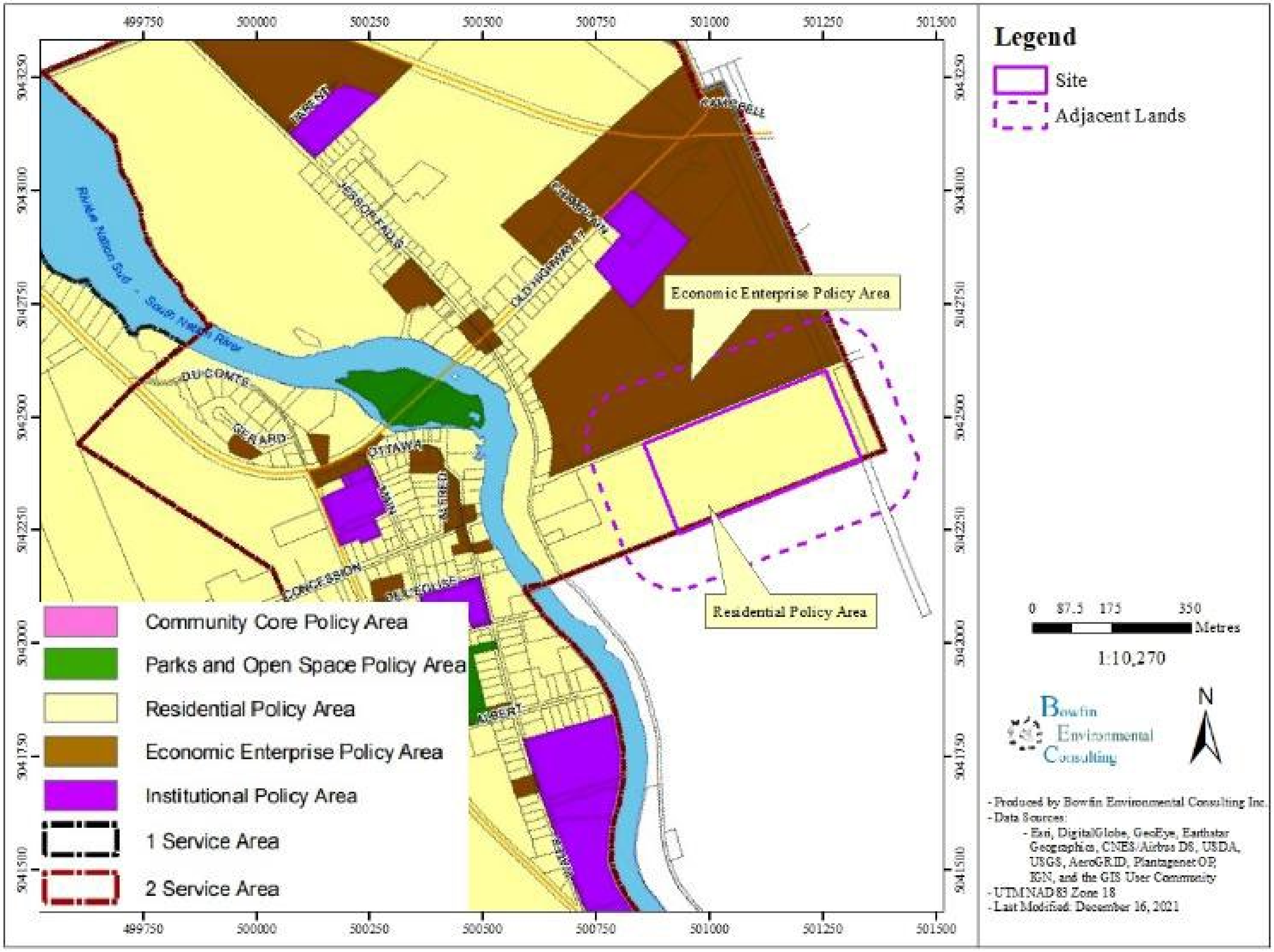
- the same unnamed tributary to South Nation as beginning roughly 1.7 km to the northeast, on the north side of County Road 17.
- Significant Woodland to the east
- Wintering Area to the east
- Wildlife Travel Corridor associated with the South Nation River
- Linkage between the significant woodland to the east and the wildlife travel corridor along the South Nation River. This linkage is to the south.

The LIO databases clarifies that the Wintering Area is for Moose Overwintering.

Table 1: Summary of Available Background Information on the Identified Natural Features

Natural Heritage Feature	Present within Site	Present within 120 m of Site	Additional Notes within 3 km
Provincially Significant Wetlands (PSW)	None		None
Areas of Natural and Scientific Interest (ANSIs)	None		None
Habitats or species designated by ESA (Provincial)	Potential for endangered or threatened species needs to be determined following assessment of the suitable habitats in or near the site. Potential species would include Chimney Swifts, bats, and Butternuts. See section 5 of this report for more information.		
Significant Woodlands	None identified on OP		Nearest woodland is 285 m to east
Significant Valleyland	None identified on OP		None
Significant Wildlife Habitat (SWH)	None	Wildlife Travel Corridor (105 m to southwest)	Wintering Area/Moose Wintering Area (2.8km to northeast) Linkage (2.0 km to southeast)
Fish Habitat	Unnamed Tributary to South Nation River appears to run along the south edge of the existing facility's property.	The same unnamed tributary begins roughly 1.7 km to the NE and continues to the South Nation River	Other watercourses are shown within the 3 km search area, but none travel through or within 120 m of the property.

Figure 4: Township of Alfred-Plantagenet Schedule B



- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, Plantagenet OP, IGN, and the GIS User Community
- UTM NAD 83 Zone 18
- Last Modified: December 16, 2021

Figure 5: Township of Alfred-Plantagenet Schedule E

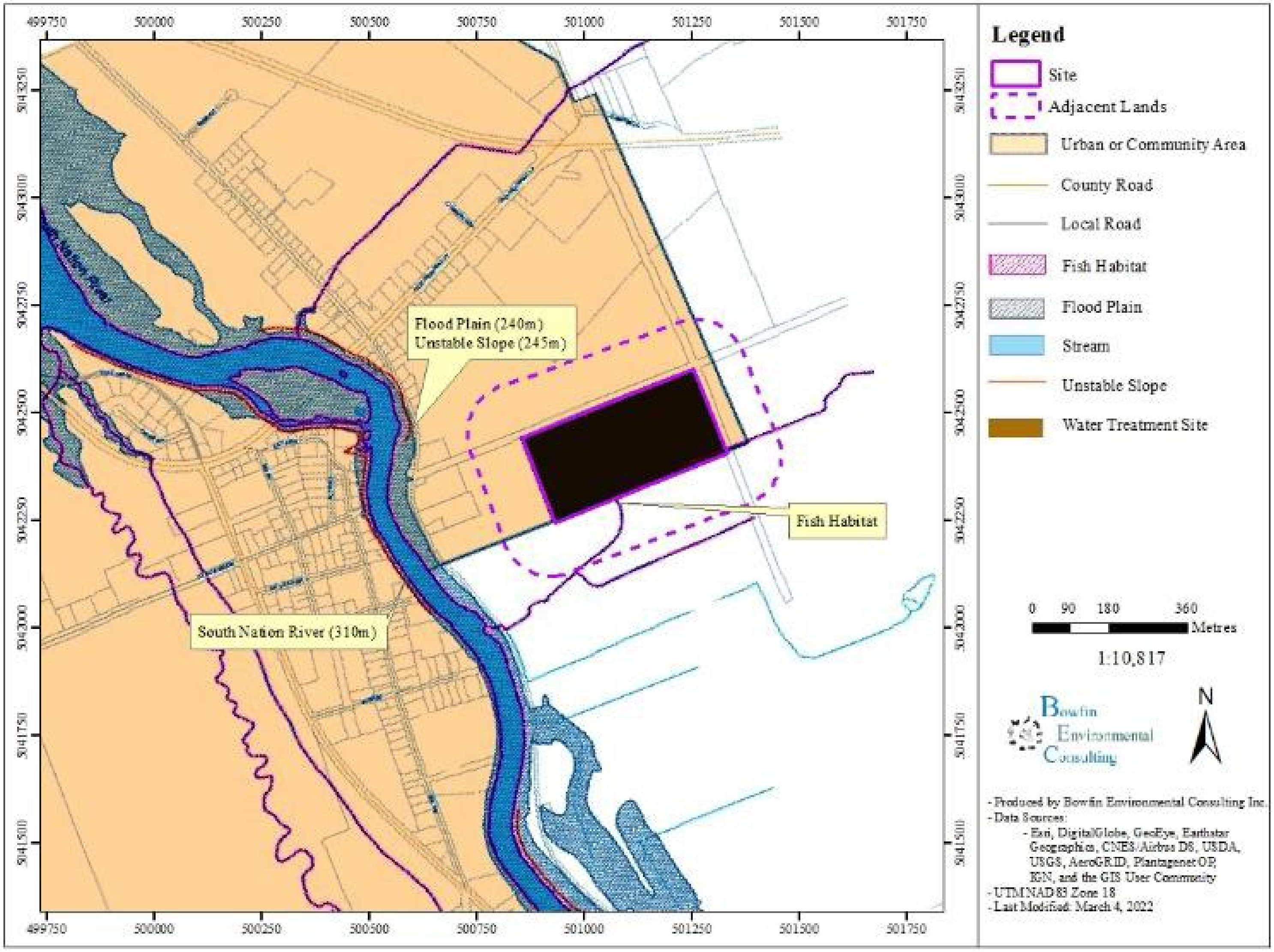
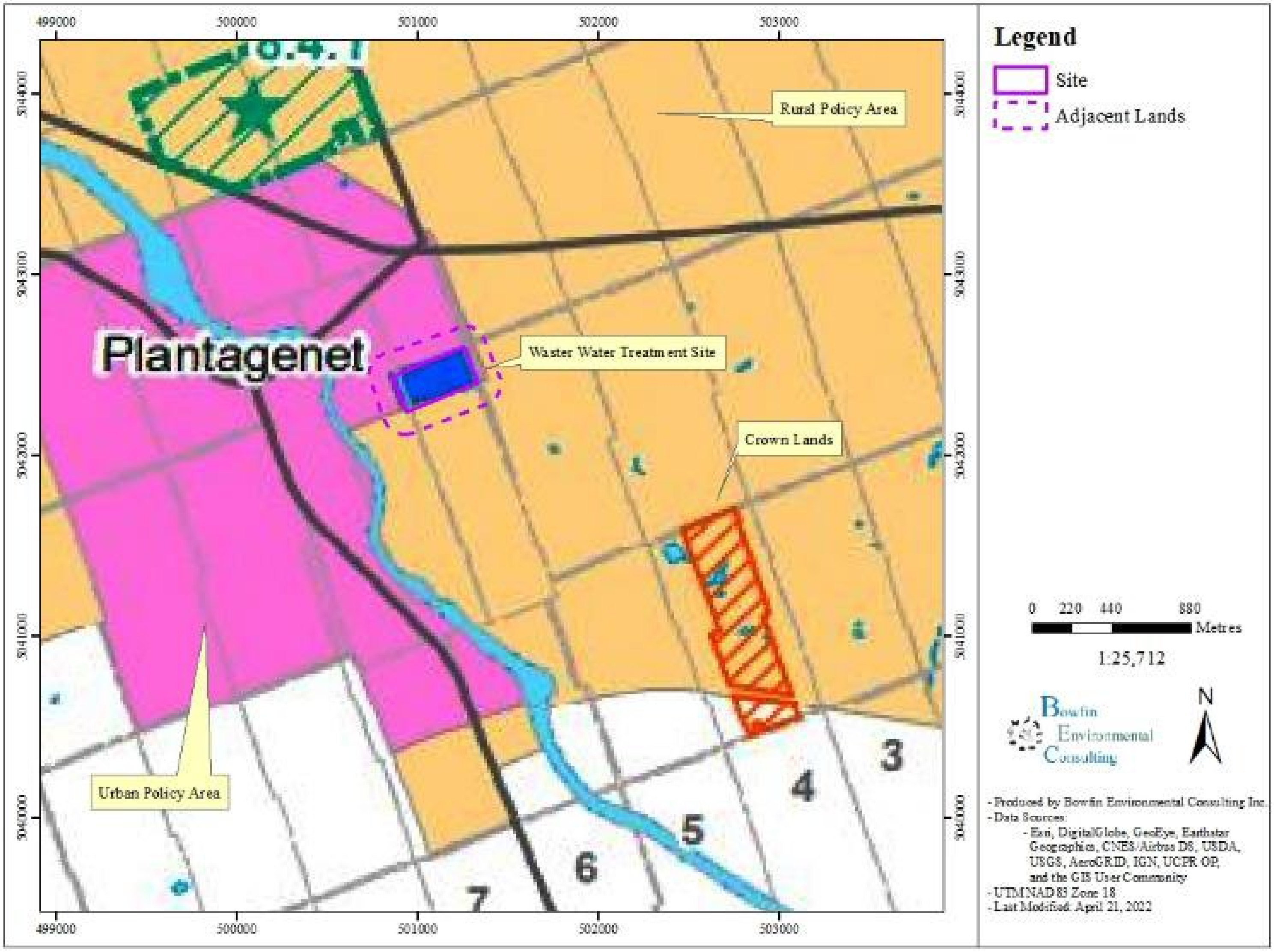
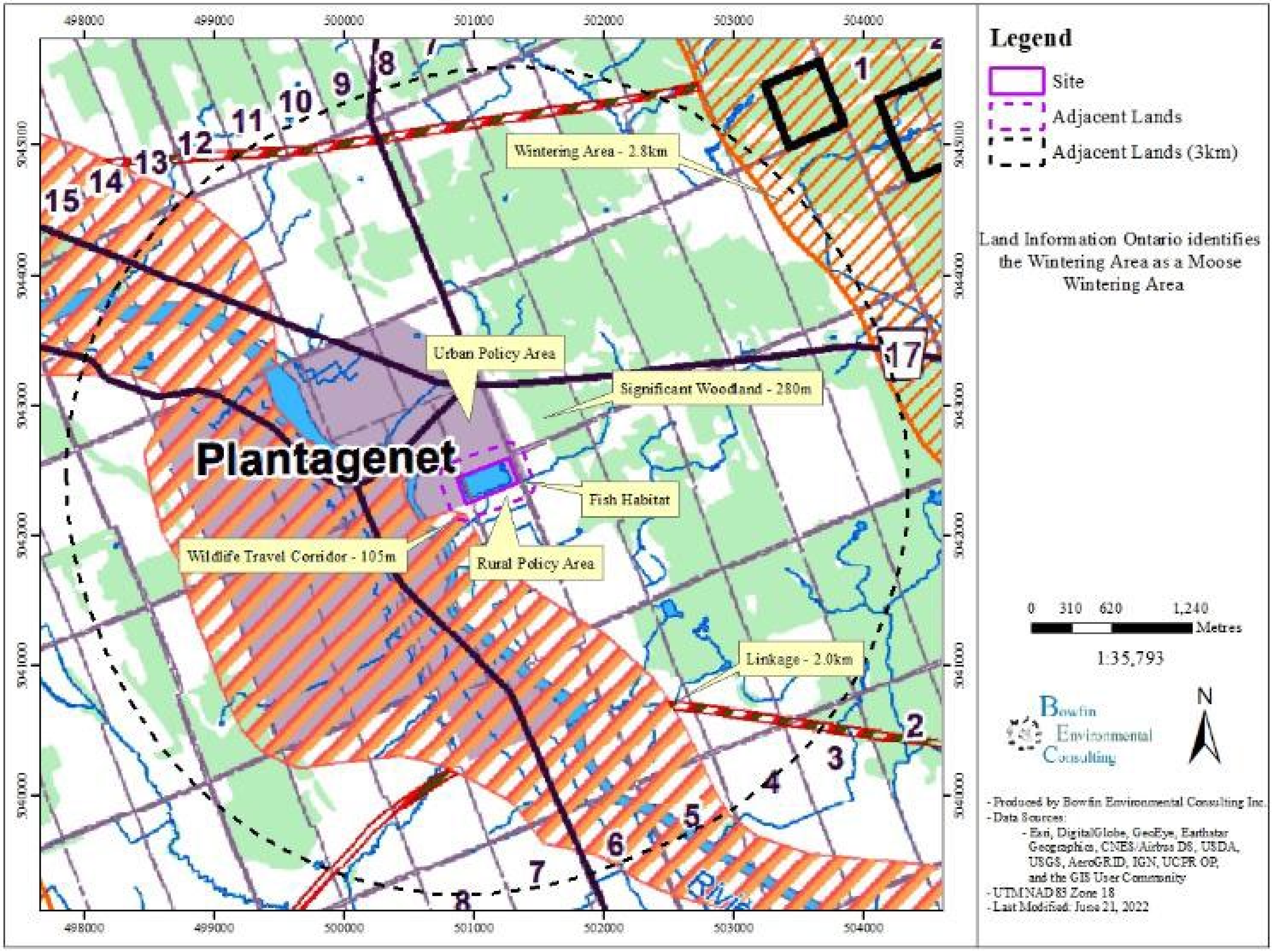


Figure 6: United Counties of Prescott and Russell Schedule A



- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, UCPR OP, and the GIS User Community
- UTM NAD 83 Zone 18
- Last Modified: April 21, 2022

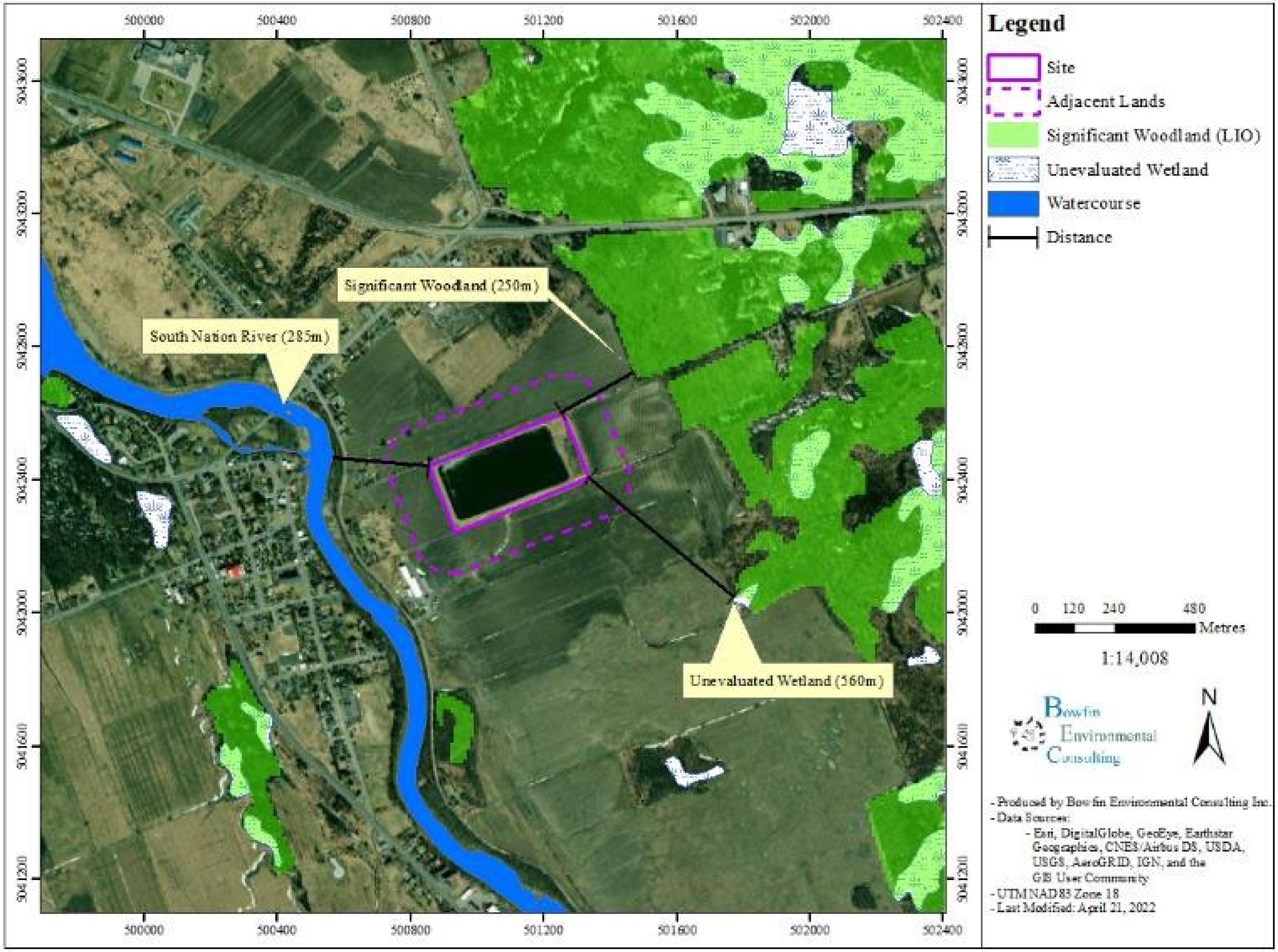
Figure 7: United Counties of Prescott and Russell Schedule B



Land Information Ontario identifies the Wintering Area as a Moose Wintering Area

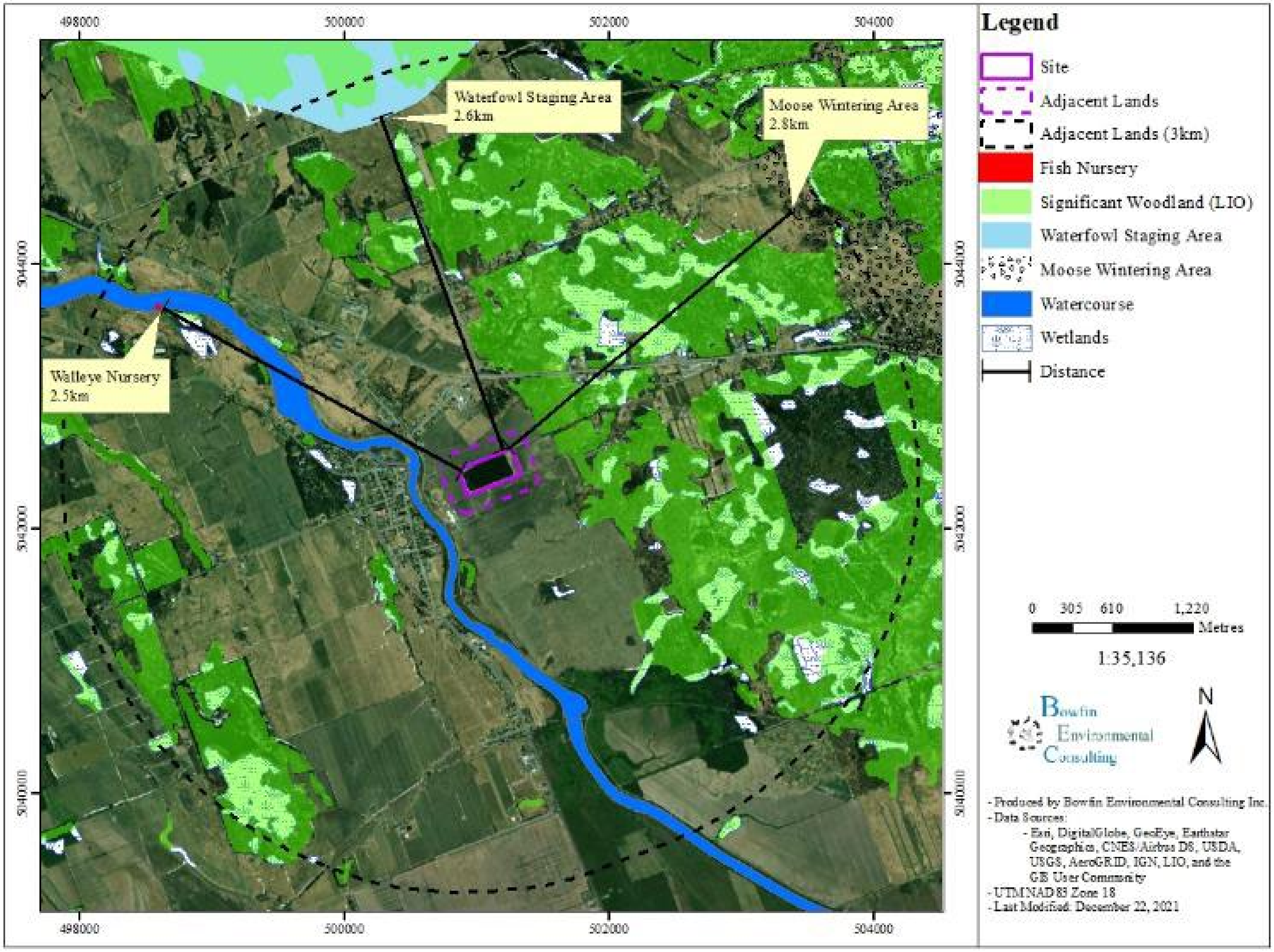
- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, UCPR OP, and the GIS User Community
- UTM NAD 83 Zone 18
- Last Modified: June 21, 2022

Figure 8: Background Information on Known Natural Heritage Features from LIO



- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- UTM NAD83 Zone 18
- Last Modified: April 21, 2022

Figure 9: Land Information Ontario (3 km adjacent lands)



- Produced by Bowfin Environmental Consulting Inc.
- Data Sources:
  - Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, LIO, and the GIS User Community
- UTM NAD 83 Zone 18
- Last Modified: December 22, 2021

3.2.1 Fish Habitat and Communities Details

The only watercourse feature identified on the background mapping was the unnamed tributary to the South Nation River. This feature began to the north of County Road 17 (±1.7 km northeast of the Site) and continued to the south and southeast to the South Nation River. Review of the background information suggests that the headwaters of the feature are within an unevaluated wetland in the significant woodland feature discussed above. Once outside of that woodland, it flows through crop lands with little in the way of a vegetated buffer. Near the downstream end, the flow passes through two private culverts on a farm property before reaching the culvert under Pitch Off Road. Within the study area, it flowed along the south edge of the site (which is roughly 510 m upstream from its confluence with the South Nation River).

This feature is shown on the schedules for the official plans, and on the province’s make-a-map (online tool) but is not present on LIO Aquatic Resource Area layers. As such, there is no information on fish community available. The nearest fish community information is for the South Nation River. LIO, South Nation Conservation (SNC), and the NHIC provided a list of 36 common warm to cool water fish species on the Plantagenet reach of the South Nation River (Figure 10). Of these, eleven sport fish were identified (longnose gar, northern pike, muskellunge, brown bullhead, channel catfish, smallmouth bass, largemouth bass, yellow perch, sauger, walleye, and freshwater drum) (Table 2). Five pan fish (rock bass, pumpkinseed, bluegill, white crappie, black crappie) were also listed. In addition, a walleye nursery is identified on the South Nation River, but this is situated far upstream (>2500 m) from the site.

The DFO National Aquatic Species at Risk Mapping (NASAR) also indicated that there are no recordings of federal endangered, threatened, or special concern species in this area (accessed on March 4, 2022).

Figure 10: Summary of Background Fish Community Information

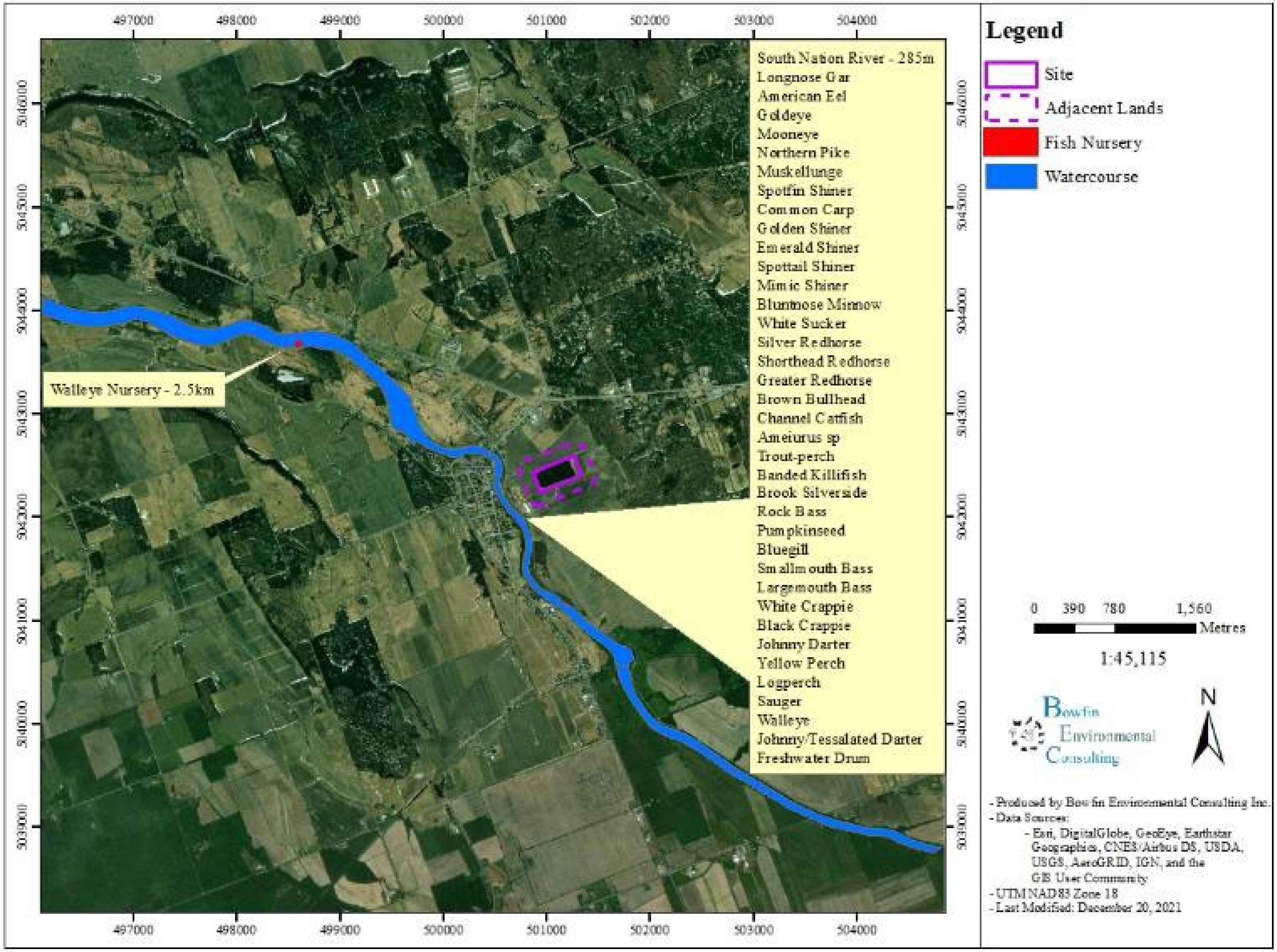


Table 2: Background Fish Community Information for the South Nation River (Plantagenet Reach)

Common Name	Scientific Name	Trophic Class*	Thermal Regime	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Source
Longnose Gar	*Lepisosteus osseus*	carnivore	warm	S4	none	none	LIO 2018
American Eel	*Anguilla rostrata*	invertivore/carnivore	cool	S1?	END	none	NHIC
Goldeye	*Hiodon alosoides*	insectivore	cool	S3	none	none	LIO 2018
Mooneye	*Hiodon tergisus*	invertivore	cool	S4	none	none	LIO 2018
Northern Pike	*Esox lucius*	carnivore	cool	S5	none	none	LIO 2018, SNC 2017
Muskellunge	*Esox masquinongy*	carnivore	warm	S4	none	none	LIO 2018
Spotfin Shiner	*Cyprinella spiloptera*	invertivore/ herbivore	warm	S4	none	none	LIO 2018
Common Carp	*Cyprinus carpio*	invertivore/ detritivore	warm	SNA	none	none	LIO 2018
Golden Shiner	*Notemigonus crysoleucas*	invertivore/herbivore	cool	S5	none	none	LIO 2018
Emerald Shiner	*Notropis atherinoides*	planktivore	cool	S5	none	none	LIO 2018
Spottail Shiner	*Notropis hudsonius*	invertivore/ planktivore	cool	S5	none	none	LIO 2018
Mimic Shiner	*Notropis volucellus*	invertivore/herbivore	warm	S5	none	none	LIO 2018
Bluntnose Minnow	*Pimephales notatus*	detritivore	warm	S5	none	none	LIO 2018
White Sucker	*Catostomus commersonii*	invertivore/ detritivore	cool	S5	none	none	LIO 2018

Common Name	Scientific Name	Trophic Class*	Thermal Regime	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Source
Silver Redhorse	*Moxostoma anisurum*	invertivore	cool	S4	none	none	LIO 2018, SNC 2017
Shorthead Redhorse	*Moxostoma macrolepidotum*	invertivore	warm	S5	none	none	LIO 2018, SNC 2017
Greater Redhorse	*Moxostoma valenciennesi*	invertivore	warm	S3	none	none	LIO 2018, SNC 2017
Brown Bullhead	*Ameiurus nebulosus*	invertivore/ herbivore/ carnivore	warm	S5	none	none	LIO 2018, SNC 2017
Channel Catfish	*Ictalurus punctatus*	invertivore/ carnivore	warm	S4	none	none	LIO 2018, SNC 2017
Trout-perch	*Percopsis omiscomaycus*	invertivore/ carnivore	cold	S5	none	none	LIO 2018
Banded Killifish	*Fundulus diaphanus*	invertivore/planktivore	cool	S5	none	none	LIO 2018
Brook Silverside	*Labidesthes sicculus*	planktivore/ invertivore	warm	S4	none	none	LIO 2018
Rock Bass	*Ambloplites rupestris*	invertivore/carnivore	cool	S5	none	none	LIO 2018, SNC 2017
Pumpkinseed	*Lepomis gibbosus*	invertivore/carnivore	warm	S5	none	none	LIO 2018, SNC 2017
Bluegill	*Lepomis macrochirus*	invertivore	warm	S5	none	none	SNC 2017
Smallmouth Bass	*Micropterus dolomieu*	invertivore/ carnivore	cool	S5	none	none	LIO 2018, SNC 2017
Largemouth Bass	*Micropterus salmoides*	invertivore/ carnivore	warm	S5	none	none	LIO 2018
White Crappie	*Pomoxis annularis*	invertivore/carnivore	warm	S4	none	none	LIO 2018

Common Name	Scientific Name	Trophic Class*	Thermal Regime	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Source
Black Crappie	*Pomoxis nigromaculatus*	invertivore/ carnivore	cool	S4	none	none	LIO 2018, SNC 2017
Johnny Darter	*Etheostoma nigrum*	invertivore	cool	S5	none	none	LIO 2018
Yellow Perch	*Perca flavescens*	invertivore/ carnivore	cool	S5	none	none	LIO 2018, SNC 2017
Logperch	*Percina caprodes*	invertivore	warm	S5	none	none	LIO 2018
Sauger	*Sander canadensis*	invertivore/ carnivore	cool	S4	none	none	LIO 2018
Walleye	*Sander vitreus*	invertivore/carnivore	cool	S5	none	none	LIO 2018, SNC 2017
Johnny/Tessellated Darter	*Etheostoma nigrum/ Etheostoma olmstedi*				none	none	LIO 2018
Freshwater Drum	*Aplodinotus grunniens*	invertivore/ carnivore	warm	S5	none	none	LIO 2018
						Number of Species	**36**

(DFO, 2019; Eakins, 2018; LIO, 2018; OMNRF, 2014; MNRF, 2017; MTO, 2006; NHIC, SNC 2017)

Status Updated: March 2022

SRANK DEFINITIONS

S1 Critically Imperiled, Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province

S3 Vulnerable, Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 Apparently Secure, Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure, Common, widespread, and abundant in the nation or state/province.

SNA Not Applicable, A conservation status rank is not applicable because the species is not a suitable target for conservation activities

?	Inexact Numeric Rank—Denotes inexact numeric rank

SARO STATUS DEFINITIONS

END	Endangered: A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's ESA.

4.0 SITE INVESTIGATION RESULTS

4.1 Site Investigation Dates and Purpose

As mentioned above, the site investigations were limited for this project due to the time of year that it was awarded, the stage of the project (alternatives not available), and the habitats present on the existing property. The timing and purpose of the visits are summarized in the table below. The information on the rainfall from the seven days prior to the visit is provided to put the aquatic habitat seen in photographs and any notes taken on water levels into perspective. The South Nation Conservation (SNC) listed the watershed conditions as Normal during the November visit (SNC website Watershed Conditions | South Nation Conservation Authority).

Table 3: Summary of Dates, Times, Conditions and Purpose of Site Investigations

Date	Time (h)	Staff	Air Temperature (Min-Max)* °C	Cloud Cover (%) Beaufort Wind Scale [Descriptor (scale)]	Total Rainfall (7 previous days) (mm)*	Watershed Condition Water Levels**	Purpose
November 24, 2021	0945-1245	S. Lafrance A. Quinsey	5.0 (-5.7-5.9)	Clear sky Wind: none	17.8	Normal Flow Rate: 38.24cms Water Level: 0.98m	-Vegetation Description -Butternut Inventory -Fish Habitat Assessment
April 29, 2022	0915-1115	M. Lavictoire S. Lafrance A. Quinsey	6.0 (-2.1-13.4)	Clear Sky Gentle Breeze (3)	21.2	Normal Flow Rate: 86.07cms Water Level: 1.38m	-Fish Sampling -Fish Habitat Assessment

M. Lavictoire – Michelle (Nunas) Lavictoire – B. Sc. Wildlife Resources and M.Sc. Natural Resources
S. Lafrance – Sophie Lafrance – B.Sc. Biology and graduate diploma in Ecosystem Restoration
A. Quinsey – Al Quinsey – B.Sc. Environmental Biology

*Min-Max Temp and Rainfall Data Taken From: Environment Canada. National Climate Data and Information Archive. Ottawa International Airport. Available http://climate.weatheroffice.gc.ca/ [June 1, 2022]
**Watershed Conditions Taken From: South Nation Conservation. Available https://www.nation.on.ca/ [June, 1, 2022]

4.2 Vegetation Description and Butternut Survey Results

The site was primarily manicured lawn with scattered Manitoba maple and staghorn sumac along the fences and the steep berms around the lagoons. The shallow wetted area around the edges of the lagoons was entirely dominated by cocklebur. There was one area on the east side of the lagoons that consisted of natural/naturalizing habitat (see Figure 11 below). While the entire area was just over 0.5 ha (the minimum community size), it consisted of two different vegetation communities, each <0.5 ha. These were cultural meadow and robust emergent marsh. All surrounding lands were agricultural fields (crops).

Cultural Meadow

This small meadow community (0.26 ha) occupied the northern third of the low-lying area on the east side of the site. It was primarily composed of smooth brome grass, common milkweed, bull thistle, tall goldenrod along with scattered largetooth aspen (onsite diameter at breast height (dbh) 5-20 cm along the border with the marsh community, larger trees were present along Concession Road 5 (20-30 cm dbh)).

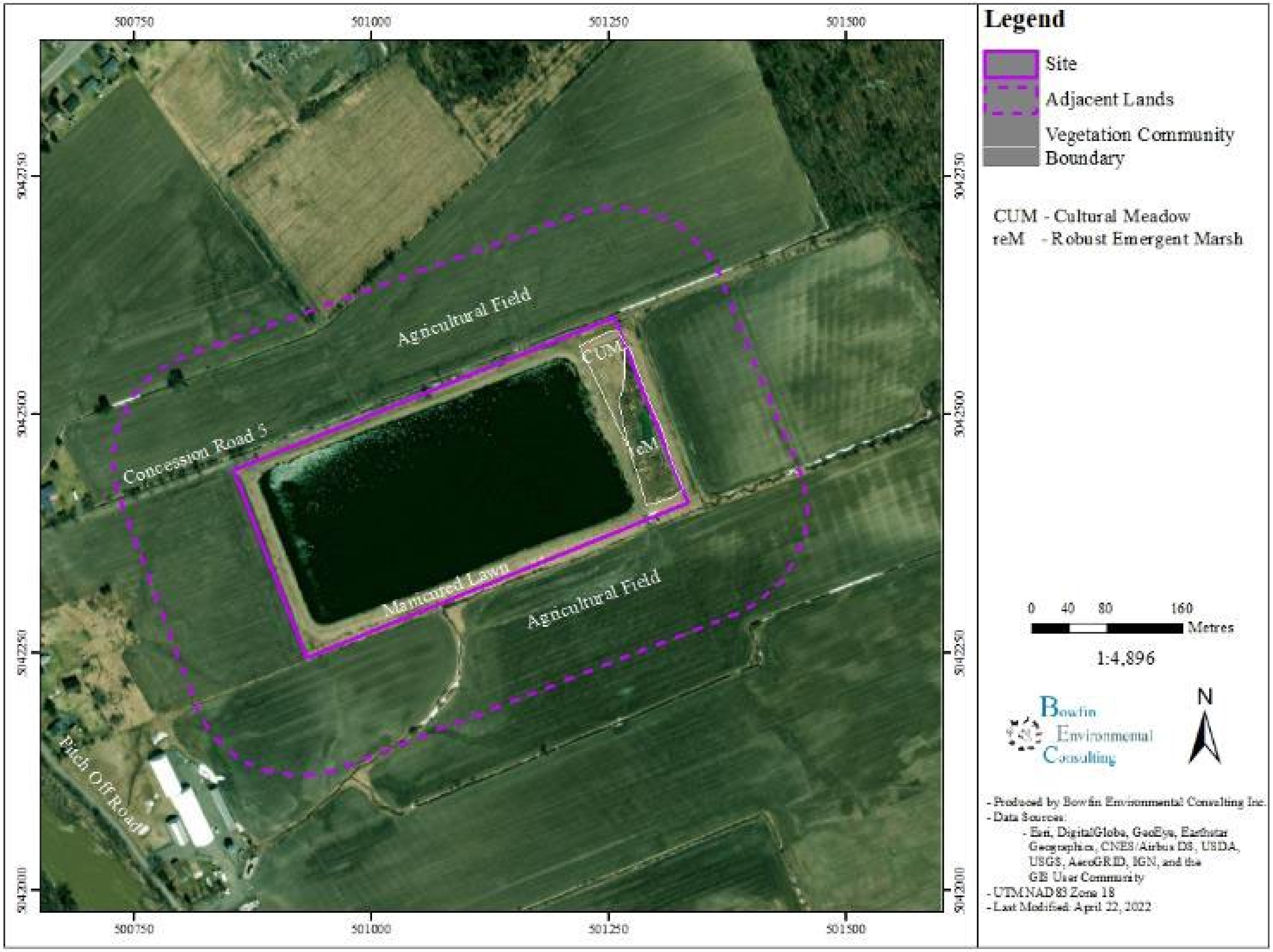
Photo 1: Looking west over the cultural meadow (November 24, 2021)

Robust Emergent Marsh

South of the cultural meadow described above; the elevation was slightly lower allowing for the vegetation to be dominated by wetland species. As per the OWES guidelines, habitats with more than 50% wetland vegetation are described as wetlands. This small wetland community (0.46 ha) was primarily composed of narrow-leaved-cattail and reed canary grass.

Photo 2: Looking north over the robust emergent marsh (November 24, 2021)

Figure 11: Vegetation Communities



Plant Species Discussion (including results from Butternut Inventory)

The plants observed were reviewed in terms of their provincial rank (SRank), presence of species of conservation value (provincial SRank of S1-S3 or listed as special concern), and species at risk (endangered or threatened provincially). Given the largely artificial nature of the site, many species had a provincial SRank of SNA indicating that they are not suitable for conservation activities (i.e., non-native species). All others were S4 or S5 signifying that the species recorded are apparently secure, uncommon but not rare (S4), secure, widespread, and abundant in the nation or province (S5).

While the work was completed outside of the green-leaf period, the butternut inventory was completed with a focus on finding larger individuals. These are readily distinguished from other trees and can be identified at any time of the year. No larger butternuts were found.

Table 4: Observed Plant Species

Species	Scientific Name	Coefficient of Conservatism	Srank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status
Manitoba Maple	*Acer negundo*	0	S5	none	none
Poison-ivy	*Rhus radicans*	5	S5	none	none
Staghorn Sumac	*Rhus hirta*	1	S5	none	none
Wild Parsnip	*Pastinaca sativa*		SNA	none	none
Common Milkweed	*Asclepias syriaca*	0	S5	none	none
Bull Thistle	*Cirsium vulgare*		SNA	none	none
Tall Goldenrod	*Solidago altissima*	1	S5	none	none
Cocklebur	*Xanthium strumarium*	2	S5	none	none
Speckled Alder	*Alnus incana*	6	S5	none	none
Red-osier Dogwood	*Cornus stolonifera*	2	S5	none	none
Green Ash	*Fraxinus pennsylvanica*	3	S4	none	none
Common Buckthorn	*Rhamnus cathartica*		SNA	none	none
Hawthorn sp.	*Crataegus sp.*			none	none
Largetooth Aspen	*Populus grandidentata*	5	S5	none	none
Common Mullein	*Verbascum thapsus*		SNA	none	none
American Elm	*Ulmus americana*	3	S4	none	none
Virginia Creeper	*Parthenocissus inserta*	3	S5	none	none
Smooth Brome	*Bromus inermis*		SNA	none	none
Reed Canary Grass	*Phalaris arundinacea*	0	S5	none	none
Narrow-leaved Cattail	*Typha angustifolia*	3	SNA	none	none

Status Updated June 17, 2022

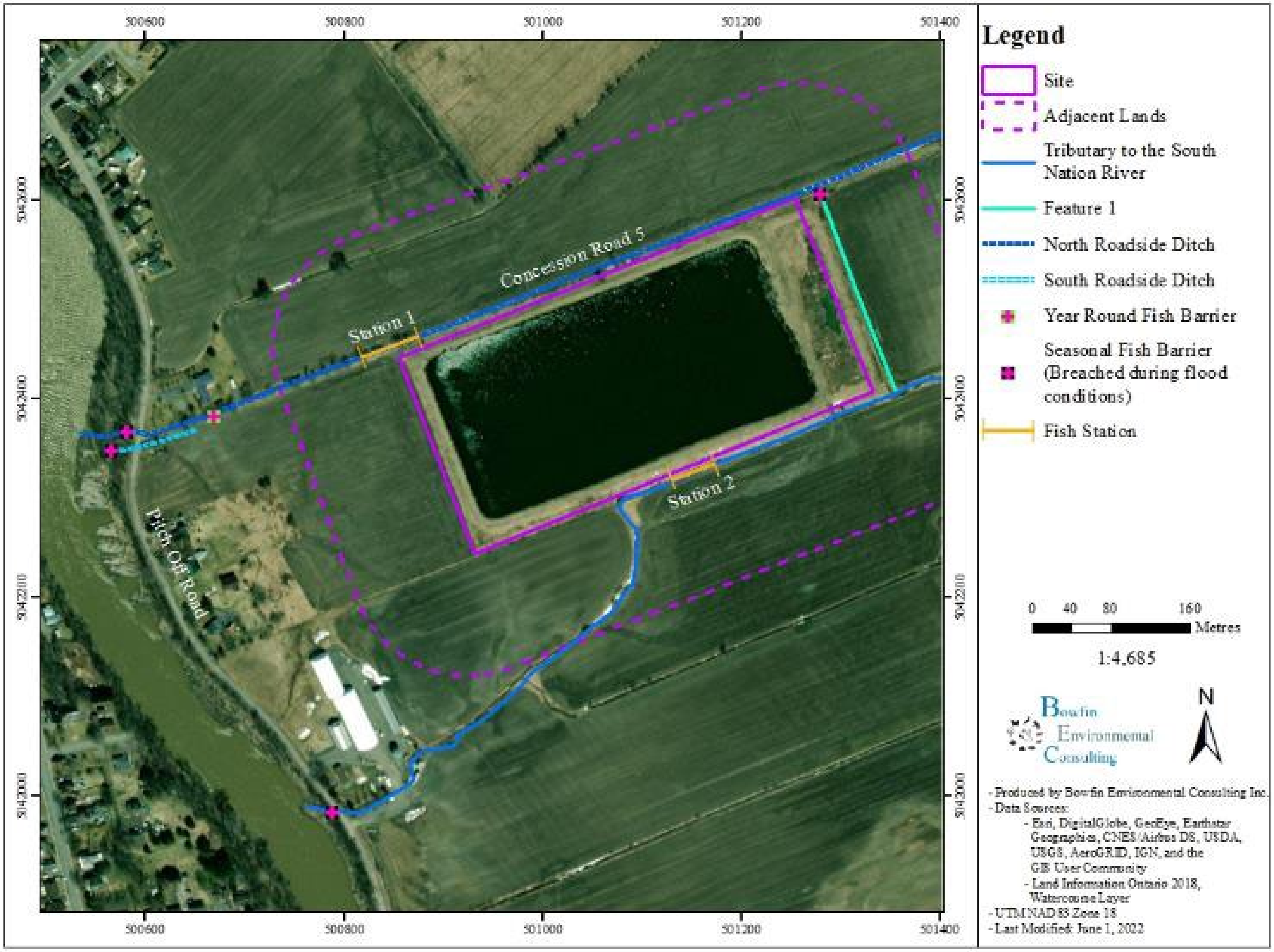
4.3 Incidentals

On November 24, 2021, several species were observed on or around the site. These species included a blue jay, American crow, and ~40 snow buntings in the adjacent lands, as well as several ground hog burrows on site.

4.4 Fish Habitat

As mentioned above, there were three features identified as potential fish habitat, the roadside ditches along Concession Road 5, the unnamed tributary to the South Nation River, and the branch labelled as Feature 1 (Figure 12). All areas were investigated from their downstream ends at Pitch Road, and along the project area during both the fall and spring visits. Two habitat and sampling stations were created; one on each watercourse (Station 1 was on the road ditch of Concession Road 5 and Station 2 was on the unnamed tributary to the South Nation River) (Figure 12).

Figure 12: Fish Stations



4.4.1 Concession Road 5 Road Ditches

The two road ditches along Concession Road 5 were investigated. The one on the south side of the road was only defined along the downstream 40 m upstream of Pitch Off Road (roughly 200 m from the existing site). This ditch was mowed in some areas and was poorly defined (shallow) near the site. Its flow crosses Pitch Off Road towards the South Nation River but is not well connected as it lacked a defined channel on the downstream end. However, fish could have access during periods of high flow/Spring freshet. With its short length, and poor connection, it is anticipated to offer only ephemeral habitat or none (it did not offer fish habitat during the April 29, 2022, visit).

Photo 3: Looking downstream at the south ditch from Concession 5 Road (April 29, 2022)

Photo 4: Culvert under Pitch Off Road for the flow coming from the south ditch (November 24, 2021)

Photo 5: Looking downstream at the absent south ditch in front of the site (November 24, 2021)

The north road ditch conveys the flow on the north side of Concession Road 5 towards the South Nation River via a culvert. The habitat was not well-connected, as it lacked a defined channel on the downstream end (downstream of the Pitch Road culvert) and flowed over bedrock nearer to the river (Photo 8 and Photo 6). Upstream of the Pitch Road culvert, the flow percolated through rip rap, travelling between the stones instead of over (Photo 10). Roughly 60 m upstream of Pitch Off Road, there was a step in the road ditch which would be a further barrier to fish movement (Photo 11). During the fall 2021 visit, the water depth was 7 cm, and the top of the step was 25 cm (Photo 11) Further upstream the ditch was typical of a road ditch and could provide fish habitat. However, based on the poor connection, barrier in the lower section (rip rap and step) and lack of fish in station 1 (see below), this channel is not considered to be direct fish habitat. This was further confirmed by electrofishing in the spring.

Photo 6: Connection of the north ditch and the river (April 29, 2022)

Photo 7: Close up where it passes over a section of bedrock (November 24, 2021)

Photo 8: Looking downstream from Pitch Road towards the river and the lack of defined channel of the north ditch (April 29, 2022)

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Photo 9: Looking upstream from the South Nation River at the culvert under Pitch Off Road Concession Road 5 north ditch and the lack of defined channel (April 29, 2022)

Photo 10: Looking upstream at the north road ditch along Concession Road 5 at the area that flow passes through rip rap (November 24, 2021)

Photo 11: Looking at the step (fish barrier) in the north road ditch of Concession Road 5 (November 24, 2021)

Photo 12: Looking downstream at the north ditch in front of the site (November 24, 2021)

Station 1 – North Road Ditch of Concession Road 5

On April 29, 2022, the north road ditch was electrofished over a 60 m adjacent to the site (Station 1). No fish were caught or observed. The average water depth for this station was 10 cm (1-18 cm) and the average wetted width was 1.1 m (1.0-1.4 m). The substrate was fines, and the habitat was a glide, there was some in stream cover provided by overhanging plants and small woody debris.

Photo 13: Looking at Station 1 in the north ditch (turbidity caused by sampling) (April 29, 2022) (date stamp was off)

4.4.2 Unnamed Tributary to South Nation River

As discussed in the background review above, this channel was estimated to begin 1.7 km upstream of the site, run along the south side of the site for roughly 0.3 km and then veer southwest reaching the South Nation River after another 0.5 km. The total length of the watercourse is estimated at 2.5 km. The portion of the watercourse closest to the Site, was a well-defined agricultural ditch running just on the opposite side of the page fence (assumed to be in the adjacent lands). One habitat description station was placed there (Station 2, see below). The potential for this tributary to provide direct fish habitat was verified from Pitch Off Road. There it was noted that there was a high drop (1.5 m) between the downstream end of the road culvert and the channel downstream. A review of information on flows and water levels from the South Nation Conservation's website notes that historical average levels would likely inundate the culvert during a few weeks in early spring (www.nation.on.ca/sites/default/files/Plantagenet%20HG%20Q%20PC.htm). As such, it is anticipated that fish from the South Nation River would have access to this road culvert and upstream habitat during high water periods. Since fish were captured at Station 2 (see below), this unnamed tributary has been confirmed to provide direct fish habitat.

Photo 14: Close up of the connection of Unnamed Tributary to South Nation River (November 24, 2021)

Photo 15: Connection of Unnamed Tributary to South Nation River (November 24, 2021)

Photo 16: Drop of 1.5 m below the culvert under Pitch Off Road (April 29, 2022)

Photo 17: Connection of Unnamed Tributary to South Nation River (yellow arrow) to road ditch on Pitch Off Road (April 29, 2022)

Station 2 -Tributary to South Nation River

The average channel width for this station was 1.5 m and the average bankfull depth 28 cm (range: 4-51 cm). On April 29, 2022, the wetted width was 1.0 m with an average water depth of 13 cm (range: 0-42 cm). The hydrological flow habitat consisted of glides and pools. Most of the substrate consisted of fines. In-water cover consisted of overhanging vegetation (goldenrods, reed canary grass, and wild parsnip), aquatic vegetation (algae), and small woody debris. Banks were slumping on the left bank[2] in several areas. The station had no canopy cover; however, it is noted that a section the watercourse downstream of the station was shaded by speckled alders. The banks were well vegetated along the entire station.

During the spring visit (April 29, 2022) the station was electroshocked over an area of approximately 40 m^2 for 366 seconds. A total of 32 fish were captured representing 3 species: fathead minnow, creek chub and brook stickleback (Table 5).

Table 5: Station 2 Fish Community

Common Name	Scientific Name	Number Caught (Size Range (mm))
Fathead Minnow	*Pimephales promelas*	1 (56)
Creek Chub	*Semotilus atromaculatus*	30 (32-136)
Brook Stickleback	*Culaea inconstans*	1 (38)
	Total	**32**

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[2] Left Bank: Defined by OSAP as the area to the left when looking upstream

Photo 18: Looking upstream from the downstream end of the station (April 29, 2022)

Photo 19: Looking downstream from the center of the station (April 29, 2022)

Feature 1 – Branch to Unnamed Tributary to South Nation River

There was also a short (roughly 215 m long), agricultural ditch running along the east side of the site connected to the unnamed tributary to South Nation. For this project, this ditch was called Feature 1. The origin of this ditch was near Concession Road 5, but in an area where the road ditch (south side) was poorly defined. During the visit (November 24, 2021), the channel was frozen (ice covered) for most of the ditch. But there was open water, near the downstream end close to the connection with the Unnamed Tributary to the South Nation River. The channel width was 1.9 m. The wetted width and maximum depths recorded in the ice-free area on November 24, 2021, were 22 cm, and 5 cm, respectively. During the April 29, 2022 site visit, it was noted that there was no defined channel through the dense reed canary grass. The lower (4 m) was possible fish habitat, but upstream of that the water was restricted to the surface. There was sediment deposition at the mouth of the channel. The wetted width and depths of the lower section on April 29, 2022, was 0.4 m and 4 cm, respectively.

Photo 20: Sediment deposition at the mouth (April 29, 2022)

Photo 21: Lower channel (April 29, 2022)

Photo 22: Water restricted to under reed canary grass (April 29, 2022)

Photo 23: Looking downstream at Feature 1 from Concession Road 5 (November 24, 2021)

5.0 ANALYSIS OF POTENTIAL TO IMPACT THE NATURAL FEATURES

5.1 Review of Findings and Project Activities

The following section looks at the identified or potential natural features and the results from the background review and field investigations to assess whether the feature is present and if present, whether it is significant based on the *Natural Heritage Reference Manual* (OMNR, 2010).

As mentioned above, the background and field investigations found that the following list of natural heritage features were not present in or within 120 m of the site:

- PSWs
- significant valleyland
- ANSIs
- Woodlands

Features identified as present or that required further investigations or discussion were:

- Endangered and Threatened species/habitats
- Significant Wildlife Habitat
- Fish habitat

Below is a summary of the impact assessment methods. This is followed by an evaluation of the natural features and list of mitigation measures. Note that the mitigation measures must be read in its entirety, as some apply to more than one type of natural habitat.

5.2 Project Activities and Impact Assessment Methods

It is important to note that the assessment is being completed without information on the alternatives. As such, this must be considered preliminary and is based on the following assumptions:

- Most project related works would be restricted to the property boundary of the existing treatment facility
- Those alternatives outside of the existing property would be limited to in the roadway or road allowance for Concession Road 5.
- No work, activity or undertaking within 30 m of the South Nation River.

It is also anticipated that the activities below may take place, all within the property or within 5 m of the Concession Road 5 road shoulder. Again, it is noted that this analysis is preliminary at this time, until more information on the area, timing, duration, and methods of construction are known.

- Clearing of terrestrial vegetation
- Excavation
- Completion of upgrades
- Possible realignment of some road ditches or unnamed tributary to South Nation River
- Backfilling

The significance of the potential impacts is measured using four different criteria:

1. Area affected may be:
    a. local in extent signifying that the impacts will be localized within the project area
    b. regional signifying that the impacts may extend beyond the immediate project area.

2. Nature of Impact:
    a. negative or positive
    b. direct or indirect

3. Duration of the impact may be rated as:
    a. short term (construction phase, 1 years)

   b. medium term (> 1 years)
   c. long term (>7 years).
   d. permanent

4. Magnitude of the impact may be:
   a. negligible signifying that the impact is not noticeable
   b. minor signifying that the project's impacts are perceivable and require mitigation
   c. moderate signifying that the project's impacts are perceivable and require mitigation as well as monitoring and/or compensation
   d. major signifying that the project's impacts would destroy the environmental component within the project area.

Where identified, the boundaries of any significant features are noted and the potential for the development to cause negative impacts is assessed. For those features which may be negatively impacted, mitigation measures and where appropriate compensation measures are recommended.

5.3 Evaluation of Potential Impacts

Note that this is a preliminary evaluation based on assumptions available at the time of writing.

5.3.1 Endangered and Threatened Species

Terrestrial and wetland Endangered and Threatened Species at Risk, on private land, are protected under provincial *Endangered Species Act*. It is noted that bird species protected under the *Species at Risk Act* (SARA) are protected by the *Migratory Bird Convention Act* (MBCA) on private lands. Within this report, the acronym SAR refers to only Endangered or Threatened species. Special Concern species do not receive protection from ESA or SARA.

A list of potential SAR was compiled using various sources and identified up to roughly 5 km from the Site. The resulting list includes 15 potential SAR: 1 insect (gypsy cuckoo bumble bee), 3 fish (lake sturgeon, American eel, and channel darter), 6 birds (eastern whip-poor-will, chimney swift, bank swallow, barn swallow, bobolink, and eastern meadowlark), 4 mammals (little brown myotis, northern myotis, eastern small-footed myotis, and the tri-colored bat), and 1 plant (butternut) (Table 6). Of these, many were determined not to be present or had no triggers for review based on guidance from the province. Table 6 notes the relevant provincial guidelines and triggers and indicates whether the species is brought forward for discussion.

Table 6: Summary of Potential Endangered and Threatened Species

Common Name/ Population	Scientific Name	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Preferred Habitat	Reference	Provincial Guidelines/Triggers for Review	Brought Forward (Yes/No)
INSECT								
Gypsy Cuckoo Bumble Bee	*Bombus bohemicus*	SU	END	END	Occurs in diverse habitats, including open meadows, mixed farmlands, urban areas, boreal forest, and montane meadows. Host nests occur in abandoned underground rodent burrows and rotten logs.	COSEWIC 2014a	COSSARO reports no Ontario records since 1990	No
FISH								
Lake Sturgeon	*Acipenser fulvescens*	S2	THR	No Status	Bottoms of lakes and large rivers. Adults are typically found in highly productive shoal areas of large rivers and large lakes.	COSEWIC 2017	The watercourse near the site is not suitable habitat for this species.	No
American Eel	*Anguilla rostrata*	S1?	END	No Status	Near cover over muddy bottoms in lakes, ponds, rivers, and creeks at depths <15 m.	COSEWIC 2012	The watercourse near the site is not suitable habitat for this species.	No
Channel Darter	*Percina copelandi*	S2	SC	SC	Pools and the edges of riffles of small to medium rivers over sand and gravel substrate. Prefers sand or gravel beach habitat within lakes and pool or riffle areas within creeks.	COSEWIC 2016	The watercourse near the site is not suitable habitat for this species.	No
BIRDS								
Eastern Whip-poor-will	*Antrostomus vociferus*	S4B	THR	THR	Rock or sand barrens with scattered trees, savannahs, old burns, or other disturbed sites in a state of early to mid-	COSEWIC 2009	The nearest woodlands are within 500 m of this site.	Yes

Common Name/ Population	Scientific Name	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Preferred Habitat	Reference	Provincial Guidelines/Triggers for Review	Brought Forward (Yes/No)
					forest succession, or open conifer plantations.			
Chimney Swift	*Chaetura pelagica*	S4B, S4N	THR	THR	Cities, towns, villages, rural, and wooded areas. When selecting trees, they prefer those that are >50 cm in diameter and that are within 1 km of waterbodies.	COSEWIC 2018	No large trees on site, no structures will be impacted by the project.	No
Bank Swallow	*Riparia riparia*	S4B	THR	THR	This species nests within vertical banks, with a preference for sand-silt substrate. Nesting sites may be near open upland habitats.	COSEWIC 2013	No vertical banks suitable for this species are present in or within 5 m. Potential to impact Category 3 habitat but this species forages above and impacts to Category 3 habitat does not need to be reviewed by MECP (Category 1 habitat are the nests; Category 2 habitat are 5 m around the nests; Category 3 habitat is within 500 m of a nest)	No
Barn Swallow	*Hirundo rustica*	S4B	THR	THR	Open or semi-open lands: farms, field, marshes.	COSEWIC 2011a	No structures will be impacted. Potential to impact Category 3 habitat but this species forages above and impacts to Category 3 habitat does not need to be reviewed by MECP (Category 1 habitat are the nests; Category 2 habitat are 5 m around	No

Common Name/ Population	Scientific Name	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Preferred Habitat	Reference	Provincial Guidelines/Triggers for Review	Brought Forward (Yes/No)
							the nests; Category 3 habitat is within 200 m of a nest)	
Bobolink	*Dolichonyx oryzivorus*	S4B	THR	THR	Primarily in forage crops, and grassland habitat.	COSEWIC 2010	Adjacent fields are active agricultural row crop and currently planted. These species do not provide grassland habitat. Further, active farmland is exempt from ESA. General mitigation measures have been included to avoid impacts should the land use change.	Yes
Eastern Meadowlark	*Sturnella magna*	S4B	THR	THR	Fields, meadows, and prairies.	COSEWIC 2011b	Adjacent fields are active farmland and currently planted. These species do not provide grassland habitat. Further, active farmland is exempt from ESA. General mitigation measures have been included to avoid impacts should the land use change.	Yes
MAMMALS								
Little Brown Myotis	*Myotis lucifugus*	S4	END	END	Buildings, attics, roof crevices and loose bark on trees or under bridges. Always roost near waterbodies.	Eder 2002	MECP recommends the use of avoidance timing window for clearing of trees (>10 cm in diameter) if this can be accomplished then no impacts.	Yes
Northern Myotis/Northern Long-eared Bat	*Myotis septentrionalis*	S3	END	END	Older (late successional or primary forests) with large interior habitat.	Menzel et al. 2002, Broders et al. 2006,		

Common Name/ Population	Scientific Name	SRank	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status	Preferred Habitat	Reference	Provincial Guidelines/Triggers for Review	Brought Forward (Yes/No)
						SWH 6E Ecoregion Criterion Schedule		
Eastern Small-footed Myotis	*Myotis leibii*	S2S3	END	No Status	Found within deciduous or coniferous forests in hilly areas.	Eder 2002		
Tri-colored Bat	*Perimyotis subflavus*	S3?	END	END	Prefers shrub habitat or open woodland near water.	Eder 2002		
PLANTS								
Butternut	*Juglans cinerea*	S3?	END	END	Variety of sites, grows best on well-drained fertile soils in shallow valleys and on gradual slopes	COSEWIC 2017	Inventory for larger individuals completed in 2021 and none found. Potential for smaller individuals remains. Inventories have a 2-year shelf-life.	Yes

Status updated: March 7, 2022

SRANK DEFINITIONS

S1 Critically Imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

S3	Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	Apparently Secure; uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	Secure; Common, widespread, and abundant in the nation or state/province.
?	Inexact Numeric Rank—Denotes inexact numeric rank
SNA	Not Applicable, A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#B	Breeding

S#N	Non-Breeding

SARA STATUS DEFINITIONS

END	Endangered: a wildlife species facing imminent extirpation or extinction.
THR	Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

SARO STATUS DEFINITIONS

END	Endangered: A species facing imminent extinction or extirpation in Ontario which is a candidate for regulation under Ontario's ESA.
THR	Threatened: A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed.

Birds

Eastern Whip-poor-will

The whip-poor-will is a well camouflaged species can be found in a multitude of forest types. Its requirements consist of areas that are semi-open forests or sites with a closed forest intermixed with other open habitats. It also needs some areas with little ground cover. Its minimum habitat size requirement is 9 ha (COSEWIC, 2009b). The G*eneral Habitat Description for Eastern Whip-poor-will* (MNRF on-line document) indicates that the protected habitat for this species includes three categories:

Category 1	known nests and 20 m of the nest
Category 2	the area between 20 m and 170 m from the nest or the approximate centre of the defended territory
Category 3	the area of suitable habitat between 170 m and 500 m of the nest or approximate centre of the defended territory

The existing facility is 280 m from the nearest woodland. Based on the above, this would restrict the potential habitat to Category 3 habitat. There are no documented occurrences within the general area on iNaturalist. The NHIC data shows the nearest documented occurrences to be 8 km to the east. Our experience in the area is that the occurrence of this species in UCPR is sporadic, and most consistent in the Limoges area.

Next Steps

The potential use of the adjacent forests could be explored with Eastern Whip-poor-will surveys. These are completed in the spring between May 18-June 30. However, the need to complete these surveys and the survey points, would be best established once the alternatives are chosen. Given that the adjacent lands are active crop lands, work within Category 3 habitat can avoid impacts by avoiding clearing of vegetation during the breeding period (May 1-July 31).

Bobolink

This species is grassland-breeding-bird requiring a minimum of 4 ha of uncut meadow or field (McCracken, 2013). The *Bobolink* General *Habitat Description* (OMNRF, 2018c) indicates that the protected habitat for this species includes three categories:

Category 1	known nests and 10 m of the nest
Category 2	the area between 10 m and 60 m from the nest or the approximate centre of the defended territory
Category 3	the area of continuous suitable habitat between 60 m and 300 m of the nest or approximate centre of the defended territory

The agricultural fields were all planted in corn or soy (not suitable for grassland species). MECP has advised that for as long as a field is under active agricultural use, there is no protected habitat for this species. This even applies to fields planted in cereal or hay (grasslands). However, should the field be left fallow, and used for nesting, then it will become protected. At this time, the adjacent hayfields are not protected habitat and as such there is no Category 1-3 habitat. That said, the individual birds are protected (under ESA) and their nests (under the *Migratory Bird Convention Act* (MVCA)). Should the fields be planted in hay or a cereal crop at the time of the work activities, then avoidance measures should be applied to minimize disturbances to this birds during their breeding bird period. These are provided below.

Eastern Meadowlark

Like the bobolink, this species is grassland-breeding-bird requiring a minimum of 4 ha of uncut meadow or field (McCracken, 2013). The *general Habitat Description for the Eastern Meadowlark* (OMNRF, 2018d) indicates that the protected habitat for this species includes three categories:

Category 1	known nests and 10 m of the nest
Category 2	the area between 10 m and 100 m from the nest or the approximate centre of the defended territory
Category 3	the area of continuous suitable habitat between 100 m and 300 m of the nest or approximate centre of the defended territory

The agricultural fields were all planted in corn or soy (not suitable for grassland species). MECP has advised that for as long as a field is under active agricultural use, there is no protected habitat for this species. This even applies to fields planted in cereal or hay (grasslands). However, should the field be left fallow, and used for nesting, then it will become protected. At this time, the adjacent hayfields are not protected habitat and as such there is no Category 1-3 habitat. That said, the individual birds are protected (under ESA) and their nests (under the *Migratory Bird Convention Act* (MVCA)). Should the fields be planted in hay or a cereal crop at the time of the work activities, then avoidance measures should be applied to minimize disturbances to this birds during their breeding bird period. These are provided below.

Bats

The potential SAR bats within the general area are little brown myotis, northern myotis, eastern small-footed myotis and tri-colored. There are three types of habitats required by bats: hibernation, maternity sites, and day-roost sites. The latter is not considered critical habitat.

These four bat species prefer to hibernate in caves or mines. They can hibernate in buildings but that is rare for these species (COSEWIC, 2013a). No caves or mines were present.

The recovery strategy for the eastern small-footed myotis indicates that the preferred maternity habitat of this species consists of open rock habitats and that it rarely uses old buildings as roosting/maternity sites (Humphrey, 2017). There was no rocky habitat present and no buildings within the study area will be impacted. Based on this information, this species' maternity sites are considered absent.

The Atlas of Mammals of Ontario (Dobbyn, 1994) suggests that the tri-colored bat is not present within this part of Ontario however, the NatureServe mapping in the COSSARO (2015) includes all southeastern Ontario. Based on this information, this species is considered to have a very low potential of occurring.

The northern myotis tends to prefer larger expanses of older forests (late successional or primary forests) and choose maternity sites in snags that are in the mid-stage of decay. They prefer habitat with intact interior habitat and is shown to be negatively correlated with edge habitat (Menzel et al., 2002; Broders et al., 2006; Yates et al., 2006; OMNRF, 2015a). There were no woodlands. As such, the preferred habitat was not present.

The little brown myotis is one of the few bat species that can use anthropogenic structures as maternity sites. Potential suitable structures can include buildings, bridges, barns, and bat boxes. The little brown myotis can also use tall, large cavity trees that are in the early to mid-stages of decay as maternity roosts, as well as loose/raised tree bark, and/or crevices in cliffs (ECCC, 2018). This bat species occurs in higher densities in mature deciduous and/or mixed forests due to increased opportunities for large snags. However, unlike the northern myotis, the little brown myotis does not exclusively require mature forest stands in order to find appropriate maternity roosts (COSEWIC, 2013a). There were several buildings within the adjacent lands, however, these will not be impacted by the potential project. This species' maternity sites are considered absent in the area of impact for this project (there are no woodlands being impacted).

There remains potential for bats to use individual trees (≥10 cm in diameter at breast height) in the adjacent lands for day-roosting. Day-roosts are not considered critical habitat and impacts to the bats can be minimized by removing the trees outside of the day-use period. Mitigation measures will be included in Section 6.0.

Vascular Plants

Butternut

Butternut is listed as an endangered species federally signifying that it is at risk of becoming Extinct or Extirpated in Ontario and in Canada. Butternut is a shade intolerant species that is often found along edge habitats on rich, moist, well-drained loams or well-drained gravels (COESWIC, 2003). The butternut is threatened by a canker for which there is no known control (COESWIC, 2003).

Butternuts are assessed based on the amount of canker (the disease which is killing the species), their size and health, as per the BHA protocol. This method classes the individual trees as one of three categories:

> Category 1 are those that are heavily infected to the point that they are not expected to survive.
> Category 2 may have some canker but are still considered healthy.
> Category 3 are the same as Category 2, but these are larger individuals situated near heavily cankered trees and province believes that some may be showing immunity to the disease.

A butternut inventory was conducted during the leaf-off period. As such, it was restricted to looking for larger individuals that can be easily observed and identified by twigs. None were found in or within 50 m of the site.

Next Steps
A survey will need to be repeated prior to clearing vegetation. Note that Butternut inventories are good for 2-years.

SAR Mitigation Measures

General:

- Endangered and threatened species are protected and cannot be harmed, harassed, or killed and in some cases their habitats are also protected. These individuals will only be handled by qualified person and only if the individual is in imminent threat of harm. An authorization under the ESA 2007 would be required to handle individuals that are not in imminent threat of harm.
- If a SAR enters the work area during the construction period, any work that may harm the individual is to stop immediately and the supervisor will be contacted. No work will continue until the individual has left the area.
- Should an individual be harmed or killed then work will stop, and the Ministry of Environment, Conservation and Parks (MECP) will be contacted immediately.
- Educate staff and contractors on the potential for SAR to be in the area and their significance.
- Mitigation measures listed elsewhere in this report are also applicable to this section.

SAR Birds: It is anticipated that the work will take place on the existing property or within 5 m of the existing road. There was very little natural vegetation in these areas. The current agricultural crops are row (corn and soy) and not suitable for the potential SAR birds for the area.

- Provided that fields are under active agricultural uses, then there is no protected grassland breeding bird habitat (as per communications with MECP). If fields on-site become fallow during the breeding bird season, then additional monitoring and/or registration of habitat may be required.
- Should the agricultural fields be planted in hay or cereal crops, then the grassland breeding bird window will need to be applied. This would signify that no clearing of vegetation could take place between May 1 and July 31 unless appropriate grassland breeding bird surveys are used to confirm absence. Note that timing windows for bird species in general are included further below as are those for bats (both of these are more restrictive).
- Potential for Eastern Whip-poor-will to use the woodlands 280 m to the east. As such, site is within Category 3 Habitat. The adjacent lands are cropped. Provided this use continues, then impacts to this species could be avoided by not clearing any vegetation during the breeding period (May 1 to July 31) and by restricting work activities to daytime during this period.
- No impacts to federal SAR bird nests, or their eggs is permitted under the federal *Species at Risk Act*. If a federally listed bird species at risk nest is encountered, then work must stop until the young have fledged. If the nest/young have been harmed, then Environment Canada must be notified immediately for guidance.
- No impacts to provincial SAR bird nests or their eggs is permitted under the provincial *Endangered Species Act*. If a provincially listed bird species at risk is encountered, then work must stop and MECP contacted (sarontario@ontario.ca).
- Should a nest be discovered, stop all work that may disturb the birds (i.e., that cause the adults to fly off the nest) and contact a biologist or MECP or Environment Canada, as appropriate for the species.

Area	**Nature**	**Duration**	**Magnitude**
Local	Negative Direct	Temporary (removal of vegetation along road shoulder)	Unlikely to occur do to existing land practices. Timing constraint (no clearing or nighttime activities between May 1 and July 31) **must** be adhered without further work.
	Indirect	Noise and light during construction	

Bats: It is anticipated that the work will take place in the existing property or within 5 m of the Concession 5 Road. There was very little natural vegetation along this side of the street and the first section, north of the houses, was mowed. There were no trees on site that were large enough to support even day-roosting. The potential to impact SAR bats would be restricted to day-roosts. Recent discussions with MECP on these species indicate that they do not need to be approached if the timing window below can be adhered to.

- Educate contractors by informing them that most bats in Ontario are protected.
- **Remove all trees 10 cm in diameter or larger (in the fencerows or forest) between October 1 and March 31 (Bat active season is currently assumed to be April 1 to September 30).** If this is not possible, conduct exit survey prior to cutting them down. If the exit survey identifies bats, contact MECP or biologist for additional guidance.

Area	Nature	Duration	Magnitude
At this time, no trees (larger than 10 cm in diameter at breast height are anticipated to be impacted)			

Plants: No SAR (Endangered or threatened) were present in or within the portion of the lands that could be observed at this time of year.

Avoidance/Mitigation Measures for Butternuts:

- Butternut inventory must be completed prior to the removal of vegetation from any area during the appropriate time of year (typically May 15-August 31 but can be affected by frosts).
- Should butternuts be identified then these will need to be assessed and the appropriate actions taken.

5.3.2 Fish Habitat

The candidate fish habitat were the road ditches on Concession Road 5, the unnamed tributary to South Nation River, and the Feature 1. As noted above, the road ditches and Feature 1 did not provide direct fish habitat. The unnamed tributary to South Nation River provided direct fish habitat (Figure 13). Based on these findings, no work below the high-water mark can take place on the Unnamed tributary to the South Nation River without a review by Fisheries and Oceans Canada (DFO). DFO is responsible for the *Fisheries Act* in which the most relevant sections to works, undertakings and activities are:

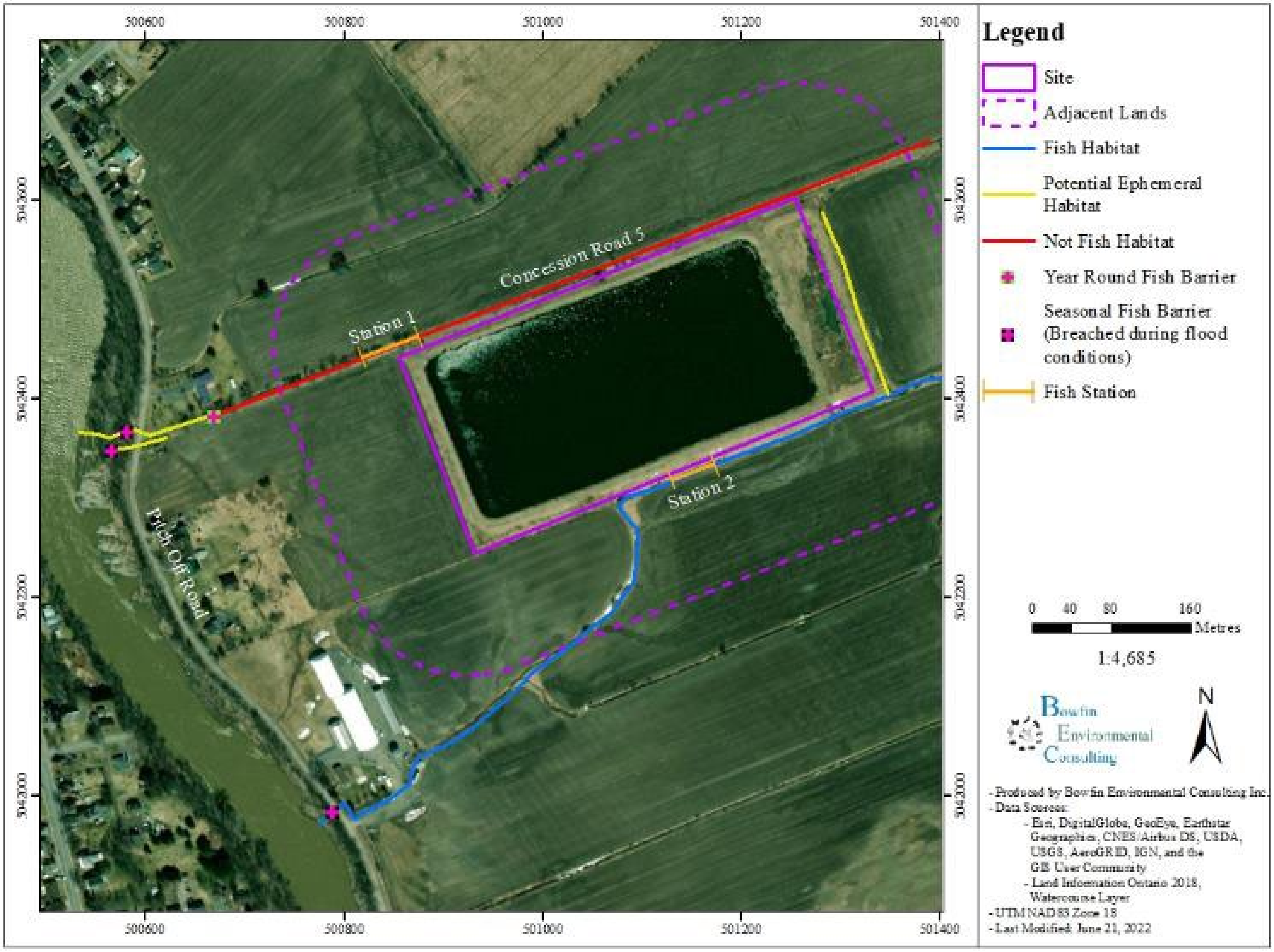
- Prohibition of the Death of Fish (Section 34.4);
- Prohibition of the Harmful alteration, disruption, or destruction of Fish Habitat (Section 35);
- Provision for Ministerial powers to ensure the free passage of fish or the protection of fish or fish habitat with respect to existing obstructions (Section 34.3).

With respect to the Official Plans in the area, no work can occur within 120 m of fish habitat with a review of potential impacts. The fish habitat is in the UCPR jurisdiction. That OP refers to the *Natural Heritage Manual* (MNRF, 2010) in which the minimum setback from warm-water is 15 m (provided there are no impacts) however, the minimum setback from the South Nation River would likely need to remain at 30 m.

Next Steps

Evaluate the alternatives for their potential to directly or indirectly impact fish habitat. This includes activities that affect the quality or quantity of water reaching fish habitat.

Figure 13: Fish Habitat



5.3.3 Other

The measures outlined above serve to protect the identified or potentially present natural features identified in the background review and/or site investigations. However, there are also some other items that should be mentioned.

1. Almost all birds in Ontario are protected by either MBCA or FWCA.
2. Most reptiles are protected by the FWCA.

Mitigation Measures:

- Almost all breeding birds are protected under the MBCA and/or FWCA. The only species not protected are: American crow, brown-headed cowbird, common grackle, house sparrow, red-winged blackbird, and starling. It is prohibited to destroy or disturb an active nest of other birds, or to take or handle nests, eggs, or nestlings. In this part of Ontario, the current standard nesting period is between **April 5 to August 28**. Outside of this timing window, it is considered unlikely that birds would be nesting. Note, there are some birds (birds of prey, herons etc.) that do begin nesting earlier in the year. It should also be noted, that if an active nest is present before or after the above dates that it is still protected. These dates only serve as a guideline.
- During construction, there is a potential for suitable habitat for ground nesting birds (i.e., killdeer) to be created. These include bare soil or gravel areas. Perform regular walks of the cleared areas looking for ground nesters. If any are present, the contact a biologist for guidance.
- Work during the daytime hours to prevent light disturbances.
- Ensure that all equipment have the appropriate mufflers to reduce noise disturbances.
- If a turtle nest is suspected, then flag a 10 m buffer to protect the nest. Contact MECP (for SAR) and MNRF (all other species).

5.3.4 Accidents and Malfunctions

Although the likelihood of accidents and malfunctions occurring would be minimized by following the mitigation measures outlined below, should accidents and/or malfunctions occur they have the possibility of presenting serious impacts and require consideration.

Maintenance on construction equipment such as refueling, oil changes or lubrication would only be permitted in designated area located at a minimum of 30 m from the natural areas to be retained. And in an area where erosion and sediment control measures and all precautions have been made to prevent oil, grease, antifreeze, or other materials from inadvertently entering the ground or the surface water flow.

Machinery should be cleaned prior to arriving on-site to prevent the potential spread of invasive species (i.e., mud and vegetation matter from other sites should be removed from machinery).

Emergency spill kits would be located on site. The crew would be fully trained on the use of clean-up materials in order to minimize impacts of any accidental spills. The area would be monitored for leakage and in the unlikely event of a minor spillage the project manager would halt the activity and corrective measures would be implemented. Any spills would be immediately reported to the Ministry of Environment, Conservation and Parks (MECP) Spills Action Centre (1800 268-6060).

5.3.5 Significant Wildlife Habitat

Wildlife habitat in Ontario is defined in the Provincial Policy Statement (PPS) as:

> *"Areas where plants, animals and other organized live and find adequate amounts of food, water, shelter, and space needed to sustain their populations. Specific wildlife habitat of concern may include areas where species concentrate at a vulnerable point in their annual or life cycle; and areas which are important to migratory or non-migratory species"*

The background review noted that there was no significant wildlife habitat in the Site however, the South Nation River has an identified Wildlife Travel Corridor associated with it which is within 105 m of the site. All other identified features are 2 km of more from the site.

Next Steps

Determine if any direct or indirect impacts to the Wildlife Travel Corridor associated with the South Nation River will be impacted. This will be dependent on the alternatives. Activities within the road allowance are not anticipated to impact the function of this habitat. Review the alternatives when available.

6.0 CONCLUSION

With the assumption that all work will be restricted to the property boundary or within 5 m of the existing Concession Road 5 road allowance and that no activity would occur within 30 m of the high water level of the South Nation River, then the potential impacts to the natural environment would be minimized. The alternatives would need to be assessed for their potential to impact:

- Endangered or Threatened Species or their habitats:
  - Candidate Category 3 Habitat for Eastern Whip-poor-will
    - No Clearing of vegetation between May 1 and July 31
  - Bobolink or Eastern Meadowlark – if the fields are abandoned or planted in hay, cereal crops
  - Confirm that no trees with a diameter of 10 cm or larger will be removed during bat active season (no removal between April 1 and September 30)

  - Confirmed absence of Butternuts (all ages) to be done during the green-leaf period.
- Fish Habitat of the Unnamed Tributary to South Nation River
- Wildlife Travel Corridor

The proposed alternative(s) should be reviewed based on the findings herein. If any impact (direct or indirect) may exceed the study area listed above, then a review of the information herein will need to be completed for that area. Further, advice with respect to species at risk is subject to change.

Finally, the avoidance and mitigation measures listed herein are preliminary and should be reviewed and adjusted as needed once the alternatives are known.

I trust that this report will meet your requirements. Should you have any questions or comments, please contact the undersigned.

Sincerely,

CIMA+

M Lavictoire

Michelle Lavictoire,
Senior Biologist / Senior Project Manager

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Appendix A: Background Information

Atlas of the Breeding Birds of Ontario

Squares: 18VR94, 18VR93, 18WR04, 18WR03

Common Name	Scientific Name	ABBO Category	SRANK	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status
Canada Goose	*Branta canadensis*	Probable	S5	no status	no status
Wood Duck	*Aix sponsa*	Confirmed	S5	no status	no status
American Wigeon	*Anas americana*	Probable	S4	no status	no status
American Black Duck	*Anas rubripes*	Confirmed	S4	no status	no status
Mallard	*Anas platyrhynchos*	Confirmed	S5	no status	no status
Northern Shoveler	*Anas clypeata*	Possible	S4	no status	no status
Northern Pintail	*Anas acuta*	Confirmed	S5	no status	no status
Green-winged Teal	*Anas crecca*	Possible	S4	no status	no status
Blue-winged Teal	*Anas discors*	Confirmed	S4	no status	no status
Ruddy Duck	*Oxyura jamaicensis*	Possible	S4B,S4N	no status	no status
Gray Partridge	*Perdix perdix*	Confirmed	SNA	no status	no status
Ruffed Grouse	*Bonasa umbellus*	Confirmed	S4	no status	no status
Wild Turkey	*Meleagris gallopava*	Confirmed	S5	no status	no status
Pied-billed Grebe	*Podilymbus podiceps*	Confirmed	S4B, S4N	no status	no status
American Bittern	*Botaurus lentiginosus*	Possible	S4B	no status	no status
Great Blue Heron	*Ardea herodias*	Possible	S4	no status	no status
Green Heron	*Butorides virescens*	Probable	S4B	no status	no status
Turkey Vulture	*Cathartes aura*	Confirmed	S5B	no status	no status
Osprey	*Pandion haliaetus*	Possible	S5B	no status	no status
Northern Harrier	*Circus cyaneus*	Confirmed	S4B	no status	no status
Sharp-shinned Hawk	*Accipiter striatus*	Confirmed	S5	no status	no status
Cooper's Hawk	*Accipiter cooperii*	Possible	S4	no status	no status
Red-shouldered Hawk	*Buteo lineatus*	Possible	S4B	no status	no status
Broad-winged Hawk	*Buteo platypterus*	Confirmed	S5B	no status	no status
Red-tailed Hawk	*Buteo jamaicensis*	Confirmed	S5	no status	no status
American Kestrel	*Falco sparverius*	Confirmed	S4	no status	no status
Merlin	*Falco columbarius*	Possible	S5B	no status	no status
Common Gallinule	*Gallinula galeata*	Confirmed	S4B	no status	no status
Sandhill Crane	*Grus canadensis*	Probable	S5B	no status	no status
Killdeer	*Charadrius vociferus*	Confirmed	S5B, S5N	no status	no status
Spotted Sandpiper	*Actitis macularia*	Confirmed	S5	no status	no status
Upland Sandpiper	*Bartramia longicauda*	Confirmed	S4B	no status	no status
Common Snipe	*Gallinago delicata*	Probable	S5B	no status	no status
American Woodcock	*Scolopax minor*	Probable	S4B	no status	no status
Wilson's Phalarope	*Phalaropus tricolor*	Confirmed	S3B	no status	no status
Black Tern	*Chlidonias niger*	Confirmed	S3B	SC	no status

Common Name	**Scientific Name**	**ABBO Category**	**SRANK**	**ESA Reg. 230/08 SARO List Status**	**SARA Schedule 1 List of Wildlife SAR Status**
Rock Pigeon	*Columba livia*	Confirmed	SNA	no status	no status
Mourning Dove	*Zenaida macroura*	Confirmed	S5	no status	no status
Black/Yellow-billed Cuckoo	*Coccyzus erythropthalmus/americanus*	Probable	S5B, S4B	no status	no status
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Confirmed	S5B	no status	no status
Eastern Screech-Owl	*Megascops asio*	Probable	S4	no status	no status
Great Horned Owl	*Bubo virginianus*	Confirmed	S4	no status	no status
Barred Owl	*Strix varia*	Possible	S5	no status	no status
Short-eared Owl	*Asio flammeus*	Probable	S2N, S4B	SC	SC
Northern Saw-whet Owl	*Aegolius acadicus*	Probable	S4	no status	no status
Whip-poor-will	*Caprimulgus vociferus*	Probable	S4B	THR	THR
Chimney Swift	*Chaetura pelagica*	Possible	S4B, S4N	THR	THR
Ruby-throated Hummingbird	*Archilochus colubris*	Probable	S5B	no status	no status
Belted Kingfisher	*Ceryle alcyon*	Confirmed	S4B	no status	no status
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Confirmed	S5B	no status	no status
Downy Woodpecker	*Picoides pubescens*	Confirmed	S5	no status	no status
Hairy Woodpecker	*Picoides villosus*	Confirmed	S5	no status	no status
Northern Flicker	*Colaptes auratus*	Confirmed	S4B	no status	no status
Pileated Woodpecker	*Dryocopus pileatus*	Confirmed	S5	no status	no status
Eastern Wood-Pewee	*Contopus virens*	Confirmed	S4B	SC	SC
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Possible	S5B	no status	no status
Alder Flycatcher	*Empidonax alnorum*	Probable	S5B	no status	no status
Willow Flycatcher	*Empidonax traillii*	Probable	S5B	no status	no status
Least Flycatcher	*Empidonax minimus*	Possible	S4B	no status	no status
Eastern Phoebe	*Sayornis phoebe*	Confirmed	S5B	no status	no status
Great Crested Flycatcher	*Myiarchus crinitus*	Confirmed	S4B	no status	no status
Eastern Kingbird	*Tyrannus*	Confirmed	S4B	no status	no status
Blue-headed Vireo	*Vireo solitarius*	Probable	S5B	no status	no status
Warbling Vireo	*Vireo gilvus*	Probable	S5B	no status	no status
Red-eyed Vireo	*Vireo olivaceus*	Probable	S5B	no status	no status
Blue Jay	*Cyanocitta cristata*	Confirmed	S5	no status	no status
American Crow	*Corvus brachyrhynchos*	Confirmed	S5B	no status	no status
Common Raven	*Corvus corax*	Confirmed	S5	no status	no status
Horned Lark	*Eremophila alpestris*	Confirmed	S5B	no status	no status
Purple Martin	*Progne subis*	Confirmed	S3S4B	no status	no status
Tree Swallow	*Tachycineta bicolor*	Confirmed	S4B	no status	no status
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Probable	S4B	no status	no status
Bank Swallow	*Riparia riparia*	Confirmed	S4B	THR	THR
Cliff Swallow	*Petrochelidon pyrrhonota*	Confirmed	S4B	no status	no status

Common Name	**Scientific Name**	**ABBO Category**	**SRANK**	**ESA Reg. 230/08 SARO List Status**	**SARA Schedule 1 List of Wildlife SAR Status**
Barn Swallow	*Hirundo rustica*	Confirmed	S4B	THR	THR
Black-capped Chickadee	*Poecile atricapilla*	Confirmed	S5	no status	no status
Red-breasted Nuthatch	*Sitta canadensis*	Confirmed	S5	no status	no status
White-breasted Nuthatch	*Sitta carolinensis*	Confirmed	S5	no status	no status
Brown Creeper	*Certhia familiaris*	Possible	S5B	no status	no status
House Wren	*Troglodytes aedon*	Confirmed	S5B	no status	no status
Winter Wren	*Troglodytes troglodytes*	Possible	S5B	no status	no status
Sedge Wren	*Cistothorus platensis*	Probable	S4B	no status	no status
Marsh Wren	*Cistothorus palustris*	Confirmed	S4B	no status	no status
Golden-crowned Kinglet	*Regulus satrapa*	Possible	S5B	no status	no status
Ruby-crowned Kinglet	*Regulus calendula*	Possible	S4B	no status	no status
Eastern Bluebird	*Sialia sialis*	Confirmed	S5B	no status	no status
Veery	*Catharus fuscescens*	Probable	S4B	no status	no status
Hermit Thrush	*Catharus guttatus*	Confirmed	S5B	no status	no status
Wood Thrush	*Hylocichla mustelina*	Probable	S4B	SC	THR
American Robin	*Turdus migratorius*	Confirmed	S5B	no status	no status
Gray Catbird	*Dumetella carolinensis*	Confirmed	S4B	no status	no status
Northern Mockingbird	*Mimus polyglottos*	Probable	S4	no status	no status
Brown Thrasher	*Toxostoma rufum*	Confirmed	S4B	no status	no status
European Starling	*Sturnus vulgaris*	Confirmed	SNA	no status	no status
Cedar Waxwing	*Bombycilla cedrorum*	Confirmed	S5B	no status	no status
Nashville Warbler	*Vermivora ruficapilla*	Confirmed	S5B	no status	no status
Yellow Warbler	*Dendroica petechia*	Confirmed	S5B	no status	no status
Chestnut-sided Warbler	*Dendroica pensylvanica*	Confirmed	S5B	no status	no status
Magnolia Warbler	*Dendroica magnolia*	Confirmed	S5B	no status	no status
Black-throated Blue Warbler	*Dendroica caerulescens*	Possible	S5B	no status	no status
Yellow-rumped Warbler	*Dendroica coronata*	Possible	S5B	no status	no status
Black-throated Green Warbler	*Dendroica virens*	Confirmed	S5B	no status	no status
Blackburnian Warbler	*Dendroica fusca*	Possible	S5B	no status	no status
Pine Warbler	*Dendroica pinus*	Possible	S5B	no status	no status
Black-and-white Warbler	*Mniotilta varia*	Confirmed	S5B	no status	no status
American Redstart	*Setophaga ruticilla*	Possible	S5B	no status	no status
Ovenbird	*Seiurus aurocapillus*	Confirmed	S4B	no status	no status
Northern Waterthrush	*Seiurus noveboracensis*	Confirmed	S5B	no status	no status
Mourning Warbler	*Oporornis philadelphia*	Confirmed	S4B	no status	no status
Common Yellowthroat	*Geothlypis trichas*	Confirmed	S5B	no status	no status
Canada Warbler	*Wilsonia canadensis*	Confirmed	S4B	SC	THR
Chipping Sparrow	*Spizella passerina*	Confirmed	S5B	no status	no status
Clay-colored Sparrow	*Spizella pallida*	Probable	S4B	no status	no status
Field Sparrow	*Spizella pusilla*	Possible	S4B	no status	no status

Common Name	Scientific Name	ABBO Category	SRANK	ESA Reg. 230/08 SARO List Status	SARA Schedule 1 List of Wildlife SAR Status
Vesper Sparrow	*Pooecetes gramineus*	Confirmed	S4B	no status	no status
Savannah Sparrow	*Passerculus sandwichensis*	Confirmed	S4B	no status	no status
Grasshopper Sparrow	*Ammodramus savannarum*	Confirmed	S4B	SC	no status
Song Sparrow	*Melospiza melodia*	Confirmed	S5B	no status	no status
Swamp Sparrow	*Melospiza georgiana*	Confirmed	S5B	no status	no status
White-throated Sparrow	*Zonotrichia albicollis*	Confirmed	S5B	no status	no status
Dark-eyed Junco	*Junco hyemalis*	Confirmed	S5B	no status	no status
Scarlet Tanager	*Piranga olivacea*	Probable	S4B	no status	no status
Northern Cardinal	*Cardinalis cardinalis*	Confirmed	S5	no status	no status
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Confirmed	S4B	no status	no status
Indigo Bunting	*Passerina cyanea*	Probable	S4B	no status	no status
Bobolink	*Dolichonyx oryzivorus*	Confirmed	S4B	THR	THR
Red-winged Blackbird	*Agelaius phoeniceus*	Confirmed	S4	no status	no status
Eastern Meadowlark	*Sturnella magna*	Confirmed	S4B	THR	THR
Common Grackle	*Quiscalus quiscula*	Confirmed	S5B	no status	no status
Brown-headed Cowbird	*Molothrus ater*	Confirmed	S4B	no status	no status
Baltimore Oriole	*Icterus galbula*	Confirmed	S4B	no status	no status
Purple Finch	*Carpodacus purpureus*	Probable	S4B	no status	no status
House Finch	*Carpodacus mexicanus*	Probable	SNA	no status	no status
American Goldfinch	*Carduelis tristis*	Confirmed	S5B	no status	no status
Evening Grosbeak	*Coccothraustes vespertinus*	Possible	S4B	SC	SC
House Sparrow	*Passer domesticus*	Confirmed	SNA	no status	no status

Status Updated March 25, 2021

SRANK DEFINITIONS

S4 Apparently Secure, Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 Secure, Common, widespread, and abundant in the nation or state/province.

SNA Not Applicable, A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

S#S# Range Rank, A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).

S#B Breeding

S#N Non-Breeding

SARO STATUS DEFINITIONS

THR Threatened: A species that is at risk of becoming endangered in Ontario if limiting factors are not reversed.

SC Special Concern: A species with characteristics that make it sensitive to human activities or natural events.

SARA STATUS DEFINITIONS

THR Threatened, a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

SC Special Concern, a wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats

Appendix B: SAR Hand-Out

The following table provides photographs and general descriptions of potential species at risk that may occur within the project area and information on what actions to take should any of these species be observed.

Endangered and Threatened species are protected and cannot be harmed, harassed, or killed and in some cases their habitats are also protected. These individuals will only be handled by qualified person and only if the individual is in imminent threat of harm. An authorization under the ESA 2007 would be required to handle individuals that are not in imminent threat of harm.

If a SAR enters the work area during the construction period, any work that may harm the individual is to stop immediately and the supervisor will be contacted. No work will continue until the individual has left the area.

Should an individual be harmed or killed then work will stop, and the Ministry of Environment, Conservation and Parks (MECP) will be contacted immediately.

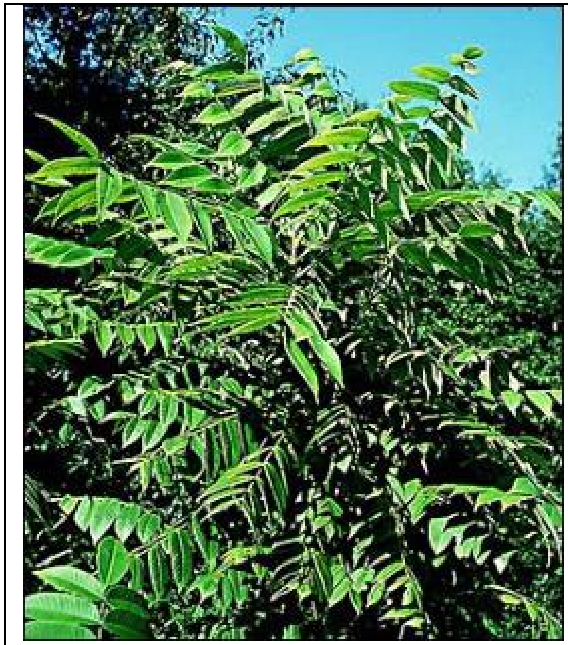
Educate staff and contractors on the potential for SAR to be in the area and their significance.

Mitigation measures listed elsewhere in this report are also applicable to this section.

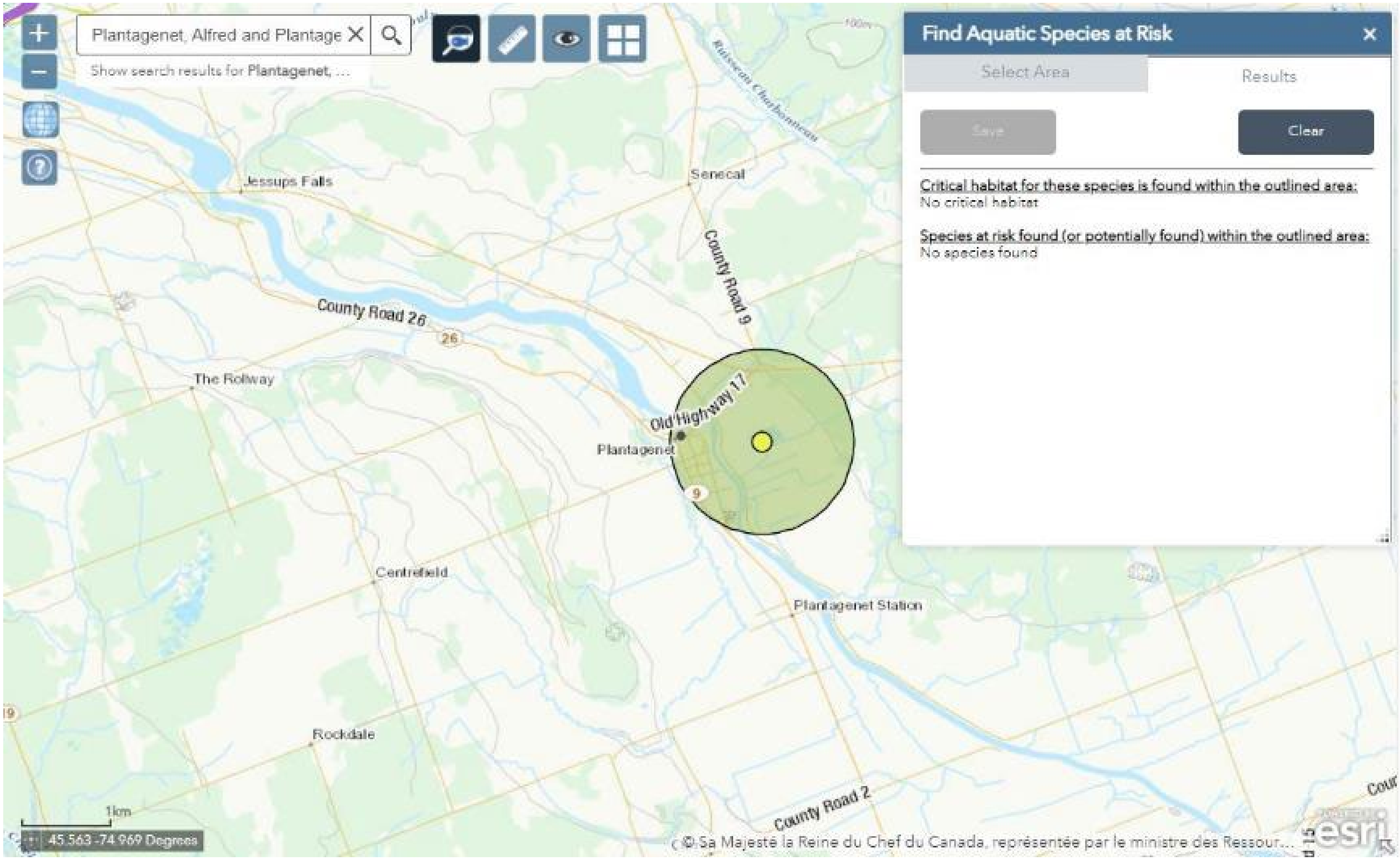
If a SAR is encountered, this information will be provided to the Natural Heritage Information Centre (Report rare species (animals and plants) | Ontario.ca)

Photograph	**Description**	**Action to be Taken**
 http://birdweb.org/Birdweb	**Barn Swallow** Swallow with a long tail which is deeply forked in adult males An orange front (no white on the forehead) Narrow pointed wings Juveniles have a white band across the top of the tail. THREATENED	Stop any activity that may cause harm to this specie and contact project Supervisor. Individuals should only be encouraged to move if it is in immediate harm's way. These animals can only be handled by a qualified biologist when it is in imminent threat of harm, otherwise an ESA 2007 authorization will be required.
 **Male**  **Female** Photo: Royal Ontario Museum Website http://www.rom.on.ca/	**Bobolink** Medium-sized songbird Female is tan with black stripes and resembles a sparrow Male is black with a white patch on the back and yellow patch on the side of his head **THREATENED**	Stop any activity that may cause harm to these species and contact project supervisor Individuals should only be encouraged to move if it is in immediate harm's way. These animals can only be handled by a qualified biologist when it is in imminent threat of harm, otherwise an ESA 2007 authorization will be required.

 https://www.macaulaylibrary.org/	**Eastern Whip-poor-will** Medium sized birds with large round heads and a generally front heavy appearance. Mottled brown colouration to blend in with tree bark, light coloured bib. Active at night, loud distinctive call that sounds like "whip-poor-will", often repeated continuously. **THREATENED**	Stop any activity that may cause harm to these species and contact project supervisor Individuals should only be encouraged to move if it is in immediate harm's way. These animals can only be handled by a qualified biologist when it is in imminent threat of harm, otherwise an ESA 2007 authorization will be required.

 http://www.rom.on.ca/ontario/risk.php?doc_type=fact&lang=&id=298	**Butternut** Medium sized tree with multiple leaflets. Similar to walnuts, but walnuts usually have a small or missing leaflet at the tip **ENDANGERED**	Note that none have been found on-site. If any are located, any construction activities within 50 m of an induvial to be retained shall be carried out carefully in order to ensure that no harm comes to the tree (i.e., no heavy machinery, no excavation or stockpiling within 50 m of the tree, no braking of branches, leaves).

Appendix C: DFO Aquatic Species at Risk Mapping (March 8, 2022)



Critical habitat for these species is found within the outlined area:
No critical habitat

Species at risk found (or potentially found) within the outlined area:
No species found

Appendix A7

Stage 1 Archaeological Assessment Study Report (ARA, 2022)

ARCHAEOLOGY | HERITAGE | OUTREACH | EDUCATION

DRAFT
Stage 1 Archaeological Assessment
Plantagenet Wastewater Class Environmental Assessment
Township of Alfred and Plantagenet
United Counties of Prescott and Russell
Part of Lots 5–8, Concessions 3–6 and Lots 9–11, Concession 4 Old Survey
Geographic Township of Plantagenet
Former Prescott County, Ontario

Prepared for
J.L. Richards & Associates Ltd.
864 Lady Ellen Place
Ottawa, ON K1Z 5M2
Tel: (613) 728-3571

Licensed under
P.J. Racher
MTCS Licence #P007
PIF #P007-1319-2022
ARA File #2021-0404

26/07/2022

Original Report

EXECUTIVE SUMMARY

Under a contract awarded in November 2021, Archaeological Research Associates Ltd. carried out a Stage 1 assessment of lands with the potential to be impacted by improvements to the Plantagenet wastewater system in the Township of Alfred and Plantagenet, United Counties of Prescott and Russell, Ontario. The project is considering the entire wastewater system, including the lagoon treatment system, two sewage pumping stations and the gravity collection system. The assessment was carried out as part of a Municipal Class Environmental Assessment in accordance with the *Environmental Assessment Act*. This report documents the background research and potential modelling involved in the investigation and presents conclusions and recommendations pertaining to archaeological concerns.

The Stage 1 assessment was conducted in May 2022 under Project Information Form #P007-1319-2022. The investigation encompassed the entire study area. All field observations were made from accessible public areas; accordingly, no permissions were required for property access. At the time of assessment, the study area comprised parts of various roadway platforms as well as adjacent ditches, grassed areas, treed areas and agricultural lands around the extant lagoon.

The Stage 1 assessment determined that the study area comprises a mixture of areas of archaeological potential and areas of no archaeological potential. Potential for deeply buried human remains and/or burial features was identified in front of the utilized portion of the St. Paul Roman Catholic Cemetery (CM-03474) in the southeastern part of the study area.

It is recommended that all areas of archaeological potential that could be impacted by the project be subject to a Stage 2 property assessment in accordance with Section 2.1 of the 2011 *Standards and Guidelines for Consultant Archaeologists* (*S&Gs*). A cemetery investigation must also be carried out in front of the St. Paul Roman Catholic Cemetery to determine whether any burial features extend beyond the property boundary. The cemetery investigation must be conducted in accordance with Section 3.3.3 and Section 4.2.3 of the 2011 *S&Gs*, and a Cemetery Investigation Authorization must be obtained from the Bereavement Authority of Ontario (BAO). The BAO will be provided with the report for their consideration and comment prior to submission to the Ministry of Tourism, Culture and Sport. If any in-water work is planned within the South Nation River, the Criteria for Evaluating Marine Archaeological Potential checklist should be consulted.

Since the potential always exists to miss important information in archaeological surveys; if any artifacts of Indigenous interest or human remains are encountered during construction, please contact: Algonquins of Ontario Consultation Office, 31 Riverside Drive, Suite 101, Pembroke, Ontario K8A 8R6, Tel: (613) 735-3759, Fax: (613) 735-6307, Email: algonquins@tanakiwin.com.

TABLE OF CONTENTS

IMAGES

MAPS

TABLES

ABBREVIATIONS

ARA – Archaeological Research Associates Ltd.
BAO – Bereavement Authority of Ontario
EA – Environmental Assessment
MTCS – Ministry of Tourism, Culture and Sport
PIF – Project Information Form
S&Gs – Standards and Guidelines for Consultant Archaeologists

PERSONNEL

Project Director: P.J. Racher (#P007)
Operations Manager: C.E. Gohm (#R187)
Project Archaeologists: S. Bolstridge (#R471), A. Dunlop (#P1146), M. Maika (#P1021)
Field Director: M. Maika
Cartographers: A. Bailey (#R1069), K. Brightwell (#R341)
Researcher: S. Clarke (#R446)
Report Writer: C.J. Gohm

1.0 PROJECT CONTEXT

1.1 Development Context

Under a contract awarded in November 2021, Archaeological Research Associates Ltd. (ARA) carried out a Stage 1 assessment of lands with the potential to be impacted by improvements to the Plantagenet wastewater system in the Township of Alfred and Plantagenet, United Counties of Prescott and Russell, Ontario. The project is considering the entire wastewater system, including the lagoon treatment system, two sewage pumping stations and the gravity collection system. The assessment was carried out as part of a Municipal Class Environmental Assessment (EA) in accordance with the *Environmental Assessment Act*. This report documents the background research and potential modelling involved in the investigation and presents conclusions and recommendations pertaining to archaeological concerns.

The study area consists of an irregularly-shaped parcel of land with an area of 65.44 ha (Map 1). This parcel is traversed by the South Nation River and is generally bounded by l'École secondaire catholique de Plantagenet to the north, wooded lands to the east, Concession Road 7 to the south and a mixture of wooded areas and residential properties to the west. In legal terms, the study area falls on parts of multiple lots and concessions in the Geographic Township of Plantagenet, former Prescott County. These include Lot 7, Concession 3; Lots 7–8, Concession 4; Lots 9–11, Concession 4 Old Survey; Lots 5 and 8, Concession 5; and Lots 6–7, Concession 6. These lands comprise part of the territory subject to Crawford's Purchases in 1783. They also fall within the proposed Algonquins of Ontario Settlement Area, which will resolve a land claim that was submitted to Canada in 1983 and Ontario in 1985 (Map 2). This claim includes a series of Algonquin petitions dating back as far as 1772. The Algonquins were not consulted about the Crawford's Purchases and are not signatory to the treaty.

The Stage 1 assessment was conducted in May 2022 under Project Information Form (PIF) #P007-1319-2022. The investigation encompassed the entire study area. All field observations were made from accessible public areas; accordingly, no permissions were required for property access. In compliance with the objectives set out in Section 1.0 of the 2011 *Standards and Guidelines for Consultant Archaeologists* (*S&G*s) this investigation was carried out in order to:

- Provide information concerning the geography, history and current land condition of the study area;
- Determine the presence of known archaeological sites in the study area;
- Present strategies to mitigate project impacts to such sites, if they are located;
- Evaluate in detail the archaeological potential of the study area; and
- Recommend appropriate strategies for Stage 2 archaeological assessment, if some or all of the study area has archaeological potential.

The Ministry of Tourism, Culture and Sport (MTCS) is asked to review the results and recommendations presented herein and enter the report into the Ontario Public Register of Archaeological Reports. ARA did not engage with any Indigenous groups over the course of the subject investigation, and it was indicated that engagement would be completed as part of the consultation work for the overall Class EA.

1.2 Historical Context

After a century of archaeological work in southern Ontario, scholarly understanding of the historical usage of the area has become very well-developed. With occupation beginning in the Late Palaeo-Indian period approximately 10,000 years ago, the greater vicinity of the study area comprises a complex chronology of Indigenous and Euro-Canadian histories. Section 1.2.1 summarizes the region's settlement history, whereas Section 1.2.2 documents the study area's past and present land uses. The summaries are intended to be succinct; the reader is encouraged to consult additional sources to gain a more fulsome understanding of Pre- and Post-Contact lifeways. Two previous archaeological reports containing relevant background information were obtained during the research component of the study. These reports are summarized in Section 1.3.3, and the references (including title, author and licence number) appear in Section 7.0.

1.2.1 Settlement History

1.2.1.1 Pre-Contact

The Pre-Contact history of the region is lengthy and rich, and a variety of Indigenous groups inhabited the landscape. Archaeologists generally divide this vibrant history into three main periods: Palaeo-Indian, Archaic and Woodland. Each of these periods comprise a range of discrete sub-periods characterized by identifiable trends in material culture and settlement patterns, which are used to interpret past lifeways. The general characteristics of these sub-periods are summarized in Table 1, and examples of archaeological sites with references are provided below.

Table 1: Pre-Contact Settlement History
(Wright 1972; Ellis and Ferris 1990; JHA 1993; Warrick 2000; ORHDC 2005; Munson and Jamieson 2013)

Sub-Period	Timeframe	Characteristics
Early Palaeo-Indian	9000–8400 BC	Small bands move into southern Ontario; Mobile hunters and gatherers; Utilization of seasonal resources and large territories; Gainey, Barnes and Crowfield traditions; Fluted points; Eastern Ontario was inundated by the Champlain Sea from about 10,000 to 8000 BC
Late Palaeo-Indian	8400–7500 BC	Holcombe, Hi-Lo and Lanceolate biface traditions; Continuing mobility; Campsite/Way-Station sites; Smaller territories are utilized; Non-fluted points; Mobile hunters/gatherers may have moved into the Ottawa Valley ca. 8000 BC
Early Archaic	7500–6000 BC	Side-notched, Corner-notched (Nettling, Thebes) and Bifurcate traditions; Gulf of Maine Archaic tradition sites are common; Growing diversity of stone tool types; Heavy woodworking tools appear (e.g., ground stone axes and chisels)
Middle Archaic	6000–2500 BC	Laurentian tradition; Reliance on local resources; Populations increasing; More ritual activities; Fully ground and polished tools; Net-sinkers common; Earliest copper tools; Inhabitants likely followed a seasonal round of hunting, fishing and gathering and engaged in long-distance trade for materials
Late Archaic	2500–900 BC	Narrow Point (Lamoka), Broad Point (Genesee) and Small Point (Crawford Knoll) traditions; Less mobility; Use of fish-weirs; True cemeteries appear; Stone pipes emerge; Long-distance trade (marine shells and galena)
Early Woodland	900–400 BC	Meadowood tradition; Crude cord-roughened ceramics emerge; Meadowood cache blades and side-notched points; Bands of up to 35 people; Middlesex tradition attested late in the period within the St. Lawrence and Ottawa Valleys; Represented primarily by mortuary contexts; Assemblages characterized by blocked-end tubes of ground and polished stone and a variety of large, bifacially worked items (e.g., long leaf-shaped blades, long stemmed blades, etc.)

Sub-Period	Timeframe	Characteristics
Middle Woodland	400 BC–AD 600	Point Peninsula tradition; Vinette 2 ceramics appear; Small camp sites and seasonal village sites; Influences from northern Ontario and Hopewell area to the south; Hopewellian influence can be seen in continued use of burial mounds
Middle/Late Woodland Transition	AD 600–900	Gradual transition between Point Peninsula and later traditions; Princess Point tradition emerges elsewhere (i.e., in the vicinity of the Grand and Credit Rivers)
Late Woodland	AD 900–1600	Area occupied by Algonquian-speaking peoples; Traditions in this region developed alongside those of the Iroquoian-speaking Huron-Petun of southern Ontario; Ceramic styles predominantly derived from the south, but also influences from Lake Superior; Adopted smoking pipes and ossuary burials from the Huron-Petun, but tool traditions and houses were dissimilar; Engaged in frequent dog burials; Practised corn horticulture in a partial way; St. Lawrence Iroquoian and Haudenosaunee presence must also be considered; This area often fell under shared usage due to overlapping territories

During the earlier sub-periods, much of eastern Ontario was characterized by glacial lakes and/or inland seas that resulted in high-water levels that have left a sequence of relict shorelines. Archaeological sites associated with these physiographic features are often located far inland from modern shorelines; they are therefore of critical importance for locating early deposits. Many sites in this area are small and have limited artifact assemblages; this lack of ‘site visibility’ is further compounded by the expedient use of local stone for tools and the sustainability of early lifeways in general. Many scatters in this area likely represent camps, chipping stations or processing areas associated with mobile peoples, utilized during their travels along the local drainage basins while making use of seasonal resources. The study area falls within Algonquin Traditional Territory.

Indigenous settlement within eastern Ontario was late in comparison to other parts of the province due to the presence of the Champlain Sea, which inundated the St. Lawrence Lowland following the retreat of the Laurentide Ice Sheet from about 10,000 BC to 8000 BC (Russell et al. 2011). Although Palaeo-Indian sites have not been identified in the immediate Ottawa Valley, it is possible that Indigenous peoples followed the changing shoreline of the Champlain Sea and moved into the area late in the period as the crust rebounded and conditions became more favourable. Examples of Late Palaeo-Indian artifacts in eastern Ontario include two lanceolate points from Lanark County and a chipped stone semi-lunar ulu from Bob’s Lake in the Township of Bedford (Watson 1990, 1999). A Late Palaeo-Indian occupation has been noted on Thompson Island in the St. Lawrence River area (Ritchie 1969:18), and non-fluted lanceolate points have been found in the Thousand Islands and north of Kingston along the Cataraqui River (HQI 2000).

The Ottawa Valley was actively utilized by Indigenous peoples during the subsequent Archaic period as the ice sheet continued to recede and the climate warmed. Sites in this region from this lengthy period include Morrison's Island-2 (BkGg-10), Morrison's Island-6 (BkGg-12) and Allumette Island-1 (BkGg-11) near Pembroke as well as the Lamoureaux site (BiFs-2) along the South Nation River (Clermont 1999). Gulf of Maine Archaic tradition sites also occur, which date from ca. 7500–4000 BC and are characterized by the bipolar reduction of quartz and the absence of bifacial reduction (Swayze and McGhee 2011). Early Woodland sites in the region include Deep River (CaGi-1), Constance Bay I (BiGa-2) and Wyght (BfGa-11) (Mitchell 1963; Watson 1972, 1980), while representative Middle Woodland sites occur at Leamy Lake Park (BiFw-6 and BiFw-16) (Laliberté 1999). Late Woodland period sites are often associated with the Algonquin groups noted during the time of European contact, such as the Kichesipirini, Weskarini, Kinounchepirini, Matouweskarini and Onontchataronon (JHA 1993; ORHDC 2005).

1.2.1.2 Post-Contact

The arrival of European explorers and traders at the beginning of the 17th century triggered widespread shifts in Indigenous lifeways and set the stage for the ensuing Euro-Canadian settlement process. Documentation for this period is abundant, ranging from the first sketches of Upper Canada and the written accounts of early explorers to detailed township maps and lengthy histories. The Post-Contact period can be effectively discussed in terms of major historical events, and the principal characteristics associated with these events are summarized in Table 2.

Table 2: Post-Contact Settlement History
(Smith 1846; Coyne 1895; Lajeunesse 1960; Cumming 1972; Ellis and Ferris 1990; JHA 1993; Surtees 1994; ORHDC 2005; AO 2015)

Historical Event	Timeframe	Characteristics
Early Exploration	Early 17th century	Brûlé explores southern Ontario in 1610/11; Champlain travels through in 1613 and 1615/1616, making contact with a number of Indigenous groups (including the Algonquin, Huron-Wendat and other First Nations); European trade goods become increasingly common and begin to put pressure on traditional industries; Names of bands suggest that Algonquin territorial organization was based on watersheds; Nipissings and Algonquins were involved in inter-tribal trade
Increased Contact and Conflict	Mid- to late 17th century	Conflicts between various First Nations during the Beaver Wars result in numerous population shifts; Nipissings and Algonquins tended to avoid the lower Ottawa in the summer due to Iroquois attacks; European explorers continue to document the area, and many Indigenous groups trade directly with the French and English; 'The Great Peace of Montreal' treaty established between roughly 39 different First Nations and New France in 1701
Fur Trade Development	Early to mid-18th century	Growth and spread of the fur trade; Bands of the Algonquin Nation occupied the Ottawa Valley; Many spent their summers at mission villages; Peace between the French and English with the Treaty of Utrecht in 1713; Ethnogenesis of the Métis; Hostilities between French and British lead to the Seven Years' War in 1754; French surrender in 1760
British Control	Mid- to late 18th century	*Royal Proclamation* of 1763 recognizes the title of the First Nations to the land; Algonquins and Nipissings attended the Niagara Treaty Council; Numerous treaties subsequently arranged by the Crown; First land cession under the new protocols is the Seneca surrender of the west side of the Niagara River in 1764; The Niagara Purchase (Treaty 381) in 1781 included this area
Loyalist Influx	Late 18th century	United Empire Loyalist influx after the American Revolutionary War (1775–1783); British develop interior communication routes and acquire additional lands; Crawford's Purchases completed in 1783 to provide land for the Loyalists; *Constitutional Act* of 1791 creates Upper and Lower Canada
County Development	Late 18th to early 19th century	Became part of Glengarry County in 1792; Prescott County established in 1800; Comprised the Townships of Alfred, Caledonia, Hawkesbury East, Hawkesbury West, Longueil, Plantagenet North and Plantagenet South; Initial settlement was slow as the county lacked a main road; Part of the United Counties of Prescott and Russell in 1820; Independent after the abolition of the district system in 1849
Township Formation	Early 19th century	The vicinity of what would become Plantagenet (Plantagenet Mills) was granted to Col. Fortune ca. 1811; Tract purchased by A. Hagar and J. Hagar in 1811, but J. Hagar sold his share in the business as the War of 1812 approached; A. Hagar funded the construction of a dam on the South Nation River, and a saw mill was in operation in 1812; J. Chesser became a partner prior to this, and oversaw the construction of the mills; French pioneers settled around 'The Mills'; Other early settlers included J. Campbell, P. Georgen, Mr. Charles and Col. Kearns; 'Irish Settlement' formed after 1817; A. Hagar removed to Plantagenet in 1818; The front of the Ottawa River was settled at a later date

Historical Event	Timeframe	Characteristics
Township Development	Mid-19th to early 20th century	Population reached 934 by 1842; 7,315 ha taken up by 1846, with 953 ha under cultivation; 1 grist mill and 1 saw mill in operation at that time; Plantagenet North and South established ca. 1848; Population of Plantagenet North was 2,539 in 1861, while Plantagenet South was 1,238; Traversed by the Canadian Pacific Railway's Montreal & Ottawa Line (1897/98) and Canadian Northern Railway (1909); Communities at Fournierville, Curran, Jessup's Falls, Kerry, Pendleton, Plantagenet, Plantagenet Springs, Riceville, Treadwell and Wendover

Many Algonquins living in this region were Christians but also belonged to traditional bands occupying various watersheds. Traditional band members lived within their hunting grounds for most of the year (ORHDC 2005). Numerous petitions were made to the Crown regarding lands and rights, the earliest of which dates from 1772 and describes the extent of Algonquin and Nipissing territory as encompassing both sides of the Ottawa River from Long Sault to Lake Nipissing (JHA 1993). As Euro-Canadian settlement progressed, Algonquin and Nipissing bands began to press for reserve lands within their own traditional territories (JHA 1993; ORHDC 2005). In the 1840s, for example, the Algonquin Chief Pierre Shawanepinesi was petitioning for a reserve in the Township of Bedford, north of Kingston. Although land was set aside to become a Reserve, it was withdrawn due to lumbering interests (ORHDC 2005:31).

1.2.2 Past and Present Land Use

1.2.2.1 Overview

During Pre-Contact and Early Contact times, the vicinity of the study area would have comprised a mixture of coniferous trees, deciduous trees and open areas. Indigenous communities would have managed the landscape to some degree. During the early 19th century, Euro-Canadian settlers arrived in the area and began to clear the forests for agricultural and settlement purposes. The study area traversed parts of the historical communities of Plantagenet and Plantagenet Springs.

Examinations of early mapping and aerial imagery were carried out to provide a general framework for reconstructing the Euro-Canadian settlement history of the study area. Detailed documentary research of the land use and occupation history specific to the St. Paul Roman Catholic Cemetery was also conducted, which involved the consultation of land registry records and additional information sources as set out in Section 3.1 of the 2011 *S&Gs*. The Bereavement Authority of Ontario (BAO) was also contacted for resources. The land use at the time of assessment can be classified as a mixture of agricultural, infrastructural, residential, educational and green space.

1.2.2.2 Plantagenet

The community of Plantagenet Village or Plantagenet Mills began to develop after Abner Hagar established a dam and saw mill on the South Nation River ca. 1812. The ownership of the mill subsequently passed to J. Chesser and later to Mr. Hatt, but Albert Hagar took possession again in the mid-19th century (Thomas 1896:638–639). The community was briefly called Hattville, but it was named Plantagenet when the post office opened. A store was established by P. McMartin, who became the first postmaster. Although tiers of lots were laid out by Hatt and Chesser on either side of the river, A. Hagar ultimately had the settlement surveyed by W. McConnell. C. Laroque opened another store in the mid-19th century. By 1881, Plantagenet contained four stores; saw, grist, carding and fulling mills; three hotels, three churches; a town hall; and a court office. It had a population of approximately 250 at that time (Cumming 1972:62–63).

1.2.2.3 Plantagenet Springs

The springs of Plantagenet became well known in the early 19th century for their restorative properties. The waters gained fame as early as 1832, when Asiatic cholera arrived and Montreal was severely impacted. Mr. Cameron, a lumber merchant, drank the water with good results, and others followed suit. The waters were later prescribed by the medical profession of Montreal and Quebec. The Plantagenet Springs were owned by William Rodden, and the Carratraca Springs were owned by P.B. Winning (Thomas 1896:643–644). By the early 20th century, the community of Plantagenet Springs had developed along the north side of the railway and contained two mills.

1.2.2.4 Mapping and Imagery Analysis

In order to gain a general understanding of the study area's past land uses, two historical settlement maps, one fire insurance plan, two topographic maps and one aerial image were examined during the research component of the study. Specifically, the following resources were consulted:

- *Map of the Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West* (1862) (OHCMP 2019);
- *Prescott and Russell Supplement in Illustrated Atlas of the Dominion of Canada* (1881) (MU 2001);
- A fire insurance plan from 1897 (LAC 2022);
- Topographic maps from 1908 and 1909 (OCUL 2022); and
- An aerial image from 1954 (U of T 2022).

The limits of the study area are shown on georeferenced versions of the consulted historical resources in Map 3–Map 7. The study area traversed several road allowances as well as parts of multiple properties. A summary of the identified historical occupants appears in Table 3.

Table 3: Occupation History

Lot	Concession	1862	1881
7	3	Mrs. Bisson	Unspecified
7	4	Unspecified	Unspecified
8	4	P. McMartin	Unspecified
9	4 Old Survey	Unspecified	Unspecified; Part of 'Mill Property'
10	4 Old Survey	J. & A. McMartin	Unspecified; Part of 'Mill Property' and eastern portion of Plantagenet
11	4 Old Survey	Multiple occupants within Plantagenet	Unspecified; Western portion of Plantagenet
5	5	Unspecified	Unspecified
8	5	B. Deroshe	Henry Smith
6	6	Unspecified; Part of Plantagenet Springs	William Rodden
7	6	William Rodden	William Rodden

The *Map of the Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West* (1862) shows several structures within lands adjacent to the study area (Map 3). At least six buildings appear near the study area in the northern part of Lot 10, Concession 4 Old Survey, and P. McMartin's home is shown in the southern part of Lot 8, Concession 4. A structure associated with J. & A. McMartin appears southeast of the intersection of Pitch Off Road and an unopened Concession Road 5 in the northwestern part of Lot 10, Concession 4.

A variety of structures are illustrated in lands adjacent to the study area within the northern part of Lot 11, Concession 4 Old Survey (the settlement of Plantagenet), including a school house, a church, an inn and several stores and dwellings. Although it was not illustrated, the angled distribution of the buildings in the north suggests that Alfred Street had also been established by this time and that the study area followed the roadways. William Rodden's home appears to the east of the study area within Lot 6, Concession 6, and another structure appears to the south of a roadway within Lot 7, Concession 6. Several former roadways are illustrated within this lot, which were later modified/removed.

The *Prescott and Russell Supplement in Illustrated Atlas of the Dominion of Canada* (1881) contains less detail than the map from 1862, but the early limits of the community of Plantagenet are shown on either side of the South Nation River and a few structures appear in the vicinity of the study area (Map 4). These include a building in the southeast corner of Lot 8, Concession 4, two structures east of the study area on Lot 6, Concession 6 and the Plantagenet Mineral Springs within Lot 7, Concession 6. Since this publication only included information for its subscribers, the lack of information pertaining to the remainder of the study area is not particularly meaningful. The most significant change to the landscape appears to have been the realignment of the southern part of Water Street, which was now closer to the western bank of the river.

The fire insurance plan from 1897 reveals that the centre of Plantagenet was very well developed, and a wide range of throughfares, dwellings, sheds/barns, businesses and public buildings appear (Map 5). The study area comprised the various road allowances, and no structures appears within its limits. A grist mill and sawmill are illustrated to the northeast of the study area.

The topographic maps from 1908 and 1909 depict a wide variety of wooden (black) and brick or stone (red) structures within the communities of Plantagenet and Plantagenet Springs, all of which appear to be adjacent to the study area (Map 6). The St. Paul Roman Catholic Cemetery parcel is shown on the east side of Water Street, and the limits seem to correspond to the extant burial ground rather than the southern extension of the current legal property. The vicinity of the lagoon in the east was partly cleared, but the majority appears to have comprised wooded lands. The aerial image from 1954 reveals that the land use pattern remained largely unchanged, although the eastern lands had been fully cleared for agricultural purposes (Map 7).

1.2.2.5 St. Paul Roman Catholic Cemetery

The St. Paul Roman Catholic Cemetery (CM-03474) is located at 674 Water Street in the eastern part of Lot 11, Concession 4 Old Survey in the Geographic Township of Plantagenet. The principal transactions documented in the land registry records for this property are summarized in Table 4. A full discussion of the results of the additional historical documentation appears below.

Table 4: Land Transaction Summary
(LRO #46)

Instrument #	Instrument	Date	Grantor	Grantee	Comments
-	Patent	30 Apr 1804	Crown	Margaret Corbin	All 200 acres
815	-	11 Oct 1827	Margaret Corbin	John Chesser	All 200 acres
891	-	10 Mar 1829	John Chesser	Alfred Chesser	All 200 acres
1957	In Trust	23 Aug 1834	Alfred Chesser	Reverend Alexander MacDonell	Illegible
6617	Illegible	5 Apr 1854	Honourable George Moffat	Peter McMartin	Part of Lot
8038	illegible	Jul 1857	Peter McMartin	Roman Catholic Church	5 acres
14047	[Release]	14 Jun 1864	Peter McMartin	The Incorporated Synod of the Diocese of Ontario	Part of Lot, 1 acre and 30 perches

The Crown Patent for Lot 11, Concession 4 Old Survey went to Margaret Corbin in April 1804. Corbin sold the lot to John Chesser in October 1827, and Chesser sold it to Alfred Chesser in 1829. In 1834, Chesser transferred 2 acres to the Right Reverend Alexander MacDonell in trust for a Catholic church and cemetery. The cemetery was consecrated in 1824, however, and the first burial reportedly took place at that time (GHP 2018:1). Part of the lot went to Peter McMartin in 1854, and he sold a 5-acre parcel to the Roman Catholic Church in 1857. Records indicate that “a small chapel was built in the area but the owner of the property refused to transfer the deed to the Diocese of Kingston therefore the chapel was moved to nearby Curran” (GHP 2018:1). In 1864, Peter McMartin sold lands to the Incorporated Synod of the Diocese of Ontario.

The cemetery currently comprises three sections, and numbered markers set into the ground appear to indicate plot numbering. The northwest section (17 rows) and southwest section (17 rows) are located along Water Street, and the east section (9 rows) occurs closer to the river (Map 8). Headstones from over 400 plots have been transcribed (GHP 2018:4–33). Given that the cemetery has been in use for nearly 200 years, however, it seems likely that “there are a large number of burials that are not remembered by a surviving memorial stone” (GHP 2018:1).

An email inquiry was sent to the BAO on February 22, 2022 regarding the status of the cemetery and whether they had any additional information that could be shared. Ray Porrill provided the relevant registry information later that day and noted that the cemetery was active and operated by the Roman Catholic Episcopal Corporation of Ottawa. The Archdiocese of Ottawa-Cornwall was contacted to determine whether they had any burial records for the cemetery on February 22, 2022. The following day, archivist Judith Dimitri stated that she did not find “anything specifically on this cemetery in the index, but I have to admit, it is not very detailed”.

Judith forwarded ARA’s email to Dominque Perrier, volunteer operator of the cemetery, who called ARA on February 23, 2022. During the telephone conversation, it was learned that the cemetery does not have any survey plans and that they rely on a hand-drawn map. Dominque stated that the known burials are located approximately 2 feet (0.6 metres) east of the western fence along Water Street. The old part of the cemetery was noted to have a monument within it, and “Area B” to the east of the mausoleum building also contains older burials. Dominque noted that he does not believe that any burials extend west of the cemetery fence into the Water Street right-of-way.

1.3 Archaeological Context

The Stage 1 assessment (property inspection) was conducted on May 28, 2022 under PIF #P007-1319-2022. ARA utilized a Google Pixel 3a with a built-in GPS/GNSS receiver during the investigation (UTM17/NAD83). The limits of the study area were confirmed using project-specific GIS data translated into GPS points for reference in the field, in combination with aerial imagery showing physical features in relation to the subject lands.

The archaeological context of any given study area must be informed by 1) the condition of the property as found (Section 1.3.1), 2) a summary of registered or known archaeological sites located within a minimum 1 km radius (Section 1.3.2) and 3) descriptions of previous archaeological fieldwork carried out within the limits of, or immediately adjacent to the property (Section 1.3.3).

1.3.1 Condition of the Property

The study area lies within the Great Lakes–St. Lawrence forest region, which is a transitional zone between the southern deciduous forest and the northern boreal forest. This forest extends along the St. Lawrence River across central Ontario to Lake Huron and west of Lake Superior along the border with Minnesota, and its southern portion extends into the more populated areas of Ontario. This forest is dominated by hardwoods, featuring species such as maple, oak, yellow birch, white and red pine. Coniferous trees such as white pine, red pine, hemlock and white cedar commonly mix with deciduous broad-leaved species, such as yellow birch, sugar and red maples, basswood and red oak (MNDMNRF 2022).

In terms of local physiography, the subject lands fall primarily within the Ottawa Valley Clay Plains. This region consists of clay plains interrupted by ridges of rock or sand that extend from Pembroke to Hawkesbury. The parts above and below Ottawa each have distinctive traits: There is a broad valley with rocky Laurentian uplands rising on either side in the upper section, and the bedrock is further faulted so that some of the uplifted blocks appear above the clay beds. East of Ottawa, the clay plains are largely situated in the floors of various channels eroded by a bigger Ottawa River in early postglacial time (Chapman and Putnam 1984:205–208). The eastern edge of the study area traverses the Russell and Prescott Sand Plains. This region comprises a group of large sand plains separated by the clays of the lower Ottawa Valley, with one continuous belt extending from Ottawa to Hawkesbury, three large areas to the north and several smaller sandy remnants dispersed over the clay plains (Chapman and Putnam 1984: 208–210).

According to the Ontario Soil Survey, the study area consists of a variety of soil types (Map 9). The majority of the soils comprise bands of Wendover clay (Wc) located on either side of the South Nation River. Areas of Bearbrook clay (Bc) flank the sections of Wendover clay, and a deposit of Uplands fine sand (Ufs) occurs at the eastern end of the study area. The characteristics of these soil types are summarized in Table 5 (Wicklund and Richards 1962).

Table 5: Soil Types

Soil Code	Soil Type	Soil Materials	Topography	Drainage
Bc	Bearbrook clay	Stonefree, dark grey clay soils with non-calcareous, layered, red and grey clay parent materials	Level, except where cut by stream channels	Poor
Ufs	Uplands fine sand	Reddish brown, loose, fine sandy soils with sorted non-calcareous fine sand parent material	Undulating	Good
Wc	Wendover clay	Stonefree, grey clay soils with non-calcareous, layered, red and grey clay parent material	Undulating	Imperfect

The subject lands fall within the Lower South Nation River drainage basin, which is under the jurisdiction of South Nation Conservation (SNC 2020). Specifically, the study area is traversed by the South Nation River and four of its tributaries and is located 22 m east of an unnamed wetland.

At the time of assessment, the study area comprised parts of various roadway platforms as well as adjacent ditches, grassed areas, treed areas and agricultural lands around the extant lagoon. Soil conditions were ideal for the activities conducted. No unusual physical features were encountered that affected the results of the Stage 1 assessment.

1.3.2 Registered or Known Archaeological Sites

The Ontario Archaeological Sites Database and the Ontario Public Register of Archaeological Reports were consulted to determine whether any registered or known archaeological resources occur within a 1 km radius of the study area. The available search facility did not return any registered sites located within at least a 1 km radius (the facility returns sites in a rectangular area, rather than a radius, potentially resulting in results beyond the specified distance). In terms of other known resources, no unregistered sites were identified within a 1 km radius of the study area.

1.3.3 Previous Archaeological Work

Reports documenting assessments conducted within the subject lands and assessments that resulted in the discovery of sites within adjacent lands were sought during the research component of the study. In order to ensure that all relevant past work was identified, an investigation was launched to identify reports involving assessments within 50 m of the study area. The investigation determined that there are two available reports documenting previous archaeological fieldwork within the specified distance. The relevant results and recommendations are summarized below as required by Section 7.5.8 Standards 4–5 of the 2011 *S&Gs*.

1.3.3.1 Lagoon Expansion/Upgrading (Stage 1)

A Stage 1 assessment was conducted for the expansion/upgrading of the Plantagenet lagoon in September and October 1994 under Licence #94-074 (OAC 1994). The assessed area encompassed all lands within a 3 km radius of Plantagenet, including the entire study area. The investigation identified numerous areas of archaeological potential for Indigenous and Euro-Canadian archaeological resources. It was recommended that a Stage 2 assessment be carried out within any areas of archaeological potential that could be impacted by the project (OAC 1994:20–21).

1.3.3.2 Community of Wendover (Stage 1)

In August 1994, the equivalent of a Stage 1 assessment was carried out for the community of Wendover under Licence #94-021 (HQI 1994). The assessed area encompassed all lands within a 12 km radius of Wendover, including the northwestern part of the study area. The investigation identified multiple areas of archaeological potential (e.g., the shorelines of the Ottawa and South Nation Rivers, the intersection of the Russell and Prescott Sand Plains and the Ottawa Valley Clay Plain, areas of 19th-century settlement, etc.). It was recommended that the areas of archaeological potential be subject to further work, with Stage 2 assessment beyond the roadway portions and archaeological monitoring within the roadway portions (HQI 1994:20).

2.0 STAGE 1 BACKGROUND STUDY

2.1 Background

The Stage 1 assessment involved background research to document the geography, history, previous archaeological fieldwork and current land condition of the study area. This desktop examination included research from archival sources, archaeological publications and online databases. It also included the analysis of a variety of historical maps and aerial imagery. The results of the research conducted for the background study are summarized below.

With occupation beginning approximately 11,000 years ago, the greater vicinity of the study area comprises a complex chronology of Pre-Contact and Post-Contact histories (Section 1.2). Artifacts associated with Archaic, Woodland and Early Contact traditions are well-attested in the United Counties of Prescott and Russell, and Euro-Canadian archaeological sites dating to pre-1900 and post-1900 contexts are likewise common. The absence of documented sites in the surrounding area is likely related to lack of local archaeological exploration and should not be taken as an indicator that the area was unattractive or undesirable for occupation (Section 1.3.2). Background research identified two areas of previous assessment within the study area (Section 1.3.3).

The natural environment of the study area would have been attractive to both Indigenous and Euro-Canadian populations as a result of proximity to the South Nation River and its tributaries. The areas of relatively well-drained soils would have been ideal for agriculture, and the diverse local vegetation would also have encouraged settlement throughout Ontario’s lengthy history. Euro-Canadian populations would have been particularly drawn to the historically-surveyed thoroughfares and amenities within the communities of Plantagenet and Plantagenet Springs.

In summary, the background study included an up-to-date listing of sites from the Ontario Archaeological Sites Database (within at least a 1 km radius), the consideration of previous local archaeological fieldwork (within at least a 50 m radius), the analysis of historical maps (at the most detailed scale available) and the study of aerial imagery. ARA therefore confirms that the standards for background research set out in Section 1.1 of the 2011 *S&Gs* were met.

2.2 Field Methods (Property Inspection)

In order to gain first-hand knowledge of the geography, topography and current condition of the study area, a property inspection was conducted on May 28, 2022. Environmental conditions were ideal during the inspection, with partly cloudy skies, bright lighting and a temperature of 20 °C. ARA therefore confirms that fieldwork was carried out under weather and lighting conditions that met the requirements set out in Section 1.2 Standard 2 of the 2011 *S&Gs*.

The study area was subjected to random spot-checking. The inspection confirmed that all surficial features of archaeological potential were present where they were previously identified and did not result in the identification of any additional features of archaeological potential not visible on mapping (e.g., relic water channels, patches of well-drained soils, etc.).

The inspection determined that many parts of the study area were disturbed by past construction activities, and steeply sloped lands and areas of exposed bedrock were also documented. All areas of exposed bedrock were examined for pictographs and/or petroglyphs, but none were found. No other natural features (e.g., permanently wet lands, overgrown vegetation, heavier soils than expected, etc.) that would affect assessment strategies were identified. The frontage of the St. Paul Roman Catholic Cemetery was inspected, and multiple built heritage resources and cultural heritage landscapes were documented during ARA’s heritage assessment (in preparation). No other significant built features (e.g., plaques, monuments, etc.) were encountered.

2.3 Analysis and Conclusions

In addition to relevant historical sources and the results of past archaeological assessments, the archaeological potential of a property can be assessed using its soils, hydrology and landforms as considerations. Section 1.3.1 of the 2011 *S&Gs* recognizes the following features or characteristics as indicators of archaeological potential: previously identified sites, water sources (past and present), elevated topography, pockets of well-drained sandy soil, distinctive land formations, resource areas, areas of Euro-Canadian settlement, early transportation routes, listed or designated properties, historic landmarks or sites, and areas that local histories or informants have identified with possible sites, events, activities or occupations.

The Stage 1 assessment resulted in the identification of numerous features of archaeological potential in the vicinity of the study area (Map 10–Map 12). The closest and most relevant indicators of archaeological potential (i.e., those that would directly affect survey interval requirements) include multiple primary water sources (the South Nation River, several of its tributaries and various unnamed waterbodies), multiple secondary water sources (unnamed wetlands), one physiographic landform (a terrace escarpment), two historical communities (Plantagenet and Plantagenet Springs), one historical railway (the Canadian Pacific Railway), multiple historical roadways (e.g., Jessup Falls Road, Water Street and County Road 9) and two historical cemeteries (the St. Paul Roman Catholic Cemetery and Chesser Cemetery).

Background research determined that the St. Paul Roman Catholic Cemetery was first utilized in 1824, rough a decade before a 2-acre parcel passed to the Reverend Alexander MacDonell in trust. It seems clear that this parcel comprises the northern portion of the greater cemetery property (the southern portion does not appear to have been utilized for interments). Although it is assumed that all burials are located within the fenced portion of the cemetery, there are no plot maps or other records that provide any reliable indication of the extent of the early burial ground. The cemetery therefore does not have clearly defined historical boundaries. Although the nearest headstones date to post-1900, it remains possible that some early interments occurred beyond the legal property line in front of the utilized portion. The adjacent parts of the study area therefore have potential for deeply buried burial features. Background research did not identify any features indicating that the remainder of the study area has potential for deeply buried archaeological resources.

Although proximity to a feature of archaeological potential is a significant factor in the potential modelling process, current land conditions must also be considered. Section 1.3.2 of the 2011 *S&Gs* emphasizes that 1) quarrying, 2) major landscaping involving grading below topsoil, 3) building footprints and 4) sewage/infrastructure development can result in the removal of archaeological potential, and Section 2.1 states that 1) permanently wet areas, 2) exposed bedrock and 3) steep slopes (> 20°) in areas unlikely to contain pictographs or petroglyphs can also be evaluated as having no or low archaeological potential. Areas previously assessed and not recommended for further work also require no further assessment.

Background research did not identify any previously assessed areas of no further concern within the study area. ARA's visual inspection, coupled with the analysis of historical sources and digital environmental data, resulted in the identification of multiple areas of no archaeological potential. Specifically, deep land alterations have resulted in the removal of archaeological potential from the extant roadways, ditches, utilities, sidewalks and lagoon (Image 1–Image 8). These areas have clearly been impacted by past earth-moving/construction activities, resulting in the disturbance of the original soils to a significant depth and severe damage to the integrity of any archaeological resources. Lands sloped > 20° and exposed bedrock were encountered along the east bank of the South Nation River (Image 9–Image 10). The river itself was observed, but archaeological potential modelling for watercourses is beyond the purview of any land-based assessment.

The remaining areas have potential for Indigenous and Euro-Canadian archaeological materials or require test pit survey to confirm that they have no archaeological potential. The areas of archaeological potential include the agricultural fields in the east and several small grassed and wooded areas (Image 11–Image 14). It seems likely that the grassed areas along Comté Road in the west and on either side of Highway 17 in the north were previously impacted, but the extent of disturbance could not be verified based on the inspection alone. Similarly, a slightly elevated area between the South Nation River and Pitch Off Road could be permanently wet. These lands have been categorized as areas of archaeological potential and must be empirically tested to confirm that they have no archaeological potential. Potential for deeply buried human remains and/or burial features was identified in front of the St. Paul Roman Catholic Cemetery (Image 15–Image 16).

In summary, the Stage 1 assessment determined that the study area comprises a mixture of areas of archaeological potential and areas of no archaeological potential. The potential modelling results are presented in Map 13–Map 24. The study area is depicted as a layer in these maps.

3.0 RECOMMENDATIONS

The Stage 1 assessment determined that the study area comprises a mixture of areas of archaeological potential and areas of no archaeological potential. Potential for deeply buried human remains and/or burial features was identified in front of the utilized portion of the St. Paul Roman Catholic Cemetery (CM-03474) in the southeastern part of the study area.

It is recommended that all areas of archaeological potential that could be impacted by the project be subject to a Stage 2 property assessment in accordance with Section 2.1 of the 2011 *S&Gs*. A cemetery investigation must also be carried out in front of the St. Paul Roman Catholic Cemetery to determine whether any burial features extend beyond the property boundary (Map 22). This investigation must be conducted in accordance with Section 3.3.3 and Section 4.2.3 of the 2011 *S&Gs*, and a Cemetery Investigation Authorization must be obtained from the BAO. The BAO will be provided with the report for their consideration and comment prior to submission to the MTCS. If any in-water work is planned within the South Nation River, the Criteria for Evaluating Marine Archaeological Potential checklist should be consulted.

Given the likelihood that the grassed areas along Comté Road in the west and on either side of Highway 17 in the north were previously impacted, a combination of visual inspection and test pit survey should be utilized to confirm the extent of disturbance in accordance with Section 2.1.8 of the 2011 *S&Gs*. This will allow for the empirical evaluation of the integrity of the soils and the depth of any impacts. Judgemental test pit survey should similarly be carried out to confirm the extent of a possible permanently wet area on the west side of Pitch Off Road. If these areas are determined to have archaeological potential, then a test pit survey interval of 5 m must be utilized. Each test pit must be excavated into at least the first 5 cm of subsoil, and the resultant pits must be examined for stratigraphy, potential features and/or evidence of fill. The soil from each test pit must be screened through mesh with an aperture of no greater than 6 mm and examined for archaeological materials. If archaeological materials are encountered, all positive test pits must be documented, and intensification may be required.

Given that the area in front of the St. Paul Roman Catholic Cemetery has no potential for surficial archaeological resources, the cemetery investigation can occur independently or concurrently with the Stage 2 assessment. Mechanical topsoil removal must be carried out to determine whether any unmarked graves are present within the study area. Based on the current landscape and the results of the background research, a 10 m investigation buffer is warranted. The excavation should begin at the edge of the paved roadway/apron and continue easterly towards the property boundary. To avoid damage to potential features and/or human remains, an excavator with an articulated wrist and a flat-edged bucket must be utilized to remove the topsoil. Mechanical excavation must continue until the topsoil/subsoil interface is reached; this interface must then be subjected to a close examination for potential features and shovel shined or trowelled to further clarify the interface in accordance with the requirements set out in Section 4.2.3 of the 2011 *S&Gs*.

The remainder of the 10 m buffer comprises paved areas that are less likely to contain deeply buried remains. Since it is not feasible to excavate this part of the buffer, archaeological monitoring must be carried out as per Section 3.3.3 Standard 4 of the 2011 *S&Gs*. All construction activities must be monitored by a licensed archaeologist, and work must cease if human remains and/or burial features are encountered so that appropriate steps can be taken.

If any burial features (e.g., grave shafts or coffin stains) are encountered, they must be fully documented in order to satisfy the requirements and objectives set out in the *Funeral, Burial and Cremation Services Act, 2002*, Section 174 of Ontario Regulation 30/11 as well as Section 4.2.1 Standard 9 and Section 4.2.2 Standard 7 of the 2011 *S&Gs*. Authorization from the BAO would be required before any further excavation to confirm the presence/absence of human remains. Disarticulated human remains found in secondary contexts must also be recorded. Mechanical excavation must be extended for a minimum of 10 m beyond any burial features.

4.0 ADVICE ON COMPLIANCE WITH LEGISLATION

Section 7.5.9 of the 2011 *S&Gs* requires that the following information be provided for the benefit of the proponent and approval authority in the land use planning and development process:

- This report is submitted to the Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the MTCS, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.
- It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act*.
- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the *Ontario Heritage Act*.
- The *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 requires that any person discovering human remains must notify the police or coroner and the Registrar at the Ministry of Government and Consumer Services.
- Since the potential always exists to miss important information in archaeological surveys; if any artifacts of Indigenous interest or human remains are encountered during construction, please contact: Algonquins of Ontario Consultation Office, 31 Riverside Drive, Suite 101, Pembroke, Ontario K8A 8R6, Tel: (613) 735-3759, Fax: (613) 735-6307, Email: algonquins@tanakiwin.com.

5.0 IMAGES

Image 1: Disturbed Lands
(May 28, 2022; Facing Northwest)

Image 2: Disturbed Lands
(May 28, 2022; Facing Northwest)

Image 3: Disturbed Lands
(May 28, 2022; Facing Southeast)

Image 4: Disturbed Lands
(May 28, 2022; Facing Northeast)

Image 5: Disturbed Lands
(May 28, 2022; Facing West)

Image 6: Disturbed Lands
(May 28, 2022; Facing North)

Image 7: Disturbed Lands
(May 28, 2022; Facing Northwest)

Image 8: Disturbed Lands
(May 28, 2022; Facing Northwest)

Image 9: Sloped Lands
(May 28, 2022; Facing Southwest)

Image 10: Exposed Bedrock
(May 28, 2022; Facing Northwest)

Image 11: Area of Potential
(May 28, 2022; Facing Southeast)

Image 12: Area of Potential
(May 28, 2022; Facing East)

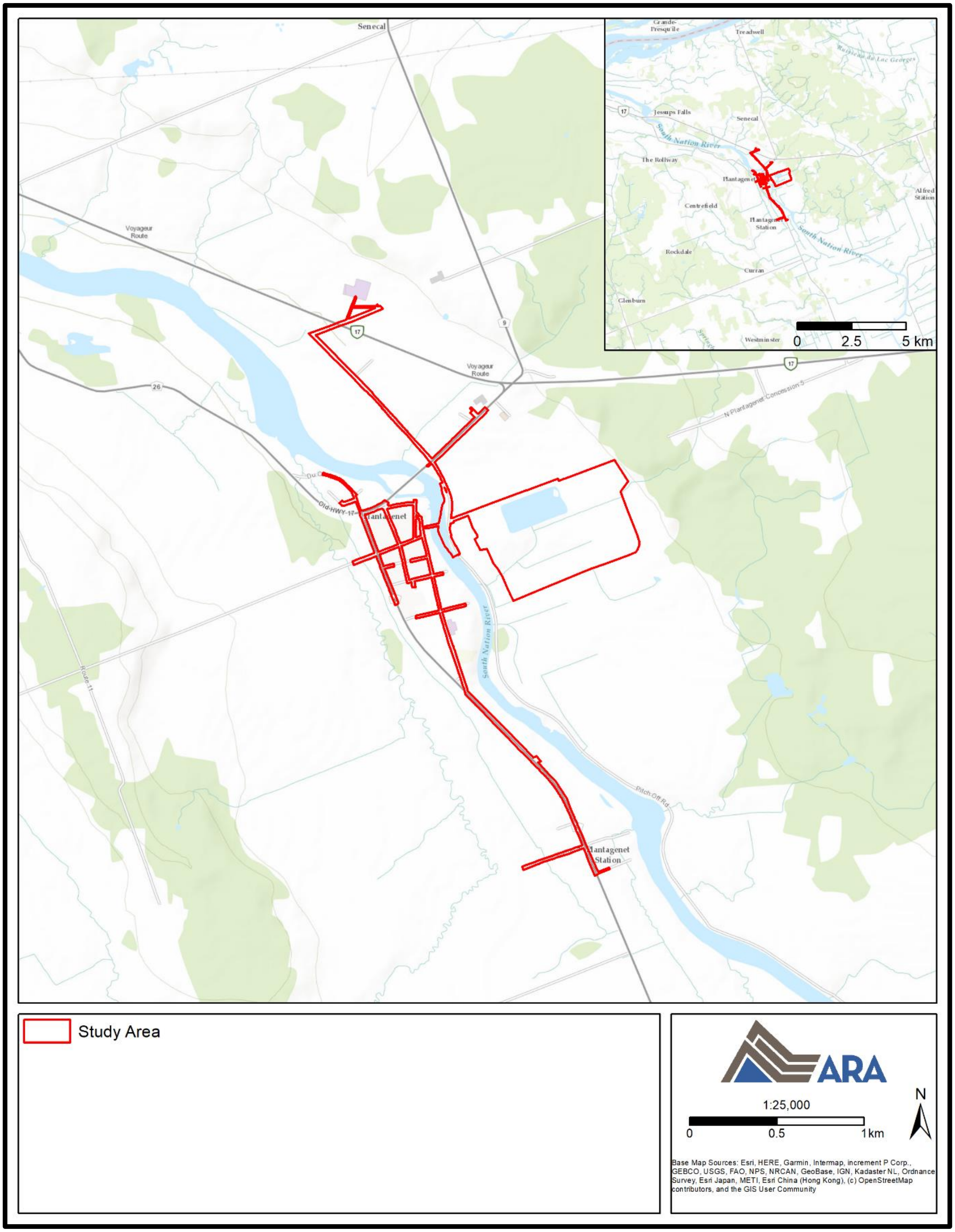
Image 13: Area of Potential
(May 28, 2022; Facing Northeast)

Image 14: Area of Potential
(May 28, 2022; Facing West)

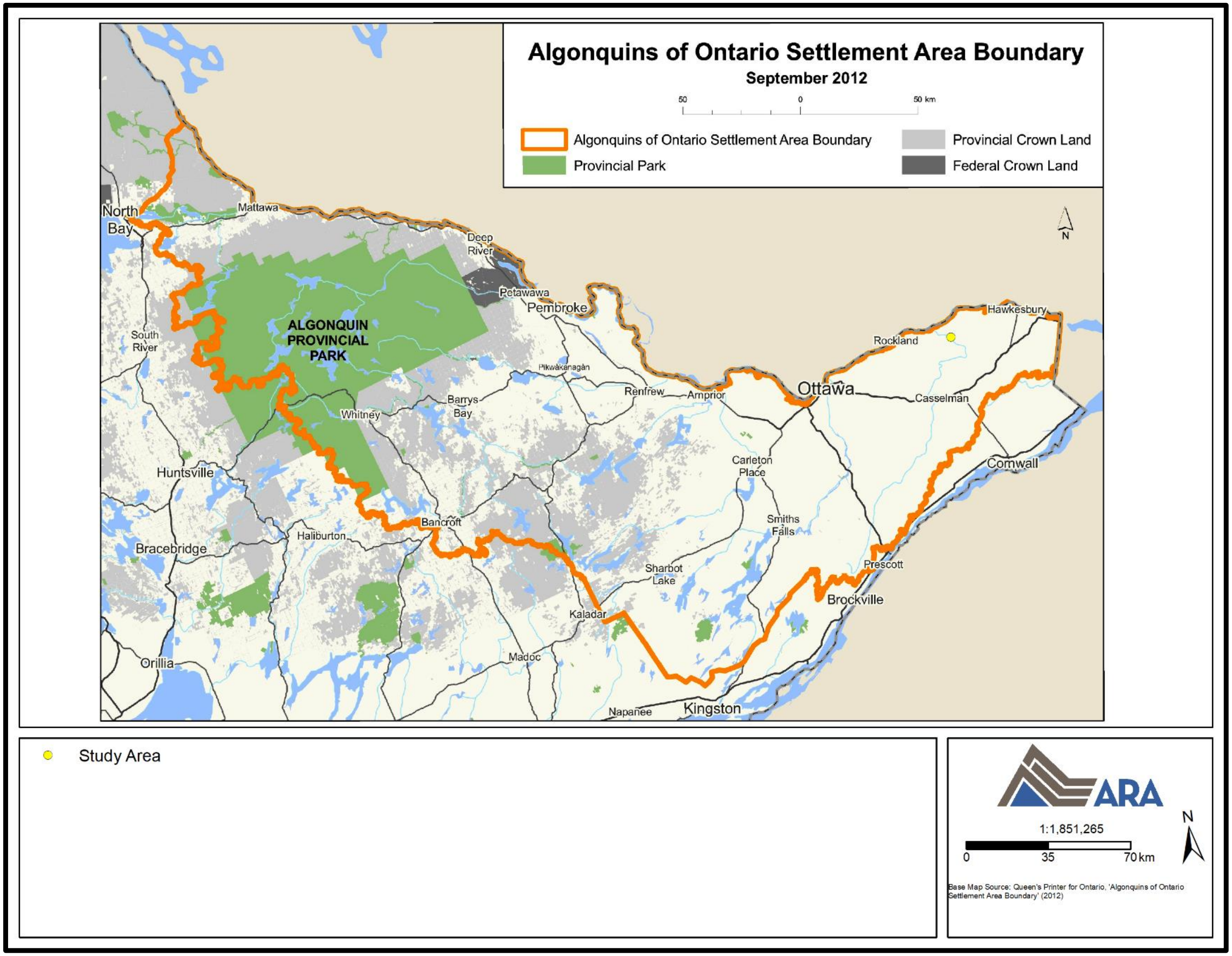
Image 15: St. Paul Roman Catholic Cemetery
(May 28, 2022; Facing Southeast)

Image 16: St. Paul Roman Catholic Cemetery
(May 28, 2022; Facing Northeast)

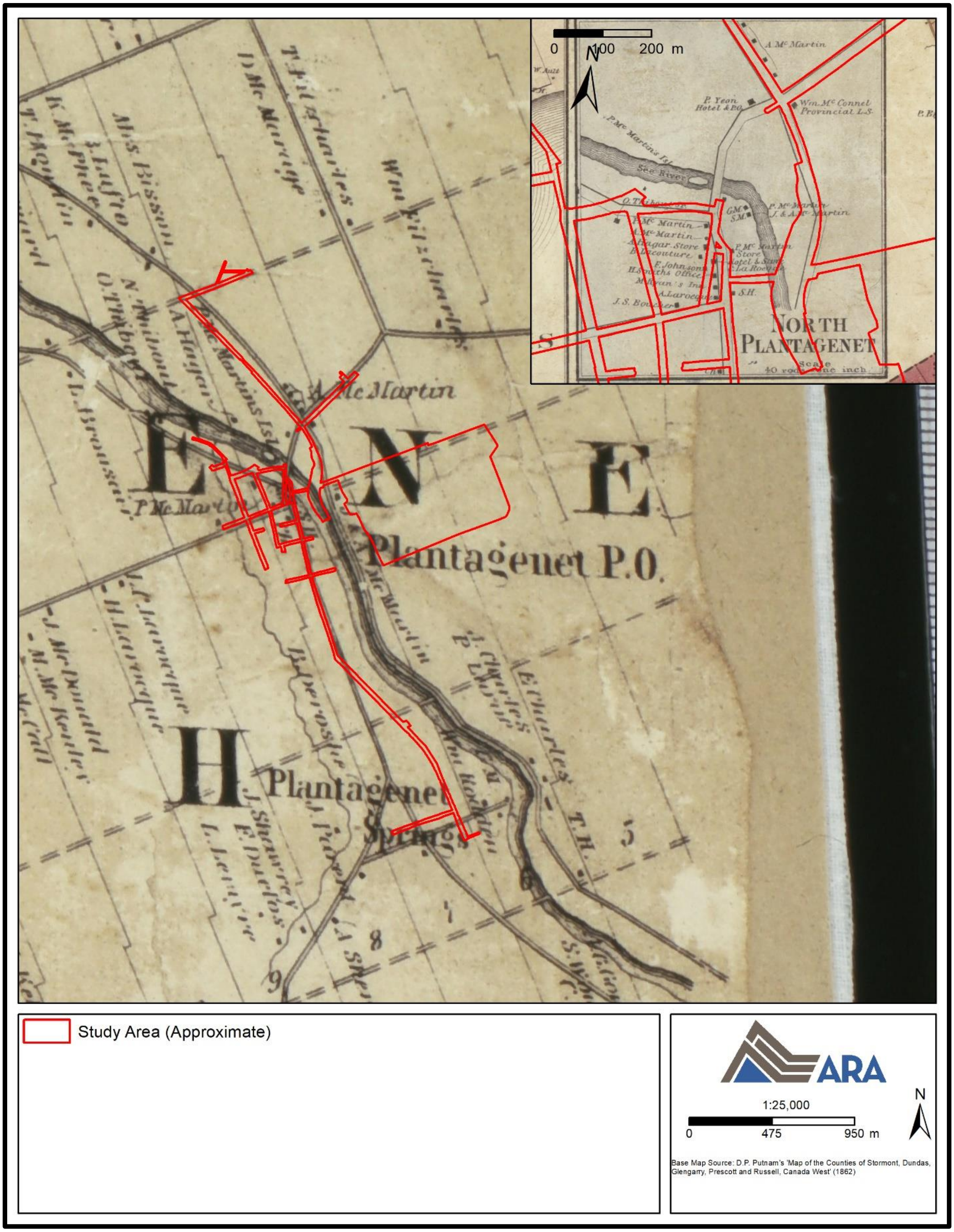
6.0 MAPS



Map 1: Location of the Study Area
(Produced under licence using ArcGIS® software by Esri, © Esri)

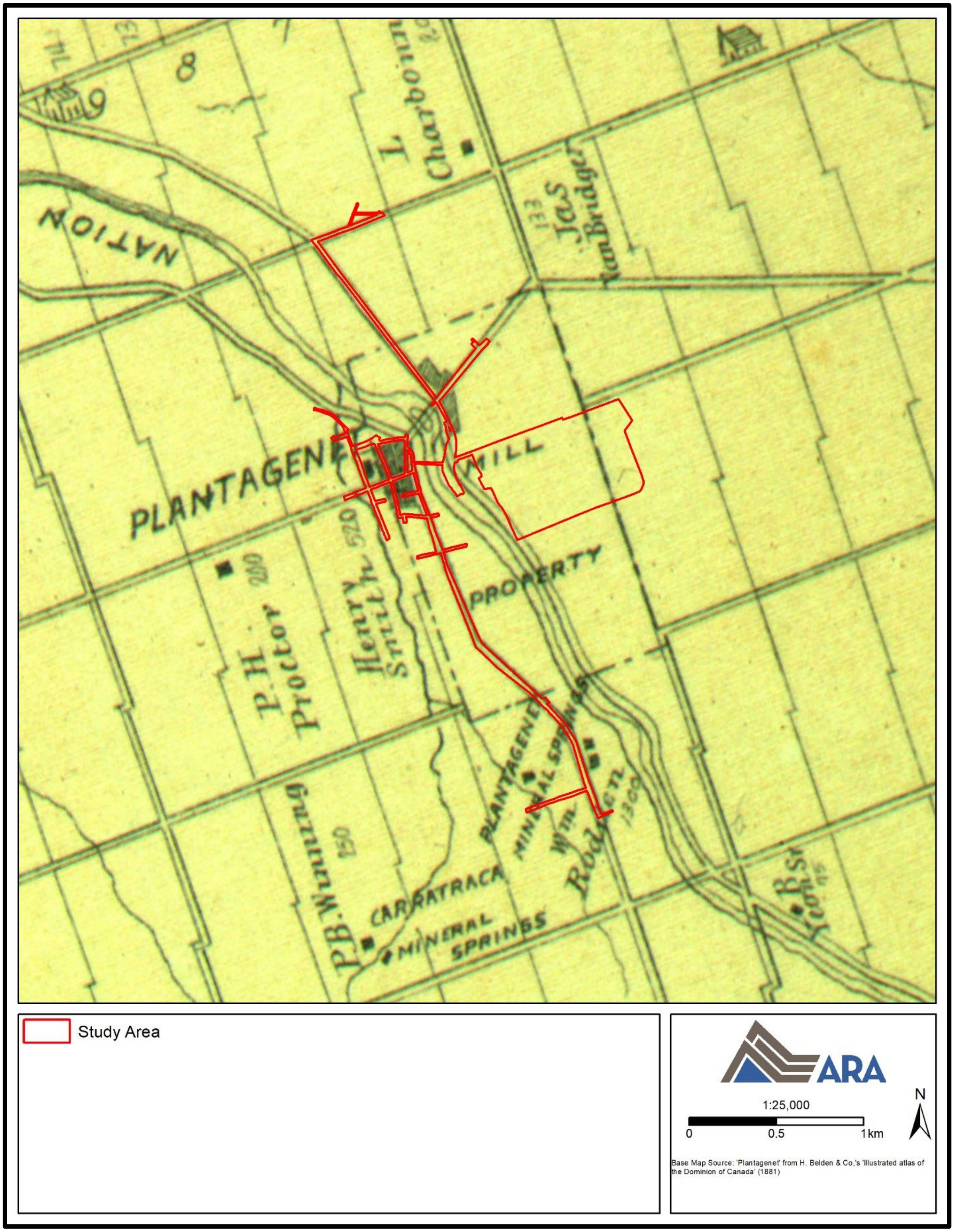


Map 2: Algonquins of Ontario Settlement Area Boundary
(Produced under licence using ArcGIS® software by Esri, © Esri; MIA 2022)



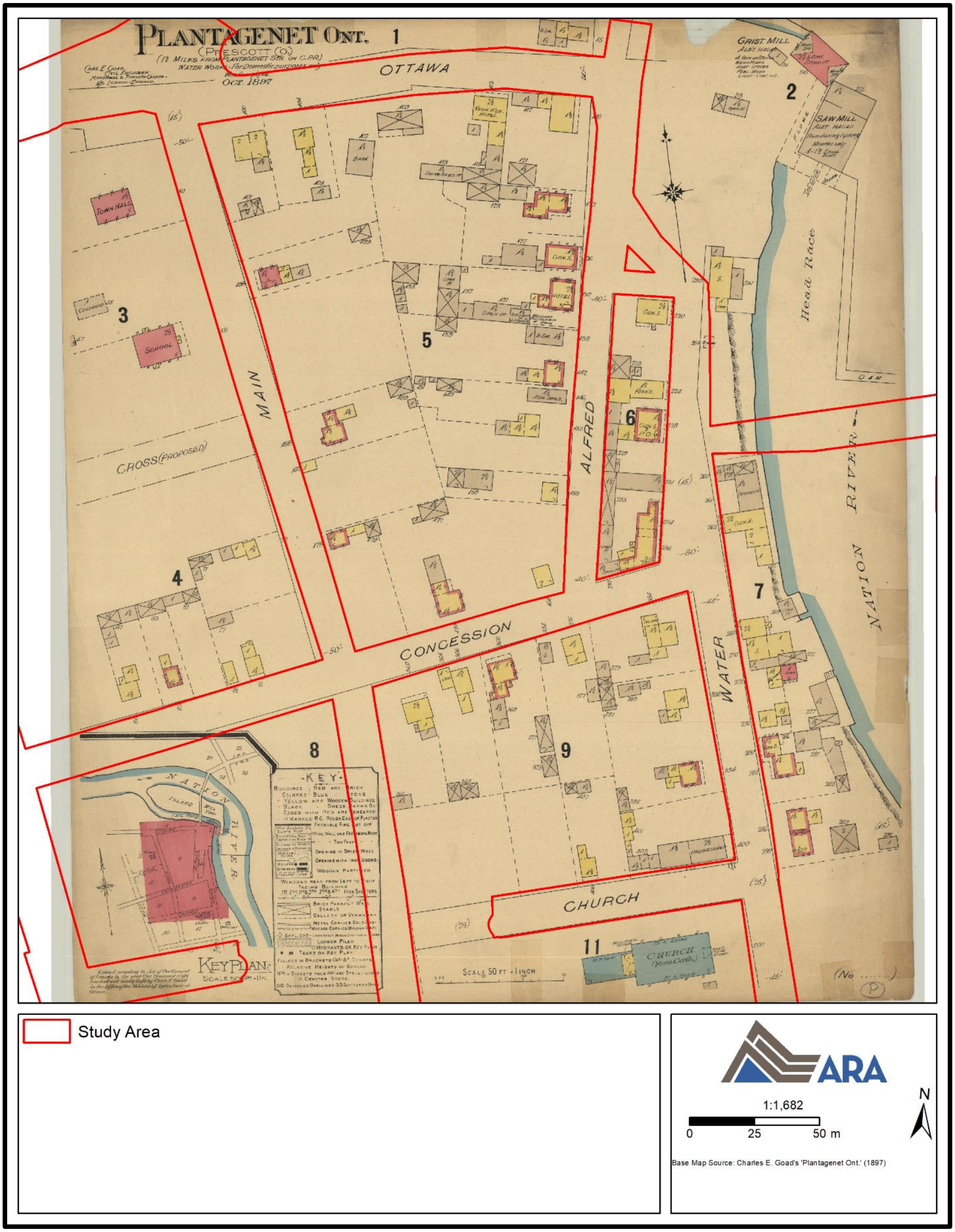
Base Map Source: D.P. Putnam's 'Map of the Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West' (1862)

Map 3: ***Map of the Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West*** **(1862)**
(Produced under licence using ArcGIS® software by Esri, © Esri; OHCMP 2019)

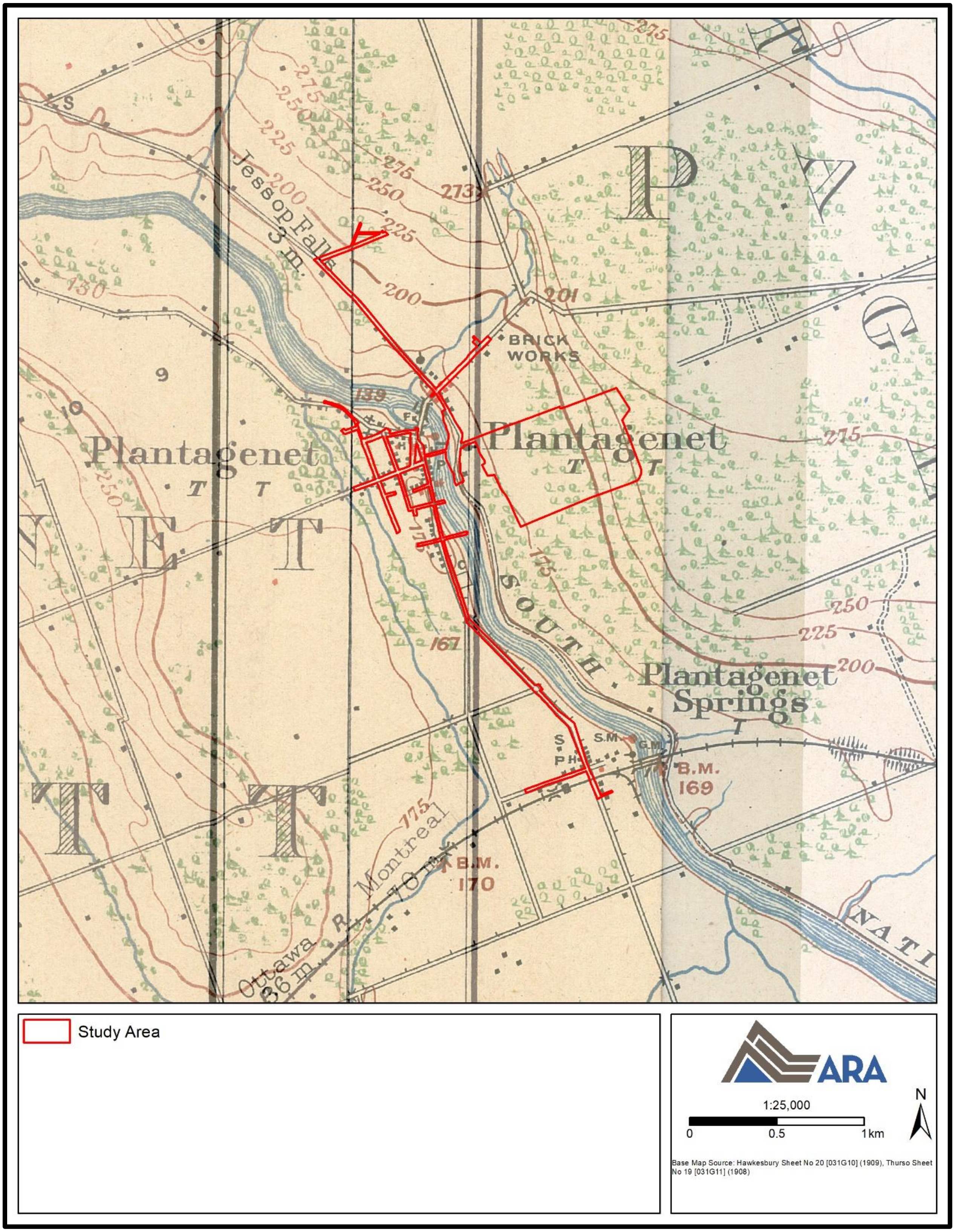


Base Map Source: 'Plantagenet' from H. Belden & Co.'s 'Illustrated atlas of the Dominion of Canada' (1881)

Map 4: ***Prescott and Russell Supplement in Illustrated Atlas of the Dominion of Canada*** **(1881)**
(Produced under licence using ArcGIS® software by Esri, © Esri; MU 2001)

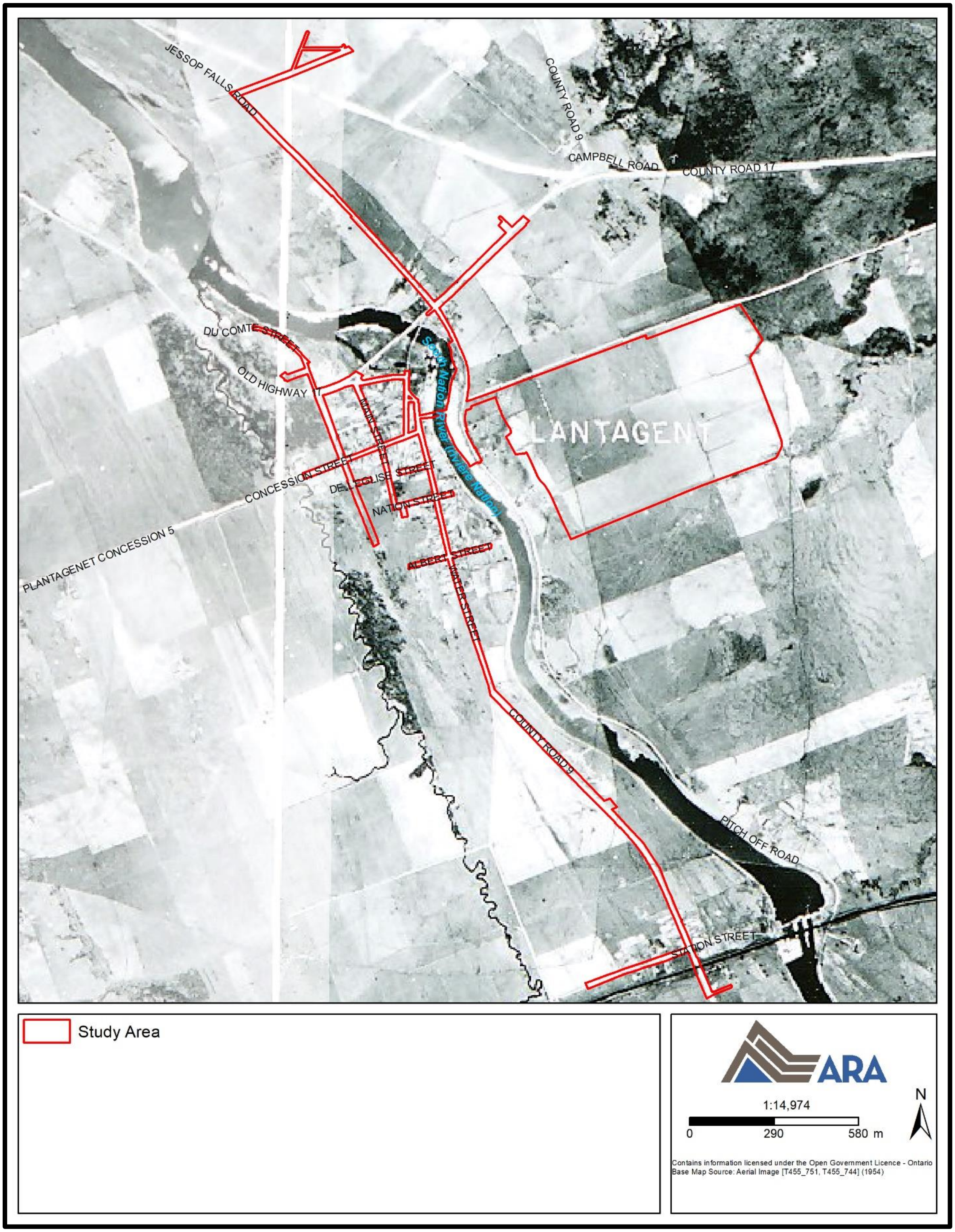


Map 5: Fire Insurance Plan (1897)
(Produced under licence using ArcGIS® software by Esri, © Esri; LAC 2022)

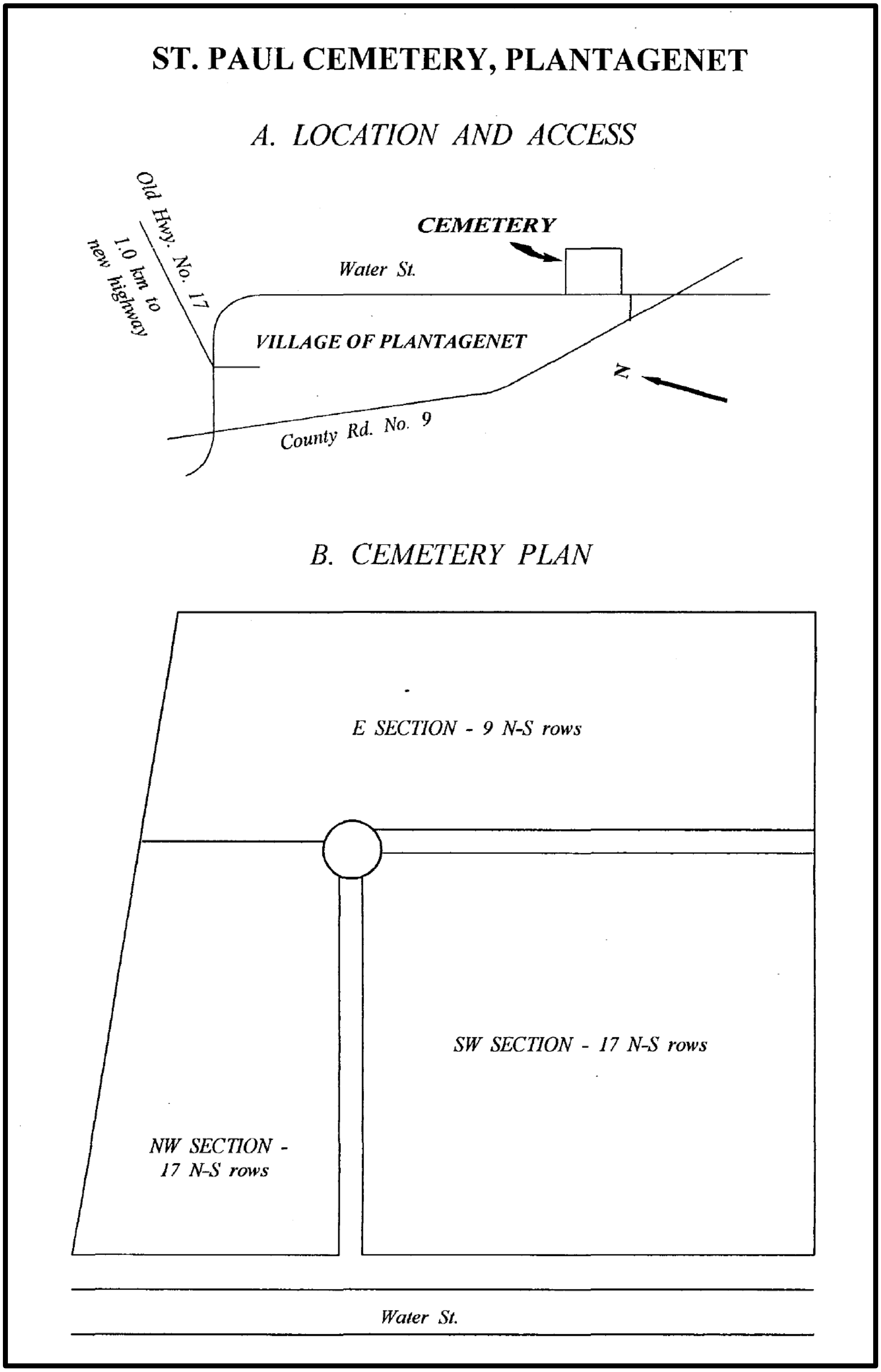


Base Map Source: Hawkesbury Sheet No 20 [031G10] (1909), Thurso Sheet No 19 [031G11] (1908)

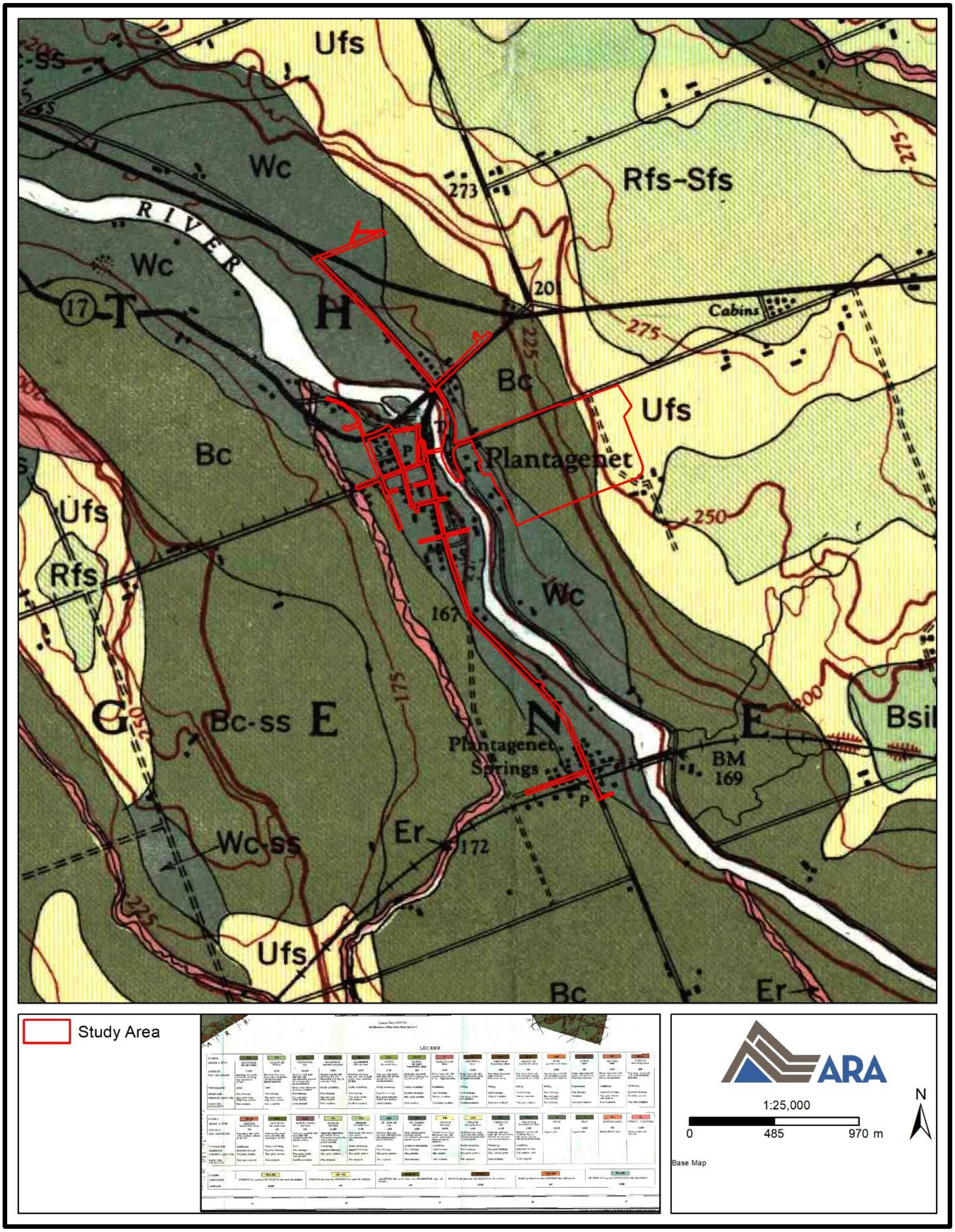
Map 6: Topographic Maps (1908 and 1909)
(Produced under licence using ArcGIS® software by Esri, © Esri; OCUL 2022)



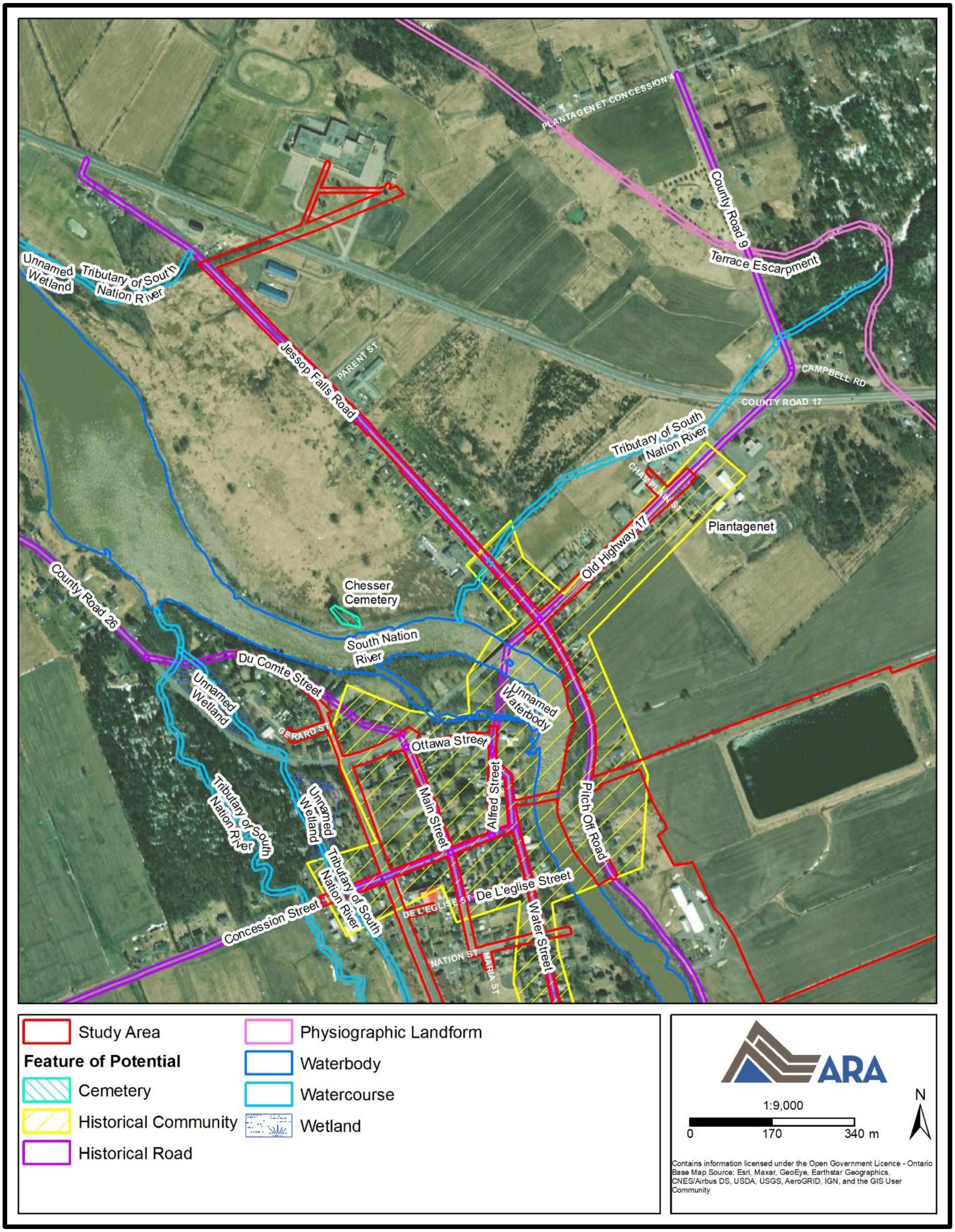
Map 7: Aerial Image (1954)
(Produced under licence using ArcGIS® software by Esri, © Esri; U of T 2022)



Map 8: St. Paul Roman Catholic Cemetery
(GHP 2018:3)



Map 9: Soil Map
(Produced under licence using ArcGIS® software by Esri, © Esri; Wicklund and Richards 1962)



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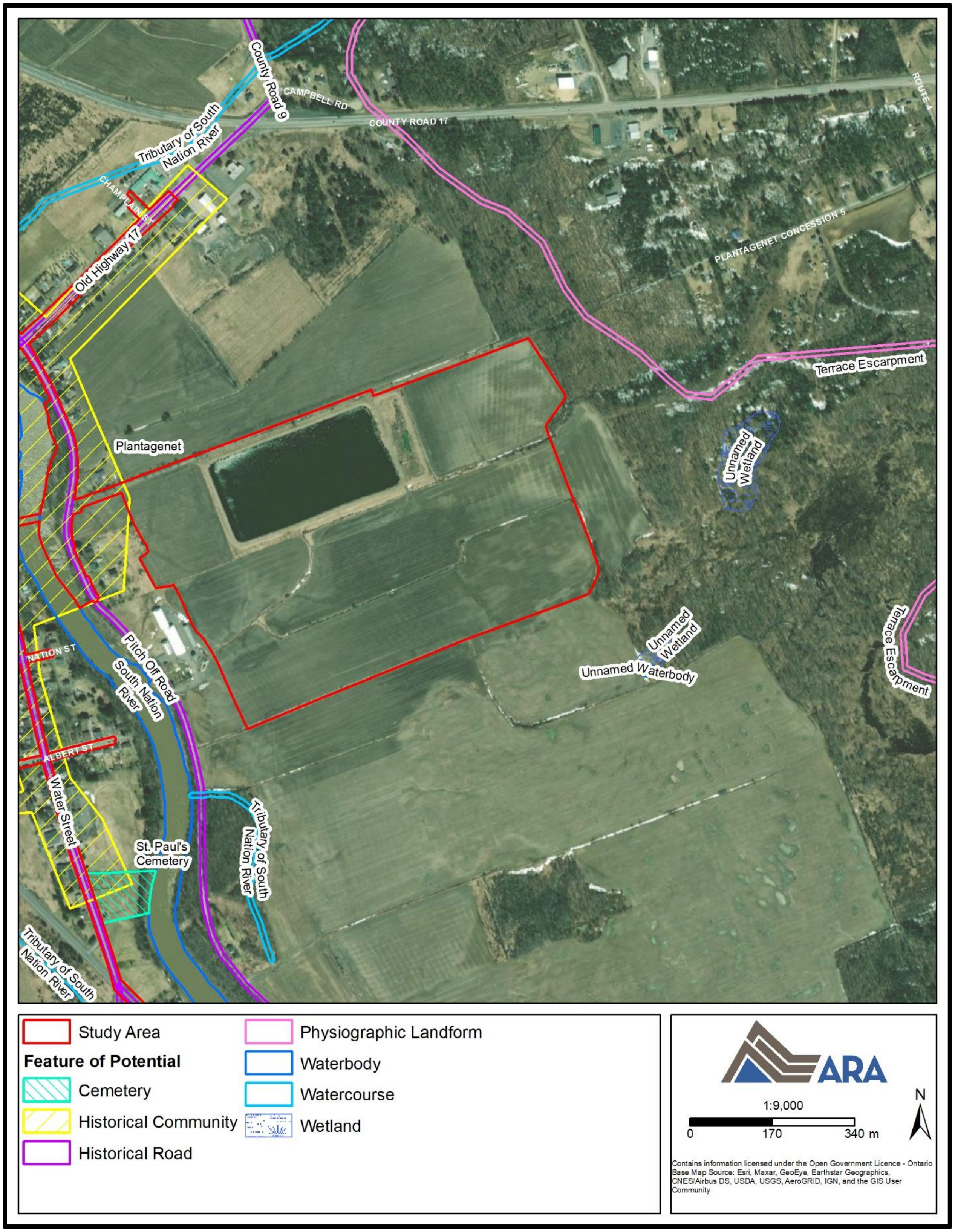
Base Map Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map 10: Features of Potential (North)
(Produced under licence using ArcGIS® software by Esri, © Esri)



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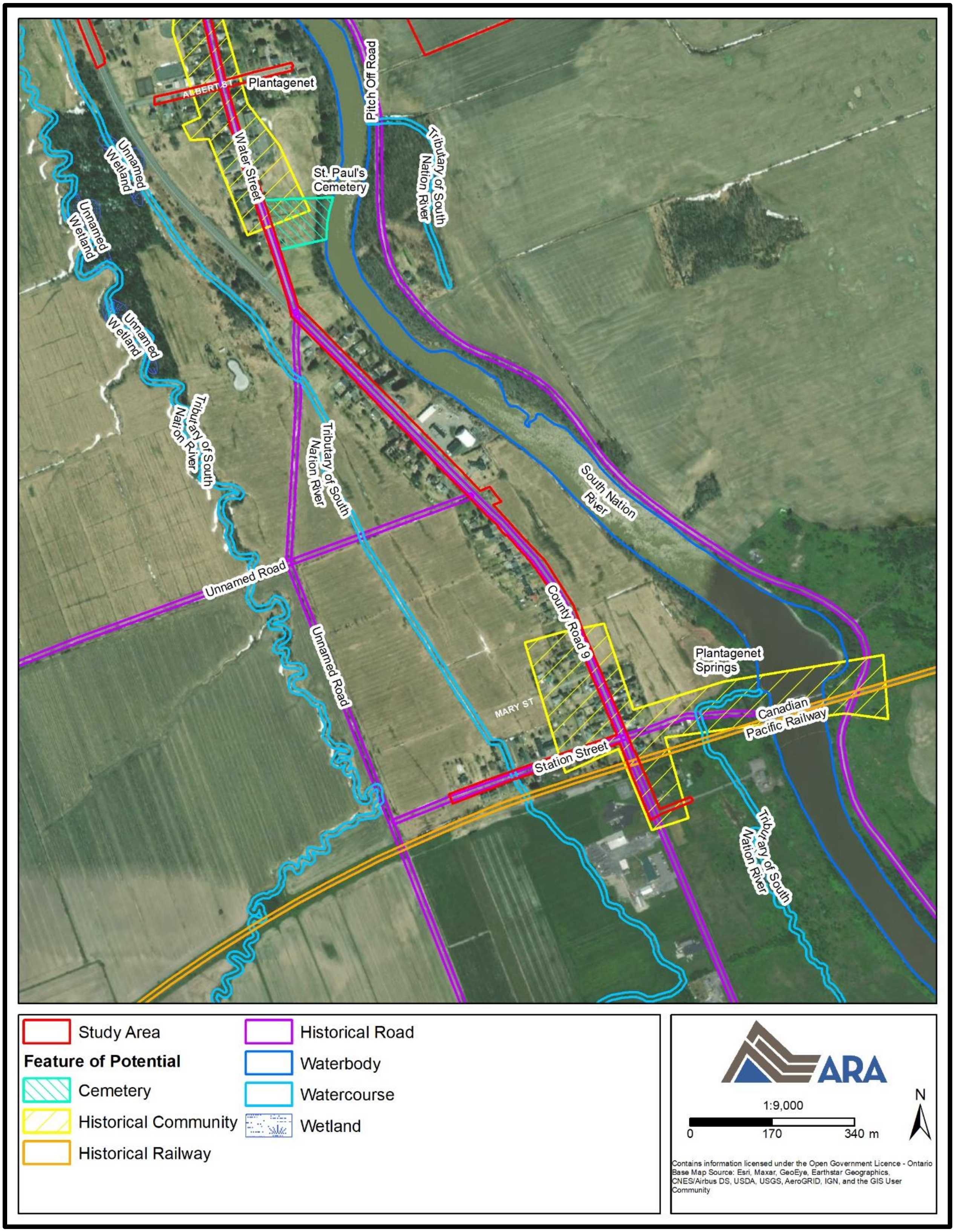
Map 11: Features of Potential (East)
(Produced under licence using ArcGIS® software by Esri, © Esri)



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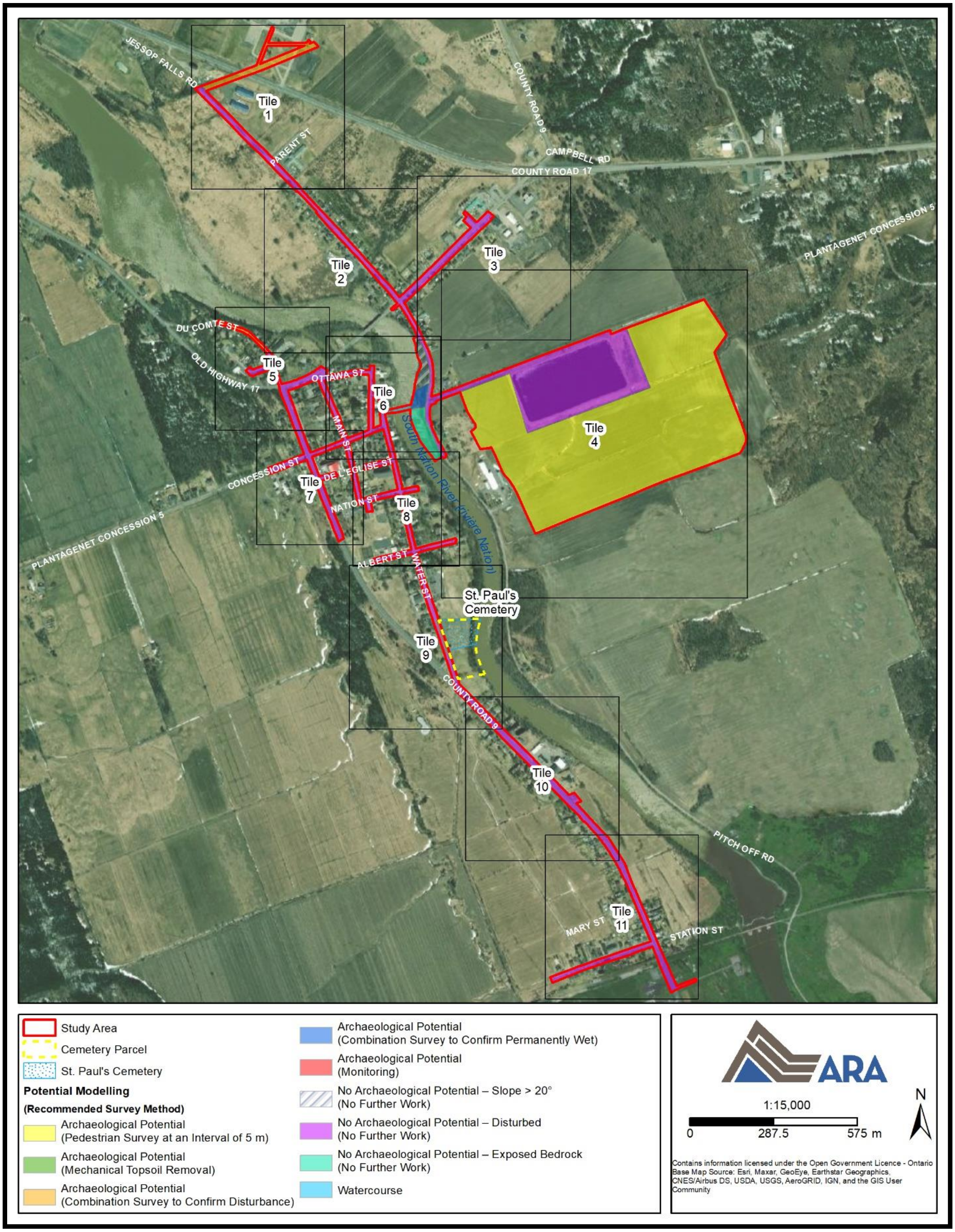
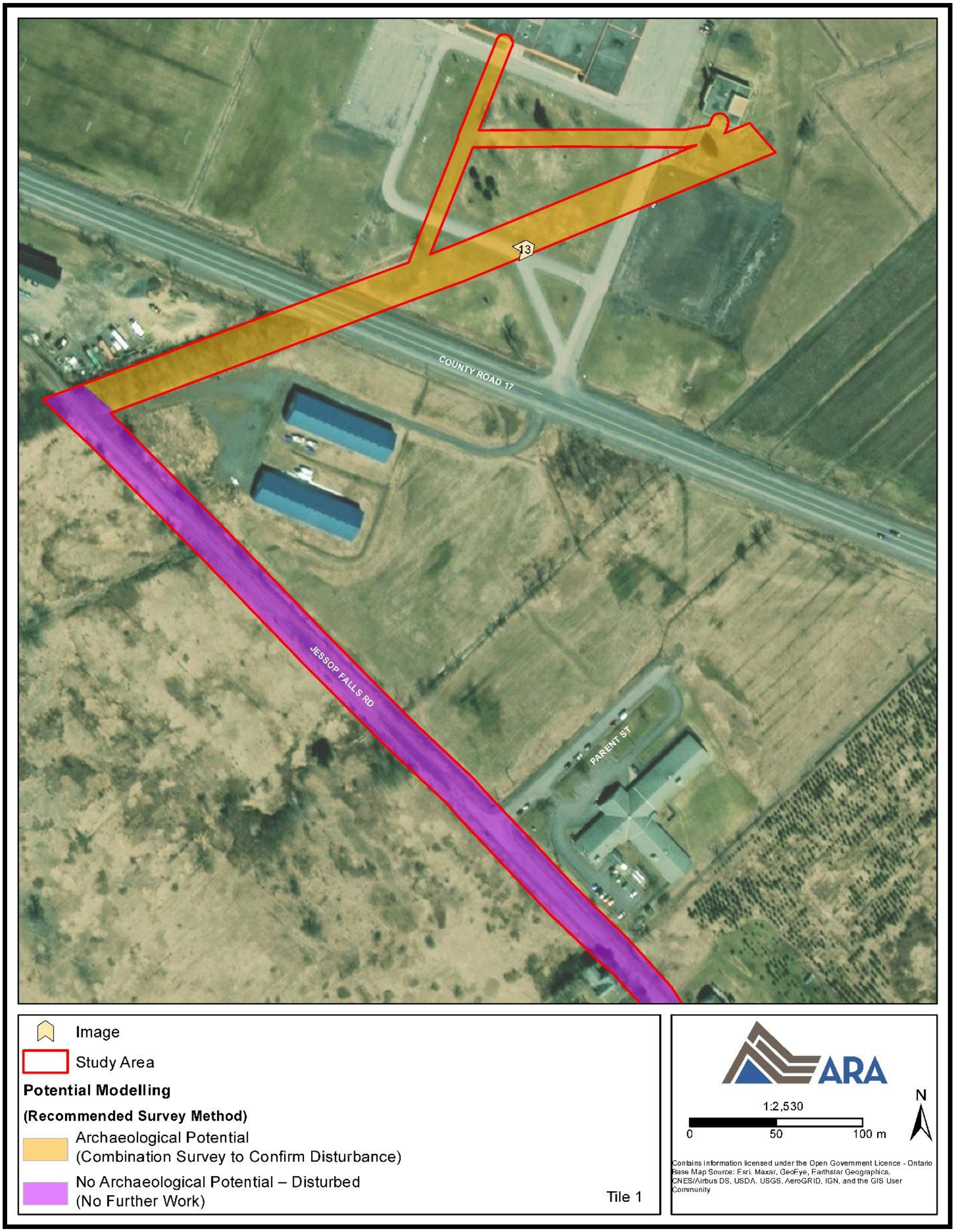
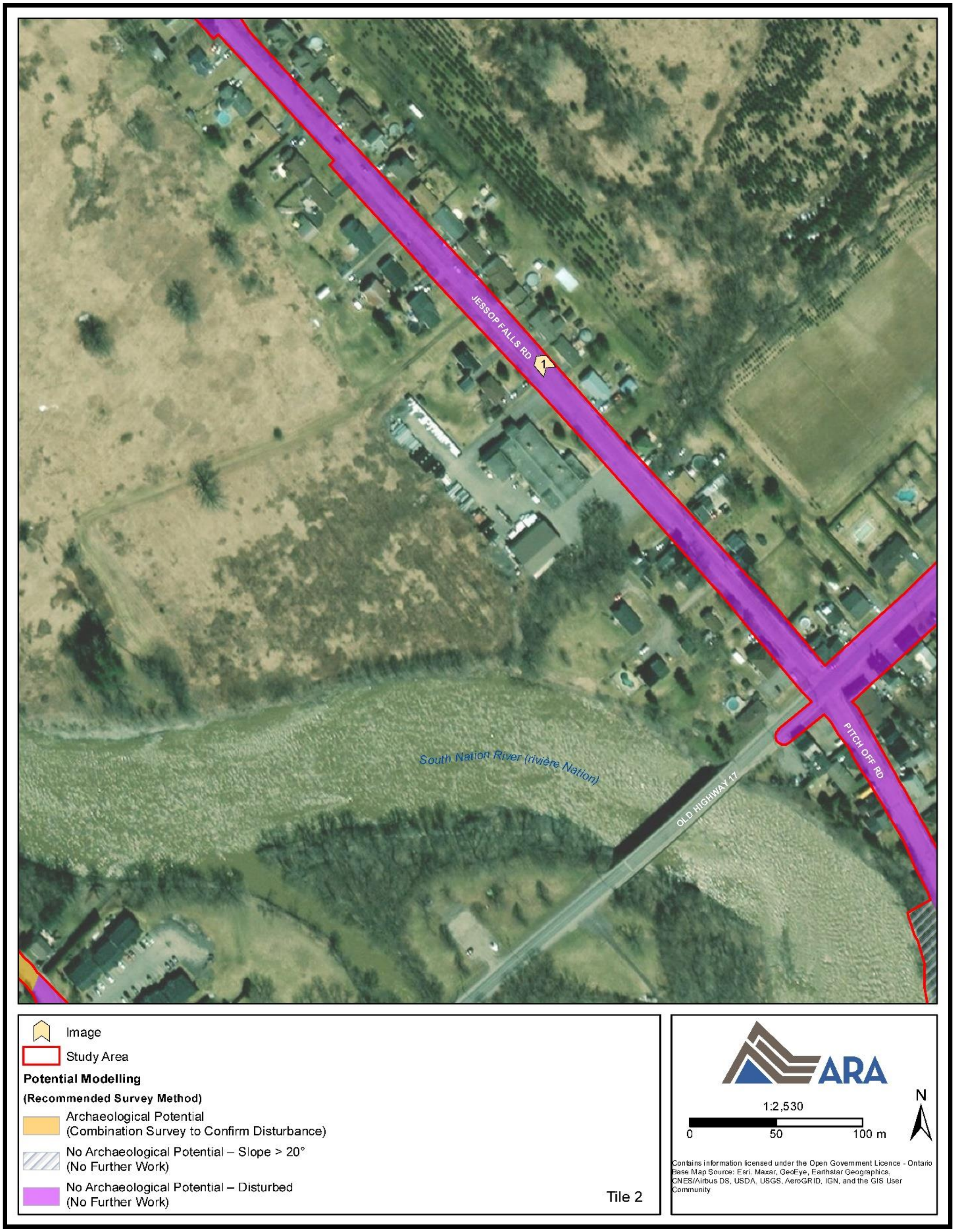
Map 12: Features of Potential (South)
(Produced under licence using ArcGIS® software by Esri, © Esri)



Map 13: Potential Modelling and Recommendations (Overview)
(Produced under licence using ArcGIS® software by Esri, © Esri)

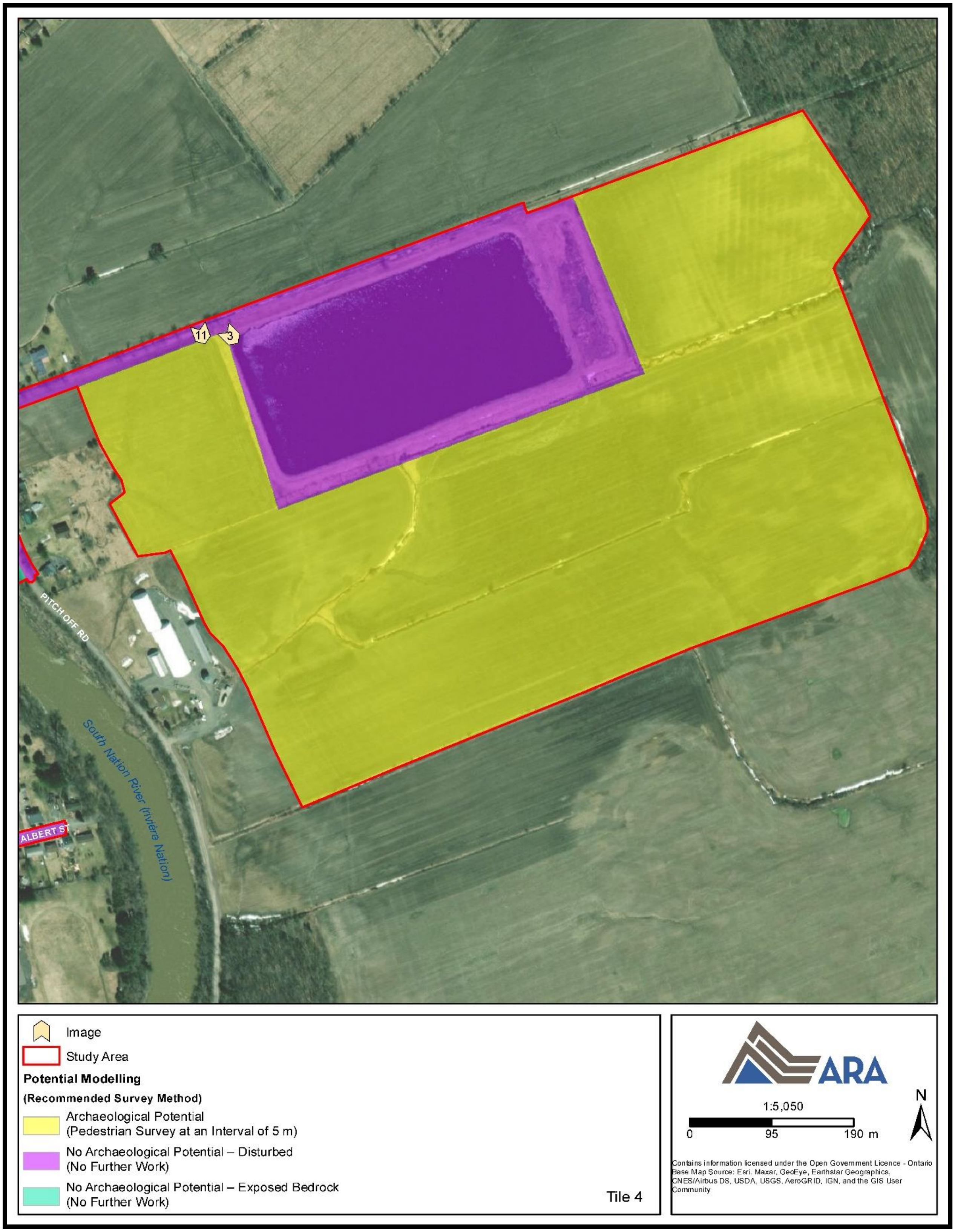


Map 14: Potential Modelling and Recommendations (Tile 1)
(Produced under licence using ArcGIS® software by Esri, © Esri)

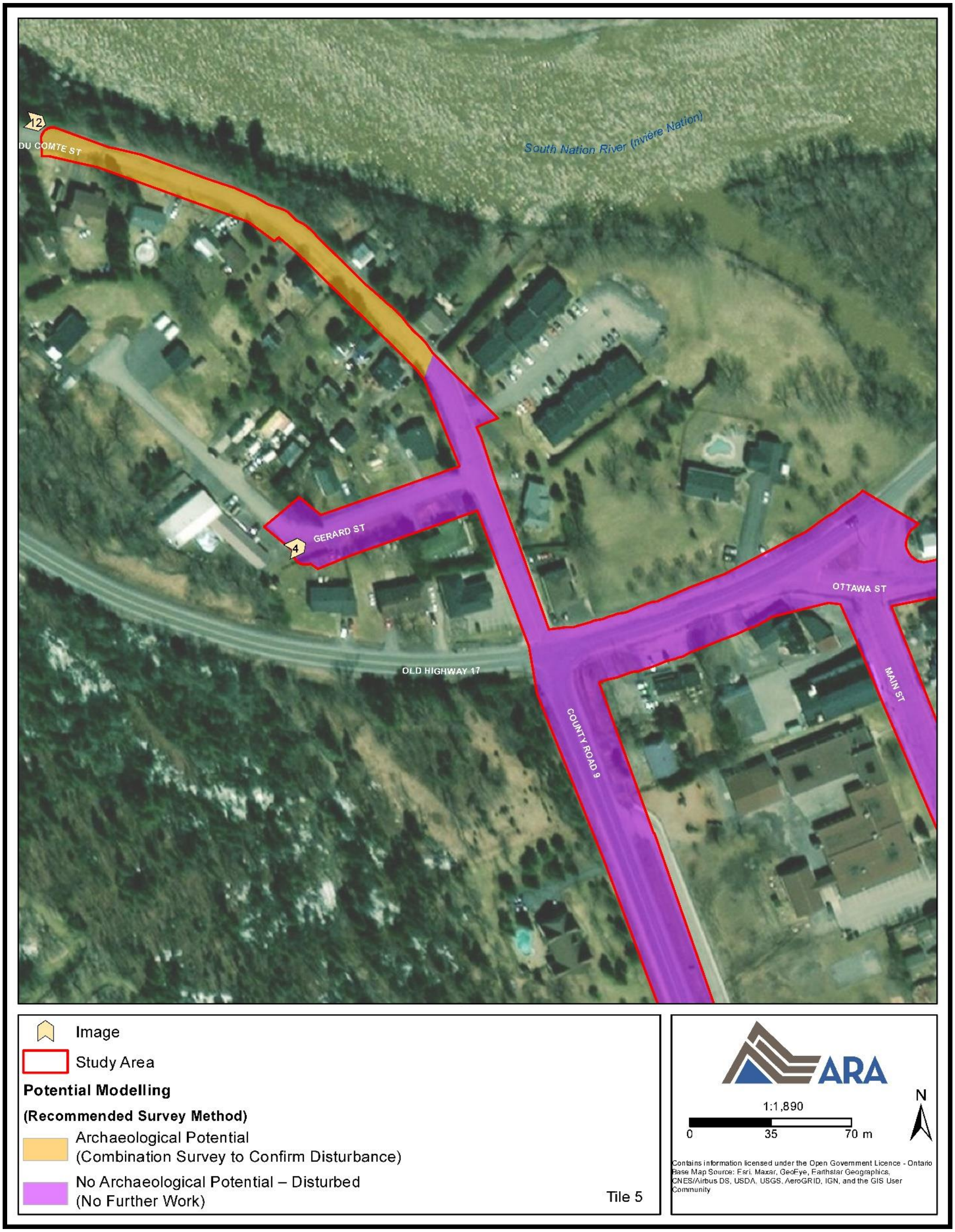


Map 15: Potential Modelling and Recommendations (Tile 2)
(Produced under licence using ArcGIS® software by Esri, © Esri)

Map 16: Potential Modelling and Recommendations (Tile 3)
(Produced under licence using ArcGIS® software by Esri, © Esri)



Map 17: Potential Modelling and Recommendations (Tile 4)
(Produced under licence using ArcGIS® software by Esri, © Esri)



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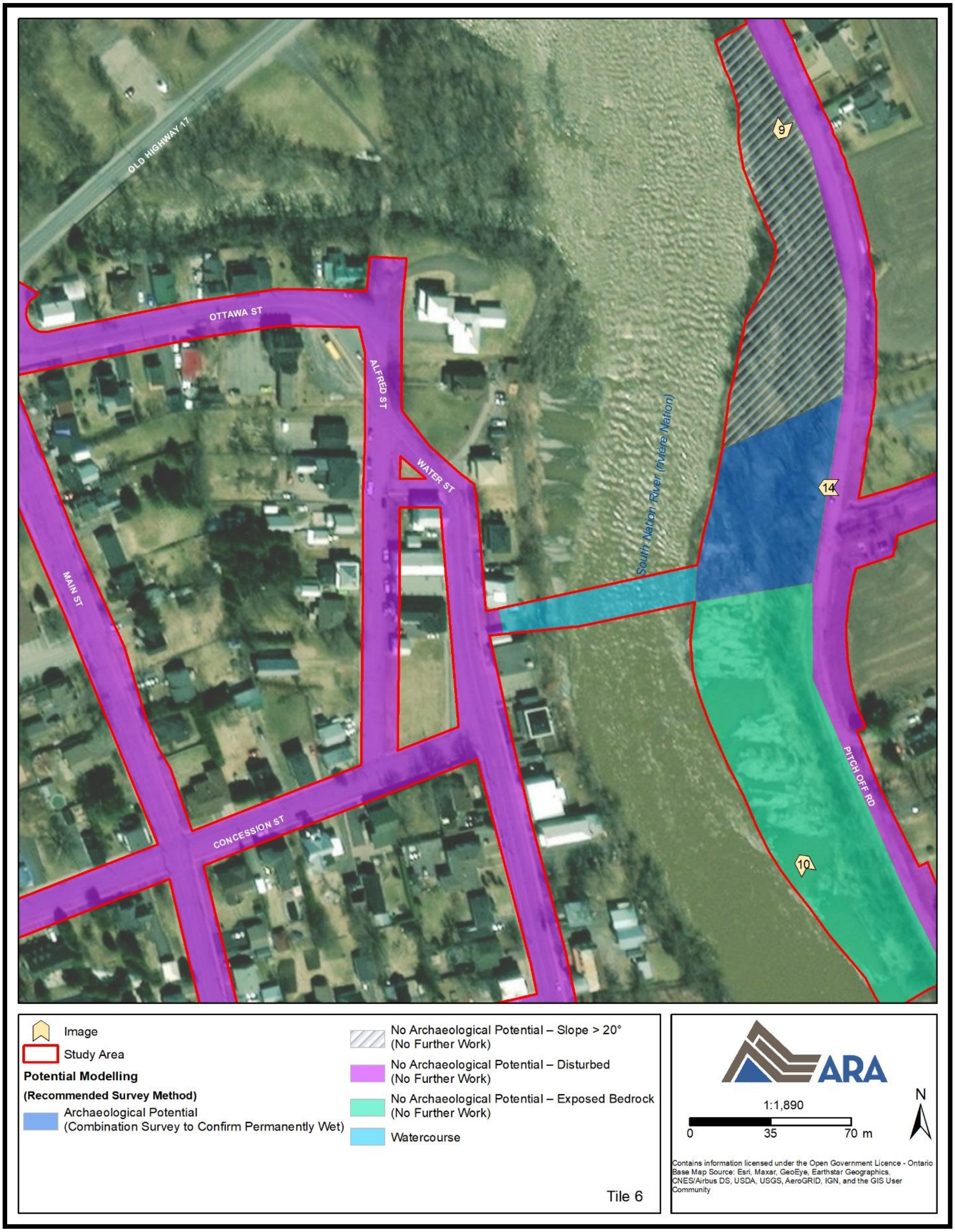
Map 18: Potential Modelling and Recommendations (Tile 5)
(Produced under licence using ArcGIS® software by Esri, © Esri)



Map 19: Potential Modelling and Recommendations (Tile 6)
(Produced under licence using ArcGIS® software by Esri, © Esri)

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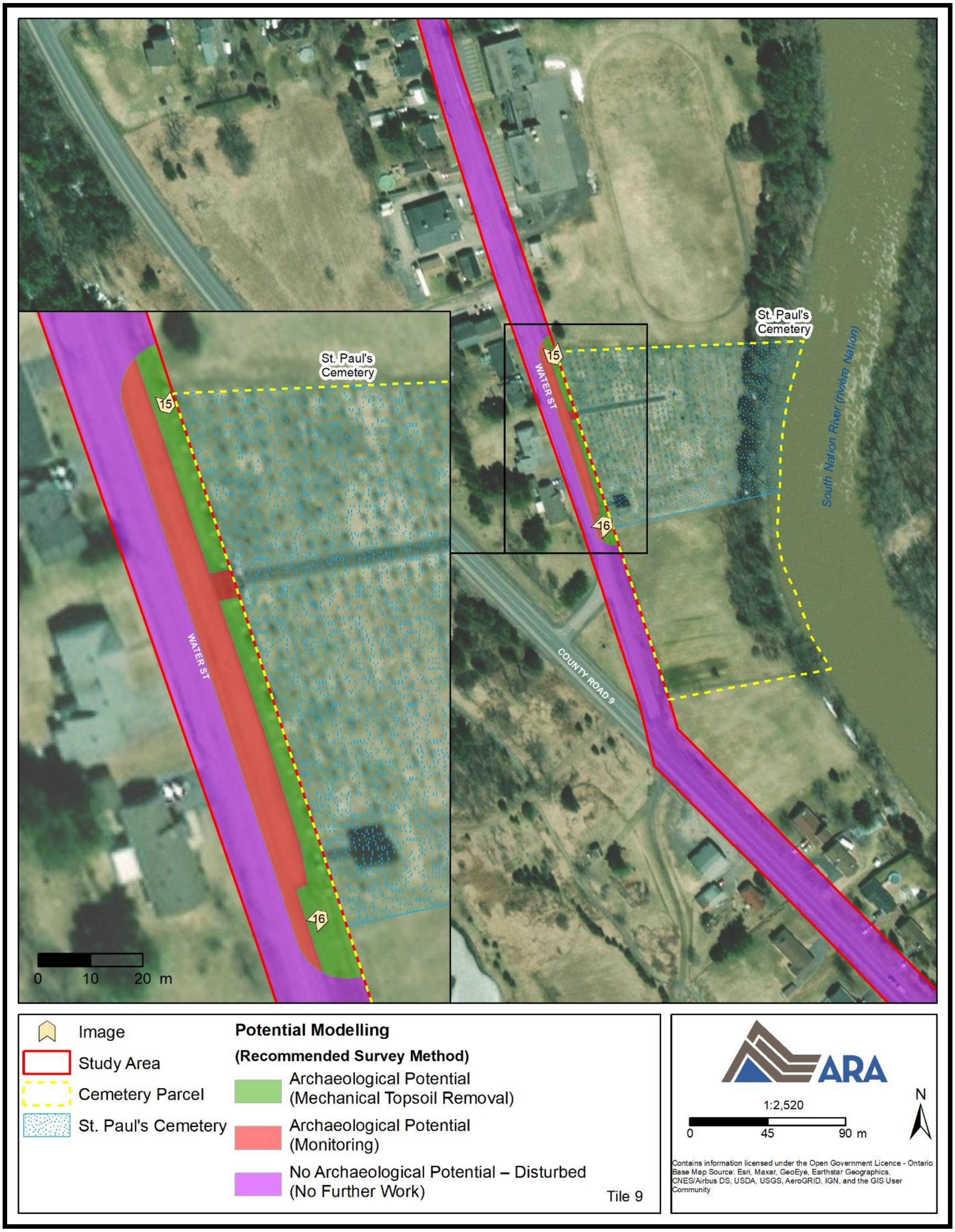
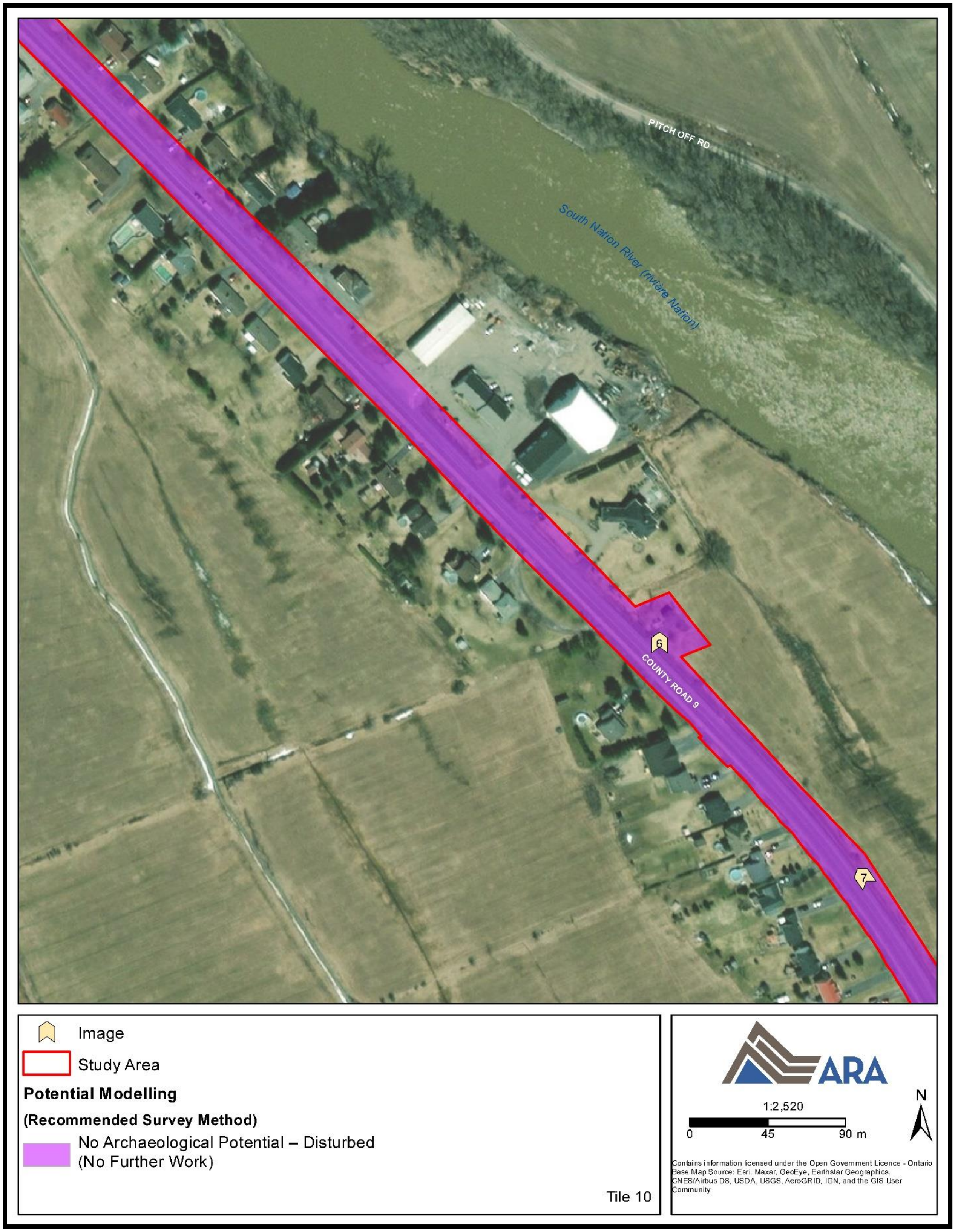
Map 20: Potential Modelling and Recommendations (Tile 7)
(Produced under licence using ArcGIS® software by Esri, © Esri)

Map 21: Potential Modelling and Recommendations (Tile 8)
(Produced under licence using ArcGIS® software by Esri, © Esri)



Map 22: Potential Modelling and Recommendations (Tile 9)
(Produced under licence using ArcGIS® software by Esri, © Esri)



Map 23: Potential Modelling and Recommendations (Tile 10)
(Produced under licence using ArcGIS® software by Esri, © Esri)

Map 24: Potential Modelling and Recommendations (Tile 11)
(Produced under licence using ArcGIS® software by Esri, © Esri)

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Appendix A8

Desktop Cultural Heritage Assessment Report (ARA, 2022)

Desktop Cultural Heritage Assessment Report
Plantagenet Wastewater Class Environmental Assessment
Township of Alfred and Plantagenet
United Counties of Prescott and Russell
Multiple Lots and Concessions
Geographic Township of Plantagenet
Former Prescott County, Ontario

Prepared for
J.L. Richards & Associates Ltd.
864 Lady Ellen Place
Ottawa, ON K1Z 5M2
Tel: (613) 728-3571

By
Archaeological Research Associates Ltd.
219-900 Guelph Street
Kitchener, ON N2H 5Z6
Tel: (519) 804-2291 Fax: (519) 286-0493
www.arch-research.com

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Project # 2022-0048

Revised
27/07/2022

EXECUTIVE SUMMARY

Under a contract awarded in March 2022, Archaeological Research Associates Ltd. (ARA) carried out a Desktop Cultural Heritage Assessment Report for the Municipal Class Environmental Assessment *Class Environmental Assessment of the Plantagenet Wastewater Collection and Treatment System* for the Township of Alfred and Plantagenet. The study area comprises approximately 65.44 ha and is located in Plantagenet, Ontario.

The study area consists of an irregularly shaped parcel of land with a total area of 65.44 ha. This parcel is bounded by agricultural and natural areas on all sides and is traversed by the South Nation River. In legal terms, the study area comprises part of Lots 7-8, Concession 4 and Lots 9-11, Concession 4 Old Survey in the Geographic Township of Plantagenet, Former Prescott County.

The Cultural Heritage Assessment Report approach included:

- Background research concerning the project and historical context of the project location;
- Consultation with Township of Alfred and Plantagenet staff regarding heritage matters in the project location;
- Identification of any designated or recognized properties within the limits of the project location;
- A desktop/virtual inspection and creation of an inventory of any properties with potential Built Heritage Resources and Cultural Heritage Landscapes within the project location;
- A description of the location and nature of potential cultural heritage resources;
- Evaluation of each potential cultural heritage resource against the criteria set out in Ontario Regulation 9/06 for determining cultural heritage value or interest;
- Evaluation of potential project impacts; and
- Provision of suggested strategies for the future conservation of identified cultural heritage resources.

As a result of consultation and field survey, 64 built heritage resources were identified within the study area as having potential cultural heritage value or interest along with 9 potential BHRs that could not be sufficiently evaluated through a desktop survey.11 CHLs within the study area as having potential cultural heritage value or interest along with 1 potential CHLs that could not be sufficiently evaluated through a desktop survey.

The following mitigation strategies are recommended to address the identified potential adverse impacts:

- That during subsequent planning and design phases, cultural heritage resources be avoided where possible and any construction staging areas be located on lands located well away from any of the identified BHRs and CHLs.
- That consideration should be given to the type of construction techniques and machinery used in close proximity to cultural heritage resources specifically those with little or no setbacks to ensure that there are impacts due to vibrations;
- That the design of any proposed project should not detract from the historic village character of the historic Plantagenet town centre located between Main Street and Water

Street between Ottawa Street and Concession Street and that any modifications should be sympathetic to the surrounding area and minimize impacts through appropriate design;

- That once design work has begun (i.e., 30% design), it should be reviewed against the findings in this CHAR and an update provided in an Impact Memo. Specifically, the memo should review all identified BHRs and CHLs and evaluate any impact of the design (or alternative design concepts), as well as outline avoidance/mitigation measures to minimize the impact. Depending on the nature of the impact (i.e., demolition, significant modification, or alteration) the review may result in additional studies being recommended (i.e., a Cultural Heritage Evaluation Report, Heritage Impact Assessment, Conservation Plan etc.). The review should be undertaken by a qualified heritage professional.
- That public consultation may result in additional potential cultural heritage resources being identified. These potential cultural heritage resources should be reviewed by a qualified heritage consultant to: 1) determine their CHVI, 2) evaluate potential project impacts, and 3) suggest strategies for future conservation of any candidate cultural heritage resources;
- That previously unrecognized cultural heritage resources with CHVI discussed in this assessment may be worthy of inclusion on a Municipal Heritage Register;
- That this CHAR should be provided to staff/planners at the municipal and regional level as needed and;
- That a Stage 1 and Stage 2 archaeological assessment has been completed with no further assessment required. No soil disturbing activities should take place until all archaeological concerns are mitigated and all reports are accepted by the MTCS.

TABLE OF CONTENTS

MAPS

TABLES

FIGURES

APPENDICES

GLOSSARY OF ABBREVIATIONS

ARA – Archaeological Research Associates Ltd.
BAO – Bereavement Authority of Ontario
BHR – Built Heritage Resource

CHER – Cultural Heritage Evaluation Report
CHL – Cultural Heritage Landscape
CHVI – Cultural Heritage Value or Interest
EA – Environmental Assessment
HIA – Heritage Impact Assessment
HSMBC – Historic Sites and Monuments Board of Canada
MCEA – Municipal Class Environmental Assessment
MOE – Ministry of Environment
MTCS – Ministry of Tourism, Culture and Sport
OHA – Ontario Heritage Act
OHT – Ontario Heritage Trust
O. Reg. – Ontario Regulation
PIC – Public Information Centre
PPS – Provincial Policy Statement

PERSONNEL

Project Director: P.J. Racher, MA, CAHP
Heritage Operations Manager: J. McDermid, BA, CAHP
Project Manager: J. McDermid
Field Survey: A. Bousfield-Bastedo, BA, Dip. Heritage Conservation, M. Maika, MA
Historical Research: S. Clarke, BA, CAHP
Cartographer: A. Bailey (GIS), K. Brightwell (GIS),
Report Writers: A. Bousfield-Bastedo
Editor: A. Barnes MA, CAHP

Two-page Curriculum Vitae (CV) for key team members that demonstrate the qualifications and expertise necessary to perform cultural heritage work in Ontario are provided in Appendix A.

1.0 PROJECT CONTEXT

Under a contract awarded in March 2022, Archaeological Research Associates Ltd. (ARA) carried out a Desktop Cultural Heritage Assessment Report (CHAR) for the Municipal Class Environmental Assessment *Class Environmental Assessment of the Plantagenet Wastewater Collection and Treatment System* for the Township of Alfred and Plantagenet. The study area comprises approximately 65.44 ha and is located in Plantagenet, Ontario.

The study area consists of an irregularly shaped parcel of land with a total area of 65.44 ha (see Map 1). This parcel is bounded by agricultural and natural areas on all sides and is traversed by the South Nation River. In legal terms, the study area comprises part of Lots 7-8, Concession 4 and Lots 9-11, Concession 4 Old Survey in the Geographic Township of Plantagenet, Former Prescott County.

The Ministry of Tourism, Sport and Culture (MTCS) provides a screening checklist of *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* to assist with determining if a project may impact cultural heritage resources. A review of aerial imagery indicated that the study area contains cemeteries and multiple properties with buildings or structures that are 40 or more years old (Questions 4b and 4d).

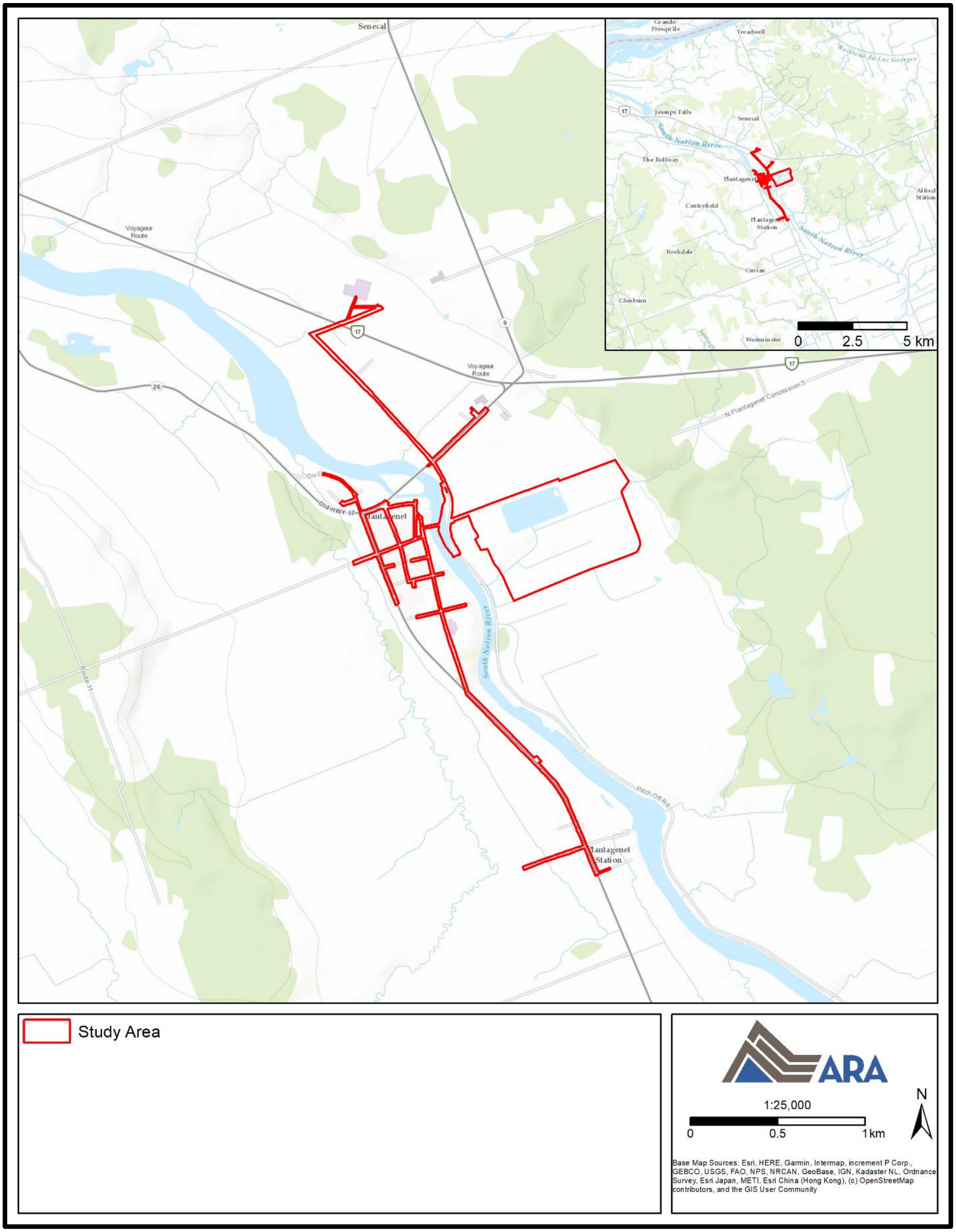
In addition to this general checklist, and due to the large study area, the MTCS recommended a three-step heritage review process specific to this project (MTCS 2021):

1. Describe the existing baseline cultural heritage conditions within the study area by identifying all known or potential built heritage resources and cultural heritage landscapes, including a historical summary of the study area. MTCS has developed screening criteria that may assist with this exercise: *Criteria for Evaluating for Potential Built Heritage Resources and Cultural Heritage Landscapes*.
2. Identify preliminary potential project-specific impacts on the known and potential built heritage resources and cultural heritage landscapes that have been identified. The report should include a description of the anticipated impact to each known or potential built heritage resource or cultural heritage landscape that have been identified.
3. Recommend measures to avoid or mitigate potential negative impacts to known or potential built heritage resources and cultural heritage landscapes. The proposed mitigation measures are to inform the next steps of project planning and design.

The MTCS noted that Steps 2 and 3 could be carried out at a later date. As a result, ARA has completed the draft report that satisfies Step 1, a Desktop Existing Conditions: Cultural Heritage Resources report.

The purpose of this assessment is to identify and evaluate any potential cultural heritage resources within and adjacent to the project location that may be impacted by the preliminary design concept. The cultural heritage assessment was carried out in accordance with current best practices and requirements set out in the following legislation and guidelines: the *Ontario Heritage Act* (R.S.O. 1990); *Provincial Policy Statement* (2020); Parks Canada's *Standards and Guidelines for the Conservation of Historic Places in Canada* (2010); the Ministry of Heritage, Sport, Tourism and

Culture Industries' *Ontario Heritage Tool Kit Series* (2006); as well as the 2018 *Prescott Russell Official Plan* and the 2010 *Official Plan of Urban Areas of Township of Alfred and Plantagenet (OP).*



Map 1: Study Area in the Township of Alfred and Plantagenet
(Produced by ARA under licence using ArcGIS® software by Esri, © Esri)

2.0 LEGISLATION AND POLICY REVIEW

The framework for this assessment report is provided by federal guidelines, provincial environmental and planning legislation and policies as well local municipal Official Plans and guidelines.

2.1 Federal Guidelines

At the national level, *The Standards and Guidelines for Conservation of Historic Places in Canada* (Parks Canada 2010) provides guidance for the preservation, rehabilitation and restoration of historic places, including cultural heritage landscapes (CHLs) and built heritage resources (BHRs). Such guidance includes the planning and implementation of heritage conservation activities.

2.2 Provincial Policies and Guidelines

2.2.1 Environmental Assessment Act and Guideline

An Environmental Assessment (EA) is a study that evaluates both the potential positive and/or negative effects of a project on the environment. Within the *Environmental Assessment Act*, the environment includes *"*any building, structure, machine or other device or thing made by humans*."* (Government of Ontario 2010). This study is conducted as part of recommendations within a streamlined EA process known as a Municipal Class EA (MCEA), which applies to routine projects grouped into classes that range from A (minor undertakings) to C (construction of new large facilities). The MCEA applies to municipal infrastructure undertakings including roads, water and wastewater projects.

The *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments* indicates a need to describe the "affected environment" that is "a spatially defined area within which land will be altered as a result of the proponent's development" (MTCS 1992:3). As such, ARA completes research and evaluation of any potential cultural heritage resource within the project area. ARA's business practice also considers the project location and any adjacent properties. This ensures that every BHR and CHL that may be subject to potential indirect project impacts is identified.

2.2.1 Planning Act

Section 2 of the Ontario *Planning Act* indicates that a council of a Municipality have regard for matters of provincial interest such as: "(d) the conservation of features of significant architectural, cultural, historical, archaeological or scientific interest" (Government of Ontario 2018). Section 3 of the *Planning Act* directs a municipal Council's decision to be consistent with the *Provincial Policy Statement* (PPS 2020).

2.2.2 The Provincial Policy Statement (2020)

The *Provincial Policy Statement* (PPS 2020) contains a combined statement of the Province's land use planning policies. It provides the provincial government's policies on a range of land use planning issues including cultural heritage. As outlined in Section 2.0 on Wise Use of and

Management of Resources: “Ontario's long-term prosperity, environmental health, and social well-being depend on conserving biodiversity, protecting the health of the Great Lakes, and protecting natural heritage, water, agricultural, mineral and cultural heritage and archaeological resources for their economic, environmental and social benefits” (MMAH 2020:24). The PPS 2020 (MMAH 2020:31) promotes the conservation of cultural heritage resources through detailed polices in Section 2.6, such as “2.6.1 Significant built heritage resources and significant cultural heritage landscapes shall be conserved” and “2.6.3 Planning authorities shall not permit development and site alteration on adjacent lands to protected heritage property except where the proposed development and site alteration has been evaluated and it has been demonstrated that the heritage attributes of the protected heritage property will be conserved."

2.2.3 Ontario Heritage Act

The *Ontario Heritage Act* (*OHA*), R.S.O. 1990, c.018 is the guiding piece of provincial legislation for the conservation of significant cultural heritage resources in Ontario. The *OHA* gives provincial and municipal governments the authority and power to conserve Ontario’s heritage. The Act has policies which address individual properties (Part IV), heritage districts (Part IV), and allows municipalities to create a register of non-designated properties which may have cultural heritage value or interest (Section 27).

Generally, potential cultural heritage resources are identified by applying a 40-year rolling timeline. This timeline is considered an industry best practice (i.e., MTO 2008). A date of 40 years does not automatically attribute CHVI to a resource; rather, that it should be flagged as a potential resource and evaluated for CHVI.

In order to objectively identify cultural heritage resources, O. Reg. 9/06 made under the *OHA* sets out three principal criteria with nine sub-criteria for determining cultural heritage value or interest (CHVI) (MTCS 2006b:20–27). The criteria set out in the regulation were developed to identify and evaluate properties for designation under the *OHA*. Best practices in evaluating properties that are not yet protected employ O. Reg. 9/06 to determine if they have CHVI. In the absence of specific CHL evaluation criteria, O. Reg 9/06 is also applied to consider the built and natural features and the property as a whole. The O. Reg. 9/06 criteria include: design or physical value, historical or associative value and contextual value.

1. The property has design value or physical value because it,
    i. is a rare, unique, representative or early example of a style, type, expression, material or construction method,
    ii. displays a high degree of craftsmanship or artistic merit, or
    iii. demonstrates a high degree of technical or scientific achievement.

2. The property has historical value or associative value because it,
    i. has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community,
    ii. yields, or has the potential to yield, information that contributes to an understanding of a community or culture, or
    iii. demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community.

3. The property has contextual value because it,
    i. is important in defining, maintaining or supporting the character of an area,
    ii. is physically, functionally, visually or historically linked to its surroundings, or
    iii. is a landmark. O. Reg. 9/06, s. 1 (2).

An *OHA* designation provides the strongest heritage protection available for conserving cultural heritage resources.

2.3 Municipal Policies

2.3.1 Official Plan for the United Counties of Prescott and Russell (UCPR)

As part of the Implementation component of the *Prescott Russell Official Plan* (2018), Section 7.7 "Cultural Heritage Policies" contains policies specifically focused on cultural heritage resource conservation. With respect to conservation of cultural heritage resources throughout the Counties, Section 7.7 indicates that UCPR Council shall:

- *protect cultural heritage resources within their jurisdiction by using the Ontario Heritage Act for designation or conservation agreements;*
- *establish and keep a municipal register…; and*
- *establish a municipal heritage committee that will advise local council on heritage matters* (UCPR 2018:145).

In addition to a municipal register, the UCPR intends to keep a cultural heritage resource database which is to result in inventories of "significant heritage buildings, heritage districts, cultural heritage landscapes, archaeological sites, archaeological potential areas located within the County" (UCPR 2018:146). The *Official Plan for the United Counties of Prescott and Russell* (2018:146) indicates the UCPR shall ensure that lower tier municipalities' official plans have 'policies consistent with the heritage policies developed in the County official plan." Additionally, the OP indicates that:

> *Council shall require that identified heritage resources not yet listed in the municipal heritage register or Heritage Register are evaluated and conserved, as appropriate, through any legislated planning or assessment processes, including the Planning Act, the Environmental Assessment Act, the Ontario Heritage Act and the Cemeteries Act* (2018:146).

Policies are provided for the promotion of cultural heritage (subsection 7.7.3), cultural resources and waterfront development (subsection 7.7.4), accessibility and heritage conservation (subsection 7.7.5), waste reduction/adaptive reuse (subsection 7.7.6), energy efficiency and heritage conservation (7.7.7), property maintenance and occupancy standards by-law (7.7.8) and the Algonquins of Ontario, their connection with areas within the County and their input/participation in the archaeological assessment process (subsection 7.7.9). The County outlines that cultural heritage resources are to include, but not be restricted to:

> *…significant built heritage, cultural significant heritage landscapes, archaeological sites, cemeteries and burials, buildings and structural remains of*

> *historical and architectural value, and human-made rural, village and urban districts or landscapes of historic and scenic interest* (UCPR 2018:147).

Archaeology is further addressed through policies under subsection 7.7.2 (Archaeological and Heritage Planning), subsection 7.7.2.1 (Archaeological Assessments) and subsection 7.7.2.2 (Marine Archaeological Resources).

2.3.2 Township of Alfred and Plantagenet

With respect to cultural heritage, Section 7.6.4 Heritage Conservation within *The Official Plan of Urban Areas of Township of Alfred and Plantagenet (OP)* begins by stating:

> *Council shall maintain a cultural heritage resource database and/or heritage management plans for land use planning, resulting in inventories of significant heritage buildings, heritage districts, cultural heritage landscapes, archaeological sites, and archaeological potential areas located within Alfred, Plantagenet and Wendover.* (2010:78).

In Policy 7.6.4.1 the Township of Alfred and Plantagenet indicates they seek to conserve and mitigate potential impacts to “all significant cultural heritage resources, when undertaking public works” (Township of Alfred and Plantagenet 2010:78). The Township further supports the importance of addressing impacts as they may require heritage impact assessment as part of the development process. Provisions of the *OHA* will be used by the Township to protect cultural heritage resources. Additionally, the Township OP provides direction concerning the conservation of archaeological resources.

2.4 Policy Conclusions

Policies in the *Prescott Russell Official Plan* and the *The Official Plan of Urban Areas of Township of Alfred and Plantagenet* call for the conservation of cultural heritage resources, the maintaining of heritage registers or database and provide policies related to potential development impacts to cultural heritage resources. The federal guidelines outline best practices for activities on heritage properties. This existing conditions’ report will address these cultural heritage policies as they relate to the Plantagenet Wastewater Collection and Treatment System project.

3.0 KEY CONCEPTS

The following concepts require clear definition in advance of the methodological overview and proper understanding is fundamental for any discussion pertaining to cultural heritage resources:

- **Adjacent lands** refers to “for the purposes of policy 2.6.3 [Planning authorities shall not permit development and site alteration on adjacent lands to protected heritage property except where the proposed development and site alteration has been evaluated and it has been demonstrated that the heritage attributes of the protected heritage property will be conserved, pg. 31], those lands contiguous to a protected heritage property or as otherwise defined in the municipal official plan”(MMAH 2020:39).

- **Cultural Heritage Value or Interest** (CHVI), also referred to as Heritage Value, is identified if a property meets one of the criteria outlined in O. Reg. 9/06 namely historic or associate value, design or physical value and/or contextual value. Provincial significance is defined under *Ontario Heritage Act (OHA) O. Reg*. 10/06.
- **Built Heritage Resource** (BHR) can be defined in the *PPS* as: "a building, structure, monument, installation or any manufactured or constructed part or remnant that contributes to a property's cultural heritage value or interest as identified by a community, including Indigenous community. Built heritage resources are located on property that has been designated under Parts IV or V of the *Ontario Heritage Act*, or that may be included on local, provincial and/or federal and/or international registers" (MMAH 2020:41).
- **Cultural Heritage Landscape** (CHL) is defined in the *PPS* as: "a defined geographical area that may have been modified by human activity and is identified as having cultural heritage value or interest by a community, including an Aboriginal community. The area may involve features such as structures, spaces, archaeological sites or natural elements that are valued together for their interrelationship, meaning or association. Examples may include, but are not limited to, heritage conservation districts designated under the *Ontario Heritage Act*; villages, parks, gardens, battlefields, mainstreets and neighbourhoods, cemeteries, trailways, viewsheds, natural areas and industrial complexes of heritage significance; and areas recognized by federal or international designation authorities (e.g., a National Historic Site or District designation, or a UNESCO World Heritage Site)" (MMAH 2020:42).
- **Conserved** means "the identification, protection, management and use of built heritage resources, cultural heritage landscapes and archaeological resources in a manner that ensures their cultural heritage value or interest is retained. This may be achieved by the implementation of recommendations set out in a conservation plan, archaeological assessment, and/or heritage impact assessment that has been approved, accepted or adopted by relevant planning authority and/or decision-makers. Mitigative measures and/or alternative development approaches can be included in these plans and assessments" (MMAH 2020:41).
- **Heritage Attributes** are defined as: "the principal features or elements that contribute to a protected heritage property's cultural heritage value or interest, and may include the property's built, constructed, or manufactured elements, as well as natural landforms, vegetation, water features, and its visual setting (e.g. significant views or vistas to or from a protected heritage property)." (MMAH 2020:44-45).
- **Protected heritage property** is defined as "property designated under Parts IV, V or VI of the Ontario Heritage Act; property subject to a heritage conservation easement under Parts II or IV of the Ontario Heritage Act; property identified by the Province and prescribed public bodies as provincial heritage property under the Standards and Guidelines for Conservation of Provincial Heritage Properties; property protected under federal legislation, and UNESCO World Heritage Sites" (MMAH 2020:49).
- **Significant** in reference to cultural heritage is defined as: "resources that have been determined to have cultural heritage value or interest. Processes and criteria for determining cultural heritage value or interest are established by the Province under the authority of the Ontario Heritage Act" (MMAH 2020:51).

4.0 HISTORICAL CONTEXT

The history of study area was constructed using background information obtained from aerial photographs, historical maps (i.e., illustrated atlases) and published secondary sources (online and print). Given the limited time frame for the production of this report there is always the possibility that additional historical information exists but may not have been identified or accessible for review.

The Township of Alfred and Plantagenet has a long history of Indigenous land use and settlement including Pre-Contact and Post-Contact campsites and villages. It should be noted that the written historical record regarding Indigenous use of the landscape in Eastern Ontario draws on accounts by European explorers and settlers. As such, this record details only a small period of time in the overall human presence in Ontario. Oral histories and the archaeological record show that Indigenous communities were mobile across great distances, which transcend modern understandings of geographical boundaries and transportation routes.

This historical context section spans the Pre-Contact Indigenous occupation history through Euro-Canadian settlement history to present. The early history of the study area can be effectively discussed in terms of major historical events. The principal characteristics associated with these events are summarized in Table 1 and Table 2.

4.1 Pre-Contact

The Pre-Contact history of the region is lengthy and rich, and a variety of Indigenous groups inhabited the landscape. Archaeologists generally divide this vibrant history into three main periods: Palaeo, Archaic, and Woodland. Each of these periods comprise a range of discrete sub-periods characterized by identifiable trends in material culture and settlement patterns, which are used to interpret past lifeways. The principal characteristics of these sub-periods are summarized in Table 1.

Table 1: Pre-Contact Settlement History
(Wright 1972; Ellis and Ferris 1990; Warrick 2000; Munson and Jamieson 2013)

Sub-Period	Timeframe	Characteristics
Early Palaeo	9000–8400 BC	Small bands move into southern Ontario; Mobile hunters and gatherers; Utilization of seasonal resources and large territories; Gainey, Barnes and Crowfield traditions; Fluted projectiles; Ottawa Valley remained on the fringe of early occupation at this time
Late Palaeo	8400–7500 BC	Holcombe, Hi-Lo and Lanceolate biface traditions; Continuing mobility; Campsite/Way-Station sites; Smaller territories are utilized; Non-fluted projectiles
Early Archaic	7500–6000 BC	Side-notched, Corner-notched (Nettling, Thebes) and Bifurcate traditions; Growing diversity of stone tool types; Heavy woodworking tools appear (e.g., ground stone axes and chisels)
Middle Archaic	6000–2500 BC	Laurentian tradition; Reliance on local resources; Populations increasing; More ritual activities; Fully ground and polished tools; Net-sinkers common; Earliest copper tools
Late Archaic	2500–900 BC	Narrow Point (Lamoka), Broad Point (Genesee) and Small Point (Crawford Knoll) traditions; Less mobility; Use of fish-weirs; True cemeteries appear; Stone pipes emerge; Long-distance trade (marine shells and galena)

Sub-Period	Timeframe	Characteristics
Early Woodland	900–400 BC	Meadowood tradition; Crude cord-roughened ceramics emerge; Meadowood cache blades and side-notched points; Bands of up to 35 people; Middlesex tradition attested within the St. Lawrence and Ottawa Valleys
Middle Woodland	400 BC–AD 600	Point Peninsula tradition; Vinette 2 ceramics appear; Small camp sites and seasonal village sites; Influences from northern Ontario and Hopewell area to the south; Hopewellian influence can be seen in continued use of burial mounds
Middle/Late Woodland Transition	AD 600–900	Gradual transition between Point Peninsula and later traditions; Princess Point tradition emerges elsewhere (i.e., in the vicinity of the Grand and Credit Rivers)
Late Woodland	AD 900–1600	Area occupied by Algonquian-speaking peoples; Eastern Algonquian tradition emerges; Developed alongside Iroquoian-speaking Huron-Petun of southern Ontario; Ceramic traditions predominantly derived from the south, but also influences from Lake Superior; Eastern Algonquians adopted smoking pipes and ossuary burials from Huron-Petun, but tool traditions and houses were dissimilar; Engaged in frequent dog burials; Adopted corn horticulture in a partial way; St. Lawrence Iroquoian and Haudenosaunee presence must also be considered; This area often fell under shared usage due to overlapping territories

Although Iroquoian-speaking populations tended to leave a much more obvious mark on the archaeological record and are therefore emphasized in the Late Woodland entries above, it must be understood that Algonquian-speaking populations also represented a significant presence in southern Ontario. Due to the sustainability of their lifeways, archaeological evidence directly associated with the Anishinaabeg remains elusive, particularly when compared to sites associated with the more sedentary agriculturalists. Many artifact scatters in southern Ontario were likely camps, chipping stations or processing areas associated with the more mobile Anishinaabeg, utilized during their travels along the local drainage basins while making use of seasonal resources. It must be recognized that this part of southern Ontario represents the ancestral territory of various Indigenous groups, each with their own land use and settlement pattern tendencies.

4.1.1 Post-Contact

The arrival of European explorers and traders at the beginning of the 17th century triggered widespread shifts in Indigenous lifeways and set the stage for the ensuing Euro-Canadian settlement process. Documentation for this period is abundant, ranging from the first sketches of Upper Canada and the written accounts of early explorers to detailed township maps and lengthy histories. The Post-Contact period can be effectively discussed in terms of major historical events, and the principal characteristics associated with these events are summarized in Table 2.

Table 2: Post-Contact Settlement History
(Smith 1846; Coyne 1895; Lajeunesse 1960; Cumming 1972; Ellis and Ferris 1990; JHA 1993; Surtees 1994; ORHDC 2005; AO 2015)

Historical Event	Timeframe	Characteristics
Early Exploration	Early 17th century	Brûlé explores southern Ontario in 1610/11; Champlain travels through in 1613 and 1615/1616, making contact with a number of Indigenous groups (including the Algonquin, Huron-Wendat and other First Nations); European trade goods become increasingly common and begin to put pressure on traditional industries; Names of bands suggest that Algonquin territorial organization was based on watersheds; Nipissings and Algonquins were involved in inter-tribal trade

Historical Event	Timeframe	Characteristics
Increased Contact and Conflict	Mid- to late 17th century	Conflicts between various First Nations during the Beaver Wars result in numerous population shifts; Nipissings and Algonquins tended to avoid the lower Ottawa in the summer due to Iroquois attacks; European explorers continue to document the area, and many Indigenous groups trade directly with the French and English; 'The Great Peace of Montreal' treaty established between roughly 39 different First Nations and New France in 1701
Fur Trade Development	Early to mid-18th century	Growth and spread of the fur trade; Bands of the Algonquin Nation occupied the Ottawa Valley; Many spent their summers at mission villages; Peace between the French and English with the Treaty of Utrecht in 1713; Ethnogenesis of the Métis; Hostilities between French and British lead to the Seven Years' War in 1754; French surrender in 1760
British Control	Mid- to late 18th century	*Royal Proclamation* of 1763 recognizes the title of the First Nations to the land; Algonquins and Nipissings attended the Niagara Treaty Council; Numerous treaties subsequently arranged by the Crown; First land cession under the new protocols is the Seneca surrender of the west side of the Niagara River in 1764; The Niagara Purchase (Treaty 381) in 1781 included this area
Loyalist Influx	Late 18th century	United Empire Loyalist influx after the American Revolutionary War (1775–1783); British develop interior communication routes and acquire additional lands; Crawford's Purchases completed in 1783 to provide land for the Loyalists; *Constitutional Act* of 1791 creates Upper and Lower Canada
County Development	Late 18th to early 19th century	Became part of Glengarry County in 1792; Prescott County established in 1800; Comprised the Townships of Alfred, Caledonia, Hawkesbury East, Hawkesbury West, Longueil, Plantagenet North and Plantagenet South; Initial settlement was slow as the county lacked a main road; Part of the United Counties of Prescott and Russell in 1820; Independent after the abolition of the district system in 1849
Township Formation	Early 19th century	The vicinity of what would become Plantagenet (Plantagenet Mills) was granted to Col. Fortune ca. 1811; Tract purchased by A. Hagar and J. Hagar in 1811, but J. Hagar sold his share in the business as the War of 1812 approached; A. Hagar funded the construction of a dam on the South Nation River, and a saw mill was in operation in 1812; J. Chesser became a partner prior to this, and oversaw the construction of the mills; French pioneers settled around 'The Mills'; Other early settlers included J. Campbell, P. Georgen, Mr. Charles and Col. Kearns; 'Irish Settlement' formed after 1817; A. Hagar removed to Plantagenet in 1818; The front of the Ottawa River was settled at a later date
Township Development	Mid-19th to early 20th century	Population reached 934 by 1842; 7,315 ha taken up by 1846, with 953 ha under cultivation; 1 grist mill and 1 saw mill in operation at that time; Plantagenet North and South established ca. 1848; Population of Plantagenet North was 2,539 in 1861, while Plantagenet South was 1,238; Traversed by the Canadian Pacific Railway's Montreal & Ottawa Line (1897/98) and Canadian Northern Railway (1909); Communities at Fournierville, Curran, Jessup's Falls, Kerry, Pendleton, Plantagenet, Plantagenet Springs, Riceville, Treadwell and Wendover

4.2 Plantagenet

The Village of Plantagenet was established in the early 19th century on the west side of the Nation River. In the early 19th century, mineral springs were identified on the south side of the Nation River at Plantagenet which were touted for their healing properties (Owler and Stevenson 1858:5,6; see Figure 1). As early as 1849, chemical analyses were undertaken on the springs' waters to better understand how they could be used medicinally. First-person accounts note that Plantagenet mineral waters cured cholera, rheumatism and general pain among others (Owler and Stevenson 1858:11-12). It is likely to assume that the Village of Plantagenet grew as a result of these mineral springs. It is also prudent to note that these springs were likely visited by Indigenous groups prior to the arrival of settlers for the same reasons. By 1869 Plantagenet was considered a post village and had a population of 200 residents of both English and French descent (McEvoy 1869: 595). At that time, Plantagenet had a post office, blacksmith, tanner, general merchant and lumber dealer, a dry goods store, a liquor dealer, tavern, hotel, harness maker and medical doctor. Twenty years later, the population of Plantagenet had doubled to 400 residents (Fuller 1889:234).

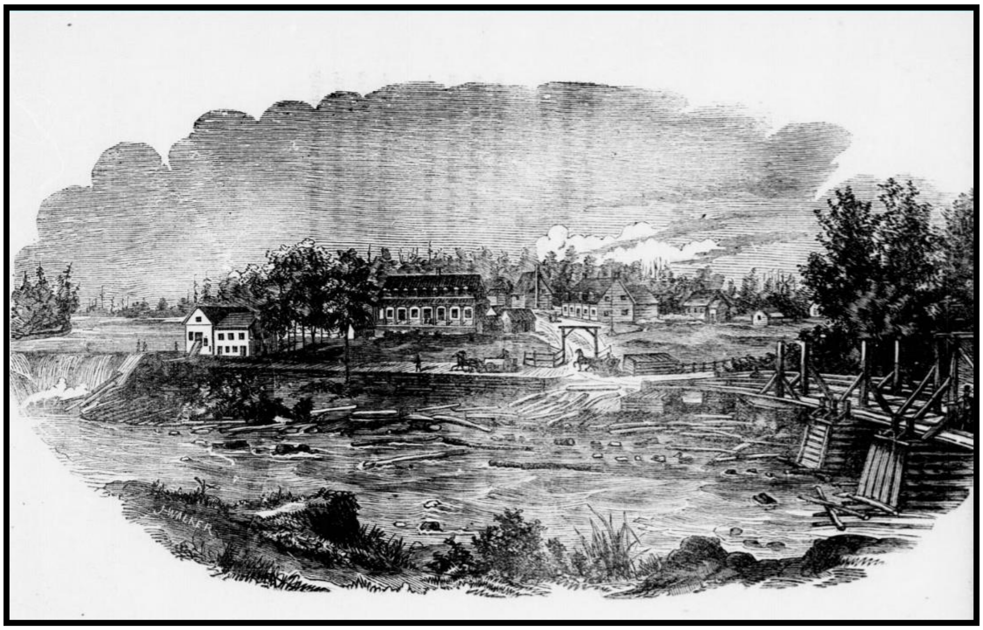


Figure 1: View of the Plantagenet Springs and Mill
(Adapted from Owler and Stevenson 1858)

4.3 Study Area

For this assessment, ARA examined three historical maps that documented past residents, structures (i.e., homes, businesses and public buildings) and features between the mid-19th and early 20th centuries, one fire insurance plan, two topographic maps and one aerial image were examined during the research component of the study. Specifically, the following resources were consulted:

- *North Plantagenet Township Map 27* Patent Plan (No Date);
- D.P. Putnam's *Map of the United Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West* (1861) (OHCMP 2022);
- H. Belden and Company's *Plantagenet* in the *Illustrated Atlas of the Dominion of Canada* (1881) (McGill University 2001);
- Goad's *Plantagenet* Fire Insurance Plan (1897) (LAC 1897);
- Topographic maps from 1908 and 1909 (OCUL 2022); and
- An aerial image from 1954 (University of Toronto 2022).

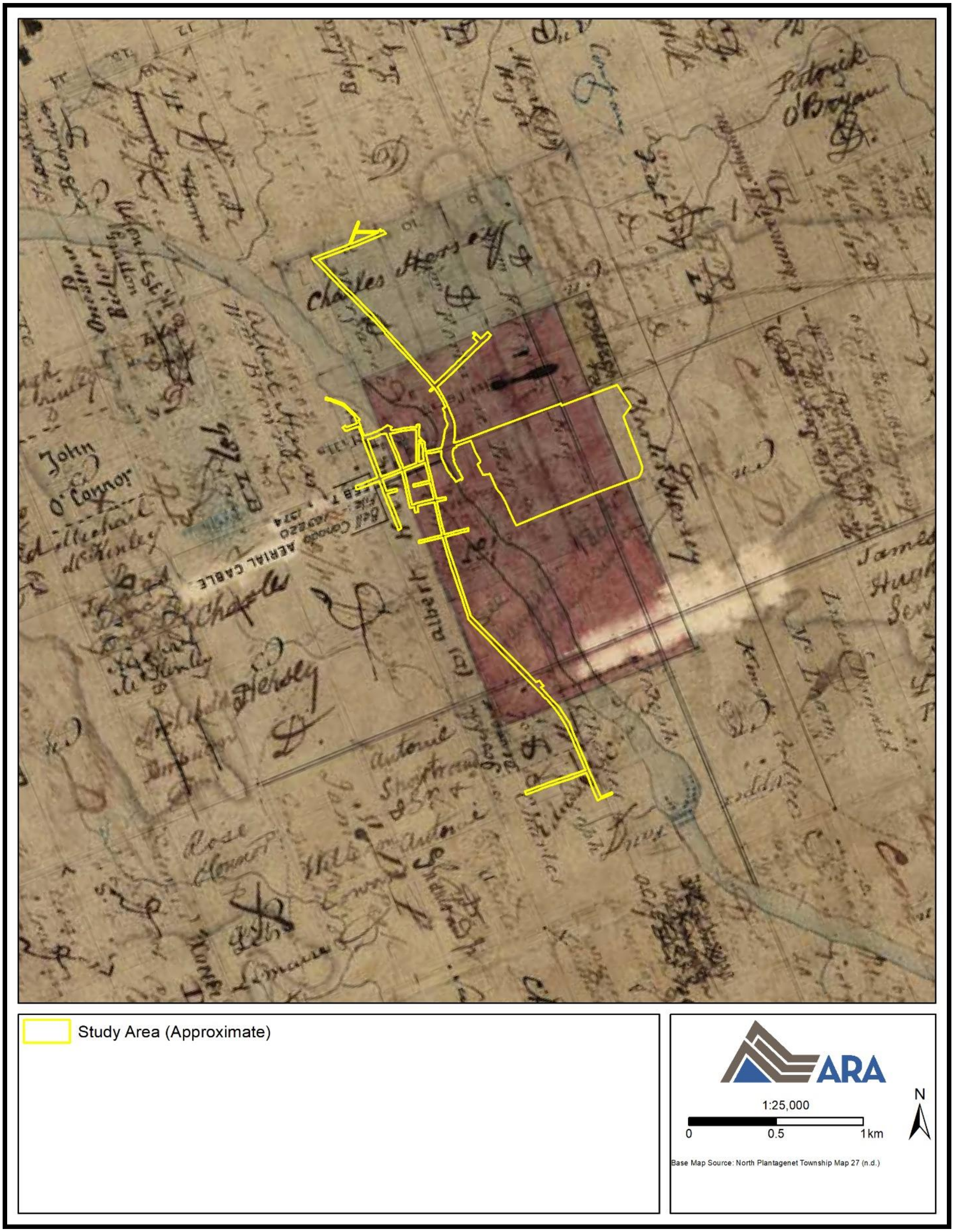
The 1862 *Map of the United Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West* indicates that the study area and Village of Plantagenet were generally well settled by this time (see Map 3). Old Highway 17, Water Street and Concession Road 5 had been laid and still follow the same general alignment as they do today. Settlement at Plantagenet was focused along the west side of Water Street opposite the grist and sawmills along the Nation River. The study area extends northwesterly from Plantagenet Springs to the postal village of Plantagenet, with another grist mill indicated to the on the west side of the Nation River to the south of the postal village.

H. Belden and Company's *Plantagenet* in the *Illustrated Atlas of the Dominion of Canada* (1881) does not show as much detail of the study area lands as depicted on the 1861 map, with a general absence of buildings within the postal village indicated (see Map 4). The extent of the mill property on either side of the Nation River at the postal village is shown to comprise a large part of the settlement at the north part of the study area. At the south end of the study area, Water Street has been realigned to follow the alignment seen today. The Plantagenet Mineral Springs are noted to the west of the south part of Water Street, with the Catarrca Mineral Springs located further west on the property of P.B. Winning.

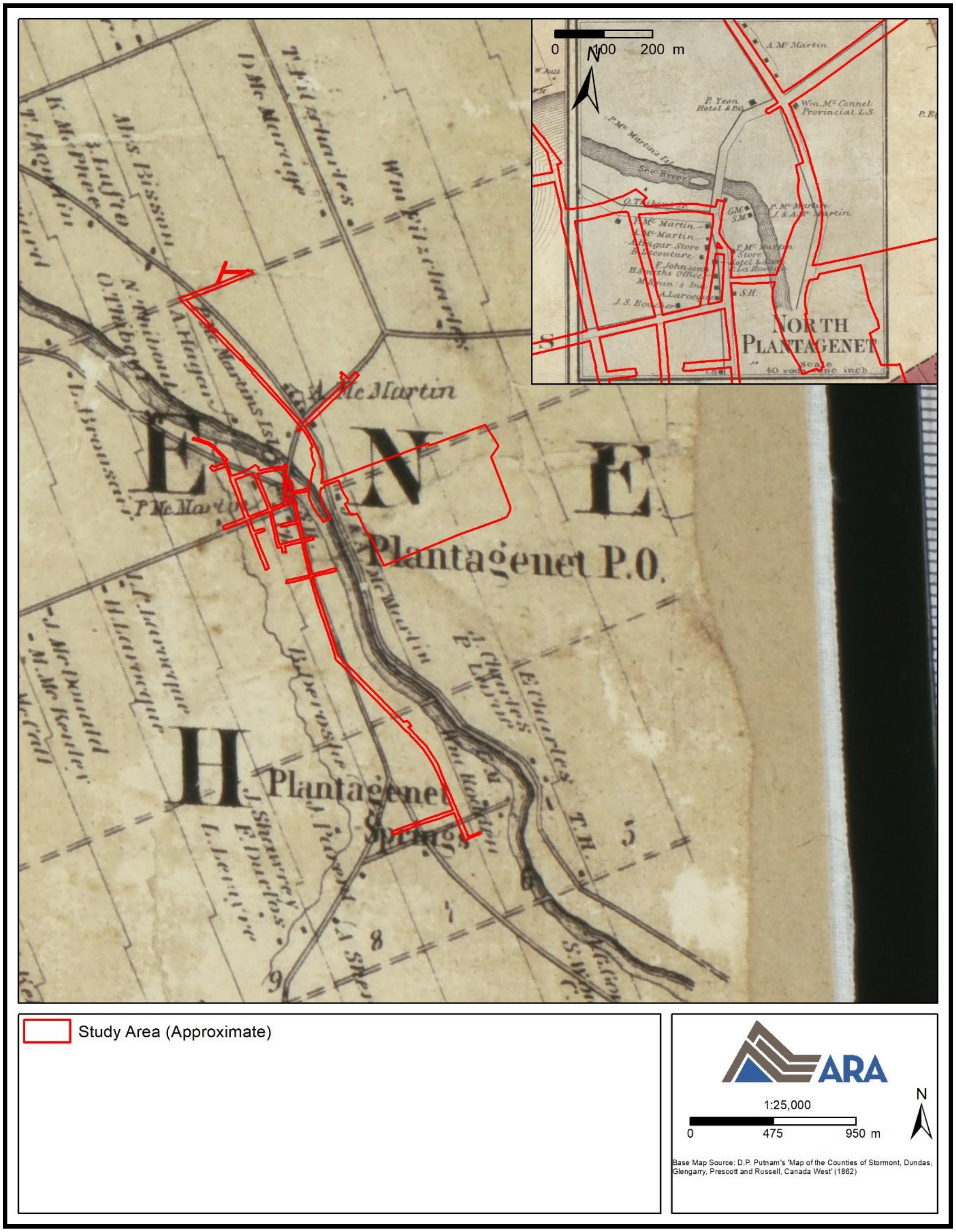
A fire insurance plan from 1897 shows the extent of development at the Village of Plantagenet at the north part of the study area (see Map 5). Roadways in this area follow their current alignment with primarily frame buildings or frame buildings clad in brick located in the village. One brick residence is located at Plantagenet at this time on the east side of Main Street. The only other brick buildings were the Town Hall and School located on the west side of Main Street and the grist mill at the Nation River to the east. The sawmill remained extant at this time, however the fire insurance plan notes that it is only run during the spring months.

A topographic map from 1909 depicts the growth of both the Village of Plantagenet at the north part of the study area and the settlement of Plantagenet Spring at the south end of the study area (see Map 6). It is unclear if a mill was still extant at the Village of Plantagenet at this time, however the mill at Plantagenet Springs remained extant. A brickworks is indicated on the south side of Highway 17, east of the Nation River and the a railway later amalgamated with he Canadian Pacific Ottawa and Montreal Railway traversed east-west through the settlement of Plantagenet Springs.

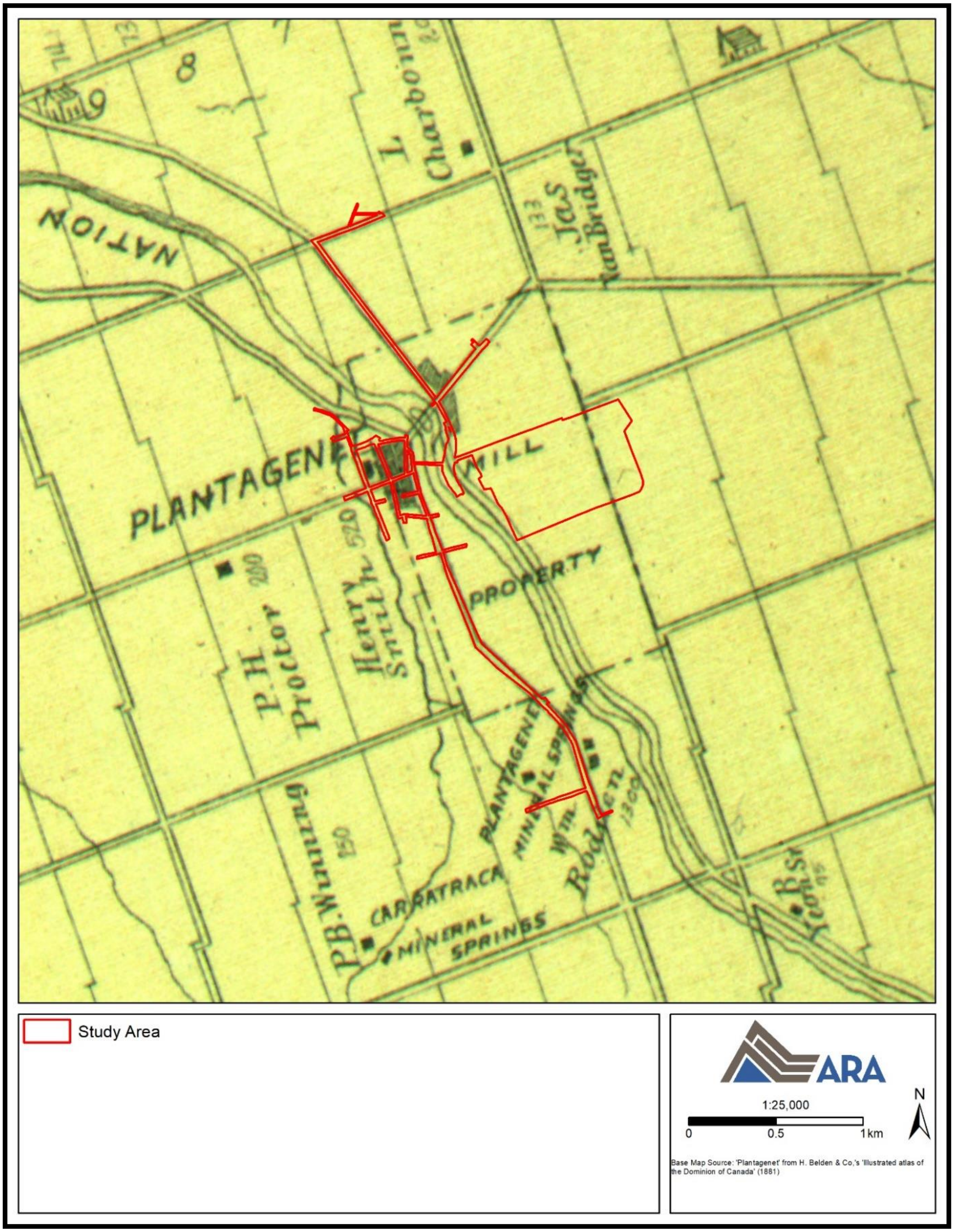
An aerial image from 1954 indicates that the streets today maintain the same layout and organization as they did historically (see Map 7). The only exception to the streets alignment is that Du Comte Street does not appear to have been laid yet. Additional features within the study area are difficult to discern as a result of the poor resolution of the aerial image.



Map 2: ***North Plantagenet Township Map 27*** **Patent Plan (No Date)**
(Produced under licence using ArcGIS® software by Esri, © Esri; AO 2022)

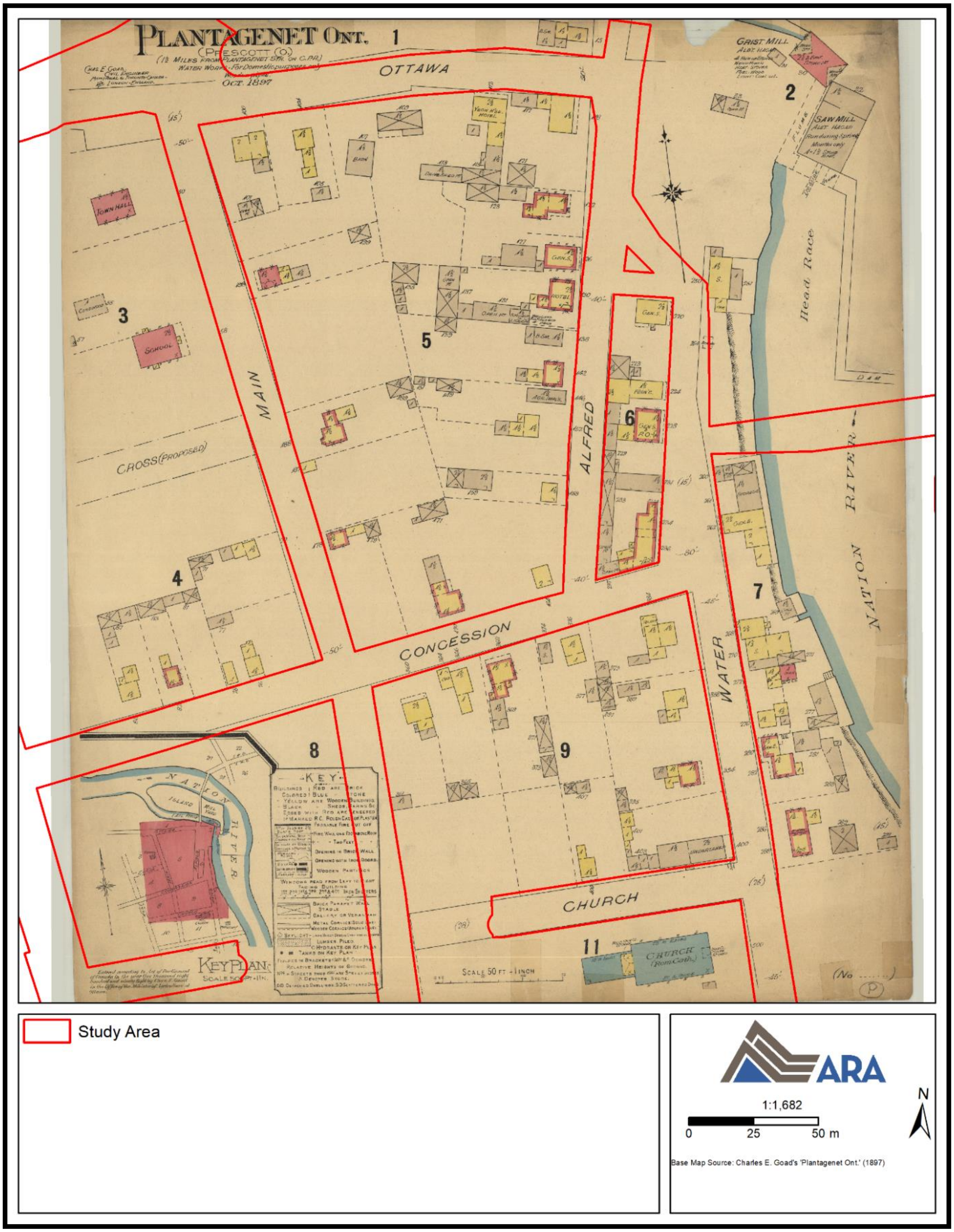


Map 3: Study Area on the *Map of the Counties of Stormont, Dundas, Glengarry, Prescott and Russell, Canada West* (1861).
(Produced under licence using ArcGIS® software by Esri, © Esri; OHCMP 2022)



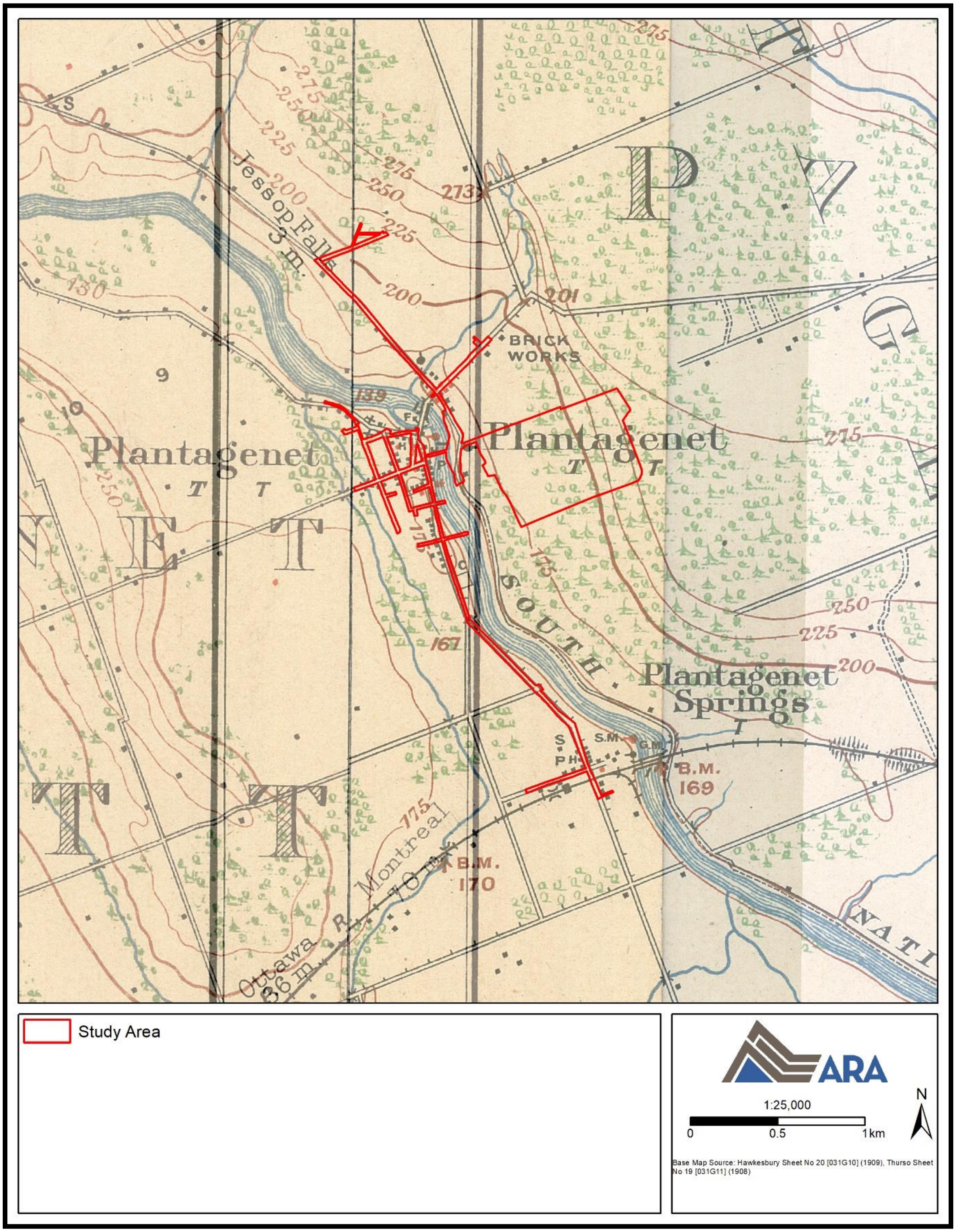
Base Map Source: 'Plantagenet' from H. Belden & Co.'s 'Illustrated atlas of the Dominion of Canada' (1881)

Map 4: Study Area on H. Belden and Company's *Plantagenet* in the *Illustrated Atlas of the Dominion of Canada* (1881)
(Produced under licence using ArcGIS® software by Esri, © Esri; McGill University 2001)



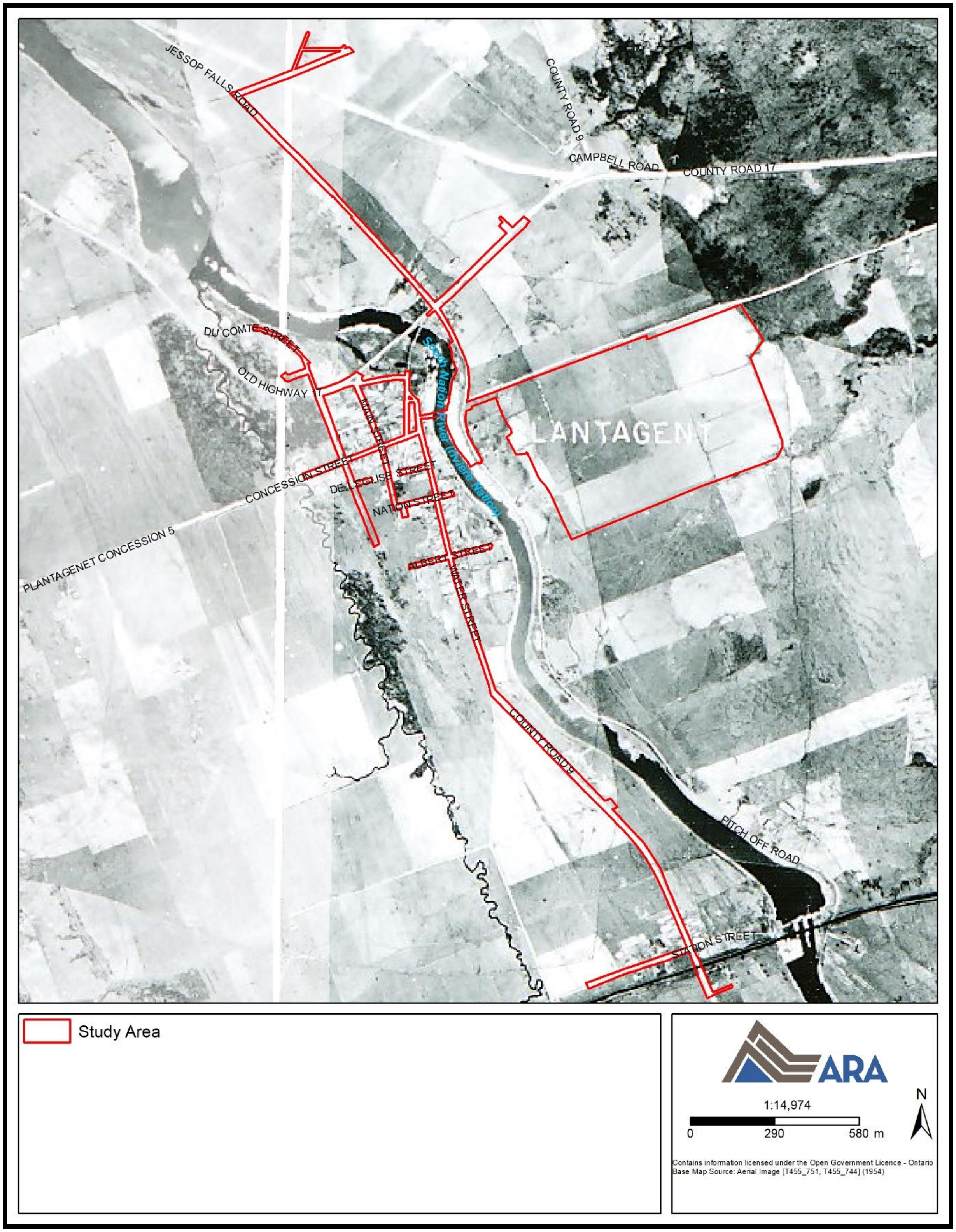
Base Map Source: Charles E. Goad's 'Plantagenet Ont.' (1897)

Map 5: Study Area on Goad's Fire Insurance Plan *Plantagenet, Ont.* 1897
(Produced under licence using ArcGIS® software by Esri, © Esri; LAC 2022)



Base Map Source: Hawkesbury Sheet No 20 [031G10] (1909), Thurso Sheet No 19 [031G11] (1908)

Map 6: Study Area on a Topographic Map from 1908/1909
(Produced under licence using ArcGIS® software by Esri, © Esri; OCUL 2022)



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Base Map Source: Aerial Image [T455_751, T455_744] (1954)

Map 7: Study Area on an Aerial Image from 1954
(Produced under licence using ArcGIS® software by Esri, © Esri; University of Toronto 2022)

5.0 CONSULTATION AND HERITAGE CONTEXT

Built Heritage Resources (BHRs) and Cultural Heritage Landscapes (CHLs) are broadly referred to as cultural heritage resources. A variety of types of recognition exist to commemorate and/or protect cultural heritage resources in Ontario.

5.1 Federal and International

5.1.1 Parks Canada

The Minister of Canadian Heritage, on the advice of the Historic Sites and Monuments Board of Canada (HSMBC), makes recommendations to declare a site, event or person of national significance. The National Historic Sites program commemorates important sites that had a nationally significant effect on, or illustrates a nationally important aspect of, the history of Canada. A National Historic Event is a recognized event that evokes a moment, episode, movement or experience in the history of Canada. National Historic People are people who are recognized as those who through their words or actions, have made a unique and enduring contribution to the history of Canada. There exists Parks Canada's online *Directory of Federal Heritage Designations* which captures these national commemorations. This directory also lists Heritage Railway Stations, Federal Heritage Buildings and Heritage Lighthouses. The *Federal Canadian Heritage Database* was searched, and no plaques or properties were noted within or adjacent to the study area (Parks Canada 2022).

The Canadian Register of Historic Places, developed under the Historic Places Initiative, a federal-provincial-territorial partnership, is an online register of locally, provincially, and federally recognized heritage properties from across Canada. No plaques or properties were listed within or adjacent to the study area. The Canadian Heritage River System Program recognizes and conserve 40 of Canada's river which have been recognized for natural, cultural and recreational heritage. There are no Canadian Heritage Rivers located within or adjacent to the study area, however the South Nation River, which runs through the study area is a tributary to Ottawa River, a designated Canadian Heritage River. It is important to note that these federal commemoration programs do not offer protection from alteration or destruction.

5.2 Provincial

The Ontario Heritage Trust (OHT) operates the Provincial Plaque Program that has over 1,250 provincial plaques recognizing key people, places and events that shaped the province. Additionally, properties owned by the province may be recognized as a "provincial heritage property" (MTCS 2010). The OHT plaque database were searched and none of the properties within or adjacent to the study area are commemorated with an OHT plaque. A cultural heritage resource may also be protected through an OHT or municipal easement. No such easement was identified.

MTCS's current list of Heritage Conservation Districts was consulted. No designated districts were identified in or adjacent to the study area (MTCS 2019). The list of properties designated by the MTCS under Section 34.5 of the OHA was consulted. No properties in or adjacent to the study area are listed.

5.3 Municipal

Based on a review of digital sources, there is no heritage register for the Township of Alfred and Plantagenet online.

ARA staff contacted the Township of Alfred and Plantagenet via email on May 12, 2022 to inquire about heritage interests in the study area. Specifically, ARA inquired if: there were any properties that were recognized or designated or on the municipal heritage register within or adjacent to the study area; if there been a Notice of Intention to Designate issued on any of the properties in the study area or adjacent properties; if there were there any other types of recognition on any of the study area or adjacent properties (i.e. easements, Secondary Plans, etc.); and finally, if there were any heritage related studies or design guidelines for the study area. The Director of Building, Planning, Engineering and Environment responded on May 18, 2022 indicating no to all of ARA's questions above. ARA reached out to the United Counties of Prescott and Russel with similar questions and at the time of writing of this report, ARA has not received a response.

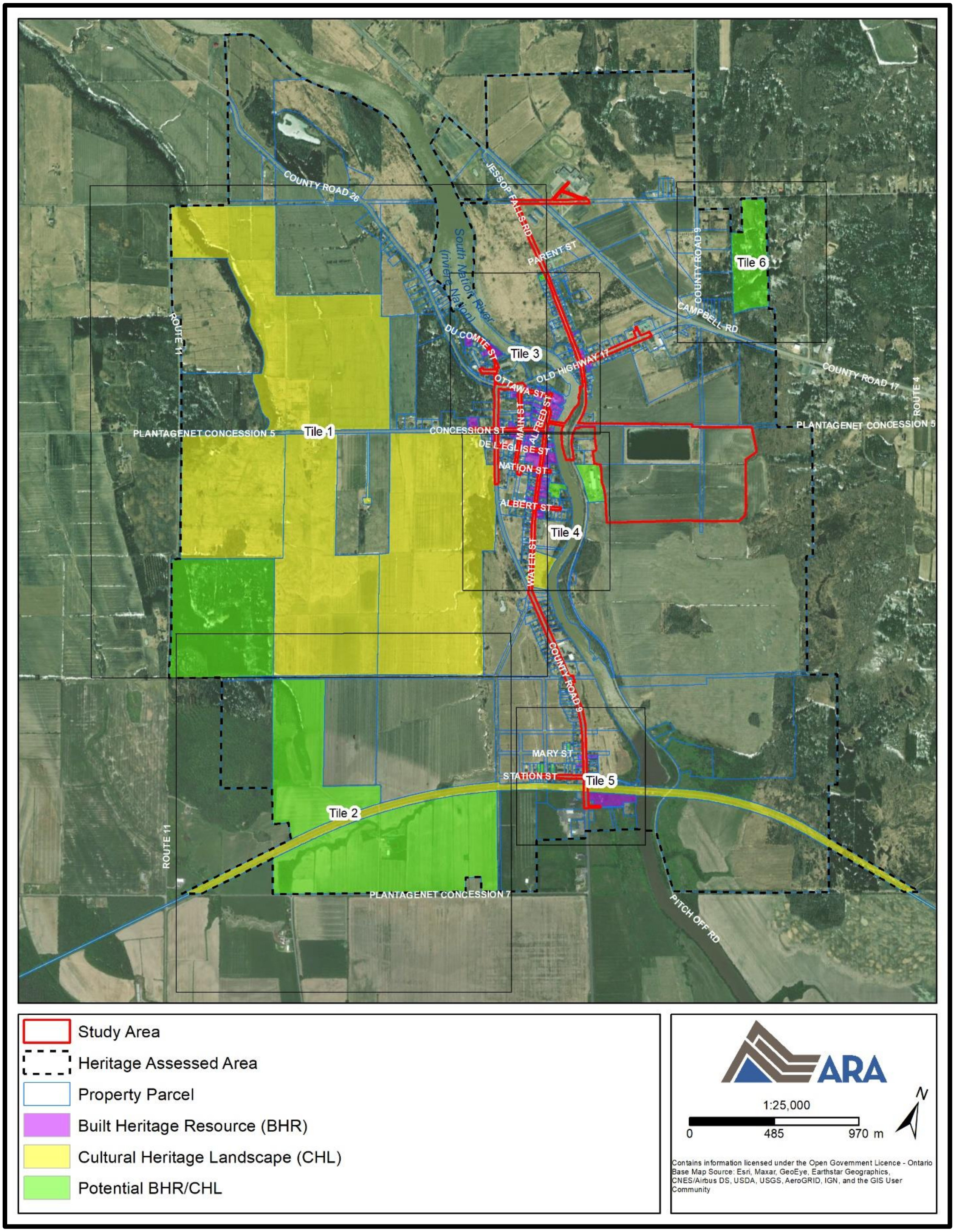
6.0 FIELD SURVEY

A desktop field survey was conducted in May 2022 in order to photograph and document the study area, and to record any local features that could enhance ARA's understanding of their setting in the landscape and contribute to the cultural heritage evaluation process. The field survey was conducted using Google Earth and Google Streetview to view the project location properties. An in-person field survey was completed in May 2022 to photograph select areas that were not visible or documented by Google's public source data.

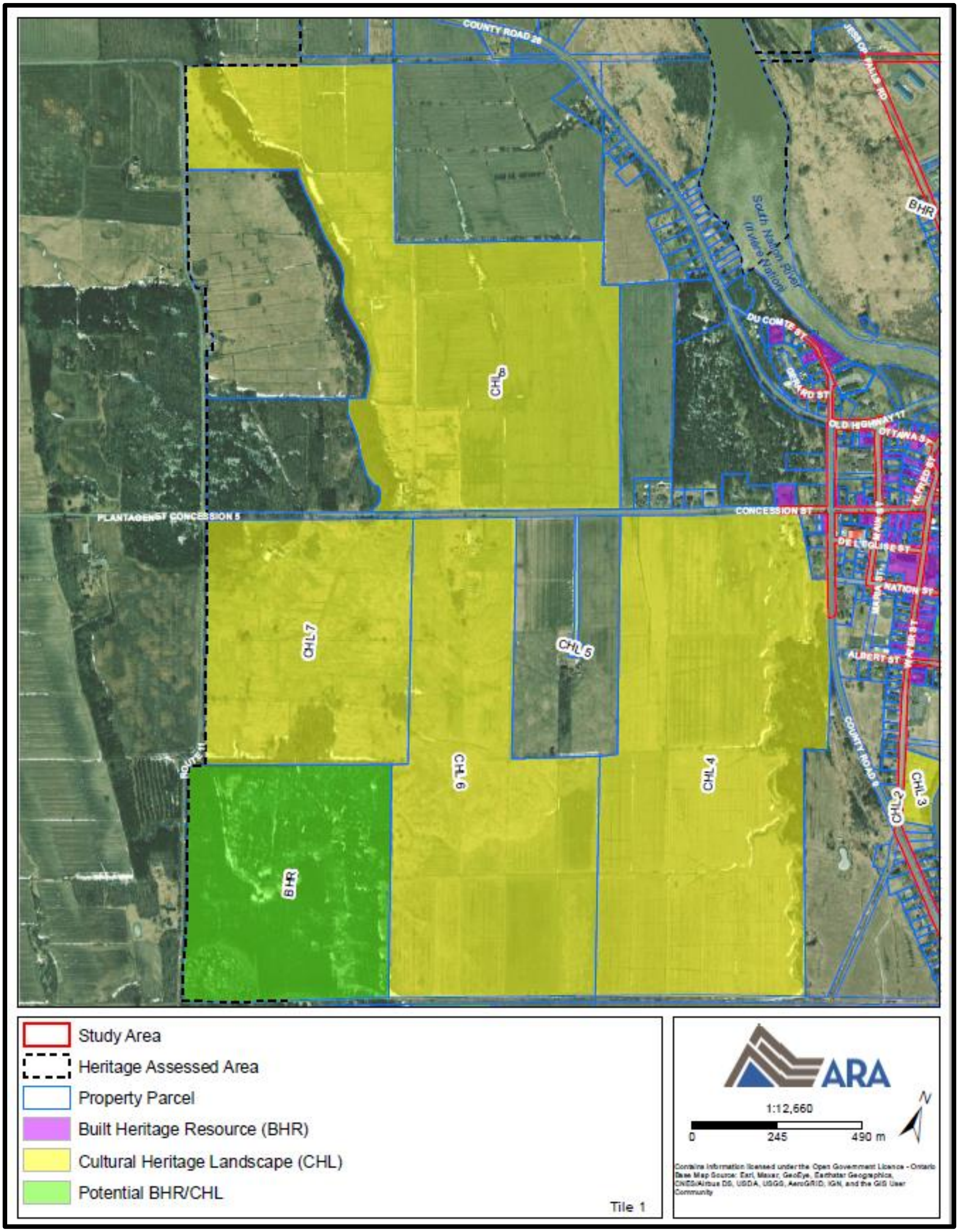
7.0 HERITAGE ASSESSMENT

The study area and all adjacent properties were assessed using online resources. Generally, potential cultural heritage resources are identified by applying a 40-year rolling timeline. There were several properties within the study area that are over the 40-year mark, however, they have been significantly modified to the extent that they no longer present with strong CHVI.

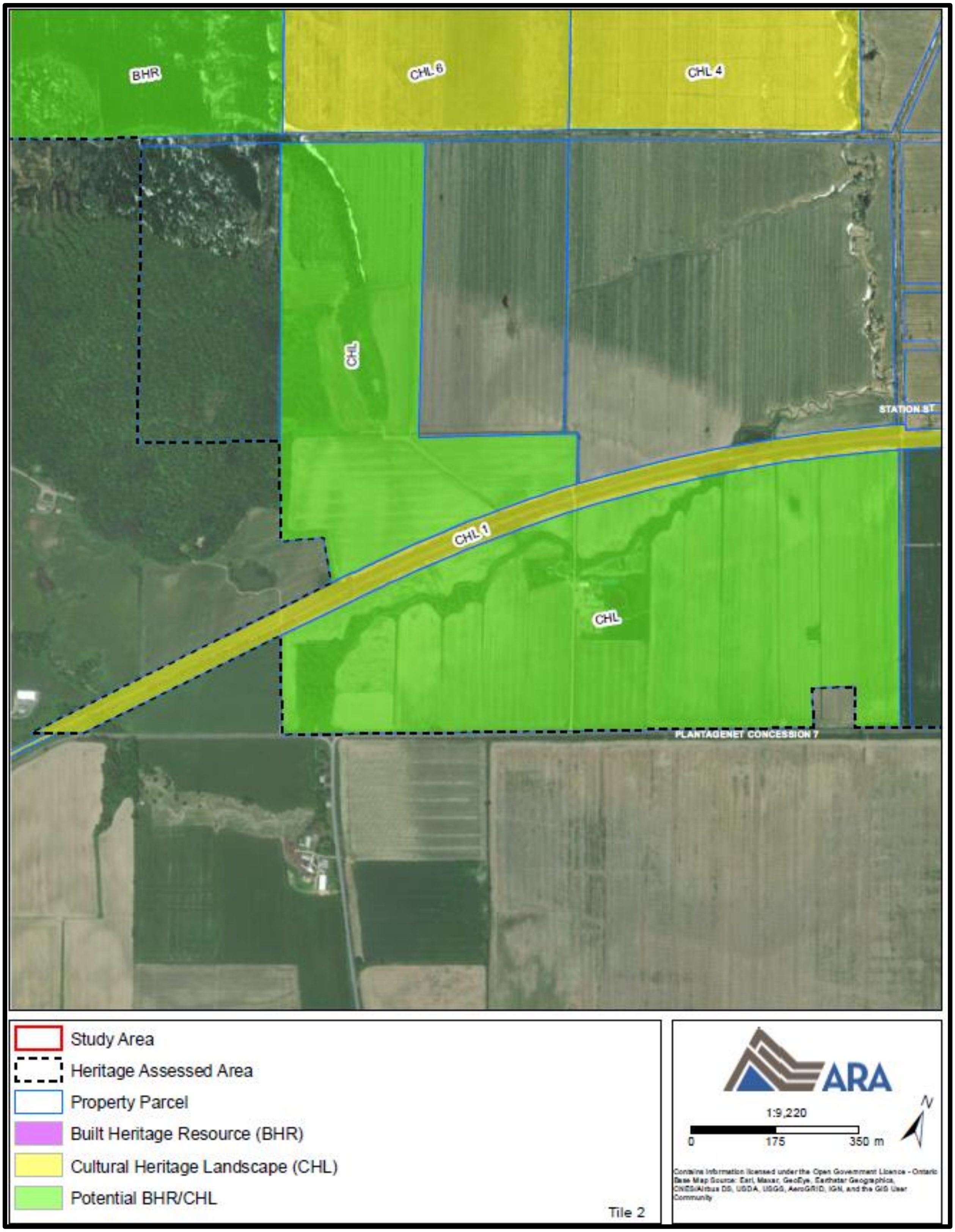
As a result of consultation, existing heritage assessment the online field survey, 64 BHRs within the study area were identified and 10 CHLs. Their potential heritage status is summarized in Table 3 and Table 4. There were several properties that could not be sufficiently evaluated via a desktop survey using available imagery, these properties are summarized in Table 5. All known and potential BHRs and CHLs are found in Map 8 to Map 14.



Map 8: Assessment Results Overview
(Produced by ARA under licence using ArcGIS® software by Esri, © Esri



Map 9: Assessment Results Tile 1
(Produced by ARA under licence using ArcGIS® software by Esri, © Esri



Map 10: Assessment Results Tile 2

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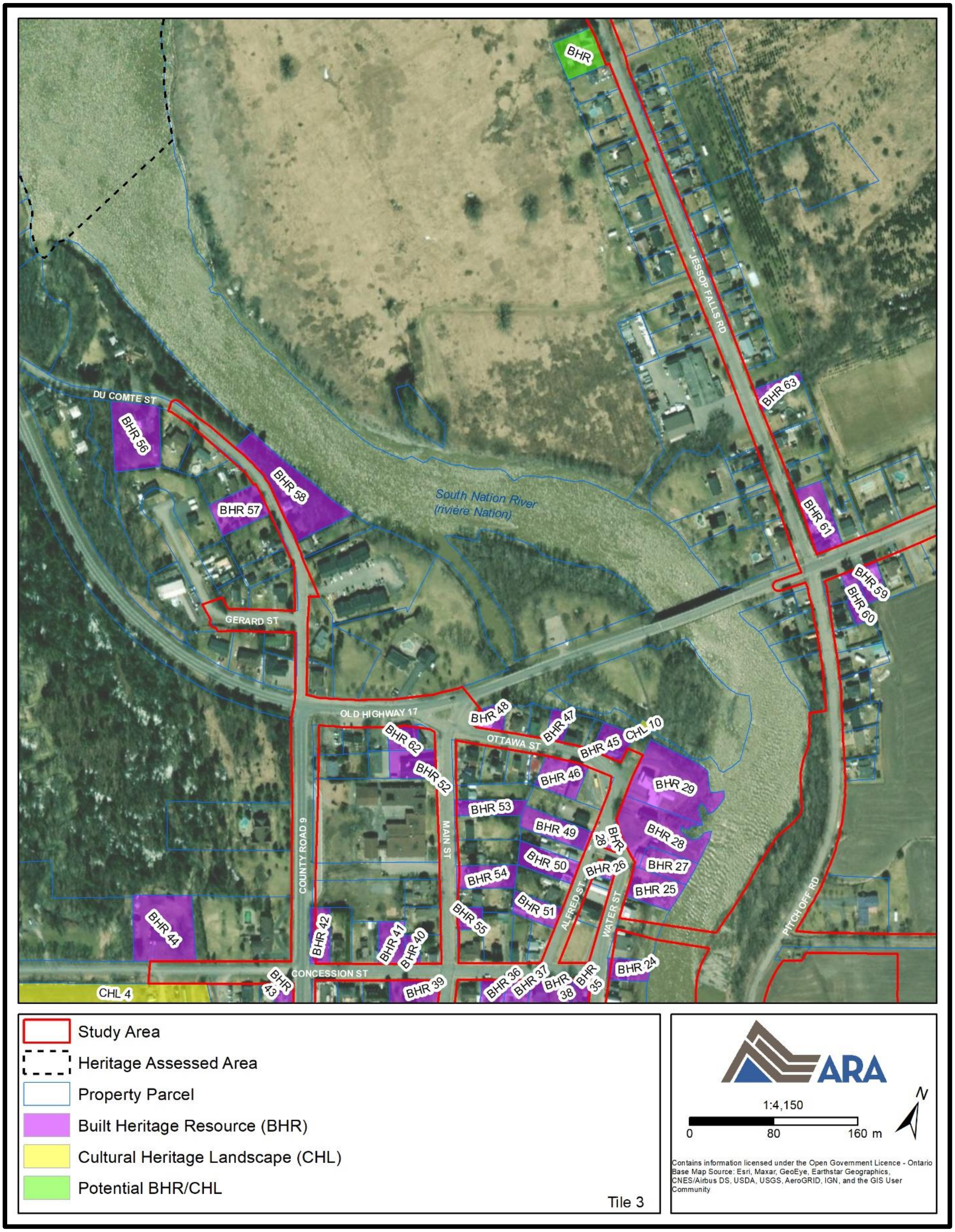
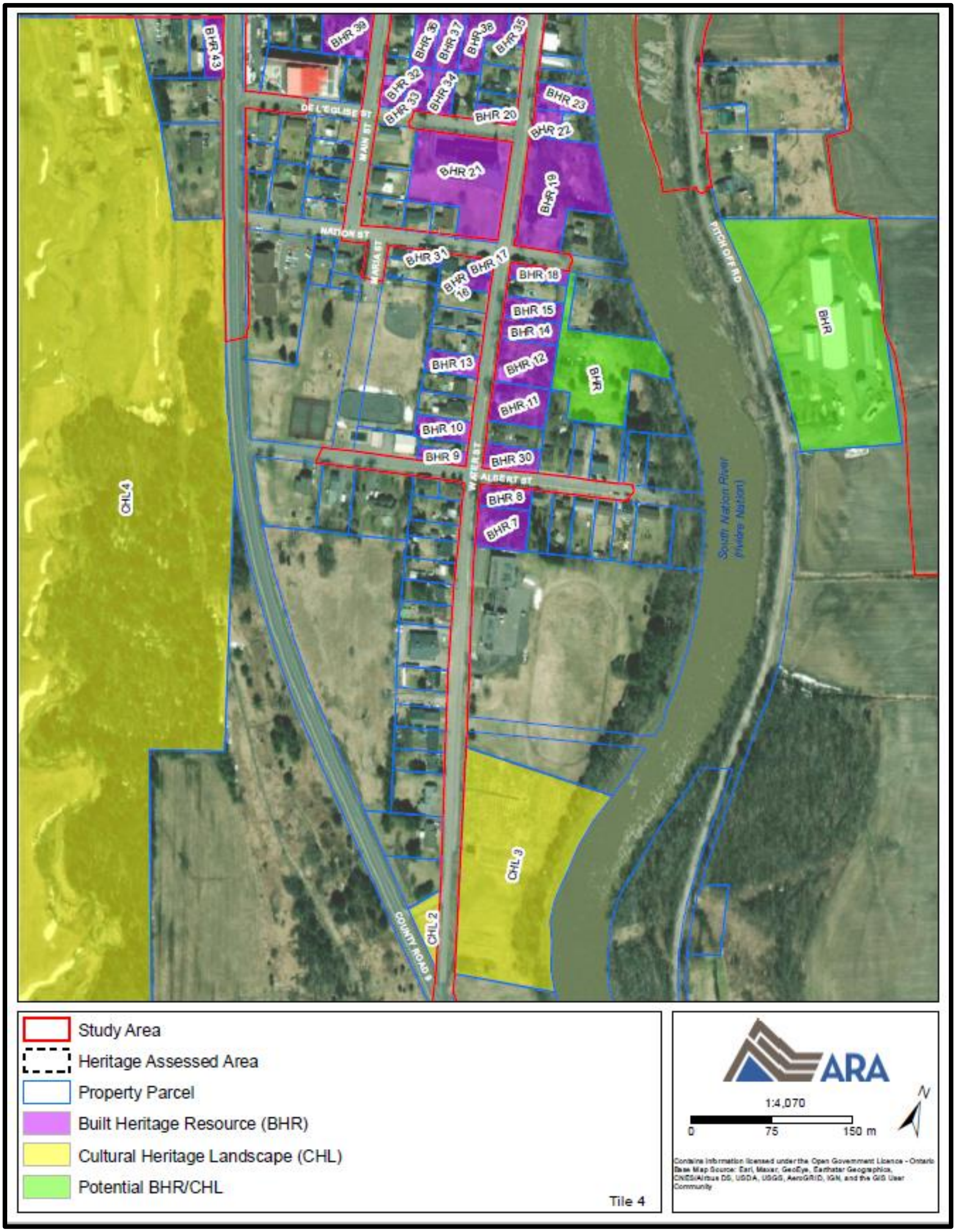


Map 11: Assessment Results Tile 3
(Produced by ARA under licence using ArcGIS® software by Esri, © Esri



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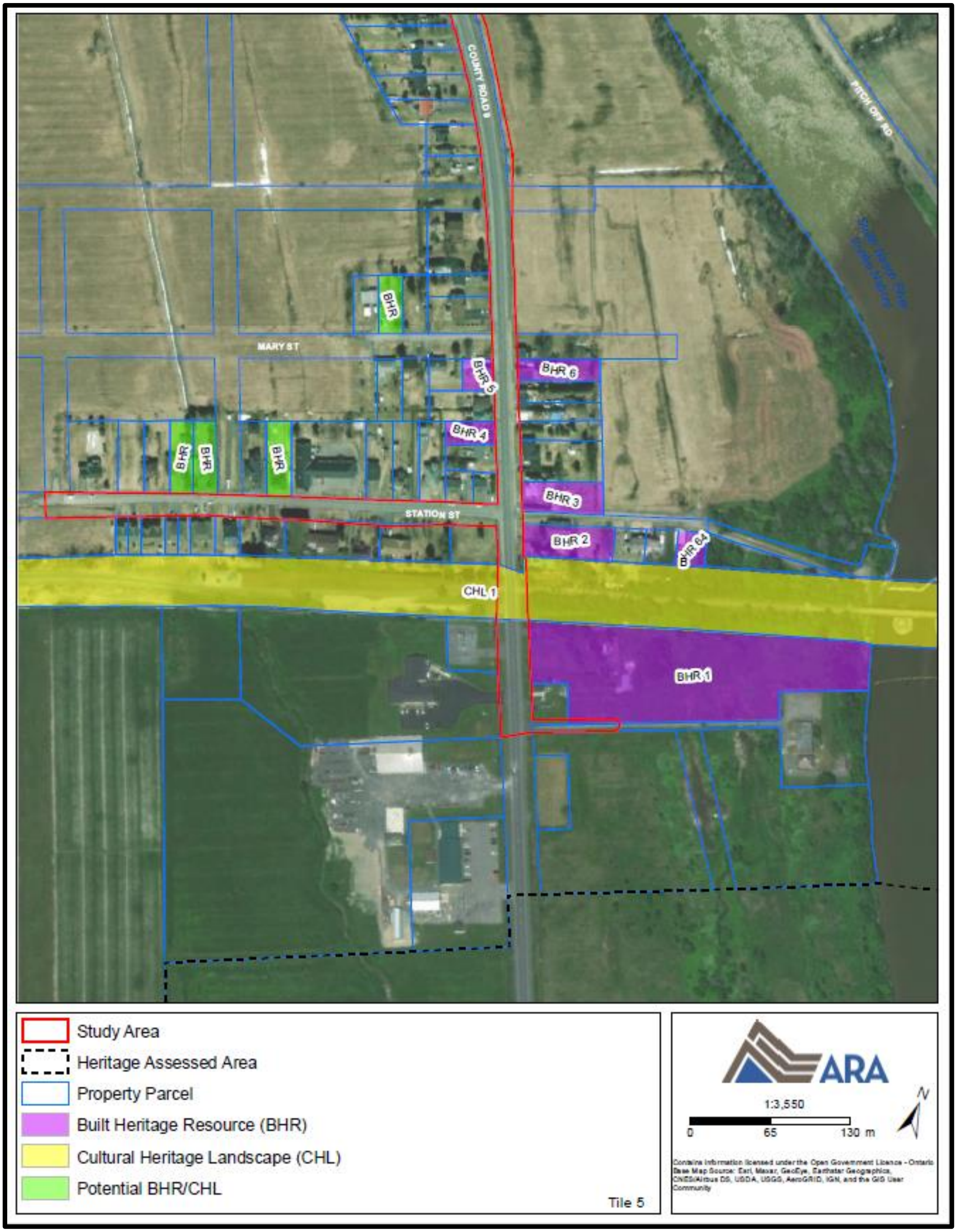
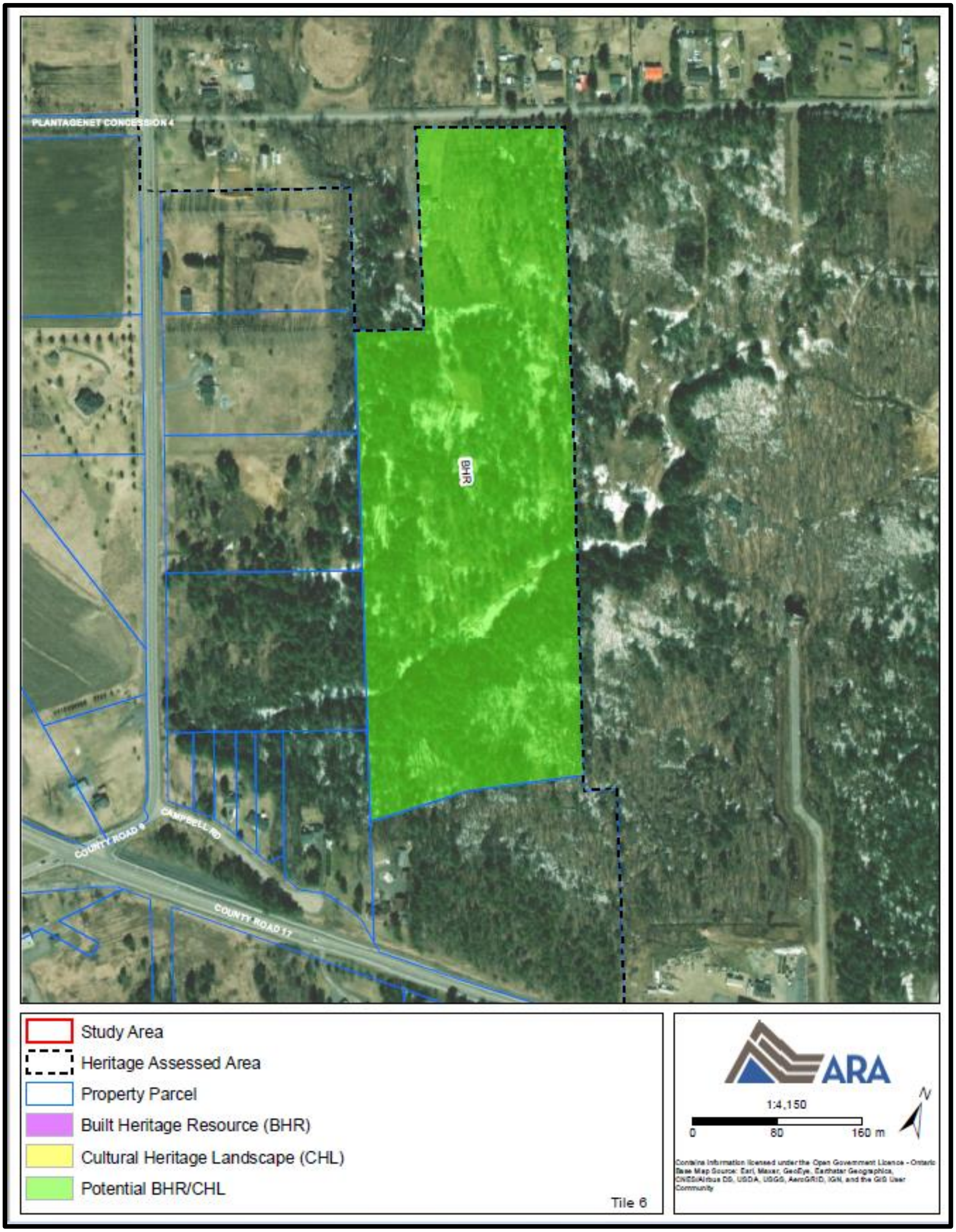
Base Map Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map 12: Assessment Results Tile 4

(Produced by ARA under licence using ArcGIS® software by Esri, © Esri



Map 13: Assessment Results Tile 5
(Produced by ARA under licence using ArcGIS® software by Esri, © Esri



Map 14: Assessment Results Tile 6
(Produced by ARA under licence using ArcGIS® software by Esri, © Esri

Table 3: BHRs with CHVI

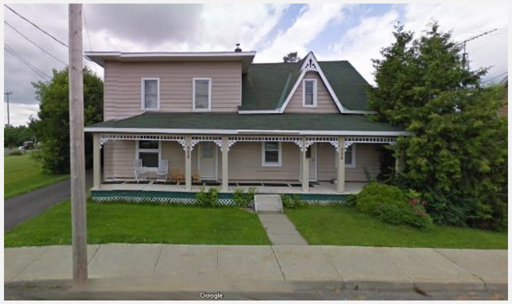
Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-1	652 County Road 9	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-2	650 County Road 9	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Representative example of Queen Anne residential architecture with Edwardian Classicism influence. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-3	646 County Road 9	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Representative example of Edwardian Classicism residential architecture using dichromatic concrete blocks and classical detailing. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-4	641 County Road 9	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-5	635-637 County Road 9	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-6	634 County Road 9	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-7	617 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Representative example of Edwardian Classicism residential architecture. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-8	605 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Representative example of Period Revival residential architecture. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	

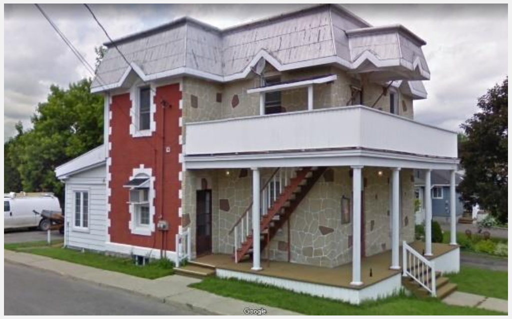
Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-9	600 Water Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-10	584 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-11	575 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Representative example of Edwardian Classicism residential architecture. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-12	565 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-13	562 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-14	545 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-15	535 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-16	520-522 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Representative example of 19th century vernacular farmhouse, with Gothic Revival architectural style influences. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	
BHR-17	510 Water Street	Adjacent	Design/Physical Value– Y Associative/Historical Value – N Contextual Value – Y Representative example of 19th century vernacular farmhouse, with Georgian architectural style influences. Supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-18	515 Water Street	Adjacent	Design/Physical Value– Y Associative/Historical Value – N Contextual Value – Y Visible at the rear of a c1910 photograph of Water Street, this building supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	  (Bibliothèque Publique de Clarence-Rockland)

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-19	425 Water Street	Adjacent	Design/Physical Value– Y Associative/Historical Value – N Contextual Value – Y Representative example of 19th century Georgian architecture. Visible on an 1877 and c1910 photograph of Water Street, this building supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community.	  (Bibliothèque Publique de Clarence-Rockland)  (Bibliothèque Publique de Clarence-Rockland)

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-20	398 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y The building is a vernacular design that displays influence from the Second Empire architectural style. Visible on an 1897 Fire Insurance Plan of Plantagenet, the building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-21	Water Street Church	Adjacent	Design/Physical Value– Y Associative/Historical Value – N Contextual Value – Y The church is a representative example of a 19th century church designed in the Gothic Revival architectural style. Visible on an 1897 Fire Insurance Plan of Plantagenet and an 1877 photograph of Water Street, the church helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The large stone church is a landmark.	   (Bibliothèque Publique de Clarence-Rockland)

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-22	385-395 Water Street	Adjacent	Design/Physical Value– Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of a 19th century vernacular residence with Second Empire architectural influence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	  (Bibliothèque Publique de Clarence-Rockland)
BHR-23	365 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-24	305 Water Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-25	253 Water Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-26	250 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Representative example of a 19th century residence with Georgian architectural style influence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet and a 1906 archival photograph, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	  (Bibliothèque Publique de Clarence-Rockland)
BHR-27	235 Water Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
BHR-28	213-219 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of Edwardian Classicism residential architecture. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-29	205 Water Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			While the building form has evolved over time with the construction of additions, the initial design as a representative example of Edwardian Classicism residential architecture is still discernable. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on a c1921 photograph, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	  (Bibliothèque Publique de Clarence-Rockland)
BHR-30	500 Albert Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			The building's design is a representative example of Period Revival residential architecture with Tudor stylistic influence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-31	555 Nation Street	Adjacent	Design/Physical Value– N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-32	595 De L'Eglise Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-33	575 De L'Eglise Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-34	555 De L'Eglise Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-35	501 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-36	575 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-37	555-557 Concession Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

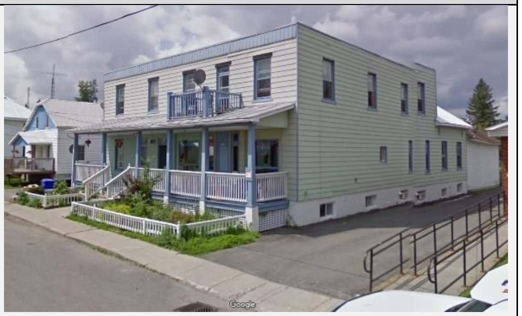
Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building is a representative example of a 19th century farmhouse designed with Gothic Revival stylistic influence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-38	535 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-39	617 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-40	626 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Visible on an 1897 Fire Insurance Map of Plantagenet, the building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-41	650 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Visible on an 1897 Fire Insurance Map of Plantagenet, the building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-42	700 Concession Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-43	705 Concession 5 Road	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-44	750 Concession 5 Road	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The wooden structure appears to be a timber-framed bank barn, a popular barn design in Ontario in the late 19th century. The barn supports. supports the historical character of the Plantagenet area as a late 19th century and early 20th century rural community	
BHR-45	500 Ottawa Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-46	525 Ottawa Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of a 19th century residence designed in the Georgian architectural style. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-47	540 Ottawa Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building is a simple vernacular residence constructed in the 19th century. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-48	592-596 Ottawa Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. The building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-49	234-244 Alfred Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building is a vernacular residence constructed in the 19th century. According to the 1897 Fire Insurance Plan for Plantagenet, the building previously operated as a hotel. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-50	260 Alfred Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of Edwardian Classicism residential architecture. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-51	280 Alfred Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The wooden structure appears to be a timber-framed outbuilding which has the potential to date back to the 19th century. Further research would be required to determine the building's age. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-52	220 Main Street	Adjacent	Design/Physical Value – N Associative/Historical Value – N Contextual Value – Y Though heavily modified, the building is a commercial building constructed in the 19th century and is still interpretable as such in its massing and placement. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an archival photograph from 1923, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	  (Bibliothèque Publique de Clarence-Rockland)
BHR-53	245 Main Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building is a representative example of a 19th century residence designed with Second Empire architectural influence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-54	275 Main Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of a 19th century vernacular residence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-55	295 Main Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building is a representative example of a 19th century vernacular residence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures. Visible on an 1897 Fire Insurance Map of Plantagenet, the building is part of a grouping of buildings which line the streets of Main, Water and Alfred Street between Ottawa and Concession Street which historically served as the Plantagenet town centre.	
BHR-56	130 Du Comte Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of a 19th century vernacular residence which may display stylistic influence from the Gothic Revival architectural style. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-57	154 Du Comte Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

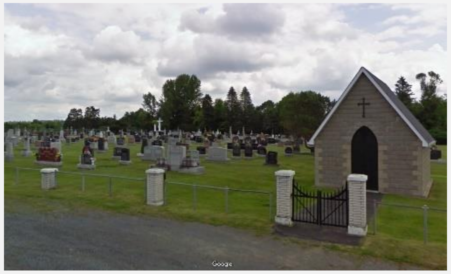
Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y Though modified, the building is a simple vernacular design of a 19th century residential structure found commonly in small towns/rural areas in Ontario. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-58	157 Du Comte Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a simple vernacular design of a 19th century residential structure found commonly in small towns/rural areas in Ontario. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-59	375 Old Highway 17	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a representative example of a 19th century residence designed with Second Empire architectural influence. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-60	385 Old Highway 17	Adjacent	Design/Physical Value – Y Associative/Historical Value – N	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
			Contextual Value – Y The building is a vernacular design of a 19th century residential structure. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-61	400 Old Highway 17	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y The building is a vernacular design of a 19th century mixed use building with a ground level commercial unit. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-62	621-627 Old Highway 17	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Though modified, the building is a commercial building constructed in the 19th century and is still interpretable as such in its massing and placement. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	
BHR-63		Adjacent	Design/Physical Value – Y	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
	165 Jessop Falls Road		Associative/Historical Value – N Contextual Value – Y The building appears to have the massing and fenestration and uses materials typically associated with Edwardian Classicism residential structures constructed in the early 20th century. Placed within a grouping of mid-to-late 20th century residences, this early 20th century residence helps support the history and continued evolution of Plantagenet as a community.	
BHR-64	625 Station Street	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Though difficult to discern using available imagery, the residence's massing, placement and decorative quoining details suggest this could be a residence dating to the 19th century. The building helps support the historic village character of Plantagenet which mainly consists of late 19th century and early 20th century residential and commercial structures.	

Table 4: CHLs with CHVI

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
CHL-1	Prescott-Russell Recreation Trail	Adjacent	Design/Physical Value – Y Associative/Historical Value – Y Contextual Value – N The trail contains the Plantagenet Train Bridge which crosses the Nation River. Resting on cut stone piers with riveted steel sides and dating to at least 1920, the bridge may contain design/physical value. The trail is associated with the railway history of Ontario as a former railway bed. Currently owned by Via Rail Canada the trail is maintained by the Prescott-Russell Recreational Trail Corporation. The 72 kilometre trail follows the path of a former Canadian Pacific railway bed and crosses through the communities of Saint-Eugene, East Hawkesbury, Champlain, the Nation, Plantagenet and Clarence-Rockland.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
CHL-2	Plantagenet War Memorial	Adjacent	Design/Physical Value – N Associative/Historical Value – Y Contextual Value – N The Plantagenet War Memorial is located on a triangle parcel of land at the intersection of County Road 9 and Water Street. The property has associative/historical value as a commemoration to wartime history.	
CHL-3	St. Paul's Cemetery	Adjacent	Design/Physical Value – N Associative/Historical Value – Y Contextual Value – N The burial ground was consecrated in 1824 and has potential to have associative/historical value to the St. Paul's church and Plantagenet community.	
CHL-4	Concession 5 Road	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Property contains a representative agricultural landscape with a timber-frame barn and surrounding agricultural fields. The property contributes and reinforces to the agricultural character surrounding the Plantagenet town.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
CHL-5	930 Concession 5 Road	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Property contains a representative agricultural landscape with a timber-frame barn and surrounding agricultural fields. The property contributes to and reinforces the agricultural character surrounding the Plantagenet town.	
CHL-6	980 Concession 5 Road	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Property contains a representative agricultural landscape with a timber-frame barn and surrounding agricultural fields. The property contributes to and reinforces the agricultural character surrounding the Plantagenet town.	
CHL-7	Concession 5 Road	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Property contains a representative agricultural landscape with a timber-frame barn and surrounding agricultural fields. The property contributes to and reinforces the agricultural character surrounding the Plantagenet town.	

Type and Number	Address/Name	Adjacent/ Participating	Criteria Met	Image
CHL-8	991 Concession 5 Road	Adjacent	Design/Physical Value – Y Associative/Historical Value – N Contextual Value – Y Property contains a representative agricultural landscape with a timber-frame barn and surrounding agricultural fields. The property contributes to and reinforces the agricultural character surrounding the Plantagenet town.	
CHL-10	Plantagenet Bridge Ruins	Adjacent	Design/Physical Value – Y Associative/Historical Value – Y Contextual Value – N A small portion of a historic bridge, that once crossed the Nation River remains. Constructed on concrete and resting on mortared stone piers, the bridge has potential for design/physical value. According to online sources, the bridge may date back to the late 19th century and has potential for associative/historical value. Further research is required. A 1960 photo shows the bridge off Ottawa Street, titled “Lovers’ Lane”.	  (Bibliothèque Publique de Clarence-Rockland)

The following table identifies nine potential BHRs and one potential CHL that that could not be sufficiently evaluated through a desktop survey (see Table 5).

Table 5: Potential BHRs/CHLs

Type	Address/Name	Adjacent/ Participating	Potential Criteria	Image
BHR	570-590 Route 11	Adjacent	Potential historical building with gable roof. Insufficient imagery available to determine CHVI via desktop survey.	
BHR	812 Station Street	Adjacent	Potential historical building with hip or gambrel roof. Insufficient imagery available to determine CHVI via desktop survey.	
BHR	806 Station Street	Adjacent	Potential historical building with gable roof. Insufficient imagery available to determine CHVI via desktop survey.	

Type	Address/Name	Adjacent/ Participating	Potential Criteria	Image
BHR	770 Station Street	Adjacent	Potential evolved historical building with side gable roof. Insufficient imagery to determine CHVI via desktop survey.	
BHR	750 Mary Street	Adjacent	Potential historical building with front gable roof. Insufficient imagery available to determine CHVI via desktop survey.	
BHR	540 Pitch Off Road	Adjacent	Potential historical building with side gable roof. Insufficient imagery available to determine CHVI via desktop survey.	
BHR	465 Nation Street	Adjacent	Potential historical building with jerkinhead roof. Insufficient imagery available to determine CHVI via desktop survey.	

Type	Address/Name	Adjacent/ Participating	Potential Criteria	Image
BHR	Concession Road 4	Adjacent	Potential historical building with side gable roof. Insufficient imagery available to determine CHVI via desktop survey.	
BHR	100 Jessup Fall's Road	Adjacent	Potential historical building and outbuilding with side gable roof. Insufficient imagery available to determine CHVI via desktop survey	
CHL	921 Concession 7	Adjacent	Potential agricultural landscape. Insufficient imagery to determine CHVI via desktop survey.	

8.0 DEVELOPMENT PLAN

The Township of Alfred and Plantagenet has initiated a Class Environmental Assessment (Class EA) to determine the most suitable expansion(s) and/or upgrade(s) to the Plantagenet wastewater system to effectively convey and treat wastewater generated from the existing service area and potential additional flows from future development. The Plantagenet wastewater system currently consists of a network of sanitary sewers, two sewage pumping stations, and a lagoon treatment system discharging treated effluent to the South Nation River.

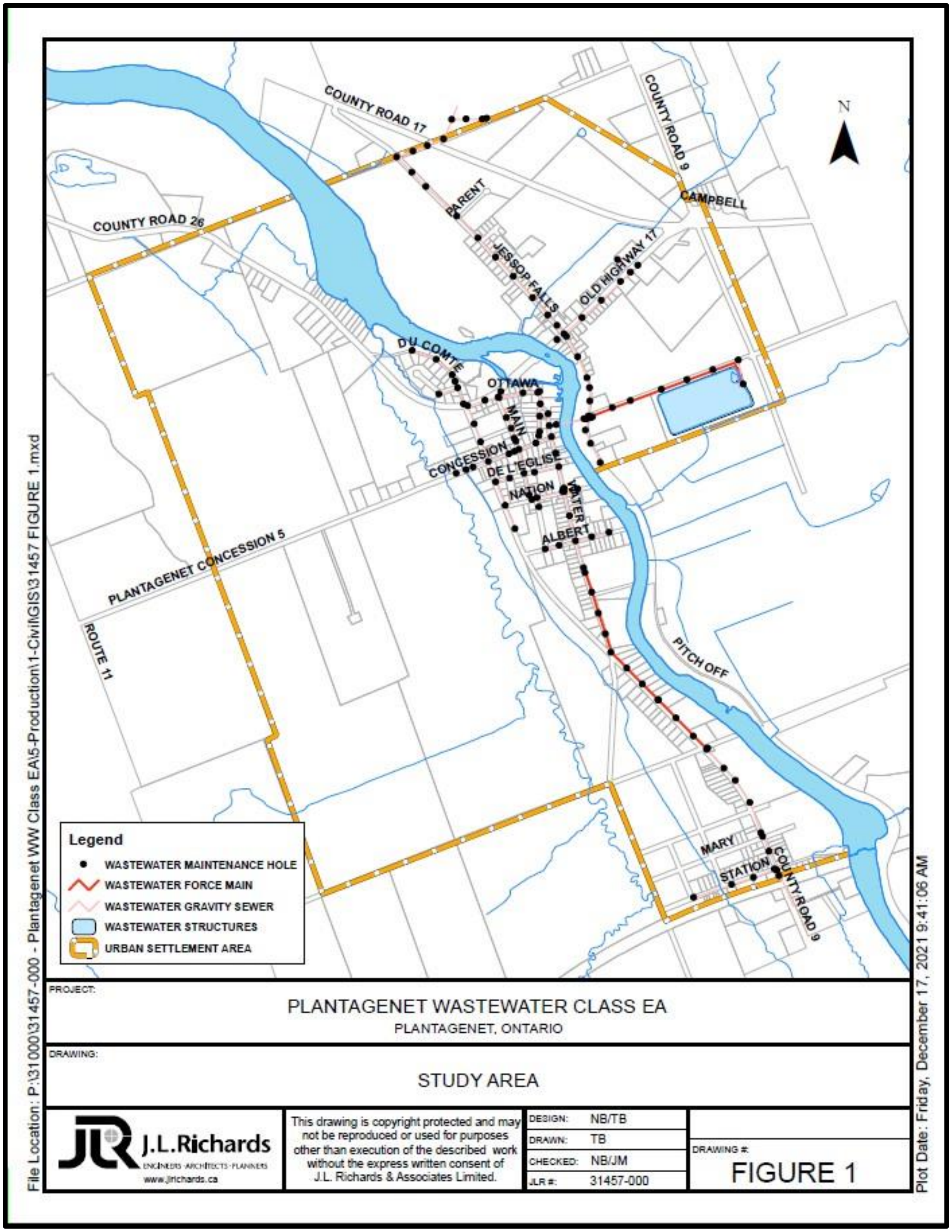


Figure 2: Map of Study Area for Plantagenet Wastewater Class EA
(JL Richards 2021)

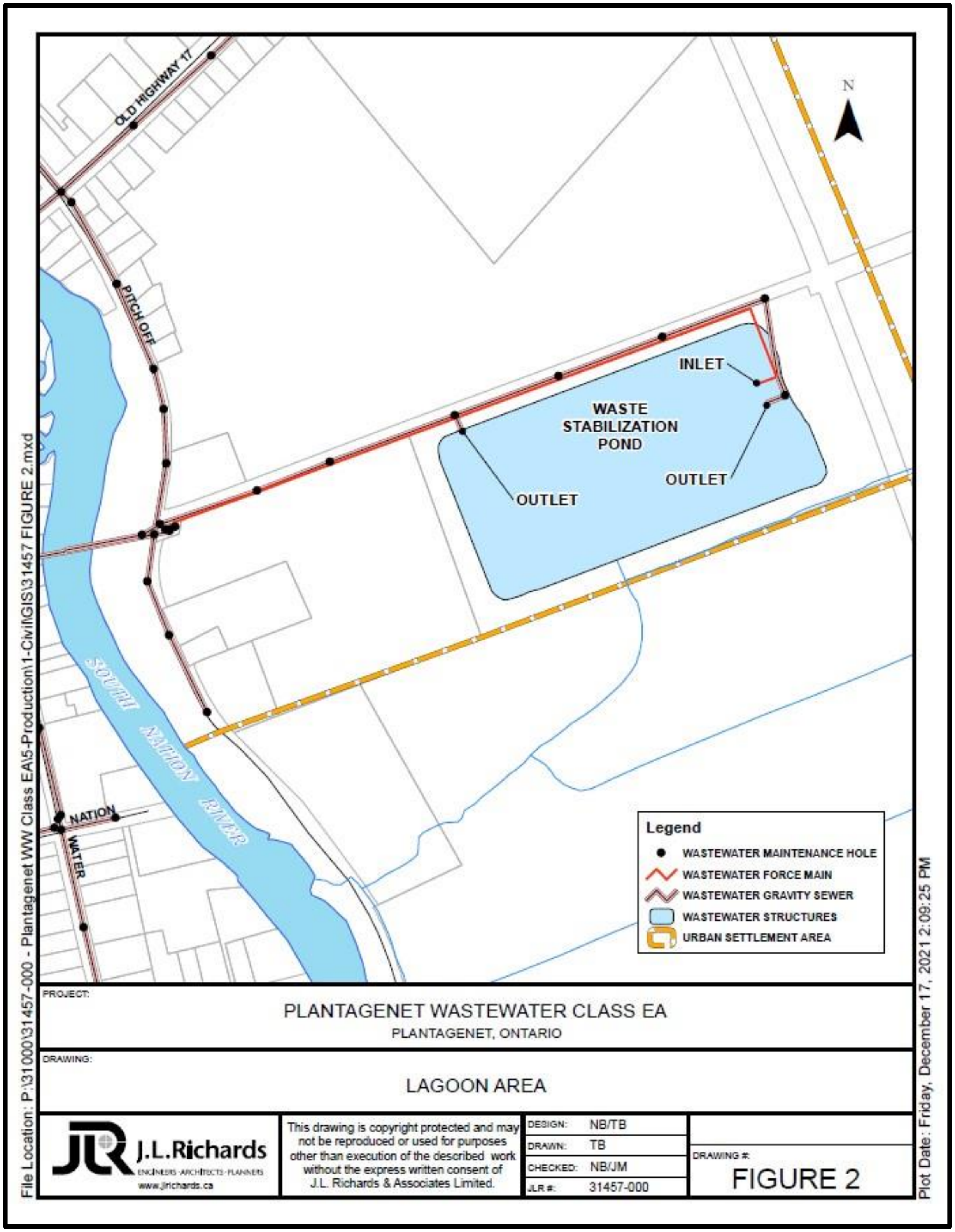


Figure 3: Map of Lagoon Area in Plantagenet Wastewater Class EA
(JL Richards 2021)

9.0 ANALYSIS OF POTENTIAL IMPACTS

The Plantagenet Wastewater improvements and expansion plans have the potential to affect cultural heritage resources. MTCS InfoSheet #5: *Heritage Impact Assessments and Conservation Plans* (MTCS 2006e:3) provides a list of potential negative impacts for evaluating against any proposed development. Impacts can be classified as either direct or indirect.

Direct impacts (those that physically affect the heritage resources themselves) include, but are not limited to: initial project staging, excavation/levelling operations, construction of access roads and renovations or repairs over the life of the project. These direct impacts may destroy some or all significant heritage attributes or may alter soils and drainage patterns and adversely impact unknown archaeological resources.

Indirect impacts include but are not limited to: alterations that are not compatible with the historic fabric and appearance of the area, the creation of shadows that alter the appearance of an identified heritage attribute, the isolation of a heritage attribute from its surrounding environment, the obstruction of significant views and vistas, change in land use such as rezoning allowing for a reduction in open spaces and other less-tangible impacts. There may be positive environmental and cultural effects as a result of an EA undertaking.

The project design outlined in Figure 2 and Figure 3 may be further refined during subsequent design phases at which time theses impacts and mitigations may need refinement depending on the scope considered for implementation. As such, potential impacts and mitigation options related to the project will be discussed at a high level as they relate to the development plan outlined in Section 8.0.

This proposed project requires road improvements/construction to accommodate new wastewater infrastructure.

No shadows will be cast near any of the identified cultural heritage resources, as the proposed improvements will take place at or below ground level. None of the BHRs or CHLs identified in Table 3 and Table 4 will be isolated from their surrounding environment, context or significant relationship. Furthermore, no rezoning is anticipated. Archaeological and environmental impacts are to be addressed in separate reports.

Many of the BHRs within the study area have minor or no setbacks. Any proposed reduction in properties' frontage that may occur during the preliminary or detailed design may have impacts on the BHRs with minor setbacks or no setbacks from the roadways. The following BHRs have no setback: BHR–4, BHR–5 BHR–6, BHR–8, BHR–9, BHR–14, BHR–15, BHR–17, BHR–18, BHR-19, BHR-20, BHR-22. BHR-23, BHR-26, BHR-27, BHR-31, BHR-36, BHR_38, BHR-40, BHR-45, BHR-46, BHR-47, BHR-48, BHR-49, BHR-52, BHR-55, BHR–57, BHR–58, BHR_59, BHR-61, and BHR-62. For all BHRs, construction activities have the potential to create vibrations that could impact built cultural heritage resources located close the road.

The proposed project is not anticipated to result in direct or indirect impacts to significant views or vistas within, from, or of built and natural features associated with any of the BHRs or CHLs.

Any impacts to potential, and known, archaeological sites, are being addressed through the archaeological assessment process.

10.0 MITIGATION MEASURES AND RECOMMENDATIONS

The study area consists of an irregularly shaped parcel of land as well as all adjacent properties. A desktop field survey of the study area was conducted, and all potential cultural heritage resources noted were evaluated against the criteria of Ontario Regulation 9/06. In total, 64 built heritage resources were identified within the study area as having potential cultural heritage value or interest along with nine potential BHRs that could not be sufficiently evaluated through a desktop survey. In total, 11 CHLs within the study area were identified as having potential cultural heritage value or interest along with one potential CHL that could not be sufficiently evaluated through the desktop survey.

This assessment is being carried out to inform future planning and design phases. Detailed designs or plans for the proposed project were not available at the time this report was written; however, depending on the nature and extent of the proposed project, there is potential that the identified BHRs and CHLs may be directly or indirectly impacted by the proposed project.

The following mitigation strategies are recommended to address the identified potential adverse impacts:

- That during subsequent planning and design phases, cultural heritage resources be avoided where possible and any construction staging areas be located on lands located well away from any of the identified BHRs and CHLs.
- That consideration should be given to the type of construction techniques and machinery used in close proximity to cultural heritage resources specifically those with little or no setbacks to ensure that there are impacts due to vibrations;
- That the design of any proposed project should not detract from the historic village character of the historic Plantagenet town centre located between Main Street and Water Street between Ottawa Street and Concession Street and that any modifications should be sympathetic to the surrounding area and minimize impacts through appropriate design;
- That once design work has begun (i.e., 30% design), it should be reviewed against the findings in this CHAR and an update provided in an Impact Memo. Specifically, the memo should review all identified BHRs and CHLs and evaluate any impact of the design (or alternative design concepts), as well as outline avoidance/mitigation measures to minimize the impact. Depending on the nature of the impact (i.e., demolition, significant modification, or alteration) the review may result in additional studies being recommended (i.e., a Cultural Heritage Evaluation Report, Heritage Impact Assessment, Conservation Plan etc.). The review should be undertaken by a qualified heritage professional.
- That public consultation may result in additional potential cultural heritage resources being identified. These potential cultural heritage resources should be reviewed by a qualified heritage consultant to: 1) determine their CHVI, 2) evaluate potential project impacts, and 3) suggest strategies for future conservation of any candidate cultural heritage resources;
- That previously unrecognized cultural heritage resources with CHVI discussed in this assessment may be worthy of inclusion on a Municipal Heritage Register;

- That this CHAR should be provided to staff/planners at the municipal and regional level as needed and;
- That a Stage 1 and Stage 2 archaeological assessment has been completed with no further assessment required. No soil disturbing activities should take place until all archaeological concerns are mitigated and all reports are accepted by the MTCS.

The EA process includes preliminary studies, an examination of alternatives, and selection of a preferred alternative prior to the development of preliminary and detailed designs. Impacts to cultural heritage resources should be considered during all phases of the EA process. Further, these preliminary mitigation recommendations are subject to review and confirmation during the preliminary and detailed design phases, in consideration of the more detailed understanding of design and project constraints.

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Township of Alfred and Plantagenet
2010 *Official Plan of Urban Areas of Township of Alfred and Plantagenet.*

United Counties of Prescott and Russel (UCPR)
2018 *Prescott Russell Official Plan*. Accessed online: http://p1cdn4static.civiclive.com/UserFiles/Servers/Server_2375121/File/Stay/planning_forestry/official_plan.pdf

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2022 *Map & Data Library.* Accessed online at: https://mdl.library.utoronto.ca/.

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Appendix A: Team Member Curriculum Vitae

Jacqueline McDermid, BA, CAHP
Acting Heritage Team Lead – Project Manager
ARCHAEOLOGICAL RESEARCH ASSOCIATES LTD.
1 King Street West, Stoney Creek, L8G 1G7
Phone: (519) 755-9983 Email: jacqueline.mcdermid@araheritage.ca
Web: www.araheritage.ca

Biography

Jacqueline McDermid has ten years of technical writing and management experience; Seven years direct heritage experience. She has gained seven years of experience conducting primary and secondary research for archaeological and heritage assessments and drafting reports and evaluating property according to Ontario Regulation 9/06 and 10/06 as part of Municipal Heritage Registers. Jacqueline is expert at copy editing heritage reports including checking grammar, consistency and fact checking, to ensure a high-quality product is delivered to clients. She has experience assisting with the drafting of Heritage Conservation District Studies through the drafting of reports for potential Heritage Conservation Districts in the City of Toronto (Weston HCD) and Township of Bradford West Gwillimbury (Bond Head HCD). Jacqueline has proven project management experience gained by completing projects on time and on budget as well as formal Project Management training. In 2018, under a six-month contract as the Heritage Planner at the Ministry of Transportation, acquired considerable experience conducting technical reviews of consultant heritage reports for Ministry compliance including Cultural Heritage Evaluation Reports, Heritage Impact Assessment, Strategic Conservation Plans, and Cultural Heritage Resource Assessments as well as gained valuable insight on provincial heritage legislation (*Ontario Heritage Bridge Guidelines*, *Ontario MTO Environmental Standards and Practices for Cultural Heritage, MTO Environmental Reference for Highway Design – Heritage,* MTCS' *Heritage Identification & Evaluation Process* as well as the new *MHTCI Information Bulletins on Heritage Impact Assessments* and *Strategic Conservation Plans*, and inter-governmental processes. She has extensive knowledge of heritage and environmental policies including the *Planning Act*, *Provincial Policy Statement,* the *Ontario Heritage Act*, Official Plans, *Environmental Assessment Act* and *Green Energy Act*. Working knowledge of the *Standards and Guidelines for Consultant Archaeologists* (2011), Ministry of Tourism, Culture and Sport.

Education

2000-2007	Honours B.A., Wilfrid Laurier University, Waterloo, Ontario Major: Near Eastern Archaeology.

Work Experience

2020-present	**Project Manager – Heritage, Archaeological Research Associates, Stoney Creek, ON**
2015-2020	**Technical Writer and Researcher – Heritage, Archaeological Research Associates Ltd., Kitchener, ON**

Research and draft designation by-laws, heritage inventories, Heritage Impact Assessments, Built Heritage and Cultural Heritage Landscape Assessments, and Cultural Heritage Resource Evaluations using Ontario Regulation 9/06, 10/06 and the Ontario Heritage Bridge Guidelines.

2018 **Environmental Planner – Heritage Ministry of Transportation, Central Region** – Six-month contract.
Responsibilities included: project management and coordination of MTO heritage program, managed multiple consultants, conducted and coordinated field assessments and surveys, estimated budgets including $750,000 retainer contracts. Provided advice on heritage-related MTO policy to Environmental Policy Office (EPO) and the bridge office.

2017-2018 **Acting Heritage Team Lead – Heritage Archaeological Research Associates Ltd., Kitchener, ON**
Managed a team of Heritage Specialists, oversaw the procurement of projects, retainers; managed all Heritage projects, ensured quality of all outgoing products.

2014-2015 **Technical Writer – Archaeology, Archaeological Research Associates Ltd., Kitchener, ON**
Report preparation; correspondence with the Ministry of Tourism, Culture, and Sport; report submission to the Ministry and clients; and administrative duties (PIF and Borden form completion).

Professional Development

2019 OPPI and WeirFoulds Client Seminar: Bill 108 – More Homes, More Choice, 2019
2019 Ontario Heritage Conference, Goderich, ON (Two-days)
2019 Rural Heritage, Webinar, National Trust for Canada
2019 Information Session: Proposed Amendments to the OHA, by Ministry of Tourism, Culture and Sport
2019 Indigenous Heritage Places and Perspectives, Webinar, National Trust for Canada
2018 Indigenous Canada, University of Alberta
2018 Grand River Watershed 21st Annual Heritage Day Workshop and Celebration (One day)
2017 Leadership Training for Managers Course, Dale Carnegie Training
2015 Introduction to Blacksmithing, One-Day
2015 Ontario Heritage Trust symposium, topics included: Cultural landscapes, City building, Tangible heritage, How the public engages with heritage, and Conserving intangible heritage
2014 Community Heritage Ontario, webinar, Part IV and V of the *Ontario Heritage Act*.

Presentations

2019 **Cemeteries and Burials Research.** Cultural Heritage Planning and Archaeology Symposium, Burlington.

Penny M. Young, MA, CAHP (#P092)
Heritage Project Manager
ARCHAEOLOGICAL RESEARCH ASSOCIATES LTD.
1 King Street West, Stoney Creek, L8G 1G7
Phone: (519) 804-2291 x121 Email: penny.young@araheritage.ca
Web: www.araheritage.ca

Biography

Penny Young has 27 years of cultural heritage management experience, 21 years working in government, as a Heritage Planner, Heritage Coordinator, Regional Archaeologist and Archaeological Database Coordinator where she managed and coordinated the impacts to cultural heritage resources including built heritage, archaeological sites and cultural heritage landscapes for compliance with municipal, provincial and federal legislation and policy. She has conducted results-driven and collaborative management of complex cultural heritage resource projects within the public sector involving developing project terms of reference, defining scope of work, preparation of budgets and conducting sites visits to monitor and provide heritage/archaeological and environmental advice and direction. At the Ministry of Transportation Penny revised, updated and developed policy, as part of a team, for the *Ontario Heritage Bridge Guidelines for Provincially Owned Bridge Guidelines for Provincially Owned Bridges*. She received the MTO Central Region Employee Recognition Award in 2001 and 2002. While at MTO she provided technical advice and input into the development of the *MTO Environmental Reference for Highway Design - Section 3.7 Built Heritage and Cultural Heritage Landscapes* and the *MTO Environmental Guide for Built Heritage and Cultural Heritage Landscapes.* She is a professional member of the Canadian Association of Heritage Planners (CAHP) and holds Professional License #P092 from MTCS. She also holds memberships in the Ontario Professional Planners Institute (OPPI) and the Ontario Archaeological Society (OAS).

Education

1990-1993	Master of Arts, Department of Anthropology McMaster University, Hamilton Ontario. Specializing in Mesoamerican and Ontario archaeology.
1983-1987	Honours Bachelor of Arts (English and Anthropology), McMaster University, Hamilton, Ontario.

Professional Memberships and Accreditations

Current	Professional Member, Canadian Association of Heritage Professionals (CAHP) Member of Ontario Archaeological Society Pre-Candidate Member, Ontario Professional Planners Institute (OPPI) Ministry of Tourism Culture & Sport Professional Licence (#P092)

Work Experience

Current	**Project Manager - Heritage, Archaeological Research Associates Ltd.** Coordinates ARA project teams and conducts heritage assessment projects including Heritage Impact Assessments, Built Heritage and Cultural Heritage Landscape Assessments, and Cultural Heritage Resource Evaluations. Additional responsibilities include the completion of designation by-laws and heritage

inventories. Liaises with municipal staff, provincial ministries and Indigenous communities to solicit relevant project information and to build relationships.

2008-2016 **Heritage Planner, Culture Services Unit, Ministry of Tourism, Culture & Sport (MTCS)**

Responsible for advising and providing technical review for management of cultural heritage resources in environmental assessment undertakings and planning projects affecting provincial ministries, municipalities, private sector proponents and Indigenous communities. Advised on municipalities' Official Plan (OP) policies cultural heritage conservation policies. Provided guidance on compliance with the Public Work Class EA, other Class EA legislation and 2010 *Standards and Guidelines for Provincial Heritage Properties*.

2014 **Senior Heritage Planner, Planning and Building Department, City of Burlington** (temporary assignment)

Project manager of the study for a potential Heritage Conservation District. Provided guidance to a multiple company consultant team and reported to municipal staff and the public. Liaised with Municipal Heritage Committee and municipal heritage property owners approved heritage permits and provided direction on Indigenous engagement, archaeological site assessments and proposed development projects.

2011 **Heritage Coordinator, Building, Planning and Design Department, City of Brampton** (temporary assignment)

Project lead for new Heritage Conservation District Study. The assignment included directing consultants, managing budgets, organizing a Public Information Session, and reporting to Senior Management and Council. Reviewed development/planning documents for impacts to heritage including OP policies, OP Amendments, Plans of subdivision and Committee of Adjustment applications and Municipal Class EA undertakings.

2010-2011 **Senior Heritage Coordinator, Culture Division, City of Mississauga** (temporary assignment)

Provided advice to Senior Management and Municipal Council on heritage conservation of built heritage, archaeological sites and cultural heritage landscapes. Liaised with multiple municipal staff including the Clerks' office, Parks and development planners and the public. Supervised and directed project work for junior heritage planner.

1999-2008 **Regional Archaeologist, Planning and Environmental Section, Ministry of Transportation (MTO)**

Responsibilities included: project management and coordination of MTO archaeology and heritage program, managed multiple consultants, conducted and coordinated field assessments, surveys and excavations, liaised with First Nations' communities and Band Councils, estimated budgets including $200,000 retainer contracts.

Sarah Clarke, BA, CAHP
Research Manager
ARCHAEOLOGICAL RESEARCH ASSOCIATES LTD.
1 King Street West, Stoney Creek, L8G 1G7
Phone: (519) 755-9983 Email: sarah.clarke@araheritage.ca
Web: www.araheritage.ca

Biography

Sarah Clarke is Archaeological Research Associates Ltd.'s Heritage Research Manager. Sarah has over 12 years of experience in Ontario archaeology and 10 years of experience with background research. Her experience includes conducting archival research (both local and remote), artifact cataloguing and processing, and fieldwork at various stages in both the consulting and research-based realms. As Team Lead of Research, Sarah is responsible for conducting archival research in advance of ARA's archaeological and heritage assessments. In this capacity, she performs Stage 1 archaeological assessment field surveys, conducts preliminary built heritage and cultural heritage landscape investigations and liaises with heritage resource offices and local community resources in order to obtain and process data. Sarah has in-depth experience in conducting historic research following the *Ontario Heritage Toolkit* series, and the *Standards and Guidelines for Provincial Heritage Properties*. Sarah holds an Honours B.A. in North American Archaeology, with a Historical/Industrial Option from Wilfrid Laurier University and is currently enrolled in Western University's Intensive Applied Archaeology MA program. She is a member of the Ontario Archaeological Society (OAS), the Society for Industrial Archaeology, the Ontario Genealogical Society (OGS), the Canadian Archaeological Association, and is a Council-appointed citizen volunteer on the Brantford Municipal Heritage Committee. Sarah holds an R-level archaeological license with the MTCS (#R446).

Education

Current	MA Intensive Applied Archaeology, Western University, London, ON. Proposed thesis topic: Archaeological Management at the Mohawk Village.
1999–2010	Honours BA, Wilfrid Laurier University, Waterloo, Ontario Major: North American Archaeology, Historical/Industrial Option

Professional Memberships and Accreditations

Current	Member of the Ontario Archaeological Society
Current	Member of the Society for Industrial Archaeology
Current	Member of the Brant Historical Society
Current	Member of the Ontario Genealogical Society
Current	Member of the Canadian Archaeological Association
Current	Member of the Archives Association of Ontario

Work Experience

Current	**Team Lead – Research; Team Lead – Archaeology, Archaeological Research Associates Ltd.** Manage and plan the research needs for archaeological and heritage projects. Research at offsite locations including land registry offices, local libraries and

	local and provincial archives. Historic analysis for archaeological and heritage projects. Field Director conducting Stage 1 assessments.
2013-2015	**Heritage Research Manager; Archaeological Monitoring Coordinator, Archaeological Research Associates Ltd.** Stage 1 archaeological field assessments, research at local and distant archives at both the municipal and provincial levels, coordination of construction monitors for archaeological project locations.
2010-2013	**Historic Researcher, Timmins Martelle Heritage Consultants Inc.** Report preparation, local and offsite research (libraries, archives); correspondence with the Ministry of Tourism, Culture, and Sport; report submission to the MTCS and clients; and administrative duties (PIF and Borden form completion and submission, data requests).
2008-2009	**Field Technician, Archaeological Assessments Ltd.** Participated in field excavation and artifact processing.
2008-2009	**Teaching Assistant, Wilfrid Laurier University.** Responsible for teaching and evaluating first year student lab work.
2007-2008	**Field and Lab Technician, Historic Horizons.** Participated in excavations at Dundurn Castle and Auchmar in Hamilton, Ontario. Catalogued artifacts from excavations at Auchmar.
2006-2010	**Archaeological Field Technician/Supervisor, Wilfrid Laurier University.** Field school student in 2006, returned as a field school teaching assistant in 2008 and 2010.

Professional Development

2019	Annual attendance at Ontario Heritage Conference, Goderich, ON
2018	Cultural Heritage, Archaeology and Planning Symposium
2018	Grand River Watershed 21st Annual Heritage Day Workshop & Celebration
2018	Mississaugas of the New Credit First Nation Historical Gathering and Conference
2017	Ontario Genealogical Society Conference
2016	Ontario Archaeological Society Symposium
2015	Introduction to Blacksmithing Workshop, Milton Historical Society
2015	Applied Research License Workshop, MTCS
2014	Applied Research License Workshop, MTCS
2014	Heritage Preservation and Structural Recording in Historical and Industrial Archaeology. Four-month course taken at Wilfrid Laurier University, Waterloo, ON. Professor: Meagan Brooks.

Presentations

2018	*The Early Black History of Brantford.* Brant Historical Society, City of Brantford.
2017	*Mush Hole Archaeology.* Ontario Archaeological Society Symposium, Brantford.
2017	*Urban Historical Archaeology: Exploring the Black Community in St. Catharines, Ontario.* Canadian Archaeological Association Conference, Gatineau, QC.

Volunteer Experience

Current	Council-appointed citizen volunteer for the Brantford Municipal Heritage Committee.

Aly Bousfield-Bastedo, BA, Dip. Heritage Conservation
Heritage Technical Writer and Researcher
ARCHAEOLOGICAL RESEARCH ASSOCIATES LTD.
1 King Street West, Stoney Creek, ON L8G 1G7
Phone: (519) 804-2291 x120 Fax: (519) 286-0493
Email: aly.bousfield-bastedo@araheritage.ca
Web: www.araheritage.ca

Education

2017-2020	Post-Graduate Diploma in Heritage Conservation, Willowbank School of Restoration Arts. Queenston, ON
2016-2017	Post-Graduate Certificate in Urban Design, Simon Fraser University, Vancouver, BC
2009-2013	Honours BA, University of Guelph, Guelph, ON Sociology

Professional Memberships and Accreditations

Current	Member, International Network for Traditional Building, Architecture & Urbanism, Guelph Chapter.

Work Experience

Current	**Technical Writer and Researcher, Archaeological Research Associates Ltd.** Produce deliverables for ARA’s heritage team, including historic research, heritage assessment and evaluation for designation by-laws, Heritage Impact Assessments, Built Heritage and Cultural Heritage Landscape Assessments, and Cultural Heritage Resource Evaluations.
2021	**Cultural Consultant, Ministry of Heritage, Sport, Tourism and Culture** Provided liaison and advisory services to municipalities and stakeholders in the heritage sector on cultural heritage legislation in Ontario.
2020	**Heritage Planning Consultant, Megan Hobson & Associates** Provided heritage consulting services, including site investigation and documentation. Provided cultural heritage value assessment and evaluations.
2019-2020	**Cultural Heritage Planning Intern, ERA Architects** Coordinated and authored various heritage related contracts. Duties included historic research, heritage impact assessments, cultural heritage assessments and evaluations.
2016-2017	**Heritage Vancouver, Programs and Communications** Conducted research and analysis of heritage properties and neighbourhoods in Vancouver. Assisted in the creation of a cultural heritage landscape assessment of Vancouver’s Chinatown neighbourhood through historical research and community engagement.

Select Relevant Projects

Cultural Heritage Landscape Inventories and Implementation

2019 **Randwood Estate Cultural Heritage Landscape Evaluation**, Niagara-on-the-Lake. Client: Confidential

2018 **Chedoke Estate Cultural Heritage Landscape Analysis**, City of Hamilton. Client: City of Hamilton

Interpretive Projects

2019 **Scotiabank Area (Canada Post Delivery Building) Interpretation Report.** Client: Private owner

Cultural Heritage Evaluations

Current **Ontario Fire College, 1495 Muskoka Road North**, Gravenhurst. Client: Infrastructure Ontario

2021 **239 Elizabeth Street,** Guelph. Client: City of Guelph

2021 **62 Bayview Parkway**, Newmarket. Client: Region of York

2021 **Structure WG-16 Cultural Heritage Evaluation Report and Heritage Impact Assessment**, Township of Centre Wellington. Client: McIntosh Perry

2021 **Hamilton Amateur Athletic Association Grounds**, Hamilton, Ontario. Client: City of Hamilton

2019 **4304-4306 Line 10 (Earl Rowe House)**, Bradford West Gwillimbury. Client: Private Owner

2019 **1347 Lakeshore Road East,** City of Mississauga Client: Private Owner

2019 **Rutherford Library**, Edmonton, Alberta. Client: University of Alberta Libraries

Heritage Impact Assessments

Current **Heritage Impact Assessment 11666 Young Street**, City of Richmond Hill. Clint: Sky Development Group.

Current **Heritage Impact Assessment 10667 Trafalgar Road**, Town of Halton Hills. Client: RVA Associates Ltd.

Current **Heritage Impact Assessment 316 Grange Road**, City of Guelph. Client: Lunor Group Inc.

Current **Heritage Impact Assessment 50-60 Ellen Street**, City of Kitchener. Client: John MacDonald Associates.

Current **Heritage Impact Assessment 415 Water Street**, City of Cambridge. Client: Private Owner.

Current **Heritage Impact Assessment 133 & 133A Main Street,** City of Brampton. Client: GSAI.

2021 **Heritage Impact Assessment 619-637 Young Street & 7-9 Isabella Street**, City of Toronto. Client: Colliers International.

2021 **Heritage Impact Assessment 436 Fountain Street**, City of Cambridge. Client: Kiah Group.

2021 **Historic Neighbourhood Character Impact Assessment 19 Dundonald Street**, City of Barrie. Client: Innovative Planning Solutions.

2021 **Heritage Impact Assessment 130 Elgin Street**, City of Brantford. Client: King Management Group Inc.

2021 **Heritage Impact Assessment 436 Fountain Street**, City of Cambridge. Client: Private Owner.
2021 **Historic Neighbourhood Character Impact Assessment 19 Dundonald Street**, City of Barrie. Client: IPS.
2021 **Heritage Impact Assessment for M.41/05 (Eramosa River)**, Township of Guelph-Eramosa. Client: Hatch on behalf of Metrolinx.
2021 **Heritage Impact Assessment Structure 16-WG**, Township of Centre Wellington. Client: McIntosh Perry.
2021 **Cultural Heritage Impact Assessment 215 & 219 King Street West**, Dundas, City of Hamilton. Client: IBI Group.
2021 **Heritage Impact Assessment 130 Elgin Street**, City of Brantford. Client: King Management.

Cultural Heritage Assessment Reports (Environmental Assessment)

Current **Cultural Heritage Assessment Report** Constance Boulevard Drainage Improvement. Town of Wasaga Beach. Client: Ainley & Associates Ltd.
2021 **Cultural Heritage Assessment Report Lundy's Lane Schedule C Municipal Class Environmental Assessment**, City of Niagara Falls. Client: Urban & Environmental Management I**nc.**
2021 **Cultural Heritage Assessment Report Merritt Street Road Improvements & Chestnut Street Extension**. City of St. Catharines. Client: Urban & Environmental Management Inc.
2021 **Morningside SPS Cultural Heritage Assessment Report**, Township of Wilmot. Client: GM Blueplan

Designation Reports

2021 **Updated Designation By-law 40 Station Street,** Clarington. Client: Municipality of Clarington
2021 **146 Wellington Street,** Clarington. Client: Municipality of Clarington
2021 **415 Davis Drive,** Town of Newmarket. Client: Town of Newmarket

Documentation/Salvage Reports

2021 **Cultural Heritage Landscape Documentation Report**, Town of Halton Hills. Client: RVA Associates Ltd.
2020 **79 Yates Street**, City of St. Catharines. Client: Private Owner
2020 **6507 Jane Street,** City of Burlington, Client: Private Owner
2020 **1460 Cataract Rd,** Town of Caledon Client: Private Owner
2020 **1110 Lakeshore Road West,** City of Oakville Client: Private Owner

Strategic Conservation Plan

Current **Brockville Psychiatric Hospital SCP**, City of Brockville. Client: Infrastructure Ontario.
Current **Conservation Plan 11666 Young Street**, City of Richmond Hill. Client: Sky Development Group.
Current **Conservation Plan 50-60 Ellen Street**, City of Kitchener. Client: John MacDonald Associates.

Current **Conservation Plan 133 & 133A Main Street,** City of Brampton. Client: GSAI.

2021 **Conservation Plan 62 Bayview Parkway**, Town of Newmarket Client: Region of York

<u>Conservation Technical Advice</u>

2021 **Conservation Advice – 41 Temperance Street,** Clarington, Client: Municipality of Clarington

2021 **Stone Wall Conservation Advice - 1220 Stavebank Road,** City of Mississauga. Client: Private Owner.

2021 **Land Registry Office Conservation Advice, 499 Centre Street,** Prescott Client: CBRE

<u>Prepared Research for Peer Reviews</u>

2019 **Peer Review of King Spadina Heritage Conservation District.** Client: Private Owner.

2019 **Peer Review of St. Lawrence Heritage Conservation District**, City of Toronto. Client: Private Owner.

Professional Development

2021 COP26 and Climate Heritage Action – Seizing Momentum and the 'Heritage Reset'". Webinar. Presented by the National Trust for Canada.

2021 "Standard Specification for Mortars for the Repair of Historic Masonry Confirmation". Webinar. Presented by APT.

2021 "Drafting Statements of Significance." Webinar presented by ARA's K. Jonas Galvin for ACO's job shadow students

2021 "Architectural Styles." Webinar presented by ARA's K. Jonas Galvin for ACO's job shadow students

2021 "Perspectives on Cultural Heritage Landscapes". Cultural Heritage, Archaeology and Planning Symposium. ARA Ltd.

2019 University of Toronto, Mark Laird "Selected topics on Landscape Architecture", Course audit
"Planning for Golf's Decline", INTBAU speaker series.
Messors, "Fornello Sustainable Preservation Workshop", Cultural Landscape Field School

2018 Points of Departure. Association for Preservation Technology (APT) Conference. Buffalo, NY.

Presentations

2018 Essential issues or themes for education in heritage conservation: Montreal Roundtable on Heritage (Canada Research Chair on Built Heritage)

Appendix B

Phase 2 Report

JLR No.: 31457-000
Revision: 0

September 18, 2023

Prepared for:

TOWNSHIP OF ALFRED AND PLANTAGENET
205 Old Highway 17, P.O. Box 350
Plantagenet, ON
K0B 1L0

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
343 Preston Street, Tower II, Suite 1000
Ottawa, ON
K1S 1N4
TEL: 613-728-3571

Phase 2 Report

Plantagenet Wastewater Municipal Class Environmental Assessment

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Value through **service** and **commitment**

Table of Contents

List of Appendices

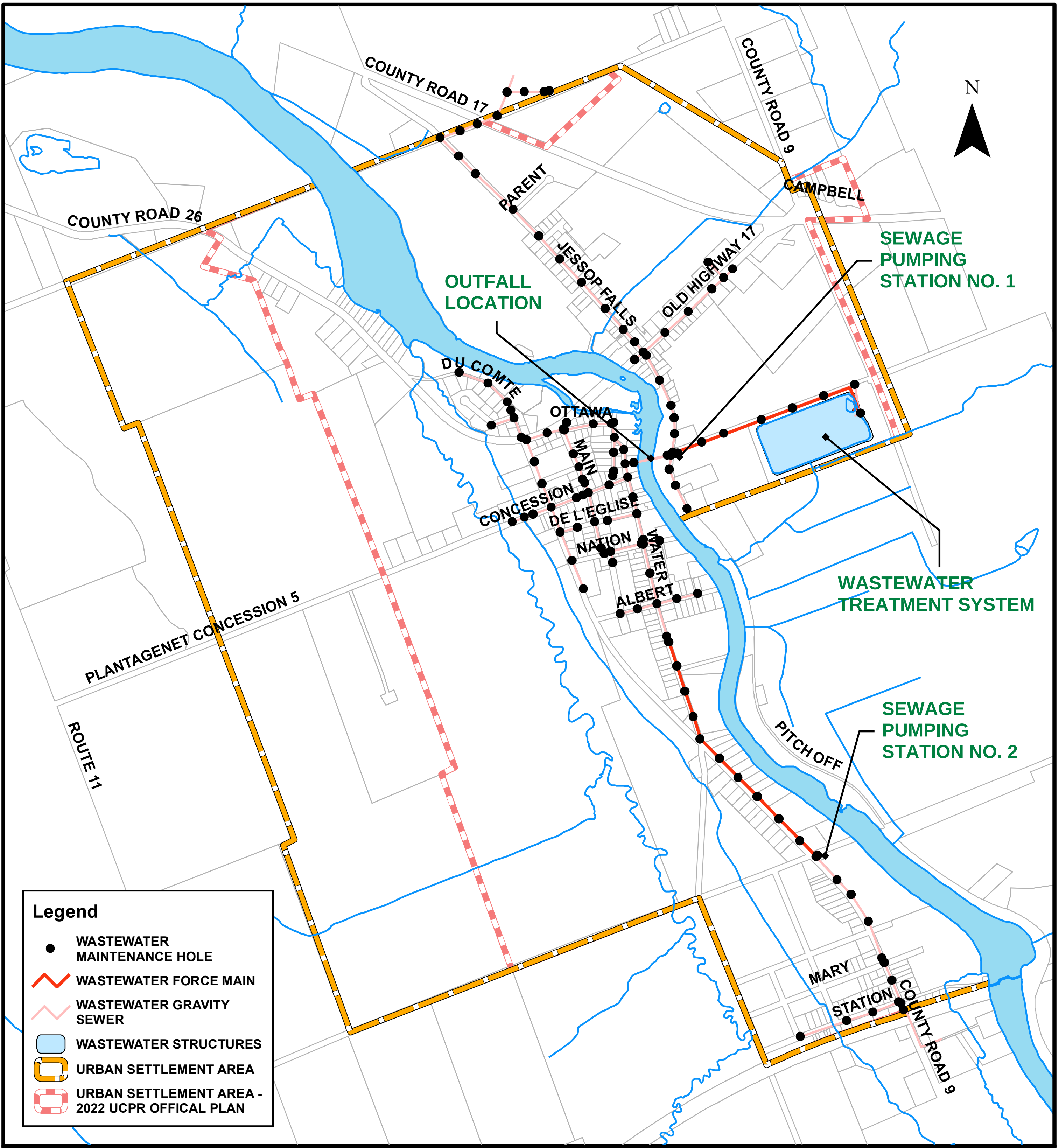
1.0 Introduction

1.1 Background

The Village of Plantagenet (Village) is located approximately 60 km east of the City of Ottawa and 7 km south of the Ottawa River, in the Township of Alfred and Plantagenet (Township) and United Counties of Prescott and Russell (UCPR). The Village is situated along the South Nation River, in the Lower South Nation River watershed, at the intersection of County Road 9 and Old Highway 17. According to the Township's Official Plan, the Plantagenet urban area covers an area of approximately 600 ha, a large portion of which is currently farmland. Village residents are serviced by a communal potable water supply/distribution system, and a communal wastewater collection/treatment system. Refer to Figure 1 for an overview of the study area and wastewater collection system.

The existing wastewater collection and treatment system is owned by the Township and operated by the Ontario Clean Water Agency (OCWA). It consists of several kilometers of gravity sewers, two (2) sewage pumping stations (SPSs) (one main SPS and one sub-area SPS), a lagoon-based wastewater treatment system and a gravity outfall to the South Nation River. The lagoon-based wastewater treatment system operates under Amended Certificate of Approval (C of A) No. 4631-5WXQE9 (refer to Appendix A). The treatment system, constructed in the early 1970s, consists of a single cell 6.9 ha facultative waste stabilization pond that is batched dose with alum prior to seasonal discharge (Spring and Fall). Refer to Figure 2 for an overview of the Plantagenet wastewater treatment system (WWTS).

Since 1988, the treatment system has operated at or above its rated capacity of 561 m^3/day, and the lagoon itself has been required to operate at its storage limit to avoid discharging during non-allowable discharge windows. The system has also regularly exceeded its seasonal total suspended solids (TSS) and 5-day biological oxygen demand (BOD5) objectives and limits. These factors have resulted in non-compliance issues with the Ministry of the Environment, Conservation and Parks (MECP). The Township has implemented some upgrades to the SPSs, minor repairs to the collection system manholes and de-sludging of the lagoons; however, no upgrades have been completed to date to address capacity and/or quality limitations associated with the WWTS. Although there has been minimal population growth within the Village in the last 20 years, the Township has noted that there has been recent interest in new development that would result in an increased serviced population for the wastewater system. To accommodate this development and resolve previous non-compliance issues, the Township is undertaking a Municipal Class Environmental Assessment (Class EA) to evaluate alternatives to expand and/or upgrade their wastewater system. The study will aim to establish reliable, robust and cost-effective solutions with low to medium operational complexity and flexibility to meet both current and anticipated future servicing requirements. The Township has retained J.L. Richards & Associates Limited (JLR) to assist them in completing the Class EA.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

STUDY AREA

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN:	NB/TB
DRAWN:	TB
CHECKED:	NB/JM
JLR #:	31457-000

DRAWING #:
FIGURE 1

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 FIGURE 1.mxd

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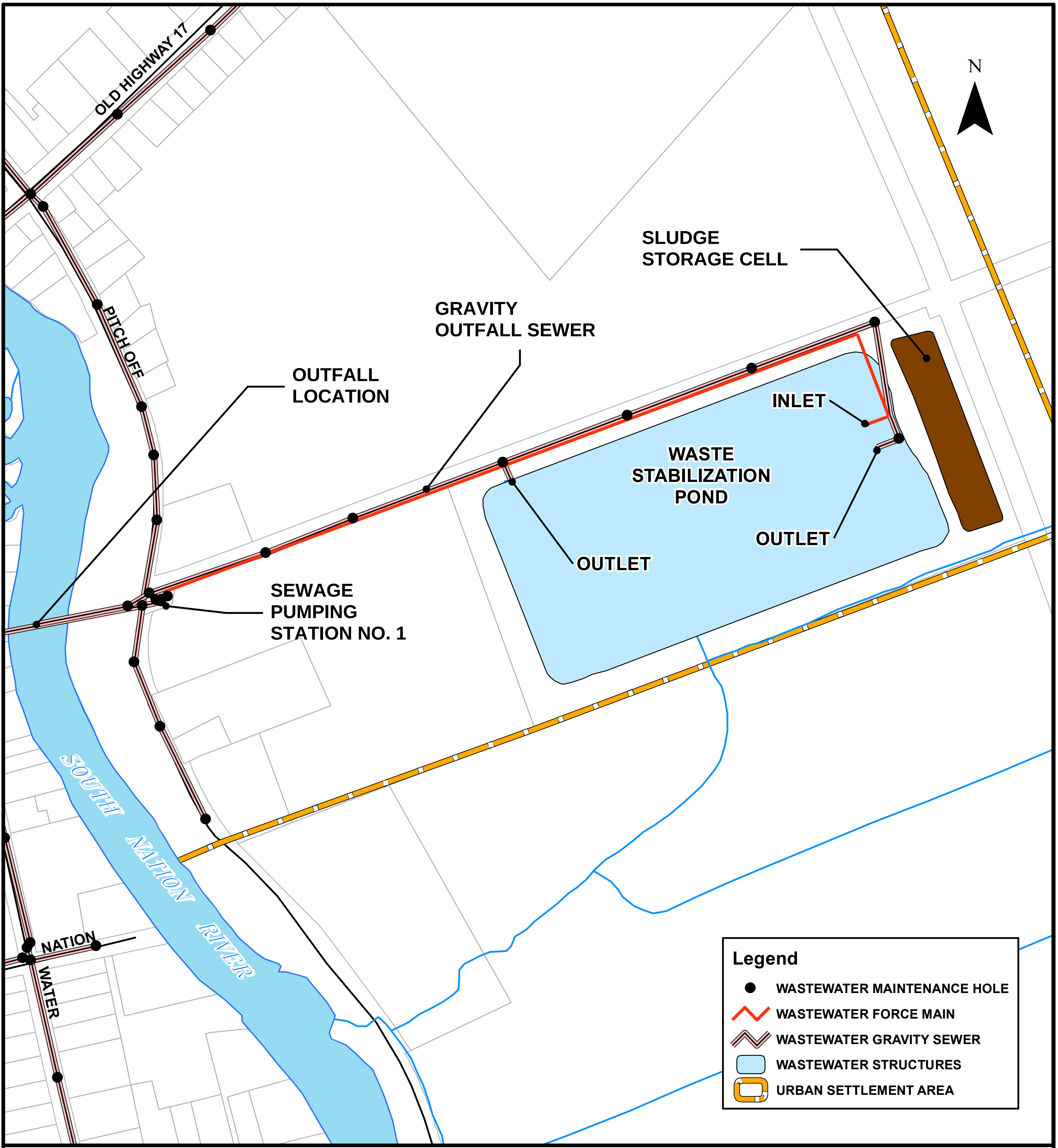

PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

PLANTAGENET WASTEWATER TREATMENT SYSTEM

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www.jlrichards.ca

DESIGN: NB/TB
DRAWN: TB
CHECKED: NB/JM
JLR #: 31457-000

DRAWING #: FIGURE 2

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 FIGURE 2.mxd

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1.2 Municipal Class Environmental Assessment Process

The Ontario Environmental Assessment Act (Act) sets out a planning and decision-making process so that potential environmental effects are considered before a project begins. The purpose of the Act is to provide for the protection and conservation of the natural environment (R.S.O. 1990, c.E.18, s.2).

The Municipal Class EA process is followed for common types of projects to streamline the review process while ensuring that the project meets the requirements of the Act. It involves detailed site-specific information gathering and studies, as well as consultation with the public and stakeholder agencies. Different schedules are followed depending on the type of project to be completed and their impact on the environment. These include Schedule A, Schedule A+, Schedule B and Schedule C, each more involved than the last. In 1987, the first Class EA document, prepared by the Municipal Engineers Association (MEA) on behalf of Ontario Municipalities, was approved under the Act. Updates and amendments were subsequently made in 1993, 2000, 2007, 2011, 2015 and 2023.

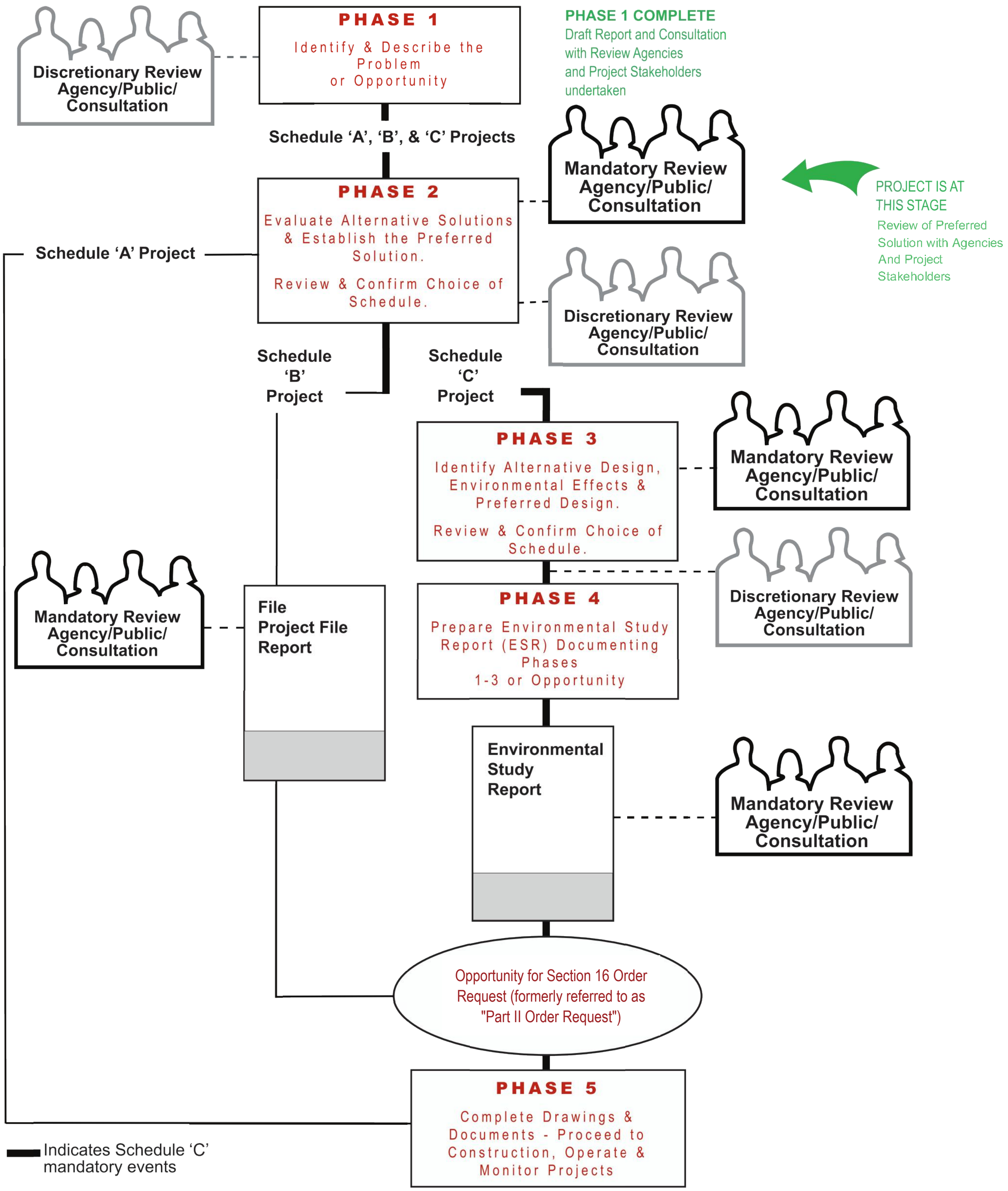
This Class EA was initiated as a Schedule C project under the Class EA process because it was expected that the Plantagenet WWTS would need to be increased beyond its existing rated capacity. Projects categorized as Schedule C undertakings have the potential for significant environmental effects, and are required to follow the full planning and design process specified under the Municipal Class EA. This includes consultation with all parties that may potentially be affected by the project, and the preparation of an Environmental Study Report (ESR) that documents the Class EA process that was followed for the project.

The Class EA framework (refer to Figure 3) defines the process for each type of project. For Schedule C projects, the completion of Phase 1 to Phase 4 of the Class EA process is required:

- Phase 1 – Identify the Problem and/or Opportunity
- Phase 2 – Identify Alternative Solutions to the Problem and/or Opportunity
- Phase 3 – Identify Alternative Design Concepts for the Preferred Solution
- Phase 4 – Preparation of Environmental Study Report
- Phase 5 – Implementation

The ESR shall be made available for review by indigenous communities, the public and review agencies at the completion of Phase 4 for a period of 30 calendar days. This period is followed by a waiting period lasting 30 days to allow the MECP to request or notify proponents of a ‘Section 16 Order’ (formerly known as a ‘Part II Order’). Following the 30-day waiting period, if there are no requests received from MECP for a ‘Section 16 Order’, then the project may proceed to implementation (Phase 5).

The Class EA is proceeding in accordance with the Schedule C requirements of the Ontario Municipal Class EA. This Schedule was confirmed as part of Phase 2 of the Class EA.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

CLASS EA PROCESS (UPDATED FOR PHASE 2 REPORT)

J.L.Richards
ENGINEERS·ARCHITECTS·PLANNERS
www.jlrichards.ca

DESIGN: JW
DRAWN: RW
CHECKED: SG

JLR NO:

DRAWING #: FIGURE 3

PLOT DATE: November 28, 2016 9:39:27 AM

1.3 Objectives of the Class Environmental Assessment

The objective of this Class EA is to identify the preferred servicing option(s) for the Plantagenet Wastewater System for the 20-year planning horizon (to 2042). All components of the wastewater system will be reviewed, including the wastewater treatment system, gravity collection system, sewage pumping stations and gravity outfall to the South Nation River.

This report provides a summary of Phase 2 of the Class EA process, including providing a review of various options that have been considered to address the Problem Statement determined during Phase 1, and to recommend the preferred solution.

The Phase 2 report objectives are to:

- Provide a summary of the problems and opportunities associated with the wastewater system identified in Phase 1. A detailed description of the wastewater system and the problems and opportunities associated with the system were presented in the Phase 1 Report (JLR, April 2023).
- Summarize additional studies undertaken to further describe the existing conditions of the wastewater system.
- Establish an evaluation criteria matrix and identify and evaluate possible alternative solutions to the identified problems/opportunities.
- Provide a discussion of the alternatives and recommend a preferred alternative for consideration by the Township and other interested parties, including review agencies, public and Indigenous Communities.

One (1) additional technical memorandum was completed during Phase 2 of the Class EA, for a total of two (2) technical memoranda during the Class EA. A summary of the Class EA technical memoranda is provided below:

- TM-1: Design Basis (Phase 1)
- TM-2: Climate Change Impacts (Phase 2, included as Appendix B to this report)

2.0 Summary of Phase 1 Findings

2.1 Existing Key Conditions and Constraints

A summary of the existing key conditions and constraints of the wastewater system, as described in the Phase 1 Report, is provided below. Refer to the Phase 1 Report for more information.

- The Plantagenet wastewater collection system consists of approximately 8.46 km of gravity sewer mains varying in size from 200 mm to 375 mm, most of which were built in the early 1970s. The collection system has historically had issues with extraneous flows. Previous studies have noted that these flows were caused mainly by illegal cross-connections from stormwater drainage facilities (direct connections from sump pumps, tile drains, etc.), but also by structural deficiencies in the sewer service laterals (I/I). A flow monitoring study was completed to review extraneous flow contributions to the system.

- The Plantagenet Lagoon site is located on roughly 9.5 ha on part of Lots 9 and 10 in Concession 4. The existing lagoon and sludge storage cell take up most of the available Township owned property on the site, with a small vacant area located at the easternmost section. Immediately adjacent lands are not owned by the Township, and therefore acquisition of adjacent land would be required if an expansion of the lagoon treatment system is part of the preferred solution. A factor to be considered in determining in which direction to expand the site is maintaining a separation distance of at least 150 m to sensitive receivers. It is noted that there are no sensitive receivers within the 150 m buffer area of the existing lagoon.

- No provincially significant wetlands (PSWs), significant valleylands, ANSIs or woodlands were present in or within 120 m of the study site. Endangered species were identified that may be impacted by the project; these include the Eastern Whip-poor-will, Bobolink, Eastern Meadowlark, little brown myotis bat and Butternut. Fish habitat was identified within an unnamed tributary crossing the farm fields and running along the south of the existing Lagoon. No significant wildlife habitat within 2 km of the site was identified. Wildlife Travel Corridor identified 105m southwest of the lagoon site.

- No registered or known archaeological resources were identified within a 1km radius of the study area. The sites for the lagoon, SPS #1 and SPS #2 were all noted as disturbed sites, with no archaeological potential. The farmland surrounding the existing treatment system was noted as having archaeological potential. Potential for deeply buried human remains and/or burial features was identified in front of the utilized portion of the St. Paul Roman Catholic Cemetery.

- 64 built heritage resources (BHRs) were identified within the study area as having potential cultural heritage value or interest, along with 9 potential BHRs that could not be sufficiently evaluated through a desktop survey. One potential BHR is located approximately 130 m west of the lagoon site and 200 m south of the SPS #1 site. 10 cultural heritage landscapes (CHLs) within the study area were identified within the study area as having potential cultural heritage value or interest, along with 1 potential CHL that could not be sufficiently evaluated through a desktop survey.

- The lagoon site and SPS #1 are within the buffer area for the Plantagenet Springs abandoned mine, requiring consultation with the Ministry of Mines during Phase 2.

- Most of the wastewater system (including SPS No. 1 and the treatment lagoon) is within a highly vulnerable aquifer, as identified in the Clean Water Act (2006), with a vulnerability score of 6 out of 10.

- The existing C of A for the Plantagenet Wastewater System sets the rated capacity of the lagoon treatment system at 561 m^3/day average daily flow and allows for the discharge of effluent during the Spring (April 01 – May 31) and the Fall (November 01 – December 20). It also sets limits on the allowable BOD_5, TSS, TP and pH concentrations in the effluent discharge, and sets forth a sampling and monitoring program that must be followed by operators of the system.

- Compared to typical wastewater strength, the raw wastewater received at the lagoon has an above-medium concentration of BOD_5, a medium concentration of TSS, a below-medium concentration of TP and medium concentration of TKN. Overall, the raw wastewater received at the lagoon can be categorized as a medium strength wastewater.

- The existing lagoon treatment system was shown to regularly operate above the system's rated capacity, averaging a daily influent flow of 747 m^3/day (33% above the rated capacity). The existing lagoon was also shown to regularly exceed effluent water quality criteria for TSS and BOD_5.

- The main operational challenges identified by the Township and OCWA for the lagoon treatment system related to the lack of capacity of the lagoon and the regular presence of algae. No operational challenges were identified for the sewage pumping stations, or the collection system.

- An evaluation of potential growth in the servicing area was undertaken. Phasing of growth was requested by the Township due to the large magnitude and timing uncertainty of projected development. A two-phase (10-year (2032) and 20-year (2042)) strategy was developed. An existing residential population of 1,336 and existing ICI serviced area of approximately 6 ha was established. A 2032 residential population of 2,636 and ICI area of 8.23 ha, and a 2042 residential population of 3,935 and ICI area of 10.46 ha, were projected. These projections were used to develop raw wastewater flow projections.

- Capacity upgrades of the sewage pumping stations and associated forcemains should be reviewed in Phase 2 of the Class EA and considered as part of the preferred solution.

- A desktop assimilative capacity study (ACS) of the South Nation River was undertaken. All water quality parameters, except for TP, were identified as having Policy 1 status. TP was identified as having Policy 2 status, meaning that the annual loading of TP cannot be increased as part of the preferred upgrade solution. Maximum daily discharge rates were established for both phases (10-year and 20-year) and for two discharge scenarios: Scenario A – Existing Discharge Period (Apr 1 to May 31 and Nov 1 to Dec 20) and Scenario B – Extended Discharge Period (Oct 1 to May 31).

- Effluent objectives and limits were also established as part of the ACS. In addition to providing criteria for $cBOD_5$, TSS, TP and pH, effluent criteria were also provided for TAN (varying monthly) and E. coli, for which treatment will need to be considered in the evaluation of alternative solutions. Participation in the Total Phosphorous Management (TPM) program was identified as a potential option to potentially increase the limit for TP. The lagoon "ice-free cover" requirement was also identified as a constraint to be considered in the evaluation of alternative upgrade solutions.

- A preliminary storage volume and discharge assessment was completed, which identified that additional storage will be required for a lagoon-based treatment solution, capacity upgrades to the discharge piping from MH-J to MH-E may be required depending on the results of Phase 2, a limiting sewer capacity of 16,000 m^3/day downstream of MH-E is sufficient to accommodate the 20-year flows from the upgraded Plantagenet WWTS, and the proposed maximum allowable monthly discharge rates allow for significant operational flexibility in both Phase 1 (2032) and Phase 2 (2042). It is noted that hydraulic modelling of the outfall would be required to determine the actual outfall flow capacity, which is impacted by tailwater elevations (water level in the South Nation River) and minor head losses within the pipe. It is recommended that hydraulic modelling be completed during preliminary design of upgrades to confirm flow capacity of the outfall.

2.2 Problem and Opportunity Statement

Based on the information developed and analyzed during Phase 1 of this Class EA, the following problem and opportunity statement was developed for the project:

> *A review of the Plantagenet Wastewater System suggests that the Plantagenet Wastewater Treatment System is operating above its rated capacity and has treatment performance issues that have resulted in effluent wastewater concentrations above the current Environmental Compliance Approval objectives and limits. As a result, the system cannot accommodate any growth of the serviced area or population. The Township of Alfred and Plantagenet is undertaking a Municipal Class Environmental Assessment (Class EA) to evaluate options to upgrade the Plantagenet Wastewater System to address issues related to achieving effluent quality criteria and ensure that the 20-year growth of Plantagenet is adequately planned for and accommodated. The Class EA will consider the level of adequacy of wastewater treatment at the lagoon and will recommend a solution to address the findings in accordance with the 2023 Municipal Class EA process.*

3.0 Stakeholder Consultation

The Class EA process requires consultation with stakeholders that may potentially be affected by the project. As part of Phase 2, the consultation plan developed in Phase 1 was followed to facilitate communication with the public, indigenous communities, agencies, and other interested stakeholders. Refer to Appendix A for the Phase 2 Stakeholder Consultation Summary and supporting documentation.

Key components of consultation completed during Phase 2 include:

- Reviewing the Stakeholder Consultation Plan
- Maintaining Stakeholder Mailing List and Contacts
- Responding to Stakeholder Comments
- Project Committee and Other Consultation Meetings

Key consultation correspondences from Phase 2 are included in Appendix A.

4.0 Additional Information on Existing and Projected Conditions

4.1 Climate Change Impacts

Technical Memorandum No. 2 (TM-2) – Climate Change Impacts was prepared to outline the potential impacts of climate change on the Plantagenet wastewater collection and treatment systems, and to outline potential areas of concerns that should be addressed in future designs and upgrades. The following is a summary of the potential effects from climate change, adaptation strategies and climate change mitigation measures identified in TM-2; refer to Appendix B for more information.

Potential Effects:

- Potential for higher volume of debris in the collection system.
- Potential for restricted access to wastewater conveyance and treatment facilities.
- Potential for surcharging of the lagoon outfall.
- Potential for higher volumes of, and more diluted, raw wastewater, especially if collection system experiences high I/I flows.
- Potential for higher demand from backup generators.

Adaptation Strategies:

- Ensure that collection system piping and pumping station wet wells are sufficiently sized for increased peak flow rates.
- Ensure that runoff is adequately controlled at the pumping stations and lagoon to minimize incursion into system from pluvial events and flooding of South Nation River.
- Explore the use of renewable energy generation or ensure backup power systems are adequately sized to address increased risk of longer duration power outages.

Climate Change Mitigation Measures:

- Fuel switching for backup power systems.
- Use of premium efficiency pumps or variable frequency drives.
- On-site renewable energy generation.
- Sourcing concrete and steel from low embodied carbon sources.

4.2 Hydrogeological Conditions for Potential Treatment System Expansion

A preliminary hydrogeological investigation was undertaken by Thurber Engineering Limited (Thurber) in the area surrounding the lagoon to establish baseline hydrogeological conditions. A subsurface investigation (4 boreholes) was completed, following which the soil and groundwater conditions were characterized, potential impacts on groundwater quality and quantity from a potential expansion of the lagoon were assessed, and associated mitigation measures were identified. The investigation also reviewed previous work carried out in the lagoon area as part of the previous ESR (Stanley, 1998). A summary of hydrogeological conditions in the lagoon area is provided below. Refer to the investigation report provided in Appendix C for additional details. Note that potential impacts to groundwater will be assessed as part of the evaluation of alternatives in Phases 2 and 3, while mitigation measures and recommended construction methods (if applicable) will be identified in the ESR in Phase 4 of the Class EA.

- Based on a review of MECP databases and mapping:
    - The existing lagoon site is divided into two physiographic regions: Russel and Prescott Sand Plains to the east and Ottawa Valley Clay Plains to the west.
    - The surficial geology of the site and immediate surrounding area consists of fine-textured glaciomarine deposits comprising of silt and clay, minor sand and gravel, massive to well laminated.
    - The bedrock underlying the site is from the Lindsay Formation and varies in depth from 30 m to 40 m.
    - Within a 500 m radius around the lagoon site, five (5) water supply well records, no Permits to Take Water (PTTWs) and no Environmental Activity and Sector Registry (EASR) registrations were identified. Below is a summary of the two closest water supply wells:
        - Well ID #5203555 – Approximately 220 m northwest of the lagoon site, 25.9 m depth, completed in May 2001.
        - Well ID #5201540 – Approximately 590 m southeast of the lagoon site, 10.4 m deep, completed in August 1979.
    - As previously noted, the lagoon site is located within a highly vulnerable aquifer (HVA) with a vulnerability score of 6 out of 10.
- Local subsurface conditions encountered during the borehole investigation conducted as part of this study consisted of topsoil or fill (comprised of silty clay with organics and variable amounts of sand), marine clay, and glacial till (varied in composition from a cohesive sandy silty clay to a non-cohesive silty sand with gravel to gravelly sand) overlying limestone bedrock. It is noted that the previous ESR (Stanley, 1998) also identified surficial silt and sand, which was not encountered as part of the current study.
- Groundwater levels within the monitoring wells between March 2022 and October 2022 were found to range from 48.1 m to 52.8 m, and generally responded immediately to significant precipitation events. The groundwater elevation northeast/east of the lagoon is generally higher than southwest/west. Groundwater flow is interpreted to be in the southwest direction towards the South Nation River and away from recorded water supply wells. Furthermore, the base of the existing lagoon is expected to be below normal groundwater level.
- The vertical hydraulic gradients at the site were observed to be downward during the study period. Results suggest good hydraulic connection between glacial till and bedrock. It is noted that the previous ESR (Stanley, 1998) also suggested that the dominant hydraulic gradient is vertically down.

- Hydraulic conductivity was estimated based on slug tests for different geological units. Clay was found to be relatively less conductive than the underlying glacial till and bedrock. It is noted that the previous ESR (Stanley, 1998) estimated lower hydraulic conductivity values for clay (based on published data and not slug tests), similar values for glacial till and slightly lower values for limestone bedrock.
  - Clay: 1.0×10^{-8} m/s to 4.8×10^{-7} m/s.
  - Glacial Till: 2.9×10^{-6} m/s to 1.0×10^{-5} m/s
  - Limestone Bedrock: 2.5×10^{-6} m/s to 3.3×10^{-5} m/s
- Unfiltered groundwater samples were collected and tested against the Ontario Drinking Water Quality Standards (ODWQS). The samples were found to generally exceed operational guidelines for hardness, exceed aesthetic objectives for total manganese and true colour, and exceed health standards for total coliforms and total sodium. Nitrate-nitrogen is a critical groundwater contaminant, as it is not adsorbed by soil and does not degrade quickly in a groundwater environment. Nitrate has the potential to reach the groundwater through lagoon seepage. Nitrate concentrations in the groundwater samples were found to be below the ODWQS limit (note that lagoon nitrate concentrations were found to be below the instrument detection limit).
- Seepage through the clay from the base of the existing lagoon, based on a lagoon area of 64,000 m^2, was estimated as 0.0022 m^3/s, equivalent to 190 m^3/day or 69,350 m^3 per year. Using a more accurate base area of 58,000 m^2, the rate reduces to 0.0020 m^3/s, equivalent to 173 m^3/day or 63,105 m^3 per year. It was also estimated that the approximate travel time for seepage to reach the river was estimated to be approximately 550 years due to a low horizontal hydraulic gradient.
- Lagoon expansion to the south and southeast, as recommended in the 1998 ESR, appears feasible. It is noted that thicker clay was observed to the east and that expansion to the southeast is preferable to expansion to the south.

4.3 Geotechnical Conditions for Potential Treatment System Expansion

A geotechnical desktop study was also undertaken by Thurber for the area surrounding the lagoon to assess baseline geotechnical conditions. This was done through a review of historical borehole records and a review of the four (4) boreholes drilled as part of the preliminary hydrogeological investigation. A summary of geotechnical conditions in the lagoon area is provided below. Refer to the study report provided in Appendix D for additional details.

- Subsurface stratigraphy based on borehole investigation:
  - Layer 1A: Silty clay topsoil with organics; thickness ranging from 0 m to 0.25 m.
  - Layer 1B: Silty clay fill with organics and variable amounts of sand; thickness ranging from 0 m to 2.3 m.
  - Layer 2: Native grey-brown marine clay layer; stiff to very stiff and high plasticity (CH); encountered depth ranging from 0.1 m to 2.3 m below grade, with thickness ranging from 1.3 m to 5.0 m.

  - Layer 3: Native glacial till with varying composition; loose to very dense consistency; thickness ranging from 0.2 m to 8.4 m.
  - Layer 4: Grey limestone bedrock; slightly weathered to fresh, fine grained, thinly to medium bedded and strong; depth ranging from 2.7 m to 8.7 m (elevation 48.9 m to 40.4 m).

- Non-liquefied Seismic Site Class D designation can likely be used for design, and more favourable Site Class C may be possible. Other preliminary seismic site data including liquefaction and cyclic mobility/softening potential is provided in Appendix D.
- Based on limited data available, the maximum recommended grade raise (conservative) for preliminary planning purposes is 3.0 m, which should maintain settlements within tolerable limits and allow for the construction of lightly loaded one-storey structures.
- For preliminary planning purposes, it is recommended that berms up to 3 m in height be constructed with side slopes of 3H:1V, or shallower.
- Subsurface conditions at the site are generally considered favourable for shallow foundations (either spread footings or mat foundations).
- Construction of new sewers and forcemains to moderate depths (3m or shallower) is not expected to present significant challenges, and typical bedding will be applicable. Seepage barriers will be required at periodic intervals within trenches.

4.4 Review of Lagoon Influent and Effluent Flow Discrepancy

The Phase 1 Report identified a large flow volume discrepancy (+90,000 m^3 or +40%) between the measured lagoon influent (+273,050 m^3) and effluent discharge (-182,940 m^3) and noted that the discrepancy was likely due to a combination of flow measurement error, net precipitation, leakage and/or seepage. These are reviewed in further detail below:

- **Flow Measurement Error** – As noted in the Phase 1 Report, effluent flow volumes are estimated based on lagoon water elevations, known lagoon storage volumes and influent flow rates. OCWA noted that when the system overflows (which occurs regularly during the discharge periods), the effluent volume is assumed equal to the influent flow volume measured at SPS No. 1. The remaining effluent volume is then estimated based on lagoon water elevations and known lagoon storage volumes. This effluent flow volume estimate has a low level of accuracy and is a likely contributing cause for the flow volume discrepancy. Additionally, OCWA noted that the flow meter at SPS No. 1 has an acceptable margin of error of +/- 5%, which also potentially contributes to the discrepancy.
- **Net Precipitation** – Net precipitation is an important consideration in lagoon storage volume assessments. For the Plantagenet WWTS, the flow contribution from net precipitation is not captured in historical influent/effluent flow data due to the location of the influent flow meter and the estimated effluent flow measurement. Based on the net precipitation projections from Phase 1, on an annual basis, net precipitation increases the total amount of wastewater volume that must be stored and discharged. However, based on how the effluent flow volume is estimated, net precipitation is underestimated in both the influent and effluent flow volumes, and therefore is not a cause of the discrepancy.

- **Leakage** – Leakage through the bottom or the sides of the lagoon may be caused by cracks in the retaining structure, or animal burrows (e.g., muskrat burrows).
- **Seepage** – Seepage through the clay bottom of the lagoon to the underlying aquifer was estimated as part of the preliminary hydrogeological investigation (see Section 4.2 and Appendix C). Due to the dominant downwards hydraulic gradient in the area, a seepage volume of 63,105 m^3 (or 23.1% of the measured inflow flow volume) per year was estimated. It is noted that a typical maximum allowable seepage rate for wastewater treatment lagoons is 1/8 inch per day or 3.2 mm/day (EPA, 2011), although this value is dependent on the governing state/province and site conditions. Assuming a 58,000 m^2 bottom of lagoon, this equates to a maximum allowable seepage volume of approximately 67,750 m^3/year, which is slightly above the estimated seepage from the Plantagenet lagoon.

Based on the above, seepage through the bottom of the lagoon is likely the main contributor to the flow volume discrepancy, with the remaining discrepancy likely due to flow measurement error, and possibly leakage through the bottom or sides of the lagoon. Noting that the potential seepage rate is close to the typical maximum allowable seepage rate in similarly governed states, it is recommended that upgrades to the existing lagoon to reduce the seepage rate be carried forward as part of any alternative that will continue using the existing lagoon for treatment or storage. During Phase 3, additional discussions will be undertaken with the MECP to determine timing required to undertake further studies related to the above. It is anticipated that the study will require a geotechnical/hydrogeological engineer to review the hydrogeological conditions and confirm whether upgrades to the existing lagoon are needed.

4.5 Wastewater Collection System Inflow and Infiltration

As noted in the Phase 1 Report, the Plantagenet wastewater collection system has historically had issues with high flow volumes from extraneous sources. Previous studies have noted that these flows were caused mainly by illegal cross-connections from stormwater drainage facilities (direct connections from sump pumps, tile drains, etc.), but also by structural deficiencies in the sewer service laterals, contributing I/I flows to the system. The Township and OCWA have noted that some improvements have been made to the system to minimize these flows (e.g., new maintenance hole covers, rehabilitation of service laterals and removal of illegal connections), but that they may still have a significant impact on the total generated wastewater volume, especially in the older parts of the Village that do not have storm sewers. Note that the following flow contributions were estimated in TM-1 – Design Basis, prepared during Phase 1 of the study:

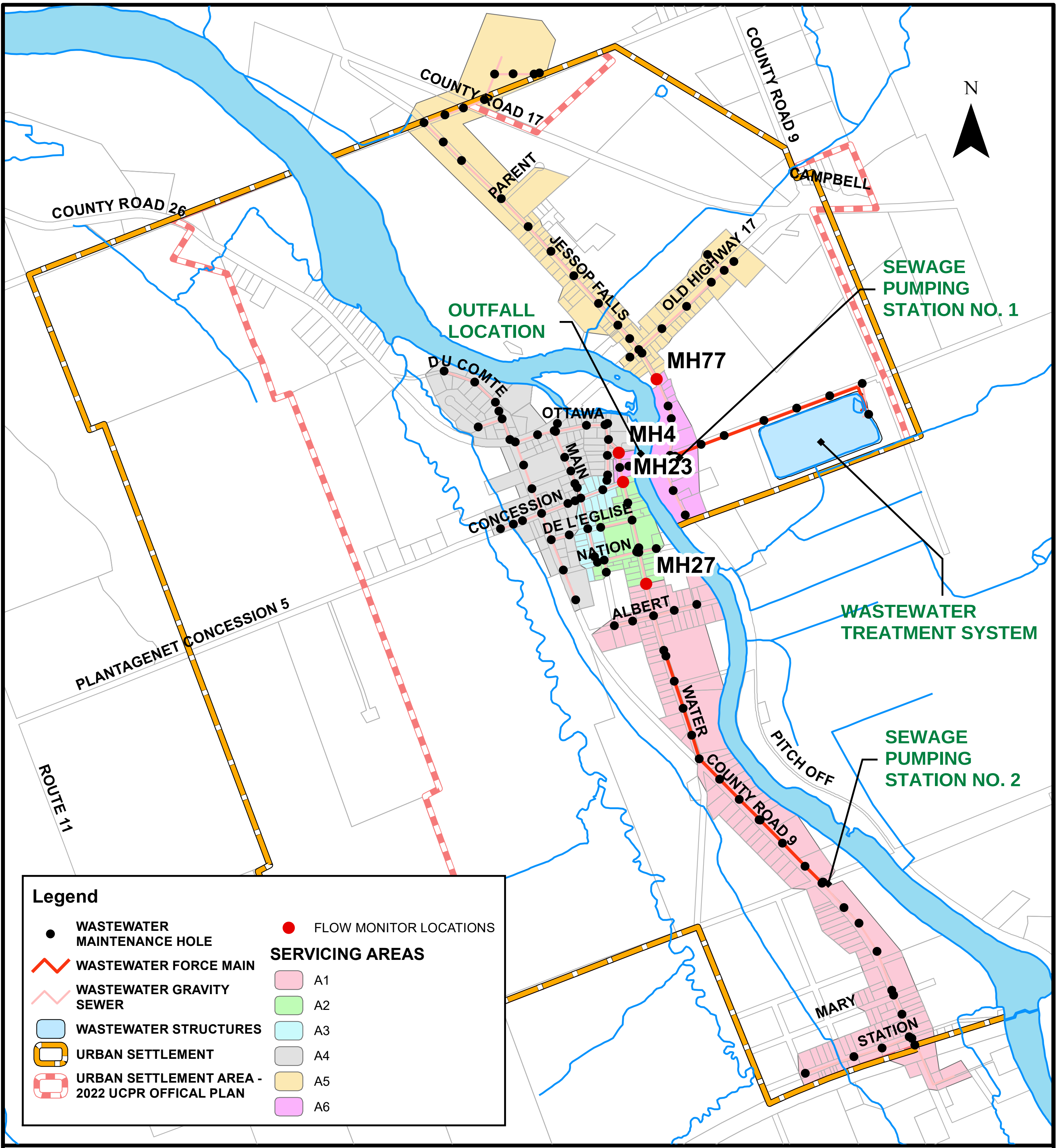
- Industrial, Commercial and Institutional (ICI) flow contribution of 102 m^3/day (13.7% of total average daily flow (ADF)), based on an estimated area of 6 ha and a typical annual ICI flow rate of 17 m^3/day/ha;
- Dry weather I/I flow contribution of 157 m^3/day (21% of total ADF), based on an estimated servicing area of 91 ha and a typical annual flow contribution of 0.02 L/s/ha; and
- Residential flow contribution of 488 m^3/day (equivalent to a per capita flow rate of 365 L/cap/day and 65.3% of total ADF), based on average daily flow of 747 m^3/day and subtracting the above two flow contributions.

A flow monitoring study was undertaken by Civica Infrastructure Inc. (Civica) to assess the I/I dry and wet weather flow contributions to the collection system. Refer to Appendix E for the Flow Monitoring Study Report. As part of the study, five (5) flow meters were installed in four (4) individual maintenance holes (MHs) at strategic locations within the collection system between March 2 to May 20, 2022. This allowed for the assessment of six (6) separate servicing areas. Refer to Figure 4 for a site plan overview of the flow monitor locations and the delineated servicing areas. A summary of estimated/approximated properties of the delineated servicing areas is provided Table 1. This information was provided to Civica for their analyses.

Table 1: Properties of Assessed Servicing Areas from Flow Monitoring Study.

ID	Description	Servicing Area Properties (Approx.)			
		Trunk Sewer Length (m)	Area (ha) (1)	Serviced Population (cap) (2)	Serviced ICI (ha) (2)
A1	Serviced area U/S of MH-27.	2,620	35.8	423	0.8
A2	Serviced area U/S of MH-23 (Water Street), but D/S of MH-27.	610	5.1	141	0.3
A3	Serviced area U/S of MH-23 (Concession and Main Street).	360	2.8	74	0.0
A4	Serviced area U/S of MH-4.	2,030	19.9	356	2.3
A5	Serviced area U/S of MH-77.	2,150	23.1	313	2.5
A6	Serviced area D/S of MH-77, MH-4 and MH-23.	690(3)	5.2	29	0.1
	Total:	**8,460**	**91.9**	**1,336**	**6.0**

Notes:
(1) Approximated based on aerial mapping and general understanding of Village topography.
(2) Approximated based on land use mapping and street-level review in Google Maps.
(3) Includes crossing below South Nation River.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

PHASE 2 FLOW MONITORING STUDY -
MONITOR LOCATIONS AND DELINEATED SERVICING AREAS

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN: NB/TB
DRAWN: TB
CHECKED: NB/JM
JLR #: 31457-000

DRAWING #:
FIGURE 4

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 FIGURE 4 ServicingAreas.mxd

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Key results from the flow monitoring study are summarized in Table 2. The report identified that MH-4 frequently experienced submerged flow conditions (backwater effects) and surcharging during rainfall events. It was noted that this is likely due to downstream capacity restrictions such as a partial blockage or a reverse sloped pipe. It is recommended that the Township undertake a CCTV inspection of the pipe downstream of MH-4 to determine if there is any blockage or if the pipe requires cleaning. Based on a review of the as-built drawings, there is potential that the identified surcharging during rainfall events at MH-4 may also be occurring between MH-3 and MH-10 (between the MH on Water Street approximately 25 m north of Concession Street and the MH located at the intersection of Old Highway 17 and County Road 9). Note that Dry Weather Flow (DWF) is a combination of population-generated wastewater flow (residential and ICI) and dry weather groundwater infiltration (GWI). Wet Weather Flow (WWF) is a combination of population-generated wastewater flow (residential and ICI), stormwater runoff infiltration, trench infiltration and groundwater infiltration, in response to a rainfall or snowmelt event.

Table 2: Key Flow Monitoring Study Results (March 2 to May 20, 2022).

Flow Monitor Location	**Contributing Servicing Areas**	**Total Flow Volume**	**DWF**		**Dry Weather GWI**	**Peak Measured Wet Weather I/I Flow Rate**
		m^3	*L/s (m^3/day)*	*L/cap/d*	*L/s/ha*	*L/s/ha*
Flow Monitoring Study Results (March 2 to May 20, 2022):						
MH-77	A5	12,860	1.71 *(147.7)*	471	0.034	0.268
MH-4	A4	16,810	1.98 *(171.1)*	480	0.052	0.481
MH-23A	A1 and A2	31,380	4.28 *(369.8)*	656	0.045	0.312
MH-23B	A3	2,230	0.30 *(25.9)*	347	0.038	0.437
MH-27	A1	22,380	2.78 *(240.2)*	568	0.039	0.347
Subtotal:	**A1, A2, A3, A4 and A5**	**63,280**	**8.27 *(714.5)***	**547**	**0.043**	**0.343**
Measured Flow at SPS No. 1 (March 2 to March 20, 2022) – for Comparison:						
SPS #1	A1, A2, A3, A4, A5 and A6	66,074	N/A	N/A	N/A	N/A
Interpreted Results (March 2 to March 20, 2022):						
N/A	A2	9,000 (1)	1.5 *(129.6)* (1)	919 (1)	0.087 (1)	N/A
N/A	A6	2,794 (2)	N/A	N/A	N/A	N/A

<u>Notes</u>:
(1) Estimated from MH-27 and MH-23A data.
(2) Estimated from SPS No. 1 and flow monitoring study data.
(3) Total DWF volume for A1 to A5 was approximately 56,450 m^3 (714.5 m^3/day) over the study period, of which approximately 25,710 m^3 (325.5 m^3/day) was estimated to be from GWI.

It is noted that the results from the flow monitoring study are preliminary and only provide a limited understanding of the extraneous flows in the collection system during the spring. The results may not represent the average extraneous flows to the system on an annual basis. To gain a more accurate understanding of the I/I flows within the system, Civica recommended that the Township complete a longer-term flow monitoring program, undertake smoke and dye testing, undertake wet-weather sewer inspections and condition assessments, and investigate the flow capacity restriction downstream of MH-4. In consideration of the above, the following preliminary observations and recommendations were drawn from the results in Table 2:

- Dry weather GWI accounted for approximately 40.6% of the total flow volume; significantly more than the 20% estimated from typical guidelines as part of TM-1 – Design Basis, although it is important to note that GWI rates are typically significantly higher during the spring due to higher groundwater levels. Nonetheless, it is likely that dry weather GWI contributes more than 20% of the annual ADF. From the assessed servicing areas, A2 appears to be the area that is most susceptible to GWI (0.087 L/s/ha vs. average of 0.043 L/s/ha), followed by A4 (0.052 L/s/ha vs. average of 0.043 L/s/ha). This aligns with previous Township/OCWA comments that higher I/I rates were suspected in the older areas of the Village.
- A typical design wet weather I/I flow rate used in the design of sanitary sewers is 0.33 L/s/ha (City of Ottawa, 2018). The average peak measured wet weather I/I flow rate measured as part of the study was 0.343 L/s/ha. This rate was achieved without the occurrence of significant rainfall events (i.e., without the occurrence of rainfall events with maximum return periods of peak intensity of greater than 2 years). It therefore appears that the peak wet weather I/I flow rates experienced in the collection system are greater than the conservative rate used in the design of sanitary sewers. From the assessed servicing areas, A4 (0.481 L/s/ha) and A3 (0.437 L/s/ha) appear to be most susceptible to high wet weather I/I flows. It is also suspected that A2 is also susceptible to high wet weather I/I flows, as it has a higher estimated GWI.
- Population-derived DWF accounted for only 48.6% of the total flow volume, which is much less than the 80% estimated from typical guidelines as part of TM1 – Design Basis. Based on the above two bullets, it is likely that the population-derived flow represents somewhere between 50% and 80% of the total flow contribution. Assuming a percentage of 65% and assuming ICI represents 17.3% of the total population-derived flow (same as in TM-1), a per capita residential flow rate of 270 L/cap/day is estimated for the period between 2016 and 2020. Note that this value does not affect the design basis of the Plantagenet WWTS, as the projected flows were based on typical guideline values. However, this value was considered in the development of the peak wastewater flow rates (see Section 4.6).

It is recommended that the Township develop and implement an I/I Reduction Program to plan and implement strategies and improvements to the collection system to minimize the impact of I/I on the wastewater system. It is recommended that the planning portion of this program be completed through an Infrastructure Master Plan (IMP). An IMP will allow for the assessment of both the condition and capacity of the existing sanitary sewer collection system. As part of the IMP, a longer-term flow monitoring program and sanitary sewer modelling should be completed to identify sections of sewer susceptible to high I/I flows, as well as identify sections of sewer with insufficient capacity to accommodate higher flows from proposed development and/or I/I flows. The IMP would identify the scope, cost and timeline of proposed upgrades, which may include upsizing of sanitary sewers, addition of storm sewers, lining or replacement of existing sanitary sewers, etc.

4.6 Peak Raw Wastewater Flow Projections

Based on the results of the flow monitoring program, peak design raw wastewater flow rates for both the entire collection system (SPS No. 1 servicing area) and for the SPS No. 2 servicing area were projected for the 10-year, 20-year, and build-out design horizons. These are summarized in Table 3 and Table 4. The peak raw wastewater flow rate is used for the design of wastewater collection and pumping systems and is a combination of the peak residential flow rate, peak ICI flow rate and the peak I/I flow rate. Note that these flow rates will be confirmed during the design of the upgrades.

Table 3: Projected Peak Design Raw Wastewater Flow Rates – Entire Collection System.

Phase	Peak Instantaneous Design Flow (m^3/day)	Peak Instantaneous Design Flow (L/s)
Existing (2022)	*2,520* (4)	*29.2* (4)
Phase 1 – 10-Year (2032)	6,570	76.0
Phase 2 – 20-Year (2042)	8,610	99.7
Phase 3 – Build-Out (Post-2042)	19,870	229.9

Notes:

1. Residential peak flow contribution was estimated using a per capita flow rate of 280 L/cap/day for existing residential (slightly above estimated 270 L/cap/day, matching City of Ottawa Design Guidelines) and 350 L/cap/day for future residential (matching TM-1 – Design Basis).
2. An ICI peaking factor of 1.0 was used because the ICI area occupies less than 20% of the total servicing area (City of Ottawa, 2018).
3. The City of Ottawa I/I design flow rate of 0.33 L/s/ha was used for new development, while a rate of 0.40 L/s/ha was used for the existing servicing area (based on flow monitoring study results, which suggested a rate higher than 0.33 L/s/ha).
4. Existing peak rated capacity.

Table 4: Projected Peak Design Raw Wastewater Flow Rates – SPS No. 2 Servicing Area.

Phase	Peak Instantaneous Design Flow (m^3/day)	Peak Instantaneous Design Flow (L/s)
Existing (2022)	*920* (3)	*10.6* (3)
Phase 1 – 10-Year (2032)	2,740	31.7
Phase 2 – 20-Year (2042)	3,640	42.1
Phase 3 – Build-Out (Post-2042)	5,720	66.2

Notes:

1. Flow monitoring results suggested that the SPS No. 2 servicing area contributed approximately 30% of the total existing ADF.
2. Refer to Table 3 for additional notes.
3. Existing peak rated capacity.

5.0 Summary of Projected Wastewater System Requirements

This section provides a summary of key design information that will be used as the basis for identifying alternative solutions for the wastewater system to meet 10-year (2032) and 20-year (2042) servicing requirements.

5.1 Projected Raw Wastewater Characteristics and Effluent Criteria

Table 5 summarizes projected raw wastewater quality and flows, Table 6 and Table 8 summarize projected maximum daily effluent discharge rates on a per month basis, and Table 7 and Table 9 summarize projected effluent limits and objectives.

Table 5: Projected Raw Wastewater Flows and Quality.

EXISTING (2016 to 2020)					
Average Daily Flow (m3/day):	*747*				
Water Quality Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Average Concentration (mg/L):	*206*	*279*	*192*	*5.63*	*45.3*
Maximum Monthly Concentration (mg/L):	*412*	*659*	*430*	*9.76*	*70.9*
PHASE 1 - 10-YEAR (2032)					
Projected Average Daily Flow (m3/day):	1,390				
Projected Peak Instantaneous Flow (m3/day or L/s):	6,566		or	76.0	
Projected Peak Daily Flow (m3/day or L/s):	3,435		or	39.8	
Projected Maximum Monthly ADF (m3/day):	2,059				
Water Quality Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Average Concentration (mg/L):	210	280	200	5.7	46
Average Loading (kg/day):	300	390	280	8.0	64
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	577	917	598	13.6	99
PHASE 2 - 20-YEAR (2042)					
Projected Average Daily Flow (m3/day):	2,020				
Projected Peak Instantaneous Flow (m3/day or L/s):	8,611		or	99.7	
Projected Peak Daily Flow (m3/day or L/s):	4,992		or	57.8	
Projected Maximum Monthly ADF (m3/day):	2,992				
Water Quality Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Average Concentration (mg/L):	210	280	200	5.7	46
Average Loading (kg/day):	430	570	410	11.6	93
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	838	1,333	869	19.8	143
PHASE 3 - BUILD-OUT (POST-2042)					
Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Projected Average Daily Flow (m3/day):	5,960				
Average Concentration (mg/L):	210	280	200	5.7	46
Average Loading (kg/day):	1,260	1,670	1,200	34.0	275
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	2,473	3,934	2,563	58.4	423

Table 6: Proposed Maximum Daily Effluent Discharge Rates – Phase 1 – 10-Year (2032).

Date Range	Maximum Daily Discharge Rate (m^3/d) (1)
Scenario A – Existing Discharge Periods	
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 8,500 or outfall capacity
November 1 to 30	Lower of 6,100 or outfall capacity
December 1 to 20	Lower of 9,500 or outfall capacity
Scenario B – Semi-Continuous Discharge	
October 1 to 31	Lower of 2,200 or outfall capacity
November 1 to 30	Lower of 6,100 or outfall capacity
December 1 to March 31	Lower of 4,500 or outfall capacity
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 8,500 or outfall capacity

Notes:

1. It is recommended that hydraulic modelling be completed to confirm the actual outfall flow capacity during each month of discharge based on tailwater elevations and minor losses within the pipe. It is expected that the outfall capacity is lowest in April due to high tailwater elevations (high water levels in the South Nation River).

Table 7: Proposed Effluent Objectives and Limits – Phase 1 – 10-Year (2032).

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.3	0.33
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

Table 8: Proposed Maximum Daily Effluent Discharge Rates – Phase 2 – 20-Year (2042).

Date Range	Maximum Daily Discharge Rate (m^3/d) (1)
Scenario A – Existing Discharge Periods	
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 15,100 or outfall capacity
November 1 to 30	Lower of 10,800 or outfall capacity
December 1 to 20	Lower of 16,000 or outfall capacity
Scenario B – Semi-Continuous Discharge	
October 1 to 31	Lower of 4,500 or outfall capacity
November 1 to 30	Lower of 10,800 or outfall capacity
December 1 to March 31	Lower of 7,600 or outfall capacity
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 15,100 or outfall capacity

Notes:

1. It is recommended that hydraulic modelling be completed to confirm the actual outfall flow capacity during each month of discharge based on tailwater elevations and minor losses within the pipe. It is expected that the outfall capacity is lowest in April due to high tailwater elevations (high water levels in the South Nation River).

Table 9: Proposed Effluent Objectives and Limits – Phase 2 – 20-Year (2042).

Parameter	Averaging Period	Objective (mg/L unless noted otherwise)	Limit (mg/L unless noted otherwise)
$cBOD_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.2	0.23
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

5.2 Preliminary Projected Storage Volume Requirements

As part of Phase 1 of the Class EA, a preliminary lagoon storage volume and discharge assessment was completed to provide a general understanding of the ability of the existing WWTS to store and discharge projected treated wastewater flow volumes. Preliminary findings suggested that if an expansion to the existing system is selected as the preferred solution, an increase in the effective storage capacity of the system would be required. Based on various assumptions, a minimum lagoon storage volume of 189,000 m^3 and 275,000 m^3 were projected for the 10-year (2032) and 20-year (2042) design horizons. These values were used in identifying alternative solutions and completing pre-screening of the alternatives (evaluation and selection methodology further discussed in Section 6.0). Note that more accurate assessments will be completed as part of the evaluation of the screened alternative (see Section 9.0).

6.0 Evaluation and Selection Methodology

The main objective of Phase 2 of a Class EA is to identify and evaluate possible alternative solutions to the problem(s) and/or opportunity(ies) identified in Phase 1. All reasonable potential solutions, including the ‘Do Nothing’ option, are considered. Class EAs for wastewater projects generally result in the identification and review of a broad range of solutions. It is also important to note that the objective of Phase 2 is to focus on determining an overall “generalized solution” to the problem, and not necessarily specific details, which are further explored in subsequent phases of the Class EA. Phase 3 will identify and evaluate alternative designs, while Phase 5 (Implementation) will review details as part of the preliminary and detailed design stages.

To facilitate the evaluation process of alternative solutions and the selection of a preferred solution, a transparent and logical 3-part assessment process was established. This process included:

1. Initial Screening of Alternatives
2. Detailed Evaluation of Screened Alternatives
3. Selection of a Preferred Solution

The first evaluation stage considered the overall feasibility of high-level alternatives and identified the alternatives that fully address the problem statement. This step ensured that unrealistic alternatives were not carried forward to a more detailed evaluation stage.

Based on the initial screening, a detailed assessment of the short list of alternatives was completed. Evaluation criteria were developed based on a review of the background information, experience on similar assessments, and consultation with Township and OCWA staff. The evaluation was completed using criterium in the following four (4) major criteria:

1. Natural Environment and Archaeology
2. Engineering and Technical Considerations
3. Social and Community Well Being
4. Financial

Each criterium was assigned a weighting to reflect its level of importance relative to other criterium, as shown in Table 10. The weighing system was developed in consultation with the Township and OCWA, and feedback received through stakeholder consultation for this Class EA. The relative level of impact of each potential solution for each criterion was then assessed based on the scoring system summarized in Table 11. The option that ranked the highest according to the scoring system was recommended as the preferred solution.

Table 10: Description and Weighing of Evaluation Criteria.

MAJOR	MINOR	DESCRIPTION	WEIGHT (1-5)
Natural Environment and Archaeology	**Natural Environment and Wildlife**	Assess potential for impacts to natural environment, including wildlife, aquatic species, and habitats.	2
	Archaeology, Culture & Heritage	Assess potential for impacts to known or potential archaeological, cultural, or natural heritage features.	2
	Global Warming	Assess potential for greenhouse gas emissions and impacts on carbon sinks.	2
Engineering, Technical Considerations and Construction	**Ability to Meet Effluent Criteria**	Assess the ability of the wastewater system to meet the 20-year effluent criteria.	5
	Cold Weather Performance	Assess the ability of the wastewater system to treat wastewater during cold weather (December to April).	4
	Reliability and Resiliency	Assess the ability of the wastewater system to respond to changes in flow and raw wastewater quality as a result of user changes or climate change.	4
	Ease of Operation & Operational Flexibility	Assess the ease of operation and operational flexibility of the wastewater system.	4
	Opportunities for Future Expansion	Assess the ease with which the wastewater system capacity can be expanded to accommodate an increase in projected flow.	3
	Constructability	Assess the potential for challenges and constraints during construction.	3
Social / Community Well Being	**Air Quality and Noise**	Assess potential impacts to long-term ambient air quality and noise.	2
	Construction Impacts	Assess potential impacts of construction to the public and neighboring properties.	2
	Adjacent Land Uses and Purchase	Assess potential for requirement to purchase land to permit construction/operation and assess compatibility with adjacent land uses.	3
Financial	**Capital Costs**	Assess the impact due to the estimated capital costs.	5
	Operational Costs	Assess the impact to the Township’s operational costs.	5

Table 11: Detailed Evaluation Impact Level and Scoring System.

Evaluation Impact Level	Score
Potential for High Positive Impact	4
Potential for Moderate Positive Impact	3
No Anticipated Impact	2
Potential for Moderate Negative Impact	1
Potential for High Negative Impact	0

7.0 List of Potential Alternatives

Several potential high-level alternative solutions to accommodate 20-year (2042) requirements of the Plantagenet Wastewater System are presented and briefly described in Table 12. Note that the following improvements are assumed to be part of all the potential alternative solutions (except Option 1: Do Nothing), and that participation in the TPM program will be considered as part of the preferred solution. Note also that phasing of the preferred solution will only be reviewed as part of Phase 4 of the Class EA.

1. **Upgrades to SPS No. 1** – Increase the rated capacity of the pumping station from 29.2 L/s to approximately 100 L/s, and complete other miscellaneous and life-cycle upgrades to accommodate projected development and potential effects from climate change.
2. **Upgrades to SPS No. 2** – Increase the rated capacity of the pumping station from 10.6 L/s to approximately 42 L/s, and complete other miscellaneous and life-cycle upgrades to accommodate projected development and potential effects from climate change.
3. **Develop an Infrastructure Master Plan (incl. I/I Reduction Program) to Identify Upgrades to the Wastewater Collection System** – Refer to Section 4.5 for more information.

Table 12: List of Potential High-Level Alternative Solutions for the Plantagenet WWTS.

Option 1: Do Nothing	
No improvements. Represents the baseline condition.	
Option 2: Optimize/Modify Existing Lagoon	
2A: Modify Dimensions of Lagoon	Raise berms or deepen lagoon to increase storage and treatment capacity.
2B: Modify Hydraulics of Lagoon	Add baffles or modify inlet/outlet piping to improve lagoon hydraulics and avoid short-circuiting.
2C: Convert Part or All of Lagoon into an Aerated Lagoon	Deepen part or all of lagoon and add fine-bubble diffusers at base of deepened lagoon. Add new building to house aeration blowers.
2D: In-line Coagulation and/or pH Adjustment	Add in-line coagulation to replace or supplement batch alum dosing prior to discharge and/or in-line pH adjustment.
Option 3: Expand WWTS with New Lagoon Cells	
3A: Expansion using Existing Discharge Windows	Add new lagoon cell(s) while maintaining existing discharge windows.
3B: Expansion using New Discharge Window	Add new lagoon cell(s), including an aerated cell downstream of existing lagoon, and use new discharge window.
Option 4: Expand WWTS with Specialized Treatment System	
4A: Expansion using Existing Discharge Windows	Add new specialized treatment system(s) within or outside of existing lagoon and use existing discharge window.
4B: Expansion using New Discharge Window	Add new specialized treatment system(s) within or outside of existing lagoon and use new discharge window.
Option 5: New Mechanical Treatment Plant with New Discharge Window	
Construct a new mechanical treatment plant with new discharge windows.	
Option 6: Pump Raw Wastewater to Wendover WWTP (1,260 m^3/day capacity)	
6A: Convey All Wastewater to Wendover WWTP	Decommission existing lagoon, upgrade SPS No. 1 with higher head pumps, add new transmission main to Wendover and upgrade capacity of Wendover WWTP.
6B: Convey Only Wastewater above Capacity of Existing WWTS to Wendover WWTP	Add new wet well and pumps at SPS No. 1, add new transmission main to Wendover and, potentially, upgrade capacity of Wendover WWTP.
6C: Convey Wastewater up to Existing Rated Capacity of Wendover WWTP	Add new wet well and pumps at SPS No. 1, add new transmission main to Wendover, and upgrade Plantagenet WWTS to accommodate remaining capacity.
Option 7: Pump Treated Effluent to the Ottawa River	
Add new effluent pumping station, add new effluent forcemain and add new outfall to discharge treated effluent from the Plantagenet WWTS to the Ottawa River.	

8.0 Initial Screening of Alternatives

Before advancing to the evaluation of alternatives, the initial high-level list of potential alternative solutions was pre-screened to eliminate un-feasible alternatives. A review of each alternative was carried out in this section with recommendations on whether the alternative should be carried forward for further evaluation.

8.1 Option 1: Do Nothing

Proceeding with this option would have a negative effect on the environment as the system would continue to discharge non-compliant treated wastewater to the South Nation River. The system would also continue to operate above its rated capacity and prevent the Township from developing. This option does not address the problem/opportunity statement; however, it will be carried forward as a baseline option for comparison.

***Option 1 Recommendation*: Carry forward as Baseline Option for comparison.**

8.2 Option 2: Optimize/Modify Existing Lagoon

8.2.1 Option 2A: Modify Dimensions of Lagoon

The previous ESR (Stanley, 1998) recommended raising the berms of the existing lagoon by 0.2 m to increase the capacity of the existing lagoon from 92,577 m^3 to 104,920 m^3. A review of design guidelines was completed to assess the feasibility of this option. MECP guidelines (MECP, 2008) specify the following design considerations for the construction of wastewater treatment lagoons:

- Maximum sewage depth of 1.8 m in primary cells.
- Effluent piping invert located 0.3 m above bottom of lagoon (retained volume represents the sediment/sludge layer).
- Cells are to be equipped with an emergency overflow system to overflow when the liquid contents reach within 0.6 m of the top of the berms.
- Berms to have a minimum top width of 3.0 m to allow for perimeter access, and maximum 4:1 slope inside the lagoon and 3:1 outside.
- Minimum freeboard above maximum operating water level to be 0.9 m.

The existing lagoon has internal side slopes of 4:1, external side slopes of 3:1, a total depth of 2.34 m, an operating depth of 1.5 m, an operating area of approximately 61,700 m^2, a top of berm width of 2.44 m and the following elevations:

- Top of Berm Elevation: 53.70 m
- Overflow Elevation: 53.34 m
- High Water Level Elevation: 52.96 m
- Bottom of Lagoon Elevation: 51.36 m
- Effluent Invert Elevation: 51.44 m (Outlet B / Current Outlet) or 51.39 m (Outlet A)

According to design guidelines, the existing lagoon is currently allowed to operate at the maximum allowable primary lagoon cell operating depth of 1.5 m and has sufficiently sloped side slopes. However, the existing lagoon does not have a deep enough sludge layer (0.03 m or 0.08 m vs. 0.3 m), does not have a deep enough overflow freeboard (0.36 m vs. 0.6 m), does not have a deep enough operating freeboard (0.74 m vs. 0.9 m) and does not have wide enough top of berm width (2.44 m vs. 3.0 m). Therefore, an increase to the operational depth of the existing lagoon, if used as a primary lagoon cell, is not recommended as part of the preferred solution. However, an increase of the berm height and width to meet current design guidelines should be carried forward in combination with alternative solutions that expand on the existing WWTS.

***Option 2A Recommendation*: Carry forward but only as an option to be considered in combination with other alternatives that utilize the existing lagoon.**

8.2.2 Option 2B: Modify Hydraulics of Lagoon

Lagoon treatment systems have been shown to be more effective and easier to operate and maintain when there are multiple cells. MECP guidelines specify that for small installations, there should be a minimum number of two (2) cells, while larger installations such as the Plantagenet WWTS should have a minimum of three (3) cells. Adding baffles within the lagoon may allow for the separation of the lagoon and prevent short-circuiting to provide additional and more consistent treatment, maximizing the effectiveness of the existing facultative lagoon. However, baffles will not reduce maintenance and operation of the lagoon system. Modifications to the existing lagoon's hydraulics should only be considered in combination with other options.

***Option 2B Recommendation*: Carry forward but only as an option to be considered in combination with other alternatives that utilize the existing lagoon.**

8.2.3 Option 2C: Convert Part or All of Lagoon into an Aerated Lagoon

Converting part or all the existing lagoon into a partial mix aerated lagoon will not fully address the identified problems due to anticipated storage requirements but was reviewed as an option to be considered in combination with other alternatives. Aerated lagoons use mechanical or diffused aeration for dissolved oxygen. Partial mix aerated lagoons are typically most efficiently operated as a system of multiple equally sized cells in series (3 or more achieved using berms or baffles), with aeration typically intensified in the initial cell. Conventional partial mix aerated lagoons in this configuration may be able to achieve up to 95% BOD_5 removal, effluent TSS concentrations of 20 mg/L, TP removal of 15-25% and effluent fecal coliform concentrations of 200 MPN/100 ml. Aerators are typically placed at a minimum submerged depth of 3 m to protect from freezing and ensure sufficient oxygen transfer. Deepening of the existing lagoon would therefore be required to convert the existing facultative lagoon into a partial mix aerated lagoon. This would be completed either through additional excavation and/or raising the berm height.

The main advantages of partial mix aerated lagoons compared to facultative lagoons include smaller land use requirements, better BOD_5 removal, reduced potential for odours and reduced winter ice cover. Their main disadvantages compared to facultative lagoons include less effective TP removal, increased energy and operational requirements and greater sludge removal requirements. Note that partial mix aerated lagoons may be able to achieve TAN removal, although pH adjustment, as well as a significantly larger lagoon volume (well above what is required for storage), would be required.

Based on the above, a partially mixed aerated lagoon on its own will not address the problem/opportunity statement; however, the conversion of part or all the existing lagoon into a partial mix aerated lagoon presents an opportunity to better utilize the existing lagoon as part of the overall preferred solution due its ability to better utilize land area, remove or limit winter ice cover and effectively remove BOD_5.

__Option 2C Recommendation__: Carry forward but only as an option to be considered in combination with other alternatives that utilize the existing lagoon.

8.2.4 Option 2D: In-line Coagulation and/or pH Adjustment

In-line coagulation has been proven to be less effective than batch dosing for seasonal discharge lagoons (MECP, 2008). However, it is unlikely that batch dosing on its own will provide sufficient TP removal to meet the projected TP effluent criteria. In-line coagulation may be required if discharging over a semi-continuous period. In-line pH adjustment (lowering pH) may help improve nitrifier growth rates and subsequent unionized ammonia (UIA) / TAN removal. pH adjustment prior to discharge may help to lower the fraction of UIA, but it would also increase the fraction of undissociated hydrogen sulphide. Both pH adjustment and in-line coagulation should be considered in combination with other options to improve treatment performance.

__Option 2D Recommendation__: Carry forward but only as an option to be considered in combination with other alternatives.

8.3 Option 3: Expand WWTS with New Lagoon Cells

8.3.1 Option 3A: Expand WWTS with New Lagoon Cells using Existing Discharge Windows

Potential lagoon expansions using the existing seasonal discharge windows (April 1 to May 31, and November 1 to December 20) could include the addition of facultative and/or aerated lagoon cells upstream or downstream of the existing system. Given the size of the system, a minimum of three (3) cells would be considered. Based on the preliminary discharge assessment in Section 5.2, the use of the existing discharge windows may be feasible and provide sufficient flexibility for operation of the system. However, storage requirements would be higher if the existing discharge windows are used instead of the new discharge windows. Expanding the WWTS with either facultative or aerated lagoon cells would address the projected storage requirements of the system but is unlikely to treat wastewater sufficiently to meet all projected effluent criteria. Even with additional cells, minimization of short circuiting and overall process optimization (e.g., combination of aeration and facultative cells), additional treatment would be required to effectively treat the wastewater to meet treatment objectives (in particular, TAN and TP). For this reason, this alternative should only be considered in combination with other alternatives.

<u>Option 3A Recommendation</u>: Carry forward but only as an option to be considered in combination with other alternatives.

8.3.2 Option 3B: Expand WWTS with New Lagoon Cells using New Discharge Window

Potential lagoon expansions using the new discharge window (October 1 to May 31) must include an aerated discharge cell that maintains the ability to allow gasses to escape through ice during winter. Given the size of the system, a minimum of three (3) cells in total would be considered. Based on the preliminary discharge assessment in Section 5.2, the use of the new discharge window provides additional flexibility on the operation of the system and requires less storage capacity compared to the existing seasonal discharge windows. Like Option 3A, this alternative would address projected storage requirements of the system but is unlikely to treat wastewater sufficiently to meet all projected effluent criteria, particularly TAN and TP during winter when there is limited biological activity (even with completely aerated system). For this reason, this alternative should only be considered in combination with other alternatives.

<u>Option 3B Recommendation</u>: Carry forward but only as an option to be considered in combination with other alternatives.

8.4 Option 4 (A and B): Expand WWTS with Specialized Treatment System

With the advancement of specialized treatment technologies, more consistent and improved effluent quality can be maintained over longer periods, including during winter months. Specialized treatment systems can be combined with an existing lagoon to provide a high-level of treatment for all parameters of interest (e.g., BOD_5, TSS, TAN, TP and E. coli) using a fraction of the land area required for a lagoon-only system. Specialized treatment technologies may provide some storage capacity but would most likely require lagoon storage to address projected storage requirements. There are many specialized treatment systems, each specialized in the removal of a certain type of contaminant (e.g., solids, oxygen-demanding substances, nutrients, fecal coliforms, etc.). Systems may include in-lagoon modular systems, submerged attached growth reactors (SAGRs), moving bed biofilm reactors (MBBRs), tertiary filtration systems or disinfection systems. One or more of these systems can be used in combination with lagoon storage to provide the necessary level of treatment using either the existing seasonal discharge windows or the new extended discharge window.

<u>Option 4A and 4B Recommendation</u>: Carry forward both Option 4A (Existing Discharge Windows) and 4B (New Discharge Window).

8.5 Option 5: New Mechanical Treatment Plant with New Discharge Windows

Mechanical treatment plants, which may consist of an activated sludge plant, rotating disc plant, submerged aerated filter plant or sequencing batch reactor plant, have the proven ability to meet current effluent criteria and address the key issues in the problem/opportunity statement. However, costs are anticipated to be much higher than other more feasible options and significant changes to the site and operations would be required. Furthermore, the soil conditions around the existing site may not be suitable for heavy buildings and anticipated significant vertical expansions, which would require purchasing of new land and undertaking additional site studies. For a system rated for an ADF of 2,000 m^3/day, capital costs for a mechanical treatment plant are estimated to range from $35M to $50M, with annual operating costs in the range of $1.25M. This does not include for significant wastewater storage infrastructure that would be required during the summer months. To avoid having to store wastewater during the summer months, a discharge to the Ottawa River over 7 km away could be required, which also presents significant costs, as detailed in the evaluation of Option 6 and Option 7. Due to the anticipated high costs, operational complexity and site constraints, this option has not been considered further.

<u>Option 5 Recommendation</u>: Do not carry forward.

8.6 Option 6: Pump Raw Wastewater to Wendover WWTP (1,260 m3/day capacity)

As previously noted, wastewater treatment plants have the proven ability to meet current effluent criteria and address the key issues in the problem/opportunity statement. An advantage of the Wendover WWTP compared to a mechanical treatment plant in Plantagenet is that it has continuous effluent discharge due its location on the Ottawa River; storage of generated wastewater is therefore not required. All three (3) options reviewed require a forcemain to be constructed from Plantagenet to Wendover. For the purpose of screening the options, the following transmission main alignment was selected for review: SPS No. 1 → Pitch Off Road → Old Highway 17 (includes water crossing) → Old Highway 17 → Concession Road 3 → Route 25 → Concession Road 2 → Route 19 → Wendover WWTP. This alignment, for which the feasibility would need to be confirmed through additional studies, has a total length of approximately 14.8 km, includes a water crossing of the South Nation River and includes a crossing of Highway 17. The capital cost of this forcemain, excluding costs for additional studies, the water crossing and the highway crossing, is estimated to be between $20M to $30M, which on its own is expected to be higher than other more feasible options. Additional costs would also be required for a new pumping station and/or upgrades to the Wendover WWTP, as described in the following reviewed scenarios.

8.6.1 <u>Option 6A: Convey All Wastewater to Wendover WWTP</u>

The existing capacity of the Wendover WWTP is only 1,260 m^3/day, a portion of which is already committed to Wendover residents. Conveying all flow from Plantagenet to Wendover would require a significant capacity upgrade of the existing WWTP (to a rated capacity of potentially 3,500 m^3/day) to accommodate both projected flows from Plantagenet (2,020 m^3/day) and projected flows from Wendover. This option would also include decommissioning the existing lagoon and a new SPS No. 1 with higher capacity pumps. Ultimately, due to the estimated high cost and complexity of this option, it has not been considered further.

<u>Option 6A Recommendation</u>: Do not carry forward.

8.6.2 Option 6B: Convey Only Wastewater Above Capacity of Existing WWTS to Wendover WWTP

This option is similar to Option 6A, except that the existing Plantagenet facultative lagoon system would be kept, and SPS No. 1 would be modified to distribute flow either to the lagoon system or to Wendover WWTP. The cost of this option is expected to be lower than Option 6A due to a lower transmission main size and smaller capacity upgrade of the Wendover WWTP (potential increase to rated capacity of 2,900 m^3/day vs. 3,500 m^3/day). However, the cost of this option is still anticipated to be significantly high, and therefore has not been considered further.

***Option 6B Recommendation*: Do not carry forward.**

8.6.3 Option 6C: Convey Wastewater up to Existing Rated Capacity of Wendover WWTP

Due to the limited capacity of the Wendover WWTP (1,260 m^3/day), only a small portion of the generated wastewater volume in the Village would be conveyed to Wendover, and therefore a large expansion of the Plantagenet WWTS would still be required. Therefore, this option has not been considered further.

***Option 6C Recommendation*: Do not carry forward.**

8.7 Option 7: Pump Treated Effluent to the Ottawa River

To pump treated effluent from the Plantagenet WWTS to the Ottawa River, a new effluent pumping station, forcemain and Ottawa River outfall would be required. For the purpose of screening this option, the following forcemain alignment was selected: Plantagenet WWTS → Concession Road 5 → Pitch Off Road → Old Highway 17 → County Road 9 → Ottawa River (near Treadwell). This alignment, for which the feasibility would need to be confirmed through additional studies, has a total length of approximately 8 km and includes a crossing of Highway 17. Based on a review of existing ECAs from other municipal sewage treatment systems discharging to the Ottawa River in the general area, it is assumed that the Plantagenet WWTS could discharge continuously to the Ottawa River (no seasonal discharge or need for additional storage) and that, at a minimum, would need additional treatment for BOD_5 and TAN, although this would need to be confirmed through a separate assimilative capacity assessment of the Ottawa River. Excluding treatment upgrades to the Plantagenet WWTS, the capital cost of this option if estimated to be \$25M. Given that the capital cost of this option without treatment upgrades is expected to be at or above other screened options, this option has not been considered further.

***Option 7 Recommendation*: Do not carry forward.**

9.0 Evaluation of Screened Alternatives

9.1 Summary of Screened Alternatives

Screening of the initial list of alternative solutions has resulted in the WWTS upgrade options identified in Table 13. A more detailed review of each screened option was completed and is summarized in this section. The options were evaluated based on the methodology described in Section 6.0. Note again that the following improvements are assumed to be part of all the potential alternative solutions (except Option 1: Do Nothing), and that participation in the TPM program will be considered as part of the preferred solution. Phasing of the preferred solution will only be reviewed as part of Phase 4 of the Class EA.

Additional Upgrades and/or Recommendations to be Carried Forward:

- Improve WWTS effluent flow measurement, as per Section 4.4.
- Upgrade existing lagoon to reduce seepage, as described in Section 4.4.
- Develop an Infrastructure Master Plan (incl. I/I Reduction Program) to identify upgrades to the wastewater collection system, as described in Section 4.5.
- Upgrade SPS No. 1 to a rated peak flow capacity of approx.100 L/s, as per Table 3.
- Upgrade SPS No. 2 to rated peak flow capacity of approx. 42 L/s, as per Table 4.

Table 13: List of Screened Potential Alternative Solutions for the Plantagenet WWTS.

Option 1: Do Nothing
No improvements. Represents the baseline condition.
Option 4A: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing Discharge Windows
Expand storage capacity of WWTS by adding additional lagoons for both storage and treatment and add new specialized treatment system(s) within or outside of lagoons for enhanced treatment prior to seasonal discharge in the Spring (April 01 to May 31) and Fall (November 1 to December 20).
Option 4B: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window
Expand storage capacity of WWTS by adding additional lagoons for both storage and treatment, and add new specialized treatment system(s) within or outside of lagoons for enhanced treatment prior to discharge from October 1 to May 31. Specialized treatment system to be capable of effective treatment during cold weather.
Additional Options to be Considered in Combination with Option 4A and Option 4B:
A - Modify dimensions of existing facultative lagoon.
B - Modify hydraulics of existing facultative lagoon.
C - Convert part or all the existing facultative lagoon into a partial mix aerated lagoon.
D - Add in-line coagulation and/or pH adjustment.

9.2 Projected Storage Volume Requirements

This section summarizes storage volume assessments undertaken to project 20-year (2042) storage requirements for Option 4A and Option 4B. The assessments took into consideration net precipitation, storage flexibility and other assumptions, as described below.

Net Precipitation – The Phase 1 Report showed that net precipitation is a significant factor in the required storage volume for lagoon-based treatment systems. It showed that for the Village, on an annual basis, net precipitation increases the overall volume of wastewater stored. Between September and April, net precipitation increases the total volume of water that must be stored (precipitation > evaporation), and between May and August, net precipitation decreases the total volume of water that must be stored (evaporation > precipitation). The magnitude of net precipitation is directly proportional to the exposed area in the treatment system (e.g., lagoon, exposed storage tank, etc.), and therefore varies depending on the potential alternative solution.

Storage Flexibility and Resiliency – Another factor to consider with wastewater treatment storage is flexibility, for both operation of the system and for climate change resiliency. It is noted that lagoons in Ontario need to be designed with a reserve storage capacity to prevent overflowing of the lagoon if it is operated temporarily above the maximum operating water level. As described in Section 8.2.1, there needs to be a minimum difference in depth of 0.3 m between the maximum operating water level and overflow water level. Based on a typical facultative lagoon operating depth of 1.5 m, this represents over 20% additional storage. For this assessment, this additional storage volume was reserved for climate change resiliency, allowing the system to respond to potential increases in influent volumes to the system from more frequent and higher intensity rainfall events. Lagoon storage flexibility was considered through the following:

- Discharge Start Date – As noted in the Phase 1 Report, discharge periods and flow rates varied significantly over the study period (2016 to 2020). The Spring discharge periods, on average, started on April 23 and ended on May 26, for a duration of 34 days (out of a possible 61 days), with discharge flow rates ranging between 1,854 m^3/day and 6,699 m^3/day. The Fall discharge periods, on average, started on November 21 and ended on December 14, for a duration of 24 days (out of a possible 50 days), with discharge flow rates ranging between 1,727 m^3/day and 5,230 m^3/day. It is noted that projected 20-year discharge volumes are significantly higher than the discharge volumes measured during the study period (2016 to 2020), and it is expected that when the rated capacity of the system is reached, discharge will need to begin as soon as it is allowed. For operational flexibility, it was assumed that Spring discharge will begin on April 11, and Fall discharge will begin on October 6 / November 6, allowing 5 to 10 days for preparation prior to discharge.
- Volume Carryover – During the study period, the system was operated at or above capacity and did not have the flexibility to carry volume over to the next discharge period. For operational flexibility, it has been assumed that the volume from the previous discharge period's final month (e.g., May during Spring and December during Fall), normalized to 30 days, will be carried forward to the next discharge period.

Assumptions – Other assumptions used in the current storage volume assessment included:

- All inflow into the system will need to be stored and discharged. The existing discrepancy between influent and effluent flows due to seepage and other potential factors was not considered.
- Additional flexibility in the Spring discharge start date for MECP's "ice-free cover" requirement (i.e., start date later than April 11), was not considered.
- Specialized treatment systems do not provide significant storage of wastewater. Storage will be accommodated with additional lagoons.
- Projected lagoon expansion areas are based on an operational depth of 1.34 m (matching operational depth of existing facultative lagoon).
- The existing outfall has sufficient capacity to accommodate the proposed maximum daily effluent discharge flow rates identified in Table 6 and Table 8.
- When permitted to discharge based on the proposed discharge windows and the above restrictions for storage flexibility, the system will discharge at the proposed maximum daily effluent discharge rates.

Results of the volume assessments are provided in Table 14. These results show that Option 4B requires significantly less storage capacity and allows for greater operational flexibility compared to Option 4A. Option 4A requires approximately 55% more storage volume than Option 4B.

Table 14: Projected Storage Requirements Including Storage Flexibility.

	Required Storage (m^3)
	Including Flexibility (1)
Option 4A: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing Discharge Windows	
10-Year (2032):	265,900
20-Year (2042):	386,500
Option 4B: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window	
10-Year (2032):	174,200
20-Year (2042):	253,200

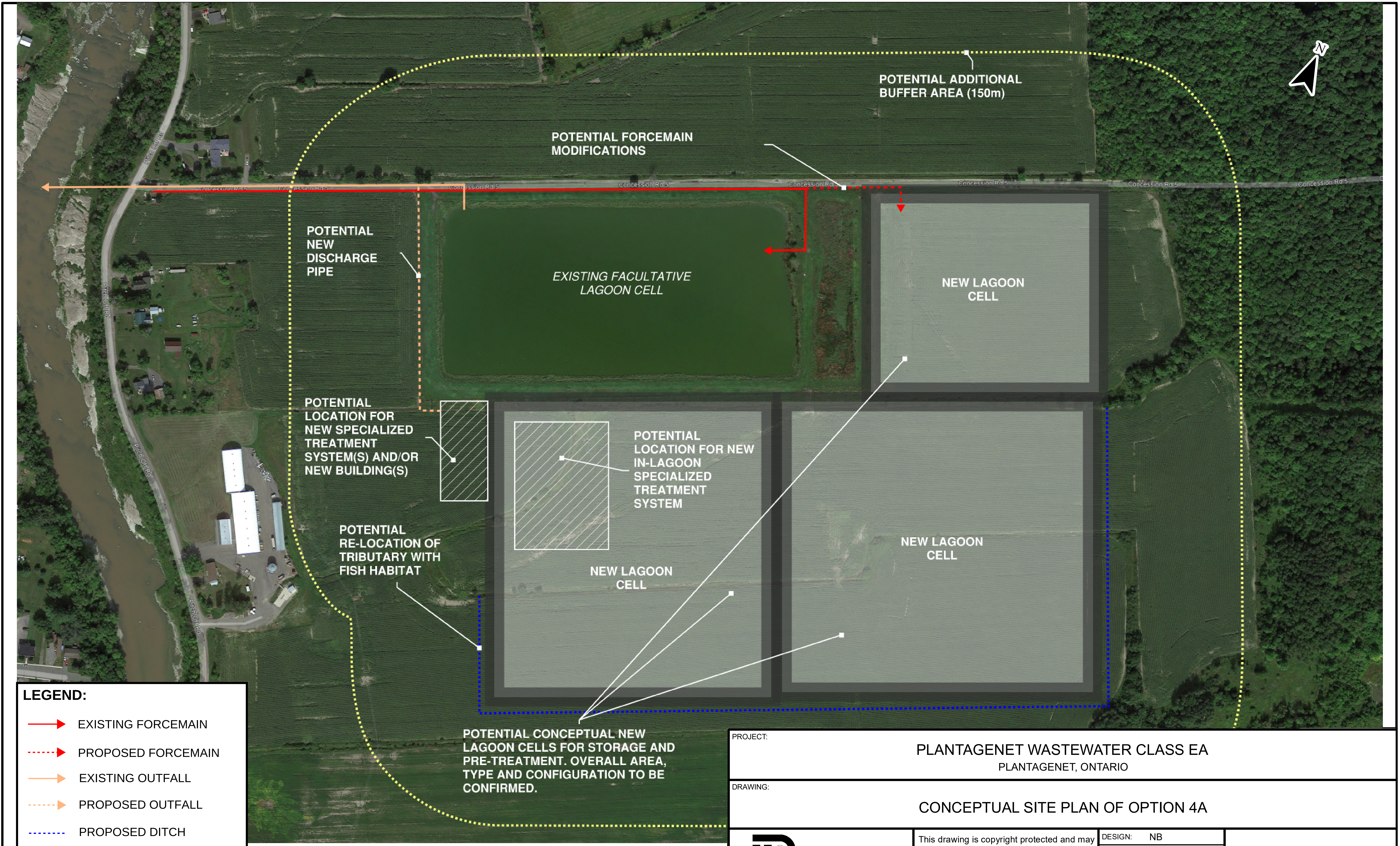
Notes:
1. Flexibility in the discharge start date and volume carryover, as described in Section 9.2.

9.3 Option 4A and 4B – Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing or New Discharge Windows

Both Options 4A and 4B are based on providing additional storage capacity via lagoons and adding one or multiple specialized treatment system(s). As previously noted, there are several different specialized treatment systems that may be applicable for the upgrades. One or more of these systems can be used in combination with lagoon storage to provide the level of treatment necessary to meet effluent criteria requirements provided in Table 9. The difference in the two screened options is with the proposed discharge windows.

Option 4A proposes to use the existing discharge windows, which allow for seasonal discharge in the spring (April 1 to May 31) and fall (November 1 to December 20). Section 9.2 showed that the existing discharge windows and associated monthly maximum daily discharge rates calculated in Phase 1 allow for the discharge of 20-year (2042) raw wastewater flows while providing flexibility in the discharge start date and in volume carryover. To accommodate 20-year (2042) raw wastewater flows, a total storage capacity of approximately 390,000 m^3 and discharge flows near the maximum allowable flows would be required. Given that Option 4A does not propose discharging between December 21 and March 31, cold weather performance of the specialized treatment system(s) is less important. The upgraded system would either include in-lagoon modular specialized treatment system(s) and an aerated discharge cell, or a treatment system that includes specialized treatment system(s), one of which is an aerated system located downstream of the lagoon cells. Note that for this option, the specialized treatment system(s) would need to be sized to accommodate higher discharge flows. Refer to Figure 5 for a conceptual site plan of Option 4A.

Option 4B proposes to use a new semi-continuous discharge window, allowing for discharge between October 1 to May 31. Similarly, Section 9.2 showed that the new discharge window, and associated monthly maximum daily discharge rates, provides adequate flexibility in discharging the 20-year (2042) raw wastewater flows. To accommodate 20-year (2042) raw wastewater flows, a total storage capacity of approximately 255,000 m^3 is required, which represents approximately 65% of the storage volume required for Option 4A. In addition, given the longer discharge period, the specialized treatment system(s) likely does not need to be sized as large as Option 4A. However, with discharge proposed during winter months, the treatment system must be designed to effectively treat wastewater in sub-zero temperatures over the period of several months. The specialized treatment systems currently on the market with proven cold-weather installations include the SAGR and MBBR systems. The upgraded system would therefore include one of these technologies installed downstream of the lagoon cells. Refer to Figure 6 for a conceptual site plan of Option 4B.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF OPTION 4A

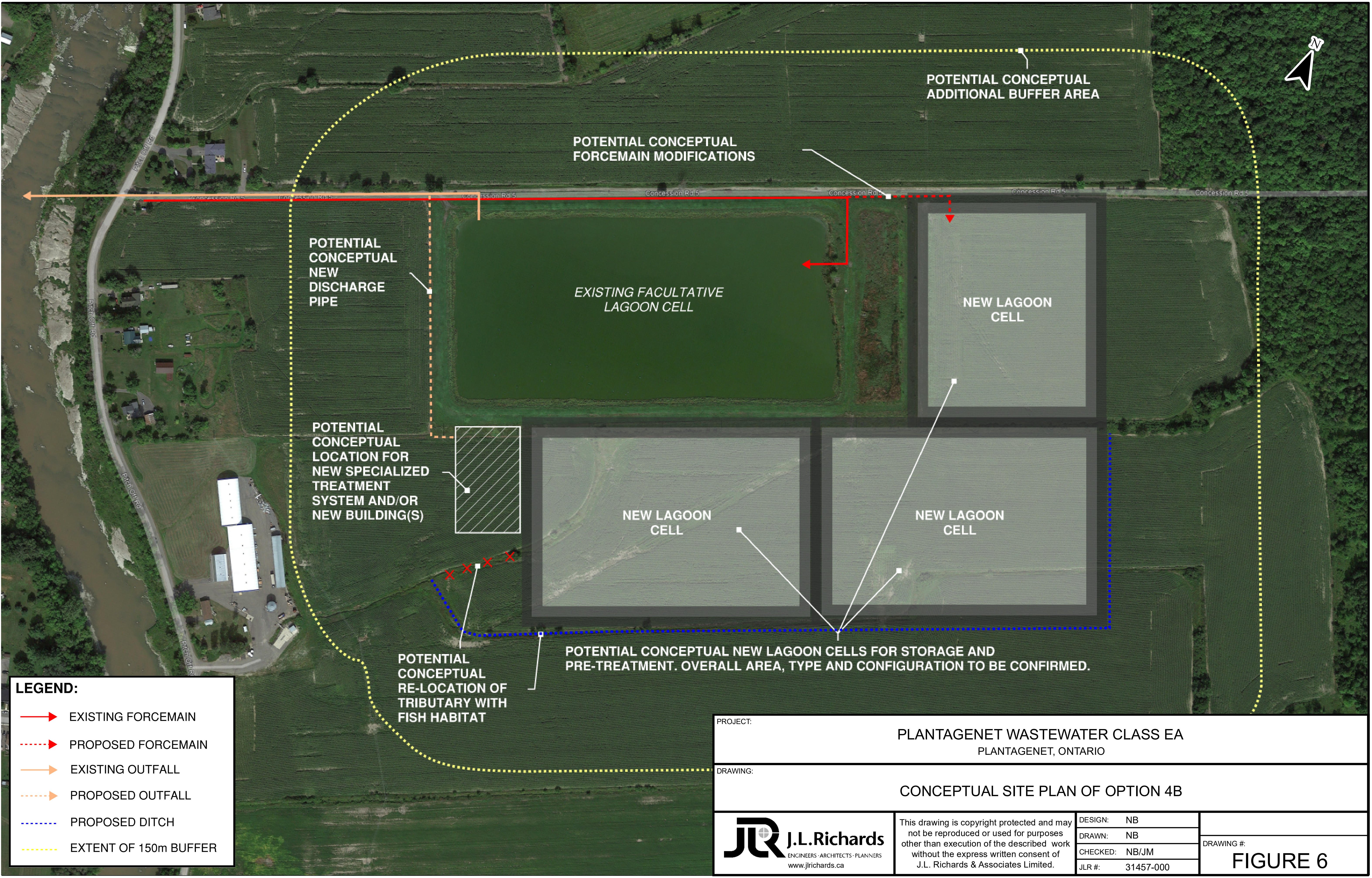
J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN: NB
DRAWN: NB
CHECKED: NB/JM
JLR #: 31457-000

DRAWING #:
FIGURE 5

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 Figure5_opt4a.mxd

Plot Date: June 6, 2023 3:23:19 PM



LEGEND:

EXISTING FORCEMAIN
PROPOSED FORCEMAIN
EXISTING OUTFALL
PROPOSED OUTFALL
PROPOSED DITCH
EXTENT OF 150m BUFFER

PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF OPTION 4B

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN:	NB
DRAWN:	NB
CHECKED:	NB/JM
JLR #:	31457-000

DRAWING #:
FIGURE 6

File Location: P:\31000\31457-000 - Plantagenet WW Class EA\5-Production\1-Civil\GIS\31457 Figure6_opt4b.mxd

Plot Date: June 6, 2023 3:05:22 PM

9.4 Opinion of Probable Cost of Screened Alternatives – Capital and Operational

A Class D opinion of probable cost (OPC) was prepared for each screened wastewater treatment system upgrade alternative and each sewage pumping station upgrade based on available information, experience on similar projects and professional judgement. Note that no cost estimates are provided for upgrades to the wastewater collection system, although it is expected that upgrades to the system will be required to minimize the impact of I/I and to accommodate proposed development. An IMP would be required to determine the scope and cost of collection system upgrades. Class D cost estimates are generally defined as follows:

- Definition of Work: A description of the option with such supporting documentation as is available (definition of project typically in the order of 1 to 5 percent).
- Intended Purpose: To aid in the screening of alternative potential solutions prior to recommending a preferred solution (not intended to establish or confirm budgets).
- Level of Effort: Is limited and expected accuracy could range from -30% to +30%.
- Dollar Value: 2023.

These OPCs have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final project cost will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors. As a result, the final project cost will vary from the OPC presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Refer to Table 15 for capital and operational cost estimates of the screened WWTS upgrade solutions. A cost range was provided for Options 4A and 4B given that there is a large variance in the cost of different specialized treatment systems, and due to general uncertainty in the design of the different options. Consultation with suppliers to refine the cost of the preferred solution will occur in Phase 3 of the study. The cost estimates for both Options 4A and 4B assume that the following will be completed as part of the upgrades; these will be confirmed during Phase 3:

- Purchase of adjacent agricultural land to accommodate lagoon storage.
- Modifications to the existing lagoon to meet latest MECP design guidelines, improve hydraulics and reduce seepage.
- Addition of new lagoon cells for storage and additional treatment, including the addition of at least one (1) 5-hectare aerated cell.
- Addition of a specialized treatment system for tertiary TP removal; no participation in the TPM program.

Table 15: Estimated Capital and Operational Cost of Wastewater Treatment Alternative Solutions.

Option	Capital Cost (excl. HST)	Operational Cost (excl. HST)
Option 1: Do Nothing	-	-
Option 4A: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing Discharge Windows	\$22M – \$27M	\$75,000 - \$125,000
Option 4B: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window	\$20M – \$25M	\$100,000 - \$150,000

Refer to Table 16 for capital cost estimates for the two (2) sewage pumping station upgrades. Note that the scope of the upgrades beyond pumping capacity increases is generally unknown (e.g., unknown existing condition of wet well and structures, unknown suitability of wet well and forcemain to accommodate new pumping capacity, etc.). However, for the purpose of developing cost estimates, and based on a visit to the sites and a general understanding of the age and condition of the existing pumping stations, the following upgrades were assumed to be required; these will be further reviewed during Phase 3 of the Class EA:

- **SPS No. 1 –** New larger diameter wet well, new higher capacity pumps, new controls, new control building, new higher capacity forcemain along same alignment (890 m long) and other miscellaneous upgrades to accommodate an increase in the rated capacity from 29.2 L/s to 100 L/s.

- **SPS No. 2 –** New larger diameter wet well, new higher capacity pumps, new controls, new outdoor back-up generator, modifications to the existing control building, new higher capacity forcemain along same alignment (970 m long) and other miscellaneous upgrades to accommodate an increase in the rated capacity from 10.6 L/s to 42 L/s.

Table 16: Estimated Capital Cost of Sewage Pumping Station and Forcemain Upgrades.

Sewage Pumping Stations	Capital Cost (excl. HST)
SPS No. 1 and Forcemain Upgrade – 29.2 L/s to 100 L/s	\$6.5M
SPS No. 2 and Forcemain Upgrade – 10.6 L/s to 42 L/s	\$5.5M

9.5 Detailed Evaluation Results

Each screened WWTS upgrade option was assigned an evaluation impact level and score based on Table 10 and Table 11. This method provides an overall assessment of the positive and negative impacts of each alternative. The final scores and rank of each alternative are summarized in Table 17. Refer to Table 18 for the detail evaluation.

Table 17: Summary of Detailed Evaluation of Screened Alternatives.

Option	Score	Rank
Option 1: Do Nothing	59	3
Option 4A: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing Discharge Windows	79	2
Option 4B: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window	89	1

Table 18: Detailed Evaluation Table of Screened Alternatives.

MAJOR	MINOR	WEIGHT	Option 1: Do Nothing		**Option 4A:** Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing Discharge Windows		**Option 4B:** Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window	
			Comment	**Score**	**Comment**	**Score**	**Comment**	**Score**
Natural Environment and Archaeology	**Natural Environment and Wildlife**	**x2**	MODERATE NEGATIVE (1): High likelihood of overflows. Quality of effluent discharged to surface water does not improve and may degrade as influent flows increase. No construction impacts.	2	MODERATE POSITIVE (3): Impacts to natural environment features can be mitigated during construction. No in-water works proposed. Higher quality effluent to South Nation River.	6	MODERATE POSITIVE (3): Impacts to natural environment features can be mitigated during construction. No in-water works proposed. Higher quality effluent to South Nation River.	6
	Archaeology, Culture & Heritage	**x2**	NO IMPACT (2): No construction impacts.	4	MODERATE NEGATIVE (1): Potential for limited impacts within study area. Likely that potential impacts can be mitigated during construction.	2	MODERATE NEGATIVE (1): Potential for limited impacts within study area. Likely that potential impacts can be mitigated during construction.	2
	Global Warming	**x2**	NO IMPACT (2): No change.	4	MODERATE NEGATIVE (1): Embodied carbon in construction materials, higher energy use due to high-capacity blowers and higher capacity pumps.	2	MODERATE NEGATIVE (1): Embodied carbon in construction materials, higher energy use due to high-capacity blowers and higher capacity pumps.	2
Engineering, Technical Considerations and Construction	**Ability to Meet Effluent Criteria**	**x5**	MODERATE NEGATIVE (1): Increased flows and more stringent effluent criteria will diminish treatment ability of existing system.	5	HIGH POSITIVE (4): High quality effluent will be produced that is better than the ECA limits for all parameters.	20	HIGH POSITIVE (4): High quality effluent will be produced that is better than the ECA limits for all parameters.	20
	Cold Weather Performance	**x4**	Criteria not applicable given that Option 4A does not require treatment during winter months.					
	Reliability and Resiliency	**x4**	MODERATE NEGATIVE (1): System is already above capacity and has treatment performance issues.	4	MODERATE POSITIVE (3): Reliable treatment. Lagoon pre-treatment will provide equalization of quality upstream of specialized treatment system(s). Biological treatment may be slower to react to significant changes.	12	MODERATE POSITIVE (3): Reliable treatment. Lagoon pre-treatment will provide equalization of quality upstream of specialized treatment system(s). Biological treatment may be slower to react to significant changes.	12
	Ease of Operation & Operational Flexibility	**x4**	MODERATE NEGATIVE (1): Relatively easy system to operate but there has been and will be challenges operating a system that is above capacity with no operational flexibility.	4	NEITHER NEGATIVE NOR POSITIVE (2): Limited operator input is required for various treatment technologies once the system is established. Storage flexibility is available, but discharge flexibility is limited. Higher capacity equipment likely required. Two startups required annually.	8	HIGH POSITIVE (4): Limited operator input is required for various treatment technologies once the system is established. Longer discharge periods can reduce storage requirements and allow for lower more consistent discharge rates and lower capacity equipment. One startup annually.	16
	Opportunities for Future Expansion	**x3**	MODERATE NEGATIVE (1): There are available technologies that can be installed within the existing footprint of the lagoon to improve effluent quality, but storage capacity and treatment performance is limited.	3	MODERATE POSITIVE (3): Dependent on the type of treatment; some treatment technologies are modular and able to increase capacity by increasing the quantity of media and limit the need to provide additional basins. Cold-weather treatment not established, which may require new treatment technology if discharge window is expanded. No future increase in lagoon storage capacity or daily discharge capacity is anticipated to be required.	9	MODERATE POSITIVE (3): Dependent on the type of treatment; some treatment technologies are modular and able to increase capacity by increasing the quantity of media and limit the need to provide additional basins. Established cold-weather treatment will facilitate future expansion. Future increase in discharge window or lagoon storage may be required.	9
	Constructability	**x3**	NO IMPACT (2): No change.	6	NEITHER NEGATIVE NOR POSITIVE (2): Proposed upgrades appear constructable based on preliminary studies, experience on similar projects and professional judgement. Design and construction may have complexities, including limits on lagoon storage expansion and allowing for a range of daily discharge rates.	6	NEITHER NEGATIVE NOR POSITIVE (2): Proposed upgrades appear constructable based on preliminary studies, experience on similar projects and professional judgement. Design and construction may have complexities, including cold-weather performance testing.	6

MAJOR	**MINOR**	**WEIGHT**	**Option 1: Do Nothing**		**Option 4A:** Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using Existing Discharge Windows		**Option 4B:** Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window	
			Comment	**Score**	**Comment**	**Score**	**Comment**	**Score**
Social / Community Well Being	**Air Quality and Noise**	**x2**	MODERATE NEGATIVE (1): Increased loadings are likely to increased odours within the facultative lagoon. No noise impacts.	2	MODERATE POSITIVE (3): Noise and odour will be similar to the current operations. May be minor odour improvements due to enhanced treatment.	6	MODERATE POSITIVE (3): Noise and odour will be similar to the current operations. May be minor odour improvements due to enhanced treatment.	6
	Construction Impacts	**x2**	NO IMPACT (2): No construction impacts.	4	HIGH NEGATIVE (1): Construction is limited to the existing lagoon site and purchased agricultural land. Impacts to neighboring properties can be mitigated during construction; however, more land is required compared to Option 4B.	0	MODERATE NEGATIVE (1): Construction is limited to the existing lagoon site and purchased agricultural land. Impacts to neighboring properties can be mitigated during construction. The land area required would be less than Option 4A.	2
	Adjacent Land Uses and Purchase	**x3**	NO IMPACT (2): No purchase of land required.	6	MODERATE NEGATIVE (1): Requirement to purchase a adjacent agricultural land. Upgraded system would not cause the 150m buffer to be extended into private lands.	3	MODERATE NEGATIVE (1): Requirement to purchase adjacent agricultural land. Upgraded system would not cause the 150m buffer to be extended into private lands.	3
Financial	**Capital Costs**	**x5**	NO IMPACT (2): No cost.	10	HIGH NEGATIVE (0): Capital costs will be in the order of $22M - $27M. Compared to Option 4B, more land must be purchased, more lagoon storage is required and specialized treatment system(s) may require higher capacity.	0	HIGH NEGATIVE (0): Capital costs will be in the order of $20M - $25M. Compared to Option 4A, more robust biological specialized treatment system effective in cold weather is required.	0
	Operational Costs	**x5**	MODERATE NEGATIVE (1): More operational oversight would be required. Increased likelihood of overflows and surcharging.	5	MODERATE NEGATIVE (1): An increase in the operational costs is anticipated. Annual operational costs are estimated to range from $75,000 to $125,000.	5	MODERATE NEGATIVE (1): An increase in the operational costs is anticipated. Annual operational costs are estimated to range from $100,000 to $150,000.	5
Total Score / Rank:			**Rank: 3**	**59**	**Rank: 2**	**79**	**Rank: 1**	**89**

9.6 Preferred Solution

Based on the evaluation methodology utilized, it was determined that Option 4B: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window, provided the highest overall net benefit to the Township for the upgrade of their WWTS. The main benefits of this option were the following:

- Ability to meet current effluent criteria, with quality that is better than current ECA limits;
- Controlled process that can be adjusted to achieve consistent effluent quality;
- Storage requirements are reduced, limiting the need for a more significant storage expansion;
- Storage flexibility is increased, allowing for more flexibility in operation of the system;
- Expandable process with minimal capital cost to increase treatment capacity;
- Relatively moderate upfront capital costs and ongoing operational costs;
- Discharge throughout winter months can help to reduce the flowrate during other months to the South Nation River; and
- Reduced flowrates over a longer discharge period provide opportunities to optimize the specialized treatment technology.

Note again that the following upgrades and/or recommendations will also be carried forward to Phase 3 of the study:

- Improve WWTS effluent flow measurement, as per Section 4.4.
- Upgrade existing lagoon to reduce seepage, as described in Section 4.4.
- Develop an Infrastructure Master Plan (incl. I/I Reduction Program) to identify upgrades to the wastewater collection system, as described in Section 4.5.
- Upgrade SPS No. 1 to a rated peak flow capacity of 100 L/s, as per Table 3.
- Upgrade SPS No. 2 to rated peak flow capacity of 42 L/s, as per Table 4.
- Review of the following alternative design concepts:
    - A – Modify dimensions of existing facultative lagoon.
    - B – Modify hydraulics of existing facultative lagoon.
    - C – Convert part or all the existing facultative lagoon into a partial mix aerated lagoon.
    - D – Add in-line coagulation and/or pH adjustment.

10.0 Next Steps and Study Milestones

Several key milestones remain. A list of key milestones and their anticipated timing are provided in Table 19.

Table 19: Key Study Milestones.

PHASE 1	Timing
Project Initiation	November 2021
Project Review Meeting	November 2021
Issue Notice of Commencement	December 2, 2021
Draft Phase 1 Report	March 2023
Progress Review Meeting	April 18, 2023
Finalize Phase 1 Report	April 2023

PHASE 2	Timing
Criteria Matrix and Draft Alternatives Report	April 2023
Progress Review Meeting	April 2023
Public Information Centre No. 1	May 10, 2023
Draft Phase 2 Report	July 2023
Progress Review Meeting	July 2023
Finalize Phase 2 Report and Confirm Project Schedule	July 2023

PHASE 3	Timing
Draft Alternative Designs Report	September 2023
Progress Review Meeting	September 2023
Public Information Centre No. 2	October 2023
Final Alternative Designs Report and Recommendation	October 2023

PHASE 4	Timing
Confirm Project Schedule	October 2023
Draft Environmental Study Report	October 2023
Progress Review Meeting	October 2023
Final Environmental Study Report	November 2023
Issue Notice of Completion	November 2023
Project Close-Out Meeting	December 2023

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J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

LICENSED PROFESSIONAL ENGINEER
N. R. BIALIK
100530276
2023-09-18
PROVINCE OF ONTARIO

Nicolas Bialik, P.Eng.
Environmental Engineer

Reviewed by:

LICENSED PROFESSIONAL ENGINEER
2023-09-18
J.M.C. MORRISSETTE
100151410
Jordan Morrissette
PROVINCE OF ONTARIO

Jordan Morrissette, M.Eng., P.Eng.
Associate, Manager, Ottawa Civil and Environmental Department

Appendix B1

Technical Memorandum No. 2 – Climate Change Impacts

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

MEMO

Date:	April 3, 2023
To:	Jonathan Gendron, P.Eng. Director of Building, Planning, Engineering and Environment Township of Alfred and Plantagenet
From:	Sean Speer, P.Eng. Ph.D. J.L. Richards & Associates Limited
CC:	Jordan Morrissette, P.Eng., M.Eng., JLR Nicolas Bialik, P.Eng., JLR
Subject:	Plantagenet Wastewater Class Environmental Assessment Climate Change Impacts Technical Memorandum
JLR No.:	31457-000

1.0 Introduction

Climate change has the potential to alter weather patterns that can affect the wastewater collection system in the Village of Plantagenet (Plantagenet) as well as the wastewater treatment system (WWTS). Climate change can affect the quality and quantity of the collected wastewater stream and the reliability of the local electrical system. Changing precipitation patterns, temperatures, and other climatic conditions have already been shown to affect flows and quality in the South Nation River with increase flooding instances in the Plantagenet area. This Technical Memorandum has been prepared to outline the potential effects of climate change on the Plantagenet wastewater collection system and the WWTS, and to outline potential areas of concerns that should be addressed in future designs and upgrades of these systems/facilities.

2.0 Potential Effects

For the purposes of this report, climate change impacts associated with both changes in precipitation and ambient temperature have been considered. The specific effects and extents of these impacts cannot be predicted; current models evaluate multiple potential scenarios and estimate a wide range of potential effects. This document is designed as a qualitative identification of the potential impacts of climate change on the wastewater collection system and the WWTS and will not address model specifics.

Increased rainfall, especially in the form of high intensity events, can increase runoff into the South Nation River, where river flow rates have been highly variable in recent years with occurrences of localized flooding. The South Nation Conservation Authority’s 2022 Flood Contingency plan lists the Plantagenet – Fournier Area as a low lying area susceptible to flooding. This flooding can directly affect the physical area surrounding the WWTS and pumping stations where the incoming flood waters can carry large volumes of debris into the wetwells and the large volumes of water can block personnel access to the facilities.

Increases in rainfall intensity and duration can also increase the overall volumes collected and managed in the collection system and the volumes of wastewater that are applied to the lagoons. Studies conducted in Southern Ontario by the Grand River Conservation Authority have noted that inflow and infiltration (I/I) can account for flows exceeding 4 times the expected wastewater flows (based on drinking water usage)[1]. This study further outlined that the extent of I/I is highly dependent on the wastewater collection system, while demonstrating the large potential impact of I/I as rainfall intensity, frequency, and duration increase.

Increased temperatures increase demand on the power grid, which can affect the emergency management systems within the wastewater collection system. Increased demand on the power grid during long “heat wave” events can lead to longer, or more frequent power failures/brown outs. This may increase the demand on the backup power generation systems at the two pump stations as well as more frequent uses of the backup generators.

3.0 Climate Change Adaptation

Climate change adaptation refers to the resilience or vulnerability of the WWTS and the associated collection infrastructure to changing climatic conditions. Climate change has the potential to alter weather patterns that can in turn affect the collection and treatment of wastewater in terms of flow volumes and the reliability of the local utility infrastructure. Higher intensity and duration precipitation events are likely to become more frequent, resulting in larger volumes of I/I that will need to be addressed by the collection system, any wastewater pumping stations, and the WWTS. Additionally, increasing ambient temperatures and prolonged instances of sustained elevated temperatures will increase local energy usage, which can stress the grid and increase the potential of brown-outs/power failures.

Increased rainfall, especially in the form of high intensity or duration events can result in increased flow in the wastewater collection system. Future designs need to include provisions for this increased flow, and the extent of these provisions need to be collection system specific. These measures include the need to ensure collection pipes are sufficiently sized for the increased peak flow rates as well as adequate sizing of wetwells and pumps in sewage pumping stations.

Pluvial flooding events are becoming more common as rainfall event intensity and duration are increasing due to climate change. These events can increase runoff into both the wastewater collection system and the WWTS. The current operating philosophy of the lagoons is to store and treat the wastewater for most of the year and discharge during the spring. The increased runoff volumes will decrease the overall available volumes in the lagoons for wastewater storage and treatment. Runoff control, especially at the pumping stations and the WWTS, should be included in designs to help minimize the incursion of runoff while maintaining access to the pumping stations for maintenance during high runoff, pluvial flooding events.

Both current pumping stations in the Plantagenet wastewater collection system are within 150m of the South Nation River. River flooding can result in additional water intrusion into the wetwells with an accompanying large volume of solids from the floodwaters. This large volume of water and the accompanying solids would then be conveyed to the WWTS, decreasing the overall liquid storage capacity of the lagoon, and loading the lagoon with additional solids that will decrease the available volume for wastewater solids holding. As with the pluvial flooding, runoff control systems at and around these pumping station should be designed to adequately address the risks of South Nation River Flooding events and should be regularly re-evaluated should the flooding extent and frequency change.

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[1] Case Study: Lessons Learned on Assessing Vulnerability of WWTPs to Climate Change Impacts (2019) Grand River Conservation Authority

Increasing ambient temperatures, and the increase in the duration of consistently high temperature “heat-waves” can increase demand on the power grid and lead to longer, or more frequent power failures/brown-outs. The emergency management and backup power system at the pump stations may need to be capable of addressing the potential of longer and more frequent power grid failures. The extent of the risks will be highly dependent on the local power grid and the designs for the backup power systems will be site specific. There are two potential methods of addressing this concern: by utilizing renewable energy generation (e.g. solar power generation) at the pump stations to reduce or eliminate the reliance on the local grid (thereby decreasing or eliminating the effect of grid failures at the sites – this will also help with climate change mitigation at the various sites), or adequately sizing the backup power systems to address the increased risk of longer duration power outages.

4.0 Climate Change Mitigation

Climate change mitigation refers to measures used to reduce a project's expected production of greenhouse gas (GHG) emissions and impacts on carbon sinks. A project’s GHG emissions can be categorized as operating carbon (emitted during the operation phase), and embodied carbon (emitted during the manufacturing and construction phase).

A WWTS’s operating carbon consist of direct emissions from combustion of fossil fuels on site (e.g. gas for space heating), indirect emissions from consuming energy that was generated from off-site combustion of fossil fuels (e.g. electricity generated from gas power plants) and emissions from the use of vehicles for operational purposes.

In the current Plantagenet wastewater system, direct emissions are minimal as the only combustion of fossil fuels comes from the use of backup generators at the pumping stations. Fuel switching for the backup power system can be considered to further reduce the direct emissions.

Indirect emissions can be mitigated by reducing the electricity consumption on site through energy efficiency measures such as selecting premium efficiency motors or using variable frequency drives for pumps. Indirect emissions can be further mitigated through the generation of zero GHG emission clean electricity, through the addition of solar photovoltaic systems or other, small scale, energy generation systems on site.

Once the operating carbon of a facility is reduced through energy efficiency measures, fuel switching and on-site renewable energy generation, the embodied carbon becomes the vast majority of a facility’s lifetime GHG emissions and has a greater impact on climate change as it is entirely emitted before the facility is operational. Concrete and steel are the largest contributors to a building’s embodied carbon content. The embodied carbon of existing infrastructure has already been emitted and cannot be changed; however, as the infrastructure is upgraded, adjustments in specifications for materials can enable major reductions in embodied carbon. For example steel manufactured by electric arc furnaces on a low emissions power grid can have 50% less embodied carbon than traditional basic oxygen furnaces. Similarly, the embodied carbon content of concrete can be reduced by up to 50% by different mixing methods, recycled aggregate, reduced cement levels, controlled particle size distribution, and using concrete as a finishing material over other, lower carbon, materials.

5.0 Conclusion

The Ministry of the Environment, Conservation and Parks (MECP) document titled Considering Climate Change in the Environmental Assessment Process Guide (2017), sets out the Ministry's expectation for considering climate change in the preparation, execution and documentation of environmental assessment studies and processes. The information within this memorandum provides an overview of some impacts that climate change may have on the WTP and some of the potential ways to help mitigate these risks. Further review of the potential mitigation measures should be considered by the Township when proceeding with additional planning for their WWTS.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:	Reviewed by:
	Jordan Morrissette
Sean Speer, P.Eng. Ph.D. Senior Environmental Engineer	Jordan Morrissette, P.Eng. M.Eng. Associate, Senior Environmental Engineer

SP:JM

Appendix B2

Preliminary Hydrogeological Investigation Report (Thurber, 2022)

THURBER ENGINEERING LTD.

PRELIMINARY HYDROGEOLOGICAL INVESTIGATION REPORT
CLASS ENVIRONMENTAL ASSESSMENT OF THE
PLANTAGENET WASTEWATER COLLECTION AND TREATMENT SYSTEM
PLANTAGENET, ONTARIO

Report

to

J.L. Richards & Associates Limited

Samuel Morton

LICENSED PROFESSIONAL ENGINEER
M. MESKAR
100536004
2022-11-10
PROVINCE OF ONTARIO

Samuel Morton, M.Sc., GIT Hydrogeologist	Mahmoud Meskar, Ph.D., P.Eng. Hydrogeological Engineer

LICENSED PROFESSIONAL ENGINEER
S. A. HEJAZI
100501447
2022-11-10
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
D. D. HILL
90550443
2022-11-10
PROVINCE OF ONTARIO

Alireza Hejazi, Ph.D., P.Eng. Senior Hydrogeologist	David Hill, M.A.Sc., MBA, P.Eng., P.Geo. Senior Hydrogeologist / Review Engineer

Date: November 10, 2022
File: 32622

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1. INTRODUCTION

Thurber Engineering Ltd. (Thurber) was retained by J.L. Richards & Associates Ltd. (J.L. Richards) to conduct a preliminary hydrogeological investigation in support of the Class Environmental Assessment (EA) for a proposed expansion at the Plantagenet Wastewater Collection and Treatment System in Plantagenet, Ontario (the Site).

Thurber's scope of work for this project was outlined in a proposal dated August 13, 2021. The purpose of this hydrogeological investigation is to establish baseline hydrogeological conditions within the Site in support of the class EA and preliminary design through subsurface investigation, including characterization of the soil and groundwater conditions. Additionally, assessment of potential impacts of the proposed expansion on groundwater quality and quantity, and associated mitigation measures are discussed.

Use of this report is subject to the *Statement of Limitations and Conditions*, which is included at the end of this document.

2. BACKGROUND REVIEW

2.1 Site and Project Description

The Plantagenet Wastewater Collection and Treatment System services the Village of Plantagenet through the collection, treatment, and discharge of treated effluent to the South Nation River. The sewage treatment facility includes a facultative sewage lagoon designed as a holding cell and surrounded by berms, an inlet distribution box to the lagoon, an outlet chamber and a gravity outfall sewer discharging to the South Nation River.

It is understood that the sewage lagoon is operating beyond its design capacity and the Township of Alfred and Plantagenet is planning an expansion of the sewage lagoon to minimize extraneous flows from inflow and infiltration. It is understood that the proposed expansion of the facility will likely be to the south of the existing lagoon.

The existing sewage lagoon is located just south of Concession Road 5 and approximately 300 m to the east of Pitch Off Road. The orientation of the Concession Road 5 and the lagoon is generally northeast to southwest, however, for project purposes they will be described as oriented east to west herein. The Site and study area for the hydrogeological investigation, which was defined as a 500 m around the Site (Study Area), are shown on Figure 1.

According to the Township of Alfred and Plantagenet Official Plan and Schedule (Land Use Designations, Transportation, Plantagenet Village, Schedule B, dated April 2010), the land use adjacent to the Site includes residential policy area, and economic enterprise policy area to the north. The areas around the South Nation River are within the flood plain (Natural and Particular Elements, Plantagenet Village, Schedule E, dated July 2010). In general, land use surrounding the project area is predominantly agricultural, with some residential dwellings and commercial properties.

2.2 Topography and Drainage

The Site is located within the South Nation watershed that falls under the jurisdiction of the South Nation Conservation (SNC) Authority. Topography within the Site varies from relatively flat expanses of agricultural land with drainage ditches/watercourses to an elevated berm structure that encompasses the existing lagoon. At the borehole locations surveyed for this investigation, the ground surface elevations ranged from approximately elevation 50.2 m to 54.0 m. Overland flow within the berm is directed into the lagoon, and overland flow outside of the berm is directed to several drainage ditches/watercourses which are interpreted to follow the existing topography and finally drain in the west-southwest direction toward the South Nation River.

2.3 Physiography

A review of the Physiographic Regions of Southern Ontario indicated that the east portion of the Site is located within the Physiographic Region of the Russell and Prescott Sand Plains and the west portion of the Site is located within the Ottawa Valley Clay Plains. The Russell and Prescott Sand Plains is a group of large sand plains separated by the clays of the lower Ottawa valley. The Russell and Prescott Sand Plains consists of one continuous belt, 105 km in length, from Ottawa to Hawkesbury, together with three fairly large areas lying to the north of it, in Alfred, North Plantagenet, and Clarence Townships, and a number of smaller sandy remnants dispersed over the clay plains. The Ottawa Valley between Pembroke and Hawkesbury consists of clay plains with intermittent ridges of rock or sand, which is naturally dividable into two parts, above and below Ottawa, each having its own distinctive traits (Chapman and Putnam, 1984). A physiographic region map of the Site and surrounding area is shown on Figure 2.

2.4 Regional Geology and Hydrogeology

Geological and hydrogeological conditions were based on publicly available information obtained from the Ontario Geological Survey (OGS) and a Water Budget Conceptual Understanding Report for Raisin-South Nation Source Protection Region by Raisin Region Conservation Authority & South Nation Conservation (RRCA & SNC, 2009).

The surficial geology across the Site consists of fine-textured glaciomarine deposits comprising of silt and clay, minor sand and gravel, massive to well laminated. Figure 3 illustrates the mapped surficial geology of the Site and surrounding area.

The bedrock underlying the Site belongs to the Ottawa Group, Simcoe Group, and Shadow Lake Formation, consisting of limestone, dolostone, shale, arkose, and sandstone (considered to be Lindsay Formation). The bedrock surface elevations in the area overall ranged approximately between elevation of 40 m and 30 m from east to west, respectively (Gwyn and Girard, 1973). A bedrock geology map is presented on Figure 4.

The regional geology includes the following key units from youngest to oldest based on a review of “Water Budget Conceptual Understanding Report, Raisin-South Nation Source Protection Region” (RRCA & SNC, 2009):

- Recent Alluvial Deposits;
- Coarse-textured Glaciomarine Deposits;
- Fine-textured Glaciomarine Deposits;
- Glaciofluvial Deposits;
- Till Deposits; and,
- Bedrock.

Recent alluvial deposits mainly consist of modern alluvial and ancient alluvial deposits, which consisting of clay, silt, sand, and gravel, that may contain organic materials. Coarse-textured glaciomarine deposits consist of sand, gravel, and minor silt and clay. Fine-textured glaciomarine deposits consist of glaciomarine silt and clay sediments, and minor sand and gravel. Glaciofluvial deposits consist of sand and gravel aquifers. Till deposits is widespread throughout the region and typically consist of stone-poor sandy to silty sand textured till on Paleozoic terrain. Bedrock consists of Paleozoic Era sedimentary rocks including sandstone, siltstone, shale, limestone and dolostone (RRCA & SNC, 2009).

2.5 Groundwater Users

A search of the Ministry of Environment, Conservation and Parks (MECP) well records database conducted for a 500 m radius around the Site returned a total of five (5) records (Figure 5). Based on the MECP well records, the nearby wells were water supply wells. It is anticipated that the Study Area is serviced with municipal water, however water supply wells for domestic use may be in use within the Study Area. A summary of the MECP’s water well record database is provided in Appendix A. According to the previous hydrogeological assessment for the Site (JWEL, 1995), the majority of the residences to the west of the Site along Pitch Off Road are serviced with municipal piped water and sanitary sewers, but this was not confirmed for all residences.

A search of permitted water takers within the Study Area was conducted in August 2022. The search returned no active Permit to Take Water (PTTW) record for construction dewatering. A review of the Environmental Activity and Sector Registry (EASR) mapping application indicated no EASR water taking registration existed within the Study Area.

2.6 Environmental Features

Based on a regional-scale source protection mapping, the Site is not located within Wellhead Protection Areas (WHPAs), or Significant Groundwater Recharge Areas (SGRAs); however, the Site is located within a Highly Vulnerable Aquifer (HVA).

South Nation River flows northwesterly, approximately 350 m to the west of the Site. Minor drainage ditches/watercourses also flow through the Site toward the South Nation River. A search on the Ministry of Natural Resources and Forestry (MNRF) online mapping indicated that woodlands are scattered around the Site mostly to the east and west, and small portions of the wetlands (unevaluated) are observed to the southeast end. The nearby environmental features located within the Study Area are illustrated on Figure 6.

3. INVESTIGATION PROCEDURES

3.1 Review of Existing Information

A hydrogeological investigation was previously carried out at the Site by others. The results of the previous investigation are contained in the following report:

- “Hydrogeological Assessment, Sewage Treatment Lagoon Upgrade/Expansion, Plantagenet, Ontario”, prepared by Jacques Whitford Environment Limited, Project No. 30464, dated April 4, 1995.

Thirteen boreholes from the previous investigation (94-1A, 94-1B, 94-2, 94-3A, 94-3B, 94-4, 94-5A, 94-5B, 94-6, 94-7A, 94-7B, 94-8, and 94-9) have been used to supplement the subsurface information collected from the current investigation. The borehole data from the previous investigation was reviewed during the current study. The approximate location of the boreholes drilled during the previous investigation are shown on Drawing 32662-1 in Appendix B. The historic data have been provided for information purposes only.

3.2 Geotechnical Investigation

Thurber personnel supervised a borehole drilling program between March 16 and March 21, 2022, during which seven (7) geotechnical boreholes were advanced at four (4) general locations, identified as 22-01 to 22-04. The geotechnical borehole logs were used to assess the local geology of the Site. The approximate locations of the boreholes and monitoring wells are shown on the Borehole Location Plan (Drawing No. 32622-1) provided in Appendix B. Drawing No. 32622-2 in Appendix B also presents stratigraphic cross sections. Respective record of borehole sheets is provided in Appendix C.

A summary of the borehole coordinates, ground surface elevations, and termination depths is provided in Table 3-1. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations. The borehole locations were selected in consultation with J.L. Richards, marked in the field, and subsequently surveyed by Thurber personnel upon completion using a Trimble Catalyst DA2 antenna survey unit. The borehole coordinates are referenced to MTM Zone 8. The elevations are in reference to the mean sea level (geodetic datum).

Table 3-1 – Borehole Details

Borehole No.	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth (m)
22-01S	5 044 847.2	188 588.8	51.5	6.2
22-02S	5 044 994.3	188 976.4	54.0	6.1
22-02D	5 044 994.4	188 977.6	54.0	10.7
22-03S	5 044 600.1	188 537.8	50.3	6.1
22-03D	5 044 600.4	188 536.6	50.2	12.1
22-04S	5 044 856.3	189 056.7	53.1	5.5
22-04D	5 044 856.3	189 055.5	53.0	8.7

The borehole drilling was carried out by CCC Geotechnical and Environmental Drilling of Ottawa, Ontario using a CME-850 track mounted drill rig equipped with hollow stem augers for advancement through the overburden and HQ-sized rotary diamond drilling equipment to advance through boulders and to core the bedrock. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). At select locations where cohesive soil deposits were encountered, in-situ vane shear testing was completed.

Geotechnical laboratory testing consisted of natural moisture content determination, grain size distribution, and Atterberg Limit testing on selected soil samples. The results of the geotechnical laboratory testing are summarized on the Record of Borehole Sheets included in Appendix C.

Details of the encountered soil stratigraphy from the current investigation are presented on the Record of Borehole sheets in Appendix C. A general description of the stratigraphy based on the conditions encountered in the boreholes from the current investigation is given. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond sampled locations. It should be noted that the shallow subsurface conditions noted on the previous borehole logs may have been altered since the time they were drilled.

In general, the subsurface conditions encountered in the boreholes consists of topsoil or fill (comprised of silty clay with organics and variable amounts of sand), marine clay, and glacial till (varied in composition from a cohesive sandy silty clay to a non-cohesive silty sand with gravel to gravelly sand) overlying limestone bedrock.

3.3 Hydrogeological Investigation

To support the hydrogeological investigation, Thurber installed a monitoring well (50 mm diameter) in all seven (7) boreholes in four (4) locations numbered as 22-01 to 22-04. Three (3) locations (22-02 to 22-04) have both a shallow (S) and a deep (D) well (one pair of nested wells), while 22-01 has only a shallow (S) well.

Following completion of the drilling program, each monitoring well was developed by removing a minimum of three well volumes of water to reduce silt and drilling debris from the sand pack and well casing.

The monitoring wells were used to measure groundwater levels, estimate the hydraulic conductivity of the screened units, and collect groundwater samples. The nested deep and shallow monitoring wells were also used to estimate the vertical hydraulic gradient of groundwater at the Site. Monitoring well details are summarized in Table 3-2.

Table 3-2 – Monitoring Well Details

Well ID	Ground Elev. (m)	Well Depth (m)	Screen Interval Elev. (m)	Screened Geologic Unit
22-01S	51.5	5.5	47.5 – 46.0	Glacial Till
22-02S	54.0	6.1	50.9 – 47.9	Clay
22-02D	54.0	10.7	44.8 – 43.3	Limestone Bedrock
22-03S	50.3	5.1	46.7 – 45.2	Glacial Till
22-03D	50.2	12.1	39.6 – 38.1	Limestone Bedrock
22-04S	53.1	5.5	49.1 – 47.6	Clay

Well ID	Ground Elev. (m)	Well Depth (m)	Screen Interval Elev. (m)	Screened Geologic Unit
22-04D	53.0	8.5	46.0 – 44.5	Glacial Till

3.4 Single Well Response Tests

Rising head single well response tests (slug tests) were conducted at all monitoring wells on March 28, 2022, for the purpose of estimating hydraulic conductivity values. The single well response tests (SWRTs) were completed using the following method:

- In advance of conducting the slug tests, the monitoring wells were developed by withdrawing a minimum of three well volumes of groundwater to remove excess sediment and to improve the transmissivity of the sand pack and well screen;
- Once the water level returned to a stabilized level, the static water level was measured and recorded. A datalogger was inserted into the well above the bottom of the well. The datalogger was set to record water levels every 0.125 to 5 seconds, depending on the anticipated rate of recovery of each well;
- A slug (or a known volume) of groundwater was removed from the well (rising head) to induce a change in the hydraulic head;
- Manual and electronic measurements of the water level were recorded until the water level in the well recovered sufficiently; and,
- Manual measurements were compared to electronic measurements for data quality control.

3.5 Water Sampling and Chemical Analysis

Groundwater samples from all seven (7) monitoring wells as well as one (1) surface water sample from the lagoon were collected on April 5, 2022. The collected samples were submitted to AGAT Laboratories (AGAT) for testing against the Ontario Drinking Water Quality Standards (ODWQS) limits for selected metals, inorganics, general chemistry parameters plus microbiological parameters (Escherichia coli (E. coli) and total coliforms), as indicated in Ontario Regulation (O. Reg.) 169/03.

The monitoring wells were developed prior to any sampling, by purging at least three (3) well volumes. The purpose of purging was to remove excess sediment that may have entered the well during installation and increase the representativeness of the natural groundwater in the well. Well development was assessed to be completed based on the number of well volumes purged, stabilization of general chemistry parameters of the purged groundwater (pH, temperature, electrical conductivity) over time, and qualitative observations such as a decrease in turbidity of the purged water.

The results obtained herein were representative of the water sampled from the monitoring wells and the lagoon at the time of sampling and provide a general understanding of water quality under those conditions; however, the water quality may vary significantly from the results obtained based on location, time, meteorological conditions, and in particular based on construction and dewatering methods if applicable.

4. TESTING RESULTS AND ANALYSIS

4.1 Groundwater Levels

Groundwater levels were measured manually in all monitoring wells on March 22 & 23, March 28, April 5, May 25, and October 7, 2022, as summarized in Table 4-1.

Table 4-1 – Measured Groundwater Levels at Monitoring Wells

Well ID	Ground Elev. (m)	March 22 & 23, 2022*		March 28, 2022		April 5, 2022		May 25, 2022		October 7, 2022	
		Depth (m)	Elev. (m)	Depth (m)	Elev. (m)	Depth (m)	Elev. (m)	Depth (m)	Elev. (m)	Depth (m)	Elev. (m)
22-01S	51.5	1.0	50.5	1.0	50.5	1.1	50.4	1.2	50.3	1.6	49.9
22-02S	54.0	1.2	52.8	1.2	52.8	1.3	52.7	1.5	52.5	1.9	52.1
22-02D	54.0	3.2	50.8	3.1	50.9	3.3	50.7	3.3	50.7	3.7	50.3
22-03S	50.3	1.5	48.8	1.4	48.9	1.5	48.8	1.6	48.7	2.0	48.3
22-03D	50.2	1.7	48.5	1.6	48.6	1.9	48.3	2.1	48.1	2.3	47.9
22-04S	53.1	3.1	50.0	1.3	51.8	1.0	52.1	1.0	52.1	1.8	51.3
22-04D	53.0	2.4	50.6	2.4	50.6	2.6	50.4	2.7	50.3	2.9	50.1

* before well development

The water level elevations in monitoring wells ranged from 48.1 m to 52.8 m. The highest water level elevation (Elev. 52.8 m, depth 1.2 m) was measured in monitoring well 22-02S, and the lowest water level elevation (Elev. 47.9 m, depth 2.3 m) was measured in monitoring well 22-03D.

Figure 7 presents the groundwater contour map in till based on water levels measured from wells screened in till on April 5, 2022. Groundwater flow is interpreted to be in the southwest direction toward the South Nation River.

It should be noted that the groundwater levels listed here are short-term readings and groundwater levels are expected to fluctuate seasonally. Higher groundwater levels may be expected during wet periods of the year such as spring or after periods of significant or prolonged precipitation.

As part of the hydrogeological investigation, long-term groundwater monitoring was conducted to assess seasonal groundwater fluctuations for a duration of six (6) months. Four (4) of the monitoring wells including wells 22-01S, 22-02D, 22-04S, and 22-04D were instrumented with water level dataloggers to record groundwater levels on an hourly basis. A barologger was also installed to record barometric pressures to correct level logger readings for atmospheric pressure changes. The groundwater monitoring was started on April 6, 2022 for a duration of six (6) months, and was completed on October 7, 2022. During the monitoring program, a site visit was also conducted on May 25, 2022 to collect the water level data from loggers along with the manual water level readings from the monitoring wells. A hydrograph is presented in Appendix D, which illustrates the seasonal groundwater level fluctuations in each well along with daily precipitation data recorded from a nearby climate monitoring station (Climate Station ID 610726; Environment and Climate Change Canada, 2022). The groundwater elevations in the monitoring wells ranged from 49.5 m to 52.3 m during the six-month monitoring period. The highest water level elevation (Elev. 52.3 m, depth 0.8 m) was measured in monitoring well 22-04S, and the lowest water level elevation (Elev. 49.5 m, depth 2 m) was measured in monitoring well 22-01S. Higher groundwater levels were observed during April (spring), and lower levels were observed during August and September (summer/autumn). As a general trend, significant precipitation events were immediately followed by increases in groundwater elevation. The range in fluctuations in each well was from 0.9 m (in monitoring well 22-04D) to 1.2 m (in monitoring well 22-04S) over the course of the monitoring period.

The vertical hydraulic gradient was estimated at three (3) monitoring well nests to characterize the general vertical groundwater flow at the Site. Table 4-2 summarizes the calculated vertical hydraulic gradient at the shallow (S) and deep (D) well nest for the water level monitoring events conducted from March 28 to May 25, 2022, and October 7, 2022.

Table 4-2 – Calculated Vertical Hydraulic Gradient

Well Nest	Screened Geologic Unit(s)	Vertical Hydraulic Gradient				
		March 28, 2022	April 5, 2022	May 25, 2022	October 7, 2022	Average
22-02 S / D	Clay (S) / Bedrock (D)	-0.36	-0.37	-0.34	-0.34	-0.35
22-03 S / D	Glacial Till (S) / Bedrock (D)	-0.04	-0.07	-0.08	-0.06	-0.06
22-04 S / D	Clay (S) / Glacial Till (D)	-0.39	-0.55	-0.58	-0.39	-0.48

Note: Positive values indicate an upward gradient and negative values indicate a downward gradient.

The vertical hydraulic gradients at the Site are downward for the months shown in Table 4-2. A review of the vertical hydraulic gradients and geological units which the wells are screened in, indicated that the downward gradients from clay to bedrock (at well 22-02 S/D) and from clay to glacial till (at well 22-04 S/D) have greater magnitudes than the downward gradient from glacial till to bedrock (at well 22-03 S/D). The magnitude of vertical hydraulic gradient from glacial till to bedrock observed at monitoring well 22-03 S/D is relatively small, which suggests that there may be good hydraulic connection between glacial till layer and bedrock.

4.2 Hydraulic Conductivity

Single well response tests were conducted on March 28, 2022, in all monitoring wells installed during the 2022 drilling program. The groundwater analysis software AquiferTest Pro was used for analyzing the slug tests, and hydraulic conductivity (K) estimates were obtained using the Hvorslev method (1951). Estimated K values are presented in Table 4-3, and plots of the slug test results are presented in Appendix E.

Table 4-3 – Estimated Hydraulic Conductivity Values

Monitoring Well	Screen Interval Elev. (m)	Screened Geologic Unit	Hydraulic Conductivity K (m/s)
22-01S	47.5 – 46.0	Glacial Till	4.0×10^{-6}
22-02S	50.9 – 47.9	Clay	4.8×10^{-7}
22-02D	44.8 – 43.3	Limestone Bedrock	3.3×10^{-5}
22-03S	46.7 – 45.2	Glacial Till	1.0×10^{-5}
22-03D	39.6 – 38.1	Limestone Bedrock	2.5×10^{-6}
22-04S	49.1 – 47.6	Clay	1.0×10^{-8}
22-04D	46.0 – 44.5	Glacial Till	2.9×10^{-6}

The monitoring wells were screened in three geologic units including clay, glacial till, and limestone bedrock. The estimated hydraulic conductivity values for the clay at monitoring wells 22-02S and 22-04S ranged between 1.0×10^{-8} m/s and 4.8×10^{-7} m/s. The estimated hydraulic conductivity values for the glacial till at monitoring wells 22-01S, 22-03S, and 22-04D ranged between 2.9×10^{-6} m/s and 1.0×10^{-5} m/s. The estimated hydraulic conductivity values for the limestone bedrock at monitoring wells 22-02D and 22-03D ranged between 2.5×10^{-6} m/s and 3.3×10^{-5} m/s. The clay unit was found to be relatively less conductive than the underlying glacial till and bedrock units.

4.3 Water Quality Results

Unfiltered groundwater samples from all seven (7) monitoring wells as well as one (1) unfiltered surface water sample from the lagoon were collected on April 5, 2022. The collected samples were submitted to AGAT Laboratories (AGAT) for testing against the Ontario Drinking Water Quality Standards (ODWQS) limits for selected metals, inorganics, general chemistry parameters plus microbiological parameters (Escherichia coli (E. coli) and total coliforms), as indicated in Ontario Regulation (O. Reg.) 169/03.

The laboratory Certificates of Analysis are provided in Appendix F. A review of the analytical results indicated that samples exceeded the ODWQS criteria for various parameters. The exceeded parameters against ODWQS for the health-based standards including maximum acceptable concentration (MAC) and interim maximum acceptable concentration (IMAC) are summarized for groundwater samples and a surface water sample in Table 4-4 and Table 4-5, respectively.

Table 4-4 – Summary of Groundwater Exceedances to the ODWQS Limits

Sample ID	Parameter	Units	Measured Concentration	ODWQS Limits
22-01S	Total Coliforms	CFU/100mL	11	0
	Total Sodium	mg/L	69.6	20
22-02S	Total Coliforms	CFU/100mL	156	0
	Total Sodium	mg/L	30.6	20
22-02D	Total Coliforms	CFU/100mL	28	0
	Total Sodium	mg/L	109	20
22-03S	Total Coliforms	CFU/100mL	6	0
	Total Sodium	mg/L	27.3	20
22-03D	Total Sodium	mg/L	120	20
22-04S	Total Coliforms	CFU/100mL	1	0
	Total Sodium	mg/L	51.5	20
22-04D	Total Coliforms	CFU/100mL	128	0
	Total Sodium	mg/L	87.0	20

Table 4-5 – Summary of Surface Water Exceedances to the ODWQS Limits

Sample ID	Parameter	Units	Measured Concentration	ODWQS Limits
Lagoon	Total Sodium	mg/L	272	20

Sample ID	Parameter	Units	Measured Concentration	ODWQS Limits
	Escherichia coli	CFU/100mL	11800	0
	Total Coliforms	CFU/100mL	22400	0

ODWQS Health Standard exceedances were identified in monitoring wells for total coliforms and total sodium. All samples collected from monitoring wells had total sodium concentrations higher than the Health Standard of 20 mg/L, which is of concern for people with low sodium requirements. Exceedances of total coliforms were found in all monitoring wells except well 22-03D.

Aesthetic Objectives (AO) exceedances were identified for the following parameters in monitoring wells: total manganese, true colour, total aluminum, total iron, and turbidity. Total aluminum exceedances were identified in every sample except wells 22-01S and 22-03S. True colour exceedances were found in every sample except wells 22-03S and 22-04S. All samples collected from monitoring wells were found to exceed total manganese except wells 22-02D and 22-03D. Well 22-02S was found to exceed total iron, and turbidity exceedance was found in well 22-03D.

An exceedance to Operational Guidelines (OG) was identified for hardness (as CaCO3) (calculated) in all monitoring wells except well 22-03D.

E. coli exceedances were not found in any of the monitoring wells.

Exceedances to ODWQS health standard in the Lagoon were identified for the following parameters: total sodium, E. coli, and total coliforms. The lagoon water was found to exceed the limits for total coliforms and E. coli, both with remarkably high numbers; this was expected due to raw untreated sewage water

Exceedances to AO and OG in the Lagoon were identified for the following parameters: total dissolved solids, chloride, total aluminum, total manganese, turbidity, total sodium, hardness (ac CaCO3) (calculated), and true colour.

5. ENGINEERING ANALYSIS AND ASSSEEMENT

5.1 Summary of Previous Hydrogeological Assessment

The previous hydrogeological assessment conducted by JWEL on April 4, 1995, was reviewed and the relevant information is summarized below:

- The design high water level and base elevation of the lagoon were 53.0 m and 51.3 m, respectively. It was also stated that the high water level at the lagoon was at elevation 53.1 m.
- Four (4) main hydrostratigraphic units were reported in the study area including: 1) surficial silt and sand, 2) silty clay aquitard, 3) sandy silt till aquifer, and 4) limestone bedrock aquifer.
- For surficial silt and sand, the water table was at 1.6 m below ground surface. The assumed hydraulic conductivity for the sand was 10^{-6} m/s.
- Regarding silty clay aquitard, it was estimated that the hydraulic conductivity of unfractured Lake Champlain silty clay at this Site was between 5.0×10^{-9} m/s and 10^{-10} m/s based on experience at other sites and published data discussed in the report.
- The calculated hydraulic conductivity for the till aquifer ranged from 6.8×10^{-8} m/s to 2.1×10^{-5} m/s; the lower value may be erroneously low due to silting in of the screened interval.
- Bedrock was located approximately 2.7 m below ground surface on the north side of the property and dips to the south portion of the property where it was found at 11 m below ground surface. The calculated hydraulic conductivity for bedrock ranged from 2.0×10^{-5} m/s to 1.0×10^{-3} m/s.
- The water level measurements at multi-level monitoring well installations suggested that the dominant hydraulic gradient is vertically downward.
- Groundwater and surface water quality samples indicated that the Ontario Drinking Water Objectives (ODWO) for hardness was exceeded in all samples and the ODWO for alkalinity was exceeded in two wells.
- Deepening of the existing lagoon was not recommended. The preferred direction of expansion was towards the east/southeast of the existing lagoon. Raising the height of the existing dykes was also supported.

5.2 Comparison of Hydrogeological Information

The subsurface units encountered at the Site based on the current investigation are overall similar to the units in the previous hydrogeological assessment prepared by JWEL on April 4, 1995. The current subsurface investigation at the Site identified clay, glacial till, and limestone bedrock; however, surficial silt and sand was not encountered.

In the previous hydrogeological assessment, hydraulic conductivities of overburden units were estimated by slug test analysis (rising and falling head tests), grain size analysis or visual examination. Those values are compared to the estimates in the current investigation as below:

- Clay: Hydraulic conductivity values estimated for clay in the current investigation (ranging from 1.0 x 10^{-8} m/s to 4.8 x 10^{-7} m/s) are higher than those values estimated in the previous assessment (between 10^{-10} m/s and 5.0 x 10^{-9} m/s). The estimates in the previous assessment were based on the published data for unfractured silty clay, while the values in the current investigation are estimated based on slug tests for clay (upper weathered crust and a lower less weathered) that could lead to different estimates.
- Glacial Till: Hydraulic conductivity values estimated for glacial till in the current investigation (ranging from 2.9 x 10^{-6} m/s to 1.0 x 10^{-5} m/s) are overall consistent with those values estimated in the previous assessment (ranging from 6.8 x 10^{-8} m/s to 2.1 x 10^{-5} m/s).
- Limestone Bedrock: Hydraulic conductivity values estimated for bedrock in the current investigation (ranging from 2.5 x 10^{-6} m/s to 3.3 x 10^{-5} m/s) are slightly lower but generally similar to those values estimated in the previous assessment (ranging from 2.0 x 10^{-5} m/s to 1.0 x 10^{-3} m/s).

The vertical hydraulic gradient was downward for both investigations.

5.3 Nitrate Concentration

The maximum permitted nitrate level is 10 mg/L based on the ODWQS. Nitrate-nitrogen is the critical contaminant which is considered a conservative anion since it is not adsorbed by soil in the subsurface, nor does it degrade quickly in a groundwater environment.

Seven (7) groundwater samples were collected from the monitoring wells. Nitrate concentrations ranged from 0.08 mg/L to 1.66 mg/L with the lowest concentration reported in monitoring well 22-03S and the highest concentration in monitoring well 22-02S, respectively. Nitrate concentrations for all seven (7) groundwater samples (with an average of 0.45 mg/L and a geomean of 0.26 mg/L) were below the ODWQS limit of 10.0 mg/L. In addition, the nitrate concentration for a surface water sample collected from the lagoon was below the detection limit of 0.07 mg/L.

To date, it appears that seepage from the lagoon has not resulted in a groundwater concentration of more than 10 mg/L.

5.4 Seepage from the Lagoon

The vertical leakage through the clay from the base of existing lagoon is estimated according to Darcy's Law as provided below:

$$Q = K\ i\ A$$

where:

K = geomean of hydraulic conductivity of clay and is estimated to be 6.9 x 10^{-8} m/s based on slug tests conducted in monitoring well 22-02S and 22-04S.

i = vertical hydraulic gradient is estimated to be 0.5, as an average estimated at monitoring well 22-04 provided in Table 4-2.

A = area of the existing lagoon is estimated as 64,000 m^2 as per the previous hydrogeological assessment prepared by JWEL on April 4, 1995.

Based on these assumed values, it is estimated the seepage through the clay from the base of the existing lagoon is 0.0022 m^3/s, which would be approximately 190 m^3/day and 69,350 m^3 annually.

According to the reports of Plantagenet Sewage Lagoon prepared by Ontario Clean Water Agency (OCWA), annual flows were reported as below:

- Annual Report 2020 (reporting period of January 1 to December 31, 2020) - total raw sewage was 275,409 m^3, and total lagoon effluent was 230,322 m^3. As such, the difference was 45,087 m^3 in a year.
- Annual Report 2019 (reporting period of January 1 to December 31, 2019) - total raw sewage was 282,161 m^3, and total lagoon effluent was 179,682 m^3. As such, the difference was 102,479 m^3 in a year.
- Annual Report 2018 (reporting period of January 1 to December 31, 2018) - total raw sewage was 288,656 m^3, and total lagoon effluent was 155,548 m^3. As such, the difference was 133,108 m^3 in a year.
- Annual Report 2017 (reporting period of January 1 to December 31, 2017) - total raw sewage was 292,381 m^3, and total lagoon effluent was 201,941 m^3. As such, the difference was 90,440 m^3 in a year.

- Annual Report 2016 (reporting period of January 1 to December 31, 2016) - total raw sewage was 226,649 m^3, and total lagoon effluent was 147,211 m^3. As such, the difference was 79,438 m^3 in a year.

The difference between the total raw sewage flow and the total lagoon (treated) effluent flow indicates that amount of flow that may be evaporated, leaked from a lagoon, etc. The average of differences for the 5 years (from 2016 to 2020) was approximately 90,110 m^3, which is close to the estimated seepage from the base of the existing lagoon (69,350 m^3). If proposed lagoons are constructed, similar flows are expected to be added as the total seepage from the Site.

5.5 Assessment of the Proposed Expansion

According to the previous hydrogeological assessment conducted by JWEL on April 4, 1995, the base of the proposed lagoon to the south would be at elevation 51.3 m, which was 1.8 m below the highest operating water level elevation (53.1 m).

According to the groundwater contour map in till (Figure 7), groundwater flow is interpreted to be in the southwest direction toward the South Nation River. As discussed in Section 4.1, good vertical hydraulic connection between till and bedrock is anticipated. As such, groundwater flow direction in bedrock is also expected to be similar to what was observed in till. It can be concluded that groundwater elevation generally is higher to the northeast/east of the proposed lagoon location than the southwest/west. The highest water level elevation (Elev. 52.8 m, depth 1.2 m) was measured in monitoring well 22-02S screened in fill, which is located on the northeast of the proposed lagoon. Overall, the groundwater level observed at the proposed lagoon location was approximately 1 m to 1.4 m below ground surface. Therefore, it is expected that the base of the proposed lagoon is below groundwater level and construction dewatering would be anticipated. It is recommended that the need for construction dewatering is evaluated during the detailed design stage.

Drawing No. 32622-2 in Appendix B presents the stratigraphic cross sections. Another consideration for the proposed lagoon base is to maintain the clay as thick as possible to avoid excessive leakage from the base. A review of the clay thickness across the proposed lagoon location indicates that clay is thicker (approximately 4 m to 5 m) to the east than the west end (approximately less than 2 m). It is noted that the upper portion of the clay deposit has been weathered to a very stiff to hard crust. Below the weathered crust in boreholes 22-01S and 22-03D, the marine clay transitions to a less weathered clay with lesser stiffness. It is suggested that the base of the proposed lagoon is not excavated within the soft clay.

A review of MECP Well Records indicates that five (5) water supply wells were located within a 500 m radius around the Site. The nearest water supply well record is located approximately 250 m to the northwest of the existing lagoon. South Nation River is approximately 350 m to the west of the Site. Considerable distances to these features should be considered to locate the proposed lagoon. It is understood that a thorough private well survey has not been conducted to date, that is recommended to be considered. Furthermore, there are drainage ditches/watercourses that flow through the Site toward the South Nation River. These drainage ditches/watercourses need to be considered for the proposed lagoon expansion. It is suggested that consultation with SNC, any other responsible authorities, and ecological and/or fisheries experts be conducted as part of the class EA study to evaluated any mitigation options due to the proposed lagoon expansion. Stream monitoring prior to, during and following construction may be required, depending on the outcome of any stream analysis.

Potential travel time of the lagoon effluent to the South Nation River was considered. Seepage through the clay from the base of the lagoon is assumed to travel through glacial till. The estimated hydraulic conductivity values for glacial till ranged between 2.9×10^{-6} m/s and 1.0×10^{-5} m/s. Given the approximate distance of 350 m to the river, the geomean hydraulic conductivity of glacial till as 1.1×10^{-6} m/s, approximate horizontal hydraulic gradient of 0.005, and an assumed porosity of 25%, the travel time for the seepage to reach the river was estimated to be approximately 550 years.

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the current investigation, the following conclusions and recommendations are provided:

- Expansion to the south/southeast of the existing lagoon as recommended in the previous hydrogeological assessment conducted by JWEL on April 4, 1995, appears to be feasible. Since the clay is generally thicker to the east, expansion to the southeast would be preferable to reduce any additional lining requirements. However, further geotechnical and hydrogeological investigations and analyses are recommended to be conducted during the detailed design stage.
- Given that construction dewatering may be required, it is recommended that groundwater quality samples will be collected and analyzed against the Provincial Water Quality Objectives (PWQO) limits during detailed design to assess different discharge options for any dewatering effluent.
- Based on a review of the MECP well records, five (5) water supply wells were found within the Study Area. However, it is understood that a thorough private well survey has not been conducted to date. While it is anticipated that known well users would

not be affected, it is recommended that a private (door-to-door) well survey to be conducted in advance of construction to identify potential well users in the area and establish baseline water levels and water quality prior to, during, and following construction.

- It is recommended that the South Nation Conservation Authority be contacted as part of the class EA study in regards to the nearby watercourses and whether they may need to be re-aligned due to proposed lagoon expansion. Additional consultation with ecological and/or fisheries experts may be required. Stream monitoring prior to, during and following construction may be required, depending on the outcome of any stream analysis.

7. CLOSURE

We trust this report provides the information you require at this time. If you have any questions or require further information, please do not hesitate to contact us.

8. REFERENCES

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STATEMENT OF LIMITATIONS AND CONDITIONS

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This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

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d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

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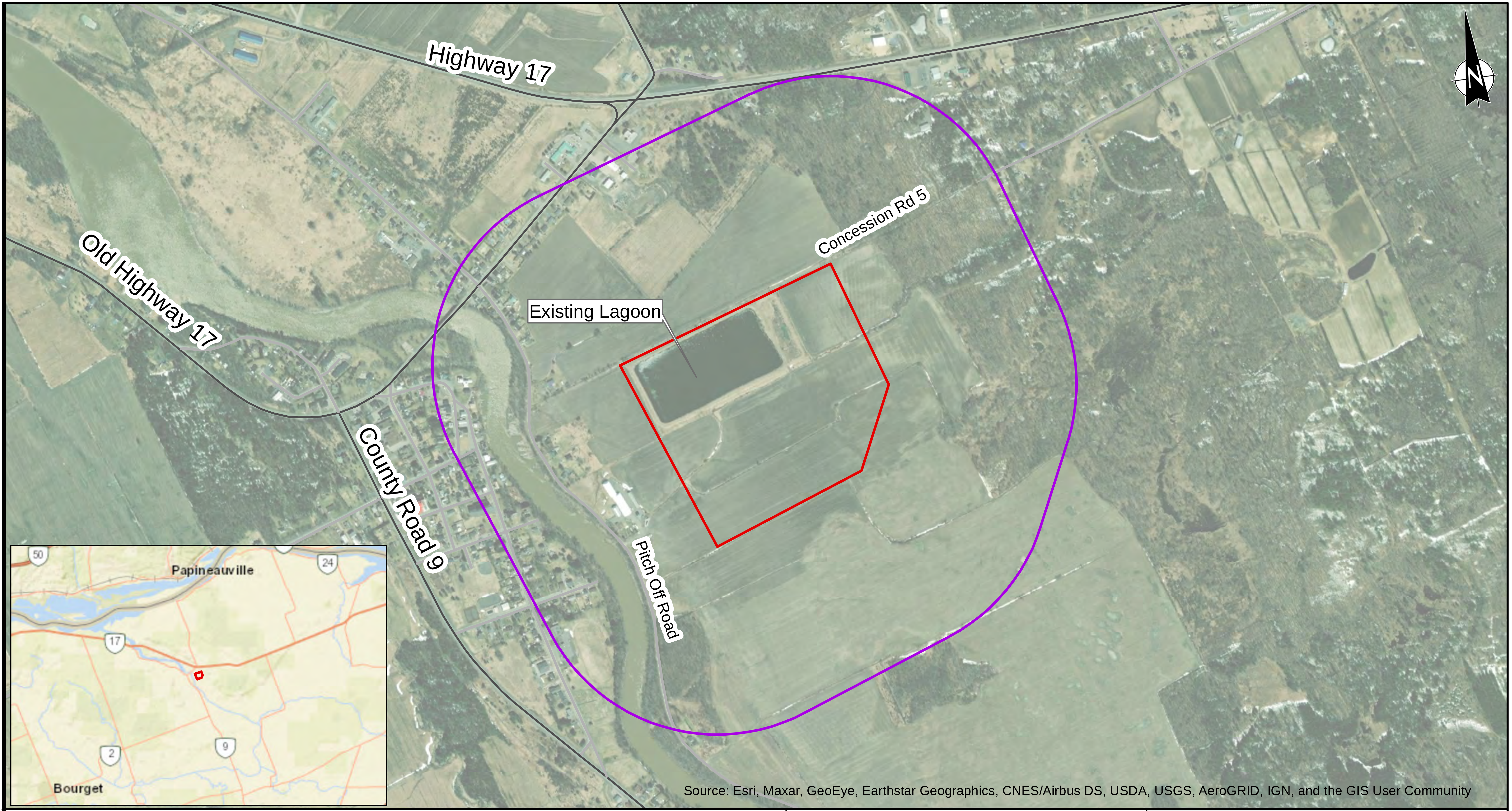
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Figures



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\Figure 1 -- Site Location_v1.mxd modified 2022-08-17 by mmeskar

LEGEND:

🟥	Site
🟪	500 m Buffer (Study Area)
—	Arterial
—	Local

200 100 0 200 m
UTM 17 NAD 83

J.L. RICHARDS & ASSOCIATES LTD.

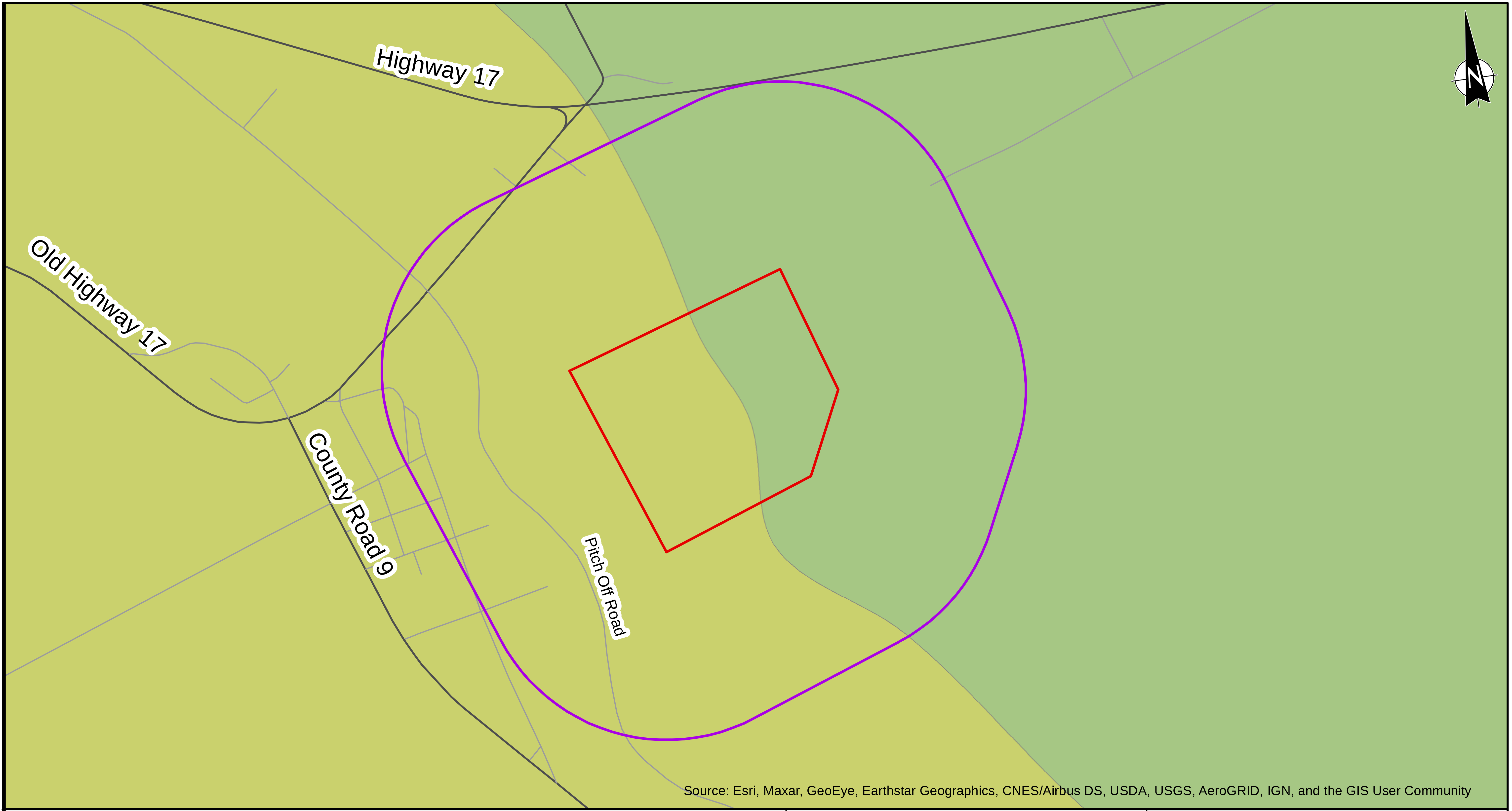
CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

SITE LOCATION MAP

PROJECT No. **32622**

THURBER ENGINEERING LTD.

DESIGNED: **JM**	DRAWN: **JM**	APPROVED: **AH**
DATE: **AUGUST 09, 2022**	SCALE: **1:10,000**	FIGURE NO. **1**



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND:

🟥 Site

🟪 500 m Buffer (Study Area)

— Arterial

— Local

Physiography

🟨 49; Ottawa Valley Clay Plains

🟩 50; Russell And Prescott Sand Plains

200 100 0 200 m

UTM 17 NAD 83

J.L. RICHARDS & ASSOCIATES LTD.

CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

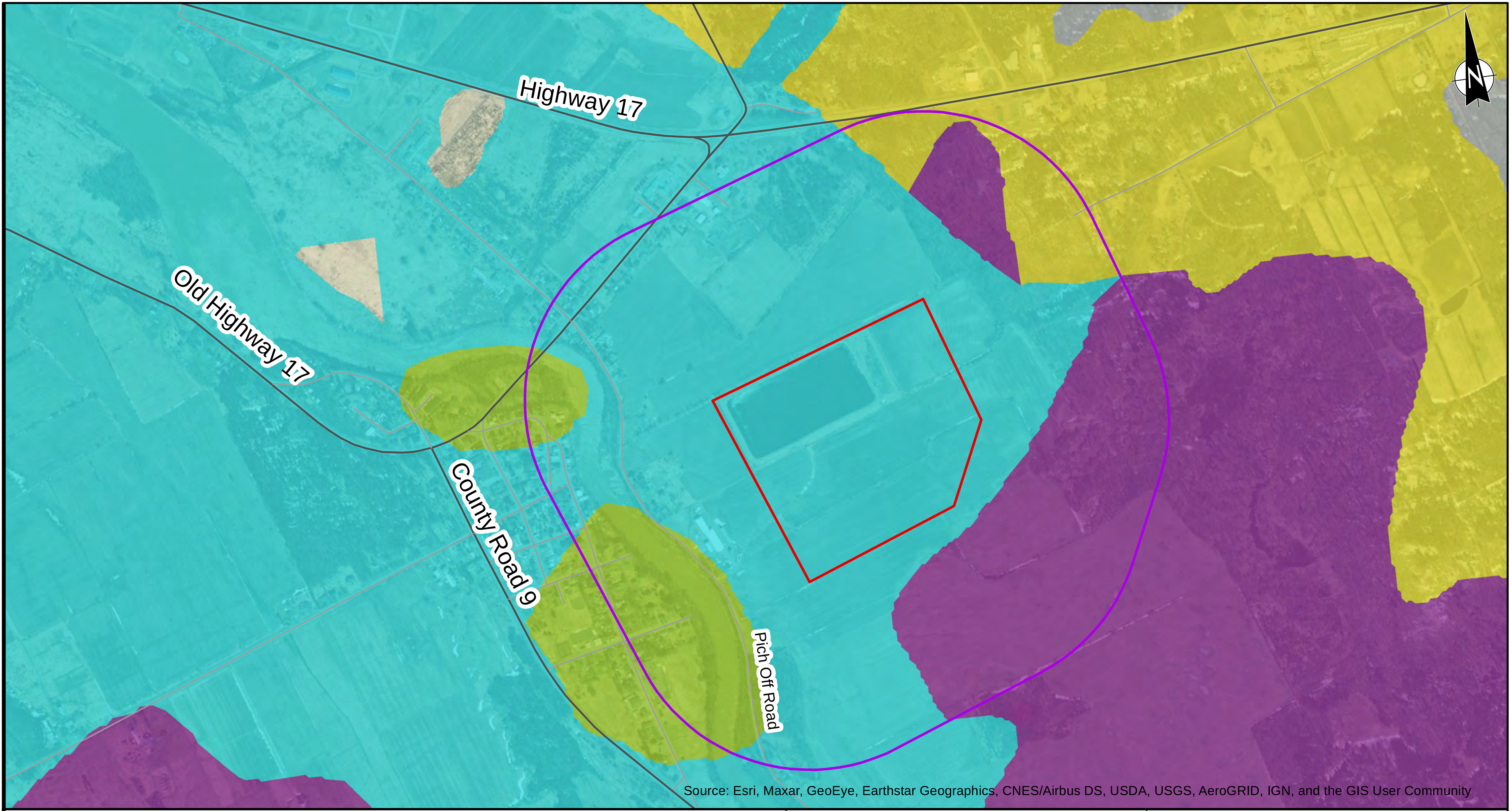
PHYSIOGRAPHY

PROJECT No. **32622**

THURBER ENGINEERING LTD.

DESIGNED:	DRAWN:	APPROVED:
JM	JM	AH
DATE: AUGUST 09, 2022	SCALE: 1:10,000	FIGURE NO. 2

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\Figure 2 -- Phsyiography_V1.mxd modified 2022-08-17 by mmeskar



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND:

- 🟥 Site
- 🟪 500 m Buffer (Study Area)
- — Arterial
- — Local

- 🟩 5b: Till (stone-poor sandy silt to silty sand-textured
- 🟦 10a: Fine-textured glaciomarine deposits
- 🟨 11a: Coarse-textured glaciomarine deposits
- 🟪 18: Colluvial deposits (boulders, scree, talus, undifferentiated landslide materials)
- ⬜ 20: Organic deposits (peat, marl, muck)

200 100 0 200 m

UTM 17 NAD 83

J.L. RICHARDS & ASSOCIATES LTD.

CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

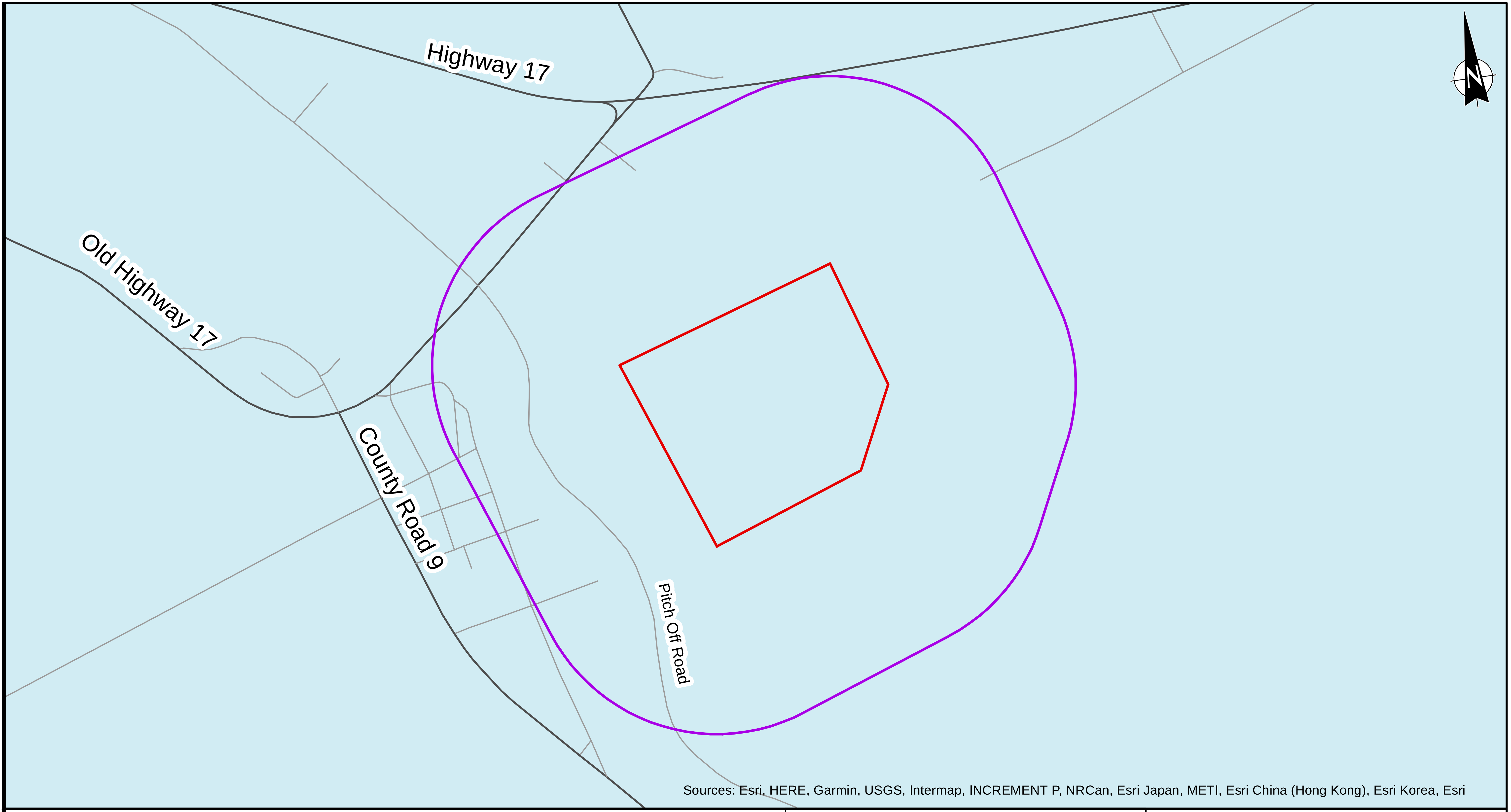
SURFICIAL GEOLOGY

PROJECT No. **32622**

THURBER ENGINEERING LTD.

DESIGNED: **JM**	DRAWN: **JM**	APPROVED: **AH**
DATE: **AUGUST 09, 2022**	SCALE: **1:10,000**	FIGURE NO. **3**

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\Figure 3 -- Surficial Geology_v1.mxd modified 2022-08-17 by mmeskar



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri

LEGEND:

- 🟥 Site
- 🟪 500 m Buffer (Study Area)
- — Arterial
- — Local

Bedrock Geology

- 🟦 11: Lindsay Formation

200 100 0 200 m

UTM 17 NAD 83

J.L. RICHARDS & ASSOCIATES LTD.

CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

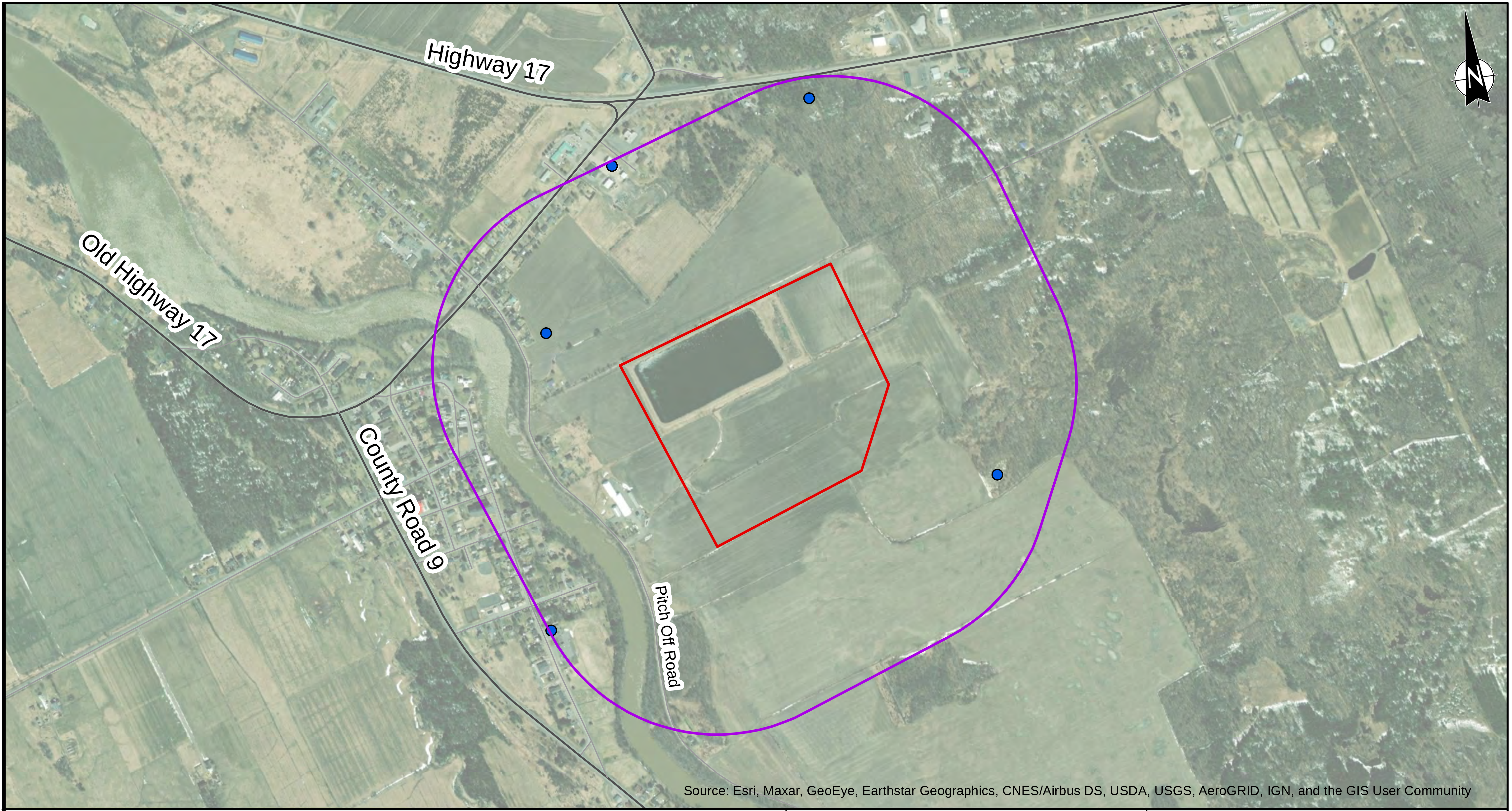
BEDROCK GEOLOGY

PROJECT No. **32622**

THURBER ENGINEERING LTD.

DESIGNED: **JM**	DRAWN: **JM**	APPROVED: **AH**
DATE: **AUGUST 09, 2022**	SCALE: **1:10,000**	FIGURE NO. **4**

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\Figure 4 -- Bedrock Geology_v1.mxd modified 2022-08-17 by mmeskar



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND:

🟥	Site
🟪	500 m Buffer (Study Area)
—	Arterial
—	Local
●	Water Supply Well

200 100 0 200 m

UTM 17 NAD 83

J.L. RICHARDS & ASSOCIATES LTD.

CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

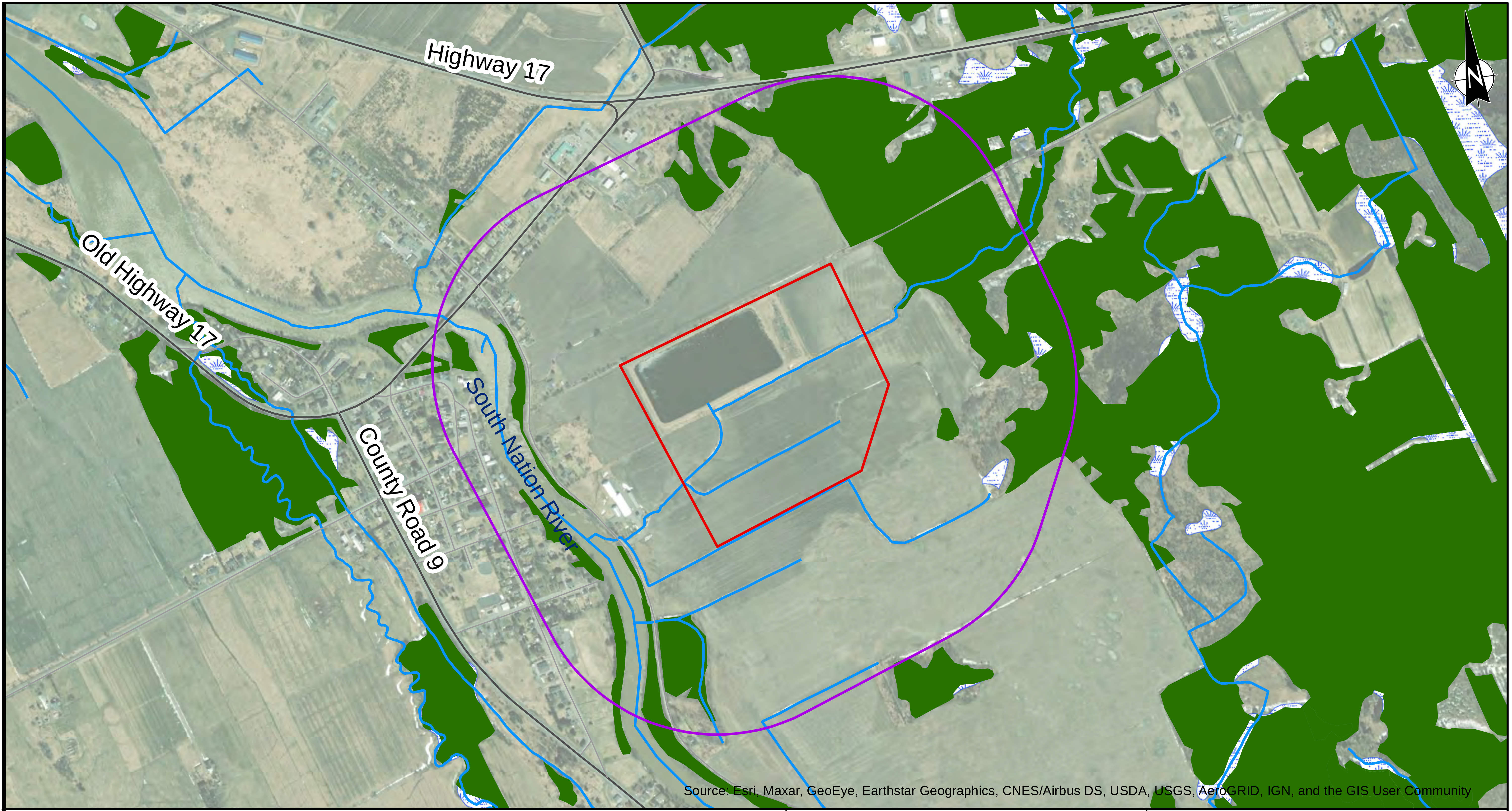
MECP WELL RECORDS

PROJECT No. 32622

THURBER ENGINEERING LTD.

DESIGNED:	DRAWN:	APPROVED:
JM	JM	AH
DATE: AUGUST 09, 2022	SCALE: 1:10,000	FIGURE NO. 5

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\Figure 5 -- MECP Well Search_v1.mxd modified 2022-08-17 by mmeskar



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND:

- 🟥 Site
- 🟪 500 m Buffer (Study Area)
- — Arterial
- — Local
- — Watercourse
- 🟩 Wooded Area
- ▨ Wetland

200 100 0 200 m

UTM 17 NAD 83

J.L RICHARDS & ASSOCIATES LTD.

CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

NEARBY ENVIRONMENTAL FEATURES

PROJECT No. **32622**

THURBER ENGINEERING LTD.

DESIGNED: JM	DRAWN: JM	APPROVED: AH
DATE: AUGUST 09, 2022	SCALE: 1:10,000	FIGURE NO. 6

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\Figure 6 -- NEARBY ENVIRONMENTAL FEATURES_v1.mxd modified 2022-08-17 by mmeskar

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND:

◐	Monitoring Wells	—	Groundwater Contour (m)
—	Watercourse	→	Inferred Groundwater Flow Direction in Tilll

100 50 0 100 m
UTM 17 NAD 83

J.L. RICHARDS & ASSOCIATES LTD.

CLASS EA
PLANTAGENET WASTEWATER TREATMENT SYSTEM

GROUNDWATER CONTOUR MAP IN TILL

PROJECT No. 32622

THURBER ENGINEERING LTD.

DESIGNED: JM	DRAWN: JM	APPROVED: AH
DATE: AUGUST 09, 2022	SCALE: 1:4,000	FIGURE NO. 7

\\TOR-FS01\Share01\Projects\30000-39999\32000-32999\32622 - Hydrogeological Investigation -Plantagenet WW Class EA\Reports & Memos\GIS\mxd\MW locations_v1.mxd modified 2022-08-17 by mmeskar

Appendix A - MECP Well Records Summary

MECP WELL RECORDS SUMMARY

BOREHOLE ID	WELL ID	DATE COMPLETED	WELL DEPTH (m)	DEPTH TO BEDROCK (m)	STATIC WATER LEVEL (m)	WELL USE
10347435	5200649	1968-09-19	33.5	25.9	3	Water Supply
10347904	5201146	1975-05-14	15.2	5.2	2.4	Water Supply
10348271	5201540	1979-08-23	10.4	7.9	3	Water Supply
10521089	5203593	2001-08-13	30.5	26.2	12.2	Water Supply
10350268	5203555	2001-05-03	25.9	7	5.5	Water Supply

THURBER

Appendix B - Borehole Location Plan and Stratigraphic Sections

LEGEND:

⌖	CURRENT BOREHOLES BY THURBER
●	PREVIOUS BOREHOLES BY OTHERS

J.L. Richards & Associates Ltd.

Hydrogeological and Geotechnical Services Class Environmental Assessment of the Plantagenet Wastewater Collection and Treatment System

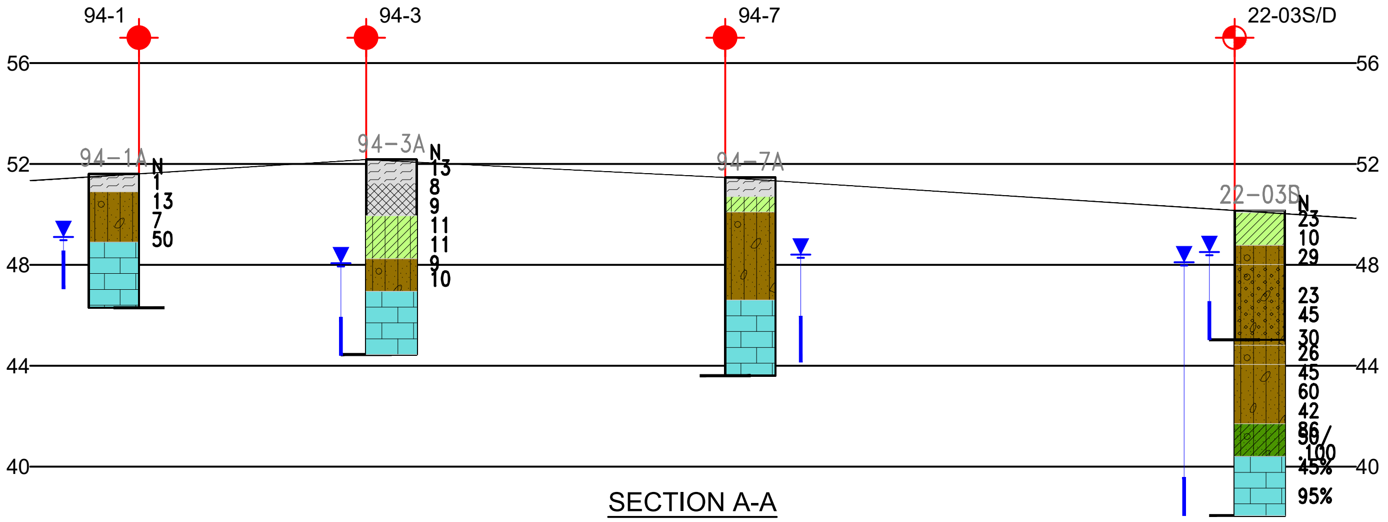
BOREHOLE LOCATION PLAN

JOB# 32622

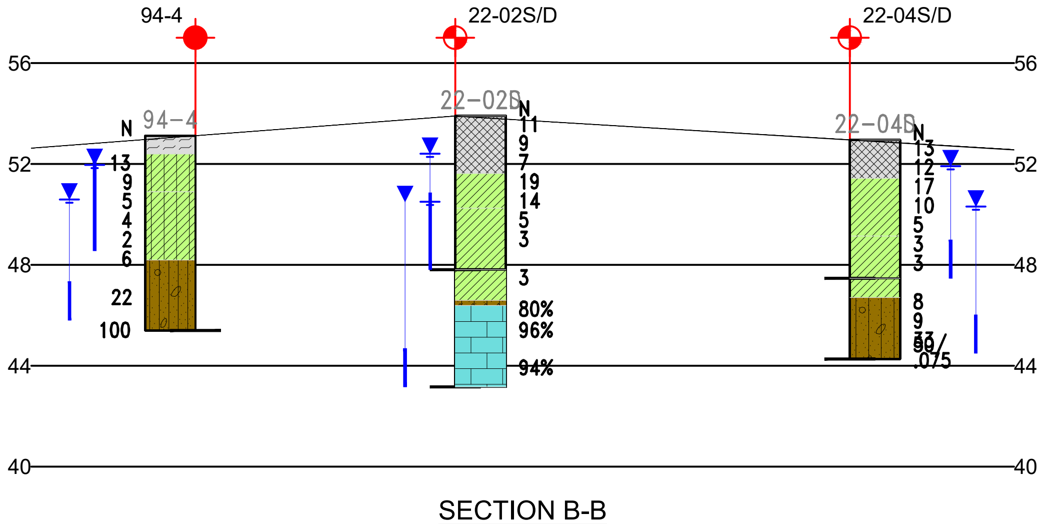
THURBER ENGINEERING LTD.

ENGINEER : MM	DRAWN : MFA	APPROVED : SD
DATE : AUGUST 2022	SCALE : 1:3000	DRAWING No. 32622-1

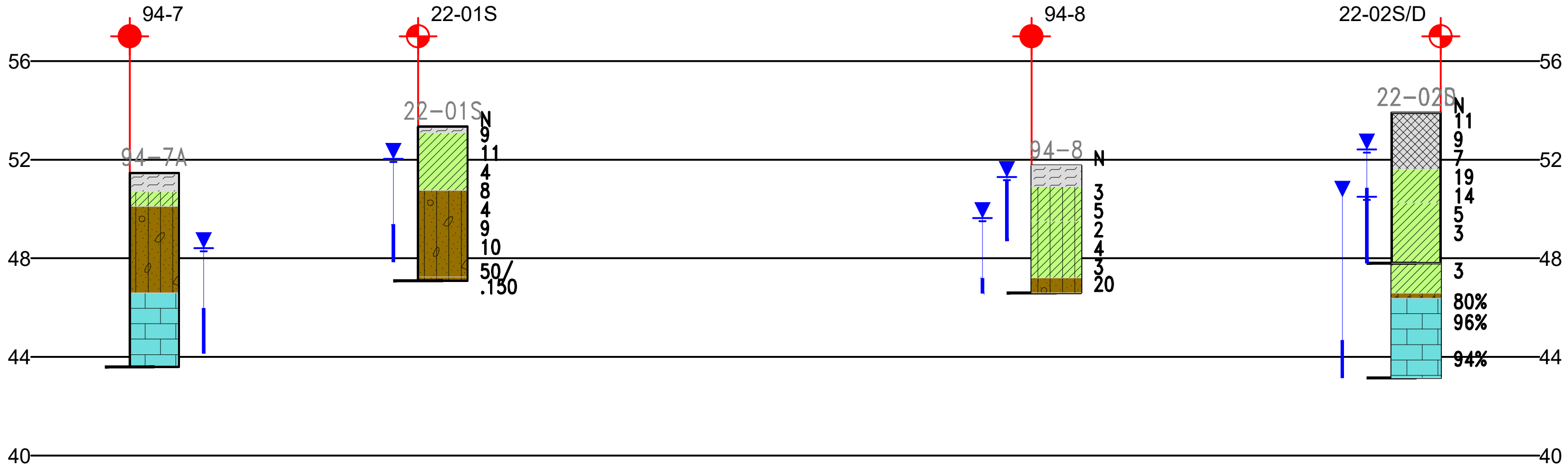
FILENAME: H:\Drafting\32000\32622\TED-32622-BHPP.dwg
PLOTDATE: Aug 23, 2022 - 1:40 PM



SECTION A-A



SECTION B-B



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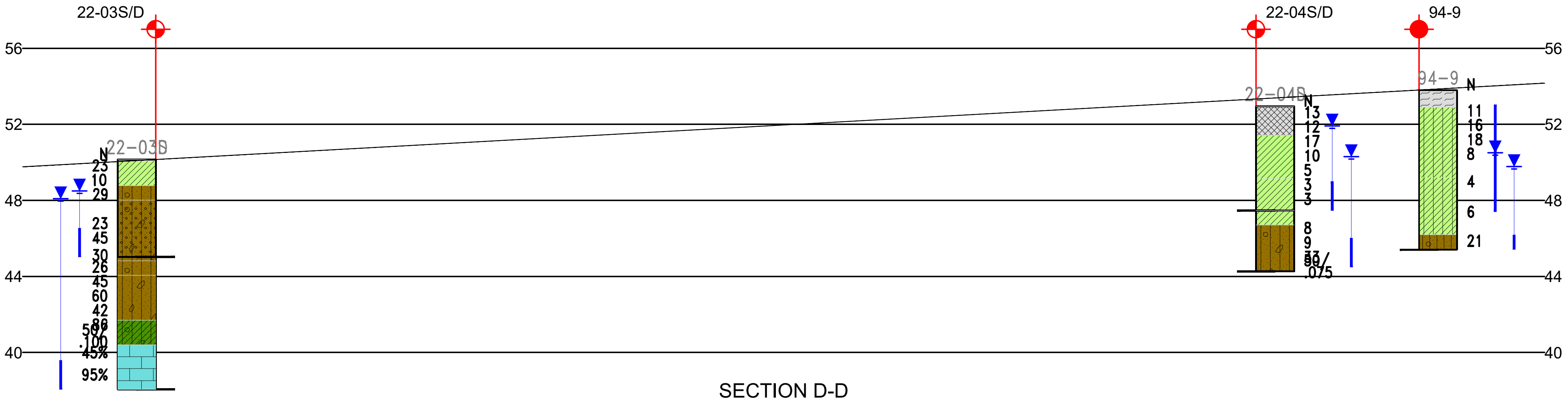


SECTION D-D

LEGEND:

- ⌖ CURRENT BOREHOLES BY THURBER
- ● PREVIOUS BOREHOLES BY OTHERS

- ▨ TOPSOIL
- ▨ FILL
- ▨ SAND
- ▨ SILTY SAND
- ▨ SILT
- ▨ CLAY
- ▨ SILTY CLAY
- ▨ SILTY SAND TILL
- ▨ SANDY SILT TILL
- ▨ SAND & SILT TILL
- ▨ SILTY GRAVELLY SAND TILL
- ▨ SILTY CLAY TILL
- ▨ LIMESTONE BEDROCK

J.L. Richards & Associates Ltd.

Hydrogeological and Geotechnical Services Class Environmental Assessment of the Plantagenet Wastewater Collection and Treatment System

STRATIGRAPHIC SECTIONS

JOB# 32622

THURBER ENGINEERING LTD.

ENGINEER :	DRAWN :	APPROVED :
MM	MFA	SD
DATE :	SCALE :	DRAWING No.
AUGUST 2022	H 1:3000 V 1:300	32622-2

FILENAME: H:\Drafting\32000\32622\TED-32622-BHPP.dwg
PLOTDATE: Aug 23, 2022 - 1:40 PM

THURBER

Appendix C - Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

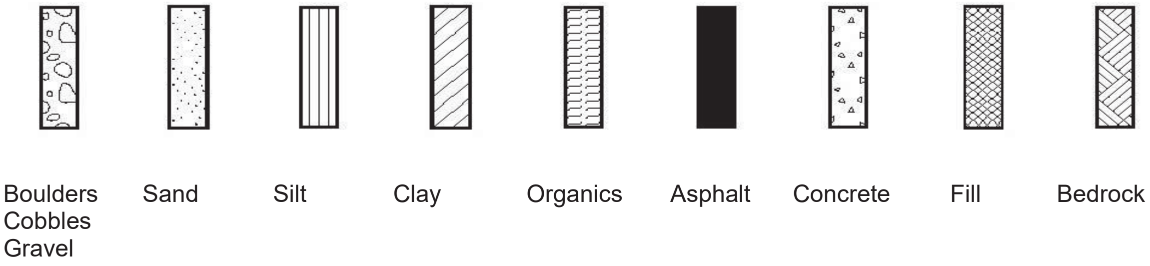
N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT "N" Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structures are preserved.

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	Less than 6 mm

STRENGTH CLASSIFICATION

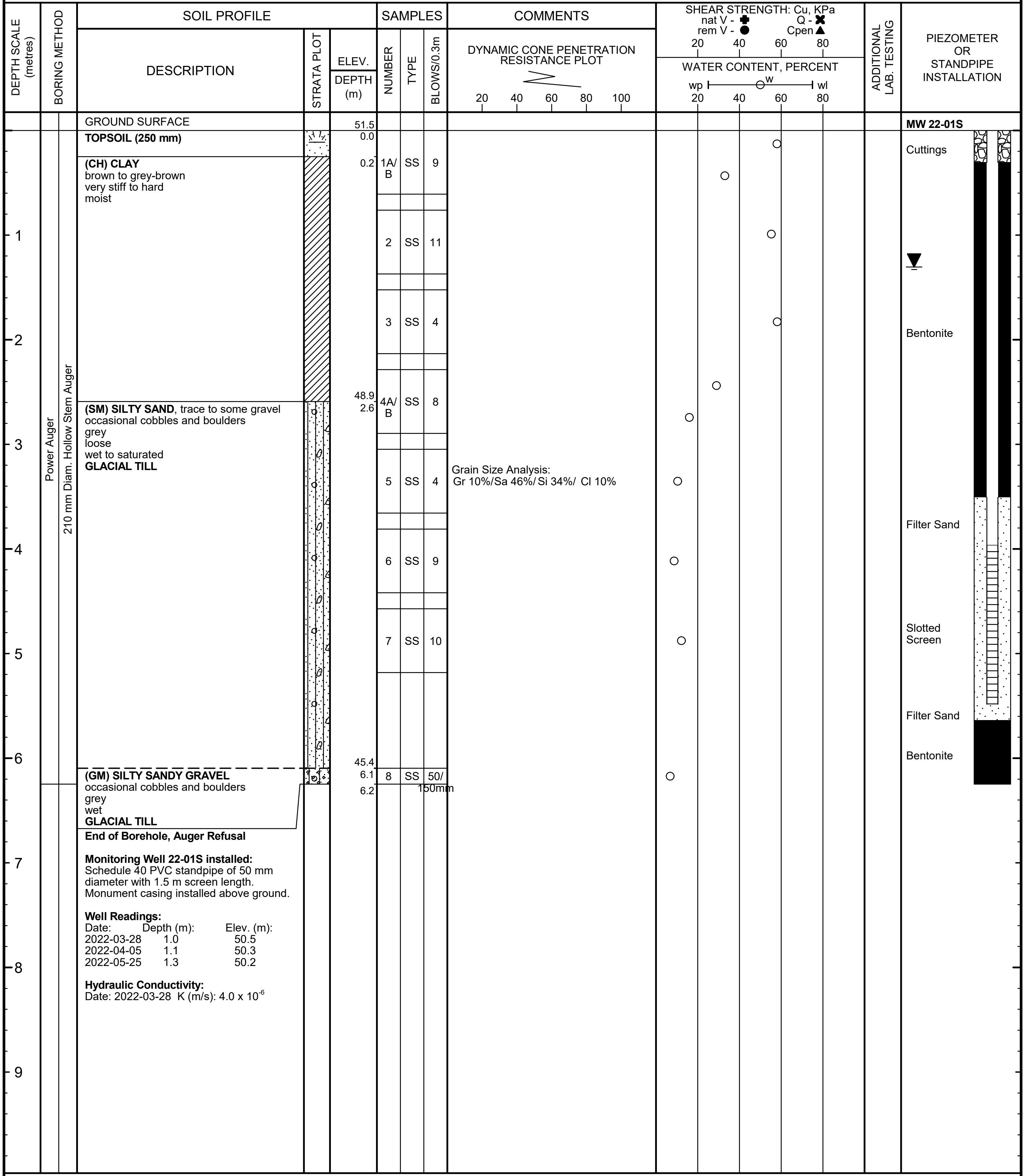
Rock Strength	**Approximate Uniaxial Compressive Strength (MPa)**
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

RECORD OF BOREHOLE 22-01S

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 847.2 E 188 588.8
STARTED : 2022 March 17
COMPLETED : 2022 March 17

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 1
DATUM Geodetic



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	51.5
TOPSOIL (250 mm)	0.0
(CH) CLAY brown to grey-brown very stiff to hard moist	0.2
(SM) SILTY SAND, trace to some gravel occasional cobbles and boulders grey loose wet to saturated **GLACIAL TILL**	48.9 2.6
(GM) SILTY SANDY GRAVEL occasional cobbles and boulders grey wet **GLACIAL TILL**	45.4 6.1
End of Borehole, Auger Refusal	6.2

NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1A/B	SS	9	
2	SS	11	
3	SS	4	
4A/B	SS	8	
5	SS	4	Grain Size Analysis: Gr 10%/Sa 46%/ Si 34%/ Cl 10%
6	SS	9	
7	SS	10	
8	SS	50/ 150mm	

Monitoring Well 22-01S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.0	50.5
2022-04-05	1.1	50.3
2022-05-25	1.3	50.2

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 4.0 x 10^{-6}

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

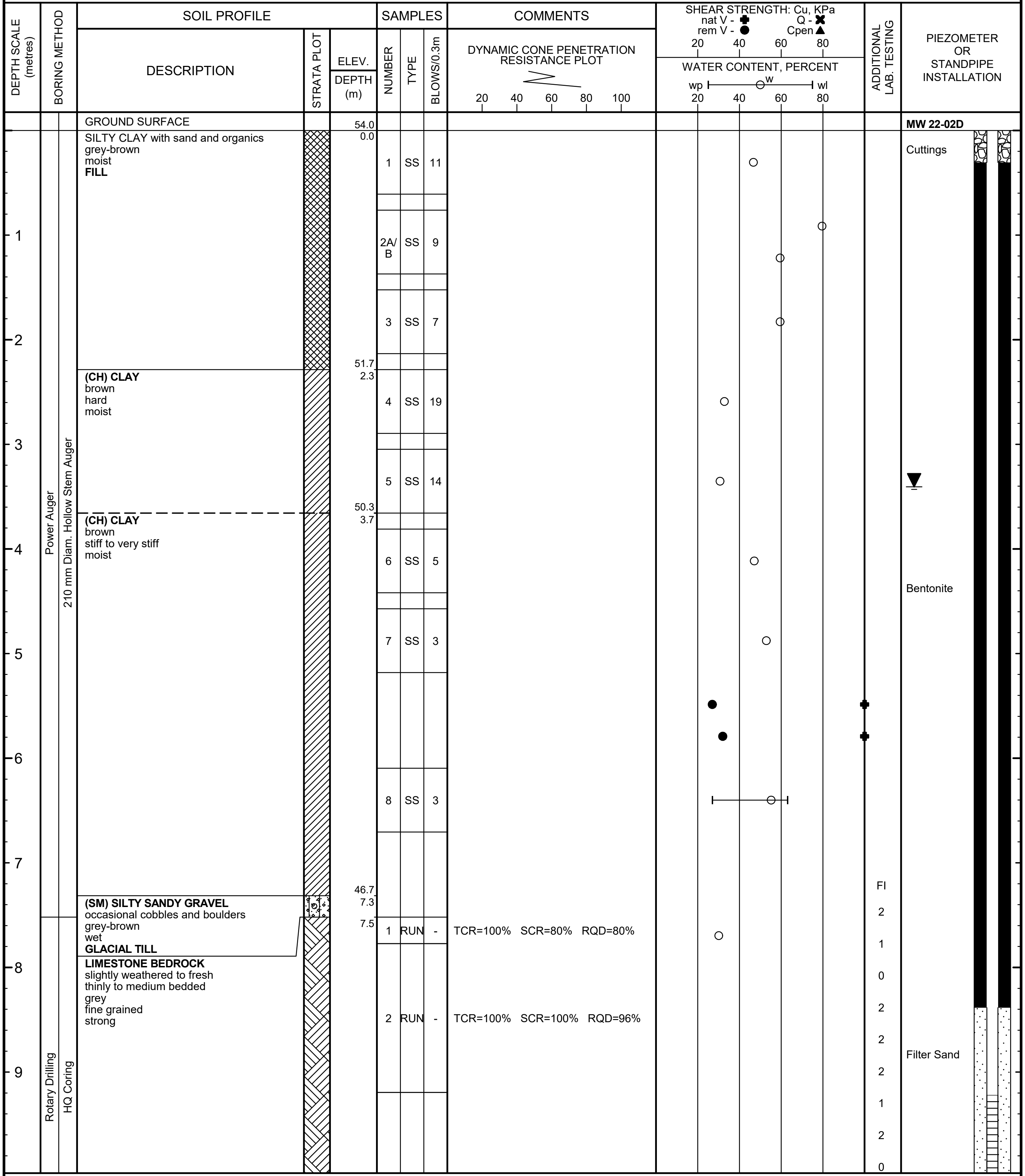
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

RECORD OF BOREHOLE 22-02D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 994.4 E 188 977.6
STARTED : 2022 March 17
COMPLETED : 2022 March 18
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 2
DATUM Geodetic



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	54.0
SILTY CLAY with sand and organics grey-brown moist **FILL**	0.0
(CH) CLAY brown hard moist	51.7 2.3
(CH) CLAY brown stiff to very stiff moist	50.3 3.7
(SM) SILTY SANDY GRAVEL occasional cobbles and boulders grey-brown wet **GLACIAL TILL**	46.7 7.3
LIMESTONE BEDROCK slightly weathered to fresh thinly to medium bedded grey fine grained strong	7.5

NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1	SS	11	
2A/B	SS	9	
3	SS	7	
4	SS	19	
5	SS	14	
6	SS	5	
7	SS	3	
8	SS	3	
1	RUN	-	TCR=100% SCR=80% RQD=80%
2	RUN	-	TCR=100% SCR=100% RQD=96%

FI: 2 1 0 2 2 2 1 2 0

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

THURBER2S 32622 PLANTAGENET.GPJ 22-11-10

RECORD OF BOREHOLE 22-02D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 994.4 E 188 977.6
STARTED : 2022 March 17
COMPLETED : 2022 March 18

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ rem V - ● Q - ✖ Cpen ▲ 20 40 60 80 / WATER CONTENT, PERCENT wp ⊢ ○w ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
			▨	43.3 10.7	3	RUN	-	TCR=100% SCR=100% RQD=94%		2 1 1	Slotted Screen
11 12 13 14 15 16 17 18 19		**End of Borehole** **Monitoring Well 22-02D installed:** Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length. Monument casing installed above ground. **Well Readings:** Date: Depth (m): Elev. (m): 2022-03-28 3.1 50.9 2022-04-05 3.3 50.7 2022-05-25 3.4 50.6 **Hydraulic Conductivity:** Date: 2022-03-28 K (m/s): 3.3 x 10^{-5}									

GROUNDWATER ELEVATIONS

$\underline{\nabla}$ WATER LEVEL UPON COMPLETION

$\underline{\blacktriangledown}$ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-02S

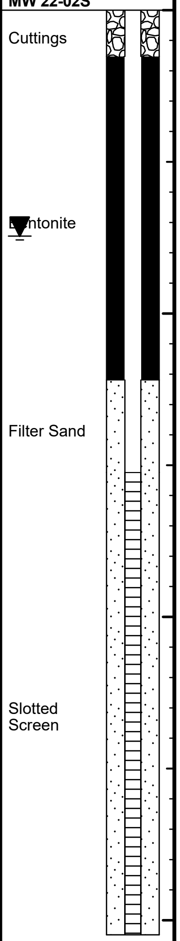
PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 994.3 E 188 976.4
STARTED : 2022 March 18
COMPLETED : 2022 March 18

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80; WATER CONTENT, PERCENT wp ⊢—○w—⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		54.0							MW 22-02S
	Power Auger 210 mm Diam. Hollow Stem Auger	**See Record of Borehole 22-02D**									
6		**End of Borehole**		47.9 6.1							

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9



End of Borehole

Monitoring Well 22-02S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 3.0 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.2	52.8
2022-04-05	1.3	52.7
2022-05-25	1.5	52.5

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 4.8 x 10^{-7}

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

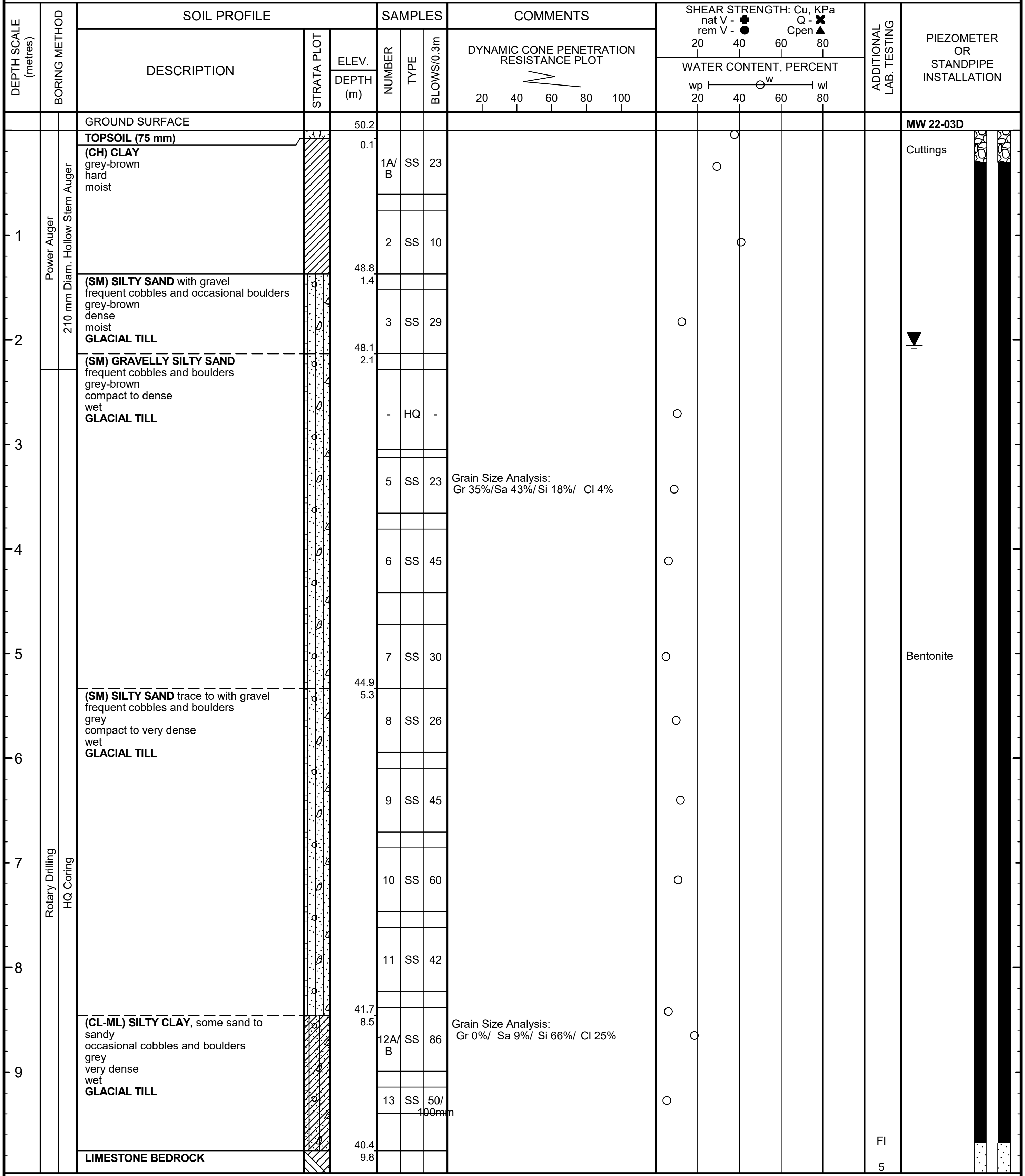
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-03D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 600.4 E 188 536.6
STARTED : 2022 March 16
COMPLETED : 2022 March 16
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount
Project No. 32622
SHEET 1 OF 2
DATUM Geodetic



DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	50.2
TOPSOIL (75 mm)	0.1
(CH) CLAY grey-brown hard moist	
(SM) SILTY SAND with gravel frequent cobbles and occasional boulders grey-brown dense moist **GLACIAL TILL**	48.8 1.4
(SM) GRAVELLY SILTY SAND frequent cobbles and boulders grey-brown compact to dense wet **GLACIAL TILL**	48.1 2.1
(SM) SILTY SAND trace to with gravel frequent cobbles and boulders grey compact to very dense wet **GLACIAL TILL**	44.9 5.3
(CL-ML) SILTY CLAY, some sand to sandy occasional cobbles and boulders grey very dense wet **GLACIAL TILL**	41.7 8.5
LIMESTONE BEDROCK	40.4 9.8

NUMBER	TYPE	BLOWS/0.3m	COMMENTS
1A/B	SS	23	
2	SS	10	
3	SS	29	
-	HQ	-	
5	SS	23	Grain Size Analysis: Gr 35%/Sa 43%/ Si 18%/ Cl 4%
6	SS	45	
7	SS	30	
8	SS	26	
9	SS	45	
10	SS	60	
11	SS	42	
12A/B	SS	86	Grain Size Analysis: Gr 0%/ Sa 9%/ Si 66%/ Cl 25%
13	SS	50/100mm	

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

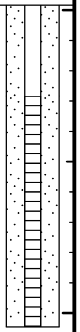
THURBER2S 32622 PLANTAGENET.GPJ 22-11-10

RECORD OF BOREHOLE 22-03D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 600.4 E 188 536.6
STARTED : 2022 March 16
COMPLETED : 2022 March 16
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ rem V - ● Q - ✖ Cpen ▲ 20 40 60 80 / WATER CONTENT, PERCENT wp ⊢ w ○ ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		slightly weathered to fresh thinly to medium bedded grey fine grained strong			1	RUN	-	TCR=100% SCR=81% RQD=45%		3 1 0	Filter Sand
11					2	RUN	-	TCR=100% SCR=98% RQD=95%		3 1 0 2	Slotted Screen
12		**End of Borehole**		38.1 12.1							



Monitoring Well 22-03D installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.6	48.6
2022-04-05	1.9	48.3
2022-05-25	2.1	48.1

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 2.5 x 10^{-6}

13
14
15
16
17
18
19

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

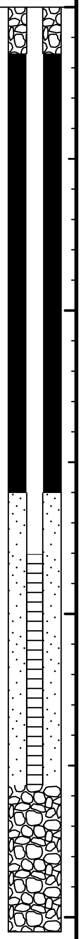
RECORD OF BOREHOLE 22-03S

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 600.1 E 188 537.8
STARTED : 2022 March 16
COMPLETED : 2022 March 16

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 / WATER CONTENT, PERCENT wp ⊢ ○w ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		50.3							**MW 22-03S**
0	Power Auger 210 mm Diam. Hollow Stem Auger	**See Record of Borehole 22-03D**		0.0							Cuttings
1											
2											▼ Bentonite
3	Rotary Drilling HQ Coring										Filter Sand
4											Slotted Screen
5											Cuttings
6		**End of Borehole**		44.2 6.1							
7											
8											
9											



Monitoring Well 22-03S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length. Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.4	48.9
2022-04-05	1.5	48.8
2022-05-25	1.6	48.6

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 1.0 x 10^{-5}

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-04D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 856.3 E 189 055.5
STARTED : 2022 March 21
COMPLETED : 2022 March 21

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 2
DATUM Geodetic

BORING METHOD: Power Auger, 210 mm Diam. Hollow Stem Auger

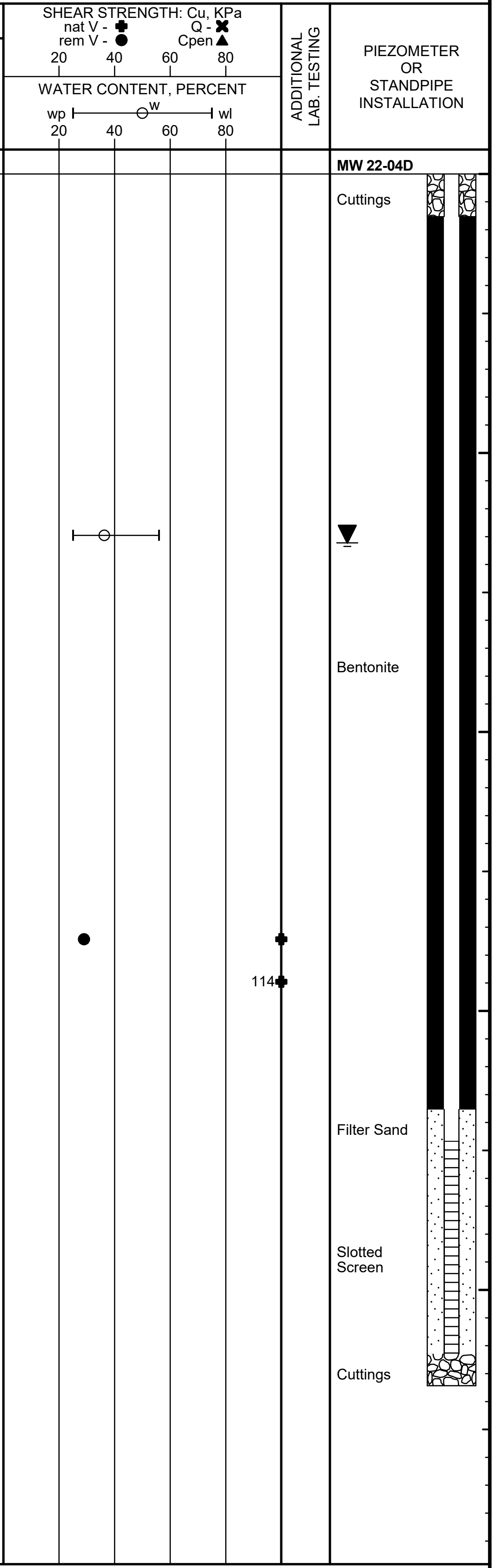
SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	53.0
SILTY CLAY, trace to with sand with organics brown moist **FILL**	0.0
(CH) CLAY grey-brown hard to very stiff moist	51.5 1.5
(CH) CLAY brown stiff to very stiff moist	49.2 3.8
(SM) SILTY SAND with gravel occasional cobbles and boulders grey-brown very dense wet **GLACIAL TILL**	46.8 6.2
End of Borehole, Auger Refusal	44.3 8.7

NUMBER	TYPE	BLOWS/0.3m
1	SS	13
2	SS	12
3	SS	17
4	SS	10
5	SS	5
6	SS	3
7	SS	3
8A/B	SS	8
9	SS	9
10	SS	33
11	SS	50/75mm

Monitoring Well 22-04D installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	2.3	50.6
2022-04-05	2.5	50.4



GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-04D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 856.3 E 189 055.5
STARTED : 2022 March 21
COMPLETED : 2022 March 21

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 WATER CONTENT, PERCENT wp ⊢ ○w ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		2022-05-25 2.6 50.1 **Hydraulic Conductivity:** Date: 2022-03-28 K (m/s): 2.9 x 10^{-6}									
11											
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-04S

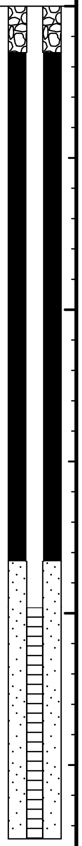
PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 856.3 E 189 056.7
STARTED : 2022 March 21
COMPLETED : 2022 March 21

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 WATER CONTENT, PERCENT wp ⊢ ○w ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		53.1							MW 22-04S
	Power Auger 210 mm Diam. Hollow Stem Auger	**See Record of Borehole 22-04D**		0.0							Cuttings ▼ Bentonite Filter Sand Slotted Screen
		End of Borehole		47.6 5.5							

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9



Monitoring Well 22-04S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.3	51.8
2022-04-05	1.0	52.1
2022-05-25	1.0	52.1

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

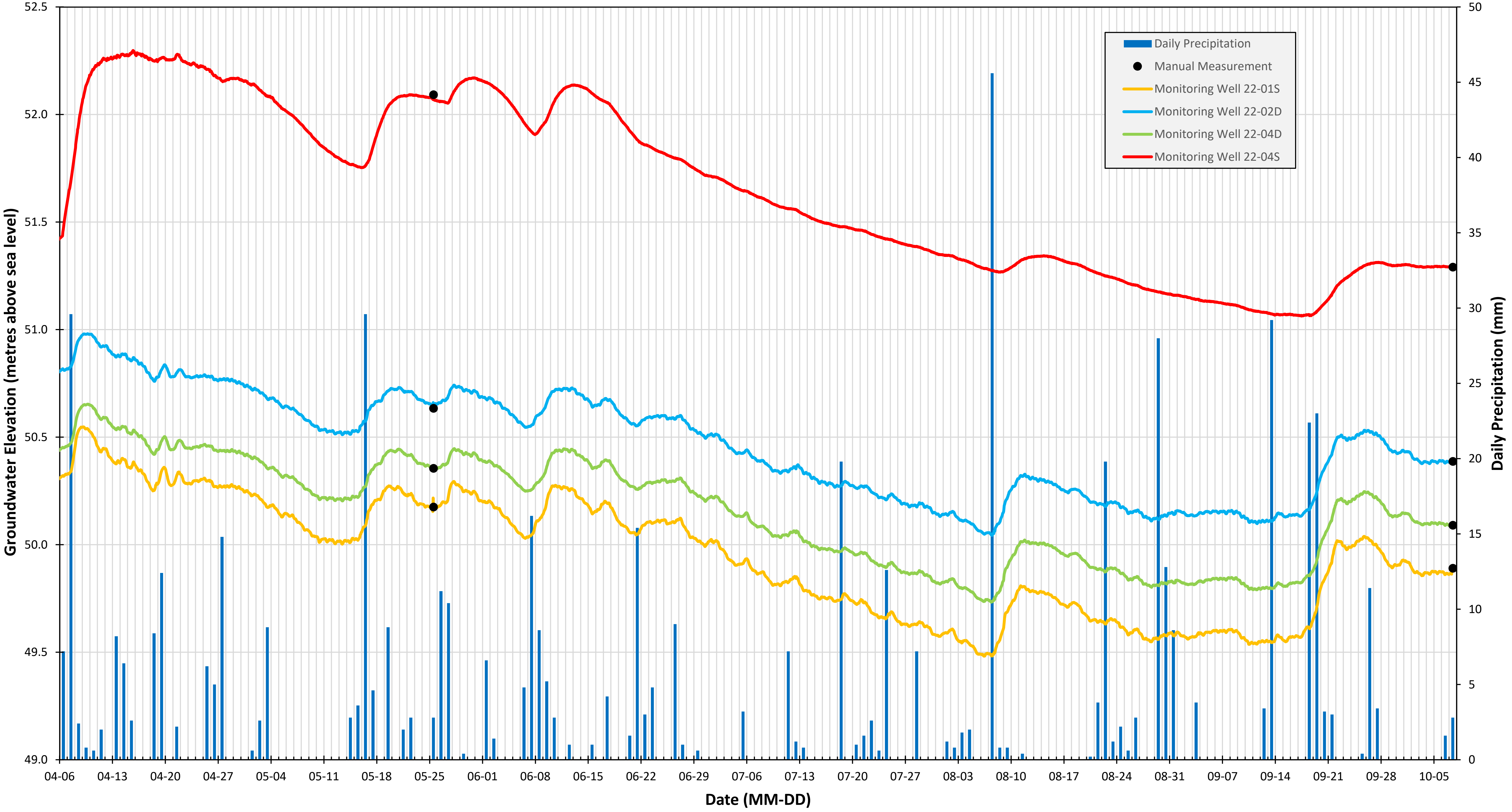
THURBER

Appendix D - Long-Term Monitoring Hydrograph

Class Environmental Assessment of the Plantagenet
Wastewater Collection and Treatment System
Plantagenet, Ontario
Thurber Project No. 32622

Long-Term Monitoring Hydrograph

April 6 to October 7, 2022



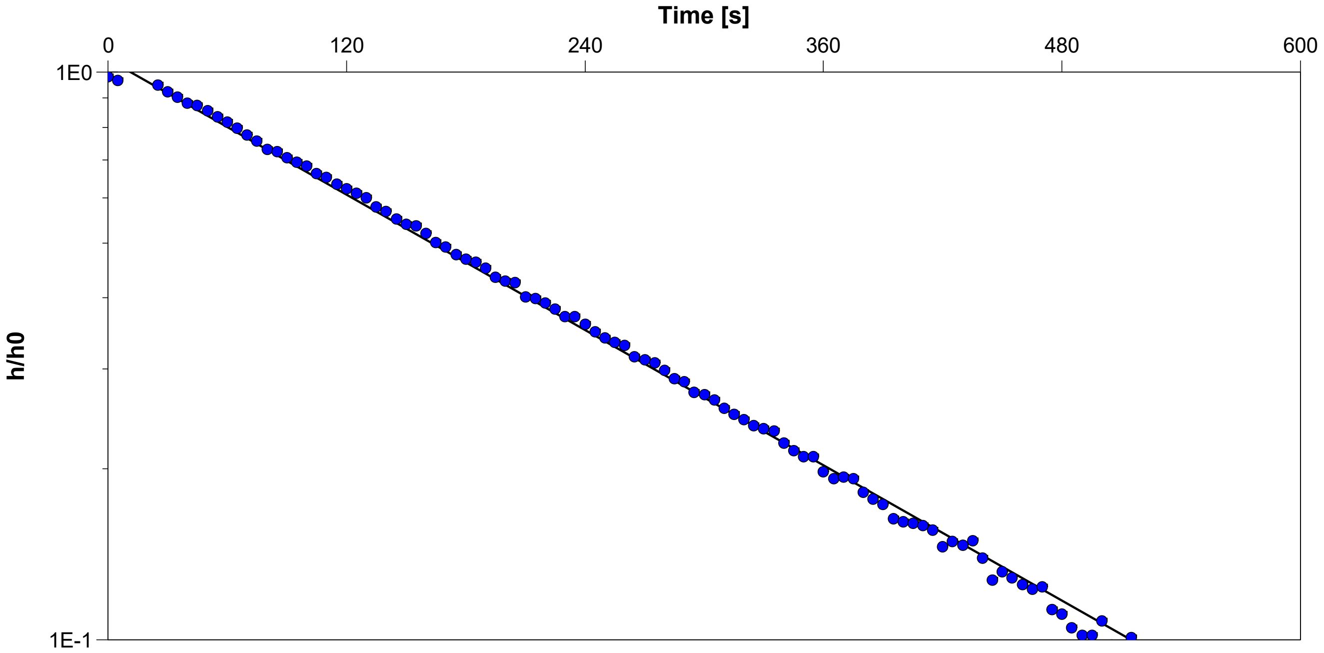
Prepared by SM

THURBER

Appendix E - Single Well Response Test Analyses

THURBER ENGINEERING LTD.	**Slug Test Analysis Report**
	Project: Plantagenet Class EA
	Number: 32622
	Client: J.L Richards and Associates Limited.

Location: Plantagenet, ON	Slug Test: 22-01S	Test Well: 22-01S
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: JM	22-01S SWRT Analysis	Analysis Date: 2022-04-07
Aquifer Thickness:		
Checked By: AH		



Calculation using Hvorslev

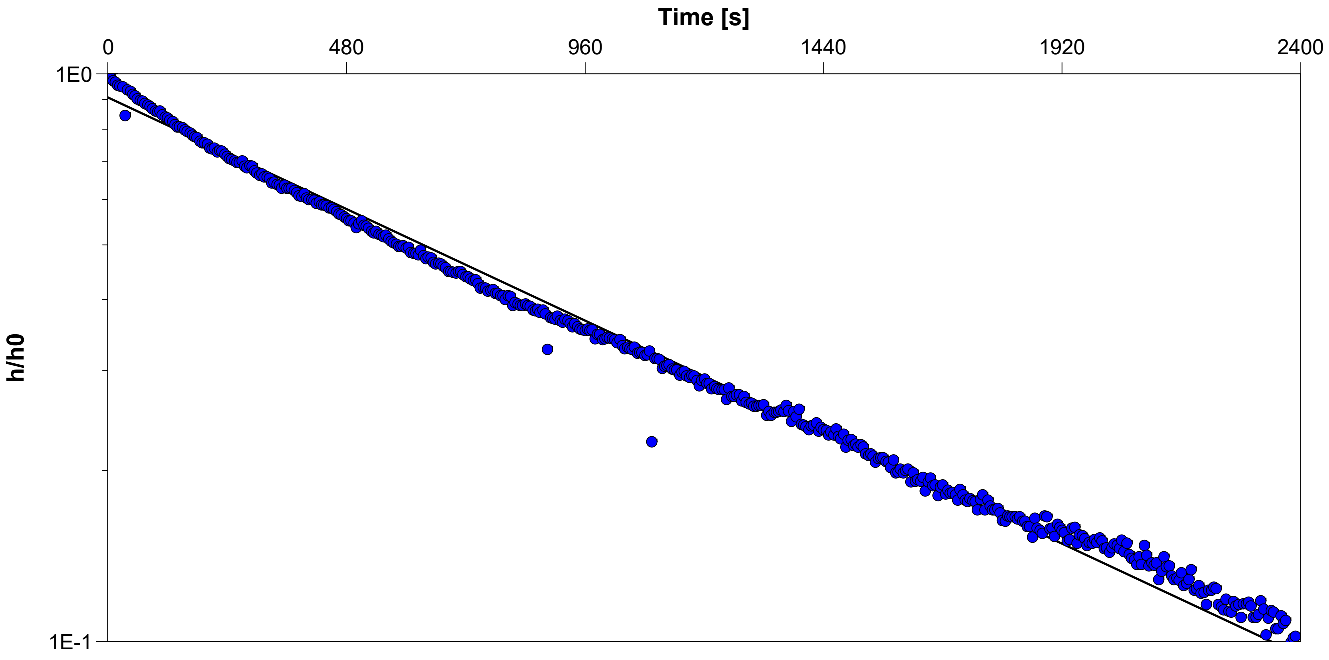
Observation Well	Hydraulic Conductivity [m/s]	
22-01S	4.0×10^{-6}	

THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project:	Plantagenet Class EA
Number:	32622
Client:	J.L Richards and Associates Limited.

Location: Plantagenet, ON	Slug Test: 22-02S	Test Well: 22-02S
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: JM	22-02S SWRT Analysis	Analysis Date: 2022-04-07
Aquifer Thickness:		
Checked By: AH		



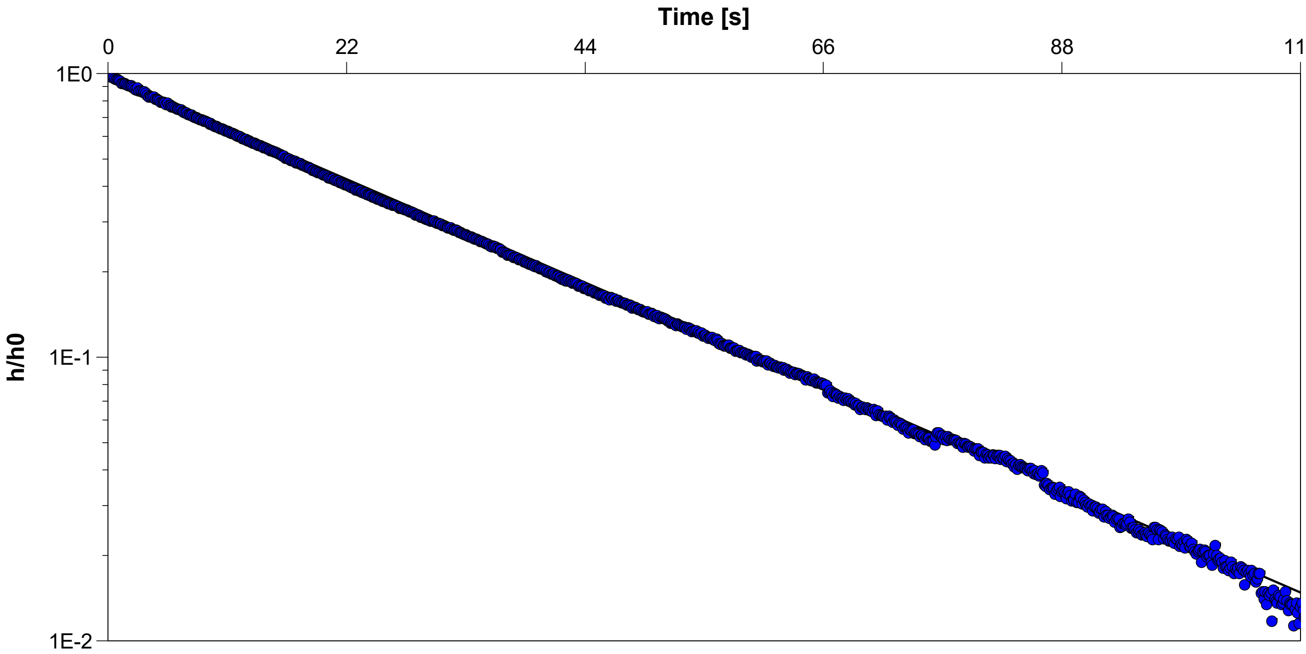
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-02S	4.8×10^{-7}	

THURBER ENGINEERING LTD.

Slug Test Analysis Report	
Project: Plantagenet Class EA	
Number: 32622	
Client: J.L Richards and Associates Limited.	

Location: Plantagenet, ON	Slug Test: 22-02D	Test Well: 22-02D
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: JM	22-02D SWRT Analysis	Analysis Date: 2022-04-07
Aquifer Thickness:		
Checked By: AH		



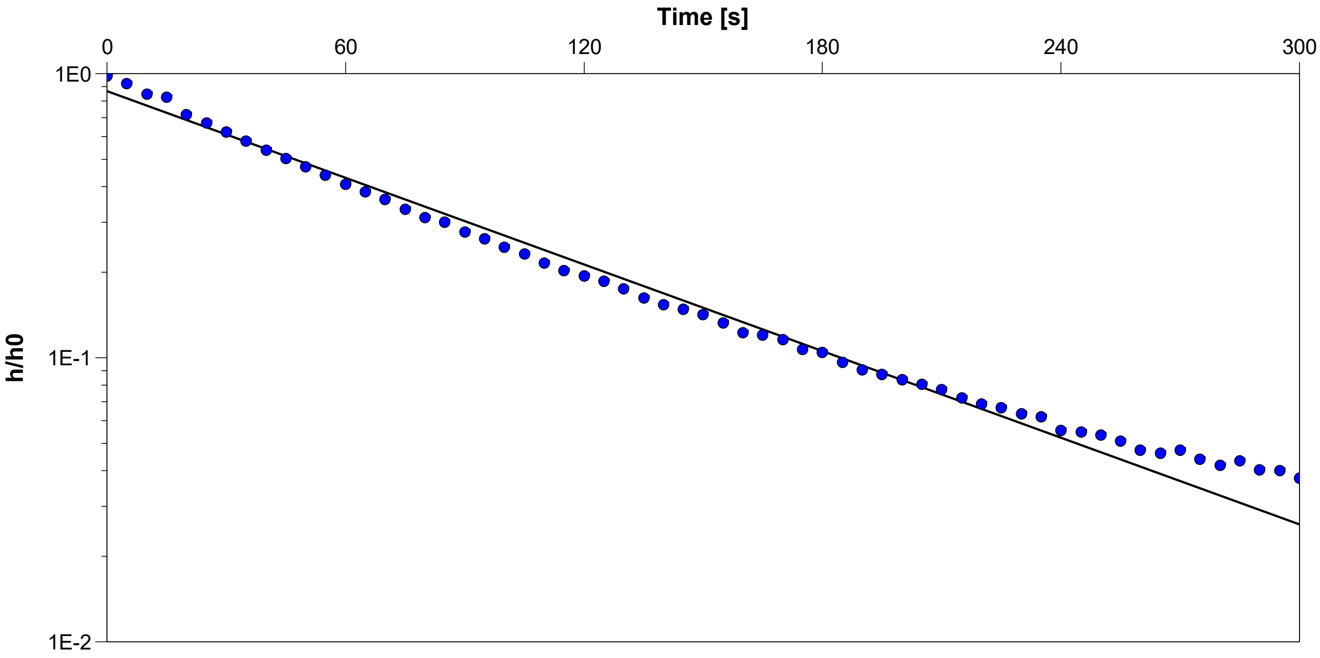
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-02D	3.3×10^{-5}	

THURBER ENGINEERING LTD.

Slug Test Analysis Report	
Project:	Plantagenet Class EA
Number:	32622
Client:	J.L Richards and Associates Limited.

Location: Plantagenet, ON	Slug Test: 22-03S	Test Well: 22-03S
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: JM	22-03S SWRT Analysis	Analysis Date: 2022-04-07
Aquifer Thickness:		
Checked by: AH		

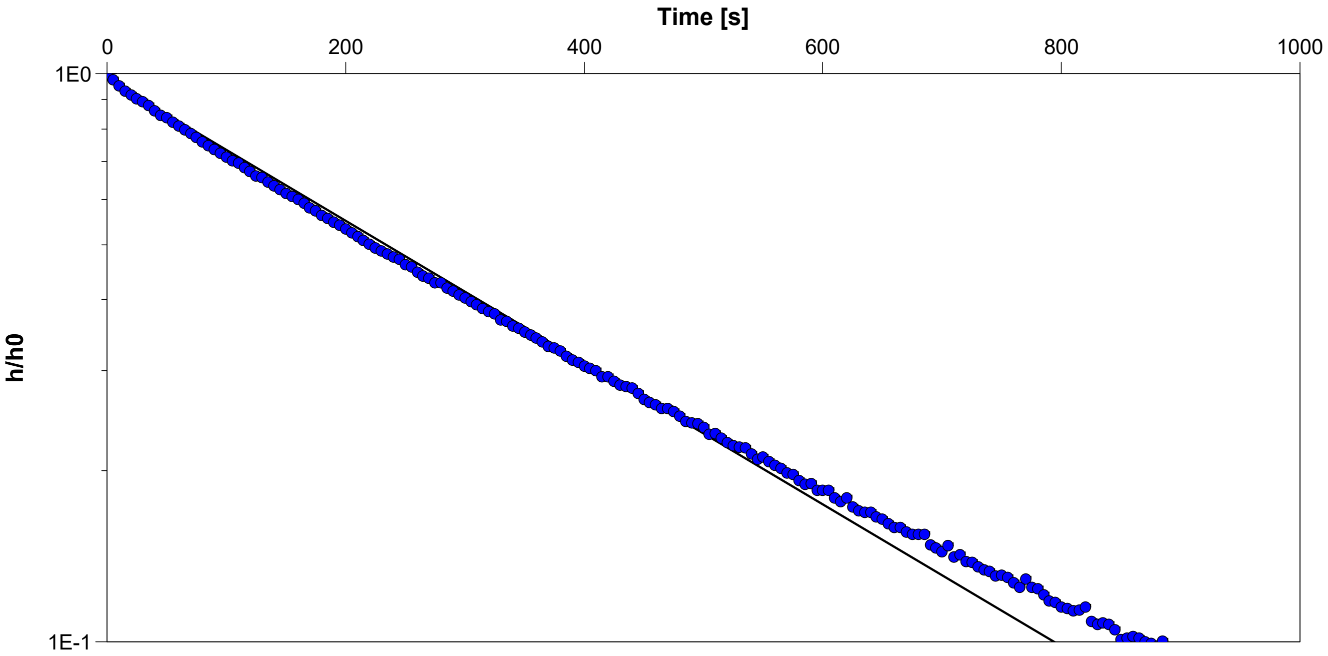


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-03S	1.0×10^{-5}	

THURBER ENGINEERING LTD.	**Slug Test Analysis Report**
	Project: Plantagenet Class EA
	Number: 32622
	Client: J.L Richards and Associates Limited.

Location: Plantagenet, ON	Slug Test: 22-03D	Test Well: 22-03D
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: JM	22-03D SWRT Analysis	Analysis Date: 2022-04-07
Aquifer Thickness:		
Checked by: AH		

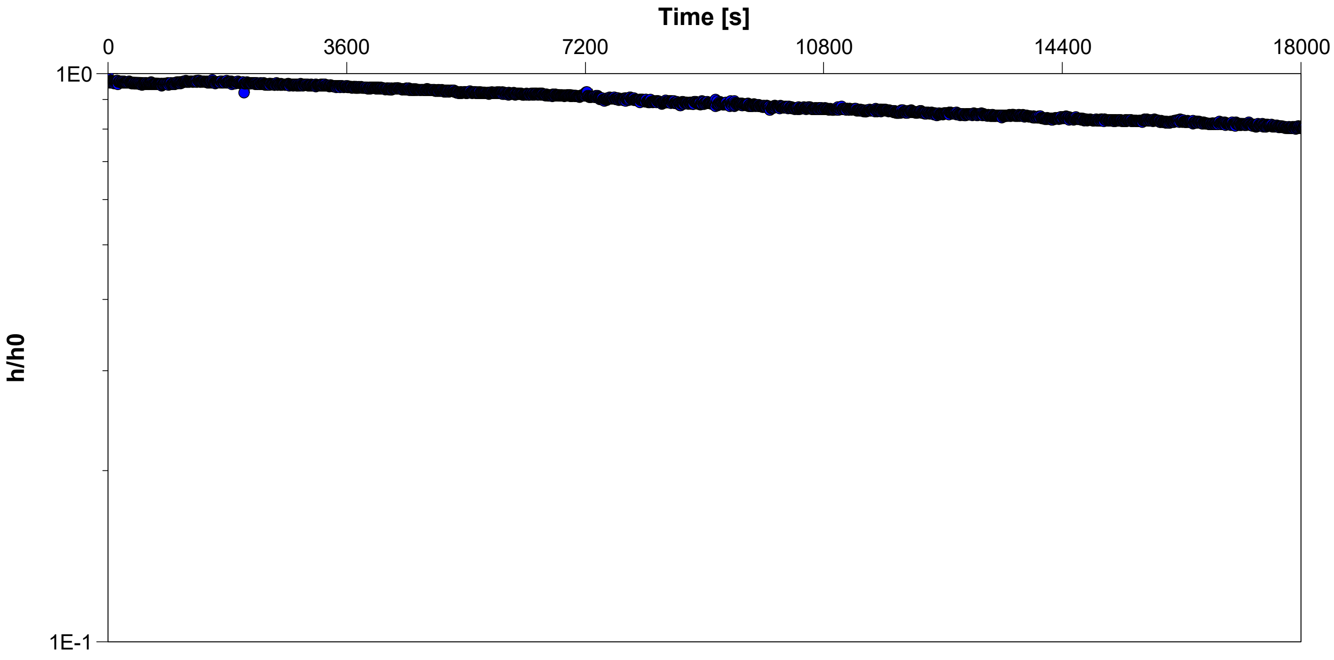


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-03D	2.5×10^{-6}	

THURBER ENGINEERING LTD.	**Slug Test Analysis Report**
	Project: Plantagenet Class EA
	Number: 32622
	Client: J.L Richards and Associates Limited.

Location: Plantagenet, ON	Slug Test: 22-04S	Test Well: 22-04S
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: SM	22-04S SWRT Analysis	Analysis Date: 2022-07-13
Aquifer Thickness:		
Checked by: DH		

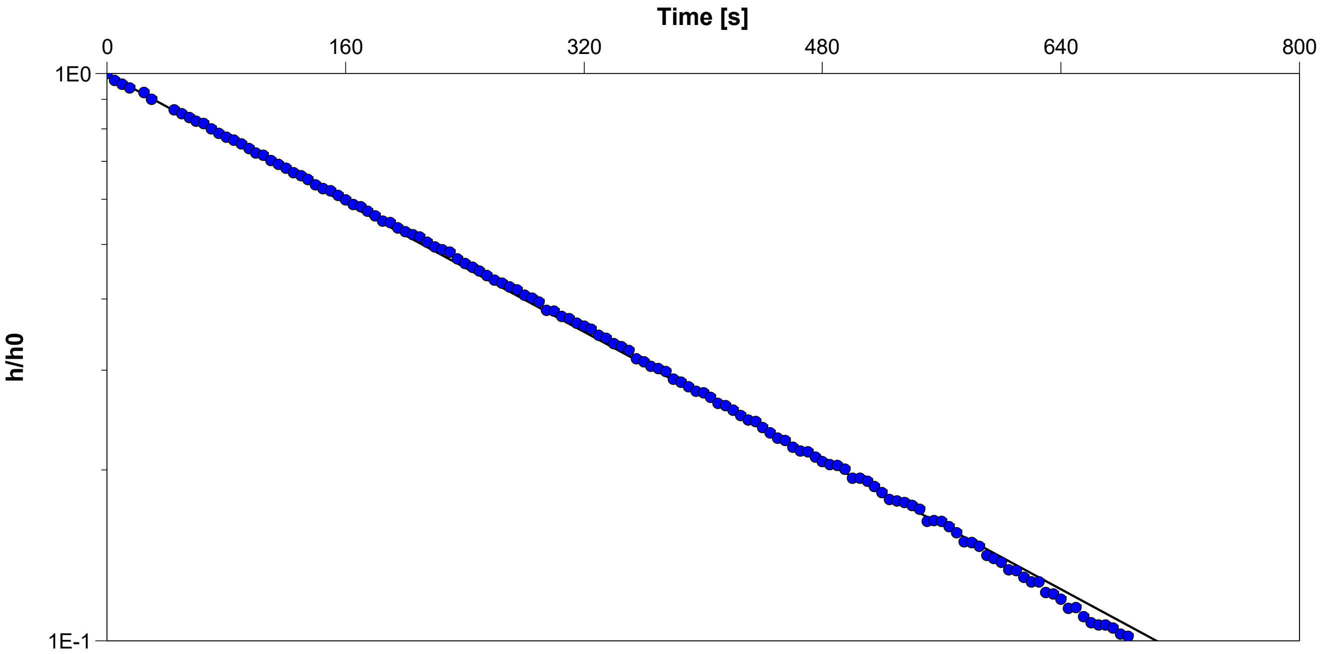


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-04S	1.0×10^{-8}	

THURBER ENGINEERING LTD.	**Slug Test Analysis Report**
	Project: Plantagenet Class EA
	Number: 32622
	Client: J.L Richards and Associates Limited.

Location: Plantagenet, ON	Slug Test: 22-04D	Test Well: 22-04D
Test Conducted by: SM		Test Date: 2022-03-28
Analysis Performed by: JM	22-04D SWRT Analysis	Analysis Date: 2022-04-07
Aquifer Thickness:		
Checked by: AH		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
22-04D	2.9×10^{-6}	

THURBER

Appendix F - Laboratory Certificate of Analysis

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: THURBER
2460 LANCASTER ROAD
OTTAWA, ON K1B4S5
(613) 247-2121
ATTENTION TO: Sarah Harrold
PROJECT: Plantagenet Hydrogeological
AGAT WORK ORDER: 22Z881153
MICROBIOLOGY ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer
WATER ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer
DATE REPORTED: Apr 12, 2022
PAGES (INCLUDING COVER): 15
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22Z881153
PROJECT: Plantagenet Hydrogeological

CLIENT NAME: THURBER
ATTENTION TO: Sarah Harrold
SAMPLING SITE:
SAMPLED BY:

Total Coliforms & E. Coli (Using MI Agar)

DATE RECEIVED: 2022-04-05
DATE REPORTED: 2022-04-12

			SAMPLE DESCRIPTION:	22-01	22-02 S	22-02 D	22-03 S	22-03 D	22-04 S	22-04 D	Lagoon
			SAMPLE TYPE:	Water	Water	Water	Water	Water	Water	Water	Water
			DATE SAMPLED:	2022-04-05 09:25	2022-04-05 10:15	2022-04-05 10:30	2022-04-05 08:30	2022-04-05 08:50	2022-04-05 11:30	2022-04-05 11:20	2022-04-05 12:30
Parameter	Unit	G / S	RDL	3717696	3718301	3718302	3718303	3718304	3718305	3718307	3718308
Escherichia coli	CFU/100mL	0		0	0	0	0	0	0	0	11800
Total Coliforms	CFU/100mL	0		11	156	28	6	0	1	128	22400

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to O. Reg 169/03 - Ontario Drinking Water Quality Standards. Na value derived from O. Reg 248
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3717696-3718307 Escherichia coli, Total Coliforms RDL = 1 CFU/100mL.

3718308 Escherichia coli, Total Coliforms RDL = 100 CFU/100mL.
RDL > 1 indicates dilutions of the sample.

Analysis performed at AGAT Toronto (unless marked by *)

NIVINE BASILY

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 22Z881153
PROJECT: Plantagenet Hydrogeological

CLIENT NAME: THURBER
SAMPLING SITE:

ATTENTION TO: Sarah Harrold
SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2022-04-05

DATE REPORTED: 2022-04-12

				SAMPLE DESCRIPTION:	22-01		22-02 S		22-02 D		22-03 S
				SAMPLE TYPE:	Water		Water		Water		Water
				DATE SAMPLED:	2022-04-05 09:25		2022-04-05 10:15		2022-04-05 10:30		2022-04-05 08:30
Parameter	Unit	G / S: A	G / S: B	RDL	3717696	RDL	3718301	RDL	3718302	RDL	3718303
Electrical Conductivity	µS/cm			2	869	2	695	2	804	2	631
pH	pH Units		6.5-8.5	NA	7.96	NA	7.52	NA	7.99	NA	7.88
Saturation pH (Calculated)					6.80		6.80		7.13		6.93
Langelier Index (Calculated)					1.16		0.719		0.863		0.954
Hardness (as CaCO3) (Calculated)	mg/L		80-100	0.5	326	0.5	349	0.5	196	0.5	318
Total Dissolved Solids	mg/L		500	10	460[<B]	10	392[<B]	10	430[<B]	10	362[<B]
Alkalinity (as CaCO3)	mg/L		30-500	5	351	5	328	5	276	5	270
Bicarbonate (as CaCO3)	mg/L			5	351	5	328	5	276	5	270
Carbonate (as CaCO3)	mg/L			5	<5	5	<5	5	<5	5	<5
Hydroxide (as CaCO3)	mg/L			5	<5	5	<5	5	<5	5	<5
Fluoride	mg/L	1.5		0.05	0.54[<A]	0.05	<0.05[<A]	0.05	0.44[<A]	0.05	0.35[<A]
Chloride	mg/L		250	0.12	84.2[<B]	0.10	21.0[<B]	0.12	97.0[<B]	0.10	8.96[<B]
Nitrate as N	mg/L	10.0		0.05	0.17[<A]	0.05	1.66[<A]	0.05	0.29[<A]	0.05	0.08[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05[<A]	0.05	<0.05[<A]	0.05	<0.05[<A]	0.05	<0.05[<A]
Bromide	mg/L			0.05	<0.05	0.05	<0.05	0.05	<0.05	0.05	<0.05
Sulphate	mg/L		500	0.10	17.8[<B]	0.10	26.9[<B]	0.10	14.3[<B]	0.10	80.2[<B]
Ortho Phosphate as P	mg/L			0.10	0.14	0.10	<0.10	0.10	<0.10	0.10	<0.10
Ammonia as N	mg/L			0.02	0.32	0.02	0.20	0.02	0.19	0.02	0.09
Total Phosphorus	mg/L			0.02	0.22	0.02	0.05	0.02	0.18	0.02	0.05
Total Organic Carbon	mg/L			0.5	4.4	0.5	6.9	0.5	4.0	0.5	2.3
True Colour	TCU		5	5	7[>B]	5	7[>B]	5	9[>B]	5	<5[<B]
Turbidity	NTU		5	0.5	0.5[<B]	0.5	0.9[<B]	0.5	2.2[<B]	0.5	1.2[<B]
Total Calcium	mg/L			0.32	60.6	0.32	78.9	0.32	33.5	0.32	70.7
Total Magnesium	mg/L			0.34	42.3	0.34	36.9	0.34	27.3	0.34	34.4
Total Potassium	mg/L			1.15	8.10	1.15	3.42	1.15	7.61	1.15	3.36
Total Sodium	mg/L	20	200	0.45	69.6[A-B]	0.45	30.6[A-B]	0.45	109[A-B]	0.45	27.3[A-B]
Total Aluminum	mg/L		0.1	0.010	0.088[<B]	0.010	0.401[>B]	0.010	0.167[>B]	0.010	0.031[<B]
Total Antimony	mg/L	0.006		0.003	<0.003[<A]	0.003	<0.003[<A]	0.003	<0.003[<A]	0.003	<0.003[<A]
Total Arsenic	mg/L	0.01		0.003	<0.003[<A]	0.003	<0.003[<A]	0.003	<0.003[<A]	0.003	<0.003[<A]

Certified By:

NIVINE BASILY

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 22Z881153

PROJECT: Plantagenet Hydrogeological

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: THURBER

ATTENTION TO: Sarah Harrold

SAMPLING SITE:

SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2022-04-05

DATE REPORTED: 2022-04-12

				SAMPLE DESCRIPTION:	22-01		22-02 S		22-02 D		22-03 S
				SAMPLE TYPE:	Water		Water		Water		Water
				DATE SAMPLED:	2022-04-05 09:25		2022-04-05 10:15		2022-04-05 10:30		2022-04-05 08:30
Parameter	Unit	G / S: A	G / S: B	RDL	3717696	RDL	3718301	RDL	3718302	RDL	3718303
Total Barium	mg/L	1.0		0.002	0.700[<A]	0.002	0.078[<A]	0.002	0.151[<A]	0.002	0.087[<A]
Total Beryllium	mg/L			0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001
Total Boron	mg/L	5.0		0.010	0.224[<A]	0.010	0.038[<A]	0.010	0.262[<A]	0.010	0.030[<A]
Total Cadmium	mg/L	0.005		0.001	<0.001[<A]	0.001	<0.001[<A]	0.001	<0.001[<A]	0.001	<0.001[<A]
Total Chromium	mg/L	0.05		0.003	<0.003[<A]	0.003	<0.003[<A]	0.003	<0.003[<A]	0.003	<0.003[<A]
Total Cobalt	mg/L			0.001	<0.001	0.001	0.001	0.001	<0.001	0.001	<0.001
Total Copper	mg/L		1	0.003	<0.003[<B]	0.003	<0.003[<B]	0.003	<0.003[<B]	0.003	<0.003[<B]
Total Iron	mg/L		0.3	0.010	0.092[<B]	0.010	0.378[>B]	0.010	0.172[<B]	0.010	0.129[<B]
Total Lead	mg/L	0.010		0.001	<0.001[<A]	0.001	<0.001[<A]	0.001	<0.001[<A]	0.001	<0.001[<A]
Total Manganese	mg/L		0.05	0.002	0.090[>B]	0.002	0.500[>B]	0.002	0.017[<B]	0.002	0.272[>B]
Total Mercury	mg/L	0.001		0.0001	<0.0001[<A]	0.0001	<0.0001[<A]	0.0001	<0.0001[<A]	0.0001	<0.0001[<A]
Total Molybdenum	mg/L			0.002	0.011	0.002	0.003	0.002	0.009	0.002	0.006
Total Nickel	mg/L			0.003	<0.003	0.003	<0.003	0.003	<0.003	0.003	<0.003
Total Selenium	mg/L	0.05		0.002	<0.002[<A]	0.002	<0.002[<A]	0.002	<0.002[<A]	0.002	<0.002[<A]
Total Silver	mg/L			0.002	<0.002	0.002	<0.002	0.002	<0.002	0.002	<0.002
Total Strontium	mg/L			0.005	1.71	0.005	0.380	0.005	1.47	0.005	0.939
Total Thallium	mg/L			0.006	<0.006	0.006	<0.006	0.006	<0.006	0.006	<0.006
Total Tin	mg/L			0.002	<0.002	0.002	0.004	0.002	0.007	0.002	<0.002
Total Titanium	mg/L			0.010	<0.010	0.010	0.027	0.010	<0.010	0.010	<0.010
Total Tungsten	mg/L			0.010	<0.010	0.010	<0.010	0.010	0.012	0.010	0.145
Total Uranium	mg/L	0.02		0.002	<0.002[<A]	0.002	0.003[<A]	0.002	<0.002[<A]	0.002	0.003[<A]
Total Vanadium	mg/L			0.002	<0.002	0.002	0.003	0.002	<0.002	0.002	<0.002
Total Zinc	mg/L		5	0.020	0.034[<B]	0.020	<0.020[<B]	0.020	<0.020[<B]	0.020	<0.020[<B]
Total Zirconium	mg/L			0.004	<0.004	0.004	<0.004	0.004	<0.004	0.004	<0.004

Certified By:

NIVINE BASILY

Certificate of Analysis

AGAT WORK ORDER: 22Z881153
PROJECT: Plantagenet Hydrogeological

CLIENT NAME: THURBER
SAMPLING SITE:

ATTENTION TO: Sarah Harrold
SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2022-04-05

DATE REPORTED: 2022-04-12

				SAMPLE DESCRIPTION:	22-03 D	22-04 S	22-04 D		Lagoon
				SAMPLE TYPE:	Water	Water	Water		Water
				DATE SAMPLED:	2022-04-05 08:50	2022-04-05 11:30	2022-04-05 11:20		2022-04-05 12:30
Parameter	Unit	G / S: A	G / S: B	RDL	3718304	3718305	3718307	RDL	3718308
Electrical Conductivity	µS/cm			2	639	534	721	2	1890
pH	pH Units		6.5-8.5	NA	8.19	7.74	8.05	NA	7.69
Saturation pH (Calculated)					7.37	7.18	6.98		7.29
Langelier Index (Calculated)					0.816	0.561	1.07		0.403
Hardness (as CaCO3) (Calculated)	mg/L		80-100	0.5	96.3	202	216	0.5	240
Total Dissolved Solids	mg/L		500	10	358[<B]	302[<B]	390[<B]	10	1110[>B]
Alkalinity (as CaCO3)	mg/L		30-500	5	318	238	350	5	171
Bicarbonate (as CaCO3)	mg/L			5	318	238	350	5	171
Carbonate (as CaCO3)	mg/L			5	<5	<5	<5	5	<5
Hydroxide (as CaCO3)	mg/L			5	<5	<5	<5	5	<5
Fluoride	mg/L	1.5		0.05	0.93[<A]	<0.05[<A]	0.36[<A]	0.05	<0.05[<A]
Chloride	mg/L		250	0.10	27.1[<B]	4.06[<B]	34.5[<B]	0.24	513[>B]
Nitrate as N	mg/L	10.0		0.05	0.09[<A]	0.66[<A]	0.23[<A]	0.07	<0.07[<A]
Nitrite as N	mg/L	1.0		0.05	<0.05[<A]	<0.05[<A]	<0.05[<A]	0.05	<0.05[<A]
Bromide	mg/L			0.05	<0.05	<0.05	<0.05	0.06	<0.06
Sulphate	mg/L		500	0.10	3.01[<B]	57.3[<B]	13.0[<B]	0.19	36.3[<B]
Ortho Phosphate as P	mg/L			0.10	0.34	<0.10	0.15	0.13	<0.13
Ammonia as N	mg/L			0.02	0.45	0.03	0.41	0.04	6.38
Total Phosphorus	mg/L			0.02	0.55	0.03	0.19	0.02	0.62
Total Organic Carbon	mg/L			0.5	5.1	6.8	6.0	0.5	27.8
True Colour	TCU		5	5	27[>B]	5[B]	11[>B]	5	30[>B]
Turbidity	NTU		5	0.5	10.2[>B]	4.3[<B]	2.0[<B]	0.5	10.2[>B]
Total Calcium	mg/L			0.32	9.69	47.0	34.7	0.32	73.7
Total Magnesium	mg/L			0.34	17.5	20.5	31.3	0.34	13.6
Total Potassium	mg/L			1.15	9.87	3.89	10.9	1.15	9.26
Total Sodium	mg/L	20	200	0.45	120[A-B]	51.5[A-B]	87.0[A-B]	0.45	272[>B]
Total Aluminum	mg/L		0.1	0.010	0.301[>B]	0.104[>B]	0.200[>B]	0.020	0.188[>B]
Total Antimony	mg/L	0.006		0.003	<0.003[<A]	<0.003[<A]	<0.003[<A]	0.006	<0.006[<A]
Total Arsenic	mg/L	0.01		0.003	<0.003[<A]	<0.003[<A]	<0.003[<A]	0.006	<0.006[<A]

Certified By:

NIVINE BASILY

Certificate of Analysis

AGAT WORK ORDER: 22Z881153
PROJECT: Plantagenet Hydrogeological

CLIENT NAME: THURBER
SAMPLING SITE:

ATTENTION TO: Sarah Harrold
SAMPLED BY:

Water Quality Assessment (mg/L)

DATE RECEIVED: 2022-04-05

DATE REPORTED: 2022-04-12

				SAMPLE DESCRIPTION:	22-03 D	22-04 S	22-04 D		Lagoon
				SAMPLE TYPE:	Water	Water	Water		Water
				DATE SAMPLED:	2022-04-05 08:50	2022-04-05 11:30	2022-04-05 11:20		2022-04-05 12:30
Parameter	Unit	G / S: A	G / S: B	RDL	3718304	3718305	3718307	RDL	3718308
Total Barium	mg/L	1.0		0.002	0.157[<A]	0.069[<A]	0.443[<A]	0.004	0.050[<A]
Total Beryllium	mg/L			0.001	<0.001	<0.001	<0.001	0.002	<0.002
Total Boron	mg/L	5.0		0.010	0.507[<A]	0.051[<A]	0.277[<A]	0.020	0.085[<A]
Total Cadmium	mg/L	0.005		0.001	<0.001[<A]	<0.001[<A]	<0.001[<A]	0.002	<0.002[<A]
Total Chromium	mg/L	0.05		0.003	<0.003[<A]	<0.003[<A]	<0.003[<A]	0.006	<0.006[<A]
Total Cobalt	mg/L			0.001	<0.001	<0.001	<0.001	0.002	<0.002
Total Copper	mg/L		1	0.003	<0.003[<B]	<0.003[<B]	<0.003[<B]	0.006	0.010[<B]
Total Iron	mg/L		0.3	0.010	0.247[<B]	0.095[<B]	0.231[<B]	0.020	0.282[<B]
Total Lead	mg/L	0.010		0.001	<0.001[<A]	<0.001[<A]	<0.001[<A]	0.002	<0.002[<A]
Total Manganese	mg/L		0.05	0.002	0.004[<B]	0.376[>B]	0.135[>B]	0.004	0.277[>B]
Total Mercury	mg/L	0.001		0.0001	<0.0001[<A]	<0.0001[<A]	<0.0001[<A]	0.0001	<0.0001[<A]
Total Molybdenum	mg/L			0.002	<0.002	0.012	0.008	0.004	<0.004
Total Nickel	mg/L			0.003	<0.003	<0.003	<0.003	0.006	<0.006
Total Selenium	mg/L	0.05		0.002	<0.002[<A]	<0.002[<A]	<0.002[<A]	0.004	<0.004[<A]
Total Silver	mg/L			0.002	<0.002	<0.002	<0.002	0.004	<0.004
Total Strontium	mg/L			0.005	1.73	0.238	0.951	0.010	0.490
Total Thallium	mg/L			0.006	<0.006	<0.006	<0.006	0.012	<0.012
Total Tin	mg/L			0.002	0.002	0.006	0.002	0.004	<0.004
Total Titanium	mg/L			0.010	0.020	<0.010	0.014	0.020	<0.020
Total Tungsten	mg/L			0.010	<0.010	<0.010	<0.010	0.020	<0.020
Total Uranium	mg/L	0.02		0.002	<0.002[<A]	<0.002[<A]	<0.002[<A]	0.004	<0.004[<A]
Total Vanadium	mg/L			0.002	0.002	<0.002	<0.002	0.004	<0.004
Total Zinc	mg/L		5	0.020	<0.020[<B]	<0.020[<B]	<0.020[<B]	0.040	0.112[<B]
Total Zirconium	mg/L			0.004	<0.004	<0.004	<0.004	0.008	<0.008

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to O. Reg 169/03 - Ontario Drinking Water Quality Standards. Na value derived from O. Reg 248, B Refers to O. Reg 169/03 - Ontario Drinking Water Quality Standards - Aesthetic Objectives and Operational Guidelines
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

3717696-3718308 Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
NIVINE BASILY
CHEMIST

Certified By:

Exceedance Summary

AGAT WORK ORDER: 22Z881153
PROJECT: Plantagenet Hydrogeological

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: THURBER
ATTENTION TO: Sarah Harrold

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3717696	22-01	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	326
3717696	22-01	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Manganese	mg/L	0.05	0.090
3717696	22-01	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	True Colour	TCU	5	7
3717696	22-01	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	11
3717696	22-01	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	69.6
3718301	22-02 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	349
3718301	22-02 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Aluminum	mg/L	0.1	0.401
3718301	22-02 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Iron	mg/L	0.3	0.378
3718301	22-02 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Manganese	mg/L	0.05	0.500
3718301	22-02 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	True Colour	TCU	5	7
3718301	22-02 S	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	156
3718301	22-02 S	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	30.6
3718302	22-02 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	196
3718302	22-02 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Aluminum	mg/L	0.1	0.167
3718302	22-02 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	True Colour	TCU	5	9
3718302	22-02 D	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	28
3718302	22-02 D	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	109
3718303	22-03 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	318
3718303	22-03 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Manganese	mg/L	0.05	0.272
3718303	22-03 S	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	6
3718303	22-03 S	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	27.3
3718304	22-03 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Aluminum	mg/L	0.1	0.301
3718304	22-03 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	True Colour	TCU	5	27
3718304	22-03 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Turbidity	NTU	5	10.2
3718304	22-03 D	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	120
3718305	22-04 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	202
3718305	22-04 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Aluminum	mg/L	0.1	0.104
3718305	22-04 S	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Manganese	mg/L	0.05	0.376
3718305	22-04 S	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	1
3718305	22-04 S	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	51.5
3718307	22-04 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	216
3718307	22-04 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Aluminum	mg/L	0.1	0.200
3718307	22-04 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Manganese	mg/L	0.05	0.135
3718307	22-04 D	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	True Colour	TCU	5	11
3718307	22-04 D	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	128
3718307	22-04 D	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	87.0
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Chloride	mg/L	250	513
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Hardness (as CaCO3) (Calculated)	mg/L	80-100	240
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Aluminum	mg/L	0.1	0.188
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Dissolved Solids	mg/L	500	1110
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Manganese	mg/L	0.05	0.277
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Total Sodium	mg/L	200	272
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	True Colour	TCU	5	30

AGAT Laboratories

Exceedance Summary

AGAT WORK ORDER: 22Z881153

PROJECT: Plantagenet Hydrogeological

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

CLIENT NAME: THURBER

ATTENTION TO: Sarah Harrold

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
3718308	Lagoon	ON 169/03 AO&OG	Water Quality Assessment (mg/L)	Turbidity	NTU	5	10.2
3718308	Lagoon	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Escherichia coli	CFU/100mL	0	11800
3718308	Lagoon	ON 169/03 MAC/IMAC	Total Coliforms & E. Coli (Using MI Agar)	Total Coliforms	CFU/100mL	0	22400
3718308	Lagoon	ON 169/03 MAC/IMAC	Water Quality Assessment (mg/L)	Total Sodium	mg/L	20	272

Quality Assurance

CLIENT NAME: THURBER
PROJECT: Plantagenet Hydrogeological
SAMPLING SITE:

AGAT WORK ORDER: 22Z881153
ATTENTION TO: Sarah Harrold
SAMPLED BY:

Microbiology Analysis

RPT Date: Apr 12, 2022			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
Total Coliforms & E. Coli (Using MI Agar)															
Escherichia coli	3717696	3717696	0	0	NA										
Total Coliforms	3717696	3717696	11	10	9.5%										

Comments: NA - % RPD Not Applicable.

Certified By:

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
NIVINE BASILY
CHEMIST

Nivine Basily

Quality Assurance

CLIENT NAME: THURBER
PROJECT: Plantagenet Hydrogeological
SAMPLING SITE:

AGAT WORK ORDER: 22Z881153
ATTENTION TO: Sarah Harrold
SAMPLED BY:

Water Analysis

RPT Date: Apr 12, 2022			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
Water Quality Assessment (mg/L)															
Electrical Conductivity	3717753		681	684	0.4%	< 2	97%	90%	110%						
pH	3717753		7.53	7.56	0.4%	NA	101%	90%	110%						
Total Dissolved Solids	3709167		398	404	1.5%	< 10	102%	80%	120%	NA			NA		
Alkalinity (as CaCO3)	3717753		98	103	4.2%	< 5	97%	80%	120%						
Bicarbonate (as CaCO3)	3717753		98	103	4.2%	< 5	NA								
Carbonate (as CaCO3)	3717753		<5	<5	NA	< 5	NA								
Hydroxide (as CaCO3)	3717753		<5	<5	NA	< 5	NA								
Fluoride	3718302	3718302	0.44	0.44	1.4%	< 0.05	100%	70%	130%	105%	80%	120%	106%	70%	130%
Chloride	3718302	3718302	97.0	97.3	0.3%	< 0.10	93%	70%	130%	106%	80%	120%	109%	70%	130%
Nitrate as N	3718302	3718302	0.29	0.27	8.2%	< 0.05	103%	70%	130%	106%	80%	120%	107%	70%	130%
Nitrite as N	3718302	3718302	<0.05	<0.05	NA	< 0.05	94%	70%	130%	96%	80%	120%	98%	70%	130%
Bromide	3718302	3718302	<0.05	<0.05	NA	< 0.05	102%	70%	130%	107%	80%	120%	107%	70%	130%
Sulphate	3718302	3718302	14.3	14.1	1.4%	< 0.10	98%	70%	130%	105%	80%	120%	104%	70%	130%
Ortho Phosphate as P	3718302	3718302	<0.10	<0.10	NA	< 0.10	92%	70%	130%	108%	80%	120%	104%	70%	130%
Ammonia as N	3718260		<0.02	<0.02	NA	< 0.02	115%	70%	130%	107%	80%	120%	101%	70%	130%
Total Phosphorus	3707935		0.03	0.03	NA	< 0.02	104%	70%	130%	103%	80%	120%	97%	70%	130%
Total Organic Carbon	3698993		6.9	6.6	5.4%	< 0.5	106%	90%	110%	103%	90%	110%	94%	80%	120%
True Colour	3698993		8	7	NA	< 5	106%	90%	110%	NA			NA		
Turbidity	3717696	3717696	0.5	0.5	NA	< 0.5	100%	80%	120%	NA			NA		
Total Calcium	3717696	3717696	60.6	62.0	2.4%	< 0.10	96%	70%	130%	94%	80%	120%	100%	70%	130%
Total Magnesium	3717696	3717696	42.3	43.1	2.0%	< 0.10	98%	70%	130%	96%	80%	120%	102%	70%	130%
Total Potassium	3717696	3717696	8.10	8.16	0.8%	< 0.50	97%	70%	130%	94%	80%	120%	100%	70%	130%
Total Sodium	3717696	3717696	69.6	71.1	2.0%	< 0.10	97%	70%	130%	95%	80%	120%	103%	70%	130%
Total Aluminum	3717696	3717696	0.088	0.078	12.6%	< 0.010	102%	70%	130%	112%	80%	120%	104%	70%	130%
Total Antimony	3717696	3717696	<0.003	<0.003	NA	< 0.003	100%	70%	130%	103%	80%	120%	105%	70%	130%
Total Arsenic	3717696	3717696	<0.003	<0.003	NA	< 0.003	102%	70%	130%	114%	80%	120%	111%	70%	130%
Total Barium	3717696	3717696	0.700	0.713	1.9%	< 0.002	97%	70%	130%	100%	80%	120%	102%	70%	130%
Total Beryllium	3717696	3717696	<0.001	<0.001	NA	< 0.001	101%	70%	130%	116%	80%	120%	107%	70%	130%
Total Boron	3717696	3717696	0.224	0.223	0.3%	< 0.010	104%	70%	130%	110%	80%	120%	110%	70%	130%
Total Cadmium	3717696	3717696	<0.001	<0.001	NA	< 0.001	100%	70%	130%	107%	80%	120%	106%	70%	130%
Total Chromium	3717696	3717696	<0.003	<0.003	NA	< 0.003	102%	70%	130%	106%	80%	120%	105%	70%	130%
Total Cobalt	3717696	3717696	<0.001	<0.001	NA	< 0.001	101%	70%	130%	109%	80%	120%	106%	70%	130%
Total Copper	3717696	3717696	<0.003	<0.003	NA	< 0.003	99%	70%	130%	105%	80%	120%	105%	70%	130%
Total Iron	3717696	3717696	0.092	0.083	10.4%	< 0.010	101%	70%	130%	108%	80%	120%	104%	70%	130%
Total Lead	3717696	3717696	<0.001	<0.001	NA	< 0.001	101%	70%	130%	109%	80%	120%	99%	70%	130%
Total Manganese	3717696	3717696	0.090	0.089	1.6%	< 0.002	102%	70%	130%	110%	80%	120%	105%	70%	130%
Total Mercury	3717696	3717696	<0.0001	<0.0001	NA	< 0.0001	99%	70%	130%	100%	80%	120%	98%	70%	130%
Total Molybdenum	3717696	3717696	0.011	0.012	7.9%	< 0.002	103%	70%	130%	108%	80%	120%	109%	70%	130%
Total Nickel	3717696	3717696	<0.003	<0.003	NA	< 0.003	102%	70%	130%	109%	80%	120%	101%	70%	130%

Quality Assurance

CLIENT NAME: THURBER
PROJECT: Plantagenet Hydrogeological
SAMPLING SITE:

AGAT WORK ORDER: 22Z881153
ATTENTION TO: Sarah Harrold
SAMPLED BY:

Water Analysis (Continued)

RPT Date: Apr 12, 2022			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
Total Selenium	3717696	3717696	<0.002	<0.002	NA	< 0.002	110%	70%	130%	117%	80%	120%	112%	70%	130%
Total Silver	3717696	3717696	<0.002	<0.002	NA	< 0.002	100%	70%	130%	108%	80%	120%	102%	70%	130%
Total Strontium	3717696	3717696	1.71	1.69	1.2%	< 0.005	100%	70%	130%	108%	80%	120%	102%	70%	130%
Total Thallium	3717696	3717696	<0.006	<0.006	NA	< 0.006	97%	70%	130%	113%	80%	120%	105%	70%	130%
Total Tin	3717696	3717696	<0.002	<0.002	NA	< 0.002	104%	70%	130%	113%	80%	120%	105%	70%	130%
Total Titanium	3717696	3717696	<0.010	<0.010	NA	< 0.010	101%	70%	130%	114%	80%	120%	102%	70%	130%
Total Tungsten	3717696	3717696	<0.010	<0.010	NA	< 0.010	89%	70%	130%	85%	80%	120%	85%	70%	130%
Total Uranium	3717696	3717696	<0.002	<0.002	NA	< 0.002	95%	70%	130%	111%	80%	120%	105%	70%	130%
Total Vanadium	3717696	3717696	<0.002	<0.002	NA	< 0.002	104%	70%	130%	109%	80%	120%	108%	70%	130%
Total Zinc	3717696	3717696	0.034	0.038	NA	< 0.020	99%	70%	130%	107%	80%	120%	100%	70%	130%
Total Zirconium	3717696	3717696	<0.004	<0.004	NA	< 0.004	99%	70%	130%	106%	80%	120%	105%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate NA: results are under 5X the RDL and will not be calculated.

Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

Water Quality Assessment (mg/L)

Electrical Conductivity	3718301	3718301	695	695	0%	< 2	98%	90%	110%	NA			NA		
pH	3718301	3718301	7.52	7.61	1.2%		103%	90%	110%	NA			NA		
Alkalinity (as CaCO3)	3718301	3718301	328	337	2.7%	< 5	98%	80%	120%	NA			NA		
Bicarbonate (as CaCO3)	3718301	3718301	328	337	2.7%	< 5	NA			NA			NA		
Carbonate (as CaCO3)	3718301	3718301	<5	<5	NA	< 5	NA			NA			NA		
Hydroxide (as CaCO3)	3718301	3718301	<5	<5	NA	< 5	NA			NA			NA		
Total Phosphorus	3718305	3718305	0.03	0.02	NA	< 0.02	104%	70%	130%	101%	80%	120%	101%	70%	130%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

CHARTERED
NIVINE BASILY
CHEMIST

Certified By: NBasily

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: THURBER

PROJECT: Plantagenet Hydrogeological

SAMPLING SITE:

AGAT WORK ORDER: 22Z881153

ATTENTION TO: Sarah Harrold

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Total Coliforms	MIC-93-7010	EPA 1604	Membrane Filtration

Method Summary

CLIENT NAME: THURBER
PROJECT: Plantagenet Hydrogeological
SAMPLING SITE:

AGAT WORK ORDER: 22Z881153
ATTENTION TO: Sarah Harrold
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Electrical Conductivity	INOR-93-6000	modified from SM 2510 B	PC TITRATE
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Saturation pH (Calculated)		SM 2320 B	CALCULATION
Langelier Index (Calculated)		SM 2330B	CALCULATION
Hardness (as CaCO3) (Calculated)	MET-93-6105	modified from EPA SW-846 6010C & 200.7 & SM 2340 B	CALCULATION
Total Dissolved Solids	INOR-93-6028	modified from EPA 1684,ON MOECC E3139,SM 2540C,D	BALANCE
Alkalinity (as CaCO3)	INOR-93-6000	Modified from SM 2320 B	PC TITRATE
Bicarbonate (as CaCO3)	INOR-93-6000	modified from SM 2320 B	PC TITRATE
Carbonate (as CaCO3)	INOR-93-6000	modified from SM 2320 B	PC TITRATE
Hydroxide (as CaCO3)	INOR-93-6000	modified from SM 2320 B	PC TITRATE
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Nitrate as N	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Nitrite as N	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Bromide	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Ortho Phosphate as P	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Ammonia as N	INOR-93-6059	modified from SM 4500-NH3 H	LACHAT FIA
Total Phosphorus	INOR-93-6057	modified from LACHAT 10-115-01-3A	LACHAT FIA
Total Organic Carbon	INOR-93-6049	modified from SM 5310 B	SHIMADZU CARBON ANALYZER
True Colour	INOR-93-6074	modified from SM 2120 B	LACHAT FIA
Turbidity	INOR-93-6044	modified from SM 2130 B	NEPHELOMETER
Total Calcium	MET-93-6105	modified from EPA 6010D	ICP/OES
Total Magnesium	MET-93-6105	modified from EPA 6010D	ICP/OES
Total Potassium	MET-93-6105	modified from EPA 6010D	ICP/OES
Total Sodium	MET-93-6105	modified from EPA 6010D	ICP/OES
Total Aluminum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Antimony	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Arsenic	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Barium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Beryllium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Boron	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cadmium	MET -93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Chromium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cobalt	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Copper	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Iron	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Lead	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

Method Summary

CLIENT NAME: THURBER
AGAT WORK ORDER: 22Z881153
PROJECT: Plantagenet Hydrogeological
ATTENTION TO: Sarah Harrold
SAMPLING SITE:
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Manganese	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Mercury	MET-93-6100	modified from EPA 245.2 and SM 3112 B	CVAAS
Total Molybdenum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Nickel	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Selenium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Silver	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Strontium	INOR-93-6003	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Thallium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Tin	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Titanium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Tungsten	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Uranium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Vanadium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zinc	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zirconium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

AGAT Laboratories

LT 1Blk 1 Med Bluefire packs & free ice.
1.5.3 / 5.7 / 4.8
2.2.5 / 2.7 / 0.4

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Laboratory Use Only

Work Order #: 22T881153

Cooler Quantity: Two-free ice

Arrival Temperatures: ① 6.9 | 7.0 | 7.1
② 4.4 | 4.3 | 4.4

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 consumed by humans)

Report Information:

Company: Thurber Engineering Ltd.
Contact: Sarah harrold
Address: 104-2460 Lancaster Rd
Ottawa, ON, K1B 4S5
Phone: 613-247-2121 Fax:
Reports to be sent to:
1. Email: sharrold@thurber.ca
2. Email:

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table ____ *Indicate One*
☐Ind/Com
☐Res/Park
☐Agriculture
Soil Texture *(Check One)*
☐Coarse
☐Fine

☐ Excess Soils R406
Table ____ *Indicate One*
☐ Regulation 558
☐ CCME

☐ Sewer Use
☐Sanitary ☐Storm
____ *Region*
☑ 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 ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: Plantagenet Hydrogeological
Site Location: Plantagenet, ON
Sampled By: SH
AGAT Quote #: PO: 32622

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

							O. Reg 153						O. Reg 558	O. Reg 406										
Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y [✓ N]	Metals & Inorganics	Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	BTEX, F1-F4 PHCs Analyze F4G if required ☐ Yes ☐ No	PAHs	PCBs	VOC	Landfill Disposal Characterization TCLP: TCLP: ☐M&I ☐VOCs ☐ABNs ☐B(a)P ☐PCBs	Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	Water Quality Ass. Reg.	E. Coli	Total Coliform					Potentially Hazardous or High Concentration (Y/N)
22-01	Apr 5/22	9:25 AM	9	GW													x	x	x					
22-02 S		10:15 AM															x	x	x					
22-02 D		10:30 AM															x	x	x					
22-03 S		8:30 AM															x	x	x					
22-03 D		8:50 AM															x	x	x					
22-04 S		11:30 AM															x	x	x					
22-04 D		11:20 AM															x	x	x					
Lagoon		12:30 PM															x	x	x					
		AM PM																						
		AM PM																						
		AM PM																						

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Sarah Harrold	Apr 5/22	2:45 PM	C. Griffith	05/04/22	14h45
CC to Purolator	05/04/22	16h00	Neil Ramnaraign	April 6/22	9:06 AM

Page ____ of ____

Nº: T 131927

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Appendix B3

Geotechnical Desktop Study Report (Thurber, 2022)

THURBER ENGINEERING LTD.

November 10, 2022 File: 32622

Jordan Morrissette, P. Eng.,
J.L. Richards & Associates Limited
jmorrissette@jlrichards.ca

GEOTECHNICAL DESKTOP STUDY
CLASS ENVIRONMENTAL ASSESSMENT OF THE PLANTAGENET WASTEWATER COLLECTION AND TREATMNET SYSTEM
PLANTAGENET, ONTARIO

Dear Mr. Morrissette:

The following letter presents a desktop geotechnical assessment carried out by Thurber Engineering Ltd. (Thurber) in support of the Class Environmental Assessment for a proposed expansion at the Plantagenet Wastewater Collection and Treatment System in Plantagenet, Ontario.

Thurber's scope of work for this assignment was outlined in a proposal dated August 13, 2021. Authorization to proceed with the work was provided by J.L. Richards & Associates Ltd. (J.L. Richards). Thurber also carried out a preliminary hydrogeological investigation for this project, the results of which are presented under separate cover.

This preliminary geotechnical assessment is based on a review of borehole data collected from the current and previous investigations. The interpreted subsurface conditions and available project details were used to prepare preliminary geotechnical engineering input for the Class Environmental Assessment (EA) stage of the project. It should be noted that additional investigations will be required for the detailed design stage of the project.

It is a condition of this report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations *and Conditions.*

1 PROJECT AND SITE DESCRIPTION

The Plantagenet Wastewater Collection and Treatment System was constructed in 1972 and services the Village of Plantagenet through the collection, treatment, and disposal of sanitary sewage to the South Nation River. The sewage treatment facility includes a facultative sewage lagoon, an inlet distribution box to the lagoon, an outlet chamber and a gravity outfall sewer discharging into the South Nation River.

It is understood that the sewage lagoon is operating beyond its design capacity and the Township of Alfred and Plantagenet is planning an expansion of the sewage lagoon to minimize extraneous flows from inflow and infiltration.

The existing sewage lagoon is located just south of Concession Road 5 and approximately 300 to 700 m east of Pitch Off Road. It is understood that the proposed expansion of the facility will likely be to the south of the existing lagoon with a base elevation in the range of approximately 51.3 m above sea level (asl). The general project area is shown on the Borehole Location Plan (Drawing 32622-1) provided in Attachment A.

The orientation of the Concession Road 5 and the lagoon is generally northeast to southwest; however, for project purposes they will be described as oriented east to west herein.

The topography within the study area varies from relatively flat expanses of agricultural land with drainage ditches to an elevated berm structure that encompasses the existing lagoon. At the borehole locations surveyed for this investigation, the ground surface elevations ranged from approximately 50.2 to 54.0 masl. Land use surrounding the project area is predominantly agricultural, with some residential dwellings and a commercial property to the west along Pitch Off Road.

2 REVIEW OF EXISTING INFORMATION

A hydrogeological investigation was previously carried out at the site by others. The results of the previous investigation are contained in the following report:

- Report prepared Jacques Whitford Environment Limited to McNeely Engineering Consultants Limited, titled “Hydrogeological Assessment, Sewage Treatment Lagoon Upgrade/Expansion, Plantagenet, Ontario”, dated April 4, 1995 (Project No. 30464).

Thirteen (13) boreholes from the previous investigation (94-1A, 94-1B, 94-2, 94-3A, 94-3B, 94-4, 94-5A, 94-5B, 94-6, 94-7A, 94-7B, 94-8, and 94-9) have been used to supplement the subsurface information collected from the current investigation.

The results of the current hydrogeological investigation are contained in the following report:

- Report prepared by Thurber to J.L. Richards & Associates Limited, titled “Draft Preliminary Hydrogeological Investigation Report, Class Environmental Assessment of the Plantagenet Wastewater Collection and Treatment System, Plantagenet, Ontario”, dated August 24, 2022 (File No. 32622).

The borehole data from the previous and current investigations were reviewed for this study and are attached to this letter for reference. The approximate location of the boreholes are shown on Drawing 32662-1 provided in Attachment A. The historic data has been provided for information purposes only.

3 OVERVIEW OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy from the current and previous hydrogeological investigation are presented on the Record of Borehole sheets provided in Attachment B. A general description of the stratigraphy based on the conditions encountered in the boreholes from the current investigation is given below. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond sampled locations.

Pertinent information from the previous investigation (e.g., water levels, depth to bedrock) is also presented below. The reader is referred to the attached borehole logs for additional information on the subsurface conditions encountered in the previous boreholes. It should be noted that the shallow subsurface conditions noted on the previous borehole logs may have been altered since the time they were drilled.

In general terms, the subsurface conditions encountered in the boreholes consist of topsoil and discontinuous fill overlying native deposits of marine clay and glacial till, which in turn overlie limestone bedrock.

A layer of topsoil consisting of silty clay with organics was encountered at the ground surface in Boreholes 22-01S and 22-03D/S, with thicknesses of approximately 250 mm and 75 mm, respectively. Fill materials were encountered in boreholes 22-02D/S and 22-04D/S. The fill materials were comprised of silty clay with organics and variable amounts of sand. The colour varied from grey-brown to brown, and SPT tests conducted gave N-values ranging from 7 to 13. The moisture contents of the fill materials ranged from 47 to 80%.

A native deposit of brown to grey-brown marine clay was encountered beneath the topsoil or fill in all boreholes. The clay deposit extends to depths ranging from approximately 1.4 to 7.3 m below the existing ground surface. SPT tests conducted in the clay gave N-values ranging from 3 to 23 blows, generally decreasing with depth. Field vane testing conducted within the lower clay gave undrained shear strengths ranging from approximately 100 to 114 kPa. These in situ testing results generally indicating a stiff to very stiff consistency. The moisture contents of the clay ranged from 29 to 58%. Atterberg Limit testing was completed on two samples of the clay.

The results of the Atterberg Limit testing are illustrated on Figure C1 in Attachment C as well as on the corresponding Record of Borehole sheets provided in Attachment B. The laboratory results indicate that the clay is of high plasticity (CH).

A deposit of glacial till was encountered beneath the marine clay in all boreholes. The thickness of the glacial till varied from approximately 0.2 m (Borehole 22-02D) to 8.4 m (Borehole 22-03D) before encountering bedrock at each location. The glacial till varied in composition from a cohesive sandy silty clay to a non-cohesive silty sand with gravel to gravelly sand. Cobbles and boulders were also identified within the glacial till. The colour varied from grey brown to grey, and SPT tests conducted in the glacial till gave N-values ranging from 4 to 86, indicating a loose to very dense consistency. The moisture contents of the glacial till ranged from 5 to 18%. The results of grain size distribution testing conducted on three samples of the glacial till are illustrated on Figure C2 in Attachment C as well as on the corresponding Record of Borehole sheets provided in Attachment B.

Boreholes 22-01S and 22-04D were terminated upon encountering practical refusal to auger advancement. The auger refusals encountered during the investigation may represent the bedrock surface; however, they could also represent the presence of a boulder within the glacial till. Boreholes 22-02D and 22-03D were cored into the bedrock upon encountering auger refusal. The bedrock encountered consisted of slightly weathered to fresh, fine grained, thinly to medium bedded, strong grey limestone. Photographs of the bedrock core are provided in Attachment C. The table below summarizes the depths and elevations of the bedrock surface encountered in the boreholes during the current and previous investigations.

Borehole	Ground Surface Elevation (m)	Depth to Bedrock (m)	Bedrock Surface Elevation (m)
22-01S	51.5	6.2$^{(A/R)}$	45.3$^{(A/R)}$
22-02D	54.0	7.5	46.5
22-03D	50.2	9.8	40.4
22-04D	53.0	8.7$^{(A/R)}$	44.3$^{(A/R)}$
94-1A	51.6	2.7	48.9
94-2	51.9	5.2	46.7
94-3A	53.7	5.2	48.5
94-4	53.0	7.7$^{(A/R)}$	45.3$^{(A/R)}$
94-5A	54.5	7.9	46.6
94-7A	51.5	4.9	46.6

Borehole	Ground Surface Elevation (m)	Depth to Bedrock (m)	Bedrock Surface Elevation (m)
94-8	51.8	5.2$^{(A/R)}$	46.6$^{(A/R)}$
94-9	53.8	8.4$^{(A/R)}$	45.4$^{(A/R)}$

Note: $^{(A/R)}$– Inferred bedrock surface based on auger refusal

Measured groundwater levels generally varied between 1.0 and 4.1 m below the ground surface. Further information on historic water level variations and hydraulic conductivity of the subsurface soils and bedrock is presented in the hydrogeological report, which is presented under separate cover.

4 PRELIMINARY ENGINEERING DISCUSSION

4.1 General

This section of the letter presents preliminary geotechnical engineering input in support of the Class EA study that is currently being undertaken by J.L. Richards for this project.

The preliminary input provided herein is based on the subsurface soil and groundwater conditions encountered during the investigation. It must be recognized that the information collected to date is limited and that the soil conditions will vary between and beyond the borehole locations. Additional geotechnical investigation will be required at the detailed design stage once additional design information is available. This document should not be used to support the tendering of the project.

4.2 Seismic Considerations

4.2.1 Spectral and Peak Acceleration Hazard Values

The seismic hazard data for the OBC is based on the fifth-generation seismic model developed by the Geological Survey of Canada (GSC). Seismic hazard data for this site has been obtained from the GSC's seismic hazard calculator. The data includes peak ground acceleration (PGA), peak ground velocity (PGV), and the 5% damped spectral response acceleration values (Sa(T)) for the reference ground condition (Site Class C) for a range of periods (T) and for a range of return periods including the 475-year, 975-year and 2475-year events. The GSC seismic hazard calculation data sheet for this site is presented in Attachment D.

The site coefficients used to determine the design spectral acceleration and displacement values are a function of the Site Class and the PGA, which is 0.33g at this site.

4.2.2 Seismic Liquefaction

The Boulanger & Idriss (2014) Simplified Method was used to assess the potential for liquefaction of the cohesionless deposits at this site. Based on the PGA and the subsurface conditions reported on the current and previous borehole records, an approximately 0.5 to 1.5 m thick layer of loose glacial till beneath the clay deposit may be potentially liquifiable to the west and north of the existing lagoon at Boreholes 22-01, 94-2, 94-3, and 94-7. In addition, the glacial till may be potentially liquifiable to the south of the existing lagoon at Borehole 22-04. However, it should be noted that the SPT blowcounts from the current and previous investigations may have been influenced by an unbalanced hydrostatic head, which may be impacting the liquefaction assessment. For subsequent stages of the design, it is recommended that a detailed liquefaction assessment be carried out, including supplementary boreholes that are advanced with casing and filled with water or drilling mud to prevent an unbalanced hydrostatic head during SPT testing. Consideration should also be given to carrying out Cone Penetration Tests (CPTs) to assess liquefaction and to confirm the seismic site classification (see 4.2.3 below). If liquefiable conditions are confirmed following the supplementary investigation, an analysis of post-liquefaction settlement and slope stability will be required to assess design options and/or mitigative measures (e.g., ground improvement) to prevent or limit the damage associated with liquefaction during a seismic event.

The susceptibility of the cohesive soils at the site (i.e., the clay) to experience cyclic mobility or cyclic softening was assessed using the Bray et al. (2004) criteria and the results of index property testing. Based on the results of this analyses, the cohesive material at this site is not considered susceptible to cyclic mobility or cyclic softening during a seismic event.

4.2.3 Seismic Site Classification

The seismic design provisions of the 2019 Ontario Building Code depend, in part, on the shear wave velocity of the upper 30 m of soil and/or bedrock below founding level.

The OBC requires a Site Class F designation for sites with liquefiable soils, which would require that a site-specific seismic response evaluation be carried out for the design of this expansion. However, the code allows the use of a “non-liquefied” Site Class for structures having a fundamental period of vibration less than or equal to 0.5 seconds. It is anticipated that this would be the case for the structures associated with the proposed expansion; however, this should be confirmed by the structural engineer. On this basis, a non-liquefied Site Class D designation can likely be used for design.

A more favourable Site Class C may be possible; however, this would need to be confirmed with site specific shear wave velocity testing, which can be carried out as part of a supplementary geotechnical investigation during the detailed design stage.

4.2.4 Site Grading and Berm Construction

4.2.4.1 Grade Raise Restrictions and Settlement

The site is underlain by a deposit of sensitive and compressible marine clay that is generally thicker to the east side of the site. It is noted that the marine clay at this site typically has a stiff to very stiff consistency and is considered suitable to support the foundations for low-rise structures with moderate grade raises; however, it must be recognized that the marine clay has a limited capacity to support additional stress from grade raise fill and foundation loads without undergoing significant consolidation settlement.

An increase in stress, if excessive (i.e., increasing the magnitude of stress above, or even close to, the marine clay's preconsolidation pressure), could lead to significant consolidation settlement. Due to the low hydraulic conductivity of the clay and the need to expel water for settlement to occur, the settlement would be long-term in nature, possibly taking many months or years to complete. If grade raises/berm construction are required on areas underlain by compressible marine clay, it will be preferable to limit the height of the fill to prevent significant consolidation settlement. Otherwise, mitigation options (e.g., preloading with a possible surcharge) may be required, which would add costs and significantly extend the schedule of construction.

It is noted that the previous investigation described the lower marine clay as very soft to firm. However, these descriptions appear to be based on SPT N values alone, which may be affected by the sensitivity of the deposit and therefore may not follow published correlations with undisturbed shear strength. Based on shear vane testing carried out during the current investigation, the lower clay has been described as stiff to very stiff. The preliminary geotechnical input provided below is based on the shear vane data collected from the current investigation and typical correlations with consolidation properties of Chaplain Sea marine clay; however, the detailed design stage of the project will require the collection of relatively undisturbed Shelby tube samples of the clay and oedometer consolidation testing to confirm the consolidation properties of the clay deposit.

Based on a geotechnical assessment carried out using data from the current investigation, the maximum recommended grade raise for preliminary planning purposes is 3.0 m, which should maintain settlements within tolerable limits (within the recompression range of the clay deposit) and also allow for the construction of lightly loaded one-storey structures. This estimate is intended to be conservative due to the limited consolidation information available. Higher grade raises may be possible following the completion of a supplementary geotechnical investigation that includes consolidation testing. Thurber can also provide input on mitigation options (e.g., preloading) if the required grade raise is higher than the recommended value.

4.2.5 Slope Stability

It is anticipated that new berms will be required for the new lagoon cells. For preliminary planning purposes, it is recommended that berms up to 3 m in height be constructed with side slopes of 3H:1V, or shallower. The global slope stability under static and seismic conditions is anticipated to exceed the minimum factors of safety under these conditions assuming that the berms are constructed with clean inorganic granular fill that is placed in maximum 200 mm thick lifts and compacted to 95% of the material's standard Proctor maximum dry density and that seepage is controlled. A detailed slope stability assessment will be required during detailed design.

4.2.6 Foundations

If new structures are required as part of the expansion, the subsurface conditions at this site are generally considered favourable for shallow foundations (either spread footings or mat foundations). The bearing resistances that will apply are dependent on the foundation depth, size of the footings (width and length), the required grade raise (if any) and the subsurface conditions that are present beneath the foundation. Additional information will be required to confirm the bearing resistances for each proposed structure; however, it is anticipated that a factored bearing resistance at Serviceability limit States in the range of 100 to 150 kPa (or higher) will likely be possible. The factored bearing resistance at Ultimate Limit States is likely to be in the range of 150 to 225 kPa (or higher).

4.2.7 Sewer and Forcemain Construction

The construction of new sewers and forcemains to moderate depths (e.g., 3 m deep or shallower) is not expected to present significant challenges and typical bedding and backfill in accordance with Ontario Provincial Standard Drawings (OPSDs) will be applicable. If deeper services are required, additional geotechnical analysis will be required to assess for the potential of basal instability/heave.

Seepage barriers will be required at periodic intervals along the trench to reduce the potential for groundwater level lowering in the surrounding area due to the "French drain" effect on the granular bedding and surround. Long-term groundwater level lowering could lead to long-term settlement of nearby structures that are supported on the sensitive clay soil underlying the site. Seepage barriers also act as cut-offs to prevent migration of contaminants along the relatively permeable backfill in the trenches.

5 LIMITATIONS AND ADDITIONAL CONSIDERATIONS

This letter report has been prepared for the Class EA and is preliminary in nature. A supplementary geotechnical investigation is recommended for the detailed design stage of the project. The supplementary investigation will need to be planned to address the potential liquefaction and consolidation issues that have been identified in this report.

Historic borehole records have been provided for information purposes only. Thurber accepts no liability for the accuracy of that information and notes that conditions may have changed since the time that the boreholes were drilled.

6 CLOSURE

We trust that this technical memorandum satisfies your current requirements. Please do not hesitate to contact us if you have any questions.

Yours truly,

THURBER ENGINEERING LTD.

Paul Carnaffan

Stephen Dunlop, M.A.Sc., P.Eng.
Associate, Senior Geotechnical Engineer

Paul Carnaffan, M.Eng., P.Eng.
Principal, Branch Manager

Attachments: Statement of Limitations and Conditions
Attachment A – Drawings
Attachment B – Record of Borehole Sheets
Attachment C – Laboratory Test Results and Bedrock Core Photographs
Attachment D – GSC Seismic Hazard Calculator

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Attachment A

Drawings

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LEGEND:

- ⌖ CURRENT BOREHOLES BY THURBER
- ● PREVIOUS BOREHOLES BY OTHERS

J.L. Richards & Associates Ltd.

Hydrogeological and Geotechnical Services Class Environmental Assessment of the Plantagenet Wastewater Collection and Treatment System

BOREHOLE LOCATION PLAN

JOB# 32622

THURBER ENGINEERING LTD.

ENGINEER :	DRAWN :	APPROVED :
SM	MFA	SD
DATE :	SCALE :	DRAWING No.
JUNE 2022	1:3000	32622-1

FILENAME: H:\Drafting\32000\32622\TED-32622-BHPL.dwg
PLOTDATE: Jun 30, 2022 - 11:46 AM

Attachment B

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

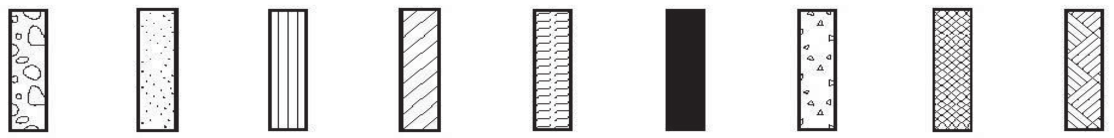
DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

THURBER

STRATA PLOT:

Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



TEXTURING CLASSIFICATION OF SOILS

Classification	**Particle Size**
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	**Undrained Shear Strength (kPa)**
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	**SPT "N" Value**
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structures are preserved.

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

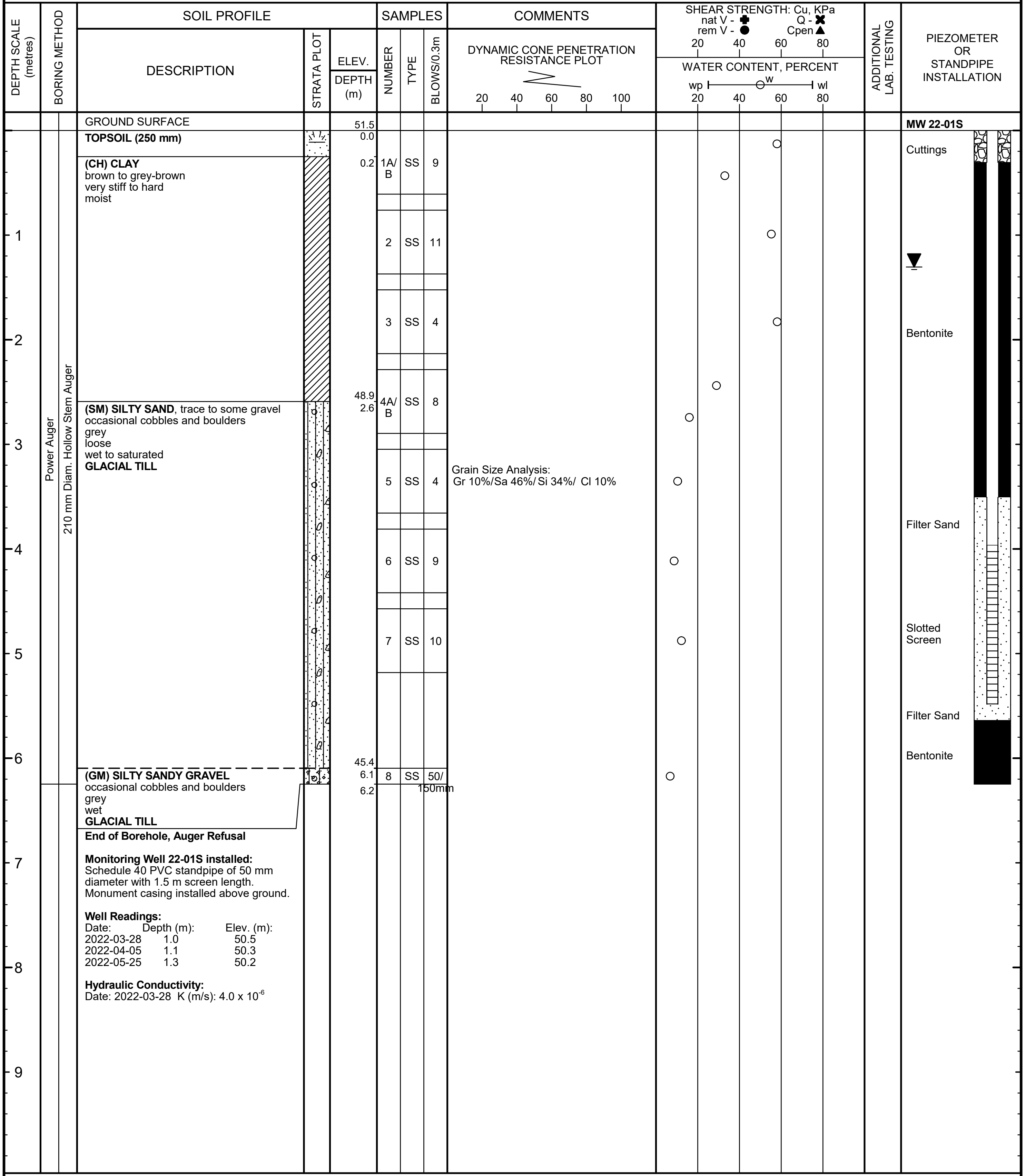
Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	Less than 6 mm

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

RECORD OF BOREHOLE 22-01S

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 847.2 E 188 588.8
STARTED : 2022 March 17
COMPLETED : 2022 March 17
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount
Project No. 32622
SHEET 1 OF 1
DATUM Geodetic



DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
GROUND SURFACE	51.5				
TOPSOIL (250 mm)	0.0				
(CH) CLAY brown to grey-brown very stiff to hard moist	0.2	1A/B	SS	9	
		2	SS	11	
		3	SS	4	
(SM) SILTY SAND, trace to some gravel occasional cobbles and boulders grey loose wet to saturated **GLACIAL TILL**	48.9 2.6	4A/B	SS	8	
		5	SS	4	Grain Size Analysis: Gr 10%/Sa 46%/ Si 34%/ Cl 10%
		6	SS	9	
		7	SS	10	
(GM) SILTY SANDY GRAVEL occasional cobbles and boulders grey wet **GLACIAL TILL**	45.4 6.1 6.2	8	SS	50/150mm	

End of Borehole, Auger Refusal

Monitoring Well 22-01S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.0	50.5
2022-04-05	1.1	50.3
2022-05-25	1.3	50.2

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 4.0 x 10^{-6}

GROUNDWATER ELEVATIONS

$\underline{\nabla}$ WATER LEVEL UPON COMPLETION

$\underline{\blacktriangledown}$ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

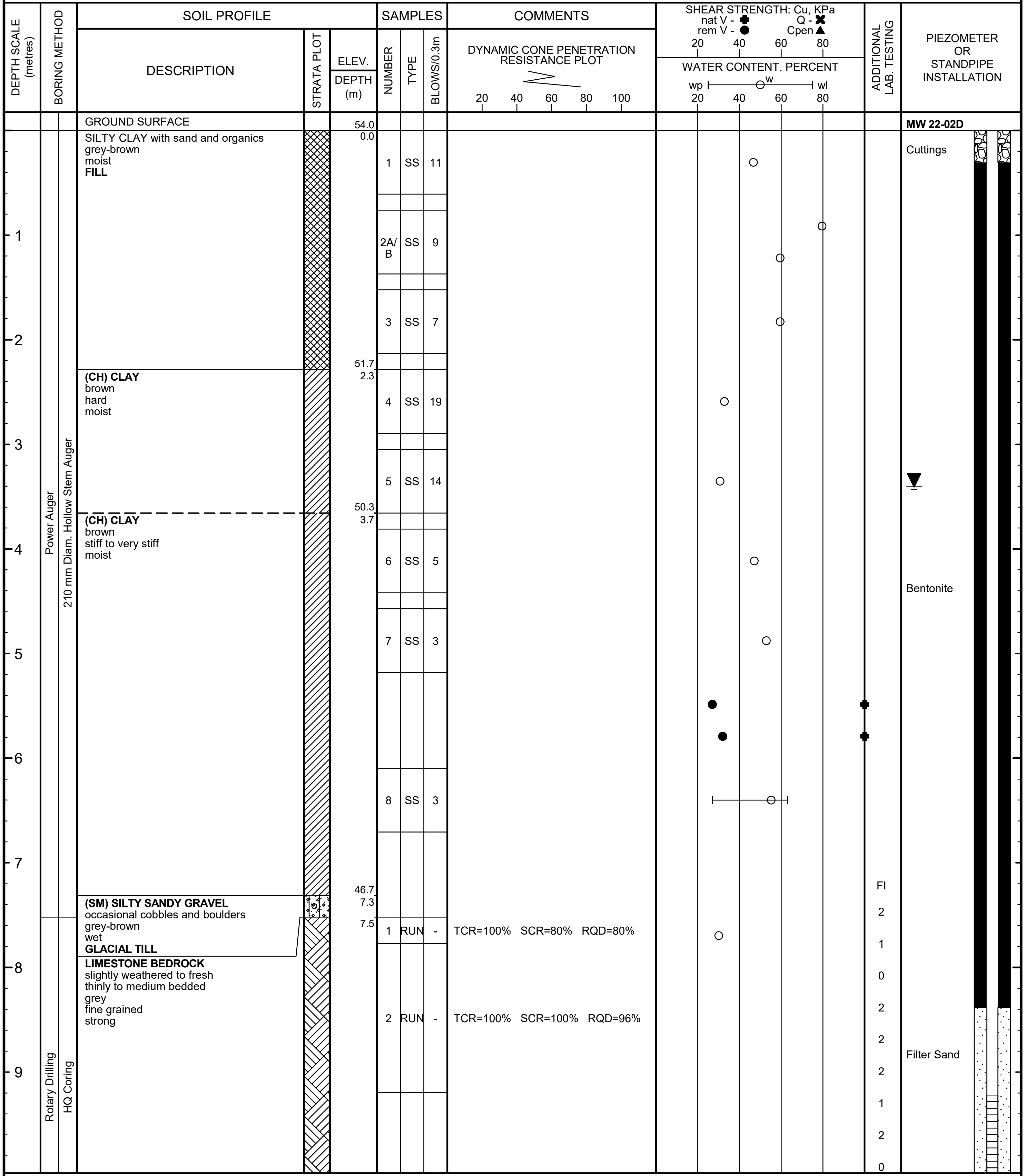
THURBER

THURBER2S 32622 PLANTAGENET.GPJ 22-11-10

RECORD OF BOREHOLE 22-02D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 994.4 E 188 977.6
STARTED : 2022 March 17
COMPLETED : 2022 March 18
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 2
DATUM Geodetic



DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
GROUND SURFACE	54.0				
SILTY CLAY with sand and organics grey-brown moist **FILL**	0.0	1	SS	11	
		2A/B	SS	9	
		3	SS	7	
(CH) CLAY brown hard moist	51.7 2.3	4	SS	19	
		5	SS	14	
(CH) CLAY brown stiff to very stiff moist	50.3 3.7	6	SS	5	
		7	SS	3	
		8	SS	3	
(SM) SILTY SANDY GRAVEL occasional cobbles and boulders grey-brown wet **GLACIAL TILL**	46.7 7.3				
LIMESTONE BEDROCK slightly weathered to fresh thinly to medium bedded grey fine grained strong	7.5	1	RUN	-	TCR=100% SCR=80% RQD=80%
		2	RUN	-	TCR=100% SCR=100% RQD=96%

FI
2
1
0
2
2
2
1
2
0

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

THURBER2S 32622 PLANTAGENET.GPJ 22-11-10

RECORD OF BOREHOLE 22-02D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 994.4 E 188 977.6
STARTED : 2022 March 17
COMPLETED : 2022 March 18
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 WATER CONTENT, PERCENT wp ├──○w──┤ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
			▨		3	RUN	-	TCR=100% SCR=100% RQD=94%		2 1 1	Slotted Screen
11 12 13 14 15 16 17 18 19		**End of Borehole** **Monitoring Well 22-02D installed:** Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length. Monument casing installed above ground. **Well Readings:** Date: Depth (m): Elev. (m): 2022-03-28 3.1 50.9 2022-04-05 3.3 50.7 2022-05-25 3.4 50.6 **Hydraulic Conductivity:** Date: 2022-03-28 K (m/s): 3.3×10^{-5}		43.3 10.7							

GROUNDWATER ELEVATIONS

$\underline{\nabla}$ WATER LEVEL UPON COMPLETION

$\underline{\blacktriangledown}$ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

RECORD OF BOREHOLE 22-02S

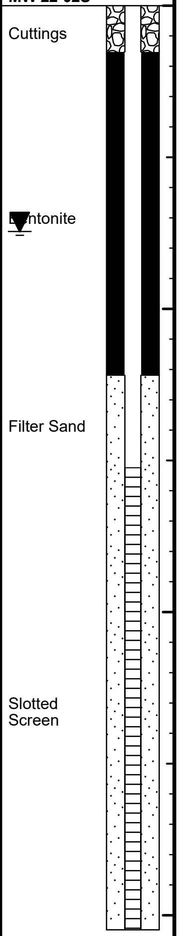
PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 994.3 E 188 976.4
STARTED : 2022 March 18
COMPLETED : 2022 March 18

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 WATER CONTENT, PERCENT wp ⊢ ○w ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		54.0							**MW 22-02S**
0–6.1	Power Auger 210 mm Diam. Hollow Stem Auger	**See Record of Borehole 22-02D**									
6.1		**End of Borehole**		47.9 6.1							

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9



Monitoring Well 22-02S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 3.0 m screen length. Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.2	52.8
2022-04-05	1.3	52.7
2022-05-25	1.5	52.5

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 4.8 x 10^{-7}

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

RECORD OF BOREHOLE 22-03D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 600.4 E 188 536.6
STARTED : 2022 March 16
COMPLETED : 2022 March 16
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount
Project No. 32622
SHEET 1 OF 2
DATUM Geodetic

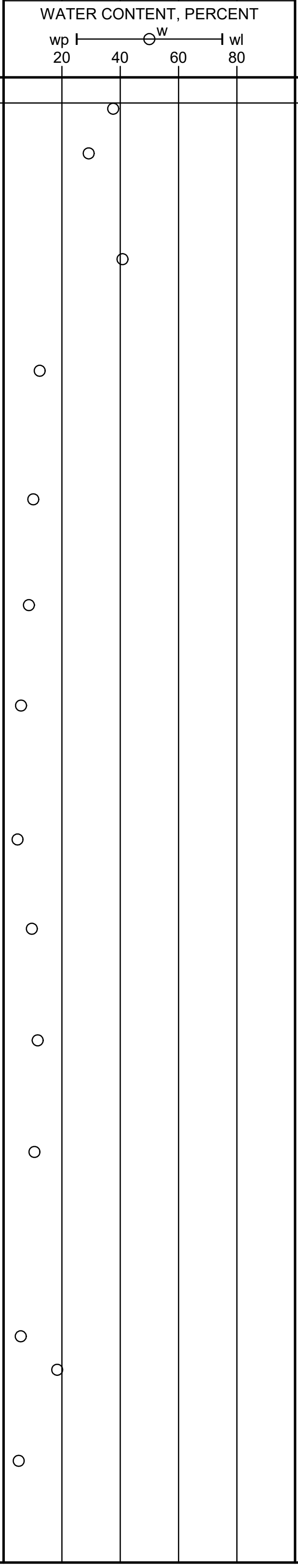
BORING METHOD: Power Auger – 210 mm Diam. Hollow Stem Auger (0 to approx. 2.3 m); Rotary Drilling – HQ Coring (below)

SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	50.2						MW 22-03D
TOPSOIL (75 mm)							Cuttings
(CH) CLAY grey-brown hard moist	0.1	1A/B	SS	23			
		2	SS	10			
(SM) SILTY SAND with gravel frequent cobbles and occasional boulders grey-brown dense moist **GLACIAL TILL**	48.8 1.4	3	SS	29			▼
(SM) GRAVELLY SILTY SAND frequent cobbles and boulders grey-brown compact to dense wet **GLACIAL TILL**	48.1 2.1	-	HQ	-			
		5	SS	23	Grain Size Analysis: Gr 35%/Sa 43%/ Si 18%/ Cl 4%		
		6	SS	45			
		7	SS	30			Bentonite
(SM) SILTY SAND trace to with gravel frequent cobbles and boulders grey compact to very dense wet **GLACIAL TILL**	44.9 5.3	8	SS	26			
		9	SS	45			
		10	SS	60			
		11	SS	42			
(CL-ML) SILTY CLAY, some sand to sandy occasional cobbles and boulders grey very dense wet **GLACIAL TILL**	41.7 8.5	12A/B	SS	86	Grain Size Analysis: Gr 0%/ Sa 9%/ Si 66%/ Cl 25%		
		13	SS	50/ 100mm		FI 5	
LIMESTONE BEDROCK	40.4 9.8						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
20 40 60 80

WATER CONTENT, PERCENT
wp ⊢—○w—⊣ wl



GROUNDWATER ELEVATIONS
⊻ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

RECORD OF BOREHOLE 22-03D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 600.4 E 188 536.6
STARTED : 2022 March 16
COMPLETED : 2022 March 16

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

Project No. 32622
SHEET 2 OF 2
DATUM Geodetic

SHEAR STRENGTH: Cu, KPa — nat V - ✚ Q - ✖ rem V - ● Cpen ▲ (20 40 60 80)
WATER CONTENT, PERCENT — wp ⊢—o w—⊣ wl (20 40 60 80)
DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

DEPTH SCALE (metres)	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	COMMENTS	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	slightly weathered to fresh thinly to medium bedded grey fine grained strong		1	RUN	-	TCR=100% SCR=81% RQD=45%	3 1 0	Filter Sand
11			2	RUN	-	TCR=100% SCR=98% RQD=95%	3 1 0 2	Slotted Screen
12	**End of Borehole**	38.1 12.1						
13								
14								
15								
16								
17								
18								
19								

Monitoring Well 22-03D installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length. Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.6	48.6
2022-04-05	1.9	48.3
2022-05-25	2.1	48.1

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 2.5 x 10^{-6}

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

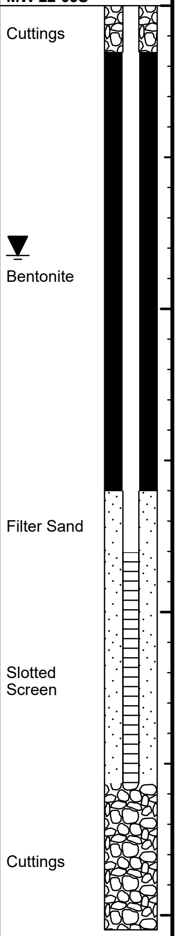
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

RECORD OF BOREHOLE 22-03S

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 600.1 E 188 537.8
STARTED : 2022 March 16
COMPLETED : 2022 March 16
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount
Project No. 32622
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 WATER CONTENT, PERCENT wp ⊢ w ○ ⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		50.3							**MW 22-03S**
0 – 2.3	Power Auger 210 mm Diam. Hollow Stem Auger	**See Record of Borehole 22-03D**		0.0							
2.3 – 6.1	Rotary Drilling HQ Coring										
6.1		**End of Borehole**		44.2 6.1							



End of Borehole

Monitoring Well 22-03S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length. Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.4	48.9
2022-04-05	1.5	48.8
2022-05-25	1.6	48.6

Hydraulic Conductivity:
Date: 2022-03-28 K (m/s): 1.0 x 10^{-5}

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-04D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 856.3 E 189 055.5
STARTED : 2022 March 21
COMPLETED : 2022 March 21
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount
Project No. 32622
SHEET 1 OF 2
DATUM Geodetic

BORING METHOD: Power Auger, 210 mm Diam. Hollow Stem Auger

SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	53.0
SILTY CLAY, trace to with sand with organics brown moist **FILL**	0.0
(CH) CLAY grey-brown hard to very stiff moist	51.5 1.5
(CH) CLAY brown stiff to very stiff moist	49.2 3.8
(SM) SILTY SAND with gravel occasional cobbles and boulders grey-brown very dense wet **GLACIAL TILL**	46.8 6.2
End of Borehole, Auger Refusal	44.3 8.7

Monitoring Well 22-04D installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

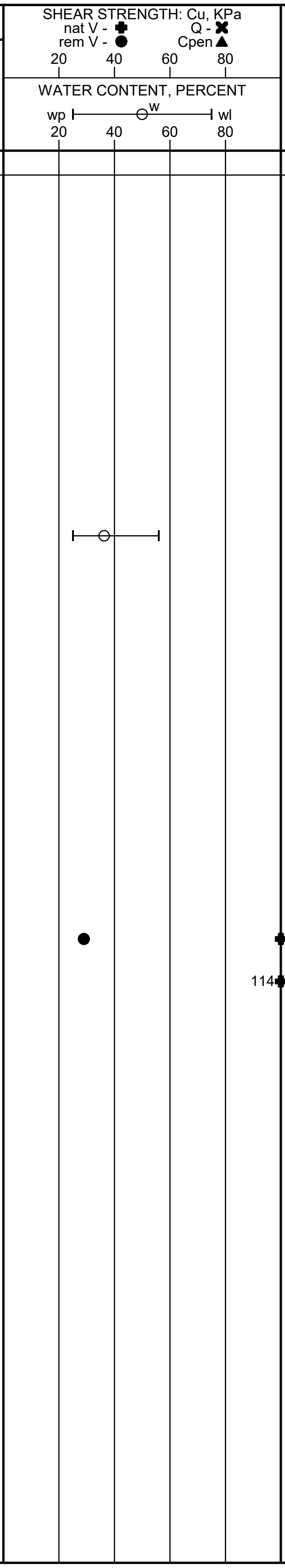
Date:	Depth (m):	Elev. (m):
2022-03-28	2.3	50.6
2022-04-05	2.5	50.4

SAMPLES

NUMBER	TYPE	BLOWS/0.3m
1	SS	13
2	SS	12
3	SS	17
4	SS	10
5	SS	5
6	SS	3
7	SS	3
8A/B	SS	8
9	SS	9
10	SS	33
11	SS	50/75mm

COMMENTS

DYNAMIC CONE PENETRATION RESISTANCE PLOT



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

MW 22-04D
Cuttings
Bentonite
Filter Sand
Slotted Screen
Cuttings

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-04D

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 856.3 E 189 055.5
STARTED : 2022 March 21
COMPLETED : 2022 March 21
DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount
Project No. 32622
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 WATER CONTENT, PERCENT wp ⊢—○w—⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		2022-05-25 2.6 50.1 **Hydraulic Conductivity:** Date: 2022-03-28 K (m/s): 2.9 x 10^{-6}									
11											
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

THURBER

RECORD OF BOREHOLE 22-04S

PROJECT : Plantagenet Wastewater Collection and Treatment System
LOCATION : MTM Zone 8 N 5 044 856.3 E 189 056.7
STARTED : 2022 March 21
COMPLETED : 2022 March 21

DRILLER: CCC Geotechnical and Environmental Drilling
DRILL RIG: CME 850 Trackmount

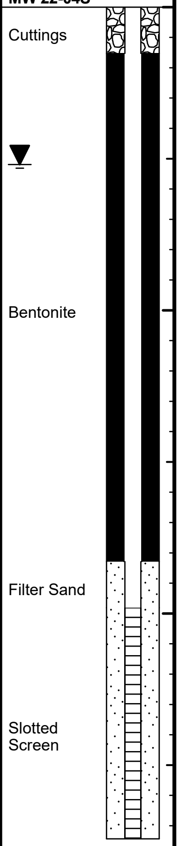
Project No. 32622
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH: Cu, KPa nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 20 40 60 80 / WATER CONTENT, PERCENT wp ⊢—○w—⊣ wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		53.1							**MW 22-04S**
0	Power Auger 210 mm Diam. Hollow Stem Auger	**See Record of Borehole 22-04D**		0.0							
5.5		**End of Borehole**		47.6 5.5							

Monitoring Well 22-04S installed:
Schedule 40 PVC standpipe of 50 mm diameter with 1.5 m screen length.
Monument casing installed above ground.

Well Readings:

Date:	Depth (m):	Elev. (m):
2022-03-28	1.3	51.8
2022-04-05	1.0	52.1
2022-05-25	1.0	52.1



Depth scale (metres): 1 2 3 4 5 6 7 8 9

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
2022 May 25

LOGGED : SM
CHECKED : SD

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-1A

CLIENT McNeely Engineering Consultants Limited

PROJECT No. 30464

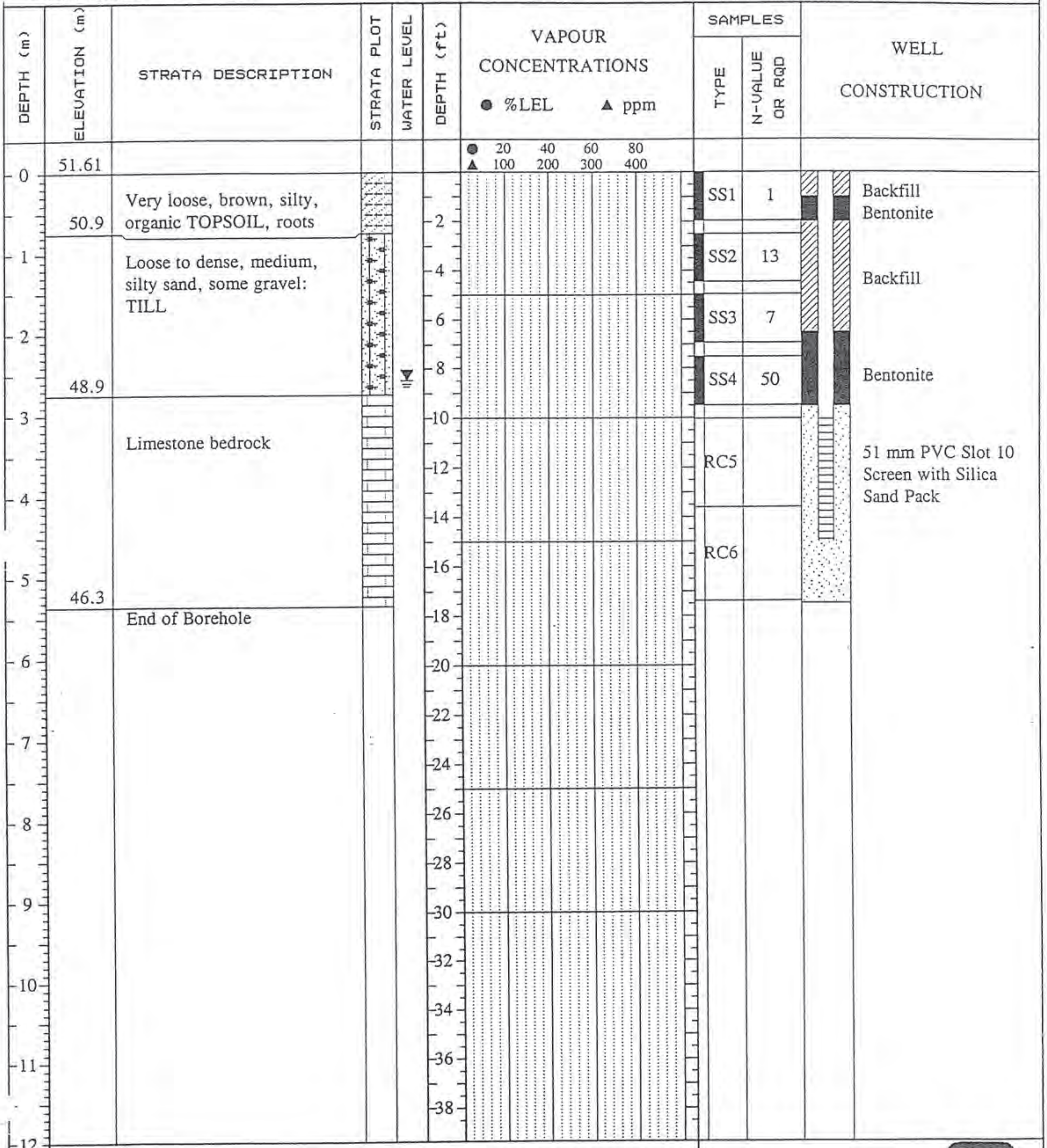
LOCATION Plantagenet Sewage Lagoon

DATUM Geodetic

DATES BORING: 94-09-28

WATER LEVEL 94/10/31

TPC ELEV. 53.35



ELEVATION (m)	STRATA DESCRIPTION
51.61	
50.9	Very loose, brown, silty, organic TOPSOIL, roots
48.9	Loose to dense, medium, silty sand, some gravel: TILL
46.3	Limestone bedrock
	End of Borehole

TYPE	N-VALUE OR RQD
SS1	1
SS2	13
SS3	7
SS4	50
RC5	
RC6	

WELL CONSTRUCTION

Backfill
Bentonite
Backfill
Bentonite
51 mm PVC Slot 10 Screen with Silica Sand Pack

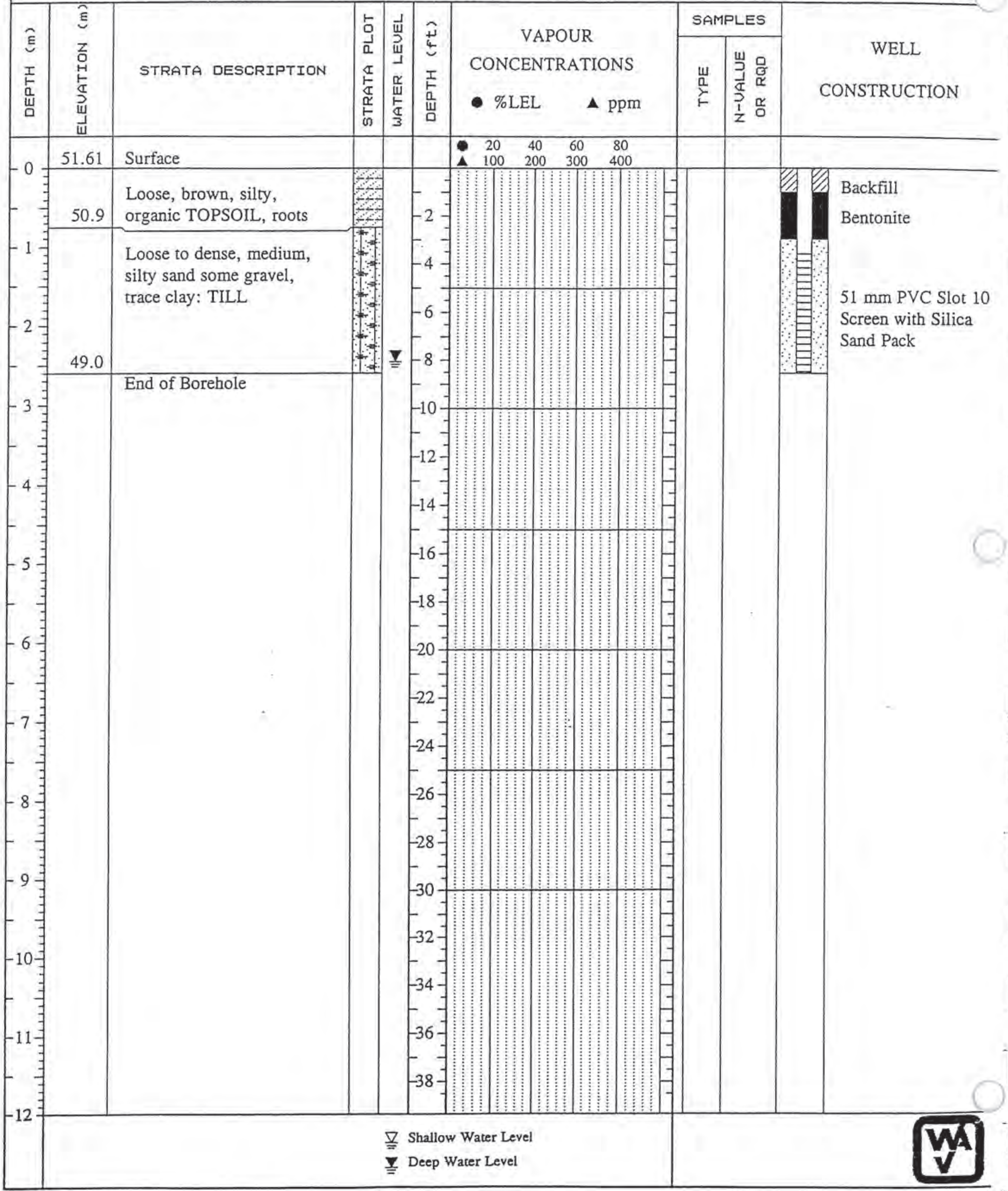
▽ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-1B

CLIENT McNeely Engineering Consultants Limited
LOCATION Plantagenet Sewage Lagoon
DATES BORING: 94-09-28
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 51.98



DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	51.61	Surface
	50.9	Loose, brown, silty, organic TOPSOIL, roots
	49.0	Loose to dense, medium, silty sand some gravel, trace clay: TILL
		End of Borehole

Backfill
Bentonite
51 mm PVC Slot 10 Screen with Silica Sand Pack

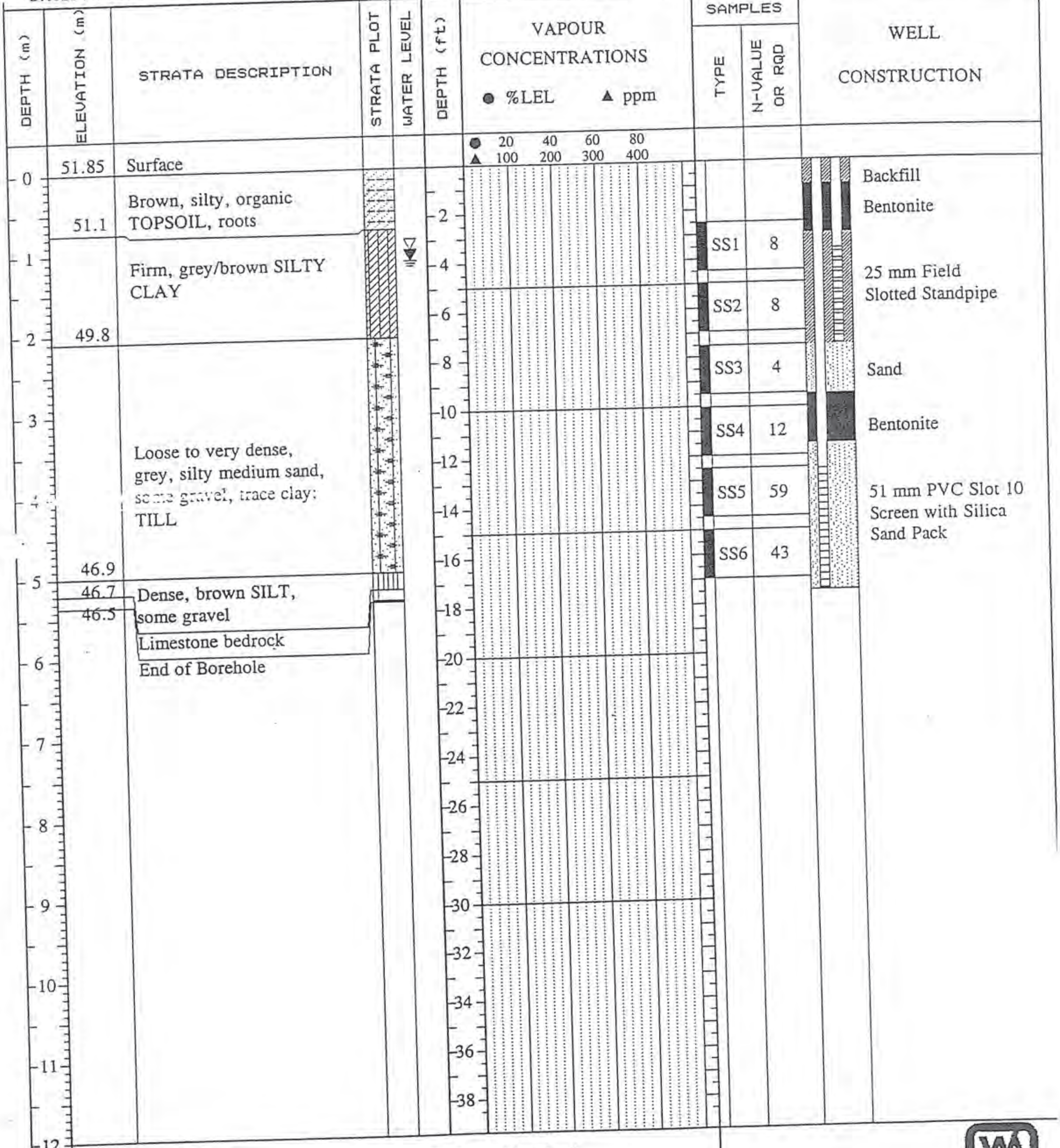
▽ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-2

CLIENT McNeely Engineering Consultants Limited
LOCATION Plantagenet Sewage Lagoon
DATES BORING: 94-09-28
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 52.75



ELEVATION (m)	STRATA DESCRIPTION
51.85	Surface
	Brown, silty, organic TOPSOIL, roots
51.1	Firm, grey/brown SILTY CLAY
49.8	Loose to very dense, grey, silty medium sand, some gravel, trace clay: TILL
46.9	Dense, brown SILT, some gravel
46.7	Limestone bedrock
46.5	End of Borehole

TYPE	N-VALUE OR RQD
SS1	8
SS2	8
SS3	4
SS4	12
SS5	59
SS6	43

WELL CONSTRUCTION

- Backfill
- Bentonite
- 25 mm Field Slotted Standpipe
- Sand
- Bentonite
- 51 mm PVC Slot 10 Screen with Silica Sand Pack

▽ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-3A

CLIENT McNeely Engineering Consultants Limited

LOCATION Plantagenet Sewage Lagoon

DATES BORING: 94-09-29

WATER LEVEL 94/10/31

PROJECT No. 30464

DATUM Geodetic

TPC ELEV. 53.75

ELEVATION (m)	STRATA DESCRIPTION
53.73	Surface
52.8	Compact, brown, silty TOPSOIL, roots
51.5	Stiff, grey to dark grey silty clay, roots and oxidation: FILL
49.8	Stiff, grey SILTY CLAY, oxidation and organic material, 2cm quartzite pebble
48.5	Loose, silty medium sand, some gravel, trace clay: TILL
46.0	Limestone bedrock
	End of Borehole

VAPOUR CONCENTRATIONS ● %LEL ▲ ppm

● 20 40 60 80
▲ 100 200 300 400

SAMPLES TYPE	N-VALUE OR RQD
SS1	13
SS2	8
SS3	9
SS4	11
SS5	11
SS6	9
SS7	10
RC8	
RC9	

WELL CONSTRUCTION

- Backfill
- Bentonite
- Backfill
- Bentonite
- Backfill
- 51 mm PVC Slot 10 Screen with Silica Sand Pack

▽ Shallow Water Level

▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-3B

CLIENT McNeely Engineering Consultants Limited

LOCATION Plantagenet Sewage Lagoon

DATES BORING: 94-09-29

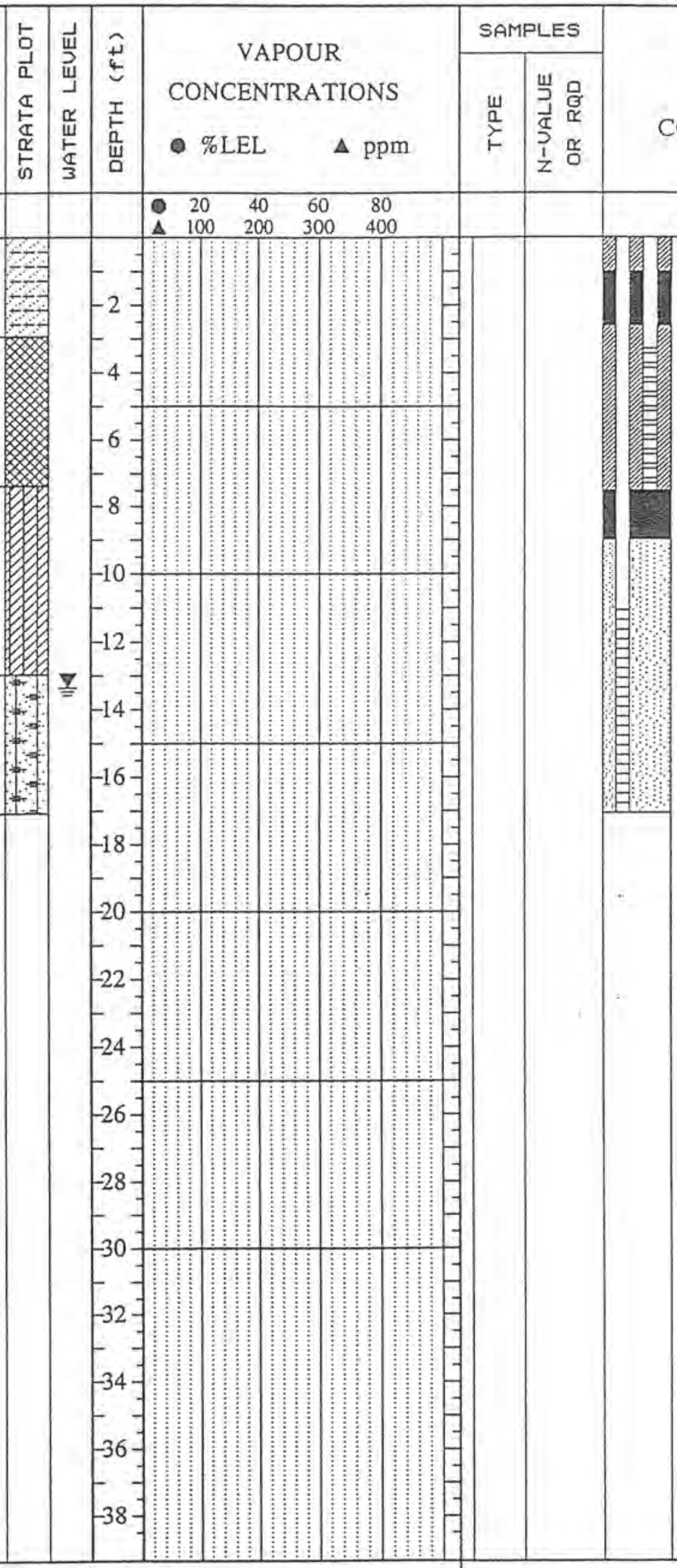
WATER LEVEL 94/10/31

PROJECT No. 30464

DATUM Geodetic

TPC ELEV. 53.67

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
	53.73	Surface
0	52.8	Compact, brown, silty TOPSOIL, roots
1	51.5	Stiff, grey to dark grey silty clay, roots and oxidation: FILL
2	49.8	Stiff, grey SILTY CLAY, oxidation and organic material, 2cm quartzite pebble
4	48.5	Loose, silty medium sand, some gravel, trace clay: TILL
5		End of Borehole
6		Limestone bedrock



WELL CONSTRUCTION

Backfill

Bentonite

25 mm Field Slotted Standpipe

Bentonite

51 mm PVC Slot 10 Screen with Silica Sand Pack

Standpipe blocked- no water level measured

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

▽ Shallow Water Level

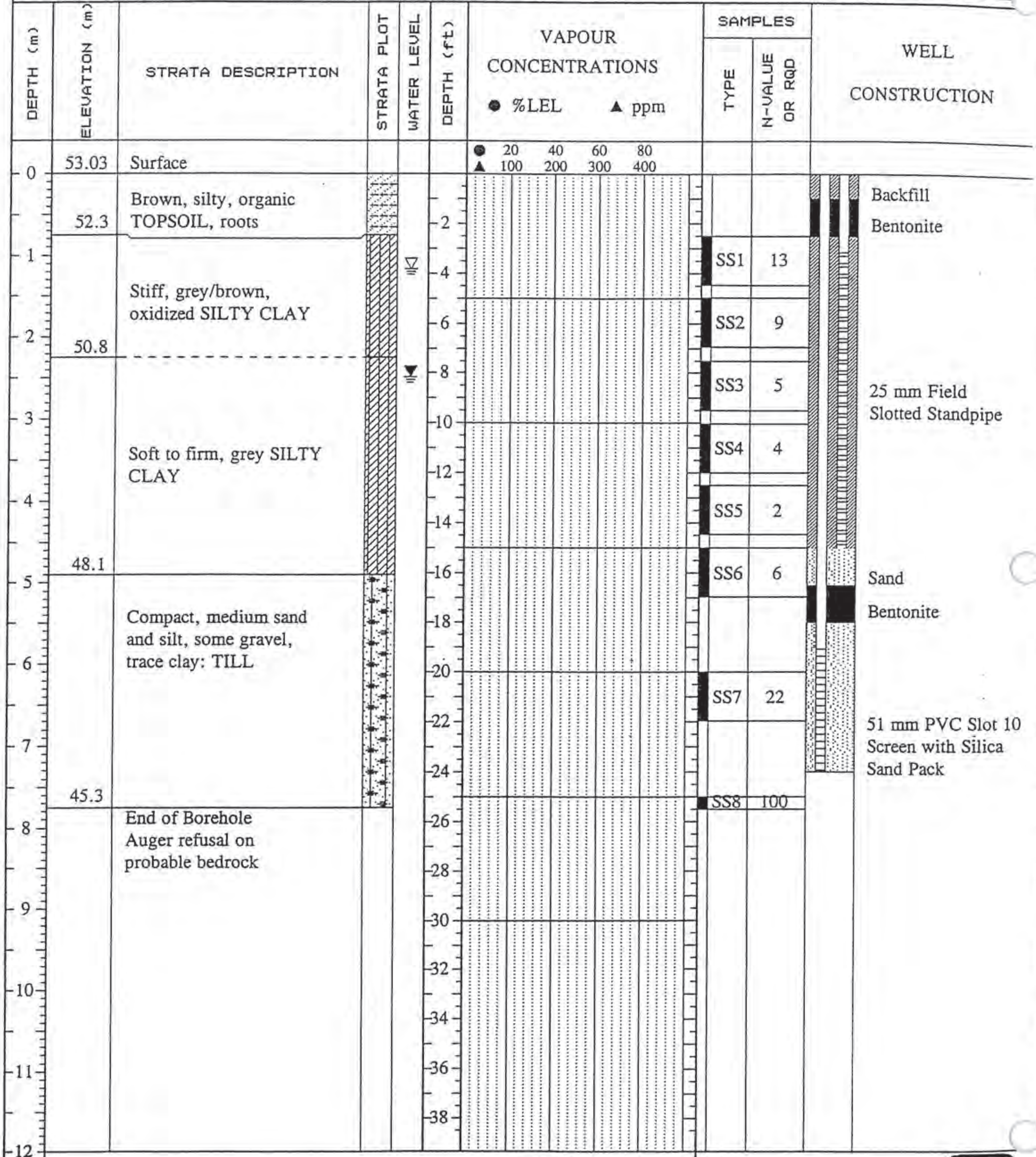
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-4

CLIENT McNeely Engineering Consultants Limited
LOCATION Plantagenet Sewage Lagoon
DATES BORING: 94-09-29
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 53.30



ELEVATION (m)	STRATA DESCRIPTION
53.03	Surface
52.3	Brown, silty, organic TOPSOIL, roots
	Stiff, grey/brown, oxidized SILTY CLAY
50.8	
	Soft to firm, grey SILTY CLAY
48.1	
	Compact, medium sand and silt, some gravel, trace clay: TILL
45.3	
	End of Borehole Auger refusal on probable bedrock

TYPE	N-VALUE OR RQD
SS1	13
SS2	9
SS3	5
SS4	4
SS5	2
SS6	6
SS7	22
SS8	100

Backfill
Bentonite
25 mm Field Slotted Standpipe
Sand
Bentonite
51 mm PVC Slot 10 Screen with Silica Sand Pack

∇ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-5A

CLIENT McNeely Engineering Consultants Limited
LOCATION Plantagenet Sewage Lagoon
DATES BORING: 94-09-28
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 54.78

ELEVATION (m)	STRATA DESCRIPTION
54.51	Surface
53.6	Brown, sandy, TOPSOIL, roots
53.0	Compact, grey/brown SILT, some organics and mica, oxidized
52.8	Compact, fine SAND, some mica flakes, oxidized
49.9	Stiff to soft, grey SILTY CLAY, some organic material
47.8	Soft, grey, SILTY CLAY
46.6	Dense, sand and silt, some gravel, trace clay: TILL
43.9	Limestone Bedrock
	End of Borehole

DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10 11 12

DEPTH (ft): 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

VAPOUR CONCENTRATIONS ● %LEL ▲ ppm

● 20 40 60 80
▲ 100 200 300 400

SAMPLES TYPE	N-VALUE OR RQD
SS1	16
SS2	13
SS3	8
SS4	4
SS5	3
SS6	2
SS7	2
SS8	2
SS9	100
RC10	
RC11	
RC12	

WELL CONSTRUCTION

Backfill

Bentonite

25 mm Field Slotted Standpipe

Bentonite

51 mm PVC Slot 10 Screen with Silica Sand Pack

∇ Shallow Water Level

▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

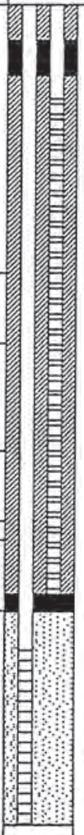
94-5B

CLIENT McNeely Engineering Consultants Limited
LOCATION Plantagenet Sewage Lagoon
DATES BORING: 94-09-28
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 55.12

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WATER LEVEL	SAMPLES TYPE	N-VALUE OR RQD	WELL CONSTRUCTION
0	54.51	Surface				
		Brown, sandy, TOPSOIL, roots				Backfill Bentonite
	53.6	Compact, grey/brown SILT, some organics and mica, oxidized				
	53.0 52.8	Compact, fine SAND, some mica flakes, oxidized	∇			
		Stiff to soft, grey SILTY CLAY, some organic material		SS1		25 mm Field Slotted Standpipe
			▼	SS2		
	49.9	Soft, grey, SILTY CLAY		SS3		Bentonite
						51 mm PVC Slot 10 Screen with Silica Sand Pack
	47.8 47.5	Dense, sand and silt, some gravel, trace clay: TILL				
		End of Borehole				

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
DEPTH (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38

VAPOUR CONCENTRATIONS
● %LEL ▲ ppm
● 20 40 60 80
▲ 100 200 300 400



∇ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-6

CLIENT McNeely Engineering Consultants Limited

LOCATION Plantagenet Sewage Lagoon

DATES BORING: 94-09-28

WATER LEVEL 94/10/31

PROJECT No. 30464

DATUM Geodetic

TPC ELEV. -

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	57.64	Surface
0 – 2.7	54.9	Loose to compact, brown, SILTY SAND, some mica flakes and organic material, oxidized
2.7 – 10.0	47.6	Very stiff to firm, grey SILTY CLAY Cone pushed from 6.70 m to 10.10 m. Cone penetration test from 10.10 m to 10.90 m.
10.0 – 10.8	46.8	Very dense, sand and silt, some gravel, trace clay: TILL
		End of Borehole

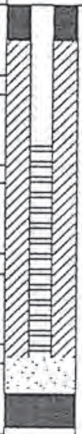
VAPOUR CONCENTRATIONS

● %LEL ▲ ppm

● 20 40 60 80
▲ 100 200 300 400

SAMPLES TYPE	N-VALUE OR RQD
SS1	4
SS2	10
SS3	12
SS4	16
SS5	20
SS6	8
SS7	6
SS8	6
SS9	7
SS10	85

WELL CONSTRUCTION



Bentonite

Backfill

25 mm Field Slotted Standpipe

Sand

Bentonite

∇ Shallow Water Level

▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-7A

CLIENT McNeely Engineering Consultants Limited

LOCATION Plantagenet Sewage Lagoon

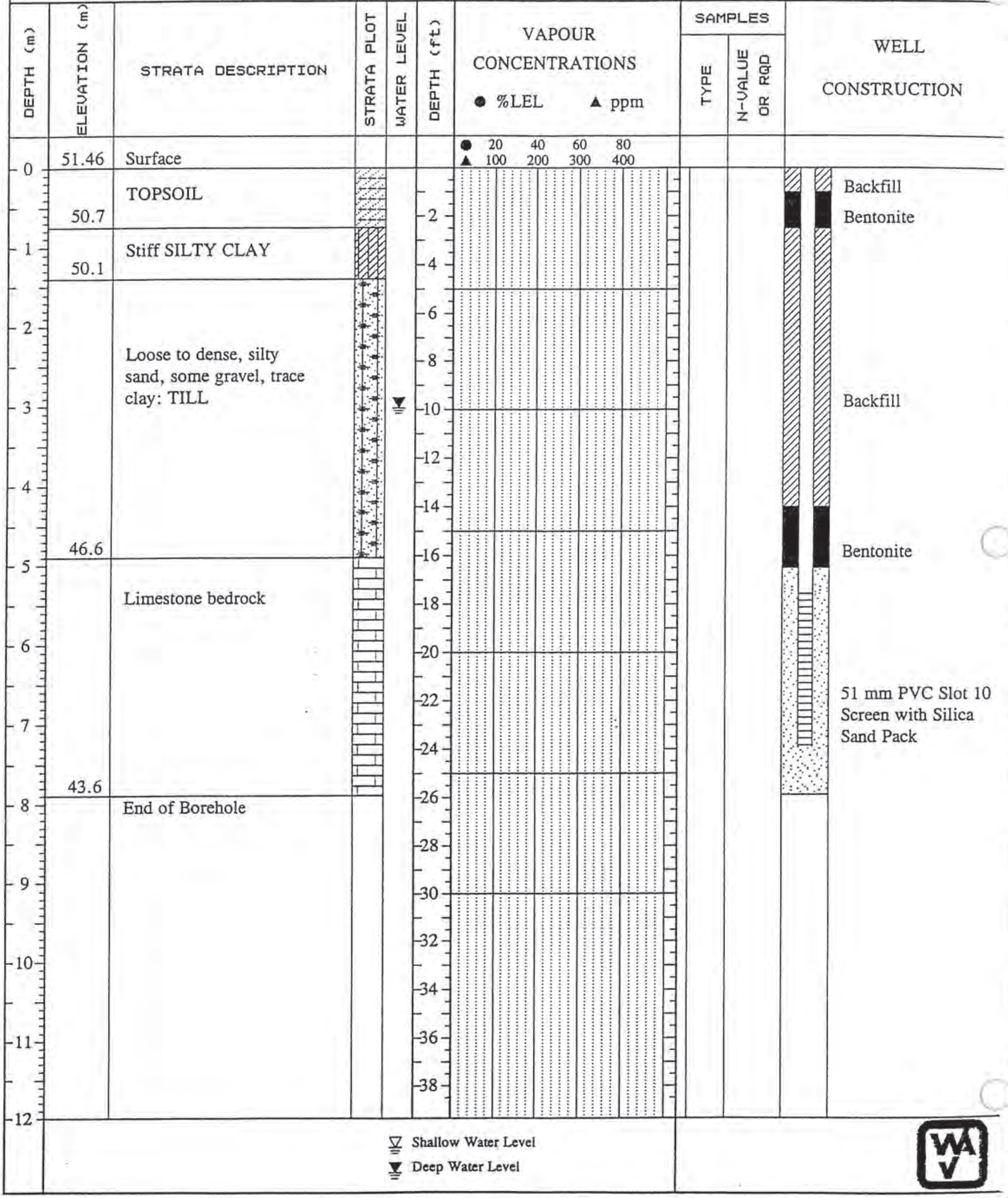
DATES BORING: 94-09-29

WATER LEVEL 94/10/31

PROJECT No. 30464

DATUM Geodetic

TPC ELEV. 51.99



DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	51.46	Surface
		TOPSOIL
	50.7	Stiff SILTY CLAY
	50.1	Loose to dense, silty sand, some gravel, trace clay: TILL
	46.6	Limestone bedrock
	43.6	End of Borehole

WELL CONSTRUCTION:
- Backfill
- Bentonite
- Backfill
- Bentonite
- 51 mm PVC Slot 10 Screen with Silica Sand Pack

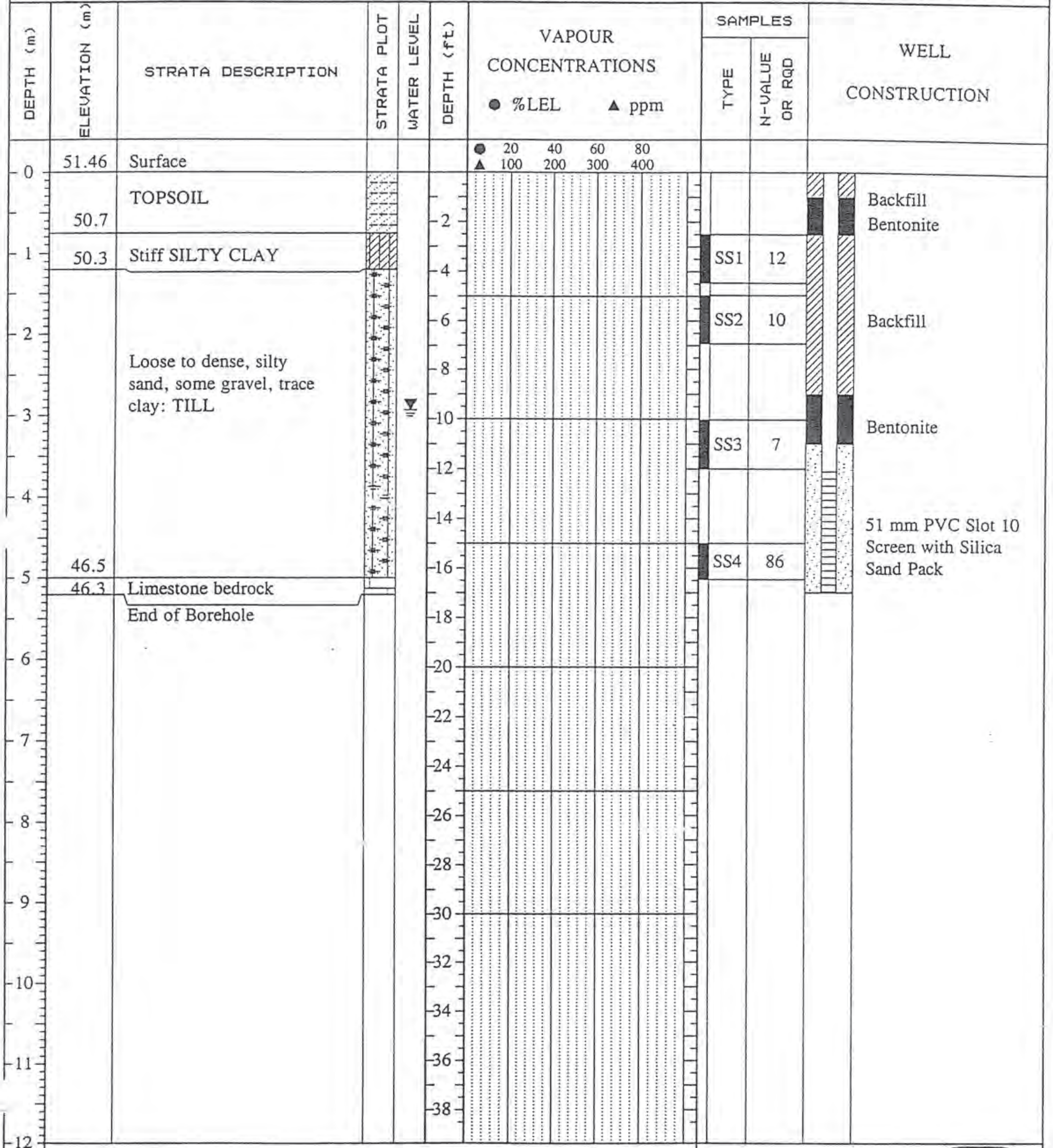
▽ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-7B

CLIENT McNeely Engineering Consultants Limited
LOCATION Plantagenet Sewage Lagoon
DATES BORING: 94-09-30
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 52.31



Elevation (m)	Strata Description	Type	N-Value or RQD	Well Construction
51.46	Surface			
	TOPSOIL			Backfill
50.7				Bentonite
50.3	Stiff SILTY CLAY	SS1	12	
	Loose to dense, silty sand, some gravel, trace clay: TILL	SS2	10	Backfill
		SS3	7	Bentonite
				51 mm PVC Slot 10 Screen with Silica Sand Pack
46.5		SS4	86	
46.3	Limestone bedrock			
	End of Borehole			

▽ Shallow Water Level

▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-8

CLIENT: McNeely Engineering Consultants Limited
LOCATION: Plantagenet Sewage Lagoon
DATES BORING: 94-09-29
WATER LEVEL: 94/10/31
PROJECT No.: 30464
DATUM: Geodetic
TPC ELEV.: 51.87

ELEVATION (m)	STRATA DESCRIPTION
51.76	Surface
	Very loose TOPSOIL
50.9	Soft to firm, grey, oxidized, SILTY CLAY
49.5	Very soft to soft, grey SILTY CLAY
47.2	Compact, grey, silty medium sand, some gravel, trace clay: TILL
46.6	End of Borehole Auger refusal on probable bedrock

VAPOUR CONCENTRATIONS ● %LEL ▲ ppm
● 20 40 60 80
▲ 100 200 300 400

SAMPLES TYPE	N-VALUE OR RQD
SS1	3
SS2	5
SS3	2
SS4	4
SS5	3
SS6	20

WELL CONSTRUCTION

Backfill
Bentonite
25 mm Field Slotted Standpipe
Sand
Bentonite
51 mm PVC Slot 1 Screen with Silica Sand Pack

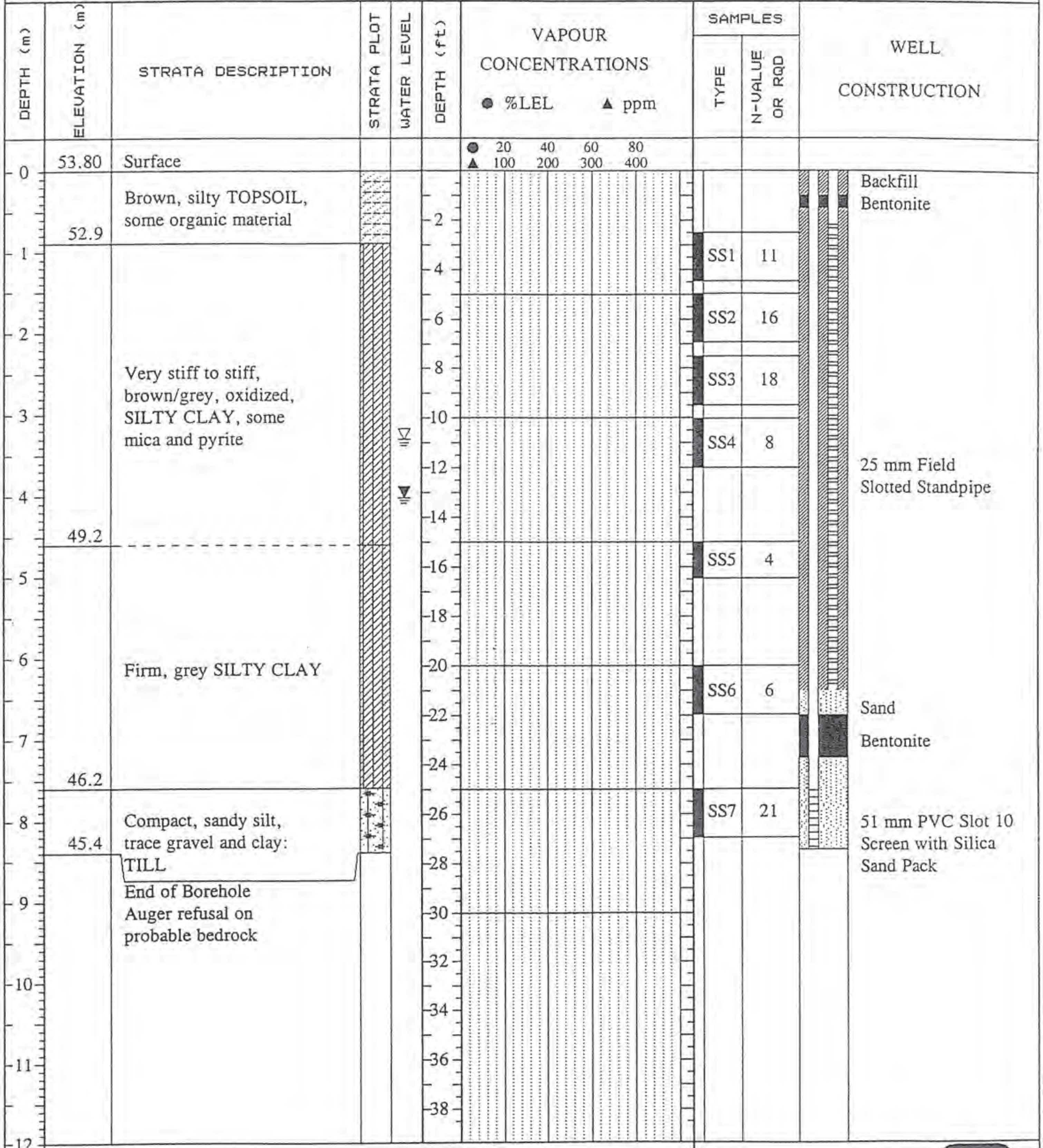
▽ Shallow Water Level
▼ Deep Water Level

JACQUES WHITFORD
ENVIRONMENT LIMITED

MONITORING WELL RECORD

94-9

CLIENT **McNeely Engineering Consultants Limited**
LOCATION **Plantagenet Sewage Lagoon**
DATES BORING: 94-09-30
WATER LEVEL 94/10/31
PROJECT No. 30464
DATUM Geodetic
TPC ELEV. 54.58



ELEVATION (m)	STRATA DESCRIPTION
53.80	Surface
52.9	Brown, silty TOPSOIL, some organic material
49.2	Very stiff to stiff, brown/grey, oxidized, SILTY CLAY, some mica and pyrite
46.2	Firm, grey SILTY CLAY
45.4	Compact, sandy silt, trace gravel and clay: TILL
	End of Borehole Auger refusal on probable bedrock

TYPE	N-VALUE OR RQD
SS1	11
SS2	16
SS3	18
SS4	8
SS5	4
SS6	6
SS7	21

▽ Shallow Water Level
▼ Deep Water Level

Attachment C

Geotechnical Laboratory Test Results

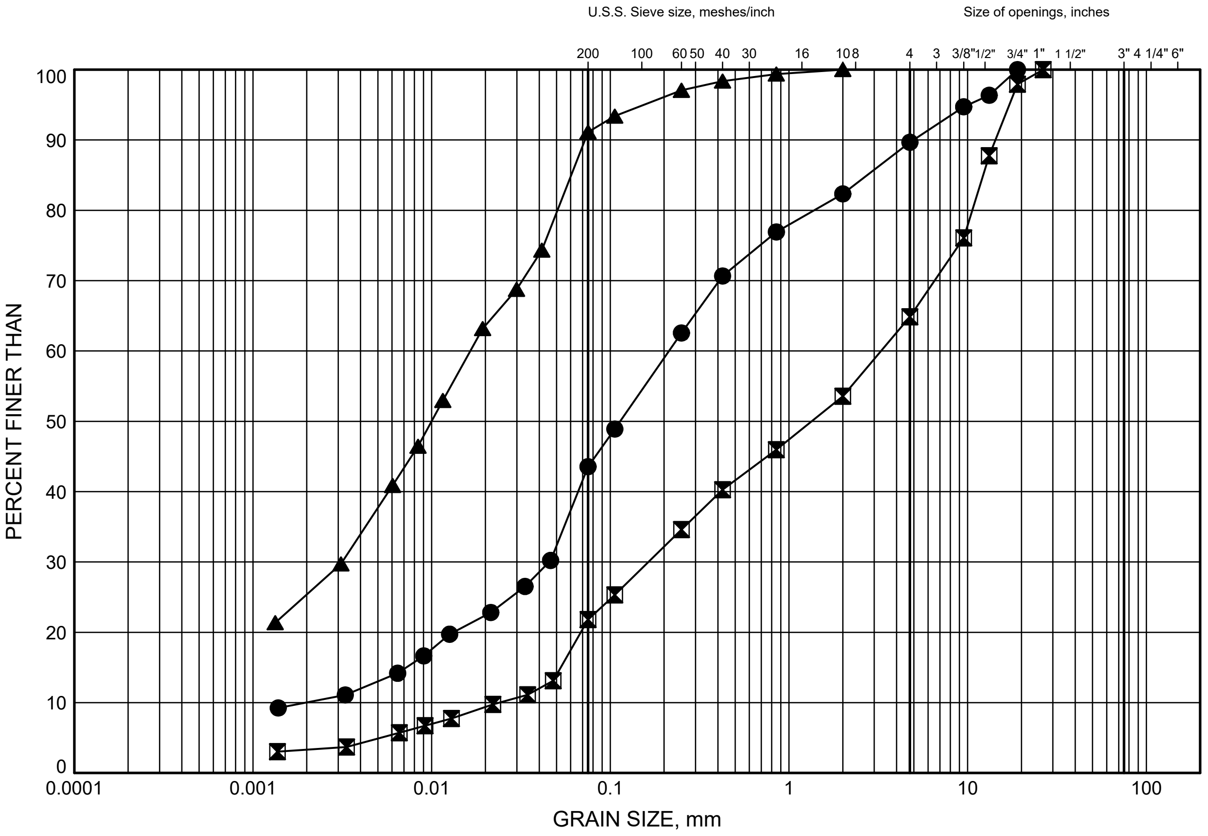
Bedrock Core Photographs

Plantagenet Wastewater Collection and Treatment System

GRAIN SIZE DISTRIBUTION

FIGURE C2

Glacial Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	22-01S	3.4	48.0
☒	22-03D	3.4	46.7
▲	22-03D	8.7	41.4

Date June 2022

32622

THURBER

Prep'd SM

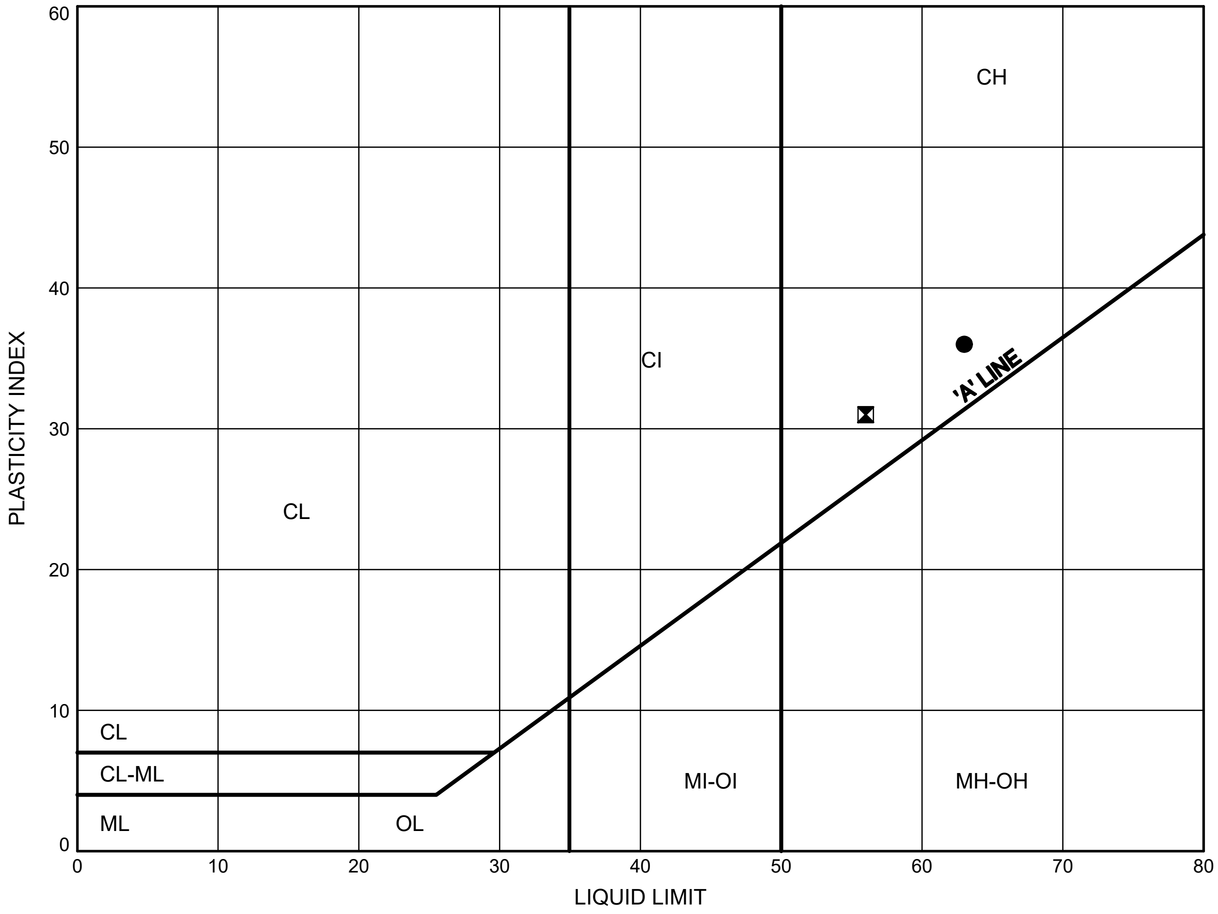
Chkd. SD

GRAIN SIZE DISTRIBUTION - THURBER 32622 PLANTAGENET.GPJ 22-6-20

Plantagenet Wastewater Collection and Treatment System

ATTERBERG LIMITS TEST RESULTS

FIGURE C1



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	22-02D	6.4	47.5
☒	22-04D	2.6	50.3

THURBALT 32622 PLANTAGENET.GPJ 22-6-20

Date June 2022

32622

THURBER

Prep'd SM

Chkd. SD

Borehole 20-02D

Run 1 to 3 (of 3)

Elevation 46.4 m to 43.2 m

THURBER ENGINEERING LTD.

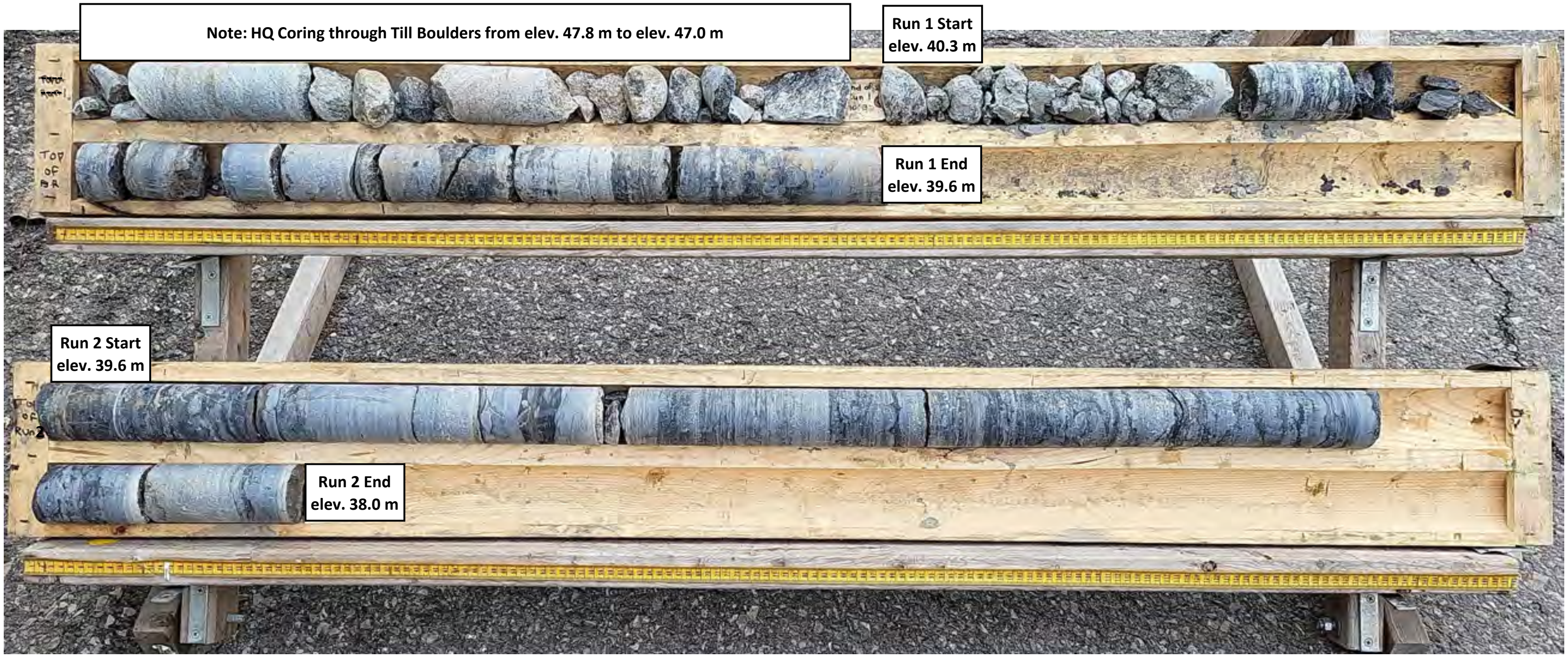
Geotechnical Investigation
Plantagenet Wastewater Collection and Treatment System
Plantagenet, Ontario

BH 22-02D
Project No.: 32622

Borehole 22-03D

Run 1 to 2 (of 2)

Elevation 40.3 m to 38.0 m



THURBER ENGINEERING LTD.

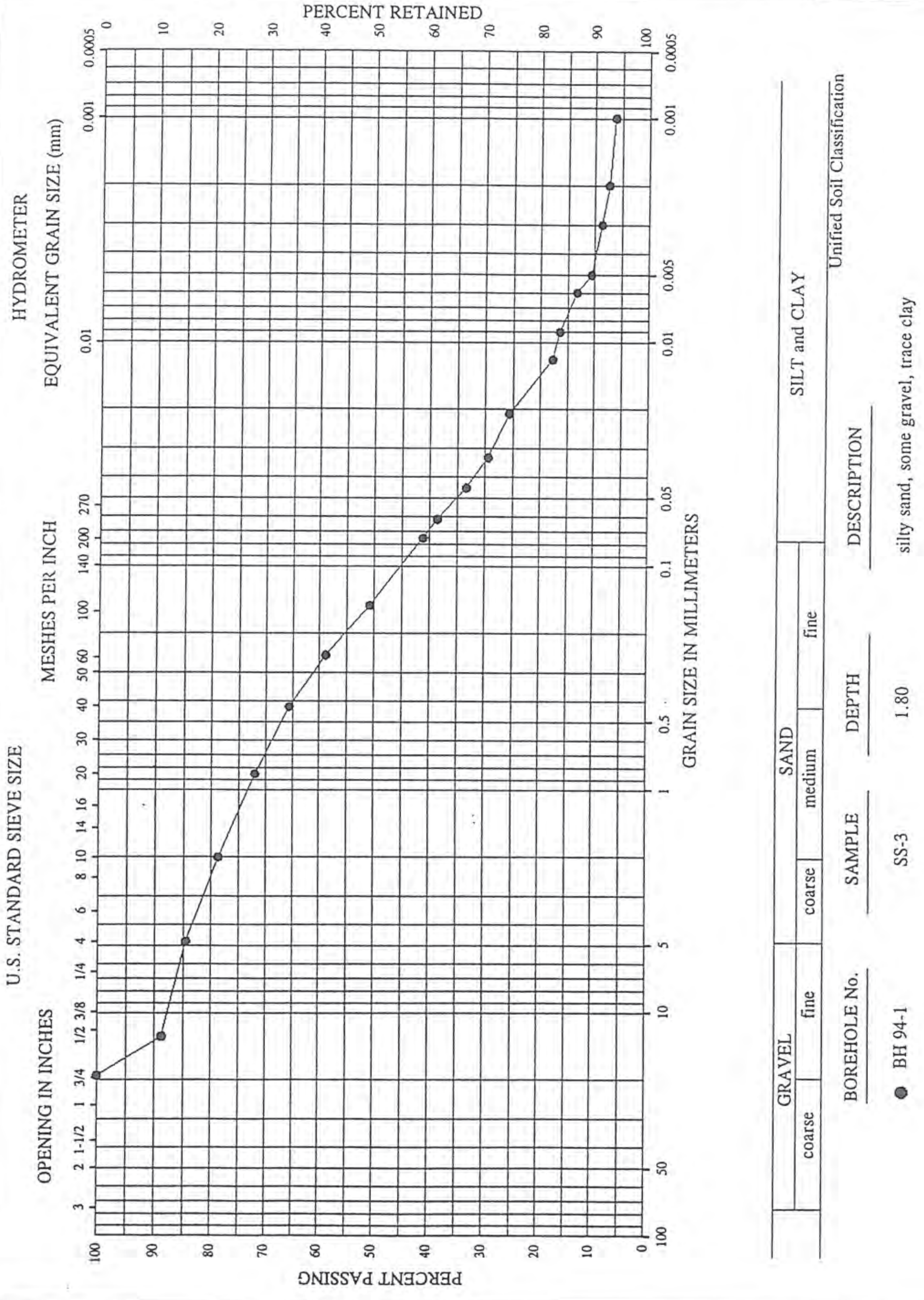
Geotechnical Investigation
Plantagenet Wastewater Collection
and Treatment System
Plantagenet, Ontario

BH 22-03D
Project No.: 32622

JACQUES
WHITFORD

GRAIN SIZE DISTRIBUTION

APPENDIX: 4
FIGURE: 1
PROJECT: 30464

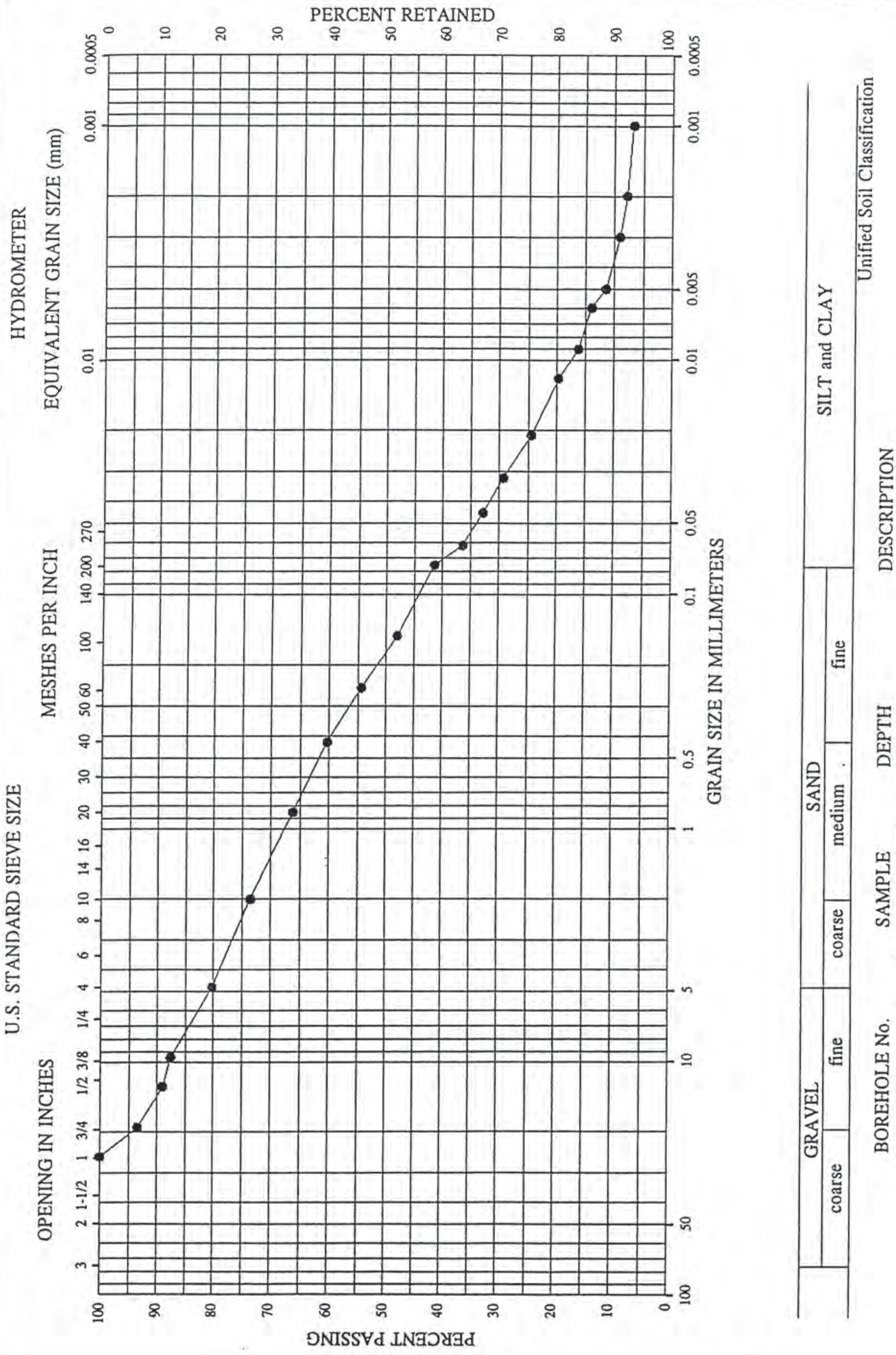


BOREHOLE No.	SAMPLE	DEPTH	DESCRIPTION
● BH 94-1	SS-3	1.80	silty sand, some gravel, trace clay

JACQUES
WHITFORD

GRAIN SIZE DISTRIBUTION

APPENDIX: 4
FIGURE: 2
PROJECT: 30464

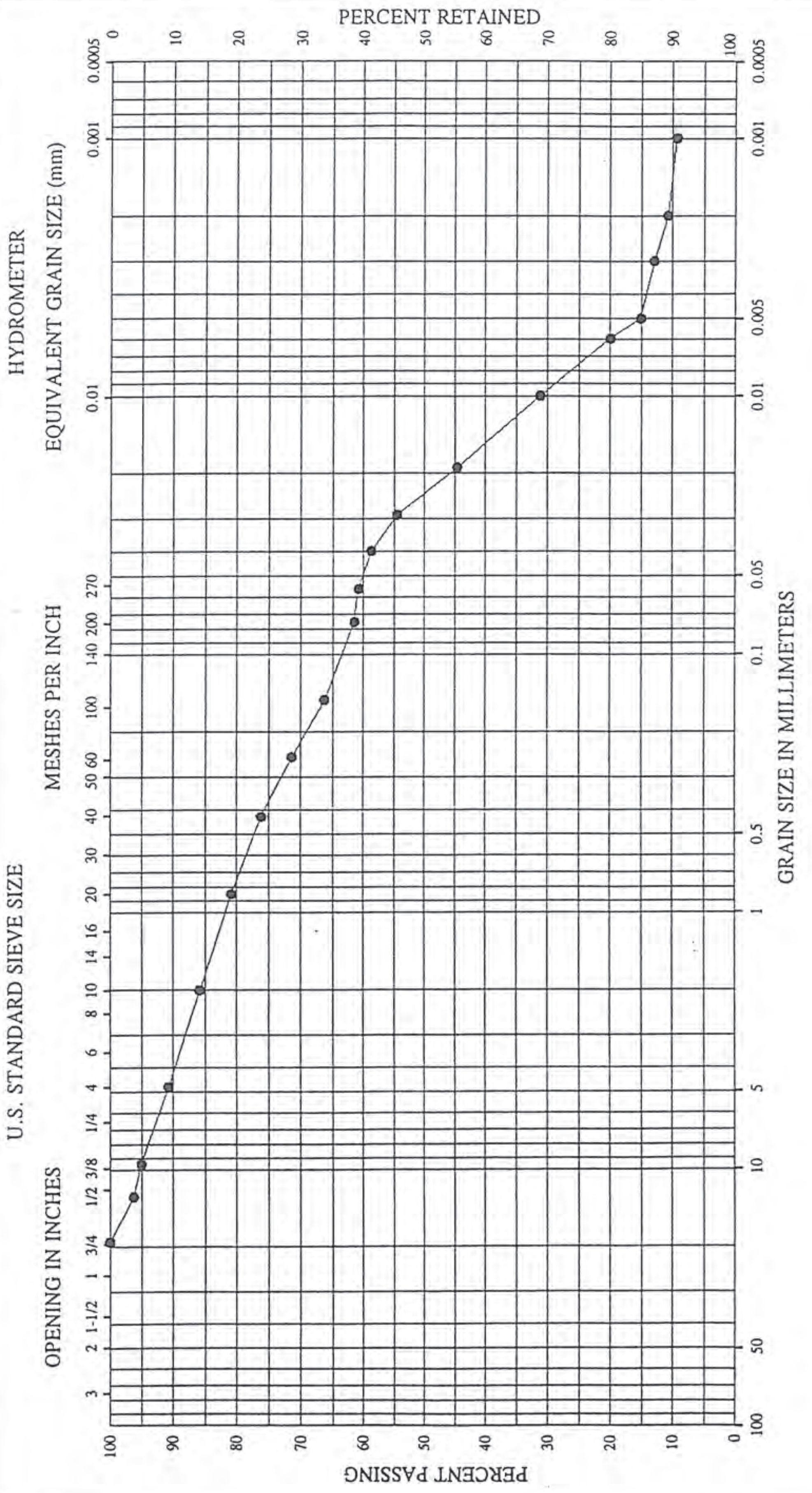


BOREHOLE No.	SAMPLE	DEPTH	DESCRIPTION
● BH 94-5	SS-9	7.80	silty sand, some gravel, trace clay

JACQUES WHITFORD

GRAIN SIZE DISTRIBUTION

APPENDIX: 4
FIGURE: 3
PROJECT: 30464



GRAVEL		SAND			SILT and CLAY
coarse	fine	coarse	medium	fine	

Unified Soil Classification

BOREHOLE No.	SAMPLE	DEPTH	DESCRIPTION
● BH 94-9	SS-7	8.00	sandy silt, trace gravel and clay

Attachment D

GSC Seismic Hazard Calculator

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.534N 74.988W **User File Reference:** Plantagenet Lagoon 2022-06-28 20:39 UT

Requested by: Thurber Engineering Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.544	0.311	0.189	0.055
Sa (0.1)	0.627	0.368	0.232	0.074
Sa (0.2)	0.516	0.308	0.195	0.065
Sa (0.3)	0.387	0.232	0.148	0.050
Sa (0.5)	0.272	0.161	0.102	0.035
Sa (1.0)	0.132	0.078	0.050	0.017
Sa (2.0)	0.062	0.036	0.023	0.007
Sa (5.0)	0.016	0.009	0.005	0.001
Sa (10.0)	0.006	0.003	0.002	0.001
PGA (g)	0.332	0.199	0.125	0.040
PGV (m/s)	0.226	0.129	0.079	0.024

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

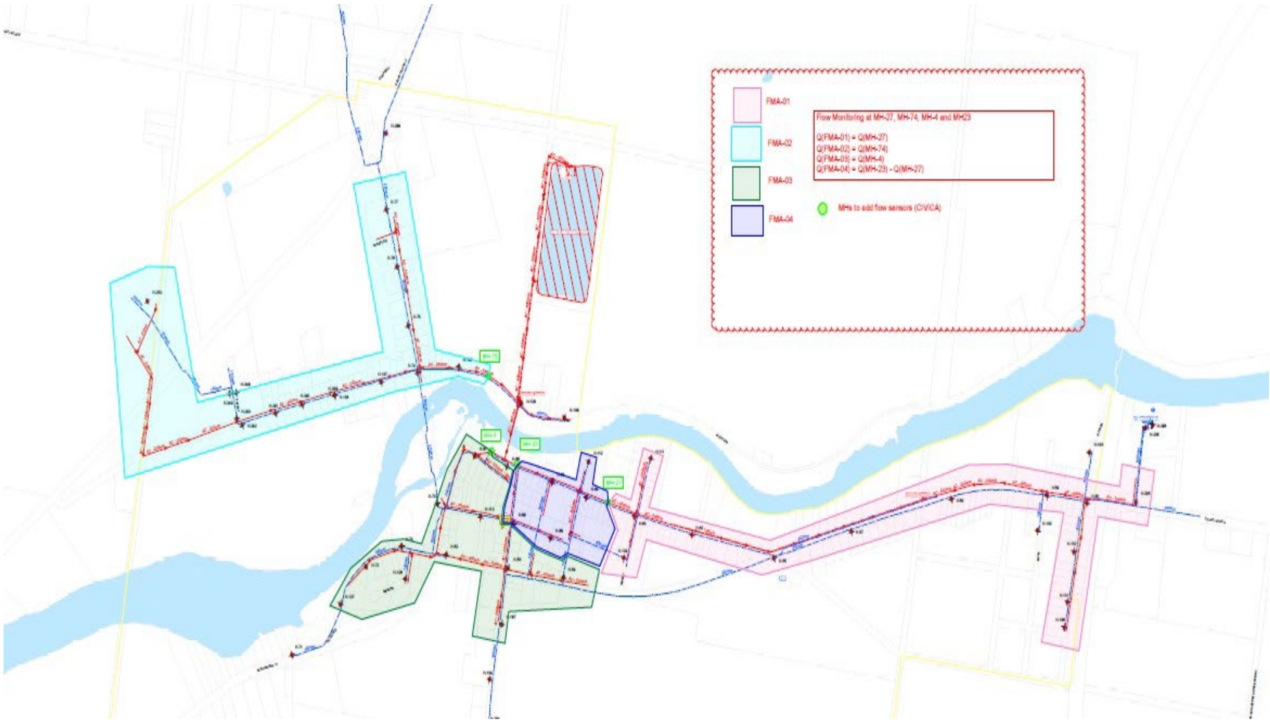
See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Appendix B4

Flow Monitoring Study Report (Civica, 2023)

J.L. Richards & Associates Limited

31457 - Plantagenet WW Class EA – Flow Monitoring Plan



Project Number: CIVICA Ref: JLR21-0002
Date of Report: April 06, 2023
Client Name: J.L. Richards & Associates Limited.

CIVICA
Water Management Solutions

330 Rodinea Road, Unit 3
Vaughan, Ontario, Canada L6A 4P5
Phone: (905) 417-9792
Fax: (866) 318-2465
www.civi.ca | info@civi.ca

STATEMENT OF QUALIFICATIONS AND LIMITATIONS

The attached Report (the “Report”) has been prepared by Civica Infrastructure Inc. (the “Consultant”) at the request of, and for the exclusive use of, the Hatch Ltd. (the “Client”) in accordance with the terms of agreement between the Consultant and the Client, including the scope of work detailed therein (the “Agreement”).

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CIVICA
Water Management Solutions

April 6, 2023 **CIVICA Ref: JLR21-0002**

J.L. Richards & Associates Limited
700 - 1565 Carling Avenue
Ottawa, ON
K1Z8R1

Attention: Nicholas Bialik and Jordan Morrissette

Dear Mr. Bialik and Mr. Morrisette,

RE: 31457 - Plantagenet WW Class EA – Flow Monitoring Plan

Civica Infrastructure Inc. (Civica) is pleased to submit this Final Report of the flow monitoring results collected for Plantagenet Flow Monitoring for J.L. Richards & Associates Limited. This document outlines the results of the flow monitoring conducted and details the flow metrics for the monitored area. The objective is to determine the flow conditions at the monitoring locations to help perform a sanitary sewer capacity analysis and identify required improvements to the existing sanitary sewer system.

The major conclusions from the monitoring data collected are:

1. Flow monitoring data was collected for one 3-month period from March 2nd, 2022 to May 20th, 2022.
2. Five flow monitoring stations were installed in the four selected manholes to determine dry-weather flow metrics and wet-weather flow analysis. The four flow meters were **MH-77**, **MH-4**, **MH-27**, and **MH-23** where **MH-23** had two monitoring stations in the same manhole: **MH-23A** and **MH-23B.** Station: MH-23A is located downstream of station: MH-27.
3. Civica rain gauge, JLR-RG was used to analyze rainfall data during the monitoring period. Five (5) rainfall events greater than 15 mm were recorded in the near vicinity of the flow monitoring catchments during this monitoring period. All captured rainfall events had a return period of less than 2 years at a Tc of 60 min. The largest volume event was captured on April 7th, 2022, which produced 39 mm of rainfall over 40 hours.
4. The average normalized dry-weather flow measured at the **MH-77** flow monitoring site is 471 L/c/d. The average normalized dry-weather flow measured at the **MH-4** flow monitoring site is 480 L/c/d. The average normalized dry-weather flow measured at the **MH-27** flow monitoring site is approximately 568 L/c/d. The average normalized dry-weather flow measured at the **MH-23A** flow monitoring site is 656 L/c/d. The average normalized dry-weather flow measured at the **MH-23B** flow monitoring site is 347 L/c/d.
5. The projected 25-year I/I rate for **MH-77** is 0.901 L/s/ha, for **MH-4** is 0.976 L/s/ha, for **MH-27** is 0.928 L/s/ha, for **MH-23A (pump isolated)** is 0.848 L/s/ha and for **MH-23B** is 0.856 L/s/ha.
6. The ground water infiltration rate (GWI) was found to be 0.034 L/s/ha at **MH-77**, 0.052 L/s/ha at **MH-4**, 0.039 L/s/ha at **MH-27**, 0.045 L/s/ha at **MH-23A** and 0.038 L/s/ha at **MH-23B**.

7. **MH-4** frequently experienced submerged flow conditions (backwater affects) and surcharging during rainfall events. This is caused by downstream capacity restriction such as partial blockage or reverse sloped pipe. Submergence, or back water effects typically began at a flow rate of 6L/s (about 20% of typical pipe capacity), while surcharge or full pipe typically occurred at a flow rate of 8L/s (about 28% of typical pipe capacity).

Do not hesitate to contact us for further clarification and/or comment.

Sincerely,

Civica Infrastructure Inc.

Alex Ding, M.A.Sc	Maaz Rizvi
Project Manager	Intermediate Project Analyst

Encl. 31457 - Plantagenet WW Class EA – Flow Monitoring Plan

Cc. Nicholas Bialik and Jordan Morrissette, J.L. Richards & Associates Limited

TABLE OF CONTENTS

List of Figures

List of Tables

Appendices

1.0 Introduction

Civica was retained by J.L. Richards & Associates Limited to perform flow monitoring of the sanitary sewers located in the Township of Alfred and Plantagenet. The flow monitoring assignment was conducted for 3 months in one period, from March 2nd, 2022 to May 20th, 2022. This report summarizes the sanitary sewer flow monitoring results for the monitoring period.

1.1 *Objectives*

The objective of this project was to install, operate, and analyze the data collected from flow meters installed within the sanitary sewers. The primary purpose of the flow monitoring is to determine dry-weather flow metrics and wet-weather flow at the selected locations in the Township of Alfred and Plantagenet. The collected flow data will be used to perform a sanitary sewer capacity analysis and identify required improvements to the existing sanitary sewer system.

1.2 *Selection of Flow Monitoring Locations*

The flow monitoring locations were selected by J.L. Richards & Associates Limited. Upon site inspection, low flow conditions were found at the prospective flow monitoring locations, therefore Detectronic (Detec) flow meters were used at three stations while ADS flow meters were used at two stations. The Detect Area/Velocity (A/V) sensors were mounted on Trapezoidal Flumes (primary flow monitoring device) and installed in the inlets of the pipe at the selected locations along with a Downward sensor to provide redundancy. The ADS Area/Velocity (A/V) sensors were installed in MH-23 at each of the two pipe inlets (no primary device).

1.3 *Study Area*

The study area is in the Town of Plantagenet located in Ontario. A schematic showing the flow monitoring locations and the rain gauge location can be seen in **Figure 1-1**.

Table 1-1 provides location summary for each sensor. The flow monitoring assignment was completed on May 20th, 2022.

Table 1-1: Flow Monitoring and RG Location Summary

Station	Address	Start Date	Finish Date	Land Use	Equipment Installed
MH-77	241 Pitch Off Rd Plantagenet, ON	March 02, 2022	May 20, 2022	Residential and ICI	Trapezoidal Flume with Detec AV + Downward Sensor
MH-27	565 Water St Plantagenet, ON	March 03, 2022	May 20, 2022	Residential and ICI	ADS: (2) x AV sensor
MH-23	300 Water St Plantagenet, ON	March 03, 2022	May 20, 2022	Residential and ICI	Trapezoidal Flume with Detec AV + Downward Sensor
MH-4	253 Water St Plantagenet, ON	March 02, 2022	May 20, 2022	Residential and ICI	Trapezoidal Flume with Detec AV + Downward Sensor
JLR-RG	403 Pitch Off Rd Plantagenet, ON	March 03, 2022	May 20, 2022	Residential and ICI	Heated Rain Guage (Detec)

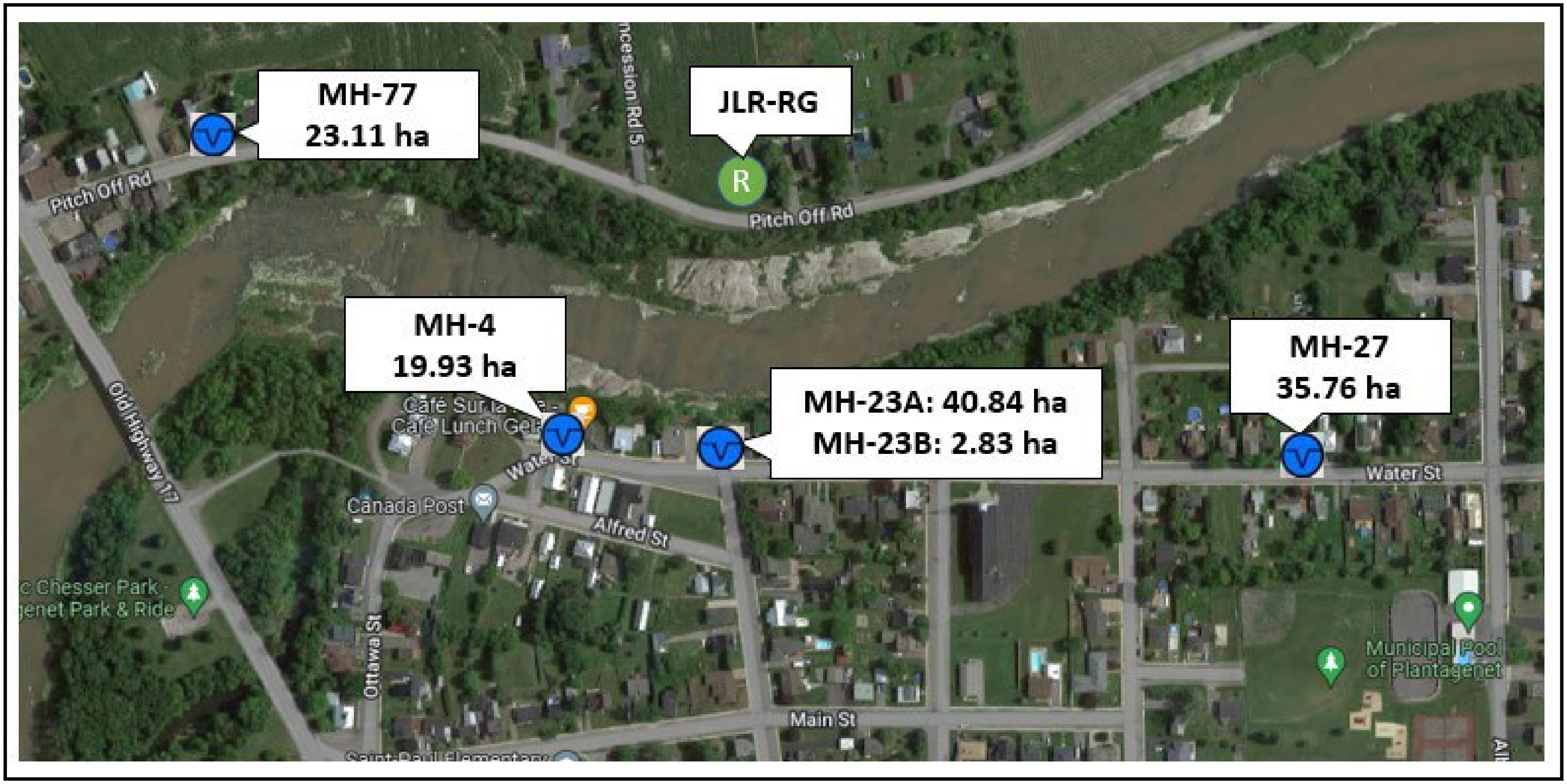

Figure 1-1: Study Area

2.0 Methodology

Collected flow and rainfall data assists in characterizing general flow conditions of the catchment areas and provides an understanding of flow metrics and flow conditions of the monitoring location from March 2022 to May 2022.

Monitoring equipment which captures flow, using area velocity meters, or depth sensors are used for calculating the flow metrics. The data collected during the monitoring period will be displayed, managed, and analyzed using Civica's DataCurrent system.

2.1 *Rainfall Monitoring*

Civica used its own rain gauge (JLR-RG) for rainfall data. The JLR-RG rain gauge is located south of Concession Rd 5 on Pitch Off Rd in Plantagenet which is equal to or less than 0.4 km away from all 4 flow monitoring locations. The data downloaded from the Civica rain gauge was used to support the wet-weather flow data analysis. An Intensity-Duration-Frequency (IDF) analysis was performed to classify and compare the measured storms to the Ottawa IDF.

2.2 *Flow Monitoring*

As previously stated, Detectronic (Detec) flow meters were used at three stations while ADS flow meters were used at two stations. The Detect Area/Velocity (A/V) sensors were mounted on Flumes and installed in the inlets of the pipe at the selected locations along with a Downward sensor to provide redundancy. The ADS flow meter with two monitoring stations, each monitoring station being an Area/Velocity sensor, was installed in MH-23 to capture flows from MH-23A and MH-23B. The flow meters collected data in a 5-minute interval to ensure high-resolution flow data was recorded. Station: MH-23A is located downstream of station: MH-27. The flow meters were calibrated after installation for quality assurance purposes. Data collected from the meters was sent four times daily through telemetry. An automated alarm system alerted Civica staff of potential flow meter issues. The data collected during this project was collected, managed, and analyzed using the DataCurrent software system.

2.3 *Data QA/QC and Process*

The data retrieved remotely from the on-site data loggers is immediately sent through a comprehensive data screening and QA/QC process and stored in a database on the cloud. The real-time data will be organized and presented through Civica's DataCurrent software. The data screening applies real-time verification of the data by testing values of velocities, levels, and flow against:

- Trend analysis for identifying debris build up.
- Dry weather flow confidence limits (e.g., 99% confidence limits)
- Dry weather flow trends for average, peak, and minimum
- Manning's value of velocity (scatter-point analysis)
- Response during wet weather conditions (rainfall and snowmelt)

Confidence limits and trend analysis will incorporate statistics previously collected by Civica. These verification tests ensure that data which measures outside of normal limits can be evaluated prior to data certification and application to further analysis. This methodology ensures the best data reliability and accuracy of coverage.

Quality Assurance and Quality Control (QA/QC) of monitoring data is critical to ensure accurate and reliable analysis results.

2.4 *Analysis of Flow Monitoring Data*

A sanitary sewer system receives two (2) flow components that have been analyzed during this project: 1) Dry-Weather Flow (DWF); and 2) Wet-Weather Flow (WWF). The DWF component is separated into population- generated sewage wastewater flow and groundwater infiltration (GWI). Population sewage wastewater flow is produced by routine water usage in the residential, commercial, and industrial areas of a given sanitary collection system. Dry-weather GWI will enter the collection system when the relative depth of the groundwater table is higher than the elevation of the pipeline, and when the condition of the sanitary sewer pipe allows infiltration through defects, such as cracks, misaligned joints, and broken pipelines. GWI is not specific to a single rainfall event. Instead, it affects the collection system over an entire year (including the dry-weather season).

The data collected was analyzed for rainfall-derived inflow and infiltration (RDII) and dry-weather flow (DWF) metrics.

The WWF component includes stormwater inflow, trench infiltration, and groundwater infiltration. WWF is generally a response to a meteorological change within the study area. There are several physical and residual factors that impact the rate of extraneous flow into the sanitary flow after a WWF event. The analysis completed within the study focuses on the factors that are easily measured and quantifiable, such as sanitary flow and rainfall. **Figure 2-1** below illustrates a typical flow monitoring response to rainfall.

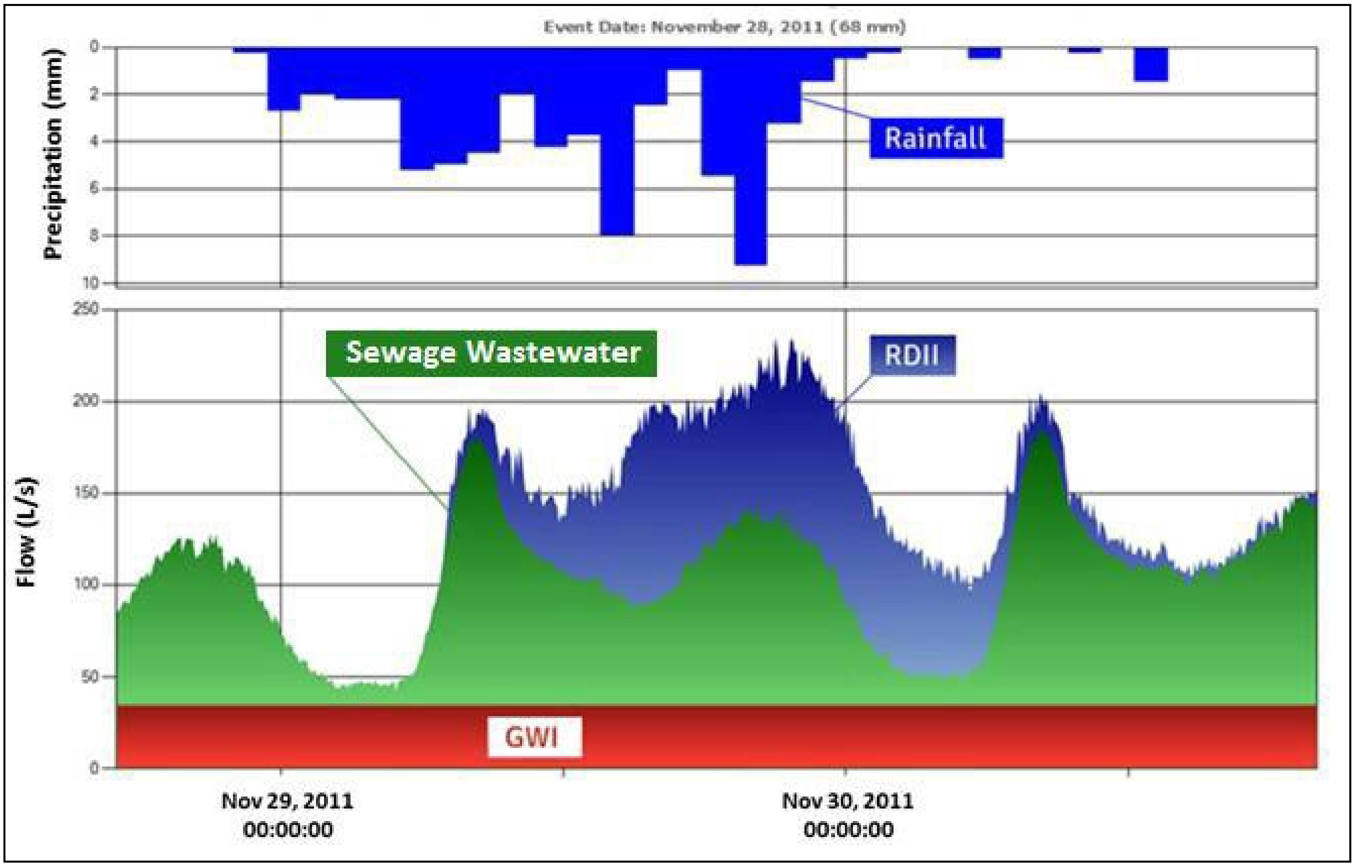

Figure 2-1: Sanitary Flow Components

Peak I/I per hectare is the main metric used to assess the overall I/I condition of a catchment and is based off the peak RDII flow measured at a flow monitoring station divided by the area upstream. This metric is useful for comparing the I/I between two catchments and to prioritize field investigations aimed at identifying sources of I/I.

The wet-weather analysis separates the dry and wet-weather contributions. The peak wet-weather response is then compared with the peak rainfall intensity. The events have been "normalized" by correlating storm intensities over the time of concentration of the catchment with measured peak I/I flow rates during events with greater than 15 mm of rainfall.

2.5 *Inflow and Infiltration (I/I) Analysis*

The rainfall derived inflow and infiltration (I/I) is inflow and infiltration directly influenced by the intensity and duration of a storm event. An I/I analysis is completed for all storms greater than or equal to 15 mm during the monitoring period and analyzes the peak RDII flow captured.

For accurate correlation, both rainfall and the flow data sets are presented in the same time zone and do not apply any daylight savings time changes. The estimated DWF for each storm event is calculated using the average dry-weather flow data captured 30 days prior to and 30 days following the storm event. The RDII flow is the difference captured between measured flow and estimated DWF during a wet-weather event. The floating and suspended debris in sanitary flow is expected to build up on A/V sensors and create spikes and noise in flow data. To mitigate this concern, cleaning and manual calibrations is carried out every 6 to 10 weeks, as is needed. The sensors will be calibrated on-site by Civica staff using independent manual depth and velocity probes during these maintenance visits. These visits also include:

- Debris and sedimentation clean up
- Invasive manual depth checks on a known frequency
- Independent velocity checks
- Battery level checks
- Telemetry checks
- Manual data download

The peak RDII flow value is the greatest difference between the 5-minute incremental measured flow and estimated DWF. To ensure the RDII flow value selected is from the RDII response, only spikes in flow occurring during the captured rainfall or within three (3) iterations of the station's Tc of peak rainfall intensity are selected for RDII analysis. Spikes in the flow occurring outside of the captured rainfall are not selected as it can be a non-RDII related response for a catchment.

2.5.1 **I/I Projections**

Once the peak I/I rates captured are plotted against the peak rainfall intensity for all storms greater than or equal to 15 mm, a linear line of best fit through zero will be established. The relationship found between the peak rainfall intensity for the flow meter and the RDII rate is used to extrapolate the projected peak RDII flow.

3.0 Summary of Results

3.1 *Rainfall Analysis*

The number and magnitude of significant storms are important for assessing the suitability of the data for model calibration. The greater the number and larger the magnitude of storms, the more reliable and accurate the I/I flow assessment. All rain events were captured by the Civica rain gauge (JLR-RG) installed within 0.4 km of the study area. Events greater than 15 mm are generally considered to be significant, as these are roughly twice the size of an average storm and are used as the minimum cut-off point for events included in an RDII analysis. The rain gauge used for the flow monitoring stations can be found in **Table 3-1.**

Table 3-1: Rain Gauges Assigned to Flow Monitoring Stations

Station	Distance (km) from JLR-RG to the station
MH-77	0.3
MH-4	0.2
MH-23	0.2
MH-27	0.4

A summary of rainfall events captured during the monitoring period is provided as follows: Nine (9) rainfall events greater than 5 mm, five (5) rainfall events greater than 15 mm and four (4) rainfall events greater than 20 mm. As there was no Time of Concentration value provided by the client, an assumption of TC = 60 mins was made for the wet weather flow analysis. Based on this assumption the Peak Intensity over TC captured durring the monitoring period was 15.8 mm/hr and occured on May 15th, 2022.

As more than three rainfall events are needed for accurate I/I analysis and I/I projection, events greater than 15 mm captured by the Civica rain gauge (JLR-RG) were used in this report. The number and magnitude of significant storms measured throughout the monitoring period are important for assessing the RDII response for storms with different peak intensities. The largest volume event was captured on April 7th, 2022, which produced 39 mm of rainfall over 40 hours.

Table 3-2 represents the summary of the rainfall amount and peak intensity for events greater than 15 mm captured by the Civica rain gauge JLR-RG at different timesteps. All rainfall events had a return period of less than 2 years for a Tc of 60 min.

Table 3-2: Rainfall Event Characteristics for RG-041 Summary

			Recorded Peak Intensity over Tc (mm/hr)	Return Period of Peak Intensity
Event	Total Precipitation (mm)	Duration (hr)	Tc = 60 min	Tc = 60 min
2022-March-18	21.8	46.17	5.8	<2 Year
2022-March-23	17.8	8.75	6.3	<2 Year
2022-April-07	39.0	40.25	3.0	<2 Year
2022-May-15	24.5	13.00	15.8	<2 Year
2022-May-16	25.0	20.50	8.8	<2 Year

Figure 3-1 highlights the IDF analysis performed for the rain events with the highest intensities captured by the Civica rain gauge (JLR-RG). All events presented in the IDF chart are above 15 mm. The largest volume event was captured on April 7th, 2022 which produced 39 mm of rainfall over 40.25 hours.

Plantagenet Flow Monitoring IDF Analysis – JLR-RG

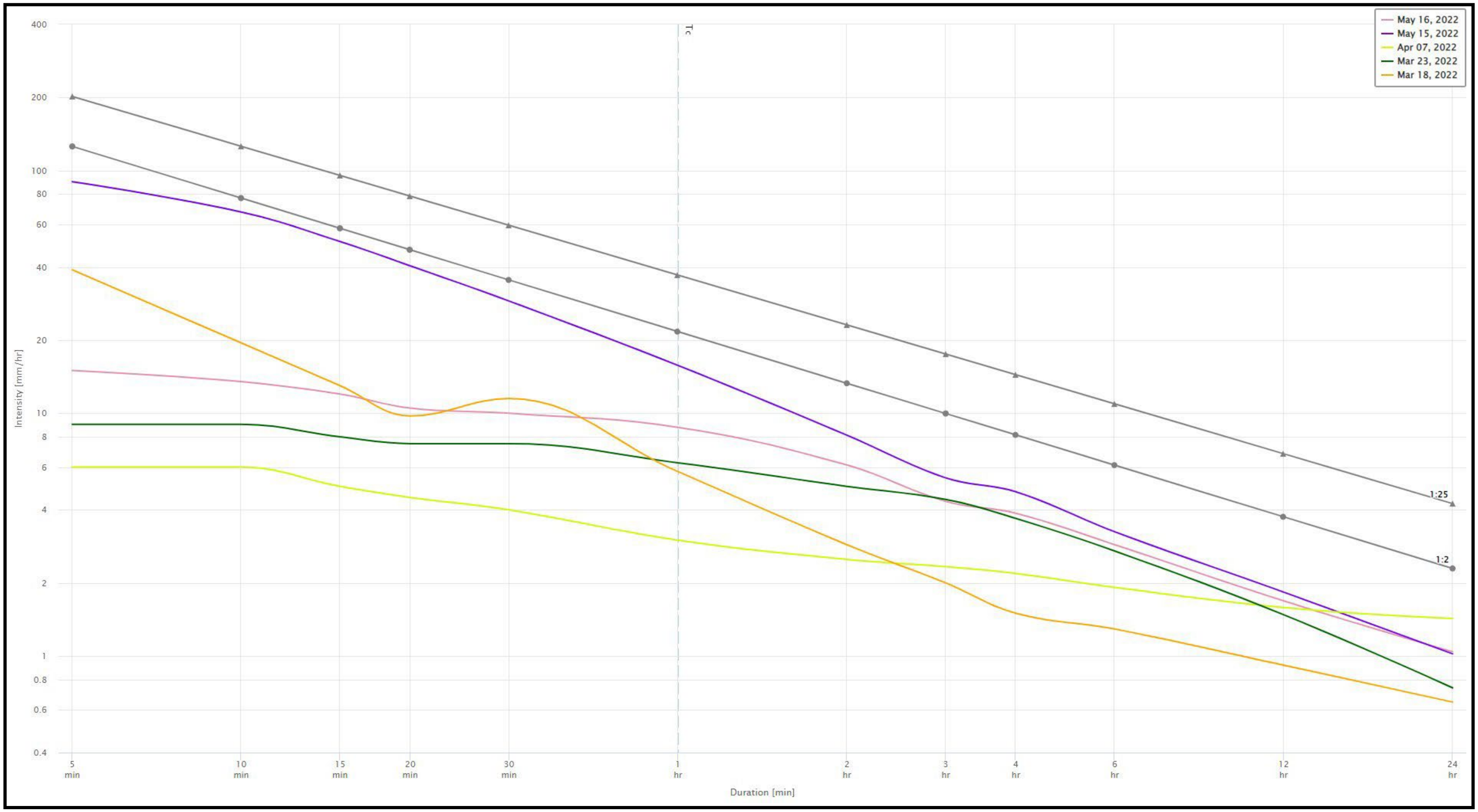

Figure 3-1: IDF Analysis for the rainfall events in Plantagenet Flow Monitoring

3.2 *Dry-Weather Flow Analysis*

Flows during dry days outside of the recessive influence of past rain events were selected to characterize the dry-weather flow generation rates. The following dry-weather flow (DWF) parameters have been calculated:

- Average Dry-Weather Flow (L/s)
- Average Daily Maximum Dry-Weather Flow (L/s)
- Average Daily Minimum Dry-Weather Flow (L/s)
- Dry-Weather Groundwater Infiltration (L/s/ha)

The average DWF is a combination of sewage and groundwater infiltration, with sewage typically being the largest proportion. The Minimum DWF typically occurs at night-time (between 1:00 am and 3:00 am), and for smaller sewer sheds it is typically 70-90% groundwater infiltration (GWI). (The percentage of GWI is typically less in large sewer sheds, due to a larger proportion of the customer sewage flow arriving at the basin outlet after a longer delay in transit).

For the purposes of this study, the GWI is 85% of the minimum DWF. Dry-weather GWI will enter the sewer system when the depth of the groundwater table is higher than the elevation of the pipeline, and reaches joint, or pipe defects; as well as, when the condition of the sewer pipe allows for infiltration (e.g., water level outside of the pipe is higher than inside). Seasonal variations of GWI occur due to changes in groundwater table elevations and soil saturation. Typically, rates increase during springtime after snowmelt, and can remain relatively constant over weeks, and months thereafter. The DWF results for the flow monitors are presented in **Table 3-3.**

Table 3-3: Dry-weather Flow Analysis for all Stations

Flow Monitor	Catchment Area [ha]	Population	Maximum DWF[1] [L/s]	Minimum DWF[2] [L/s]	Average normalized DWF [L/c/d]	GWI[3] [L/s/ha]
MH-77	23.11	313	4.890	0.928	471	0.034
MH-4	19.93	356	5.247	1.237	480	0.052
MH-23A	40.84	564	7.692	2.180	656	0.045
MH-23B	2.83	74	1.105	0.128	347	0.038
MH-27	35.76	423	6.083	1.667	568	0.039

[1] Average Daily Dry-Weather Flow Maximum
[2] Average Daily Dry-Weather Flow Minimum
[3] Dry-Weather Groundwater Infiltration: 85% of Average Daily Dry-Weather Flow Minimum

Monthly data charts and sanitary reports can be found in the **Appendices.**

3.3 *Wet Weather Event Flow Analysis*

Wet-weather flow (WWF) includes stormwater runoff inflow, trench infiltration, and groundwater infiltration, and is generally a response to a rain event within the study area.

The wet-weather flow response for the flow monitors have been reviewed and analyzed to estimate the peak inflow and infiltration (I/I) rate during each storm. The peak I/I flow values selected are the highest reported I/I flow value occurring during the rain event or within three (3) iterations of the station's Tc. The WWF results for the flow monitors are presented in **Table 3-4.**

Table 3-4: Wet-weather Flow Analysis for all Stations

MH ID	Peak measured I/I event date	Peak measured I/I Flow (L/s)	Peak measured I/I Rate (L/s/ha)	1:25 year I/I rate projection (L/s/ha)	Peak Precipitation Intensity Over Tc = 60min (mm/hr)
MH-77	Apr 07, 2022	6.195	0.268	0.901	15.8
MH-27	Mar 23, 2022	12.440	0.347	0.928	
MH-23A	Mar 23, 2022	12.729	0.312	0.848	
MH-23B	Apr 07, 2022	1.224	0.437	0.856	
MH-4	Apr 07, 2022	9.570	0.481	0.976	

MH-4 frequently experienced submerged flow conditions (backwater affects) and surcharging during rainfall events. This is caused by downstream capacity restriction such as partial blockage or reverse sloped pipe. Submergence, or back water effects typically began at a flow rate of 6L/s (about 20% of typical pipe capacity), while surcharge or full pipe typically occurred at a flow rate of 8L/s (about 28% of typical pipe capacity).

The detailed I/I graphs can be found in the **Appendices.**

4.0 Conclusions

4.1 ***Conclusions***

Based on the findings of this report, the following conclusions can be made:

1. Flow monitoring data was collected for one 3-month period from March 2nd, 2022 to May 20th, 2022.
2. Five flow monitoring stations were installed in the four selected manholes to determine dry-weather flow metrics and wet-weather flow analysis. The four flow meters were **MH-77**, **MH-4**, **MH-27**, and **MH-23** where **MH-23** had two monitoring stations in the same manhole: **MH-23A** and **MH-23B.** Station: MH-23A is located downstream of station: MH-27.
3. Civica rain gauge, JLR-RG was used to analyze rainfall data during the monitoring period. Five (5) rainfall events greater than 15 mm were recorded in the near vicinity of the flow monitoring catchments during this monitoring period. All captured rainfall events had a return period of less than 2 years at a Tc of 60 min. The largest volume event was captured on April 7th, 2022, which produced 39 mm of rainfall over 40 hours.
4. The average normalized dry-weather flow measured at the **MH-77** flow monitoring site is 471 L/c/d, 480 L/c/d at **MH-4**, 568 L/c/d at **MH-27**, 656 L/c/d at **MH-23A,** and 347 L/c/d at **MH-23B**.
5. The projected 25-year I/I rate for **MH-77** is 0.901 L/s/ha, for **MH-4** is 0.976 L/s/ha, for **MH-27** is 0.928 L/s/ha, for **MH-23A** is 0.848 L/s/ha and for **MH-23B** is 0.856 L/s/ha.
6. The ground water infiltration rate (GWI) was found to be 0.034 L/s/ha at **MH-77**, 0.052 L/s/ha at **MH-4**, 0.039 L/s/ha at **MH-27**, 0.045 L/s/ha at MH-23A and 0.038 L/s/ha at **MH-23B**.
7. **MH-4** frequently experienced submerged flow conditions (backwater affects) and surcharging during rainfall events. This is caused by downstream capacity restriction such as partial blockage or reverse sloped pipe. Submergence, or back water effects typically began at a flow rate of 6L/s (about 20% of typical pipe capacity), while surcharge or full pipe typically occurred at a flow rate of 8L/s (about 28% of typical pipe capacity).

5.0 Recommendations:

The following recommendations are proposed from the findings of this project:

1. The projected I/I rates are more accurate with capture of higher intensity and larger volume storms. In future, longer monitoring period should be considered for flow monitoring.
2. To identify sources of inflow to the catchments, a detailed drainage inventory followed by smoke and dye testing is recommended.
3. Wet-weather sewer inspections and pipe and MH condition can also help to ensure that the sanitary system is water-tight and reduce entrance of extraneous flows to the sanitary system.
4. It is also recommended to cross reference the **1:25 year I/I rate projection** against the design criteria specified for the flow monitoring region to see if the projections presented in this report are with in conformity or out of conformity.
5. It is also recommended to investigate the flow capacity restriction downstream of **MH-4** through comparison to design or as-built capacity and through sewer inspection.

Appendices

Plantagenet Flow Monitoring

Monitoring Period: March 02, 2022 – May 22, 2022

Generated on: Apr 06, 2023

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Table of Contents

Monitoring Station List

Station Name	Inlet/Outlet	Station Type	Station State	Latitude	Longitude	Start Date	End Date	Station Pipe Diameter (mm)	Catchment Area (ha)	Population	Average Dry Weather Flow (L/s)	Equipment Installed
MH-4	Inlet	Sanitary Flow	Receiving	45.5348367	-74.99457537	Mar 02, 2022	May 20, 2022	200	19.93	356	1.97	Detect: Flume with AV + Downward Sensor
MH-23A[1]	Inlet	Sanitary Flow	Receiving	45.533983	-74.994328	Mar 03, 2022	May 20, 2022	MP1: 300	40.84	564	MP1: 4.28	ADS: (2) x AV sensor
MH-23B[1]								MP2: 200	2.83	74	MP2: 0.29	
MH-27	Inlet	Sanitary Flow	Receiving	45.530575	-74.993211	Mar 03, 2022	May 22, 2022	300	35.76	423	2.78	Detect: Flume with AV + Downward Sensor
MH-77	Inlet	Sanitary Flow	Receiving	45.536126	-74.992506	Mar 02, 2022	May 22, 2022	250	23.11	313	1.70	Detect: Flume with AV + Downward Sensor

[1] Two inlets were monitored to capture the whole catchment area.

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IDF Return Period Analysis

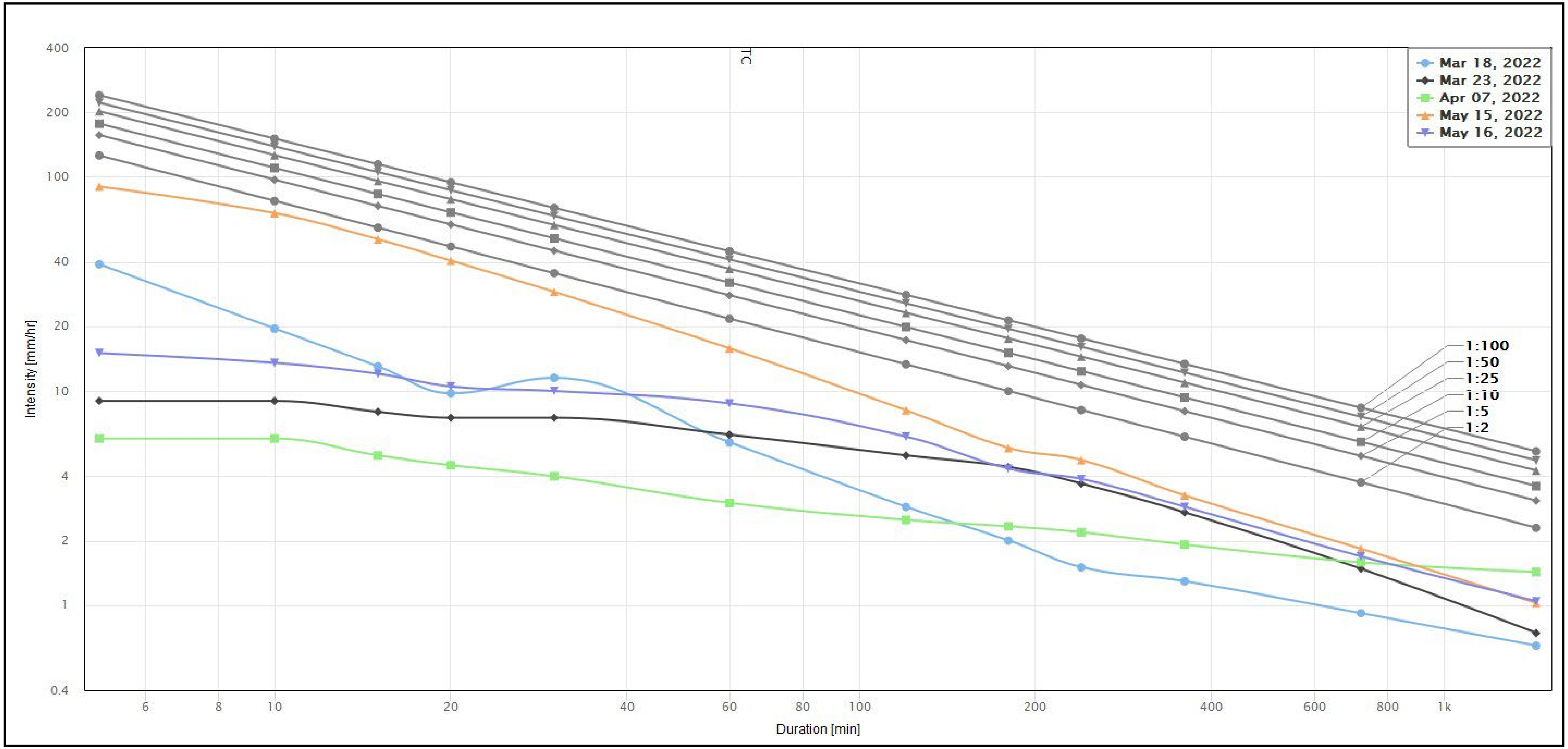

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Table 1: Ottawa IDF Design Storm

Event	Peak Intensity at Timestep (mm/hr)											
	5 min	10 min	15 min	20 min	30 min	60 min	120 min	180 min	240 min	360 min	720 min	1440 min
2 Year Storm	125.73	77.02	57.83	47.18	35.42	21.70	13.29	9.98	8.14	6.11	3.75	2.29
5 Year Storm	156.52	96.75	73.02	59.80	45.14	27.90	17.25	13.02	10.66	8.05	4.97	3.07
10 Year Storm	176.86	109.78	83.06	68.14	51.55	32.00	19.86	15.03	12.33	9.33	5.79	3.59
25 Year Storm	202.01	125.91	95.49	78.48	59.52	37.10	23.12	17.54	14.41	10.93	6.81	4.25
50 Year Storm	221.59	138.40	105.10	86.45	65.64	41.00	25.61	19.45	16.00	12.15	7.59	4.74
100 Year Storm	240.33	150.42	114.36	94.15	71.58	44.80	28.04	21.32	17.55	13.34	8.35	5.23

Table 2: IDF Return Period Results

Event	Duration (hrs)	Return Period Over Tc	Total Precipitation (mm)	Peak Intensity at Timestep (mm/hr)											
				5 min	10 min	15 min	20 min	30 min	60 min	120 min	180 min	240 min	360 min	720 min	1440 min
Mar 18, 2022	46.17	< 2 Yr	21.75	39.00	19.50	13.00	9.75	11.50	5.75	2.88	2.00	1.50	1.29	0.92	0.65
Mar 23, 2022	8.75	< 2 Yr	17.75	9.00	9.00	8.00	7.50	7.50	6.25	5.00	4.42	3.69	2.71	1.48	0.74
Apr 07, 2022	40.25	< 2 Yr	39.00	6.00	6.00	5.00	4.50	4.00	3.00	2.50	2.33	2.19	1.92	1.58	1.43
May 15, 2022	13.00	< 2 Yr	24.50	90.00	67.50	51.00	40.50	29.00	15.75	8.13	5.42	4.75	3.25	1.83	1.02
May 16, 2022	20.50	< 2 Yr	25.00	15.00	13.50	12.00	10.50	10.00	8.75	6.13	4.33	3.88	2.88	1.69	1.04

Aggregate Data

Station: MH-4

Level (Head)

Date From	Date To	Days	Min (m)	Avg (m)	Max (m)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 20, 2022	80	0.03	0.06	0.47	22,703	Sun May 08, 2022 05:45	Fri Apr 08, 2022 03:35

Velocity

Date From	Date To	Days	Min (m/s)	Avg (m/s)	Max (m/s)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 20, 2022	80	0.00	0.07	0.46	22,703	Wed Mar 02, 2022 23:05	Wed May 11, 2022 14:15

Flow

Date From	Date To	Days	Min (L/s)	Avg (L/s)	Max (L/s)	Total Volume (1 ML)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 20, 2022	80	0.00	2.47	11.14	16.81	22,702	Fri Apr 01, 2022 07:45	Fri Apr 08, 2022 03:25

Precipitation

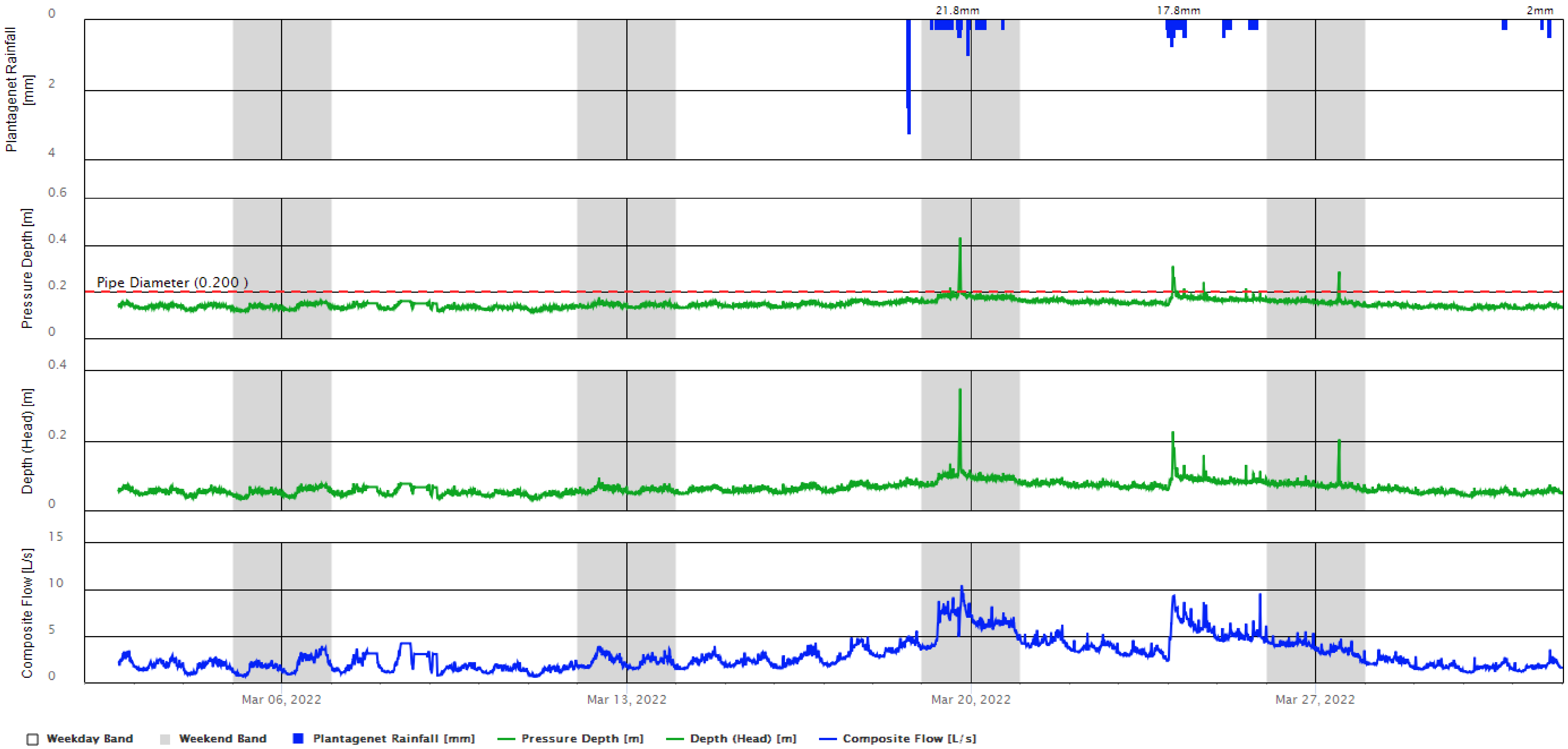
Date From	Date To	Days	Min (mm)	Avg (mm)	Max (mm)	Sum (mm)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 20, 2022	67	0.00	0.01	7.50	184.25	18,662	Wed Mar 09, 2022 20:00	Sun May 15, 2022 17:00

[1] Time of Min and Time of Max will be displayed by first occurrence

Data Chart

Station: MH-4

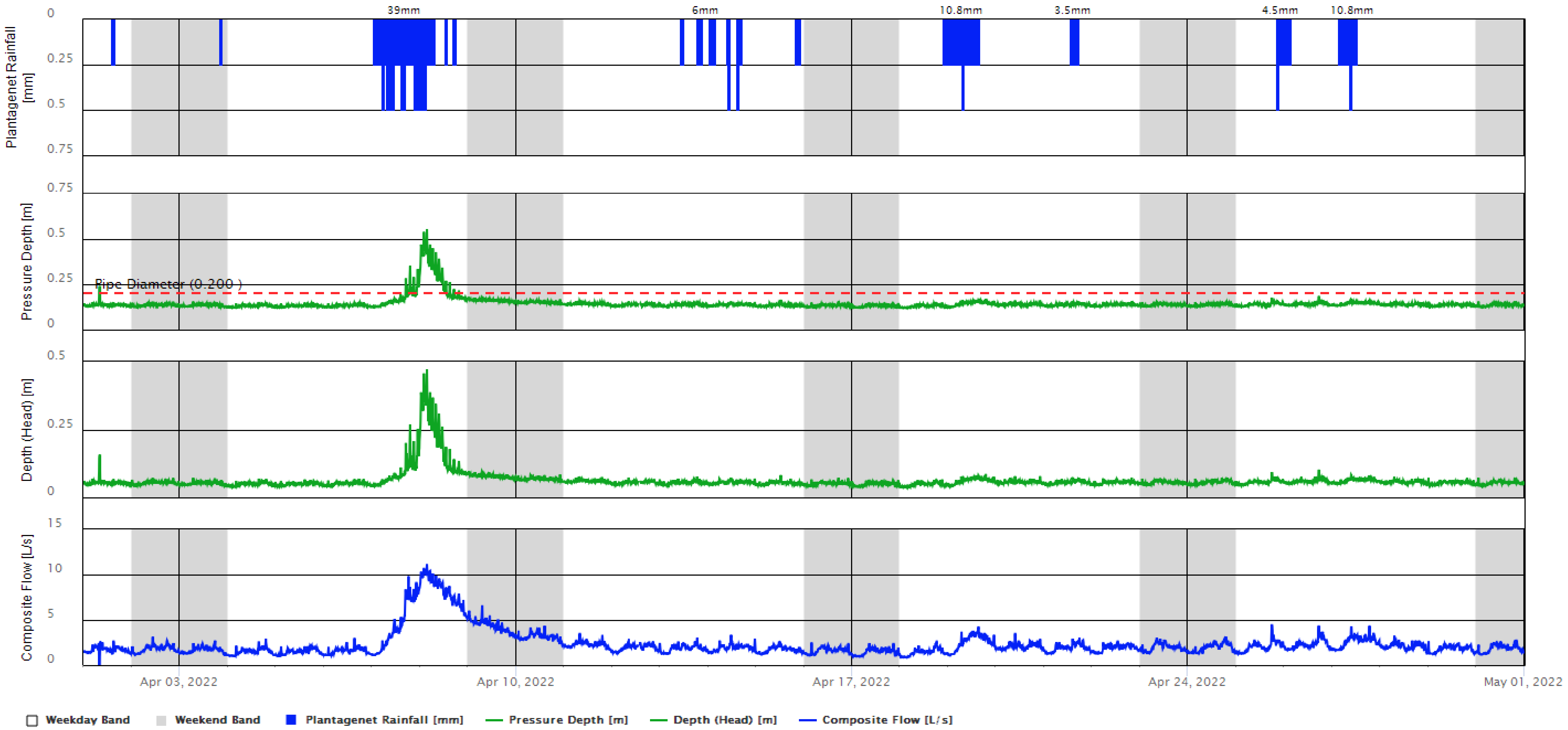
Mar 02, 2022 – Mar 31, 2022



Data Chart

Station: MH-4

Apr 01, 2022 – Apr 30, 2022



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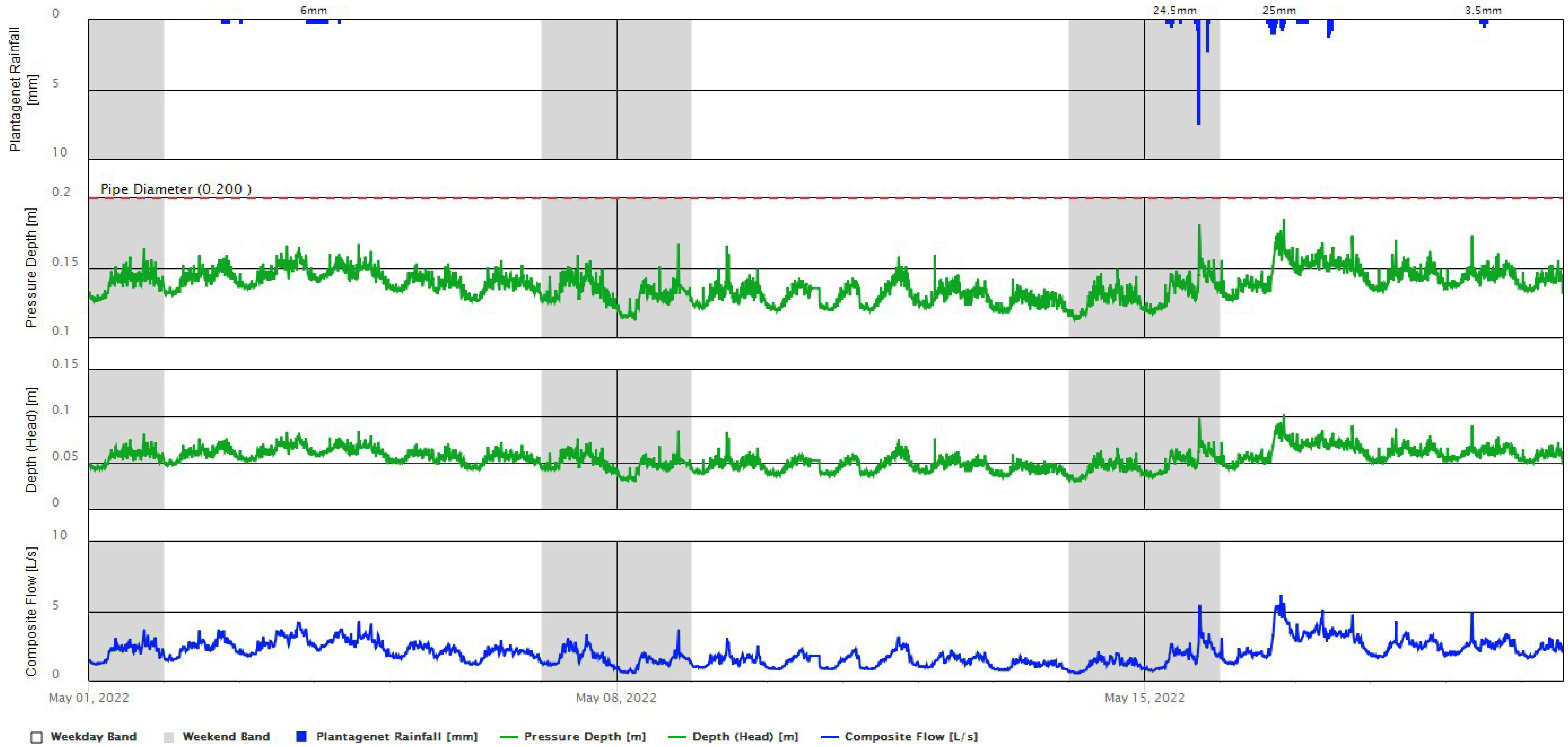
Data Chart

Station: MH-4

May 01, 2022 – May 20, 2022

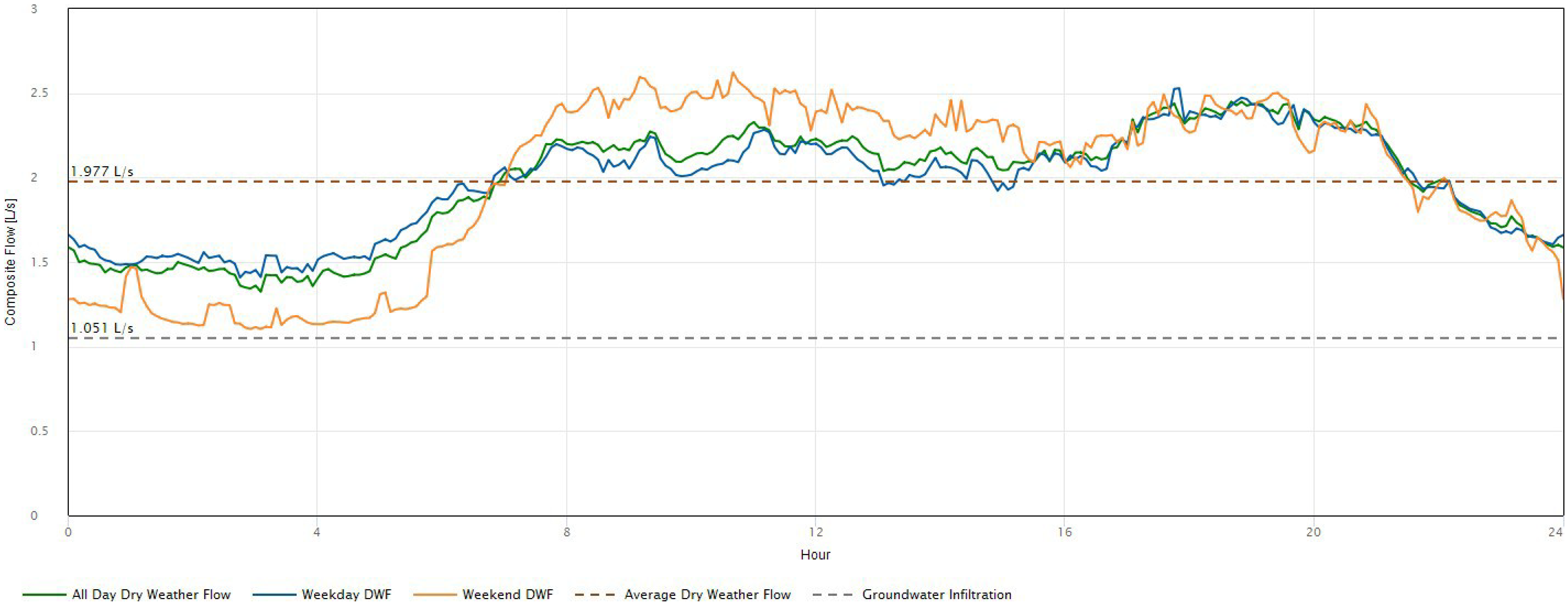


Sanitary Report

Station: MH-4

Average Dry Weather Flow (L/s)	Average Dry Weather Flow (L/c/d)	Average Daily Minimum Dry Weather Flow (L/s)	Average Daily Peak Dry Weather Flow (L/s)
1.977	479.885	1.237	3.267
Peaking Factor	**Groundwater Infiltration (L/s)[1]**	**Groundwater Infiltration (L/ha/d)**	**% of GWI in Average DWF**
1.652	1.051	4,556.893	53.161

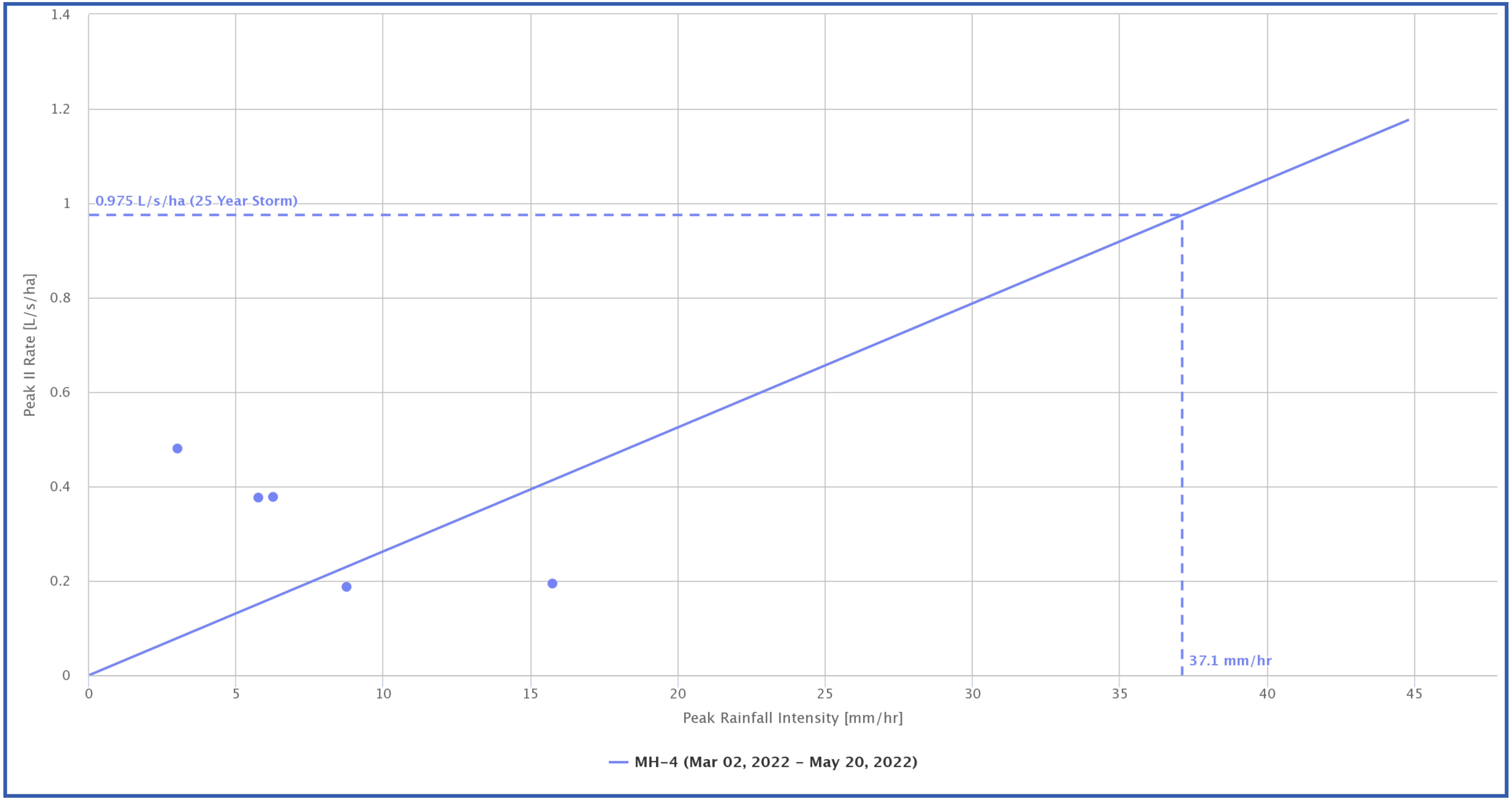
Dry Weather Flow (DWF) Pattern



[1] Groundwater infiltration (GWI) is assumed as 85% of the daily minimum flow averaged over the monitoring period

RDII Projection Graph

Station: MH-4 (19.93 ha)



I/I Analysis Table

Station: MH-4 (19.93 ha)

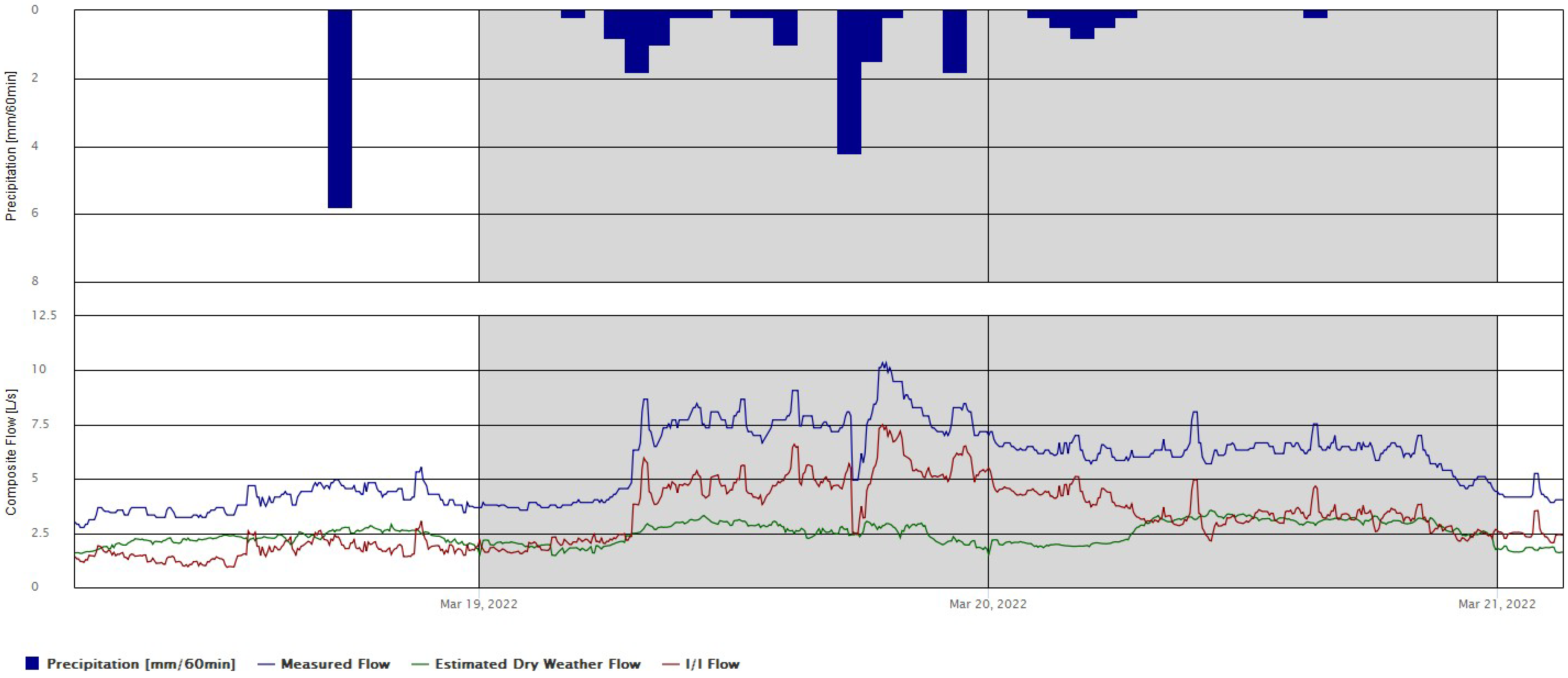
	Event[1]	Total Precipitation (mm)	Duration (hours)	Peak Intensity Over Tc=60min at Station (mm/hr)		MH-4								
						Time of Peak I/I Flow (TD) (date)	Total I/I Flow Volume during Event (L)	Estimated Dry Weather Flow at TD (L/s)	Peak I/I Flow (L/s)	Peak I/I Flow Rate (L/s/ha)	Total Dry Weather Flow Volume during Event (L)	Peak Rainfall Intensity (5 min)	Volumetric Runoff Coefficient (CV%)	Instantaneous Peaking Factor (PF)
Measured Storms	Mar 18, 2022	21.75	46.17	5.80	Flow KPIs	Mar 19, 2022 19:00	734,198.70	2.85	7.50	0.37	530,011.70	3.30	16.94 %	4.10
	Mar 23, 2022	17.75	8.75	6.20		Mar 24, 2022 02:45	319,912.10	1.65	7.53	0.37	163,473.00	0.80	9.04 %	4.30
	Apr 07, 2022	39.00	40.25	3.00		Apr 08, 2022 03:30	813,608.10	1.57	9.57	0.48	370,076.80	0.50	10.47 %	5.72
	May 15, 2022	24.50	13.00	15.80		May 15, 2022 17:15	40,978.30	1.45	3.94	0.19	142,077.40	7.50	0.84 %	3.43
	May 16, 2022	25.00	20.50	8.80		May 16, 2022 19:05	170,805.40	2.44	3.73	0.18	235,640.60	1.30	3.43 %	3.08
	Average	**25.60**	**25.73**	**7.92**			**415,900.52**	**1.99**	**6.45**	**0.32**	**288,255.90**	**2.68**	**8.14 %**	**4.13**
	Maximum	**39.00**	**46.17**	**15.80**			**813,608.10**	**2.85**	**9.57**	**0.48**	**530,011.70**	**7.50**	**16.94 %**	**5.72**

[1] An event is a storm with a minimum volume of 15mm and a minimum inter-event dry period of 12 hours

I/I Analysis Graph

Station: MH-4

Infiltration/Inflow Event Analysis
Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm



Infiltration/Inflow Event Analysis
Station: MH-4
Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm (4,334,775.00 L)

Station Details		Storm Details			
Catchment Area	19.93 ha	**Total Precipitation**	21.75 mm (4,334,775.00 L)	**Duration of Storm**	46.17 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	5.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 19, 2022 19:00	**Time of Peak I/I Flow (TD)**	Mar 19, 2022 19:00	**Estimated Dry Weather Flow at TD**	2.85 L/s
Peak Measured Flow	10.35 L/s	**Peak I/I Flow [4]**	7.50 L/s	**Peak I/I Rate [5]**	0.38 L/s/ha
Peak Measured Depth	349.00 mm [10]	**Total I/I Flow Volume during event**	734,198.70 L	**Volumetric Coefficient (Cv%) [6]**	16.94%
Total Measured Flow Volume during Event	1,264,210.40 L	**Peak I/I Coefficient [7]**	0.0236	**Hourly Wet-Weather Peaking Factor [8]**	3.92
		Instantaneous Wet-Weather Peaking Factor [9]	4.09		

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[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

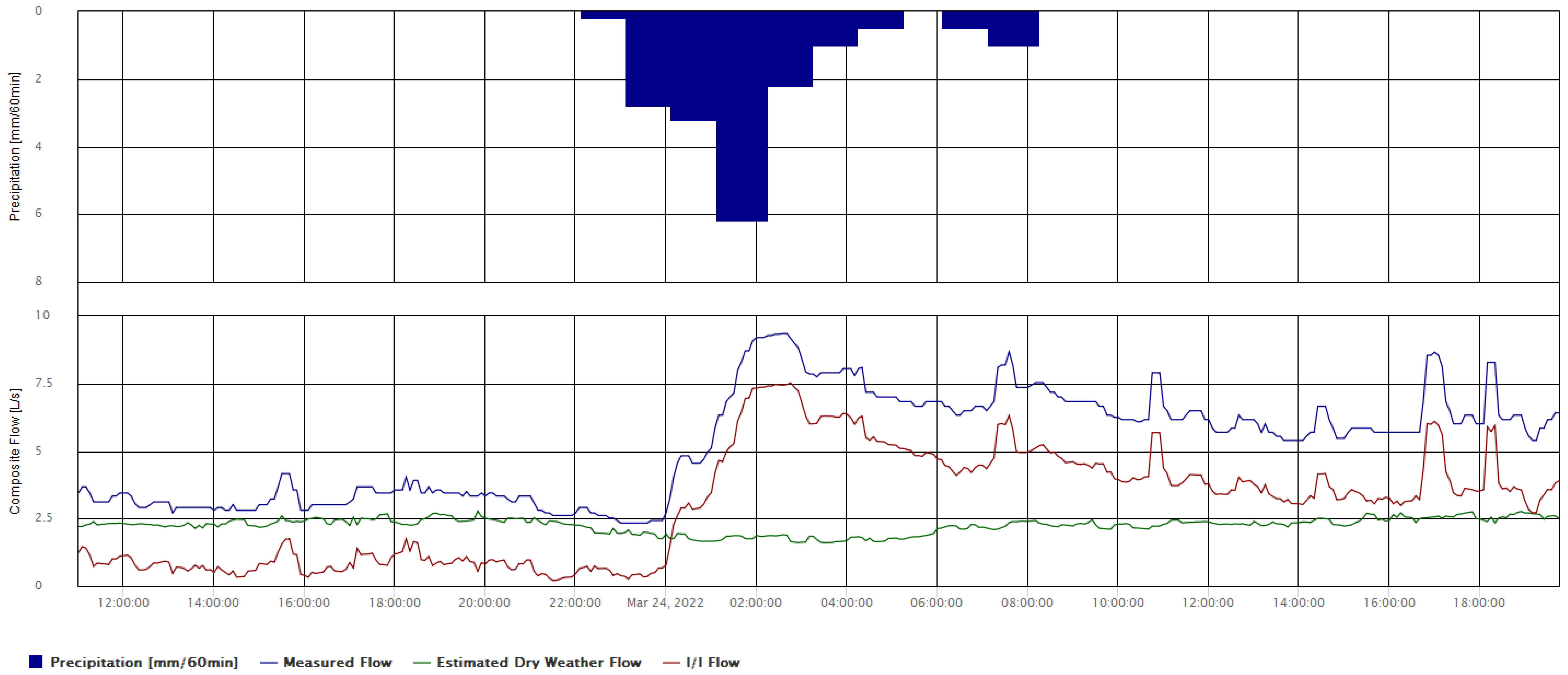
[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

[10] Captured peak depth is greater than 90% of pipe diameter, pipe containing flow monitor may have experienced surcharge

I/I Analysis Graph

Station: MH-4

Infiltration/Inflow Event Analysis
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm



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Infiltration/Inflow Event Analysis
Station: MH-4
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm (3,537,575.00 L)

Station Details		Storm Details			
Catchment Area	19.93 ha	**Total Precipitation**	17.75 mm (3,537,575.00 L)	**Duration of Storm**	8.75 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	6.20 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 24, 2022 02:35	**Time of Peak I/I Flow (TD)**	Mar 24, 2022 02:45	**Estimated Dry Weather Flow at TD**	1.65 L/s
Peak Measured Flow	9.34 L/s	**Peak I/I Flow [4]**	7.53 L/s	**Peak I/I Rate [5]**	0.38 L/s/ha
Peak Measured Depth	226.50 mm [10]	**Total I/I Flow Volume during event**	319,912.10 L	**Volumetric Coefficient (Cv%) [6]**	9.04%
Total Measured Flow Volume during Event	483,385.10 L	**Peak I/I Coefficient [7]**	0.0218	**Hourly Wet-Weather Peaking Factor [8]**	4.23
		Instantaneous Wet-Weather Peaking Factor [9]	4.29		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

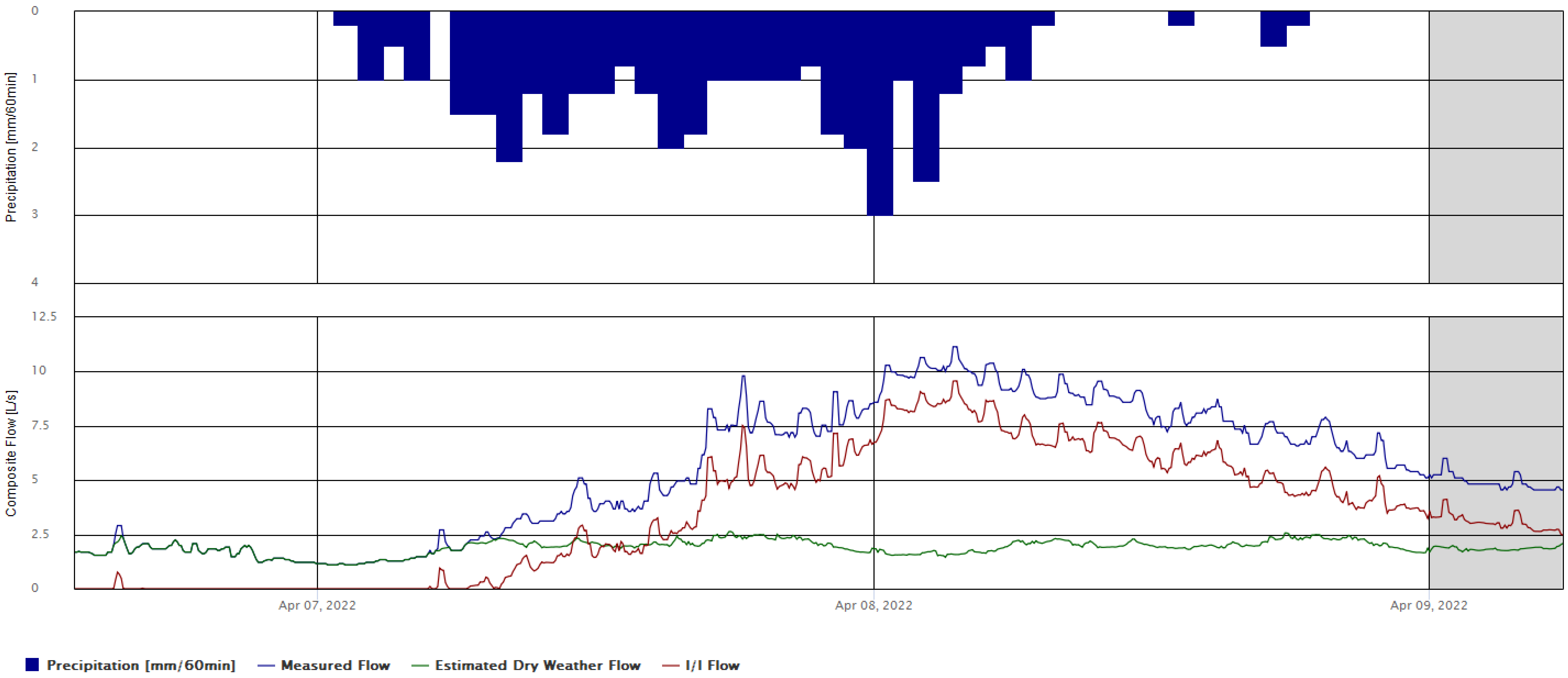
[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

[10] Captured peak depth is greater than 90% of pipe diameter, pipe containing flow monitor may have experienced surcharge

I/I Analysis Graph

Station: MH-4

Infiltration/Inflow Event Analysis
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39 mm



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Infiltration/Inflow Event Analysis
Station: MH-4
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39.00 mm (7,772,700.00 L)

Station Details		Storm Details			
Catchment Area	19.93 ha	**Total Precipitation**	39.00 mm (7,772,700.00 L)	**Duration of Storm**	40.25 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	3.00 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Apr 08, 2022 03:25	**Time of Peak I/I Flow (TD)**	Apr 08, 2022 03:30	**Estimated Dry Weather Flow at TD**	1.57 L/s
Peak Measured Flow	11.14 L/s	**Peak I/I Flow [4]**	9.57 L/s	**Peak I/I Rate [5]**	0.48 L/s/ha
Peak Measured Depth	470.00 mm [10]	**Total I/I Flow Volume during event**	813,608.10 L	**Volumetric Coefficient (Cv%) [6]**	10.47%
Total Measured Flow Volume during Event	1,183,684.90 L	**Peak I/I Coefficient [7]**	0.0576	**Hourly Wet-Weather Peaking Factor [8]**	5.35
		Instantaneous Wet-Weather Peaking Factor [9]	5.67		

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[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

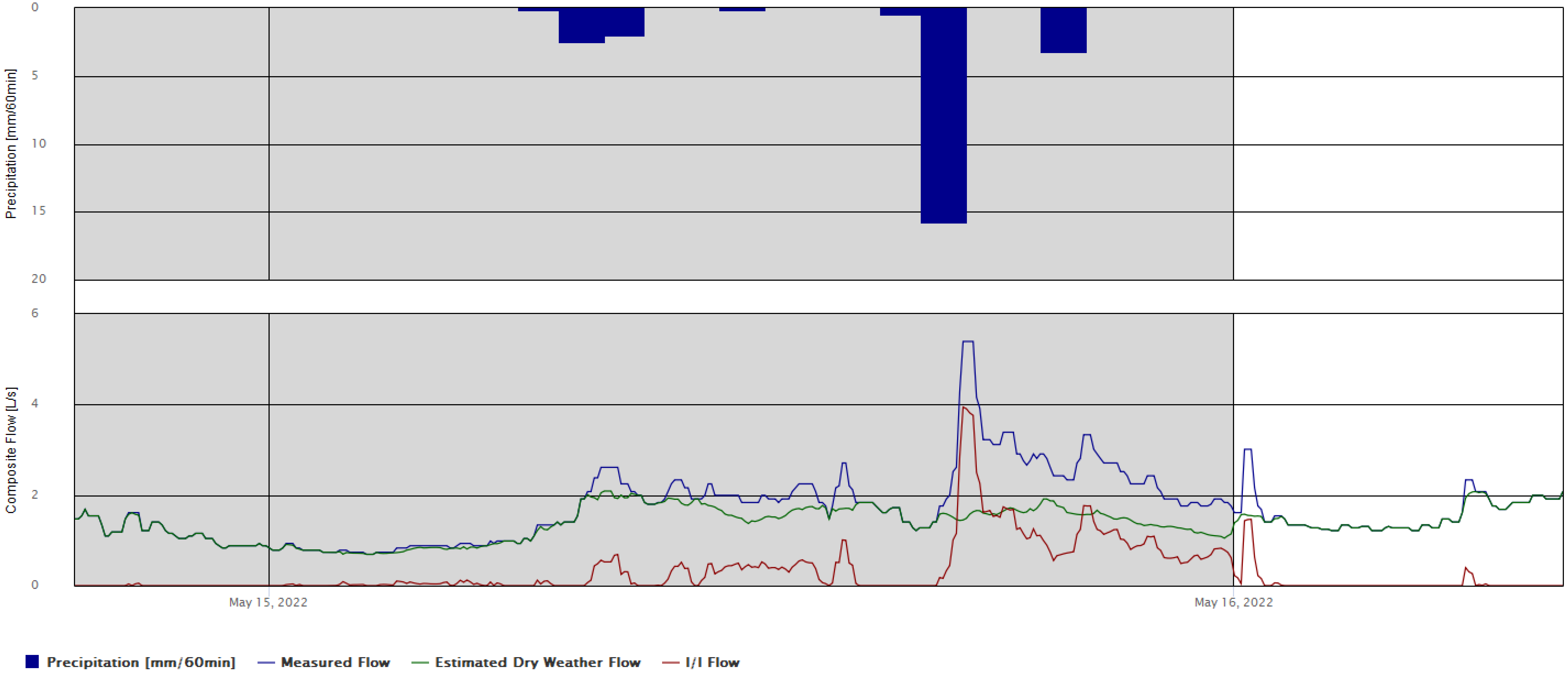
[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

[10] Captured peak depth is greater than 90% of pipe diameter, pipe containing flow monitor may have experienced surcharge

I/I Analysis Graph

Station: MH-4

Infiltration/Inflow Event Analysis
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.5 mm



Infiltration/Inflow Event Analysis
Station: MH-4
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.50 mm (4,882,850.00 L)

Station Details		Storm Details			
Catchment Area	19.93 ha	**Total Precipitation**	24.50 mm (4,882,850.00 L)	**Duration of Storm**	13.00 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	15.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 15, 2022 17:15	**Time of Peak I/I Flow (TD)**	May 15, 2022 17:15	**Estimated Dry Weather Flow at TD**	1.45 L/s
Peak Measured Flow	5.39 L/s	**Peak I/I Flow** [4]	3.94 L/s	**Peak I/I Rate** [5]	0.20 L/s/ha
Peak Measured Depth	98.00 mm	**Total I/I Flow Volume during event**	40,978.30 L	**Volumetric Coefficient (Cv%)** [6]	0.84%
Total Measured Flow Volume during Event	183,055.70 L	**Peak I/I Coefficient** [7]	0.0045	**Hourly Wet-Weather Peaking Factor** [8]	2.64
		Instantaneous Wet-Weather Peaking Factor [9]	3.43		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

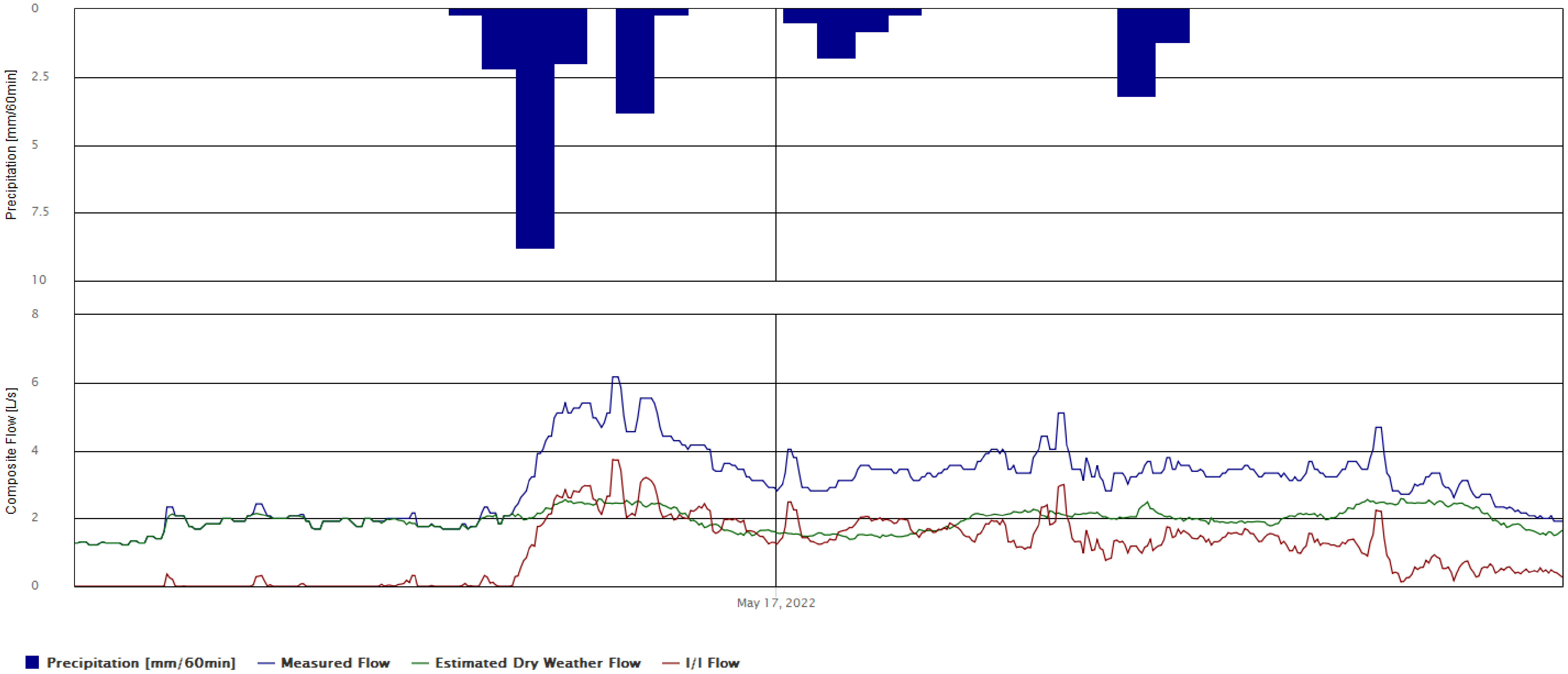
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-4

Infiltration/Inflow Event Analysis
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25 mm



Infiltration/Inflow Event Analysis
Station: MH-4
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25.00 mm (4,982,500.00 L)

Station Details		Storm Details			
Catchment Area	19.93 ha	**Total Precipitation**	25.00 mm (4,982,500.00 L)	**Duration of Storm**	20.50 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	8.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 16, 2022 19:05	**Time of Peak I/I Flow (TD)**	May 16, 2022 19:05	**Estimated Dry Weather Flow at TD**	2.44 L/s
Peak Measured Flow	6.16 L/s	**Peak I/I Flow** [4]	3.73 L/s	**Peak I/I Rate** [5]	0.19 L/s/ha
Peak Measured Depth	102.00 mm	**Total I/I Flow Volume during event**	170,805.40 L	**Volumetric Coefficient (Cv%)** [6]	3.43%
Total Measured Flow Volume during Event	406,446.00 L	**Peak I/I Coefficient** [7]	0.0077	**Hourly Wet-Weather Peaking Factor** [8]	2.66
		Instantaneous Wet-Weather Peaking Factor [9]	3.07		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

Aggregate Data

Station: MH-23A

Level

Date From	Date To	Days	Min (m)	Avg (m)	Max (m)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	79	0.01	0.04	0.09	22,461	Fri May 20, 2022 12:25	Sun May 15, 2022 17:10

Velocity

Date From	Date To	Days	Min (m/s)	Avg (m/s)	Max (m/s)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	79	0.20	0.81	1.39	22,461	Wed Mar 09, 2022 01:20	Thu Mar 24, 2022 02:30

Flow

Date From	Date To	Days	Min (L/s)	Avg (L/s)	Max (L/s)	Total Volume (1 ML)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	79	0.85	4.66	16.24	31.38	22,461	Fri May 20, 2022 12:25	Sun May 15, 2022 17:10

Precipitation

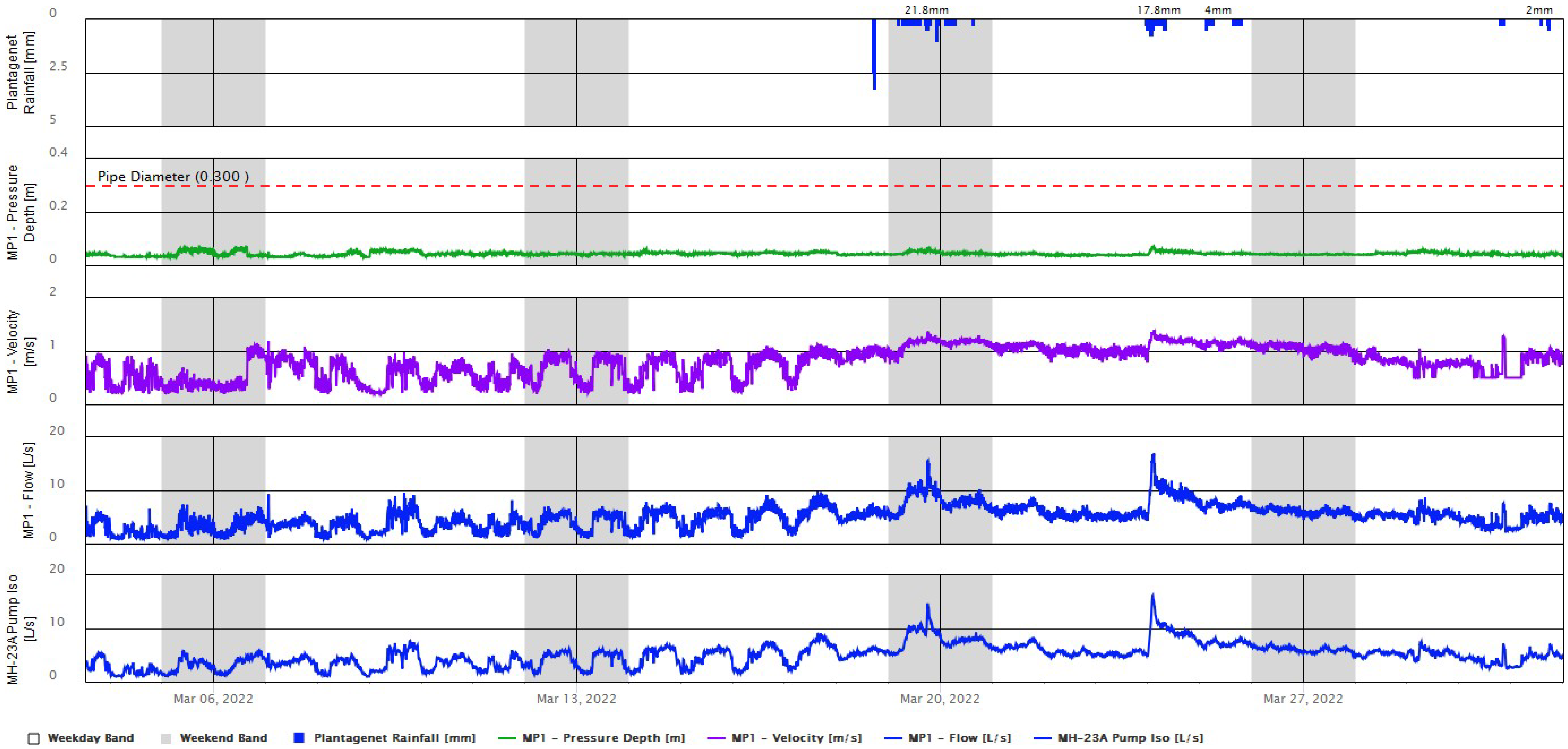
Date From	Date To	Days	Min (mm)	Avg (mm)	Max (mm)	Sum (mm)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	67	0.00	0.01	7.50	184.25	18,658	Wed Mar 09, 2022 20:00	Sun May 15, 2022 17:00

[1] Time of Min and Time of Max will be displayed by first occurrence

Data Chart

Station: MH-23A

Mar 03, 2022 – Mar 31, 2022



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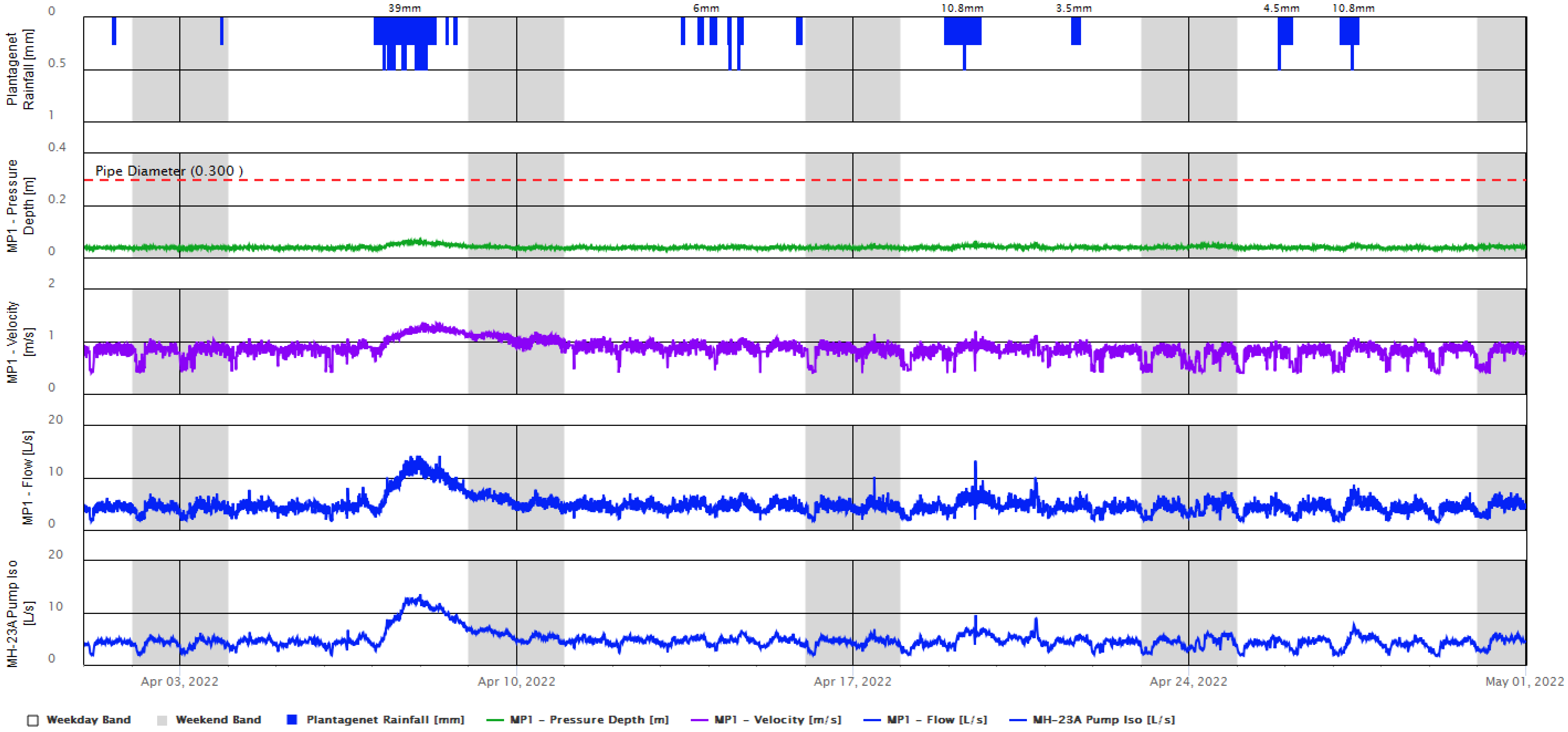
Data Chart

Station: MH-23A

Apr 01, 2022 – Apr 30, 2022



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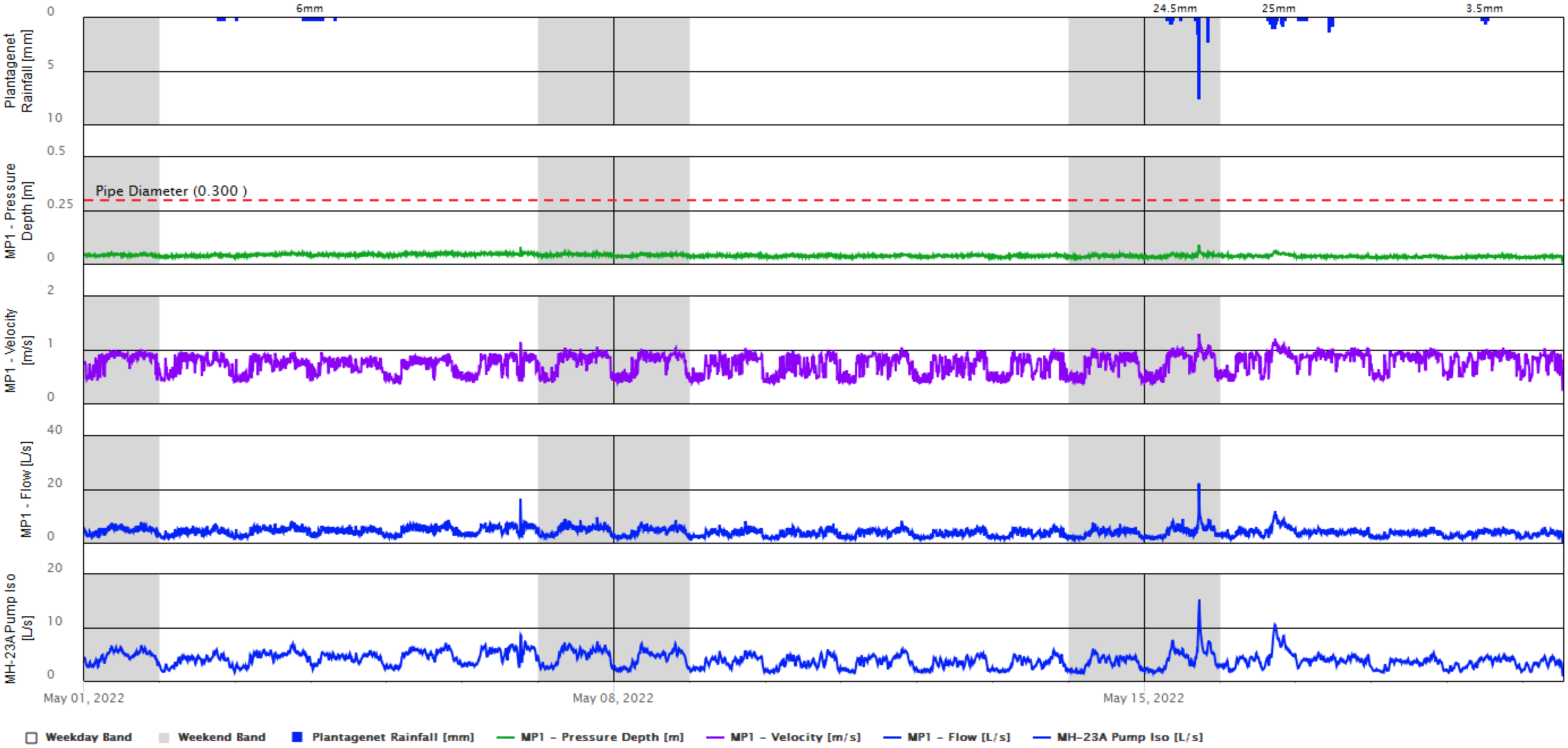
Data Chart

Station: MH-23A

May 01, 2022 – May 20, 2022

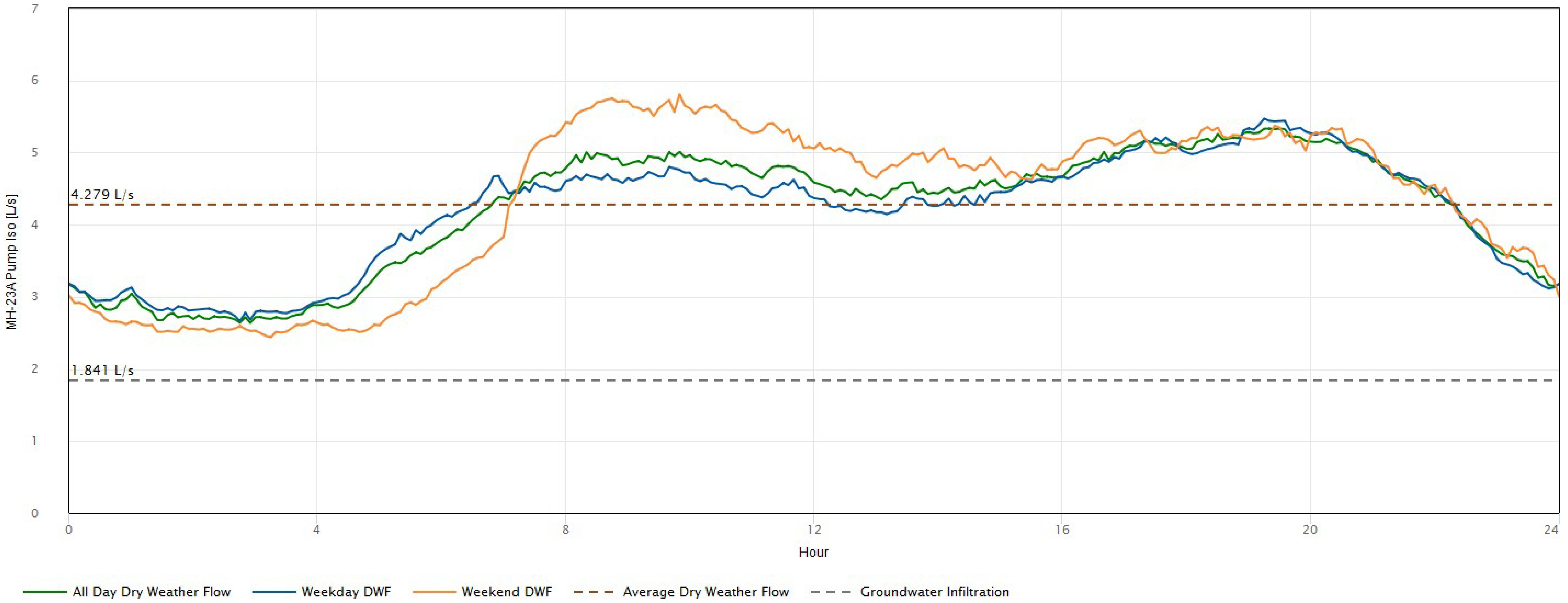


Sanitary Report

Station: MH-23A

Average Dry Weather Flow (L/s)	Average Dry Weather Flow (L/c/d)	Average Daily Minimum Dry Weather Flow (L/s)	Average Daily Peak Dry Weather Flow (L/s)
4.279	655.463	2.165	6.169
Peaking Factor	**Groundwater Infiltration (L/s)[1]**	**Groundwater Infiltration (L/ha/d)**	**% of GWI in Average DWF**
1.442	1.841	3,894.038	43.019

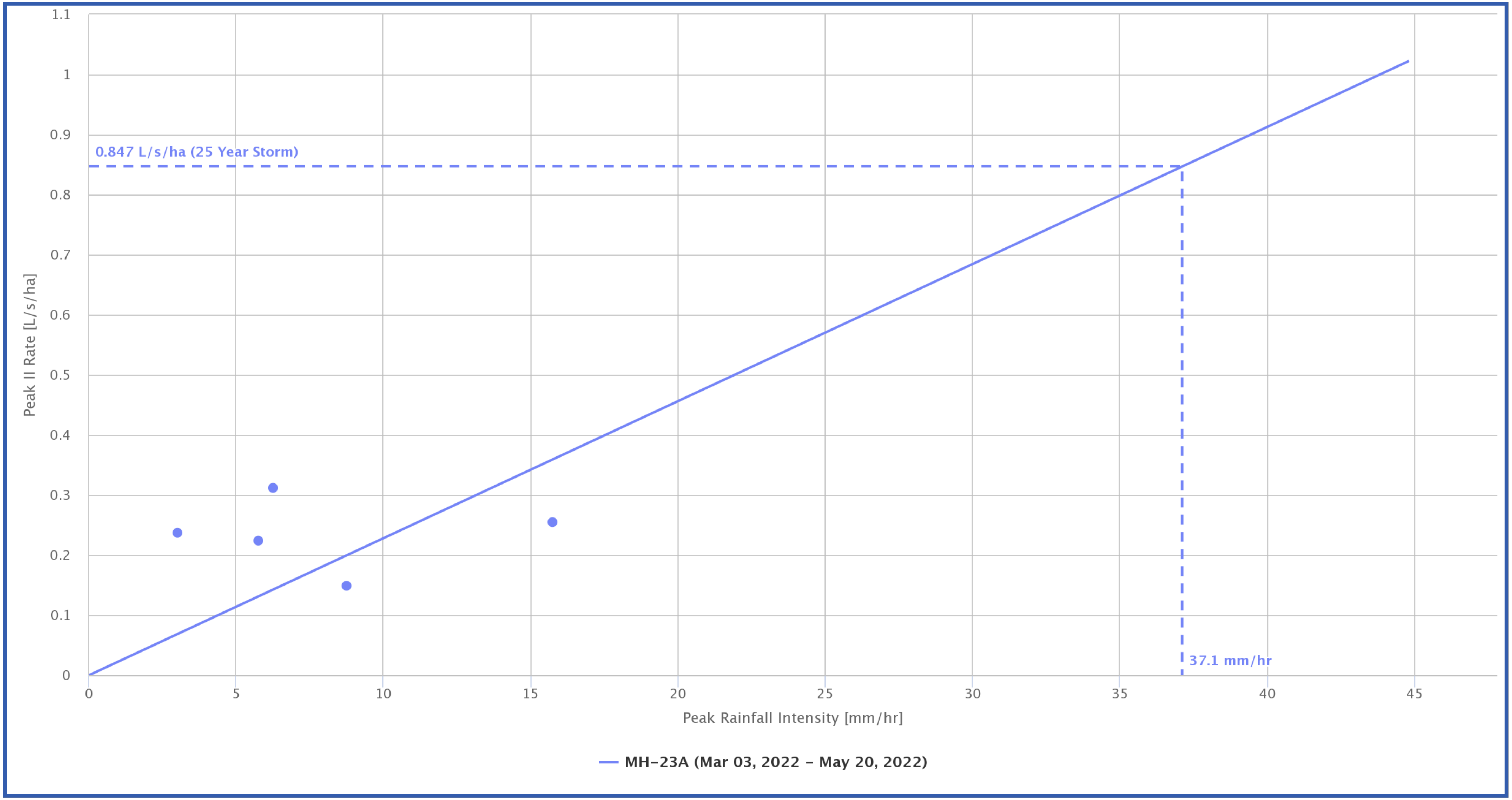
Dry Weather Flow (DWF) Pattern



[1] Groundwater infiltration (GWI) is assumed as 85% of the daily minimum flow averaged over the monitoring period

RDII Projection Graph

Station: MH-23A (40.84 ha)



I/I Analysis Table

Station: MH-23A (40.84 ha)

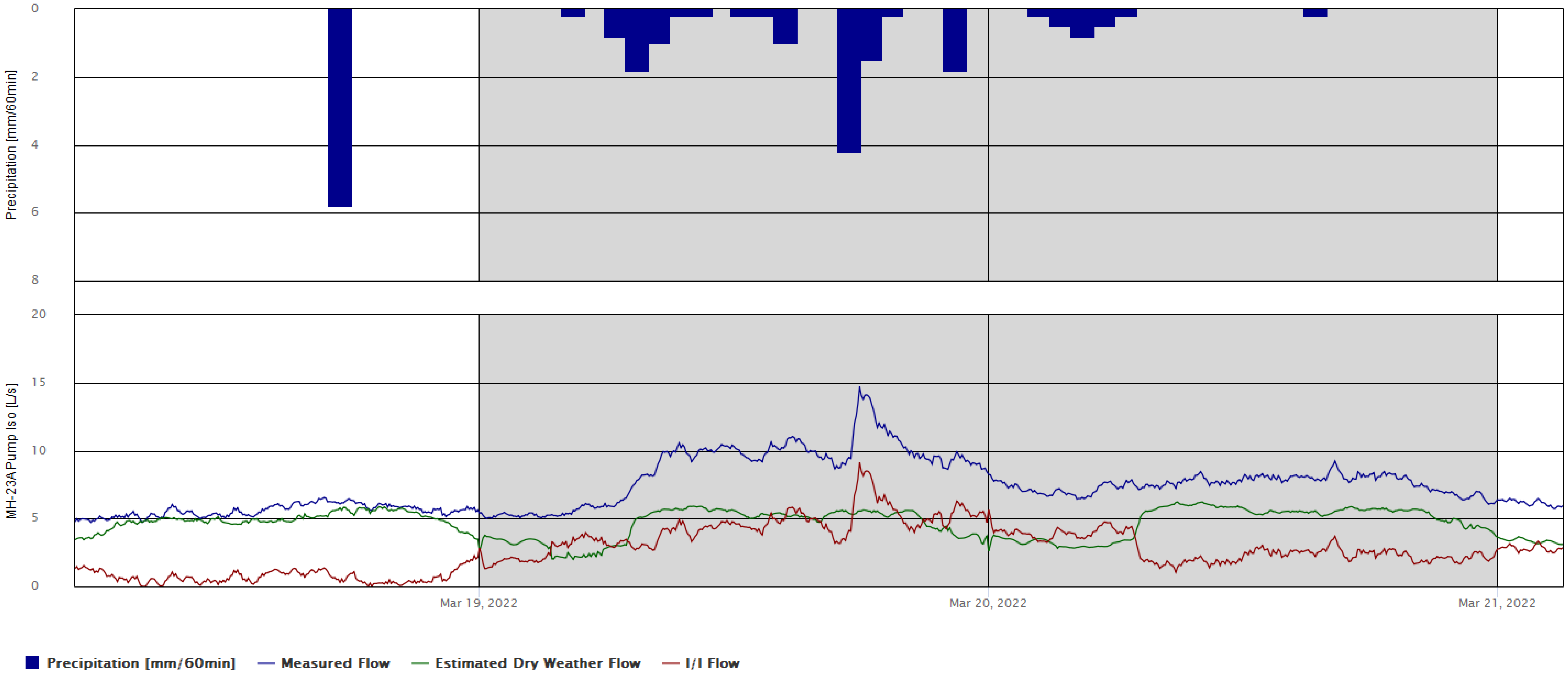
	Event[1]	Total Precipitation (mm)	Duration (hours)	Peak Intensity Over Tc=60 min at Station (mm/hr)		MH-23A								
						Time of Peak I/I Flow (TD) (date)	Total I/I Flow Volume during Event (L)	Estimated Dry Weather Flow at TD (L/s)	Peak I/I Flow (L/s)	Peak I/I Flow Rate (L/s/ha)	Total Dry Weather Flow Volume during Event (L)	Peak Rainfall Intensity (5 min)	Volumetric Runoff Coefficient (CV%)	Instantaneous Peaking Factor (PF)
Measured Storms	Mar 18, 2022	21.75	46.17	5.80	Flow KPIs	Mar 19, 2022 17:55	644,829.50	5.56	9.14	0.22	970,985.70	3.30	7.26 %	3.17
	Mar 23, 2022	17.75	8.75	6.20		Mar 24, 2022 02:10	397,615.70	3.51	12.73	0.31	345,531.50	0.80	5.49 %	3.52
	Apr 07, 2022	39.00	40.25	3.00		Apr 07, 2022 23:50	885,370.40	3.88	9.68	0.24	840,113.10	0.50	5.56 %	3.05
	May 15, 2022	24.50	13.00	15.80		May 15, 2022 17:20	56,971.10	4.89	10.40	0.25	359,930.90	7.50	0.57 %	3.88
	May 16, 2022	25.00	20.50	8.80		May 16, 2022 17:15	115,367.50	4.46	6.08	0.15	426,366.10	1.30	1.13 %	2.90
	Average	**25.60**	**25.73**	**7.92**			**420,030.84**	**4.46**	**9.61**	**0.24**	**588,585.46**	**2.68**	**4.00 %**	**3.30**
	Maximum	**39.00**	**46.17**	**15.80**			**885,370.40**	**5.56**	**12.73**	**0.31**	**970,985.70**	**7.50**	**7.26 %**	**3.88**

[1] An event is a storm with a minimum volume of 15mm and a minimum inter-event dry period of 12 hours

I/I Analysis Graph

Station: MH-23A

Infiltration/Inflow Event Analysis
Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm



Infiltration/Inflow Event Analysis
Station: MH-23A
Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm (8,882,700.00 L)

Station Details		Storm Details			
Catchment Area	40.84 ha	**Total Precipitation**	21.75 mm (8,882,700.00 L)	**Duration of Storm**	46.17 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	5.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 19, 2022 17:55	**Time of Peak I/I Flow (TD)**	Mar 19, 2022 17:55	**Estimated Dry Weather Flow at TD**	5.56 L/s
Peak Measured Flow	14.70 L/s	**Peak I/I Flow [4]**	9.14 L/s	**Peak I/I Rate [5]**	0.22 L/s/ha
Peak Measured Depth	67.14 mm	**Total I/I Flow Volume during event**	644,829.50 L	**Volumetric Coefficient (Cv%) [6]**	7.26%
Total Measured Flow Volume during Event	1,615,815.20 L	**Peak I/I Coefficient [7]**	0.0140	**Hourly Wet-Weather Peaking Factor [8]**	2.93
		Instantaneous Wet-Weather Peaking Factor [9]	3.17		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

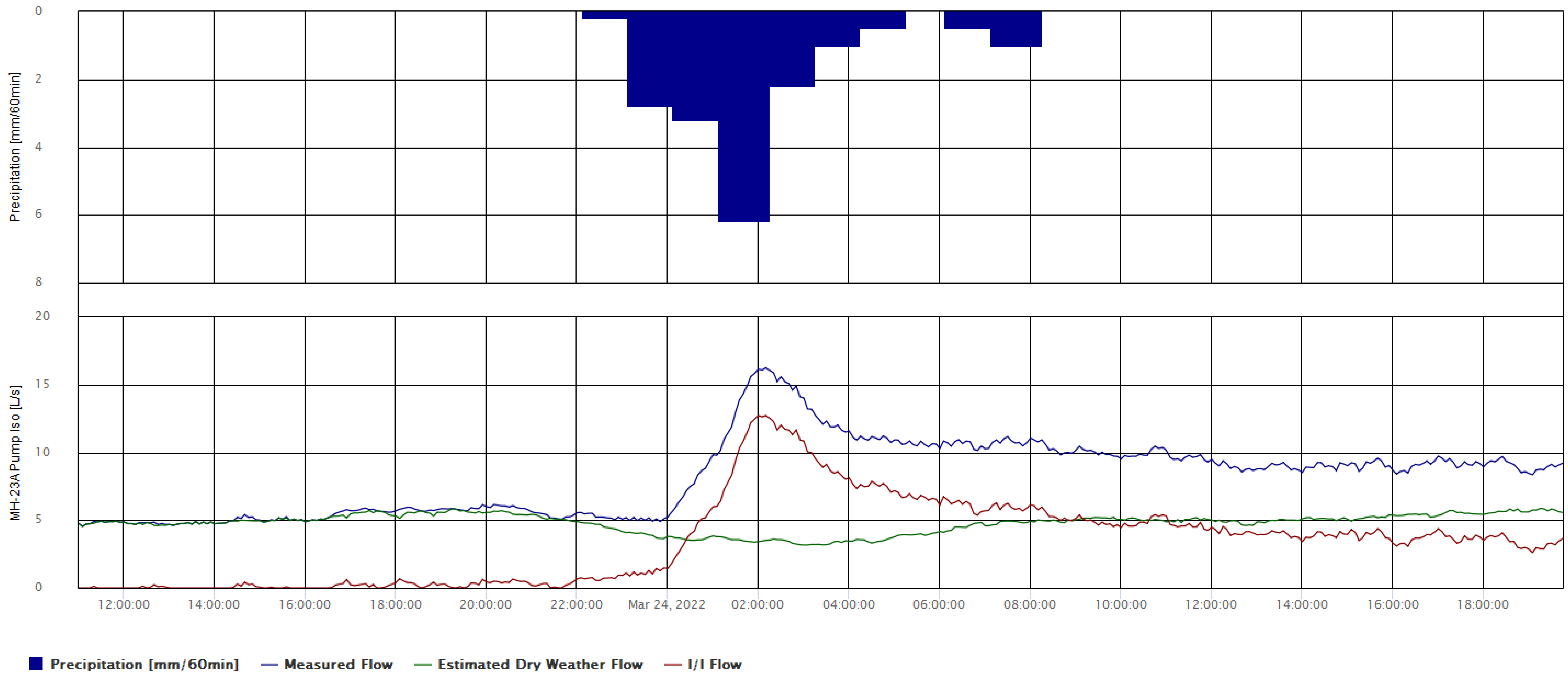
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23A

Infiltration/Inflow Event Analysis
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm



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Infiltration/Inflow Event Analysis
Station: MH-23A
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm (7,249,100.00 L)

Station Details		Storm Details			
Catchment Area	40.84 ha	**Total Precipitation**	17.75 mm (7,249,100.00 L)	**Duration of Storm**	8.75 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	6.20 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 24, 2022 02:10	**Time of Peak I/I Flow (TD)**	Mar 24, 2022 02:10	**Estimated Dry Weather Flow at TD**	3.51 L/s
Peak Measured Flow	16.24 L/s	**Peak I/I Flow** [4]	12.73 L/s	**Peak I/I Rate** [5]	0.31 L/s/ha
Peak Measured Depth	69.80 mm	**Total I/I Flow Volume during event**	397,615.70 L	**Volumetric Coefficient (Cv%)** [6]	5.49%
Total Measured Flow Volume during Event	743,147.20 L	**Peak I/I Coefficient** [7]	0.0180	**Hourly Wet-Weather Peaking Factor** [8]	3.40
		Instantaneous Wet-Weather Peaking Factor [9]	3.52		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

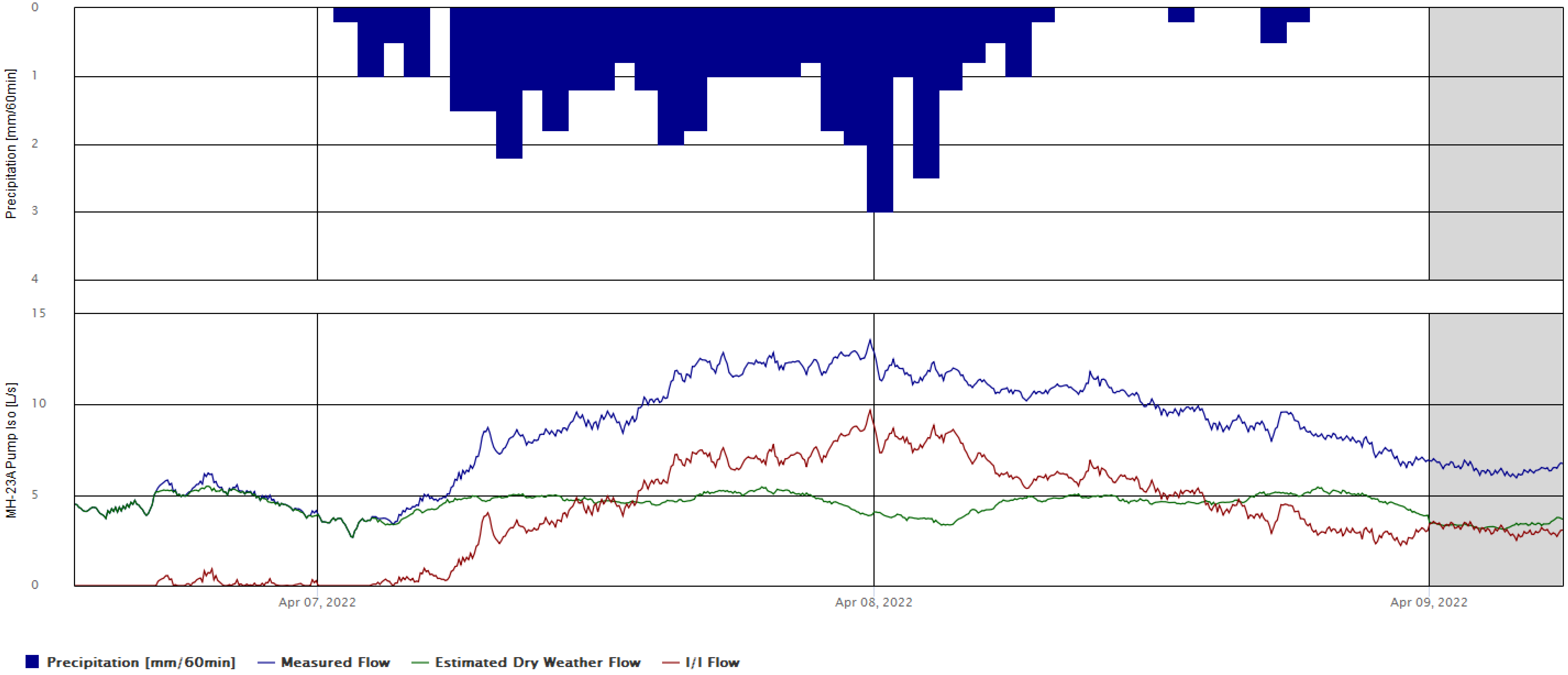
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23A

Infiltration/Inflow Event Analysis
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39 mm



Infiltration/Inflow Event Analysis
Station: MH-23A
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39.00 mm (15,927,600.00 L)

Station Details		Storm Details			
Catchment Area	40.84 ha	**Total Precipitation**	39.00 mm (15,927,600.00 L)	**Duration of Storm**	40.25 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	3.00 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Apr 07, 2022 23:50	**Time of Peak I/I Flow (TD)**	Apr 07, 2022 23:50	**Estimated Dry Weather Flow at TD**	3.88 L/s
Peak Measured Flow	13.56 L/s	**Peak I/I Flow [4]**	9.68 L/s	**Peak I/I Rate [5]**	0.24 L/s/ha
Peak Measured Depth	64.69 mm	**Total I/I Flow Volume during event**	885,370.40 L	**Volumetric Coefficient (Cv%) [6]**	5.56%
Total Measured Flow Volume during Event	1,725,483.50 L	**Peak I/I Coefficient [7]**	0.0284	**Hourly Wet-Weather Peaking Factor [8]**	2.89
		Instantaneous Wet-Weather Peaking Factor [9]	3.04		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

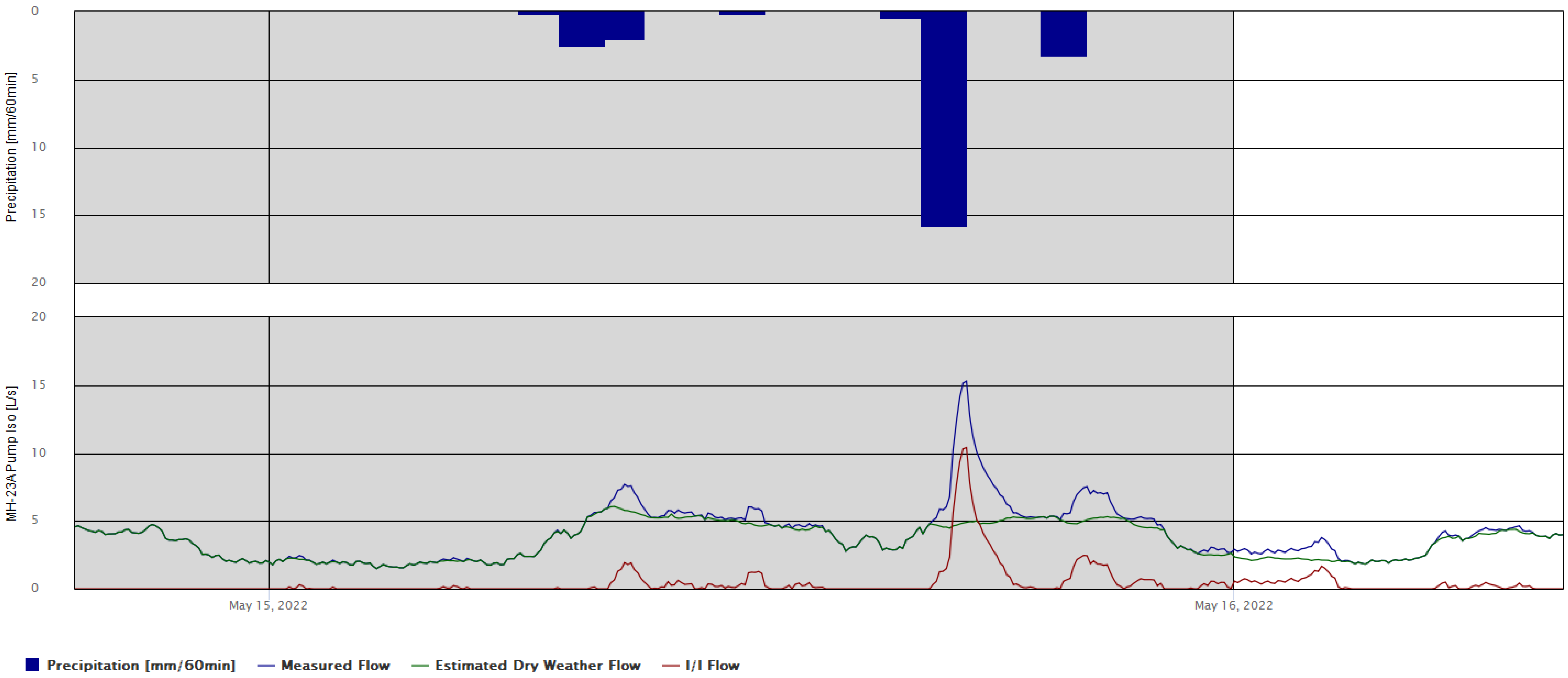
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23A

Infiltration/Inflow Event Analysis
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.5 mm



Infiltration/Inflow Event Analysis

Station: MH-23A

May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.50 mm (10,005,800.00 L)

Station Details		Storm Details			
Catchment Area	40.84 ha	**Total Precipitation**	24.50 mm (10,005,800.00 L)	**Duration of Storm**	13.00 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	15.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 15, 2022 17:20	**Time of Peak I/I Flow (TD)**	May 15, 2022 17:20	**Estimated Dry Weather Flow at TD**	4.89 L/s
Peak Measured Flow	15.29 L/s	**Peak I/I Flow [4]**	10.40 L/s	**Peak I/I Rate [5]**	0.26 L/s/ha
Peak Measured Depth	87.49 mm	**Total I/I Flow Volume during event**	56,971.10 L	**Volumetric Coefficient (Cv%) [6]**	0.57%
Total Measured Flow Volume during Event	416,902.00 L	**Peak I/I Coefficient [7]**	0.0058	**Hourly Wet-Weather Peaking Factor [8]**	2.85
		Instantaneous Wet-Weather Peaking Factor [9]	3.84		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

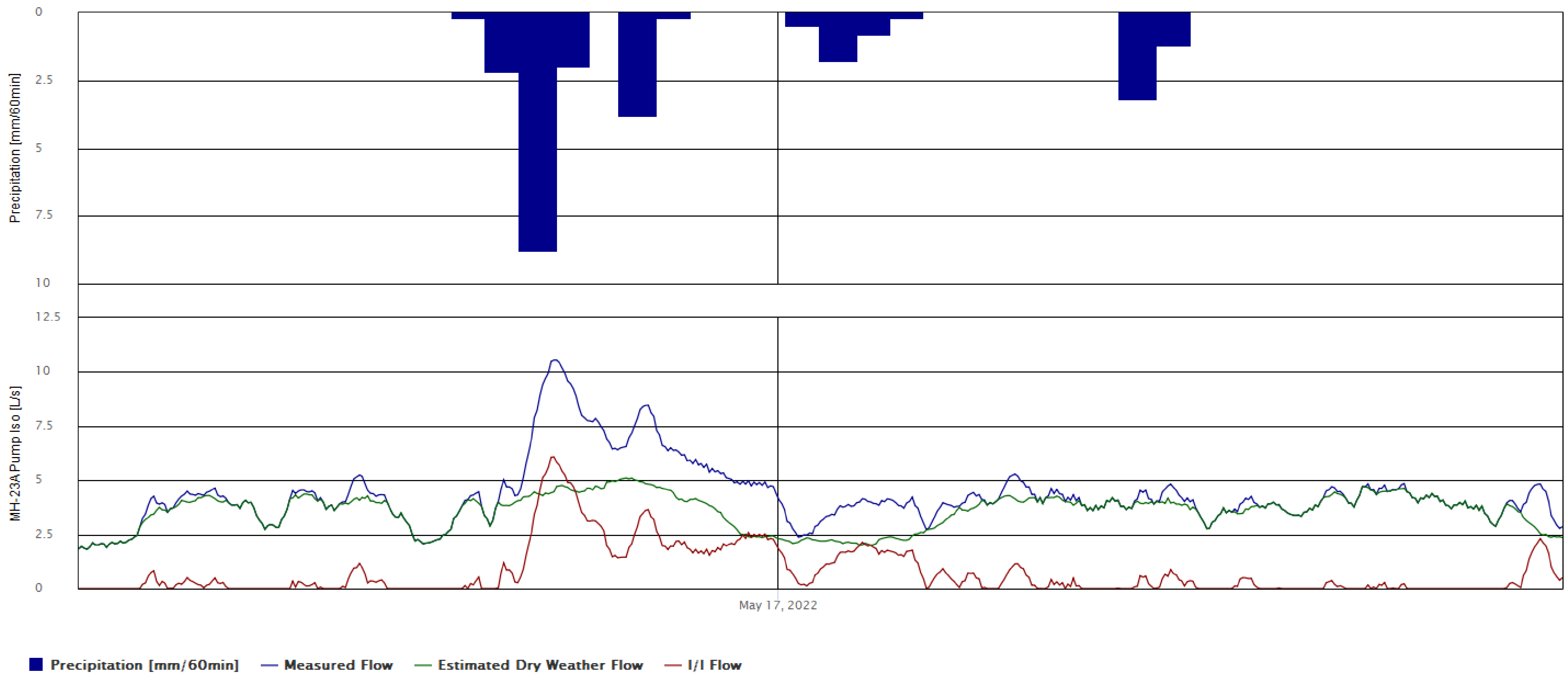
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23A

Infiltration/Inflow Event Analysis
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25 mm



Infiltration/Inflow Event Analysis
Station: MH-23A
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25.00 mm (10,210,000.00 L)

Station Details		Storm Details			
Catchment Area	40.84 ha	**Total Precipitation**	25.00 mm (10,210,000.00 L)	**Duration of Storm**	20.50 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	8.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 16, 2022 17:15	**Time of Peak I/I Flow (TD)**	May 16, 2022 17:15	**Estimated Dry Weather Flow at TD**	4.46 L/s
Peak Measured Flow	10.54 L/s	**Peak I/I Flow [4]**	6.08 L/s	**Peak I/I Rate [5]**	0.15 L/s/ha
Peak Measured Depth	58.76 mm	**Total I/I Flow Volume during event**	115,367.50 L	**Volumetric Coefficient (Cv%) [6]**	1.13%
Total Measured Flow Volume during Event	541,733.70 L	**Peak I/I Coefficient [7]**	0.0061	**Hourly Wet-Weather Peaking Factor [8]**	2.74
		Instantaneous Wet-Weather Peaking Factor [9]	2.90		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s
[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration
[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria
[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)
[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area
[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%
[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow
[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

Aggregate Data

Station: MH-23B

Level

Date From	Date To	Days	Min (m)	Avg (m)	Max (m)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	79	0.02	0.03	0.05	22,461	Mon Mar 14, 2022 12:15	Sat May 07, 2022 20:20

Velocity

Date From	Date To	Days	Min (m/s)	Avg (m/s)	Max (m/s)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	79	0.00	0.12	0.33	22,461	Thu Mar 03, 2022 12:45	Thu Mar 03, 2022 12:55

Flow

Date From	Date To	Days	Min (L/s)	Avg (L/s)	Max (L/s)	Total Volume (1 ML)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	79	0.00	0.33	1.73	2.23	22,461	Thu Mar 03, 2022 12:45	Fri Mar 25, 2022 16:45

Precipitation

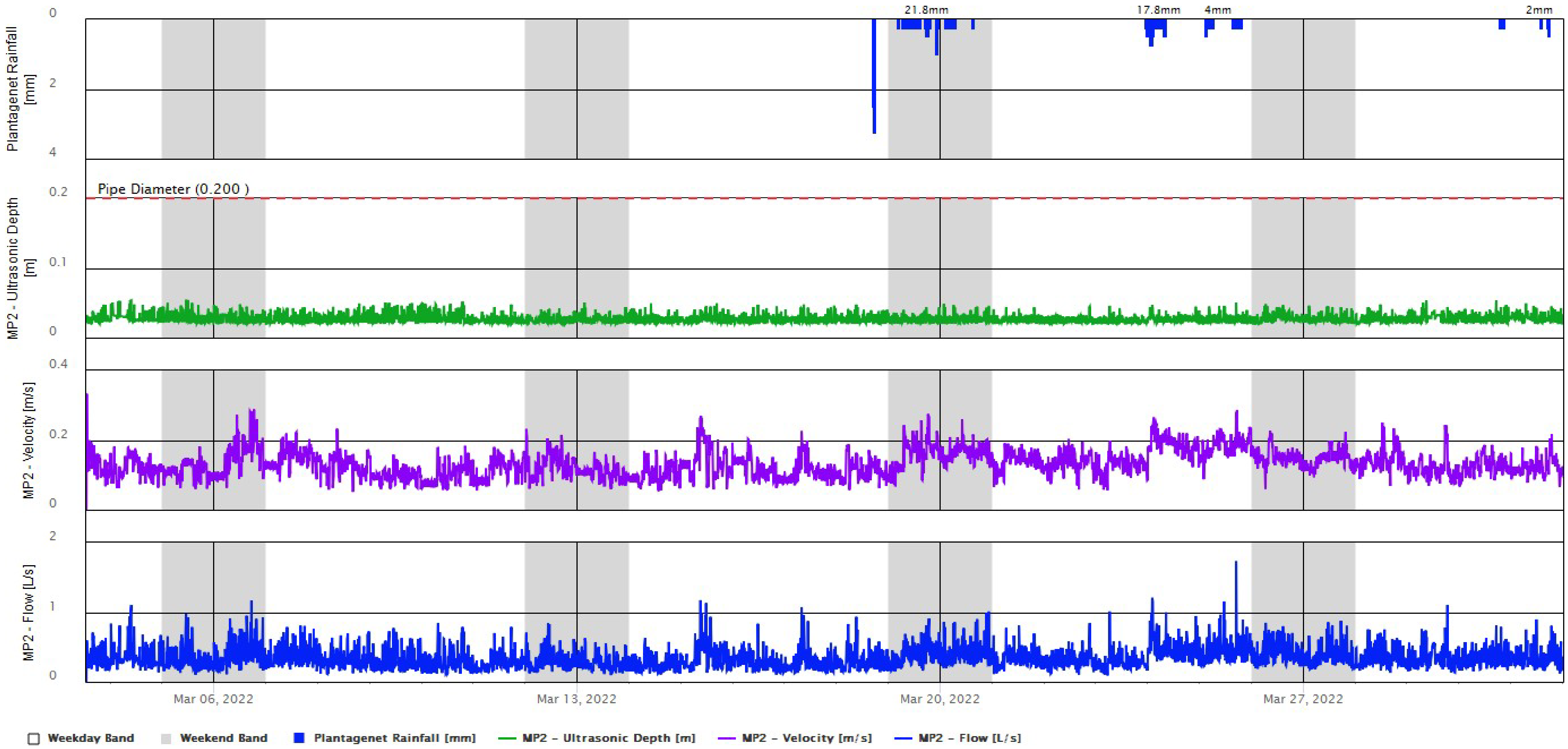
Date From	Date To	Days	Min (mm)	Avg (mm)	Max (mm)	Sum (mm)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 20, 2022	67	0.00	0.01	7.50	184.25	18,658	Wed Mar 09, 2022 20:00	Sun May 15, 2022 17:00

[1] Time of Min and Time of Max will be displayed by first occurrence

Data Chart

Station: MH-23B

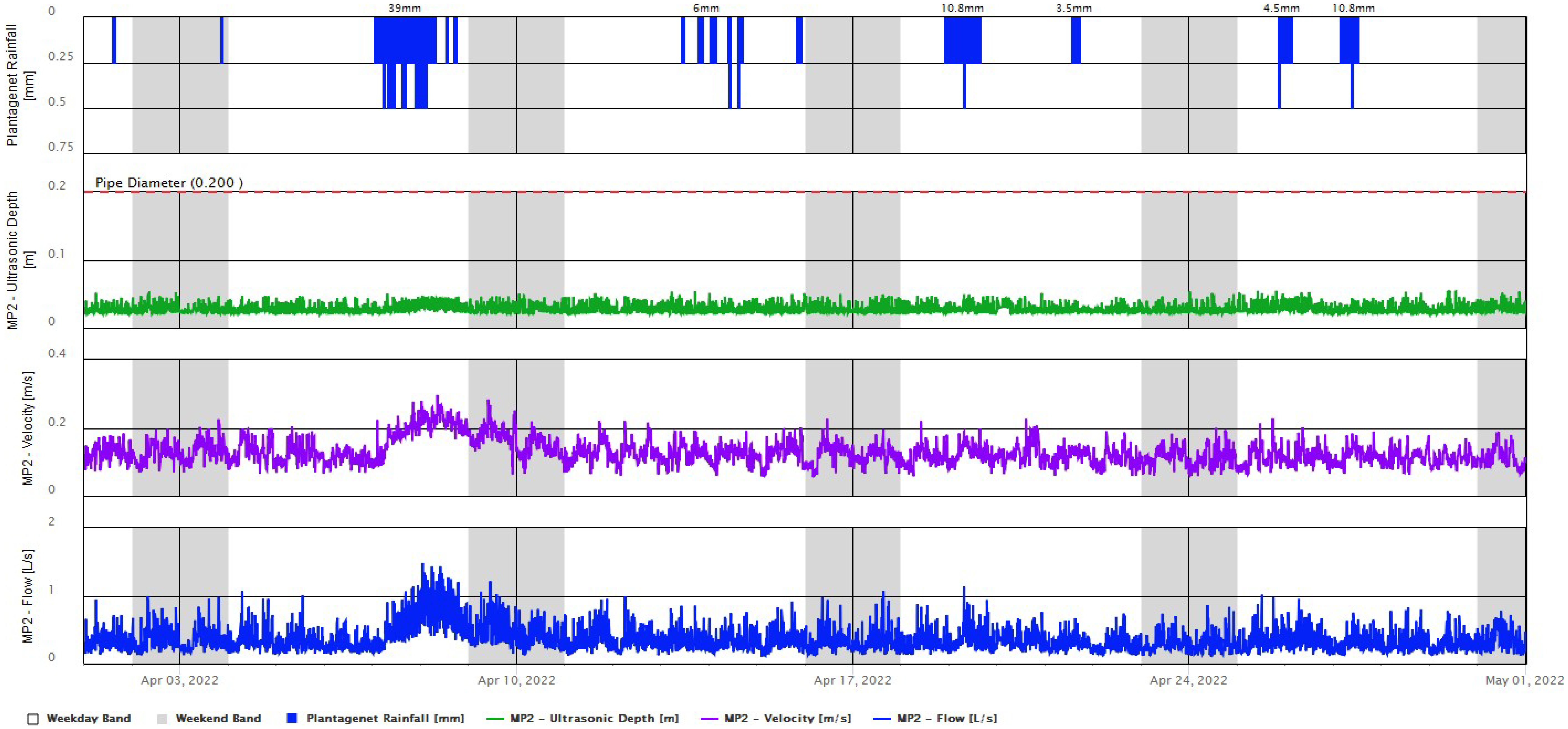
Mar 03, 2022 – Mar 31, 2022



Data Chart

Station: MH-23B

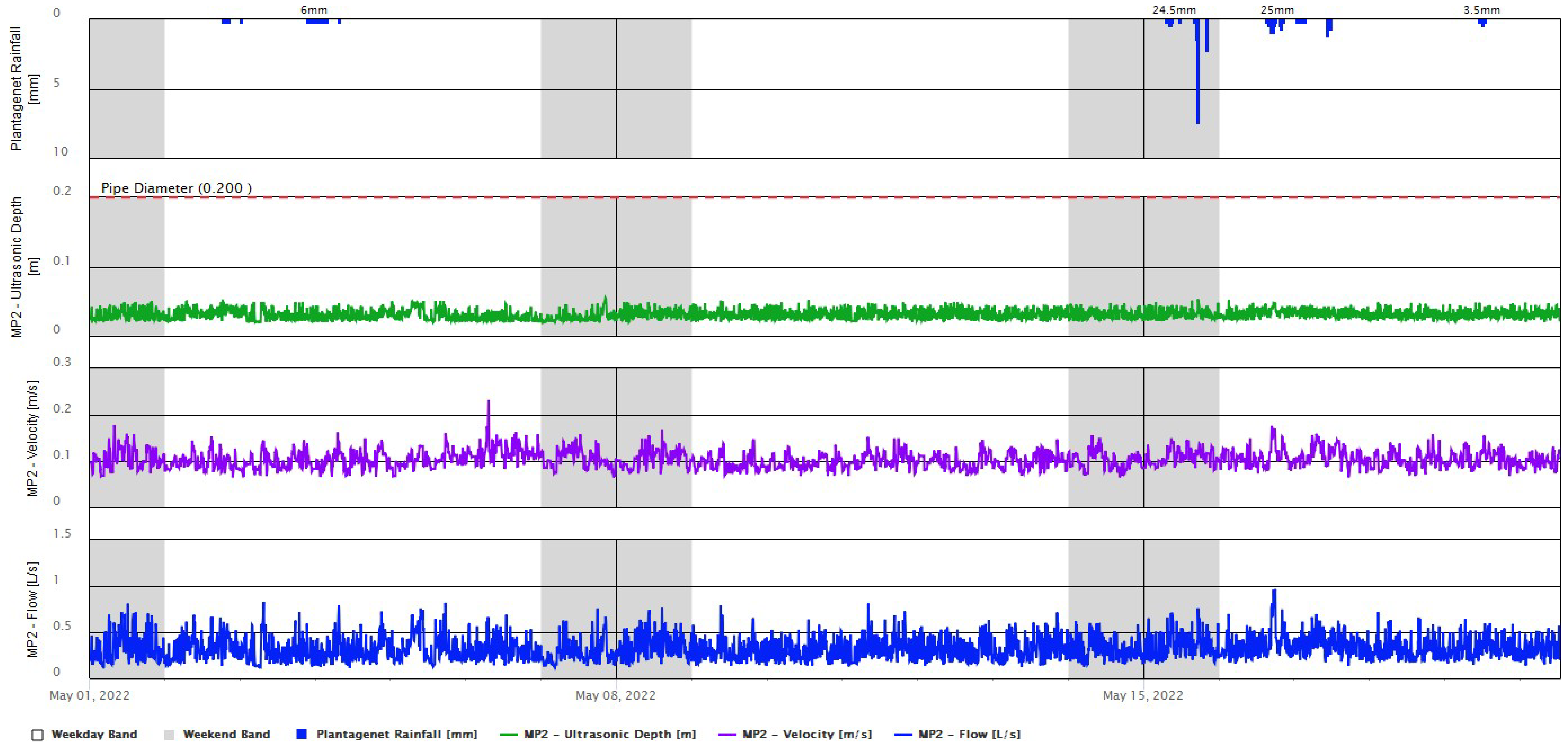
Apr 01, 2022 – Apr 30, 2022



Data Chart

Station: MH-23B

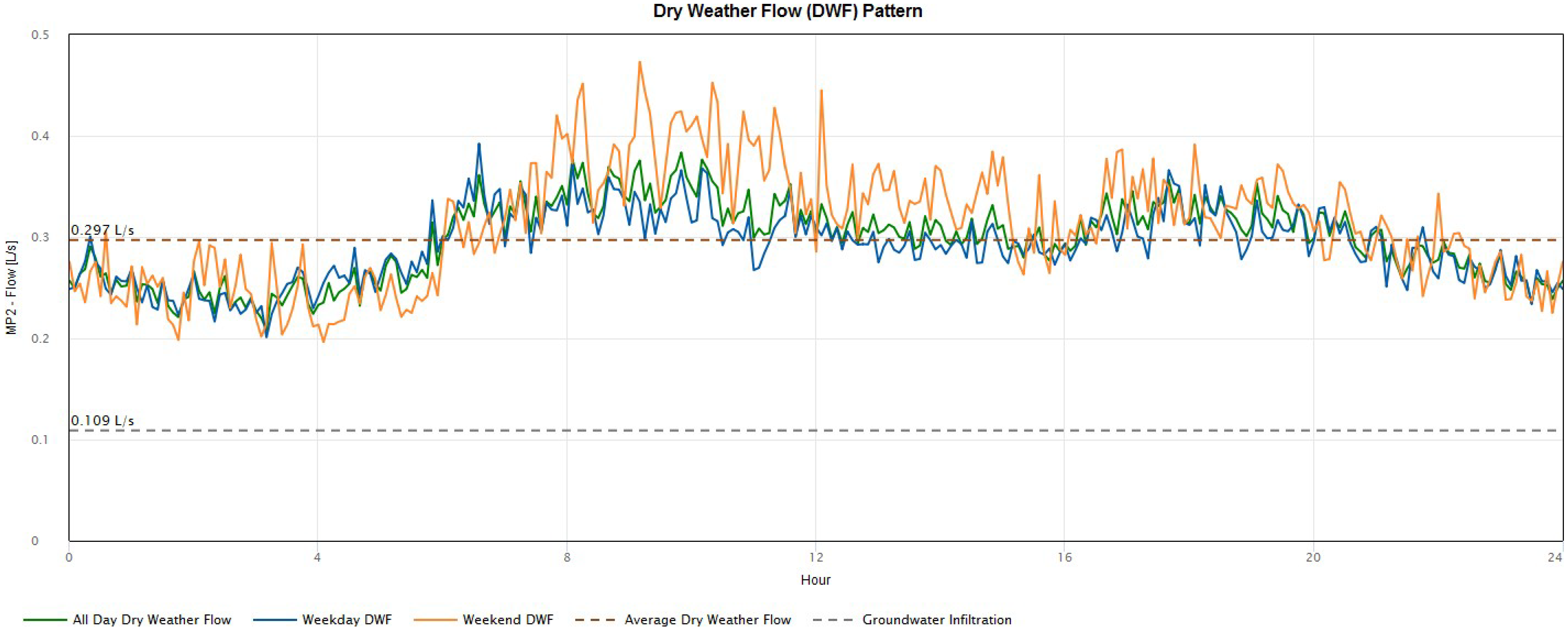
May 01, 2022 – May 20, 2022



Sanitary Report

Station: MH-23B

Average Dry Weather Flow (L/s)	Average Dry Weather Flow (L/c/d)	Average Daily Minimum Dry Weather Flow (L/s)	Average Daily Peak Dry Weather Flow (L/s)
0.297	346.734	0.128	0.823
Peaking Factor	**Groundwater Infiltration (L/s)[1]**	**Groundwater Infiltration (L/ha/d)**	**% of GWI in Average DWF**
2.770	0.109	3,329.776	36.726



[1] Groundwater infiltration (GWI) is assumed as 85% of the daily minimum flow averaged over the monitoring period

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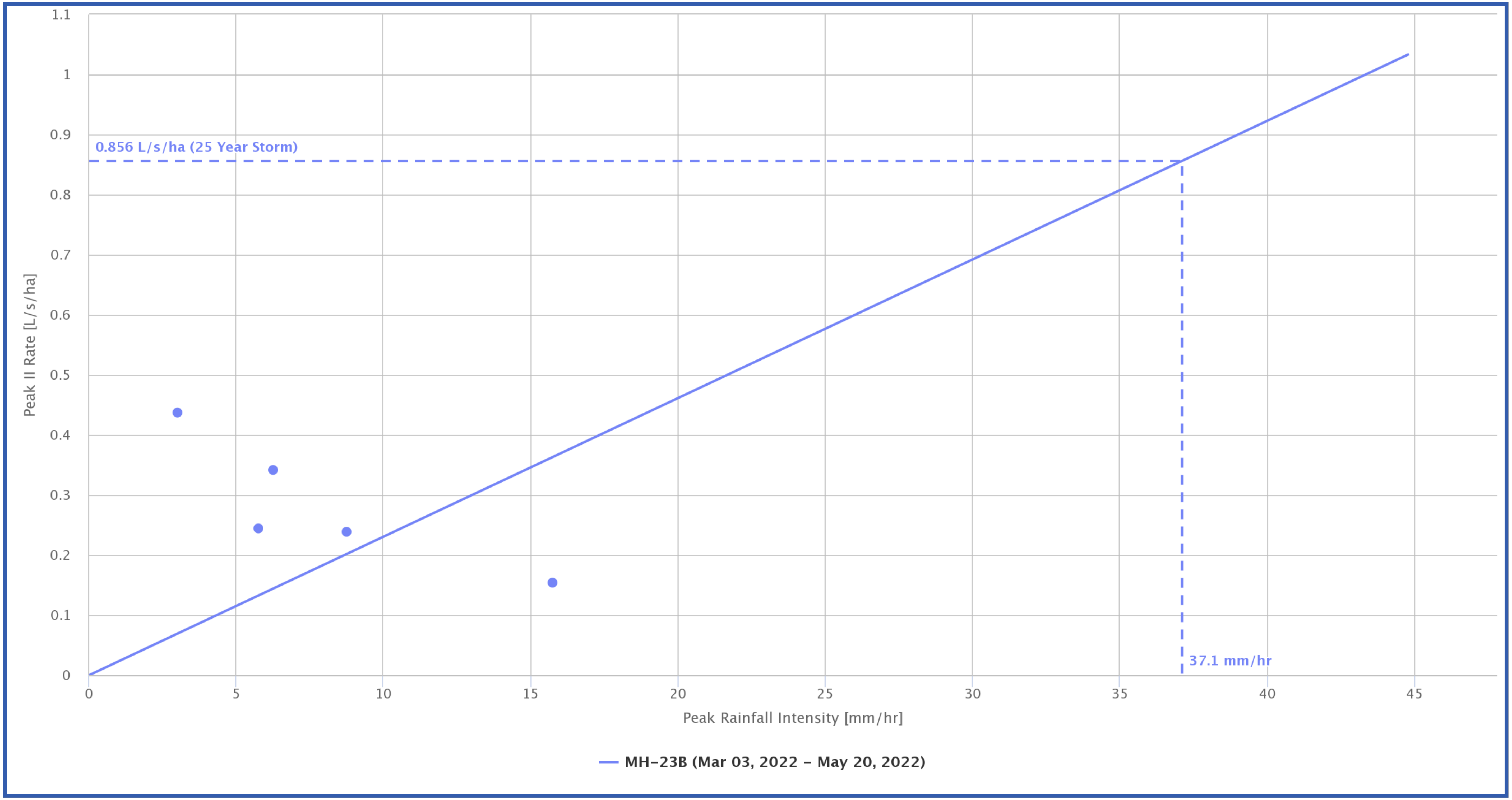
RDII Projection Graph

Station: MH-23B (2.83 ha)



I/I Analysis Table

Station: MH-23B (2.83 ha)

	Event[1]	Total Precipitation (mm)	Duration (hours)	Peak Intensity Over Tc at Station (mm/hr)		MH-23B								
						Time of Peak I/I Flow (TD) (date)	Total I/I Flow Volume during Event (L)	Estimated Dry Weather Flow at TD (L/s)	Peak I/I Flow (L/s)	Peak I/I Flow Rate (L/s/ha)	Total Dry Weather Flow Volume during Event (L)	Peak Rainfall Intensity (5 min)	Volumetric Runoff Coefficient (CV%)	Instantaneous Peaking Factor (PF)
Measured Storms	Mar 18, 2022	21.75	46.17	5.80	Flow KPIs	Mar 20, 2022 22:15	17,730.50	0.33	0.68	0.24	58,737.00	3.30	2.88 %	3.61
	Mar 23, 2022	17.75	8.75	6.20		Mar 24, 2022 01:55	13,710.70	0.25	0.96	0.34	21,112.10	0.80	2.73 %	4.32
	Apr 07, 2022	39.00	40.25	3.00		Apr 08, 2022 01:00	60,823.50	0.26	1.22	0.43	53,073.40	0.50	5.51 %	5.28
	May 15, 2022	24.50	13.00	15.80		May 15, 2022 17:10	6,068.60	0.30	0.46	0.16	25,047.70	7.50	0.88 %	2.38
	May 16, 2022	25.00	20.50	8.80		May 16, 2022 17:20	13,454.80	0.26	0.65	0.23	33,154.30	1.30	1.90 %	3.42
	Average	**25.60**	**25.73**	**7.92**			**22,357.62**	**0.28**	**0.79**	**0.28**	**38,224.90**	**2.68**	**2.78 %**	**3.80**
	Maximum	**39.00**	**46.17**	**15.80**			**60,823.50**	**0.33**	**1.22**	**0.43**	**58,737.00**	**7.50**	**5.51 %**	**5.28**

[1] An event is a storm with a minimum volume of 15 mm and a minimum inter-event dry period of 12 hours

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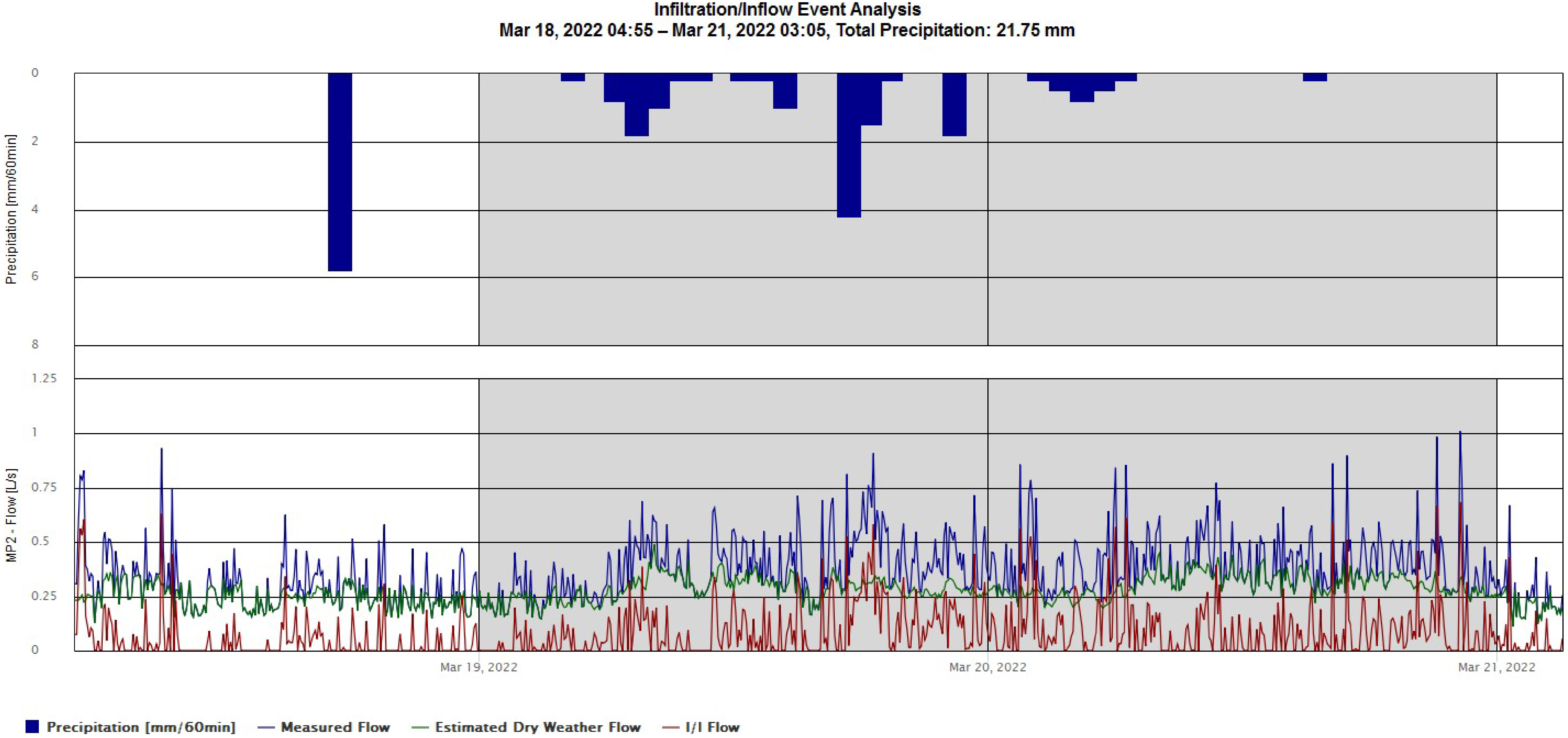
Water Management Solutions

I/I Analysis Graph

Station: MH-23B



Infiltration/Inflow Event Analysis
Station: MH-23B
Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm (615,525.00 L)

Station Details		Storm Details			
Catchment Area	2.83 ha	**Total Precipitation**	21.75 mm (615,525.00 L)	**Duration of Storm**	46.17 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	5.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 20, 2022 22:15	**Time of Peak I/I Flow (TD)**	Mar 20, 2022 22:15	**Estimated Dry Weather Flow at TD**	0.33 L/s
Peak Measured Flow	1.01 L/s	**Peak I/I Flow [4]**	0.68 L/s	**Peak I/I Rate [5]**	0.24 L/s/ha
Peak Measured Depth	48.52 mm	**Total I/I Flow Volume during event**	17,730.50 L	**Volumetric Coefficient (Cv%) [6]**	2.88%
Total Measured Flow Volume during Event	76,467.50 L	**Peak I/I Coefficient [7]**	0.0151	**Hourly Wet-Weather Peaking Factor [8]**	2.32
		Instantaneous Wet-Weather Peaking Factor [9]	3.61		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

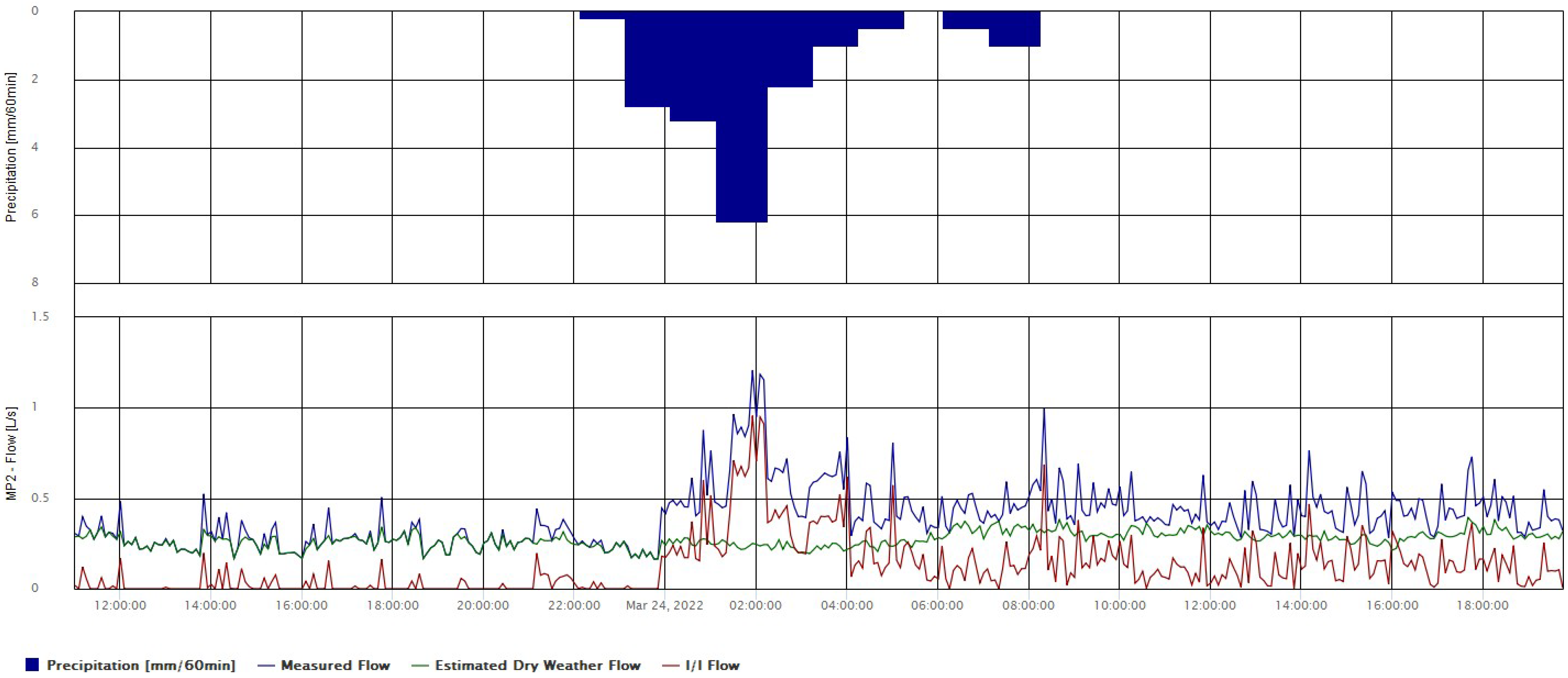
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23B

Infiltration/Inflow Event Analysis
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm



Infiltration/Inflow Event Analysis
Station: MH-23B
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm (502,325.00 L)

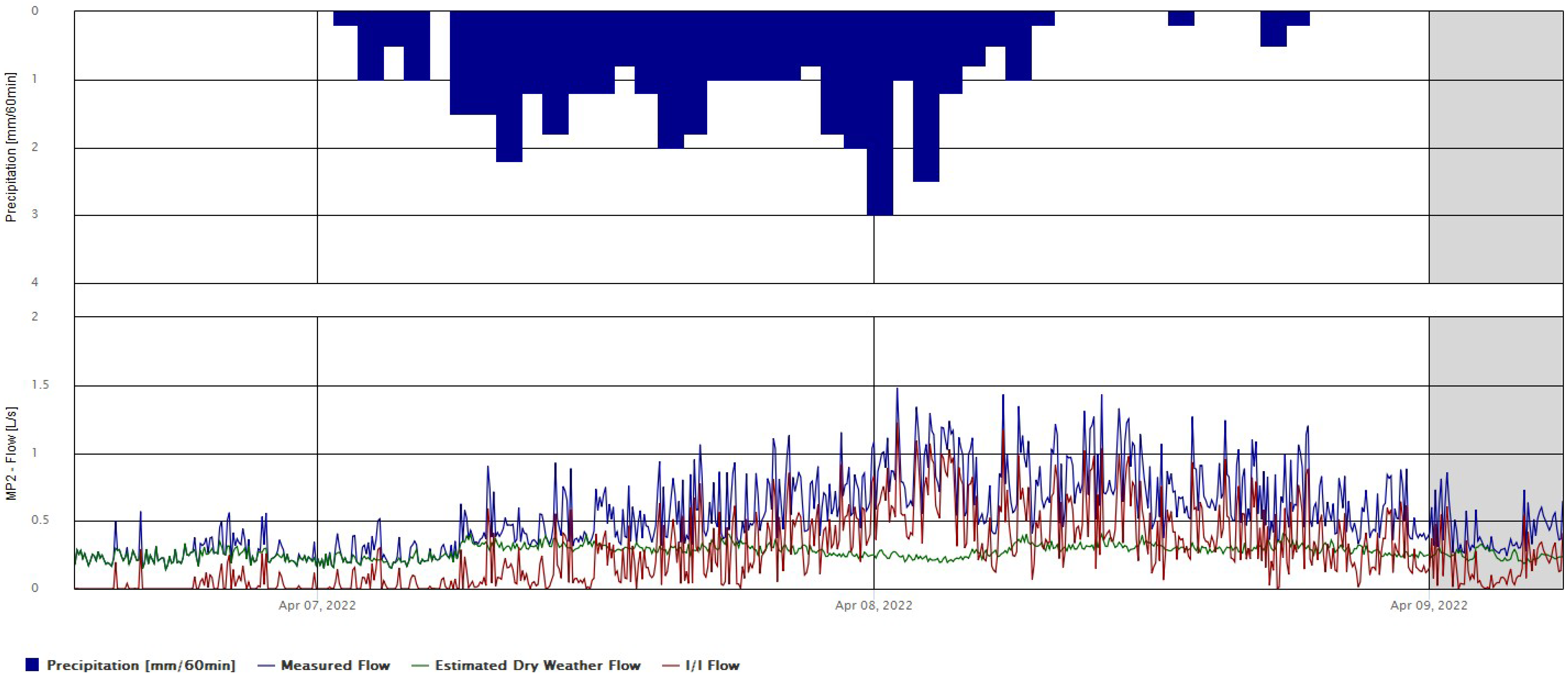
Station Details		Storm Details			
Catchment Area	2.83 ha	**Total Precipitation**	17.75 mm (502,325.00 L)	**Duration of Storm**	8.75 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	6.20 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 24, 2022 01:55	**Time of Peak I/I Flow (TD)**	Mar 24, 2022 01:55	**Estimated Dry Weather Flow at TD**	0.25 L/s
Peak Measured Flow	1.21 L/s	**Peak I/I Flow [4]**	0.96 L/s	**Peak I/I Rate [5]**	0.34 L/s/ha
Peak Measured Depth	46.69 mm	**Total I/I Flow Volume during event**	13,710.70 L	**Volumetric Coefficient (Cv%) [6]**	2.73%
Total Measured Flow Volume during Event	34,822.80 L	**Peak I/I Coefficient [7]**	0.0195	**Hourly Wet-Weather Peaking Factor [8]**	3.20
		Instantaneous Wet-Weather Peaking Factor [9]	4.29		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s
[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration
[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria
[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)
[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area
[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%
[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow
[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23B

Infiltration/Inflow Event Analysis
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39 mm



Infiltration/Inflow Event Analysis
Station: MH-23B
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39.00 mm (1,103,700.00 L)

Station Details		Storm Details			
Catchment Area	2.83 ha	**Total Precipitation**	39.00 mm (1,103,700.00 L)	**Duration of Storm**	40.25 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	3.00 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Apr 08, 2022 01:00	**Time of Peak I/I Flow (TD)**	Apr 08, 2022 01:00	**Estimated Dry Weather Flow at TD**	0.26 L/s
Peak Measured Flow	1.48 L/s	**Peak I/I Flow** [4]	1.22 L/s	**Peak I/I Rate** [5]	0.43 L/s/ha
Peak Measured Depth	50.12 mm	**Total I/I Flow Volume during event**	60,823.50 L	**Volumetric Coefficient (Cv%)** [6]	5.51%
Total Measured Flow Volume during Event	113,896.90 L	**Peak I/I Coefficient** [7]	0.0519	**Hourly Wet-Weather Peaking Factor** [8]	3.78
		Instantaneous Wet-Weather Peaking Factor [9]	5.26		

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[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

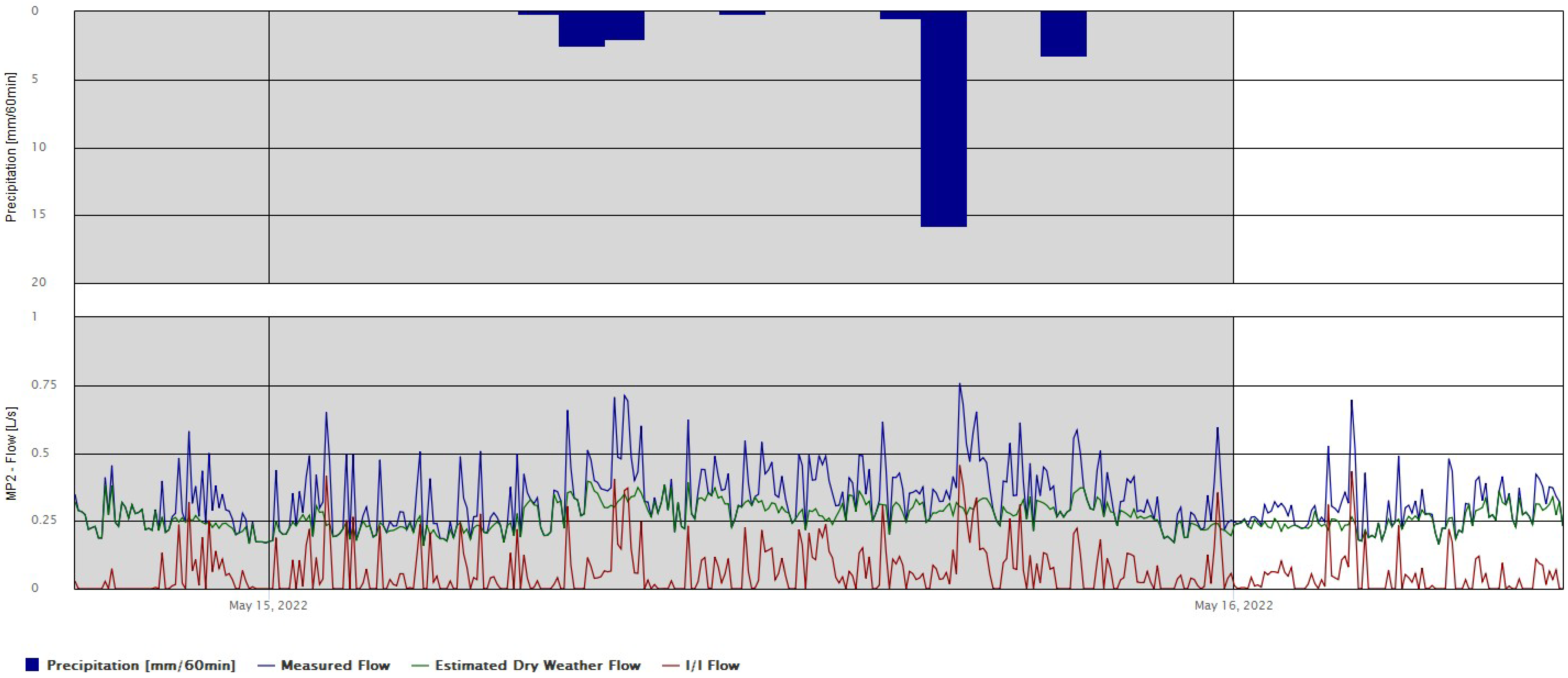
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23B

Infiltration/Inflow Event Analysis
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.5 mm



Infiltration/Inflow Event Analysis
Station: MH-23B
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.50 mm (693,350.00 L)

Station Details		Storm Details			
Catchment Area	2.83 ha	**Total Precipitation**	24.50 mm (693,350.00 L)	**Duration of Storm**	13.00 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	15.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 15, 2022 17:10	**Time of Peak I/I Flow (TD)**	May 15, 2022 17:10	**Estimated Dry Weather Flow at TD**	0.30 L/s
Peak Measured Flow	0.76 L/s	**Peak I/I Flow** [4]	0.46 L/s	**Peak I/I Rate** [5]	0.16 L/s/ha
Peak Measured Depth	52.78 mm	**Total I/I Flow Volume during event**	6,068.60 L	**Volumetric Coefficient (Cv%)** [6]	0.88%
Total Measured Flow Volume during Event	31,116.30 L	**Peak I/I Coefficient** [7]	0.0037	**Hourly Wet-Weather Peaking Factor** [8]	1.87
		Instantaneous Wet-Weather Peaking Factor [9]	2.73		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

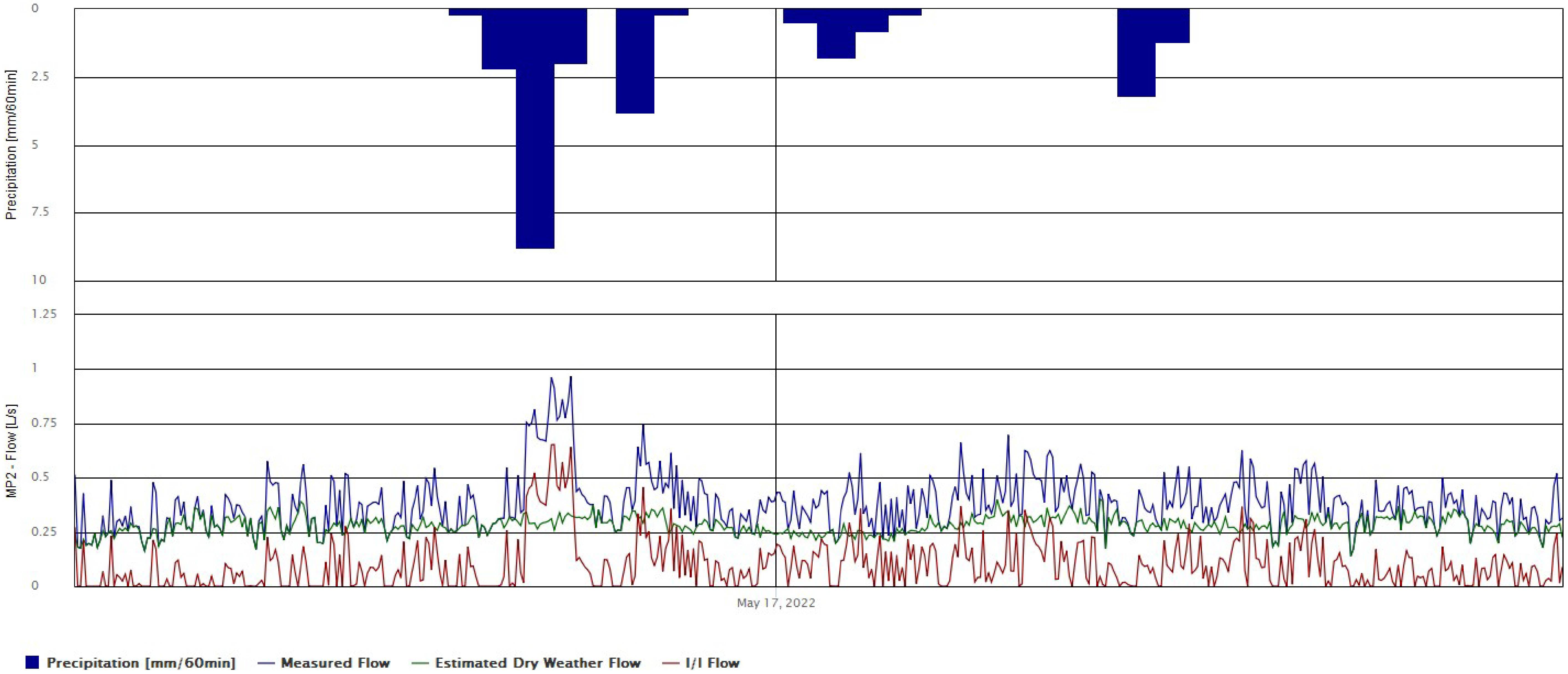
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-23B

Infiltration/Inflow Event Analysis
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25 mm



Infiltration/Inflow Event Analysis
Station: MH-23B
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25.00 mm (707,500.00 L)

Station Details		Storm Details			
Catchment Area	2.83 ha	**Total Precipitation**	25.00 mm (707,500.00 L)	**Duration of Storm**	20.50 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	8.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 16, 2022 17:50	**Time of Peak I/I Flow (TD)**	May 16, 2022 17:20	**Estimated Dry Weather Flow at TD**	0.26 L/s
Peak Measured Flow	0.97 L/s	**Peak I/I Flow** [4]	0.65 L/s	**Peak I/I Rate** [5]	0.23 L/s/ha
Peak Measured Depth	51.34 mm	**Total I/I Flow Volume during event**	13,454.80 L	**Volumetric Coefficient (Cv%)** [6]	1.90%
Total Measured Flow Volume during Event	46,609.00 L	**Peak I/I Coefficient** [7]	0.0095	**Hourly Wet-Weather Peaking Factor** [8]	2.85
		Instantaneous Wet-Weather Peaking Factor [9]	3.42		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

Aggregate Data

Station: MH-27

Level (Head)

Date From	Date To	Days	Min (m)	Avg (m)	Max (m)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 21, 2022	79	0.02	0.06	0.14	22,462	Fri Mar 04, 2022 02:55	Sun May 15, 2022 17:10

Velocity

Date From	Date To	Days	Min (m/s)	Avg (m/s)	Max (m/s)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 21, 2022	79	0.00	0.02	0.34	22,462	Thu Mar 03, 2022 12:10	Thu Mar 24, 2022 01:50

Flow

Date From	Date To	Days	Min (L/s)	Avg (L/s)	Max (L/s)	Total Volume (1 ML)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 21, 2022	79	0.56	3.31	14.74	22.38	22,556	Sat Mar 05, 2022 01:50	Thu Mar 24, 2022 02:10

Precipitation

Date From	Date To	Days	Min (mm)	Avg (mm)	Max (mm)	Sum (mm)	Count	Time of Min[1]	Time of Max[1]
Mar 03, 2022	May 21, 2022	68	0.00	0.01	7.50	185.75	19,083	Wed Mar 09, 2022 20:00	Sun May 15, 2022 17:00

[1] Time of Min and Time of Max will be displayed by first occurrence

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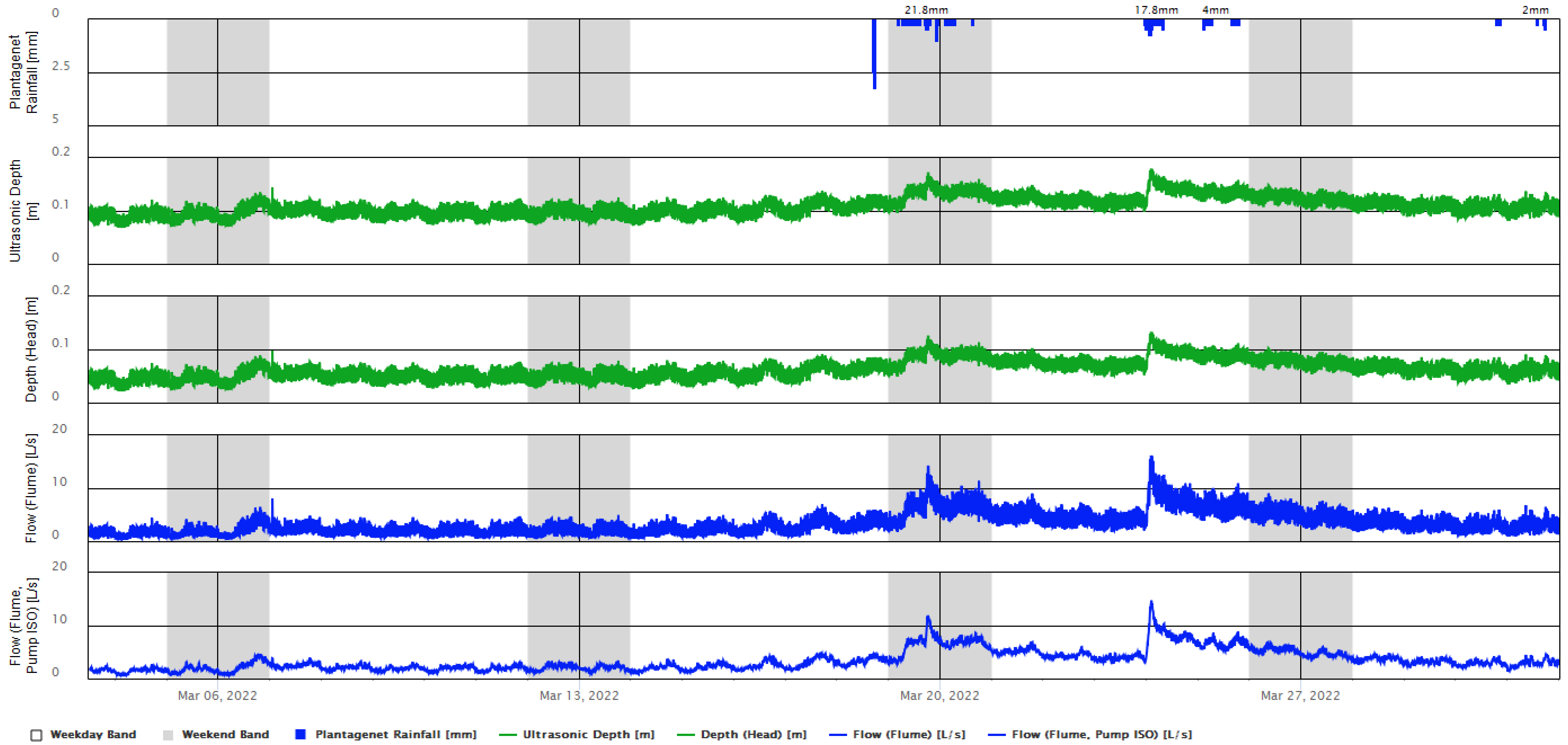
Data Chart

Station: MH-27

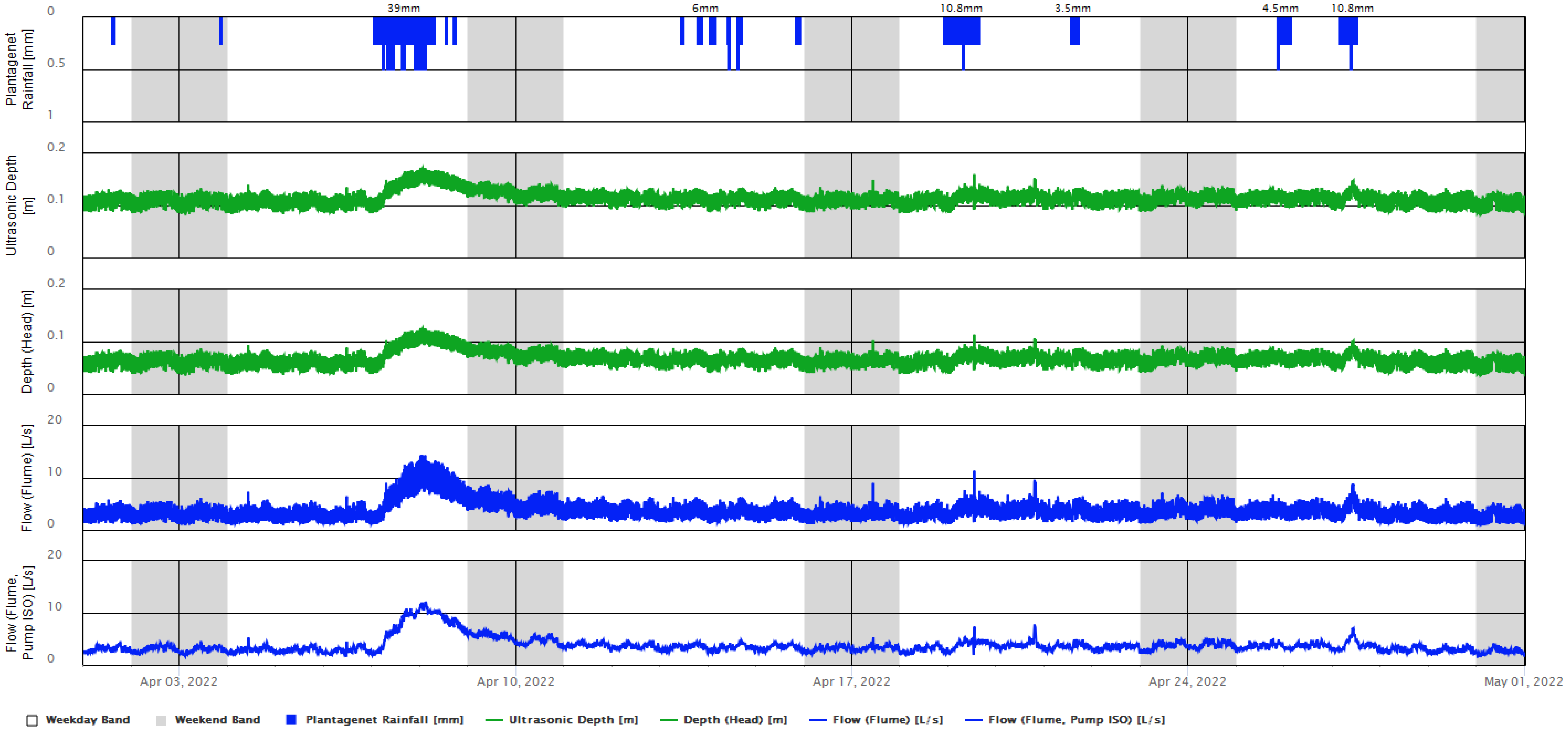
Mar 03, 2022 – Mar 31, 2022



Data Chart

Station: MH-27

Apr 01, 2022 – Apr 30, 2022



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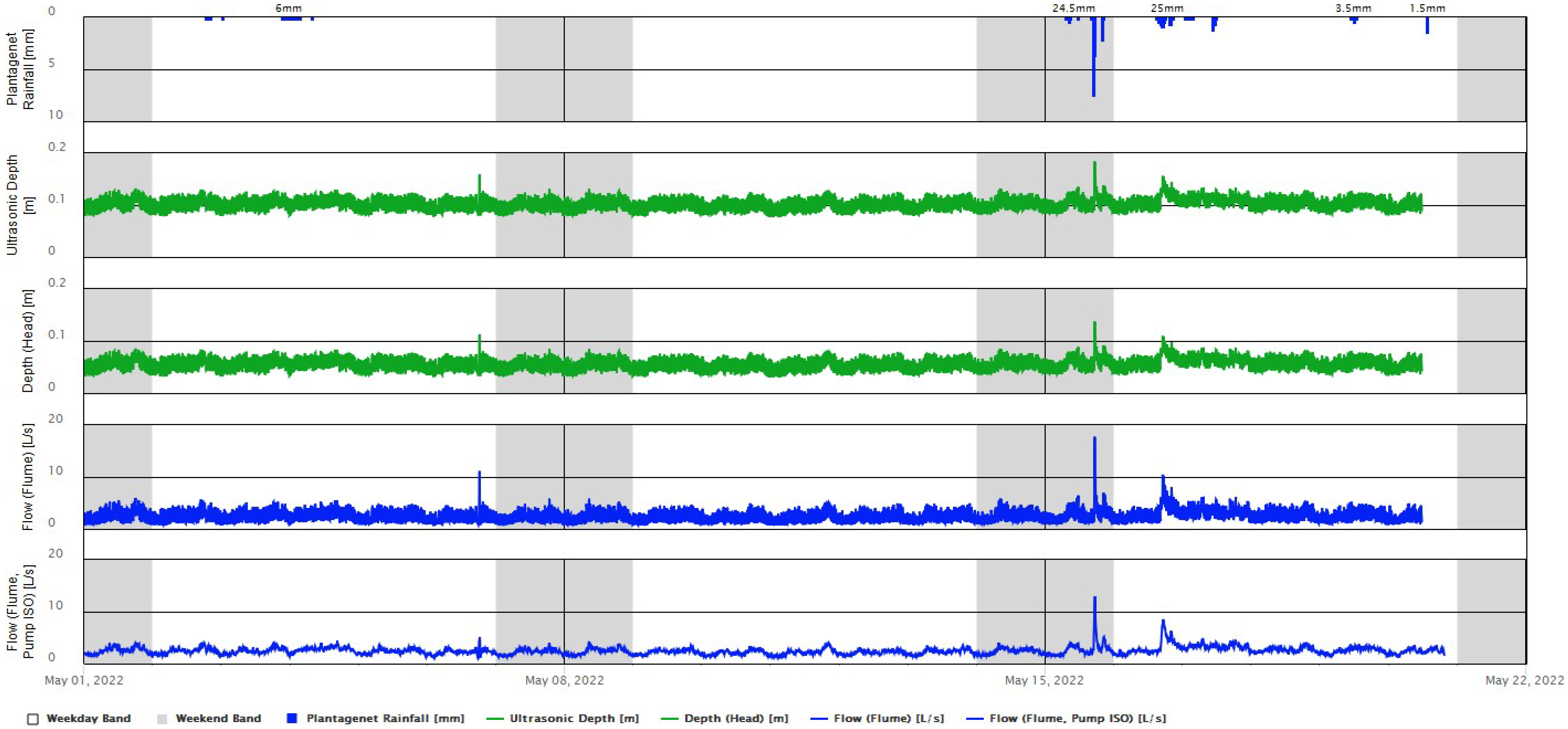
Data Chart

Station: MH-27

May 01, 2022 – May 21, 2022

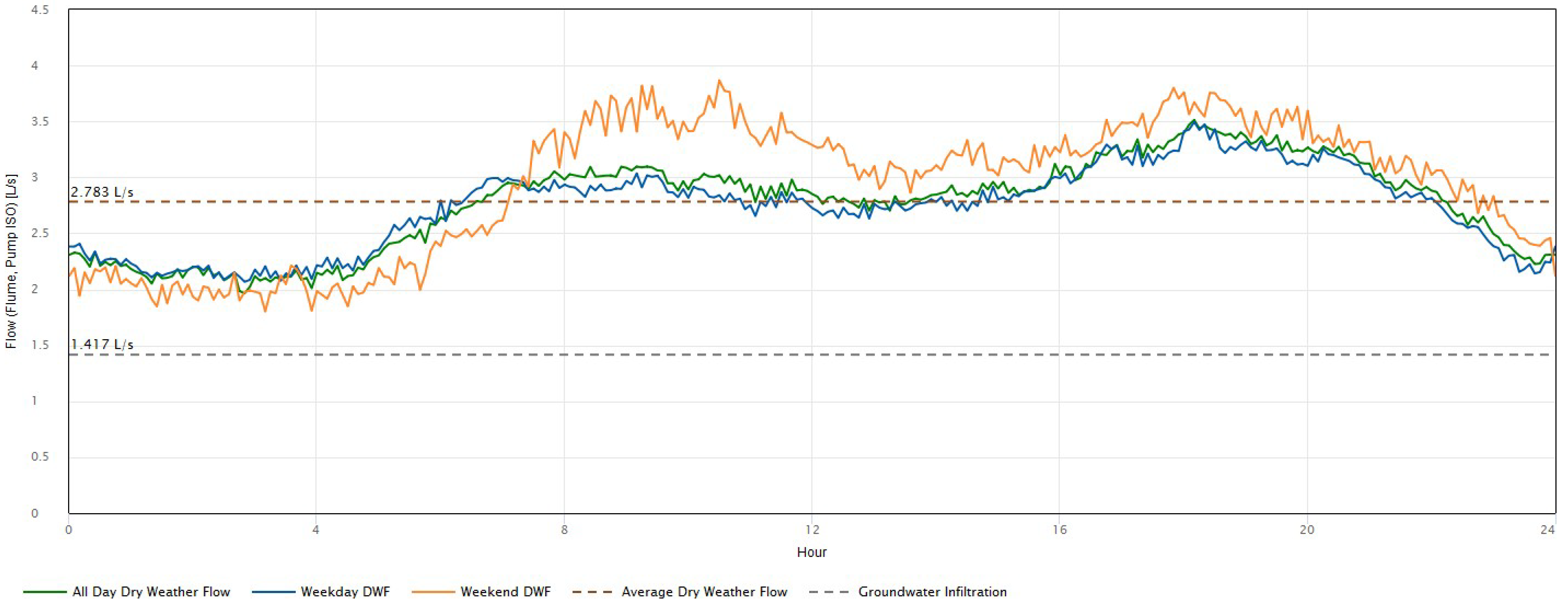


Sanitary Report

Station: MH-27

Average Dry Weather Flow (L/s)	Average Dry Weather Flow (L/c/d)	Average Daily Minimum Dry Weather Flow (L/s)	Average Daily Peak Dry Weather Flow (L/s)
2.783	568.465	1.667	4.200
Peaking Factor	**Groundwater Infiltration (L/s)[1]**	**Groundwater Infiltration (L/ha/d)**	**% of GWI in Average DWF**
1.509	1.417	3,424.465	50.927

Dry Weather Flow (DWF) Pattern



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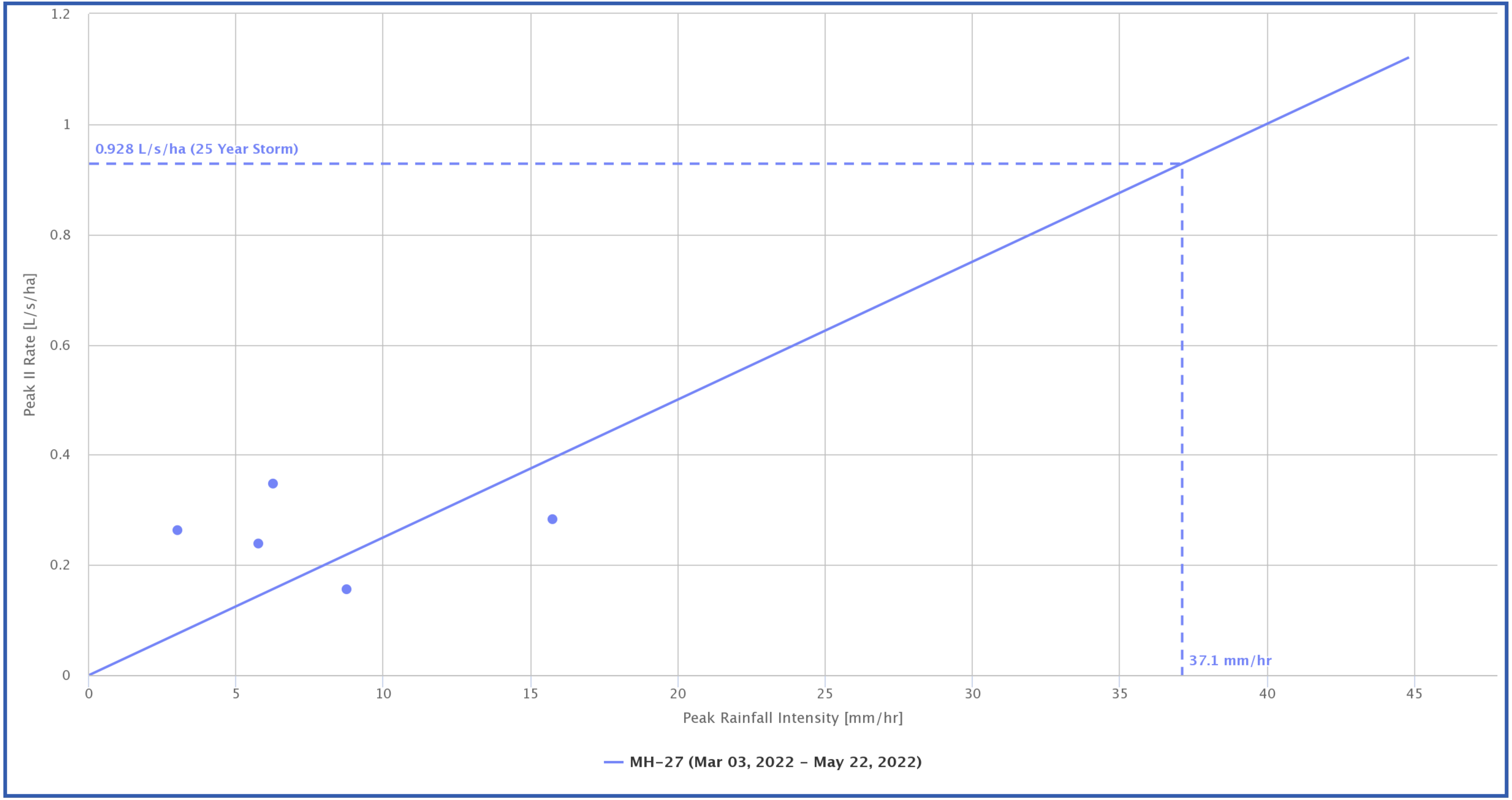
[1] Groundwater infiltration (GWI) is assumed as 85% of the daily minimum flow averaged over the monitoring period

RDII Projection Graph

Station: MH-27 (35.76 ha)



I/I Analysis Table

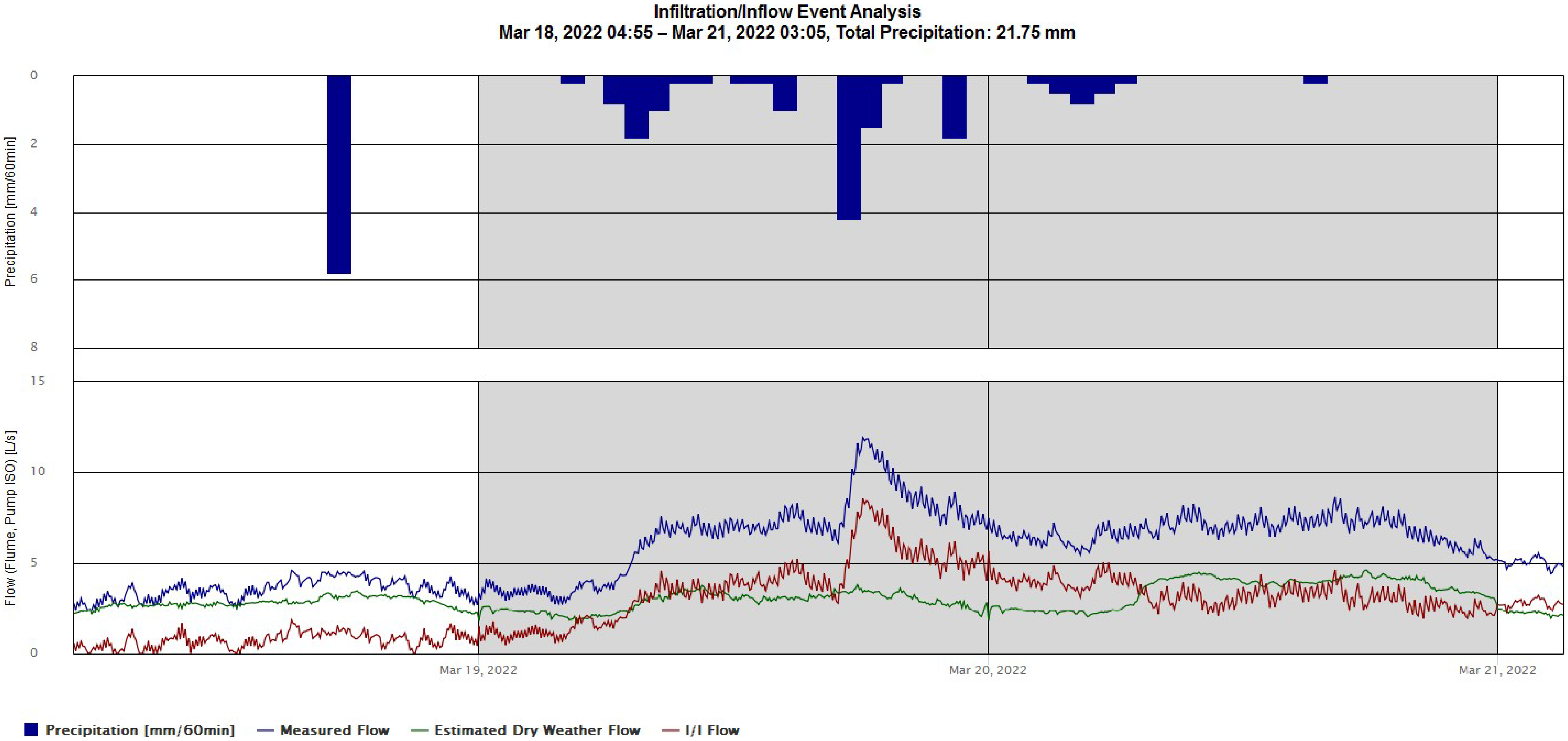
Station: MH-27 (35.76 ha)

	Event[1]	Total Precipitation (mm)	Duration (hours)	Peak Intensity Over Tc=60min at Station (mm/hr)		MH-27								
						Time of Peak I/I Flow (TD) (date)	Total I/I Flow Volume during Event (L)	Estimated Dry Weather Flow at TD (L/s)	Peak I/I Flow (L/s)	Peak I/I Flow Rate (L/s/ha)	Total Dry Weather Flow Volume during Event (L)	Peak Rainfall Intensity (5 min)	Volumetric Runoff Coefficient (CV%)	Instantaneous Peaking Factor (PF)
Measured Storms	Mar 18, 2022	21.75	46.17	5.80	Flow KPIs	Mar 19, 2022 18:05	653,606.20	3.38	8.55	0.24	646,367.40	3.30	8.40 %	3.87
	Mar 23, 2022	17.75	8.75	6.20		Mar 24, 2022 02:10	436,120.60	2.30	12.44	0.35	213,480.10	0.80	6.87 %	5.19
	Apr 07, 2022	39.00	40.25	3.00		Apr 08, 2022 02:50	861,851.60	2.71	9.42	0.26	616,442.50	0.50	6.18 %	3.74
	May 15, 2022	24.50	13.00	15.80		May 15, 2022 17:15	44,186.00	2.85	10.13	0.28	212,810.40	7.50	0.50 %	5.54
	May 16, 2022	25.00	20.50	8.80		May 16, 2022 17:05	122,748.00	2.95	5.58	0.16	302,292.40	1.30	1.37 %	3.32
	Average	**25.60**	**25.73**	**7.92**			**423,702.48**	**2.84**	**9.22**	**0.26**	**398,278.56**	**2.68**	**4.66 %**	**4.33**
	Maximum	**39.00**	**46.17**	**15.80**			**861,851.60**	**3.38**	**12.44**	**0.35**	**646,367.40**	**7.50**	**8.40 %**	**5.54**

[1] An event is a storm with a minimum volume of 15 mm and a minimum inter-event dry period of 12 hours

I/I Analysis Graph

Station: MH-27



Infiltration/Inflow Event Analysis
Station: MH-27
Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm (7,777,800.00 L)

Station Details		Storm Details			
Catchment Area	35.76 ha	**Total Precipitation**	21.75 mm (7,777,800.00 L)	**Duration of Storm**	46.17 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	5.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 19, 2022 18:05	**Time of Peak I/I Flow (TD)**	Mar 19, 2022 18:05	**Estimated Dry Weather Flow at TD**	3.38 L/s
Peak Measured Flow	11.92 L/s	**Peak I/I Flow** [4]	8.55 L/s	**Peak I/I Rate** [5]	0.24 L/s/ha
Peak Measured Depth	124.30 mm	**Total I/I Flow Volume during event**	653,606.20 L	**Volumetric Coefficient (Cv%)** [6]	8.40%
Total Measured Flow Volume during Event	1,299,973.60 L	**Peak I/I Coefficient** [7]	0.0150	**Hourly Wet-Weather Peaking Factor** [8]	3.71
		Instantaneous Wet-Weather Peaking Factor [9]	3.87		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

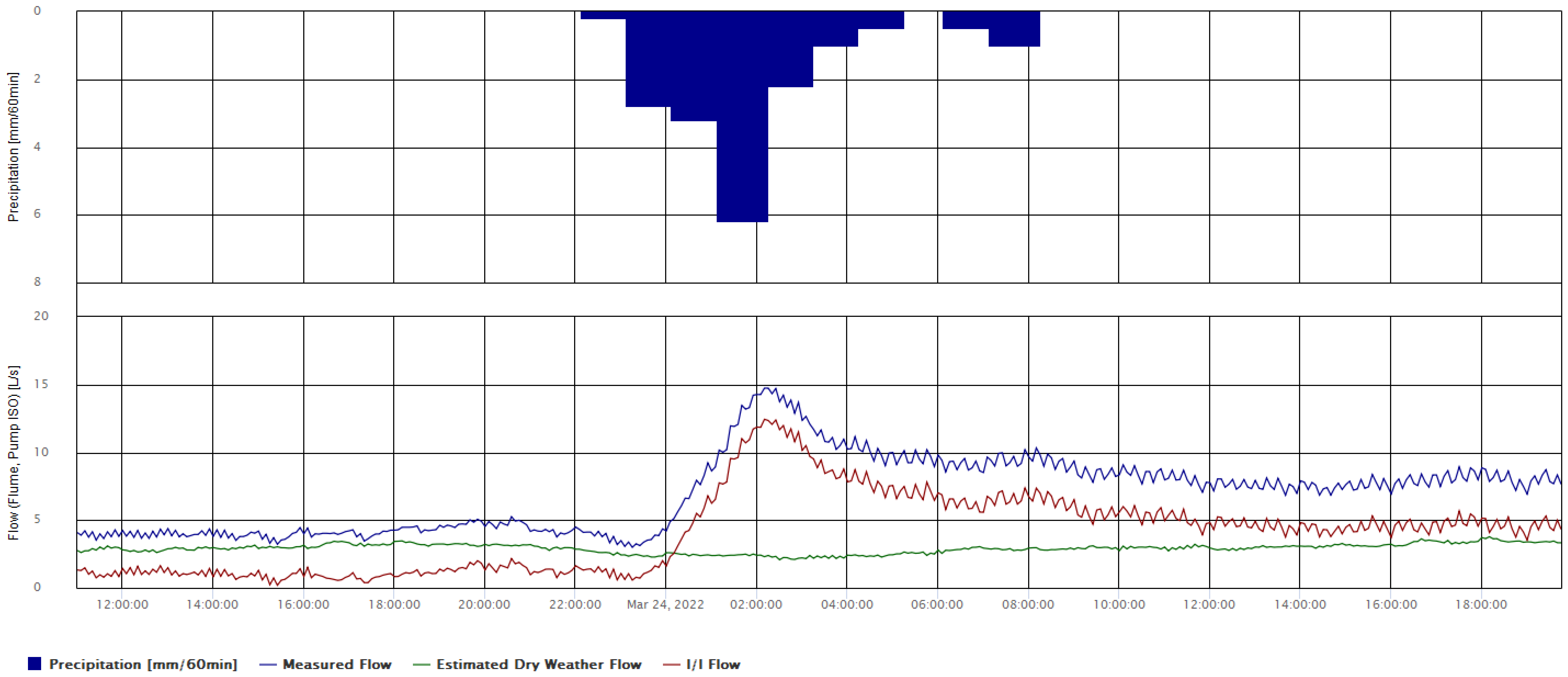
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-27

Infiltration/Inflow Event Analysis
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm



Infiltration/Inflow Event Analysis

Station: MH-27

Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm (6,347,400.00 L)

Station Details		Storm Details			
Catchment Area	35.76 ha	**Total Precipitation**	17.75 mm (6,347,400.00 L)	**Duration of Storm**	8.75 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	6.20 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 24, 2022 02:10	**Time of Peak I/I Flow (TD)**	Mar 24, 2022 02:10	**Estimated Dry Weather Flow at TD**	2.30 L/s
Peak Measured Flow	14.74 L/s	**Peak I/I Flow** [4]	12.44 L/s	**Peak I/I Rate** [5]	0.35 L/s/ha
Peak Measured Depth	131.30 mm	**Total I/I Flow Volume during event**	436,120.60 L	**Volumetric Coefficient (Cv%)** [6]	6.87%
Total Measured Flow Volume during Event	649,600.70 L	**Peak I/I Coefficient** [7]	0.0200	**Hourly Wet-Weather Peaking Factor** [8]	4.97
		Instantaneous Wet-Weather Peaking Factor [9]	5.18		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

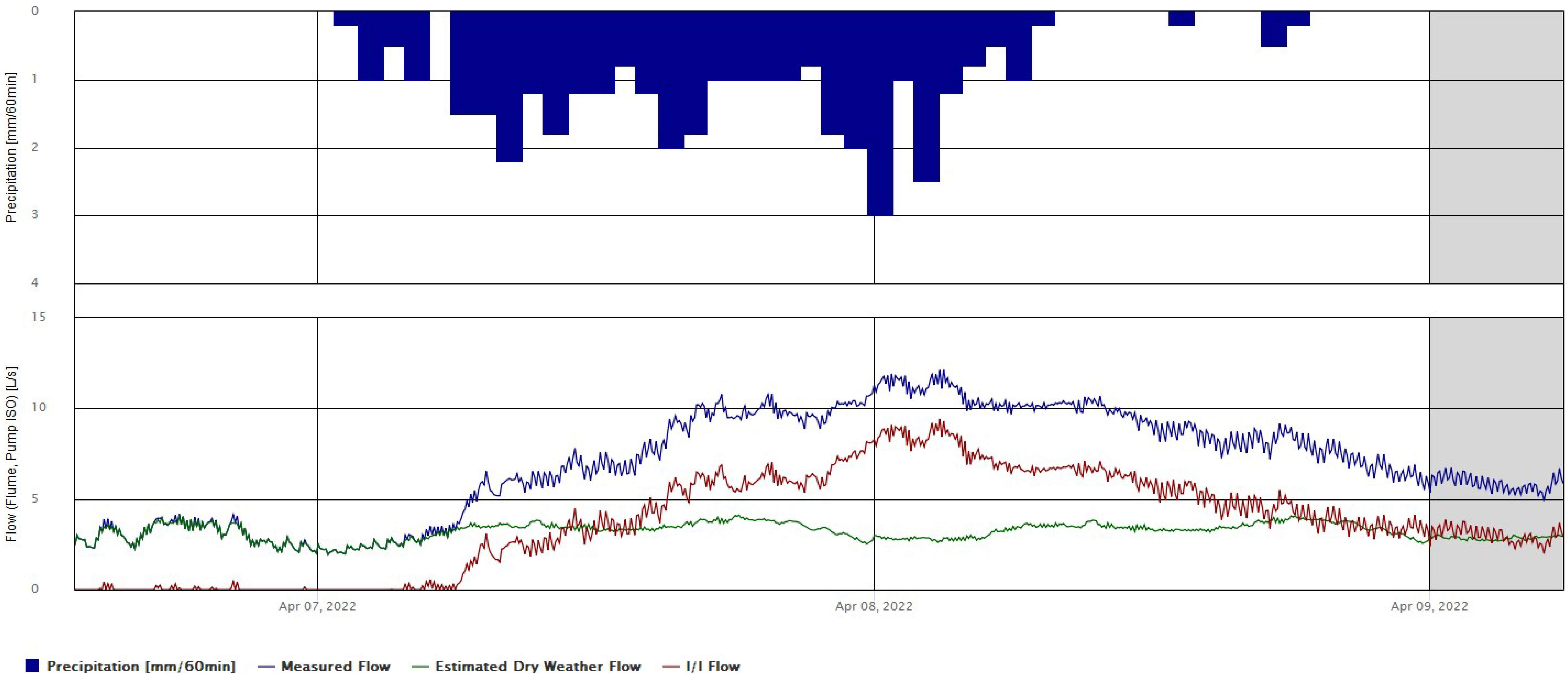
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-27

Infiltration/Inflow Event Analysis
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39 mm



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Infiltration/Inflow Event Analysis
Station: MH-27
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39.00 mm (13,946,400.00 L)

Station Details		**Storm Details**			
Catchment Area	35.76 ha	**Total Precipitation**	39.00 mm (13,946,400.00 L)	**Duration of Storm**	40.25 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	3.00 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Apr 08, 2022 03:00	**Time of Peak I/I Flow (TD)**	Apr 08, 2022 02:50	**Estimated Dry Weather Flow at TD**	2.71 L/s
Peak Measured Flow	12.15 L/s	**Peak I/I Flow [4]**	9.42 L/s	**Peak I/I Rate [5]**	0.26 L/s/ha
Peak Measured Depth	125.30 mm	**Total I/I Flow Volume during event**	861,851.60 L	**Volumetric Coefficient (Cv%) [6]**	6.18%
Total Measured Flow Volume during Event	1,478,294.10 L	**Peak I/I Coefficient [7]**	0.0316	**Hourly Wet-Weather Peaking Factor [8]**	3.54
		Instantaneous Wet-Weather Peaking Factor [9]	3.71		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

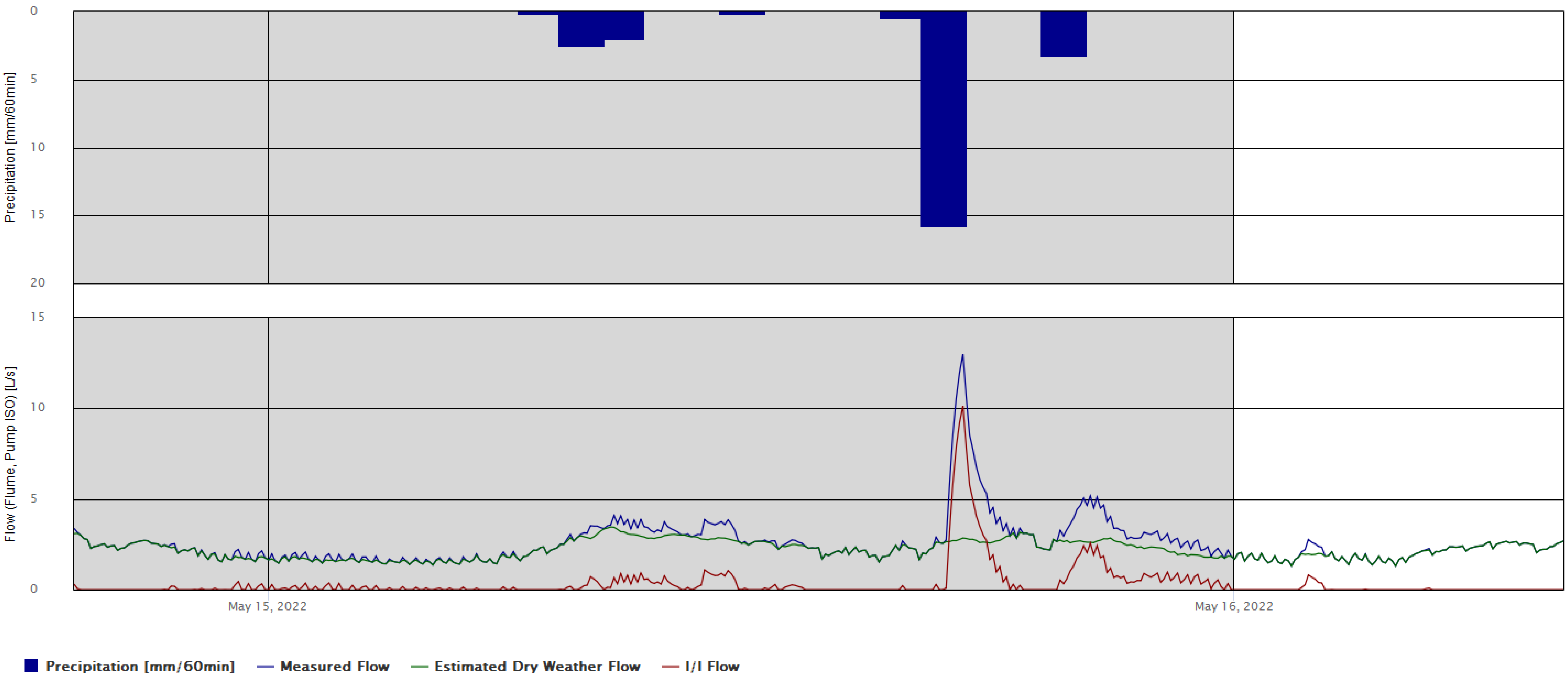
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-27

Infiltration/Inflow Event Analysis
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.5 mm



Infiltration/Inflow Event Analysis

Station: MH-27

May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.50 mm (8,761,200.00 L)

Station Details		Storm Details			
Catchment Area	35.76 ha	**Total Precipitation**	24.50 mm (8,761,200.00 L)	**Duration of Storm**	13.00 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	15.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 15, 2022 17:15	**Time of Peak I/I Flow (TD)**	May 15, 2022 17:15	**Estimated Dry Weather Flow at TD**	2.85 L/s
Peak Measured Flow	12.98 L/s	**Peak I/I Flow** [4]	10.13 L/s	**Peak I/I Rate** [5]	0.28 L/s/ha
Peak Measured Depth	137.30 mm	**Total I/I Flow Volume during event**	44,186.00 L	**Volumetric Coefficient (Cv%)** [6]	0.50%
Total Measured Flow Volume during Event	256,996.40 L	**Peak I/I Coefficient** [7]	0.0065	**Hourly Wet-Weather Peaking Factor** [8]	3.55
		Instantaneous Wet-Weather Peaking Factor [9]	5.51		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

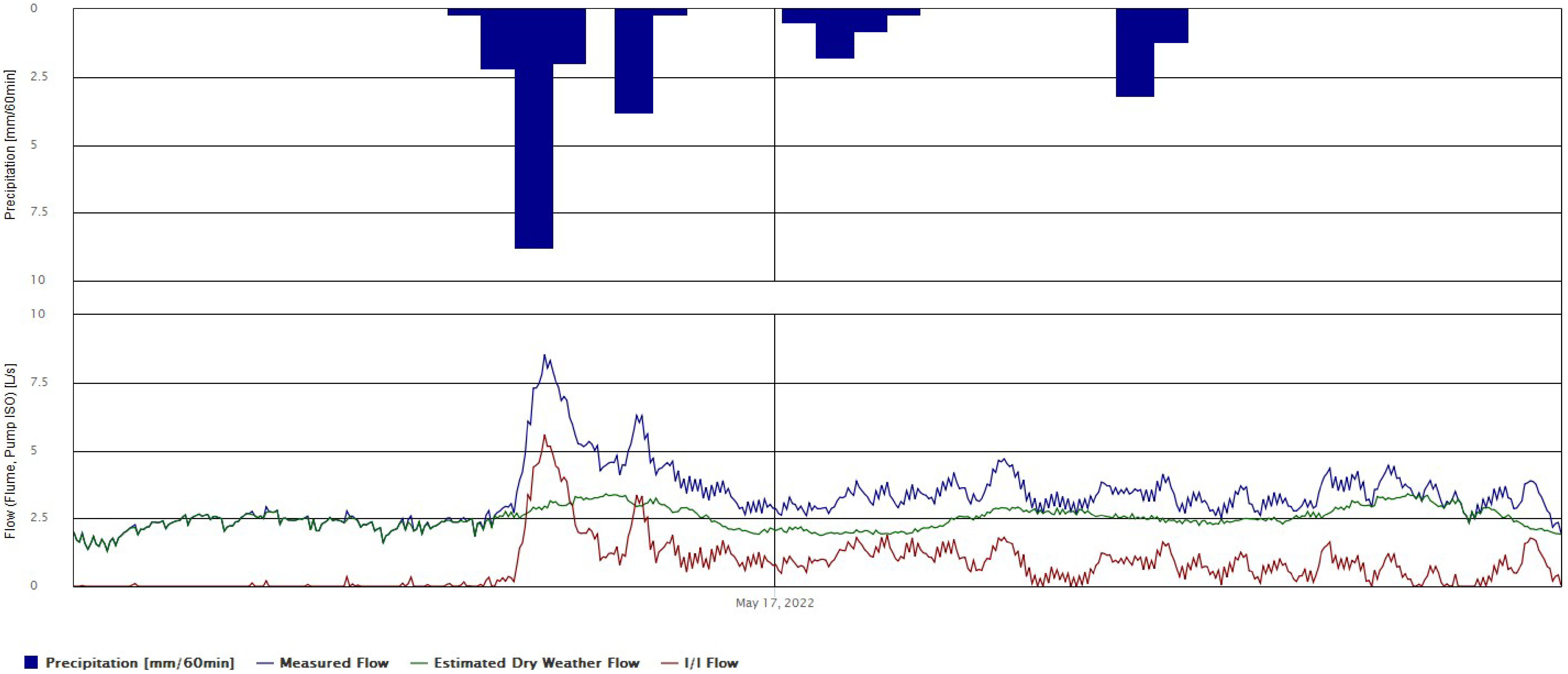
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-27

Infiltration/Inflow Event Analysis
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25 mm



Infiltration/Inflow Event Analysis
Station: MH-27
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25.00 mm (8,940,000.00 L)

Station Details		Storm Details			
Catchment Area	35.76 ha	**Total Precipitation**	25.00 mm (8,940,000.00 L)	**Duration of Storm**	20.50 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	8.80 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 16, 2022 17:05	**Time of Peak I/I Flow (TD)**	May 16, 2022 17:05	**Estimated Dry Weather Flow at TD**	2.95 L/s
Peak Measured Flow	8.53 L/s	**Peak I/I Flow** [4]	5.58 L/s	**Peak I/I Rate** [5]	0.16 L/s/ha
Peak Measured Depth	109.30 mm	**Total I/I Flow Volume during event**	122,748.00 L	**Volumetric Coefficient (Cv%)** [6]	1.37%
Total Measured Flow Volume during Event	425,040.40 L	**Peak I/I Coefficient** [7]	0.0064	**Hourly Wet-Weather Peaking Factor** [8]	2.95
		Instantaneous Wet-Weather Peaking Factor [9]	3.31		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

Aggregate Data

Station: MH-77

Level (Head)

Date From	Date To	Days	Min (m)	Avg (m)	Max (m)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 21, 2022	80	0.02	0.05	0.10	22,697	Wed Apr 27, 2022 05:40	Sun May 15, 2022 17:25

Velocity

Date From	Date To	Days	Min (m/s)	Avg (m/s)	Max (m/s)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 21, 2022	80	0.00	0.01	0.27	22,697	Thu Mar 03, 2022 04:15	Fri Apr 08, 2022 00:55

Flow

Date From	Date To	Days	Min (L/s)	Avg (L/s)	Max (L/s)	Total Volume (1 ML)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 21, 2022	80	0.38	1.89	7.61	12.86	22,697	Wed Apr 27, 2022 05:40	Sun May 15, 2022 17:25

Precipitation

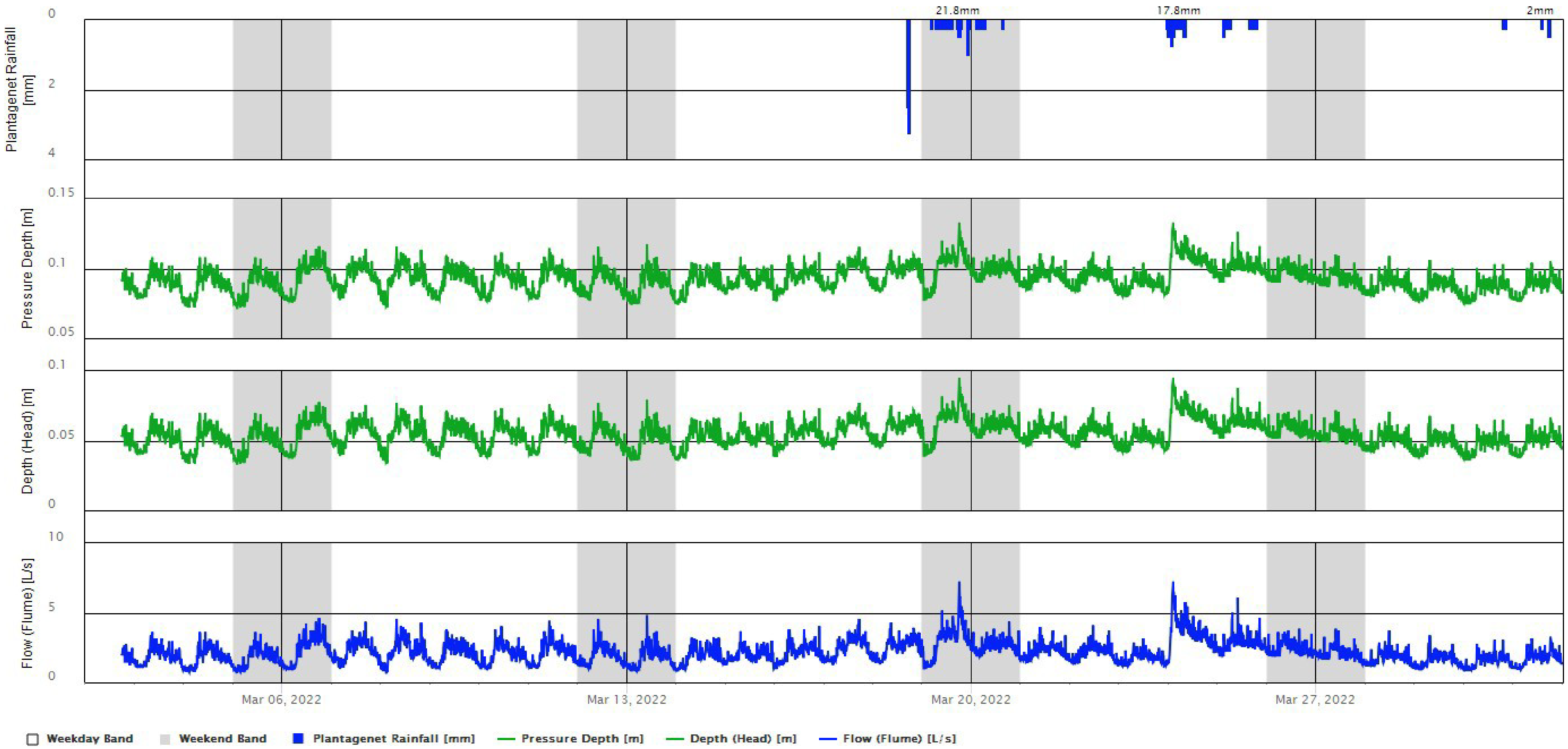
Date From	Date To	Days	Min (mm)	Avg (mm)	Max (mm)	Sum (mm)	Count	Time of Min[1]	Time of Max[1]
Mar 02, 2022	May 21, 2022	68	0.00	0.01	7.50	185.75	19,083	Wed Mar 09, 2022 20:00	Sun May 15, 2022 17:00

[1] Time of Min and Time of Max will be displayed by first occurrence

Data Chart

Station: MH-77

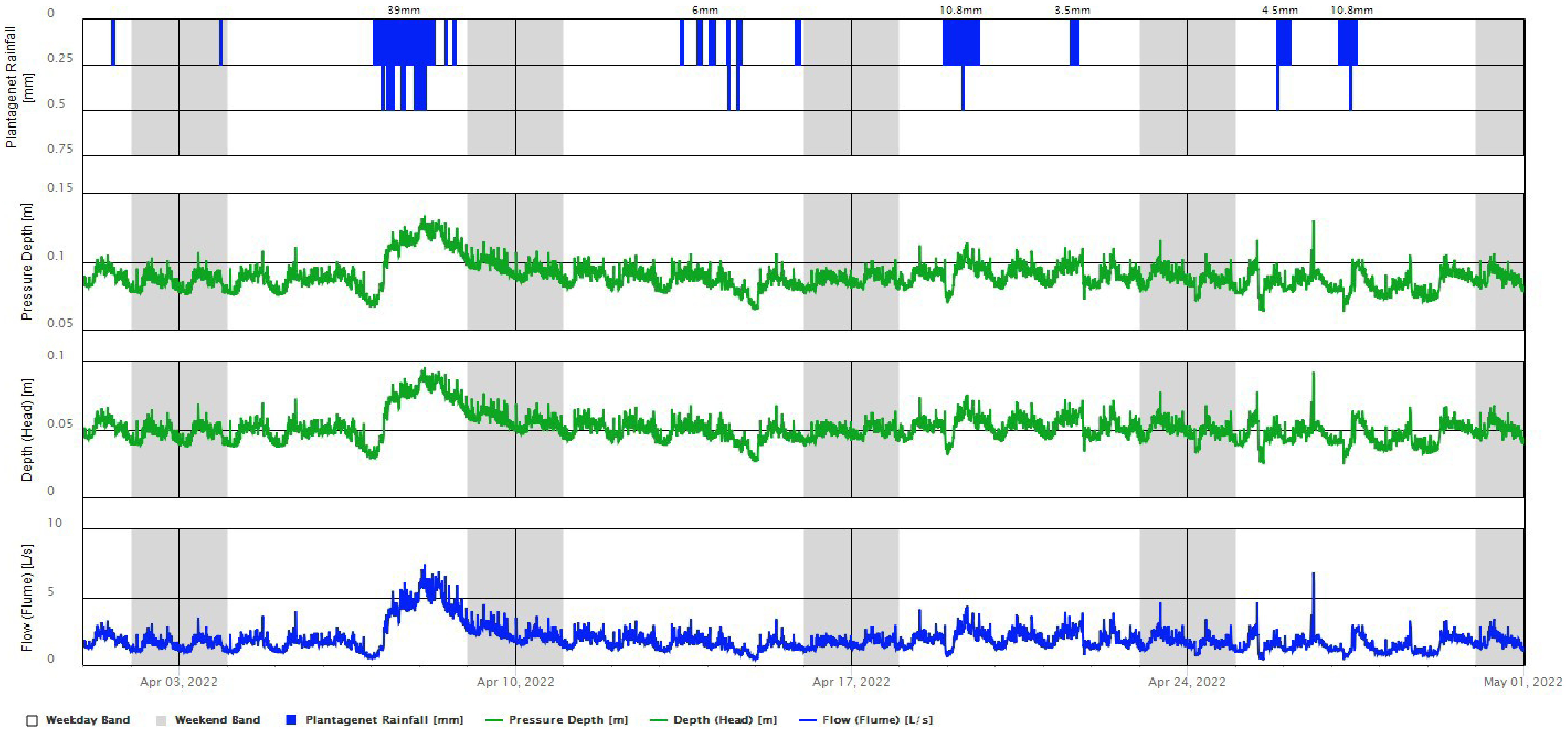
Mar 02, 2022 – Mar 31, 2022



Data Chart

Station: MH-77

Apr 01, 2022 – Apr 30, 2022



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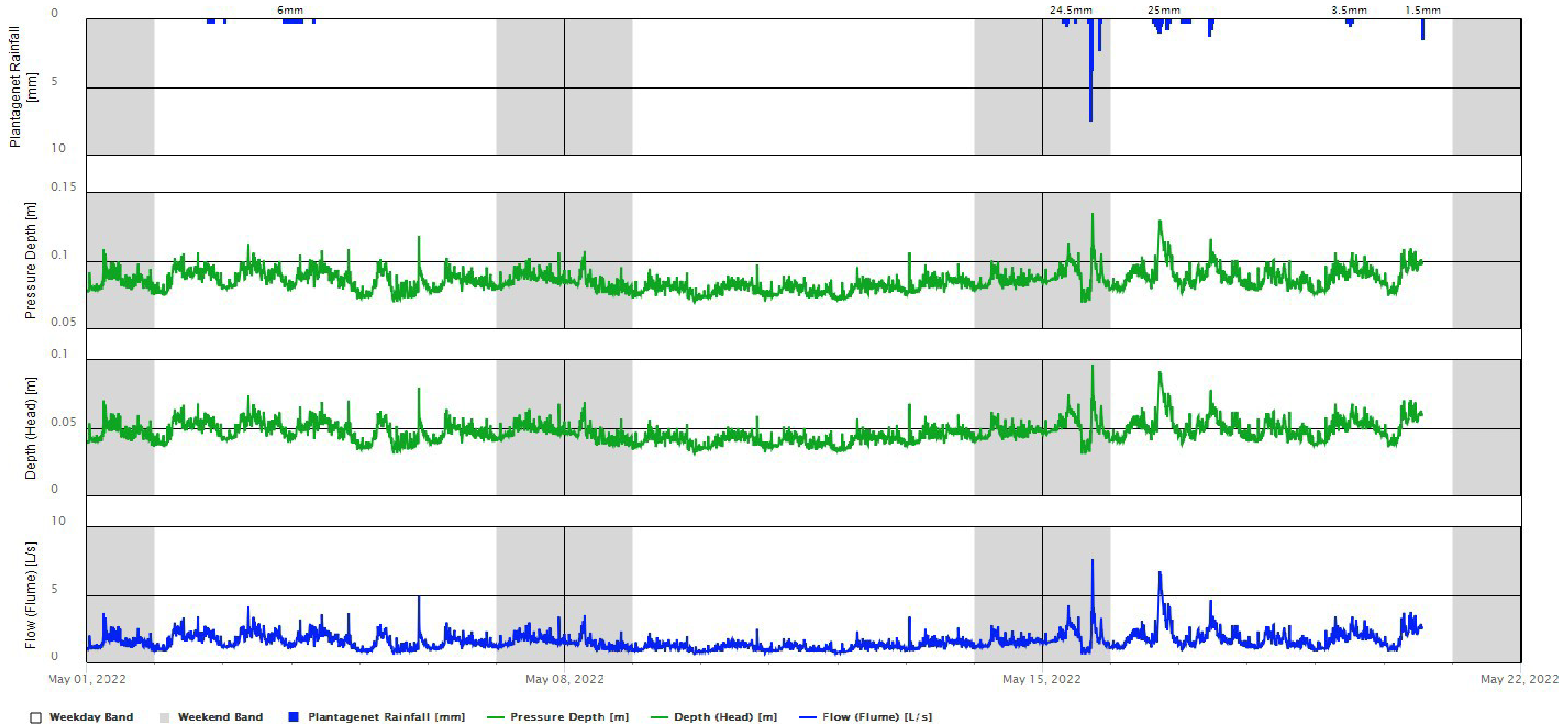
Data Chart

Station: MH-77

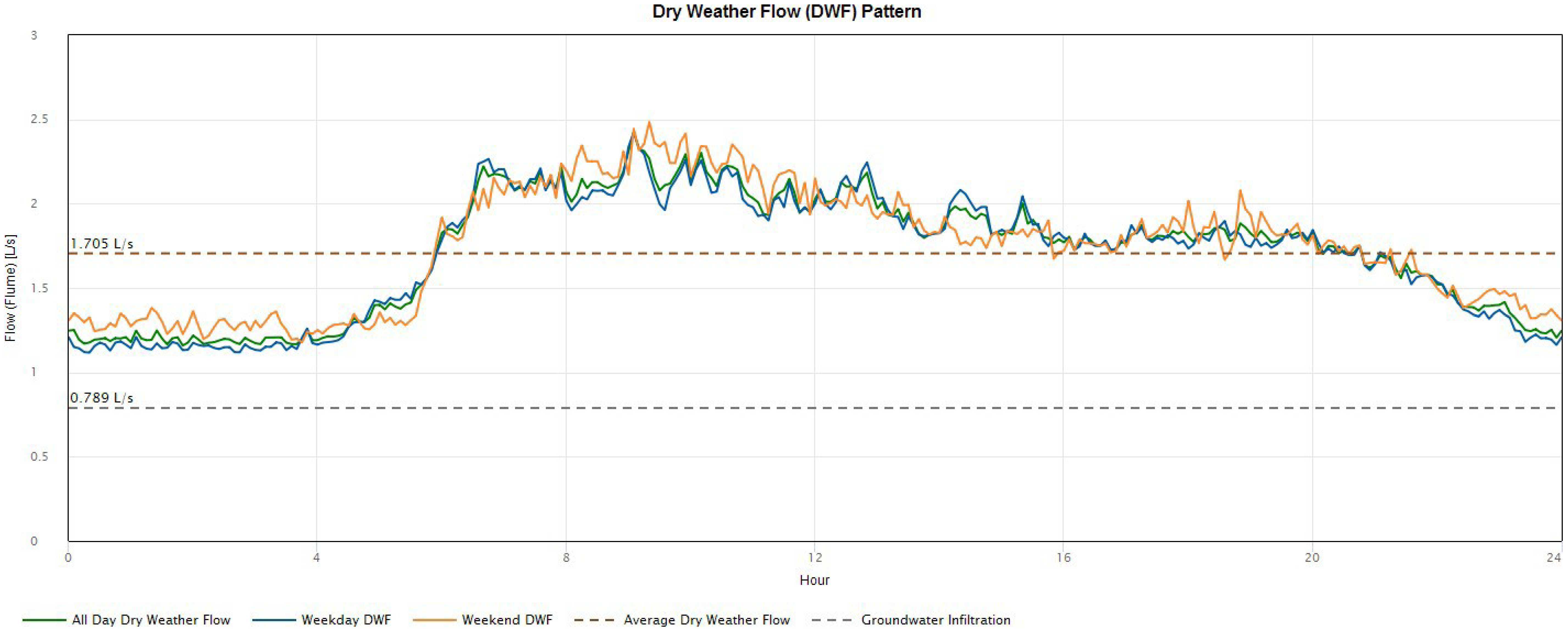
May 01, 2022 – May 21, 2022



Sanitary Report

Station: MH-77

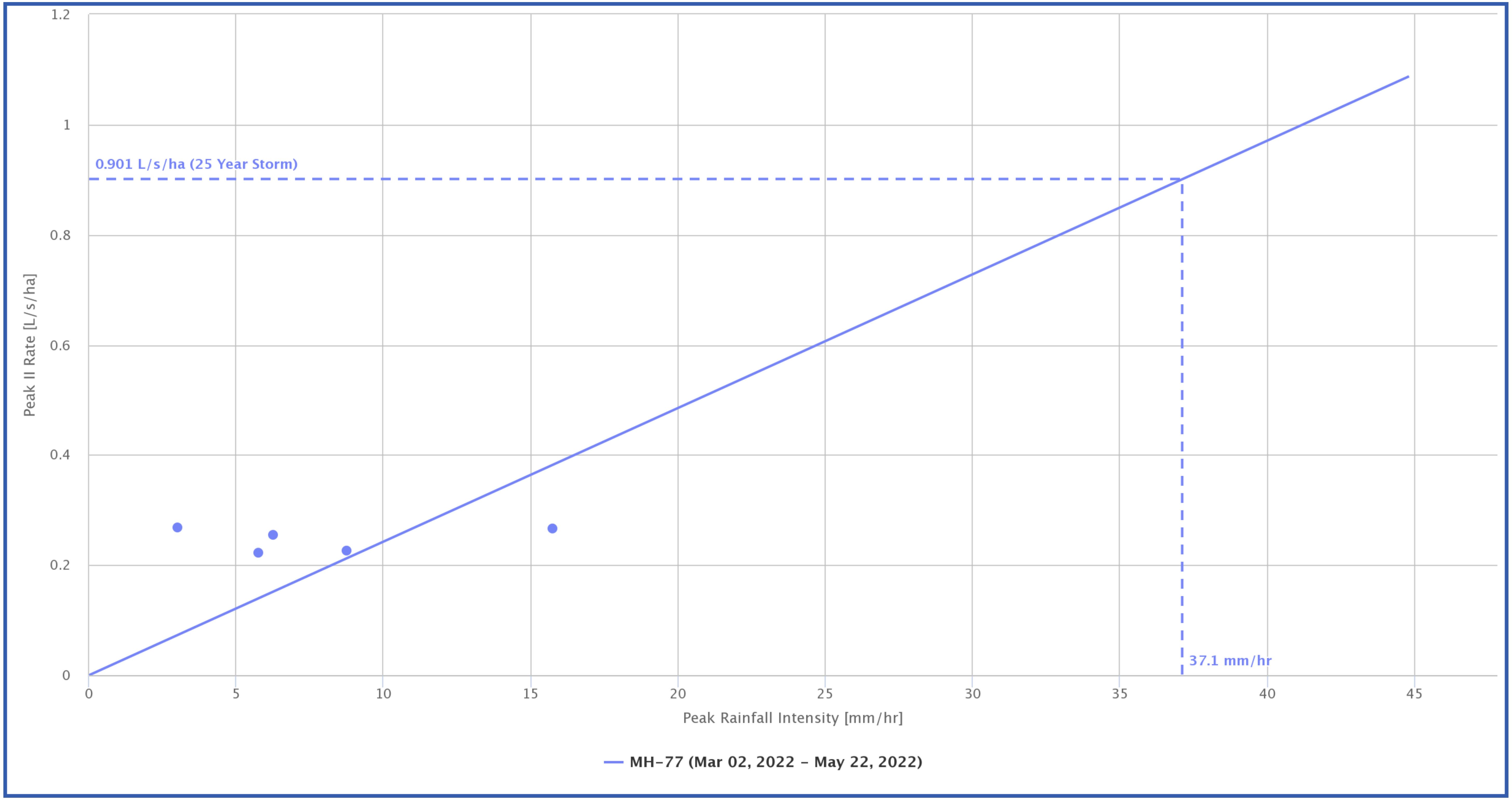
Average Dry Weather Flow (L/s)	Average Dry Weather Flow (L/c/d)	Average Daily Minimum Dry Weather Flow (L/s)	Average Daily Peak Dry Weather Flow (L/s)
1.705	470.719	0.928	3.637
Peaking Factor	**Groundwater Infiltration (L/s)[1]**	**Groundwater Infiltration (L/ha/d)**	**% of GWI in Average DWF**
2.133	0.789	2,950.063	46.273



[1] Groundwater infiltration (GWI) is assumed as 85% of the daily minimum flow averaged over the monitoring period

RDII Projection Graph

Station: MH-77 (23.11 ha)



I/I Analysis Table

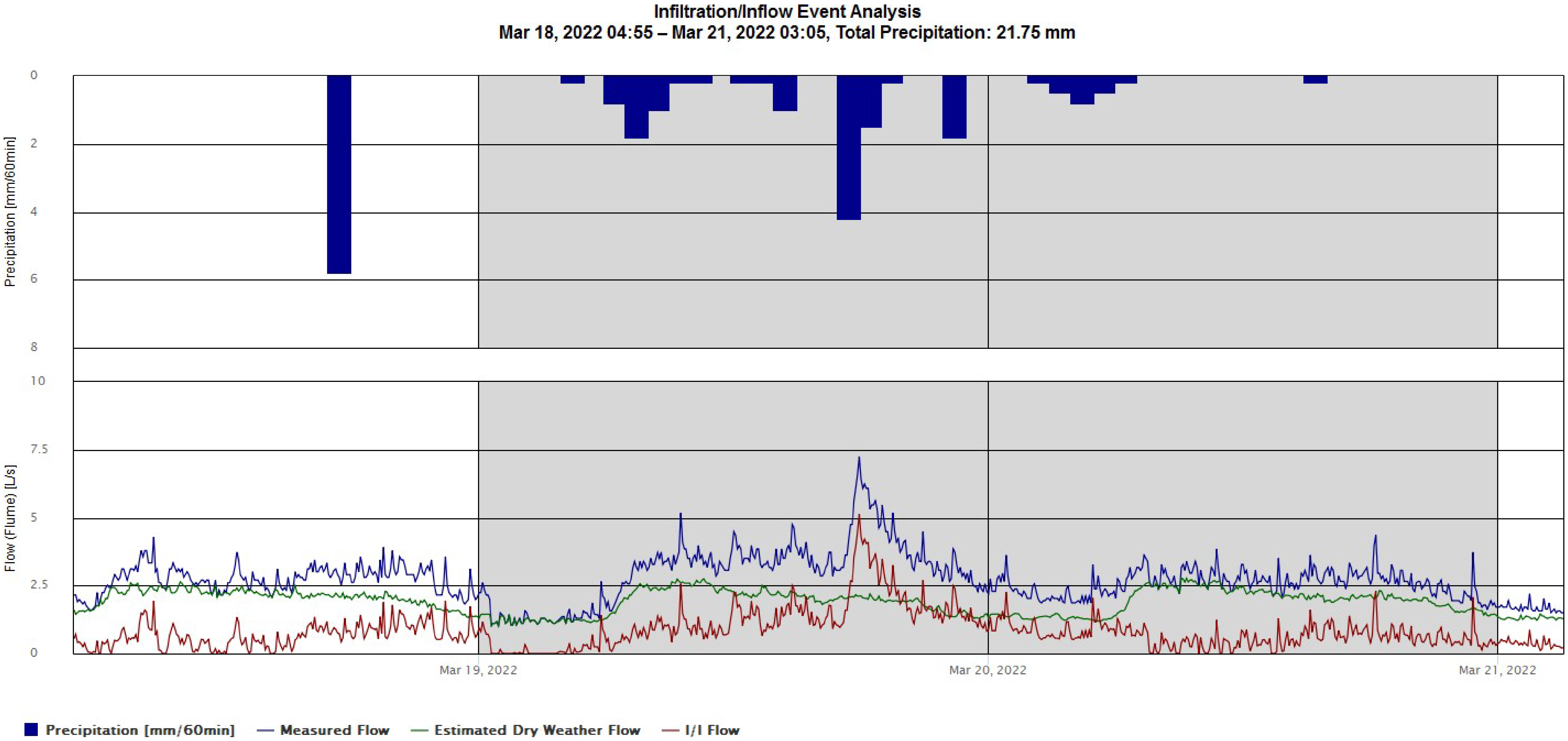
Station: MH-77 (23.11 ha)

							MH-77							
	Event[1]	**Total Precipitation (mm)**	**Duration (hours)**	**Peak Intensity Over Tc=60min at Station (mm/hr)**		**Time of Peak I/I Flow (TD) (date)**	**Total I/I Flow Volume during Event (L)**	**Estimated Dry Weather Flow at TD (L/s)**	**Peak I/I Flow (L/s)**	**Peak I/I Flow Rate (L/s/ha)**	**Total Dry Weather Flow Volume during Event (L)**	**Peak Rainfall Intensity (5 min)**	**Volumetric Runoff Coefficient (CV%)**	**Peaking Factor (PF)**
Measured Storms	Mar 18, 2022	21.75	46.17	5.80	Flow KPIs	Mar 19, 2022 17:55	184,758.70	2.11	5.14	0.22	387,602.60	3.30	3.68 %	3.91
	Mar 23, 2022	17.75	8.75	6.20		Mar 24, 2022 02:10	138,797.60	1.36	5.89	0.25	143,611.90	0.80	3.38 %	3.84
	Apr 07, 2022	39.00	40.25	3.00		Apr 08, 2022 02:30	437,352.10	1.23	6.20	0.27	314,897.80	0.50	4.85 %	4.50
	May 15, 2022	24.50	13.00	15.80		May 15, 2022 17:25	37,867.10	1.46	6.15	0.27	123,730.00	7.50	0.67 %	5.47
	May 16, 2022	25.00	20.50	8.80		May 16, 2022 17:05	90,826.80	1.51	5.22	0.23	163,615.60	1.30	1.57 %	4.81
	Average	**25.60**	**25.73**	**7.92**			**177,920.46**	**1.53**	**5.72**	**0.25**	**226,691.58**	**2.68**	**2.83 %**	**4.51**
	Maximum	**39.00**	**46.17**	**15.80**			**437,352.10**	**2.11**	**6.20**	**0.27**	**387,602.60**	**7.50**	**4.85 %**	**5.47**

[1] An event is a storm with a minimum volume of 15 mm and a minimum inter-event dry period of 12 hours

I/I Analysis Graph

Station: MH-77



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Infiltration/Inflow Event Analysis

Station: MH-77

Mar 18, 2022 04:55 – Mar 21, 2022 03:05, Total Precipitation: 21.75 mm (5,026,425.00 L)

Station Details		Storm Details			
Catchment Area	23.11 ha	**Total Precipitation**	21.75 mm (5,026,425.00 L)	**Duration of Storm**	46.17 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	5.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 19, 2022 17:55	**Time of Peak I/I Flow (TD)**	Mar 19, 2022 17:55	**Estimated Dry Weather Flow at TD**	2.11 L/s
Peak Measured Flow	7.25 L/s	**Peak I/I Flow [4]**	5.14 L/s	**Peak I/I Rate [5]**	0.22 L/s/ha
Peak Measured Depth	94.70 mm	**Total I/I Flow Volume during event**	184,758.70 L	**Volumetric Coefficient (Cv%) [6]**	3.68%
Total Measured Flow Volume during Event	572,361.30 L	**Peak I/I Coefficient [7]**	0.0139	**Hourly Wet-Weather Peaking Factor [8]**	3.27
		Instantaneous Wet-Weather Peaking Factor [9]	3.92		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

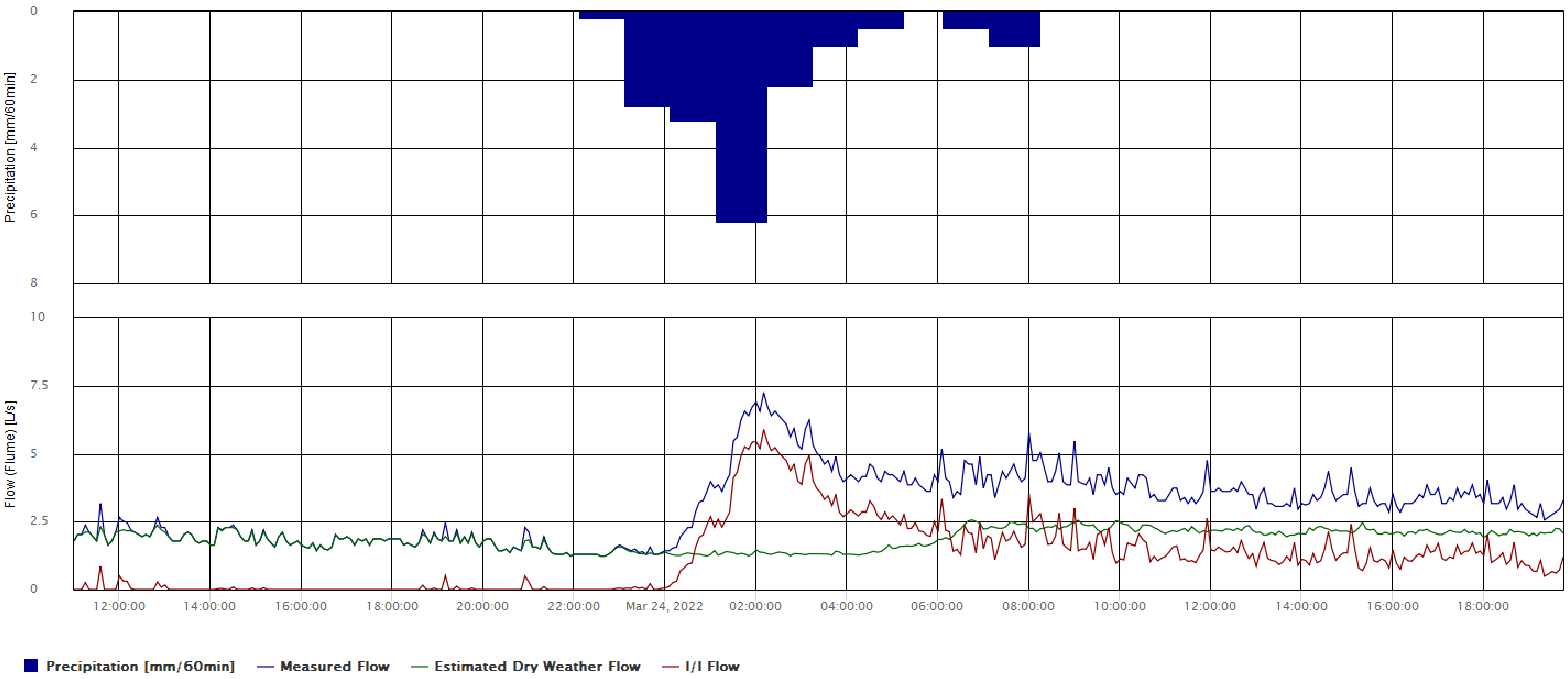
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-77

Infiltration/Inflow Event Analysis
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm



Infiltration/Inflow Event Analysis
Station: MH-77
Mar 23, 2022 11:00 – Mar 24, 2022 19:45, Total Precipitation: 17.75 mm (4,102,025.00 L)

Station Details		Storm Details			
Catchment Area	23.11 ha	**Total Precipitation**	17.75 mm (4,102,025.00 L)	**Duration of Storm**	8.75 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	6.20 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Mar 24, 2022 02:10	**Time of Peak I/I Flow (TD)**	Mar 24, 2022 02:10	**Estimated Dry Weather Flow at TD**	1.36 L/s
Peak Measured Flow	7.25 L/s	**Peak I/I Flow** [4]	5.89 L/s	**Peak I/I Rate** [5]	0.26 L/s/ha
Peak Measured Depth	94.70 mm	**Total I/I Flow Volume during event**	138,797.60 L	**Volumetric Coefficient (Cv%)** [6]	3.38%
Total Measured Flow Volume during Event	282,409.50 L	**Peak I/I Coefficient** [7]	0.0147	**Hourly Wet-Weather Peaking Factor** [8]	3.44
		Instantaneous Wet-Weather Peaking Factor [9]	3.79		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

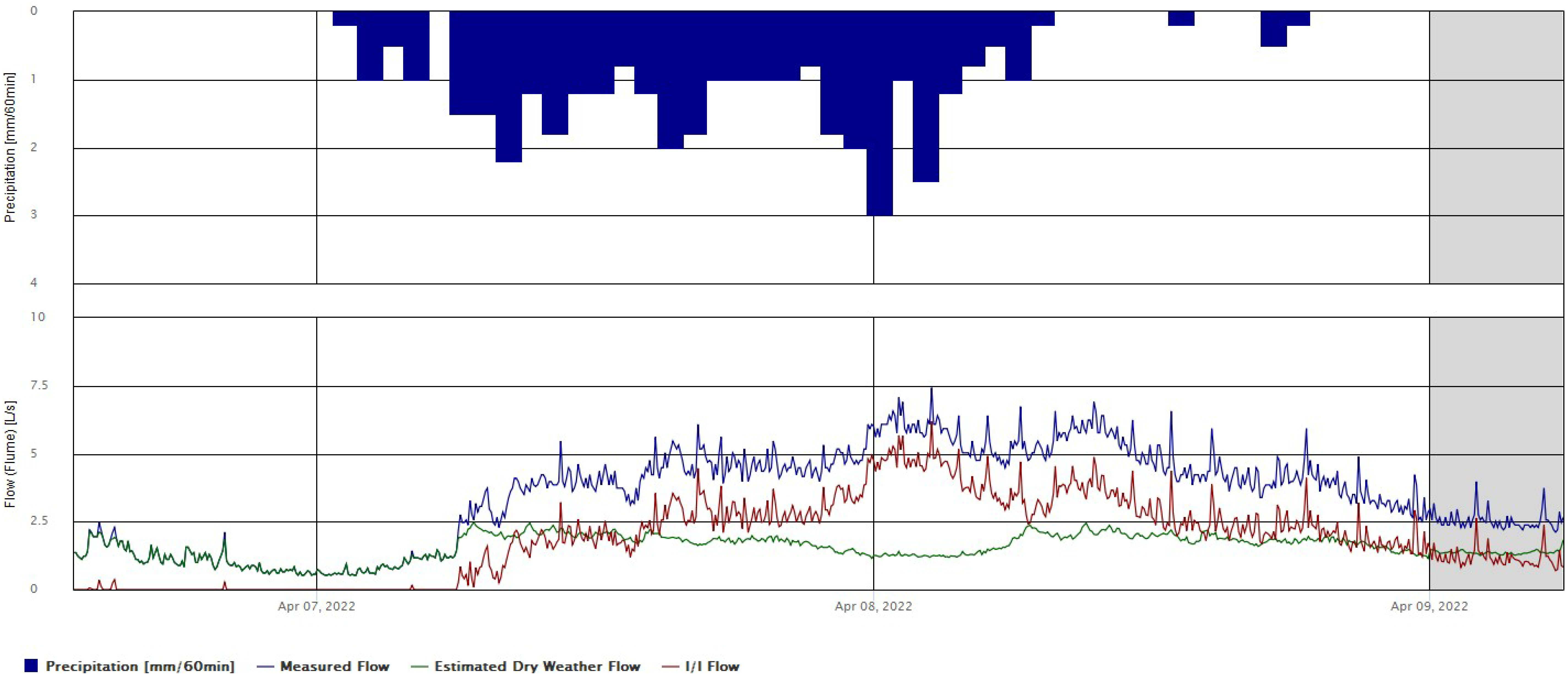
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-77

Infiltration/Inflow Event Analysis
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39 mm



Infiltration/Inflow Event Analysis
Station: MH-77
Apr 06, 2022 13:30 – Apr 09, 2022 05:45, Total Precipitation: 39.00 mm (9,012,900.00 L)

Station Details		Storm Details			
Catchment Area	23.11 ha	**Total Precipitation**	39.00 mm (9,012,900.00 L)	**Duration of Storm**	40.25 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc** [2]	3.00 mm/hr	**Return Period over Tc** [3]	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	Apr 08, 2022 02:30	**Time of Peak I/I Flow (TD)**	Apr 08, 2022 02:30	**Estimated Dry Weather Flow at TD**	1.23 L/s
Peak Measured Flow	7.43 L/s	**Peak I/I Flow** [4]	6.20 L/s	**Peak I/I Rate** [5]	0.27 L/s/ha
Peak Measured Depth	95.70 mm	**Total I/I Flow Volume during event**	437,352.10 L	**Volumetric Coefficient (Cv%)** [6]	4.85%
Total Measured Flow Volume during Event	752,249.90 L	**Peak I/I Coefficient** [7]	0.0322	**Hourly Wet-Weather Peaking Factor** [8]	3.79
		Instantaneous Wet-Weather Peaking Factor [9]	4.44		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

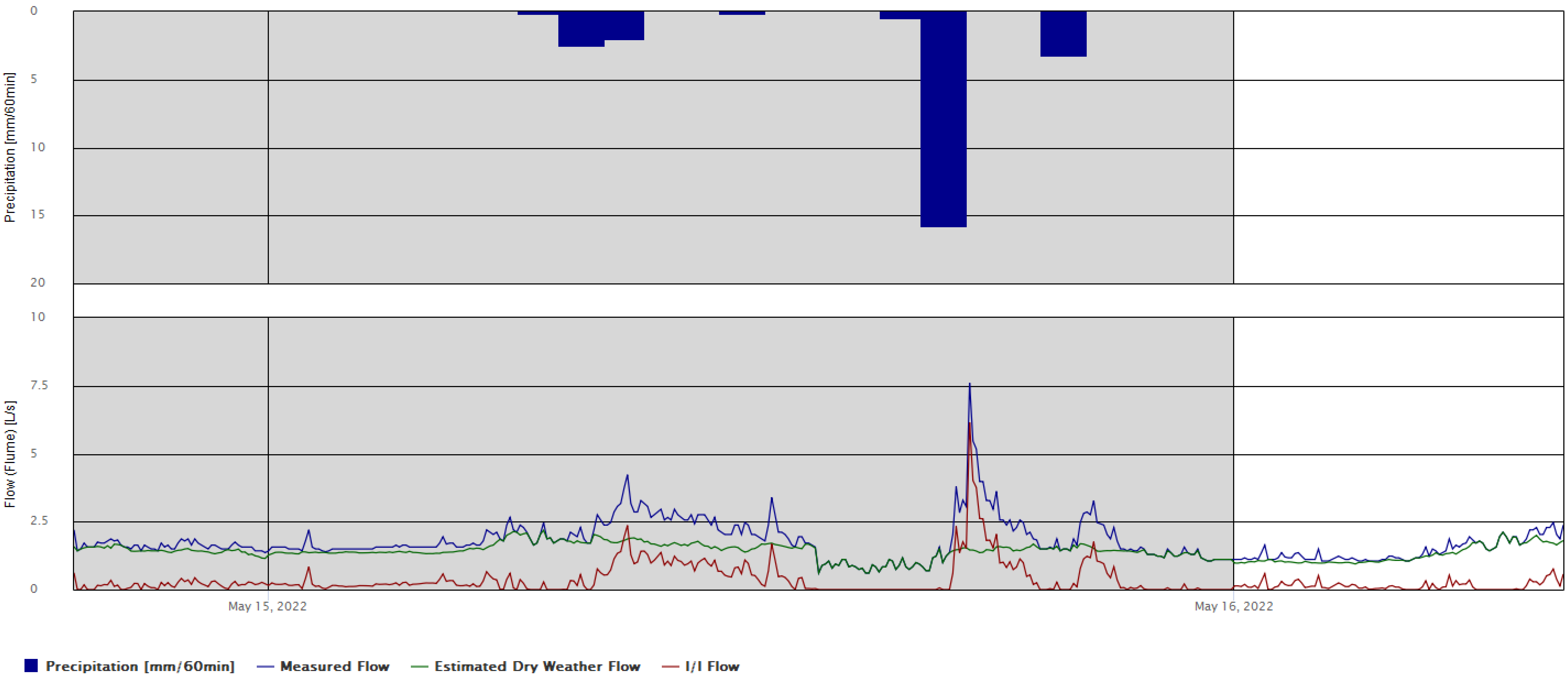
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-77

Infiltration/Inflow Event Analysis
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.5 mm



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Water Management Solutions

Infiltration/Inflow Event Analysis
Station: MH-77
May 14, 2022 19:10 – May 16, 2022 08:10, Total Precipitation: 24.50 mm (5,661,950.00 L)

Station Details		Storm Details			
Catchment Area	23.11 ha	**Total Precipitation**	24.50 mm (5,661,950.00 L)	**Duration of Storm**	13.00 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	15.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 15, 2022 17:25	**Time of Peak I/I Flow (TD)**	May 15, 2022 17:25	**Estimated Dry Weather Flow at TD**	1.46 L/s
Peak Measured Flow	7.61 L/s	**Peak I/I Flow [4]**	6.15 L/s	**Peak I/I Rate [5]**	0.27 L/s/ha
Peak Measured Depth	96.70 mm	**Total I/I Flow Volume during event**	37,867.10 L	**Volumetric Coefficient (Cv%) [6]**	0.67%
Total Measured Flow Volume during Event	161,597.10 L	**Peak I/I Coefficient [7]**	0.0061	**Hourly Wet-Weather Peaking Factor [8]**	2.96
		Instantaneous Wet-Weather Peaking Factor [9]	5.55		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

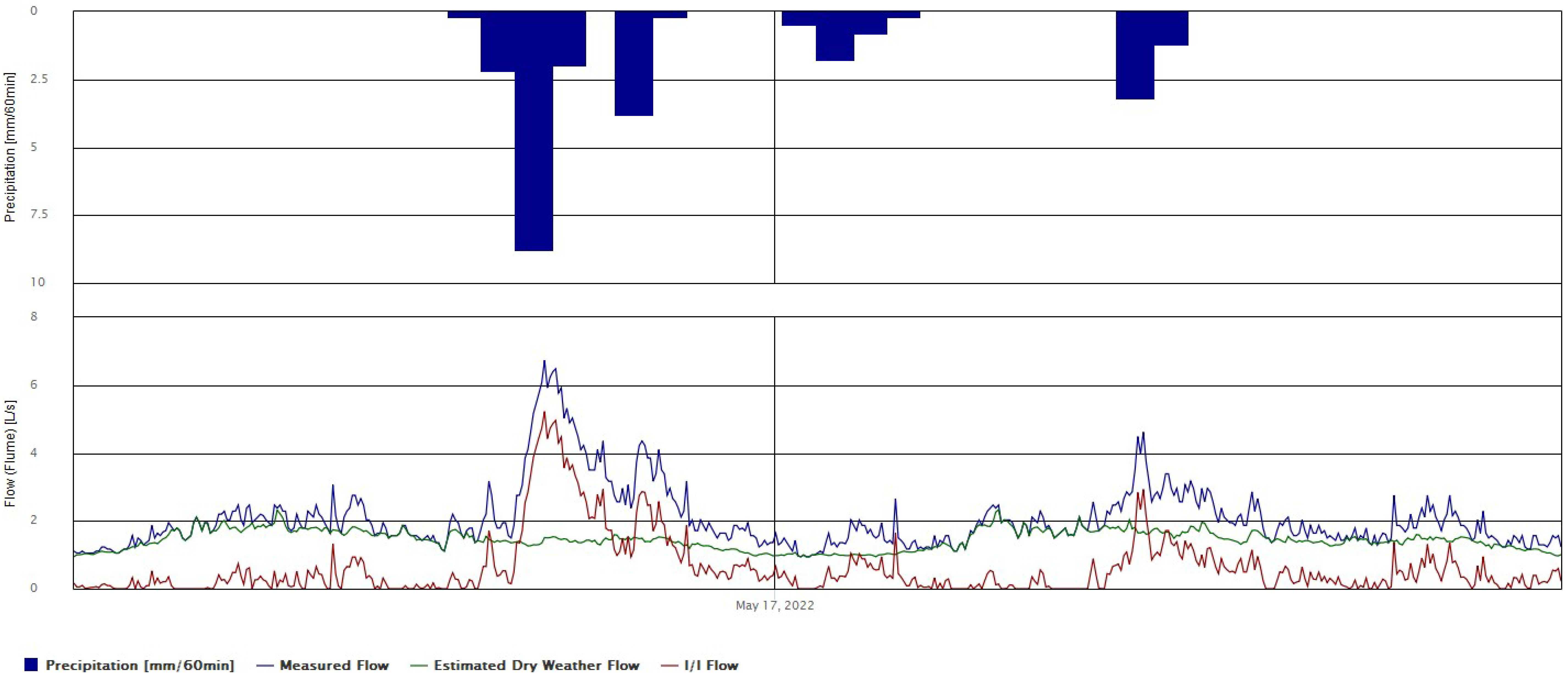
[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

I/I Analysis Graph

Station: MH-77

Infiltration/Inflow Event Analysis
May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25 mm



Infiltration/Inflow Event Analysis

Station: MH-77

May 16, 2022 03:00 – May 17, 2022 23:30, Total Precipitation: 25.00 mm (5,777,500.00 L)

Station Details		Storm Details			
Catchment Area	23.11 ha	**Total Precipitation**	25.00 mm (5,777,500.00 L)	**Duration of Storm**	20.50 hr
Time of Concentration (Tc) [1]	60 min	**Peak Precipitation Intensity Over Tc [2]**	8.80 mm/hr	**Return Period over Tc [3]**	< 2 Yr
Measured Flow		**I/I Flow**			
Time of Peak Measured Flow	May 16, 2022 17:05	**Time of Peak I/I Flow (TD)**	May 16, 2022 17:05	**Estimated Dry Weather Flow at TD**	1.51 L/s
Peak Measured Flow	6.73 L/s	**Peak I/I Flow [4]**	5.22 L/s	**Peak I/I Rate [5]**	0.23 L/s/ha
Peak Measured Depth	91.70 mm	**Total I/I Flow Volume during event**	90,826.80 L	**Volumetric Coefficient (Cv%) [6]**	1.57%
Total Measured Flow Volume during Event	254,442.40 L	**Peak I/I Coefficient [7]**	0.0093	**Hourly Wet-Weather Peaking Factor [8]**	4.25
		Instantaneous Wet-Weather Peaking Factor [9]	4.83		

[1] Time of Concentration (Tc): The estimated time for the flow to travel from the furthest point in the upstream area to the point of monitoring, assume flow is travelling at 1.00 m/s

[2] Peak Precipitation Intensity Over Tc: The peak rainfall intensity for the duration of the storm with the time interval defined by time of concentration

[3] Return Period over Tc: The estimated time to elapse before a storm of equal or greater intensity will likely occur again, based on design storm criteria

[4] Peak I/I Flow: The greatest difference captured between measured flow and estimated dry weather flow, Peak I/I Flow = Maximum (Measured Flow – Estimated Dry Weather Flow)

[5] Peak I/I Rate: A normalized peak I/I flow based on catchment area size, Peak I/I Rate = Peak I/I Flow / Catchment Area

[6] Volumetric Coefficient (Cv%): The ratio of total I/I volume and total rainfall volume, Cv% = Total I/I Flow Volume / Total Precipitation Volume * 100%

[7] Peak I/ I Coefficient: The ratio of peak I/I flow and peak rainfall intensity, Peak I/ I Coefficient = Peak I/I Flow / (Peak Rainfall Intensity over Tc * Catchment Area)

[8] Hourly Wet-Weather Peaking Factor: The ratio of peak hourly wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Hourly Wet-Weather Measured Flow / Average Dry-Weather Flow

[9] Instantaneous Wet-Weather Peaking Factor: The ratio of peak wet-weather measured flow and average dry-weather flow, Wet-Weather Peaking Factor = Peak Wet-Weather Measured Flow / Average Dry-Weather Flow

Appendix C

Technical Memorandum No. 3 – Alternatives design (Phase 3)

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

MEMO

Date:	November 9, 2023
To:	Jonathan Gendron, P. Eng. Director of Building, Planning, Engineering and Environment Township of Alfred and Plantagenet
From:	Camila Valcarcel, EIT J.L. Richards & Associates Limited (JLR)
CC:	Nicolas Bialik, P.Eng., JLR Jordan Morrissette, P.Eng., M.Eng., JLR
Subject:	Technical Memorandum No. 3 – Alternatives Design Memorandum
JLR No.:	31457-000

Table of Contents

1. INTRODUCTION

The Township of Alfred and Plantagenet (Township) is undertaking a Schedule 'C' Municipal Class Environmental Assessment (Class EA) to evaluate alternatives to expand and/or upgrade the Village of Plantagenet (Village) Wastewater System. The goal of the Class EA is to establish reliable, robust, and cost-effective solutions with low to medium operational complexity and flexibility to meet both current and anticipated future servicing requirements of the wastewater system. During Phase 1 of the Class EA, existing conditions and constraints of the system were reviewed and a problem and/or opportunity statement was established. The Phase 1 Report was completed on April 26, 2023. During Phase 2 of the Class EA, additional studies were undertaken to obtain additional information regarding the system, alternative solutions to the problem and/or opportunity statement were assessed, and a preferred solution was identified. The preferred solution for the upgrade/expansion of the Plantagenet Wastewater System is summarized below:

Preferred Solution: Expand Plantagenet Wastewater Treatment System (WWTS) with Additional Lagoon Storage (total storage of 255,000 m^3) and Specialized Treatment System(s) using a New Discharge Window (October 1 to May 31). The following upgrades and/or recommendations were also carried forward as part of the preferred solution:

- Improve WWTS effluent flow measurement.
- Upgrade existing lagoon to reduce seepage through the bottom of the lagoon.
- Develop an Infrastructure Master Plan (incl. I/I Reduction Program) to identify upgrades to the wastewater collection system to minimize extraneous flows into the system.
- Upgrade SPS No. 1 to a rated peak flow capacity of 100 L/s (flow to be confirmed during design).
- Upgrade SPS No. 2 to rated peak flow capacity of 42 L/s (flow to be confirmed during design).
- Consider the following optimization concepts in design of the upgrades:
    - A – Modify dimensions of existing facultative lagoon.
    - B – Modify hydraulics of existing facultative lagoon.
    - C – Convert part or all the existing facultative lagoon into a partial mix aerated lagoon.
    - D – Add in-line coagulation and/or pH adjustment.

Refer to Figure 1 for a conceptual site plan of the preferred solution, developed as part of Phase 2. The Phase 2 Report was completed on September 18, 2023. The purpose of Phase 3 of the Class EA is to identify alternative design concepts for the preferred solution and establish a preferred design concept for the Plantagenet WWTS. This memorandum summarizes the evaluation undertaken as part of Phase 3 to establish a preferred design concept.

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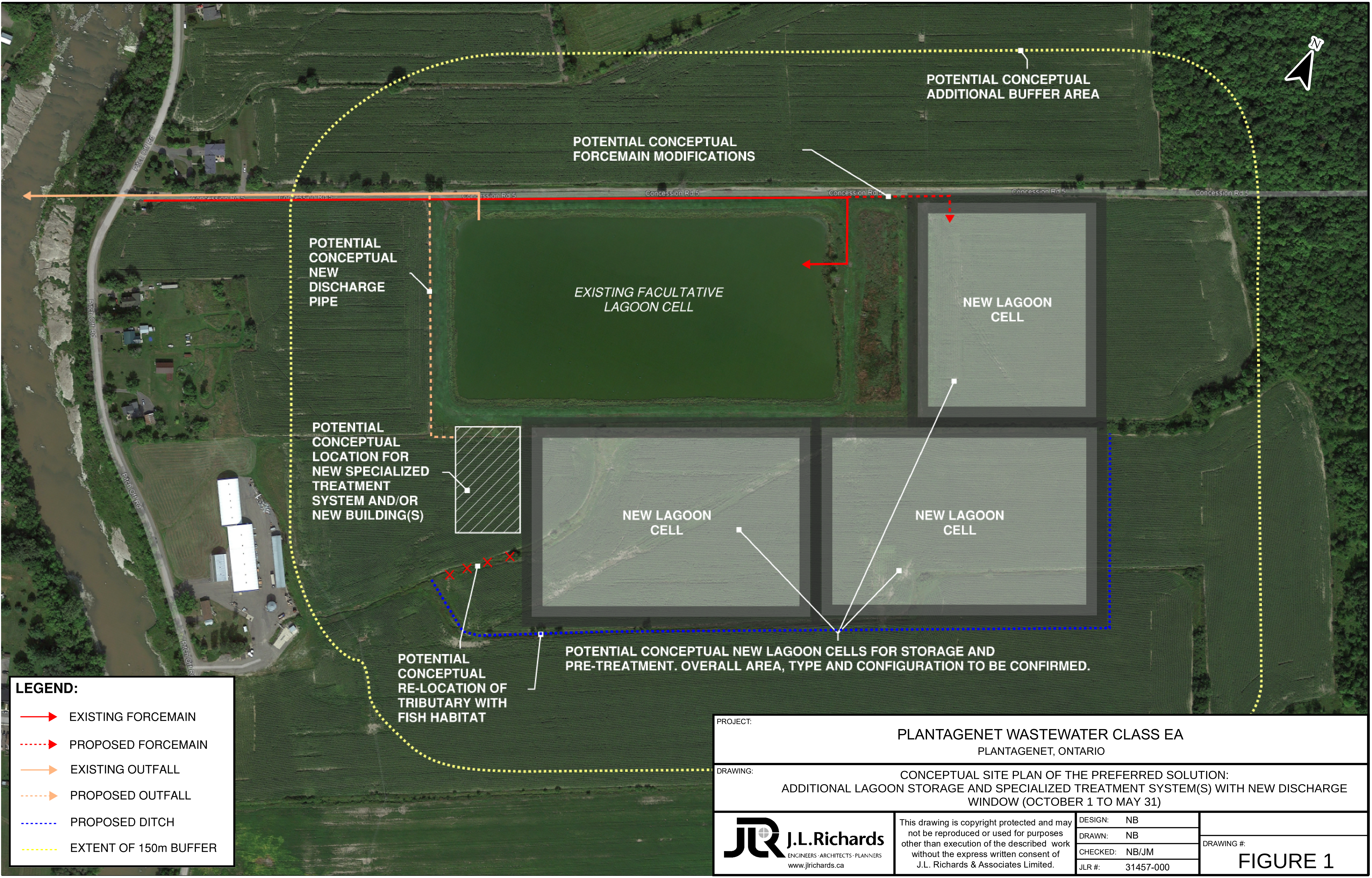

PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF THE PREFERRED SOLUTION:
ADDITIONAL LAGOON STORAGE AND SPECIALIZED TREATMENT SYSTEM(S) WITH NEW DISCHARGE WINDOW (OCTOBER 1 TO MAY 31)

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FIGURE 1

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2. DESIGN BASIS (PHASE 3)

During Phase 2 of the Class EA, a design basis was established for the identification of alternative design concepts in Phase 3. It is noted that Phase 1 and Phase 2 reviewed a phased approach (10-year and 20-year) for upgrading/expanding the Plantagenet WWTS. The ability to phase upgrades was considered in the evaluation of alternative design concepts in Phase 3. The potential phasing of upgrades will be further reviewed in Phase 4 of the Class EA (Environmental Study Report). A summary of the design basis for Phase 3 is provided in Attachment 1. It is noted that the preferred design concept for upgrading the Plantagenet WWTS would require the following:

1. Upgrades to the WWTS to reduce the effluent concentration of 5-day biochemical oxygen demand (BOD5), total ammonia nitrogen (TAN) and total suspended solids (TSS), while allowing for discharge to the South Nation River (SNR) over an extended discharge period (October 1 to May 31).

2. Participation in an offsetting program to maintain the existing level of total phosphorous (TP) treatment, or upgrades to the WWTS to reduce the effluent concentration of TP, while allowing for discharge to the SNR over an extended discharge period (October 1 to May 31).

3. Upgrades to provide a total storage volume of approximately 255,000 m^3.

3. REVIEW OF SPECIALIZED TREATMENT TECHNOLOGIES AND OFFSETTING PROGRAM

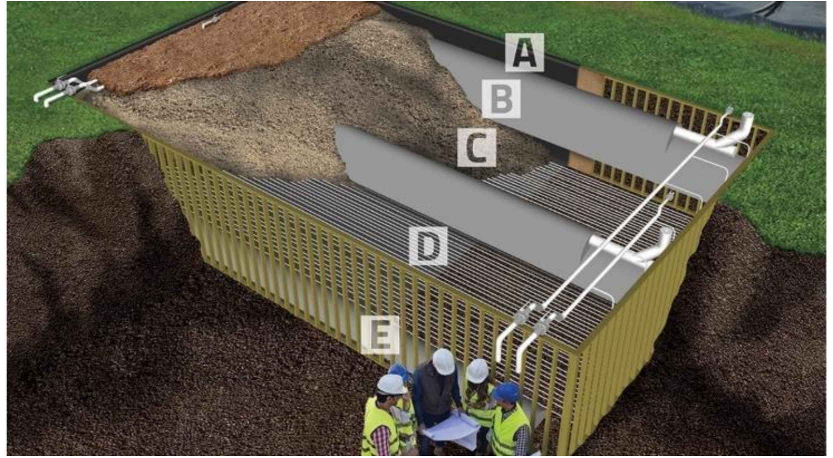
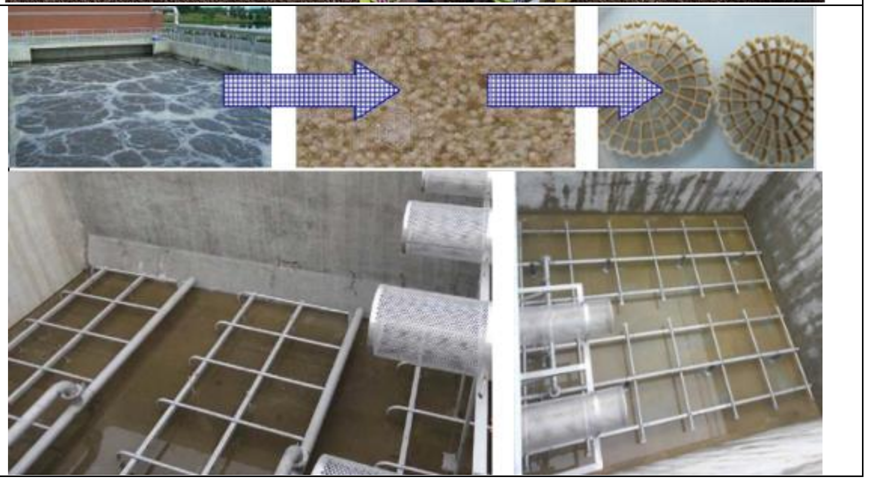
A review of available technologies and programs was undertaken to develop a list of potential alternative design concepts to meet the three (3) requirements listed in Section 2. Note that lagoon storage may either be added through facultative lagoons or aerated lagoons, both of which were described in Phase 2 of the Class EA. A small amount of storage may also be added through the implementation of certain specialized treatment systems.

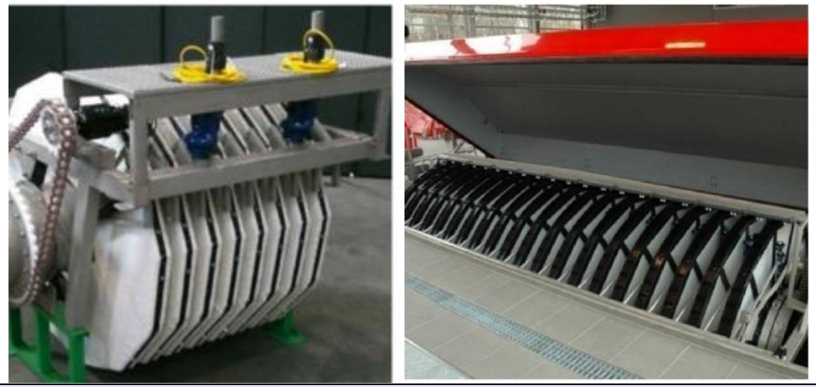
To develop a list of potential specialized treatment technologies, the design basis summary developed for Phase 3 (Attachment 1) was provided to various suppliers of specialized treatment systems to obtain information and to identify technologies currently available on the market that can meet the future requirements of the Plantagenet WWTS. The treatment technologies presented in this section were also required to meet the following conditions:

- The technologies must meet the design effluent criteria presented in Attachment 1; and
- The suppliers of the technologies must be able to guarantee the performance of their technology, through a cold-weather performance test and minimum 12-month guarantee period.

The technologies presented in the table below include specialized biological treatment technologies for the removal of BOD_5 and TAN, as well as specialized physical treatment technologies for the removal of TSS and TP. The specialized biological treatment technologies were subdivided into two main categories: in-lagoon and tertiary technologies. In addition to specialized treatment technologies, the total phosphorous management (TPM) offsetting program is also included in the below table as an alternative to a specialized TP treatment system. No other offsetting programs are available to limit the amount of treatment needed for BOD_5, TAN and TSS.

Table 1: Summary of Specialized Treatment Technologies and Offsetting Programs.

	Technology Type / Program	Description	Photos
Specialized Treatment Technologies			
Biological			
In-Lagoon	Fixed Film Biological Process – Submerged Biological Reactor	Submerged Biological Reactors are modular biological reactors submerged directly into lagoons. An example of these types of reactors are ECOFIXE and BIOFIXE by Technologies Ecofixe. These modular reactors are designed for the removal of BOD_5 (ECOFIXE) and TAN (BIOFIXE). Although not designed to treat TSS, the technology has been shown to provide TSS removal if followed by a non-aerated lagoon that allows for the settling of flocs. The technologies require installation within aerated lagoons to be able to improve removal of organics (ECOFIX) and to provide nitrification at cold temperatures (BIOFIXE).	
Tertiary	Fixed Film Biological Process – Submerged Attached Growth Reactor	Submerged Attached Growth Reactors (SAGR) systems generally consists of a submerged gravel bed with evenly distributed wastewater flow across the width of the cell, aeration piping and diffusers at the bottom of the cell, inlet and outlet structures, piping, blowers, and an effluent recycle stream. The gravel material provides a surface area for growth and attachment of a nitrifying biomass within the bed. The SAGR provides TAN removal, while offering BOD and TSS polishing if installed downstream of lagoon cells. Pictured is a SAGR system from Nexom.	
Tertiary	Fixed Film Biological Process – Moving Bed Biofilm Reactor	Moving Bed Biofilm Reactor (MBBR) systems generally consists of a concrete tank filled with floating media, aeration blowers, aeration piping and grids, media retention sieves, and auxiliary instrumentation and controls. The microorganisms treating the wastewater grow on the surfaces of the media, which is retained by sieves in the treatment reactor. MBBR systems can be designed to remove both TAN and BOD_5. Pictured is Veolia's LagoonGuard^{TM} MBBR system with floating AnoxK^{TM}5 media.	

	Technology Type / Program	Description	Photos
Physical (Filtration)			
Tertiary	Filter – Polishing Treatment Technology	Filters are a polishing treatment technology used for the removal of TSS and TP. There are many filters available on the market. One type of filter that is commonly used in combination with lagoon-based biological treatment systems is the disc filter, which are available from suppliers such as Veolia (Hydrotech Discfilter) and Nexom (MITA filter). Disc filters consist of submerged or partially submerged cloth mesh discs. They are typically combined with coagulant and flocculant dosing to provide high levels of TP removal.	
Programs			
Offsetting Program	Total Phosphorous Management Program – Phosphorous Offsetting	The Total Phosphorus Management (TPM) program is currently managed by South Nation Conservation (SNC). The TPM program approach is based on a broader view of pollution control that relies on the improvement of water quality by reduction of non-point source phosphorous loads. The TPM approach requires a 4:1 offset ratio; meaning 4 kg of non-point source phosphorus (measured as TP) must be removed annually for every 1 kg of phosphorus contributed annually by point sources. The one-time fee paid by municipalities at time of system expansion is invested in capital projects that will contribute to reduce the total phosphorus loading to the South Nation River.	N/A

4. DEVELOPMENT OF ALTERNATIVE DESIGN CONCEPTS

Section 3 summarized the different types of treatment technologies that will be evaluated to determine the preferred design concept, including three (3) different specialized biological treatment systems, one type of specialized physical filtration system and the TPM offsetting program. To develop alternative design concepts that meet the requirements of the upgraded Plantagenet WWTS (storage and treatment), the different technologies, programs and/or lagoon expansions were combined. The following four (4) alternative design concepts were developed:

- OPTION 1: Submerged Biological Reactor + Filter + Lagoon Storage
- OPTION 2: MBBR + Filter + Lagoon Storage
- OPTION 3: SAGR + Filter + Lagoon Storage
- OPTION 4: SAGR + TPM Program + Lagoon Storage

Each alternative design concept is summarized in the following sub-sections. A preliminary conceptual design has been developed for each of these options based on information provided by suppliers and based on the 2042 projected average daily flow of 2,020 m^3/d. Note that, for the purpose of evaluating these options, it was assumed that each specialized treatment system and aerated lagoon would need to be designed to be able to achieve a minimum effluent flow of 5,000 m^3/day to allow operational flexibility for the discharge of treated effluent within the allowable monthly discharge rates developed in Phase 2. It is noted that for all options, there are various WWTS configurations that can be explored to optimize the design flow of the specialized treatment systems, including the addition of treated effluent storage, the conversion of the existing lagoon into a partial mix lagoon, flow recirculation, etc. Conceptual level site plans for the different options are presented in Figure 2, Figure 3 and Figure 4.

A Class D opinion of probable cost (OPC) capital cost estimate was prepared for each option based on available information, experience on similar projects and professional judgement. Note that a 30% contingency was added to the cost estimates based on the below definition of a Class D cost estimate:

- Definition of Work: A description of the option with such supporting documentation as is available (definition of project typically in the order of 1 to 5 percent).
- Intended Purpose: To aid in the screening of alternative potential design concepts prior to recommending a preferred design concept (not intended to establish or confirm budgets).
- Level of Effort: Is limited and expected accuracy could range from -30% to +30%.
- Dollar Value: 2023.

These OPCs have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final project cost will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors. As a result, the final project cost will vary from the OPC presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

An approximate annual cost was also developed for the projected annual energy consumption and projected annual chemical consumption of each option. It is noted that the annual cost for supervision, maintenance and spare parts is expected to be provided by the Ontario Clean Water Agency (OCWA), based on their experience operating these types of systems. This cost will be included in the evaluation table in Section 5.

Section 4.1 summarizes a review of the cost of participating in the TPM program (Option 4).

4.1 Offsetting Program – Total Phosphorus Management (TPM) Program

The TPM program consists of a one-time payment from municipalities to the SNC, based on the additional annual loading of TP forecasted to be produced by the expanded/upgraded WWTS. As previously noted, the fee paid by the municipalities is invested in capital projects that will contribute to reducing the total phosphorus loading to the South Nation River via non-point sources. The projects are evaluated by the SNC using the Agricultural Non-Point Source (AGNPS) model to predict and evaluate non-point source loadings from the implementation of best managements practice projects under the Clean Water Program. The best management practice projects include septic system repairs, improvements to manure storage, barnyard runoff/clean water diversion, milkhouse wastewater treatment, livestock access restrictions, etc.

Municipalities/industries within the catchment area of the South Nation River who intend to expand their works (systems) have the option of implementing non-point source reduction measures to offset any increase in phosphorus load (4:1 ratio), or by implementing potentially more costly phosphorus treatment to maintain the loading at current levels. The current 2023 fee for the TPM program is $550/kg TP. This fee paid by the municipalities is based on any additional loading from the existing ECA (current loading at the Plantagenet lagoon is 204.8 kg/year). As part of the Environmental Compliance Approval (ECA) process, the Municipality would have to set a target TP loading and confirm with the MECP the final amount of TP (in kg) to be offset.

Assuming the TP limit remains at a concentration of 1 mg/L, which is the compliance limit of the existing ECA, it is estimated that approximately 532.5 kg/year (737.3 kg/year – 204.8 kg/year) of additional TP could be released from the lagoon based on a projected 20-year flow of 737,300 m^3/year. Multiplying by a factor of 4:1, a total of 2,130 kg would need to be offset to meet TPM program requirements. Based on the current 2023 offset rate of $550/kg provided by the SNC, the approximate cost to offset the potential additional TP loading of the upgraded Plantagenet lagoon would be approximately $1.17M.

Participation in the TPM program has been added to Option 4 as an alternative to using a filter for TP removal.

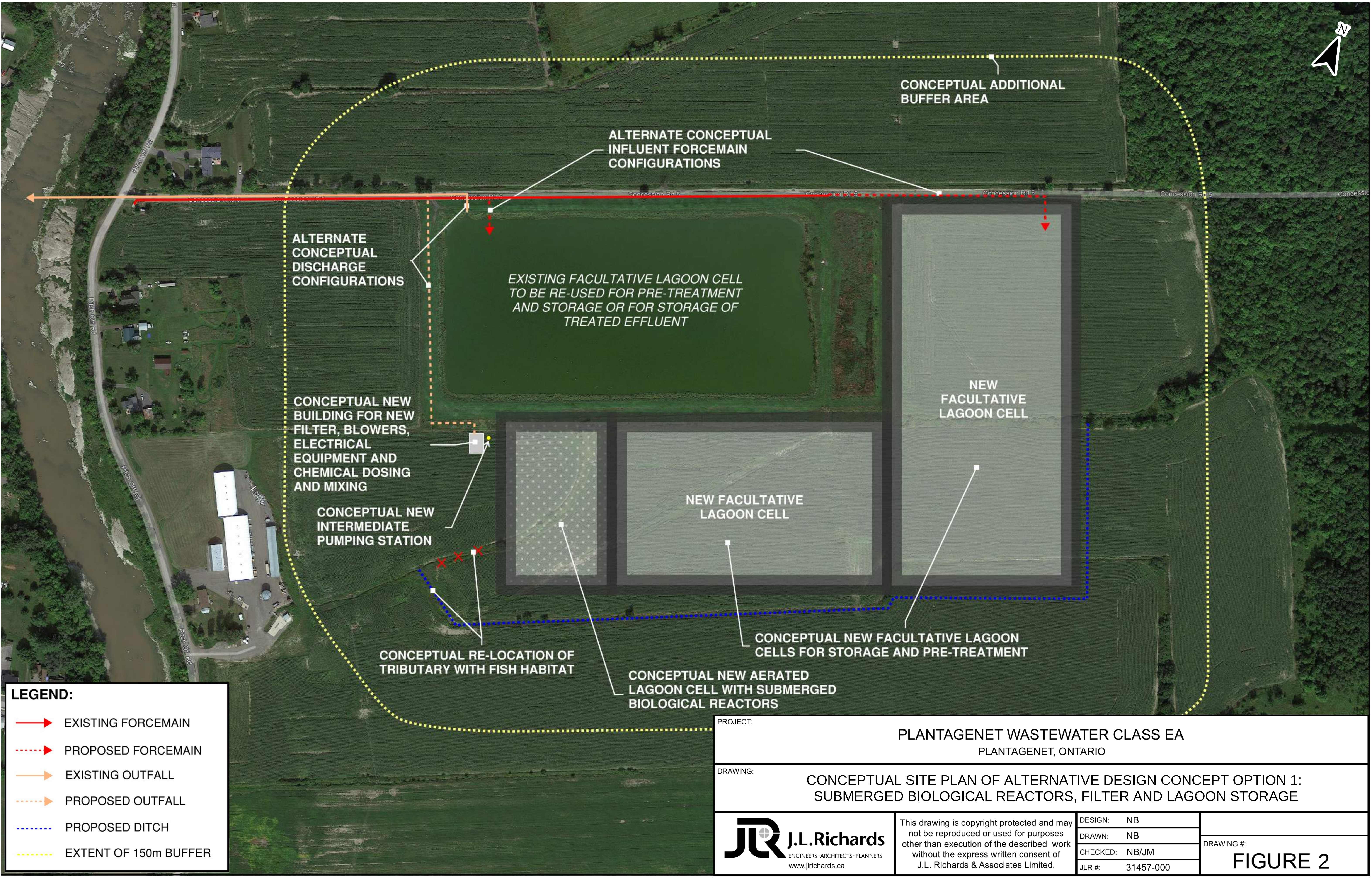
4.2 OPTION 1: Submerged Biological Reactor + Filter + Lagoon Storage

Option 1 presents a potential conceptual design based on in-lagoon biological treatment for BOD and TAN removal, a tertiary filter for TSS and TP polishing and additional lagoons to accommodate the projected necessary storage requirements. To provide a conceptual cost and design of this concept, it was assumed that in-lagoon biological treatment would be provided by modular submerged biological reactors supplied by Technologies Ecofixe, and that tertiary filtration would be provided using a disc filter appropriately sized for this application. Further information on this potential design concept is provided in this section. Refer to Figure 2 for a conceptual design of this alternative.

The following items are assumed to be included as part of Option 1:

- Addition of one (1) aerated lagoon with coarse bubble aeration units.
- Addition of ECOFIXE modules within the aerated lagoon for the removal of BOD_5, and addition of BIOFIXE modules within the aerated lagoon for the removal of TAN.
- Addition of two (2) additional facultative lagoon cells to provide additional storage.
- Addition of new blowers to meet aeration requirements.
- Addition of a tertiary disc filter for the removal of TSS and TP.
- Addition of chemical storage and dosing system to facilitate removal of TSS and TP.
- Addition of new electrical service, backup generator, panels and instrumentation.
- Addition of a new building to house the blowers, disc filter, chemical dosing and mixing equipment and electrical equipment.
- Addition of an intermediate pumping station and other miscellaneous piping, chambers, and valves.
- Other miscellaneous upgrades and/or requirements to accommodate the above items (e.g., purchase of adjacent lands, modifications to existing lagoon, relocation of tributary, etc.).

Based on the above, a Class ‘D’ cost estimate of $30M (excluding HST) was developed for this option. This option is projected to also require annual energy consumption and chemical consumption costs of approximately $215,000/year.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA

PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF ALTERNATIVE DESIGN CONCEPT OPTION 1: SUBMERGED BIOLOGICAL REACTORS, FILTER AND LAGOON STORAGE

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FIGURE 2

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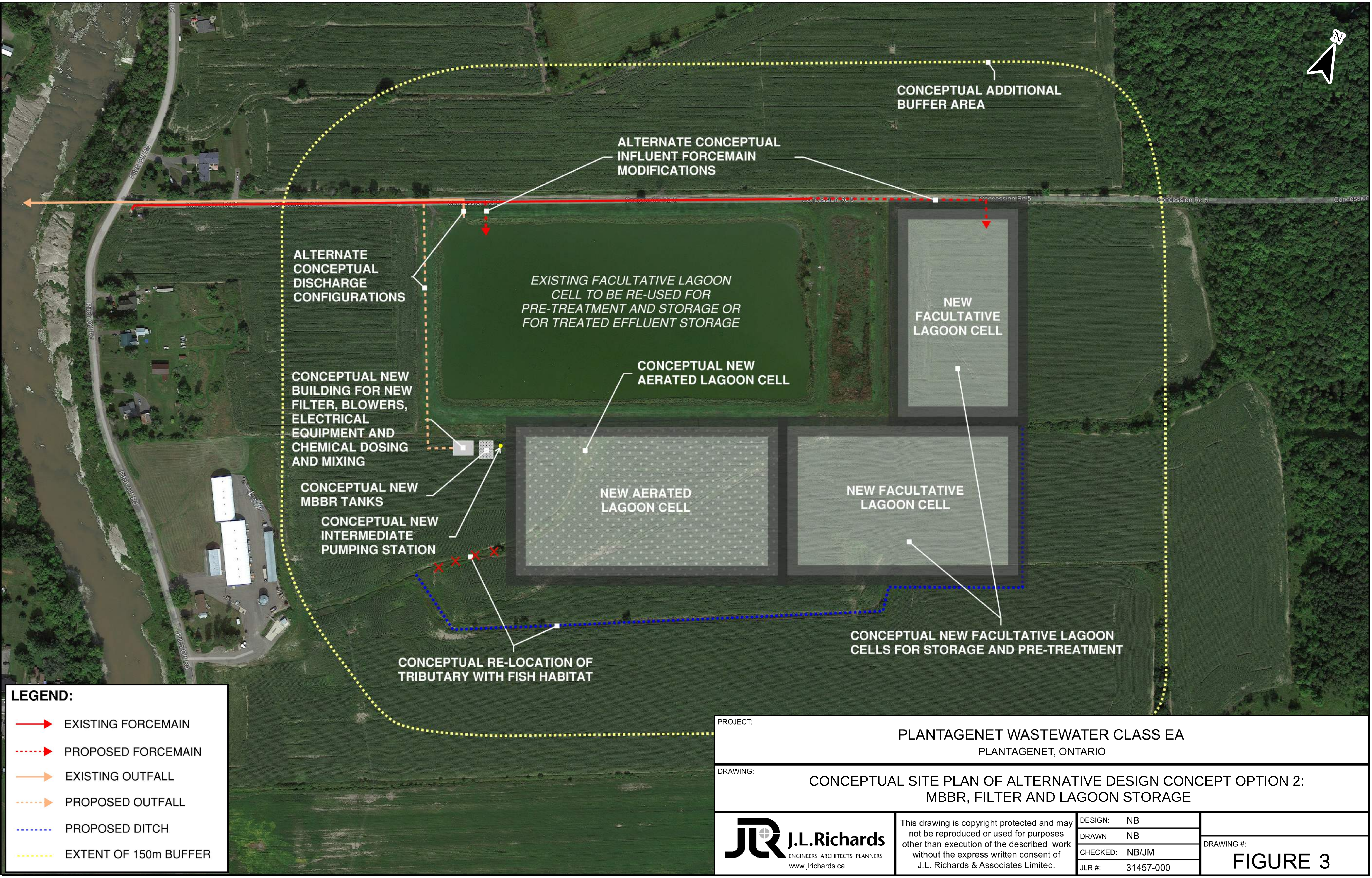
4.3 OPTION 2: MBBR + Filter + Lagoon Storage

Option 2 presents a potential conceptual design based on an aerated lagoon for BOD_5 removal, an MBBR for TAN removal and BOD_5 polishing, a tertiary filter for TSS and TP polishing and additional lagoons to accommodate the projected necessary storage requirements. Further information on this potential design concept is provided in this section. Refer to Figure 3 for a conceptual design of this alternative.

The following items are assumed to be included as part of Option 2:

- Addition of one (1) aerated lagoon with fine bubble aeration units.
- Addition of two (2) parallel MBBR tanks for TAN removal and BOD_5 polishing.
- Addition of two (2) additional facultative lagoon cells to provide additional storage.
- Addition of new blowers to meet aeration requirements.
- Addition of a tertiary disc filter for the removal of TSS and TP.
- Addition of chemical storage and dosing system to facilitate removal of TSS and TP.
- Addition of new electrical service, backup generator, panels and instrumentation.
- Addition of a new building to house the blowers, disc filter, chemical dosing and mixing equipment and electrical equipment.
- Addition of an intermediate pumping station and other miscellaneous piping, chambers, and valves.
- Other miscellaneous upgrades and/or requirements to accommodate the above items (e.g., purchase of adjacent lands, modifications to existing lagoon, relocation of tributary, etc.).

Based on the above, a Class ‘D’ cost estimate of $26M (excluding HST) was developed for this option. This option is projected to also require annual energy consumption and chemical consumption costs of approximately $180,000/year.



PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF ALTERNATIVE DESIGN CONCEPT OPTION 2:
MBBR, FILTER AND LAGOON STORAGE

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FIGURE 3

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4.4 OPTION 3: SAGR + Filter + Lagoon Storage

Option 3 presents a potential conceptual design based on a SAGR for TAN removal and BOD_5 and TSS polishing, a tertiary filter for TP polishing and additional lagoons to accommodate the projected necessary storage requirements. Further information on this potential design concept is provided in this section. Refer to Figure 4 for a conceptual design of this alternative.

The following items are assumed to be included as part of Option 3:

- Addition of one (1) aerated lagoon with fine bubble aeration units.
- Addition of two (2) parallel horizontal flow SAGR cells for TAN removal and BOD_5 and TSS polishing.
- Addition of two (2) additional facultative lagoon cells to provide additional storage.
- Addition of new blowers to meet aeration requirements.
- Addition of a tertiary disc filter for the removal of TSS and TP.
- Addition of chemical storage and dosing system to facilitate removal of TSS and TP.
- Addition of new electrical service, backup generator, panels and instrumentation.
- Addition of a new building to house the blowers, disc filter, chemical dosing and mixing equipment and electrical equipment.
- Addition of an intermediate pumping station and other miscellaneous piping, chambers, and valves.
- Other miscellaneous upgrades and/or requirements to accommodate the above items (e.g., purchase of adjacent lands, modifications to existing lagoon, relocation of tributary, etc.).

Based on the above, a Class ‘D’ cost estimate of $25M (excluding HST) was developed for this option. This option is projected to also require annual energy consumption and chemical consumption costs of approximately $180,000/year.

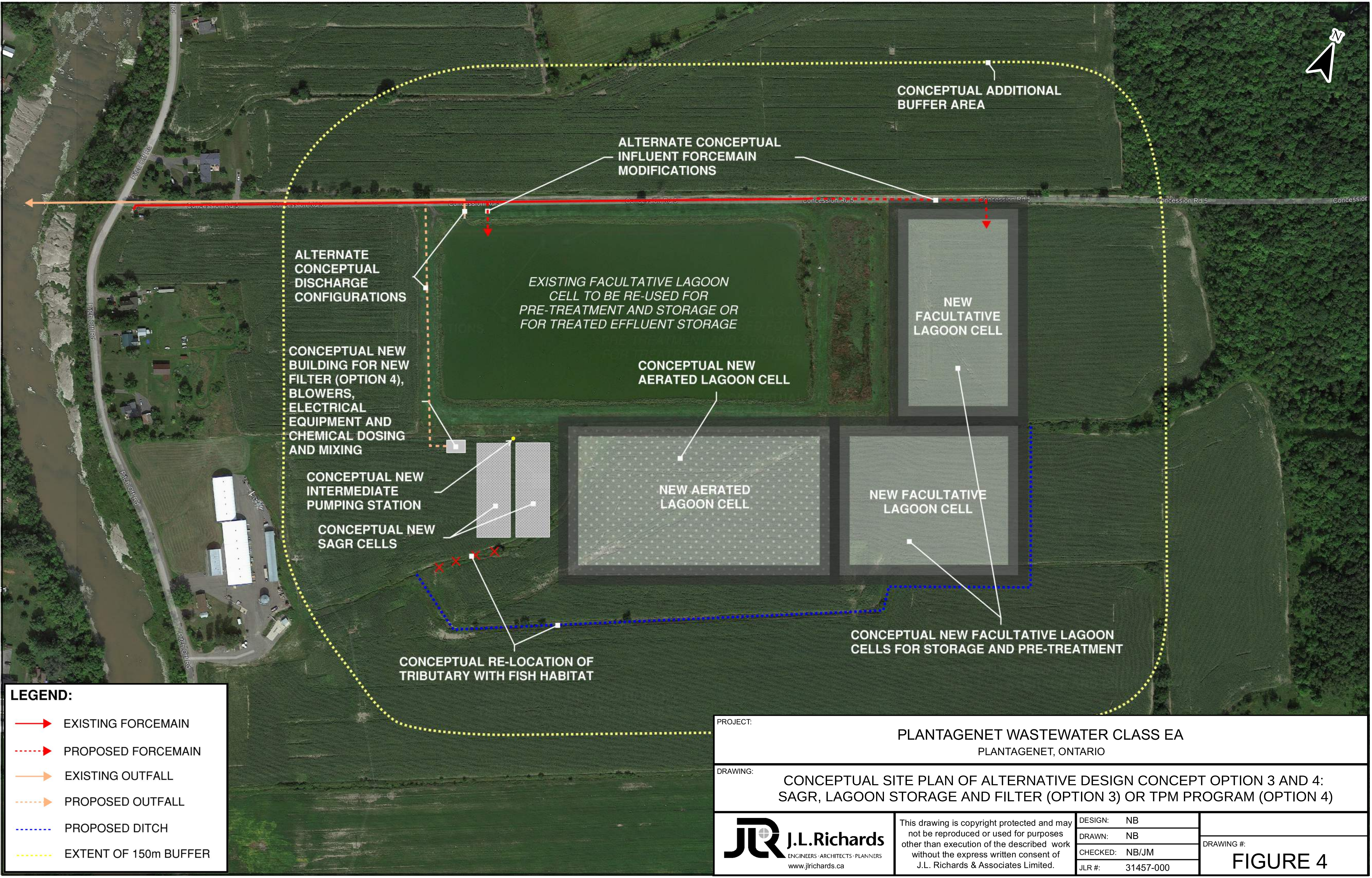
4.5 OPTION 4: SAGR + TPM + Lagoon Storage

Option 4 presents a potential conceptual design based on a SAGR for TAN removal and BOD_5 and TSS polishing, participation in the TPM Program for reduction of TP via non-point sources and additional lagoons to accommodate the projected necessary storage requirements. Further information on this potential design concept is provided in this section. Refer to Figure 4 for a conceptual design of this alternative.

The following items are assumed to be included as part of Option 4:

- Participation in the TPM program to eliminate the need for TP removal beyond an effluent concentration limit of 1.0 mg/L.
- Addition of one (1) aerated lagoon with fine bubble aeration units.
- Addition of two (2) parallel horizontal flow SAGR cells for TAN removal and BOD_5 and TSS polishing.
- Addition of two (2) additional facultative lagoon cells to provide additional storage.
- Addition of new blowers to meet aeration requirements.
- Addition of chemical storage and dosing system to facilitate removal of TSS and TP.
- Addition of new electrical service, backup generator, panels and instrumentation.
- Addition of a new building to house the blowers, chemical dosing and mixing equipment and electrical equipment.
- Addition of an intermediate pumping station and other miscellaneous piping, chambers, and valves.
- Other miscellaneous upgrades and/or requirements to accommodate the above items (e.g., purchase of adjacent lands, modifications to existing lagoon, relocation of tributary, etc.).

Based on the above, a Class ‘D’ cost estimate of $24M (excluding HST) was developed for this option. This option is projected to also require annual energy consumption and chemical consumption costs of approximately $140,000/year.



LEGEND:

- EXISTING FORCEMAIN
- PROPOSED FORCEMAIN
- EXISTING OUTFALL
- PROPOSED OUTFALL
- PROPOSED DITCH
- EXTENT OF 150m BUFFER

PROJECT:

PLANTAGENET WASTEWATER CLASS EA
PLANTAGENET, ONTARIO

DRAWING:

CONCEPTUAL SITE PLAN OF ALTERNATIVE DESIGN CONCEPT OPTION 3 AND 4:
SAGR, LAGOON STORAGE AND FILTER (OPTION 3) OR TPM PROGRAM (OPTION 4)

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FIGURE 4

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5. EVALUATION OF ALTERNATIVES

Following a similar evaluation method as Phase 2 of the Class EA, the alternative design concepts were evaluated based on a set of criteria developed in coordination with the Township and OCWA. The following criteria were used for the assessment:

- Financial – Capital Cost
- Financial – Operation and Maintenance Cost
- Technical – Proven Cold-Weather Installations in Ontario/Canada
- Technical – Degree of Process Control and Ease of Operation
- Technical – Phasing Flexibility
- Technical – Constructability and Complexity of Construction

In coordination with the Township and OCWA, each criterium was assigned a weighting from 1 to 5 to reflect its level of importance relative to other criteria. For each alternative design concept, scores from 0 to 4 were then assigned for each criterion. The following scoring system was followed when evaluating the options:

- 4 – Highly favorable design concept or exceeds criterium requirement.
- 3 – Favorable design concept or meets criterium requirement.
- 2 – Neither favorable or unfavorable design concept or partially meets criterium requirement.
- 1 – Less favorable design concept or barely meets criterium requirement.
- 0 – Unfavorable design concept or does not meet criterium requirement.

Refer to Table 2 for the full summary and final scores/ranks from the evaluation of the alternative design concepts/options. Based on the evaluation of the options with the Township and OCWA, the preferred design concept for the Plantagenet WWTS upgrade is Concept Option No. 4.

Table 2: Evaluation of Alternative Design Concepts.

MAJOR CRITERIA	MINOR CRITERIA	WEIGHT (1-5)	**CONCEPT OPTION NO. 1** SUBMERGED BIOLOGICAL REACTOR + FILTER + STORAGE		**CONCEPT OPTION NO. 2** MBBR + FILTER + STORAGE		**CONCEPT OPTION NO. 3** SAGR + FILTER + STORAGE		**CONCEPT OPTION NO. 4** SAGR + TPM PROGRAM + STORAGE	
FINANCIAL	**Capital Cost**	5	**Score**: 1 Class 'D' capital cost estimate of $30M.	5	**Score**: 2 Class 'D' capital cost estimate of $26M.	10	**Score**: 2 Class 'D' capital cost estimate of $25M.	10	**Score**: 3 Class 'D' capital cost estimate of $24M.	15
	Operation and Maintenance Cost	5	**Score**: 1 Energy and chemical cost of approximately $215,000/year. Cost of operator labour, maintenance and replacement parts is lower than energy/chemical consumption costs and similar for all biological treatment systems. These costs are also similar between disc filters and biological treatment systems.	5	**Score**: 2 Energy and chemical cost of approximately $180,000/year. Cost of operator labour, maintenance and replacement parts is lower than energy/chemical consumption costs and similar for all biological treatment systems. These costs are also similar between disc filters and biological treatment systems.	10	**Score**: 2 Energy and chemical cost of approximately $180,000/year. Cost of operator labour, maintenance and replacement parts is lower than energy/chemical consumption costs and similar for all biological treatment systems. These costs are also similar between disc filters and biological treatment systems.	10	**Score**: 3 Energy and chemical cost of approximately $140,000/year. Cost of operator labour, maintenance and replacement parts is lower than energy/chemical consumption costs and similar for all biological treatment systems. No O&M costs related to the disc filter.	15
ENGINEERING AND TECHNICAL CONSIDERATIONS	**Proven Cold Weather Installations in Ontario/Canada**	3	**Score**: 1 ECOFIXE/BIOFIXE are a promising technology but still relatively new. Only one (1) newly installed installation in Ontario (Temagami, operated by OCWA); others in Quebec. Disc filters are a proven technology and not water temperature dependent.	3	**Score**: 3 MBBRs are an established technology. Previously approved by the MECP for wastewater treatment in cold-weather applications. Only one (1) existing tertiary installation in Ontario (Casselman, operated by OCWA); others in Alberta and the United States. Disc filters are a proven technology and not water temperature dependent.	9	**Score**: 4 SAGRs are an established technology for cold-weather nitrification, and a technology that is well-regarded by the MECP. Several similar successful installations in Ontario (Winchester, Glencoe, Perth, etc.). Disc filters are a proven technology and not water temperature dependent.	12	**Score**: 4 SAGRs are an established technology for cold-weather nitrification, and a technology that is well-regarded by the MECP. Several similar successful installations in Ontario (Winchester, Glencoe, Perth, etc.).	12
	Degree of Process Control and Ease of Operation	2	**Score**: 2 Relatively simple operation. There are several factors that can be controlled in a submerged biological reactor system; however, the lagoon is still required for treatment and certain process modifications must be done manually. Disc filter has a relatively simple operation and high degree of process control but requires backwashing and increases the level of operator involvement required.	4	**Score**: 2 Relatively simple operation. There are several factors that can be controlled in the MBBR system; however, the lagoon is still required for treatment. MBBR is an automated process that requires periodic operator input. The level of operator involvement is greater for MBBR than other concept options. Disc filter has a relatively simple operation and high degree of process control but requires backwashing and increases the level of operator involvement required.	4	**Score**: 2 Relatively simple operation. SAGR systems have higher degree of control than a lagoon alone, however, process control may be limited, and the system may be slow to respond. Limited operator input once SAGR system is established. Disc filter has a relatively simple operation and high degree of process control but requires backwashing and increases the level of operator involvement required.	4	**Score**: 3 Relatively simple operation. SAGR systems have higher degree of control than a lagoon alone, however, process control is limited, and the system may be slow to respond. Limited operator input once SAGR system is established. No operation of disc filter needed.	6

MAJOR CRITERIA	MINOR CRITERIA	WEIGHT (1-5)	CONCEPT OPTION NO. 1 SUBMERGED BIOLOGICAL REACTOR + FILTER + STORAGE		CONCEPT OPTION NO. 2 MBBR + FILTER + STORAGE		CONCEPT OPTION NO. 3 SAGR + FILTER + STORAGE		CONCEPT OPTION NO. 4 SAGR + TPM PROGRAM + STORAGE	
	Phasing Flexibility	4	**Score**: 3 Ability to add additional ECOFIXE/BIOFIXE modules as needed in the aerated lagoon if originally sized to accommodate some expansion. *(Aside: May be added as required in the future to an existing aerated lagoon and may be combined with other tertiary biological treatment systems to improve removal of TAN/BOD$_5$ without increasing footprint.)* Filter can operate at a range of flows. Additional discs would be required if TP/TSS loading increased significantly or if treatment requirements increased. May be able to upsize disc filter to allow for phasing.	12	**Score**: 2 Ability to add additional media inside the MBBR tanks at a relatively low cost to increase BOD$_5$ and TAN removal capability to a certain extent. If significant increase in capacity is needed, additional MBBR tanks may be added in parallel to increase system capacity, although additional footprint is needed to accommodate this expansion. Filter can operate at a range of flows. Additional discs would be required if TP/TSS loading increased significantly or if treatment requirements increased. May be able to upsize disc filter to allow for phasing.	8	**Score**: 2 No ability to expand capacity of existing SAGR cells (with additional media, etc.) and cost of expansion may be significant. However, SAGR cells may be originally oversized to allow for higher future loading and SAGR cells may also be installed within existing lagoon cells (if no additional lagoon storage is required). Filter can operate at a range of flows. Additional discs would be required if TP/TSS loading increased significantly or if treatment requirements increased. May be able to upsize disc filter to allow for phasing.	8	**Score**: 2 No ability to expand capacity of existing SAGR cells (with additional media, etc.) and cost of expansion may be significant. However, SAGR cells may be originally oversized to allow for higher future loading and SAGR cells may also be installed within existing lagoon cells (if no additional lagoon storage is required). To increase the loading of TP from the system, another lump sum payment through the TPM program could be completed.	8
	Constructability and Complexity of Construction	1	**Score**: 3 Relatively simple and speedy installation of ECOFIXE/BIOFIXE modules within aerated lagoons. *<u>For all options</u>: Relatively high bedrock and water elevations on site; a combination of excavation and grade raise is anticipated for lagoon construction. Relatively low-lift intermediate pumping expected (i.e., no deep excavations). Building construction to be similar for all options. Relatively high dewatering volumes are expected. Preference for options with shallower excavations.*	3	**Score**: 1 Ability of the existing site soils to accommodate water-filled concrete tank would require confirmation during design. *<u>For all options</u>: Relatively high bedrock and water elevations on site; a combination of excavation and grade raise is anticipated for lagoon construction. Relatively low-lift intermediate pumping expected (i.e., no deep excavations). Building construction to be similar for all options. Relatively high dewatering volumes are expected. Preference for options with shallower excavations.*	1	**Score**: 2 Reduced requirement for concrete works. If significant dewatering is expected, there is potential to install the SAGR cells within the existing clay-lined facultative lagoon. *<u>For all options</u>: Relatively high bedrock and water elevations on site; a combination of excavation and grade raise is anticipated for lagoon construction. Relatively low-lift intermediate pumping expected (i.e., no deep excavations). Building construction to be similar for all options. Relatively high dewatering volumes are expected. Preference for options with shallower excavations.*	2	**Score**: 2 Reduced requirement for concrete works. If significant dewatering is expected, there is potential to install the SAGR cells within the existing clay-lined facultative lagoon. *<u>For all options</u>: Relatively high bedrock and water elevations on site; a combination of excavation and grade raise is anticipated for lagoon construction. Relatively low-lift intermediate pumping expected (i.e., no deep excavations). Building construction to be similar for all options. Relatively high dewatering volumes are expected. Preference for options with shallower excavations.*	2
Total Score and Rank:			**Rank #4**	**32**	**Rank #3**	**42**	**Rank #2**	**46**	**Rank #1**	**58**

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

Camila Valcarcel, EIT
Environmental Engineering Intern

Reviewed by:

N Bialik

Nicolas Bialik, P.Eng.
Environmental Engineer

Reviewed by:

Jordan Morrissette

Jordan Morrissette, M.Eng., P.Eng.
Associate, Senior Environmental Engineer
Manager, Ottawa Civil & Environmental Department

Attachments:

- Attachment 1 – Phase 3 Design Basis Information

Appendix C1

Phase 3 Design Basis Information

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

MEMO

Date: August 16, 2023

To: File

From: Camila Valcarcel

CC: Nicolas Bialik, Jordan Morrissette

Subject: Plantagenet Wastewater Class Environmental Assessment, Phase 3 Design Basis

JLR No.: 31457-000

1.0 Background information

The Village of Plantagenet (Village) is located approximately 60 km east of the City of Ottawa and 7 km south of the Ottawa River, in the Township of Alfred and Plantagenet (Township) and United Counties of Prescott and Russell (UCPR). The existing wastewater collection and treatment system is owned by the Township and operated by the Ontario Clean Water Agency (OCWA). It consists of several kilometers of gravity sewers, two (2) sewage pumping stations (SPSs) (one main SPS and one sub-area SPS), a lagoon-based wastewater treatment system and a gravity outfall to the South Nation River. The lagoon-based wastewater treatment system operates under Amended Certificate of Approval (C of A) No. 4631-5WXQE9. The treatment system, constructed in the early 1970s, consists of a single cell 6.9 ha facultative waste stabilization pond that is batched dose with alum prior to seasonal discharge (Spring and Fall).

Since 1988, the treatment system has operated at or above its rated capacity of 561 m^3/day, and the lagoon itself has been required to operate at its storage limit to avoid discharging during non-allowable discharge windows. The system has also regularly exceeded its seasonal total suspended solids (TSS) and 5-day biological oxygen demand (BOD5) objectives and limits. These factors have resulted in non-compliance issues with the Ministry of the Environment, Conservation and Parks (MECP). The Township has implemented some upgrades to the SPSs, minor repairs to the collection system manholes and de-sludging of the lagoons; however, no upgrades have been completed to date to address capacity and/or quality limitations associated with the WWTS.

Although there has been minimal population growth within the Village in the last 20 years, the Township has noted that there has been recent interest in new development that would result in an increased serviced population for the wastewater system. To accommodate this development and resolve previous non-compliance issues, the Township is undertaking a Municipal Class Environmental Assessment (Class EA) to evaluate alternatives to expand and/or upgrade their wastewater system. **The study will aim to establish reliable, robust and cost-effective solutions with low to medium operational complexity and flexibility to meet both current and anticipated future servicing requirements.**

2.0 Existing Raw Wastewater and Treated Effluent Quality

Table 1: Existing Raw Wastewater Quality.

	cBOD		BOD$_5$		TSS		TP		TKN	
	mg/L	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*	*mg/L*	*kg/day*
2016	229	141	-	-	218	149	5.84	3.67	48.6	30.6
2017	169	138	297	211	176	139	4.27	3.34	36.3	28.5
2018	221	182	360	282	194	153	6.03	4.71	40.8	31.2
2019	-	-	195	140	170	125	5.48	3.97	44.7	32.4
2020	-	-	265	216	202	161	6.55	5.06	56.1	42.4
AVG:	**206**	**154**	**279**	**213**	**192**	**145**	**5.63**	**4.15**	**45.3**	**33.0**
75th Percentile	225	162	312	233	202	153	6.03	4.71	48.6	32.4
MAX:	229	182	360	282	218	161	6.55	5.06	56.1	42.4
MIN:	169	138	195	140	170	125	4.27	3.34	36.3	28.5
Low (see Note 4)	-	-	110	-	120	-	4	-	20	-
Medium (see Note 4)	-	-	190	-	210	-	7	-	40	-
High (see Note 4)	-	-	350	-	400	-	12	-	70	-
Characterization:	-	-	Medium-High		Medium		Low-Medium		Medium	

Notes:

1 - The following outliers were removed from the data: **BOD5**: February 2018 (1,300 mg/L); **TSS**: January 2016 (1,360 mg/L), February 2016 (1,670 mg/L), July 2016 (2,420 mg/L), January 2017 (8,920 mg/L), January 2018 (6,910 mg/L), and February 2018 (1,700 mg/L); **TKN**: November 2018 (162 mg/L).

2 - CBOD5 data from 2019 and 2020 was excluded from the analysis due to CBOD5 sampling stopping after March 2019.

3 - BOD5 data from 2016 was excluded from the analysis, as data was only available for 4/12 months.

4 - Typical wastewater strength is from Metcalf and Eddy, 2003.

Table 2: Existing Treated Effluent Quality.

	BOD$_5$		TSS		TP		pH	CBOD$_5$		TAN	
	# samples*	mg/L	# samples	mg/L	# samples	mg/L	-	# samples	mg/L	# samples	mg/L
ECA Objective		***15***		***20***		***0.8***	***6.5 - 9.0***				
ECA Limit		***25***		***25***		***1.0***	***6.0 - 9.5***				
Spring 2016	10	17.2	10	19.4	10	0.67	6.3 - 7.8	6	10.7	10	7.5
Fall 2016	6	18.0	6	26.2	6	0.53	7.0 - 7.5	2	14.5	6	5.4
Spring 2017	8	12.0	8	26.0	8	0.35	6.8 - 8.1	3	9.3	8	6.5
Fall 2017	8	23.0	8	40.1	8	0.59	7.2 - 8.3	3	8.3	8	10.8
Spring 2018	8	10.0	8	29.0	8	0.57	7.2 - 8.4	7	8.9	8	6.6
Fall 2018	7	19.6	7	36.9	7	2.96	7.1 - 8.0	7	12.7	7	10.3
Spring 2019	8	15.2	8	30.1	8	0.63	7.1 - 8.5	8	12.4	8	6.9
Fall 2019	5	19.2	5	32.4	5	0.85	7.5 - 8.2	5	10.8	5	10.1
Spring 2020	7	12.6	7	19.7	7	0.26	7.0 - 8.7	7	9.7	7	10.4
Fall 2020	8	9.4	8	23.7	8	0.58	7.4 - 8.1	8	6.6	8	10.7
# of Objective Exceedances (/10):	-	6	-	8	-	2	1	-	-	-	-
# of Limit Exceedances(/10):	-	0	-	7	-	1	0	-	-	-	-
Average Spring Discharge:	8.2	13.4	8.2	24.8	8.2	0.49	N/A	6.2	10.2	8.2	7.6
Average Fall Discharge:	6.8	17.8	6.8	31.9	6.8	1.10	N/A	5.0	10.6	6.8	9.4

Notes:

1 - Number of effluent samples taken for BOD$_5$ was not provided. It was assumed to be equal to the number of TSS and TP effluent samples collected.

2 - Only 1 data point for E.Coli was provided - this was not included in the analysis.

3 - Data for pH was collected from OCWA's annual wastewater reports.

4 - Effluent NO3 and NO2 were collected, but were present in negligeable quantities.

3.0 Raw Wastewater Projections

Table 3: Projected Raw Wastewater Flows and Quality.

EXISTING (2016 to 2020)					
Average Daily Flow (m3/day):	*747*				
Water Quality Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Average Concentration (mg/L):	*206*	*279*	*192*	*5.63*	*45.3*
Maximum Monthly Concentration (mg/L):	*412*	*659*	*430*	*9.76*	*70.9*
PHASE 2 - 20-YEAR (2042)					
Projected Average Daily Flow (m3/day):	2,020				
Projected Peak Instantaneous Flow (m3/day or L/s):	8,611		or	99.7	
Projected Peak Daily Flow (m3/day or L/s):	4,992		or	57.8	
Projected Maximum Monthly ADF (m3/day):	2,992				
Water Quality Parameter:	**cBOD**	**BOD$_5$**	**TSS**	**TP**	**TKN**
Average Concentration (mg/L):	210	280	200	5.7	46
Average Loading (kg/day):	430	570	410	11.6	93
Maximum Monthly Concentration (mg/L):	415	660	430	9.8	71
Maximum Monthly Loading (kg/day):	838	1,333	869	19.8	143

4.0 Projected Effluent Criteria

Table 4: Proposed Maximum Daily Effluent Discharge Rates – Phase 2 – 20-Year (2042).

Date Range	**Maximum Daily Discharge Rate (m^3/d)**
Semi-Continuous Discharge	
October 1 to 31	Lower of 4,500 or outfall capacity
November 1 to 30	Lower of 10,800 or outfall capacity
December 1 to March 31	Lower of 7,600 or outfall capacity
April 1 to 30	Lower of 16,000 or outfall capacity
May 1 to 31	Lower of 15,100 or outfall capacity

Table 5: Proposed Effluent Objectives and Limits – Phase 2 – 20-Year (2042).

Parameter	**Averaging Period**	**Design Objective** (mg/L unless noted otherwise)	**Compliance Limit** (mg/L unless noted otherwise)
cBOD$_5$	Monthly	15	20
TSS	Monthly	20	25
TAN	Monthly		
Oct 1 – 31		4.5	5.0
Nov 1 – 30		7.0	7.5
Dec 1 – 31		10.0	12.0
Jan 1 – Feb 28		12.0	14.0
Mar 1 – 31		10.0	12.0
Apr 1 – 30		5.0	5.5
May 1 – 31		3.0	3.5
TP	Monthly	0.2	0.23
E. coli	Monthly	150 cfu/100 mL	200 cfu/100 mL
pH	Single Grab	6.5 to 9.0	6.0 to 9.5

5.0 Overview of Preferred Solution

It was determined that Option 4B: Expand Plantagenet WWTS with Additional Lagoon Storage and Specialized Treatment System using New Discharge Window, provided the highest overall net benefit to the Township for the upgrade of their WWTS. A summary of the preferred solution is provided below. A conceptual site plan of the proposed solution is appended to the memorandum.

- Specialized treatment system(s) for treatment of BOD, TAN and TSS.
- Specialized treatment system for treatment of TP. TP removal may also be possible using a combination of alum and participating in the South Nation Conservation (SNC) Total Phosphorous Management (TPM) program.
- Additional lagoons for both storage (255,000 m^3 needed) and treatment. Assume an aerated cell will be required upstream of specialized treatment system(s).
- Discharge to the South Nation River between October 1 and May 31. Cold-weather performance is a requirement of the specialized treatment systems.
- A review of the following alternative design concepts will be completed during Phase 3 to optimize the performance of the existing lagoon system:
    - A - Modify dimensions of existing facultative lagoon.
    - B – Modify hydraulics of existing facultative lagoon.
    - C – Convert part or all the existing facultative lagoon into a partial mix aerated lagoon.
    - D – Add in-line coagulation and/or pH adjustment.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:	Reviewed by:
Camila Valcarcel, EIT Environmental Engineering Intern	Nicolas Bialik, P.Eng. Environmental Engineer

Appendix D

Stakeholder Consultation Summary